PROCEEDINGS BOOK OF THE 4th

ADVANCED ENGINEERING DAYS

21 September 2022 / MERSIN, TURKIYE

International Engineering Symposium

Congress Chairman

PROF. DR. MURAT YAKAR

http://aed.mersin.edu.tr/

ISBN: 978-605-73805-9-3

4th Advanced Engineering Symposium

I would like to thank all of the contributing authors and reviewers to the 4th Advanced Engineering Days (AED) Symposium, 21 September 2022. In this international symposium there are 45 presentations. We would like to see you in the 5th AED which will be held on 3-4 December 2022.

Best regards

Prof. Dr. Murat YAKAR

The proceedings of the
4th Advanced Engineering Days

Editor-in-Chief

Prof. Dr. Murat YAKAR

Editors

Assoc. Prof. Dr. Furkan AYAZ

Lec. Lale Karataş

Res. Asst. Aydın ALPTEKİN

ISBN: 978-605-73805-9-3

Mersin, 2022

HONOR BOARD

Ali Hamza PEHLİVAN – Governor of Mersin Province
Prof. Dr. Ahmet ÇAMSARI – Rector of Mersin University
Prof. Dr. Orhan AYDIN – Rector of Tarsus University
Prof. Dr. Ömer ARIÖZ – Rector of Toros University

SCIENCE BOARD

Prof. Dr. Murat YAKAR (Mersin University)
Prof. Dr. İlker Fatih KARA (Mersin University)
Prof. Dr. Mehmet Cihan AYDIN (Bitlis Eren University)
Prof. Dr. Ali Rıza SÖĞÜT (Konya Technical University)
Prof. Dr. Şükrü DURSUN (Konya Technical University)
Prof. Dr. Donato ABRUZZESE (Roma University)
Prof. Dr. Edmönd Höxha (Albania University, Titana Albania)
Prof. Dr. Hysen Mankolli, University of Maryland College Park
Prof. Dr. Erdem KOCADAĞISTAN (Erzurum Atatürk University)
Prof. Dr. Sailesh Iyer (Rai University)
Prof. Spase Shumka (Albania Agriculture University)
Prof. Dr. Nurcan ÇALIŞ AÇIKBAŞ (Mersin University)
Assoc. Prof. Dr. Erdinç AVAROĞLU (Mersin University)
Assoc. Prof. Dr. Khalil Valizadeh KAMRAN (University of Tabriz, IRAN)
Assoc. Prof. Dr. Nida NAYCI (Mersin University)
Assoc. Prof. Dr. Musa ÇIBUK (Bitlis Eren University)
Assoc. Prof. Dr. Ümit BUDAK (Bitlis Eren University)
Assoc. Prof. Dr. Beyhan KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Barış BULDUM (Mersin University)
Assoc. Prof. Dr. İskender ÖZKUL (Mersin University)
Assoc. Prof. Dr. Fatih ÜNAL (Mersin University)
Assoc. Prof. Dr. Şenay GÜNGÖR (Nevşehir Hacı Bektaş Veli University)
Assoc. Prof. Dr. Lyudmyla Symochko (Uzhhorod National University)
Assoc. Prof. Dr. Gökhan AÇIKBAŞ (Mersin University)
Asst. Prof. Dr. Merve Şentürk ACAR (Bilecik Şeyh Edebali University)
Asst. Prof. Dr. Abdulkadir AYANOĞLU (Mardin Artuklu University)
Asst. Prof. Dr. Mehmet Rida Tur (Batman University)
Lect. İbrahim BOZ (Mardin Artuklu University)
Lect. Lale KARATAŞ (Mardin Artuklu University)
Dr. Hakan DOĞAN (Turkish State Meteorological Service)
Dr. Ahmet Erhan AKAN (Namık Kemal University)
Dr. Fatih ADIGÜZEL (Nevşehir Hacı Bektaş Veli University)

ORGANIZING BOARD

Prof. Dr. Murat YAKAR (Mersin University)
Prof. Dr. Cengiz ALYILMAZ (Uludağ University)
Prof. Dr. Semra ALYILMAZ (Uludağ University)
Prof. Dr. Şükrü DURSUN (Konya Technical University)
Prof. Dr. Mehmet Cihan AYDIN (Bitlis Eren University)
Prof. Dr. Erdem KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Beyhan KOCADAĞISTAN (Erzurum Atatürk University)
Assoc. Prof. Dr. Bünyamin DEMİR (Mersin University)
Asst. Prof. Dr. Vahdettin DEMİR (KTO Karatay University)
Asst. Prof. Dr. Esra URAY (KTO Karatay University)
Asst. Prof. Dr. Ali ULVİ (Mersin University)
Asst. Prof. Dr. Umut ÖZKAYA (Konya Technical University)
Dr. Hakan DOĞAN (Turkish State Meteorological Service)
Lect. Atilla KARABACAK (Mersin University)
Lect. Şafak FİDAN (Mersin University)
Res. Asst. Aydın ALPTEKİN (Mersin University)
Res. Asst. Ramazan AKKURT (Mersin University)
Res. Asst. Abdurahman Yasin YİĞİT (Mersin University)
Res. Asst. İrem YAKAR (Istanbul Technical University)
Eng. Engin KANUN (Mersin University)
Eng. Mücahit Emre ORUÇ (Mersin University)

Session 1	
09:00-09.10	**Sterilization packaging with appropriate materials and sterility assurance level** Ebru Öner Usta, Furkan Ayaz
09.10-09.20	**Spinal Muscular Atrophy (SMA) and mRNA-based therapy against it** Simay Ayden, Furkan Ayaz
09.20-09.30	**Protective effect of flavonoids against the colorectal cancer** Hülya Servi, Furkan Ayaz
09.30-09.40	**Cardiovascular diseases and treatment methods** Umutcan Hendekci, Furkan Ayaz
09.40-09.50	**Anti-Spot cream with nano silver effect** Nazlı Tekin , Furkan Ayaz

Session 2	
10.00-10.10	**In vitro fertilization and its applications** Helin Aytar, Furkan Ayaz
10.10-10.20	**Dendritic cells: Their functions in immunity and disease** Havva Türkben , Furkan Ayaz
10.20-10.30	**Mast cells and their importance for the immune system** Ceren Canatar, Furkan Ayaz
10.30-10.40	**Carcinogens and protective genes against the cancer** Ümmühani Önder, Furkan Ayaz
10.40-10.50	**Use of the gene drive system in harmful species' suppression in the ecosystem** Gülseven Aleyna Yatmaz , Furkan Ayaz

Session 3	
11.00-11.10	**Enzymes in the food industry** Besime Gül Hizmetçi, Furkan Ayaz
11.10-11.20	**The role of the soil bacteria on the plant immunity** Özge Ceyhan, Furkan Ayaz
11.20-11.30	**A review on phage as biocontrol agent in food industry** Qadar Ahmed Isse, Furkan Ayaz, Hatice Korkmaz Güvenmez, Mete Karaboyun
11.30-11.40	**Effects of microplastics on the biological systems** Harika Topal Önal, Furkan Ayaz
11.40-11.50	**Thyroid diseases in primary care** Begüm Çelik , Furkan Ayaz

Session 4	
12.00-12.10	**The importance of CTLA-4 and PD-1 pathways in the cancer treatment** Şule Merve Aslan, Furkan Ayaz
12.10-12.20	**Antibiotic Resistance: How it develops and affects the public health** Neslihan Çiflik, Furkan Ayaz
12.20-12.30	**Female sex hormones and their effects on the immune system** Tanya Beril Korkmaz, Furkan Ayaz

Session 5	
13.00-13.10	**Material deteriorations occurring on the facades of the Mor Sergios Bakhos Church** Lale Karataş, Aydın Alptekin, Murat Yakar
13.10-13.20	**Contribution of architectural design of ancient city Dara's water cisterns to the water efficiency of the city** Lale Karataş, Aydın Alptekin, Murat Yakar
13.20-13.30	**Investigation of Molla Hari (Halil) Süleyman Paşa Mosque's material deteriorations** Lale Karataş, Aydın Alptekin, Murat Yakar
13.30-13.40	**Documentation of Mardin Kadife Ertem Mansion's architectural characteristics** Lale Karataş, Aydın Alptekin, Murat Yakar
13.40-13.50	**Restitution suggestion for Mardin TatlıDede Mansion** Lale Karataş, Aydın Alptekin, Murat Yakar

Session 6	
14.00-14.10	**The study of land use and slope role in flow coefficient determination** Ayse Yeter Gunal, Ruya Mehdi
14.10-14.20	**Joints in rigid pavements** Muhammed Tanyıldızı
14.20-14.30	**Examination of District Süleymanpaşa/Kumbag, province Tekirdag in terms of Geotechnics** Aykut Akdağ, İsa Kul
14.30-14.40	**Investigation of the effects of using steel cross and reinforced concrete shears earthquake performance in buildings** Muhammed Mustafa Eser, Hüsnü Can
14.40-14.50	**Creating digital elevation model with Google Earth Pro** Vahdettin Demir, Ramazan Doğu

Session 7	
15.00-15.10	**Implementing unmanned aerial systems equipped with Sniffer4D payloads for volcanic gas detection and data analysis used for forecasting volcanic eruptions** Ian Godfrey, José Pablo Sibaja Brenes, María Martinez Cruz
15.10-15.20	**Introducing an integrated evaluation index for recreational beaches in Albania aiming at improvement of assessment and integrated approach** Edjona Bici, Spase Shumka , Anilda Kokali
15.20-15.30	**Geological and geochemical signatures of the calcite quarry in the southeast of Biga (Çanakkale, Turkey)** Mustafa Kaya, Cihan Yalçın, Mustafa Kumral
15.30-15.40	**Geological and Geochemical characterization of the radiolarite hosted Mn mineralization in Taşdemir (Pazarcık, Kahramanmaraş, Turkey)** Cihan Yalçın, Mustafa Tekin Akkütük, Yusuf Uras
15.40-15.50	**Petrographic and geochemical characterization of sandstones in upper level of ophiolitic melange in Central Pontides** Cihan Yalçın, Nurullah Hanilçi, Mustafa Kumral, Mustafa Kaya

Session 8	
16.00-16.10	**Investigation of stress in rotating cylinders with gray irons (Grade G4000) materials by mathematical programming** Hüseyin Fırat Kayıran
16.10-16.20	**Development of individualized education system with artificial intelligence fuzzy logic method** Hüseyin Fırat Kayıran, Ufuk Şahmeran
16.20-16.30	**Evaluation of silicon nitride reinforced silica aerogel composites for radom application** İlhan Enes Çetin, Öyküm Başgöz, Gökhan Açikbaş, Nurcan Çaliş Açikbaş
16.30-16.40	**Direct pouring system design and optimization in steel castings** Mustafa Murat Zor, Serdar Kesim, Buğra Erbakan, Ferhat Tülüce, Alper Yoloğlu, Kazım Çakır
16.40-16.50	**The water footprint of Bursa province** Afnan Mohsin , Sinan Uyanik

	Session 9
17.00-17.10	**Consolidation characteristics of clayey soils improved with rice husk ash** Abuzer Buluş Karakurt, Özgür Lütfi Ertuğrul
17.10-17.20	**An investigation on the consistency limits of cohesive soils improved with rice husk ash** Abuzer Buluş Karakurt, Özgür Lütfi Ertuğrul
17.20-17.30	**Comparison of the performance of single energy piles and group energy piles in summer mode** Fatma Dülger Canoğulları, Özgür Lütfi Ertuğrul
17.30-17.40	**Friction stir welding of plastics** Emre Kaygusuz
17.40-17.50	**Hydrophobic surfaces found in nature** Serhat Akinci, Filiz Karaömerlioğlu
17.50-18.00	**Graphene doped metal oxide based thermoelectric materials production method** Serhat Koçyiğit, Arda Aytimur, İbrahim Uslu
18.00-18.10	**Investigation of the usage of coconut shells in epdm rubber as biodegradable filling material** Ahmet Güngör

Advanced Engineering Days

aed.mersin.edu.tr

Sterilization packaging with appropriate materials and sterility assurance level

Ebru Öner Usta *[1], **Furkan Ayaz** [2]

[1]*Mersin University, Biotechnology Department, Türkiye, oner_ebru@hotmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Usta, E. Ö., & Ayaz, F. (2022). Sterilization packaging with appropriate materials and sterility assurance level. 4th Advanced Engineering Days, 1-3

Keywords
Sterilization
Sterilization Packaging
ISO 11607-1 Standard

Abstract

All disinfected materials should be packed with appropriate materials to ensure sterilization safety. The most important step of the sterilization cycle is considered to be packaging. The function of sterile material packaging is to prevent the deterioration of the sterilization integrity of the material by creating a defense against unwanted microorganisms and viruses after sterilization. There are many packaging materials with different properties produced for this purpose. ISO, Standards Institution attaches importance to the packaging of medical devices at an international level. ISO 11607-1 Part-1,-2 standardizes the technical standards that must be followed in medical device packaging. This standard is a guide that is valid in all areas where medical devices are packaged, especially in hospitals. For the sterilization of steam, ethylene oxide, formaldehyde, and hydrogen peroxide gas plasma sterilization methods, sterilization bags, transparent multi-layer copolymer PET/PP film, and medical paper combinations are used. Liquid and steam and C2H4O EO processing indicators by the ISO 11140-1 standard are applied to the paper surface, and these indicators distinguish between treated and untreated packages. Advantages of Sterilization Packaging materials can be summarized as Product protection, Microbial barrier, Physical protection from damage, Compatibility with the sterilization method, Maintenance of sterility and integrity until use, Easy opening, and aseptic presentation, Identification of the Product (printing, labeling). As a result, the probability of a single viable microorganism remaining at the end of the selected sterilization process should be ≤10-6.

Introduction

Sterilization means the complete removal or destruction of all forms of microbial life including bacterial spores. No absolute assurance that there is 0 microorganism.

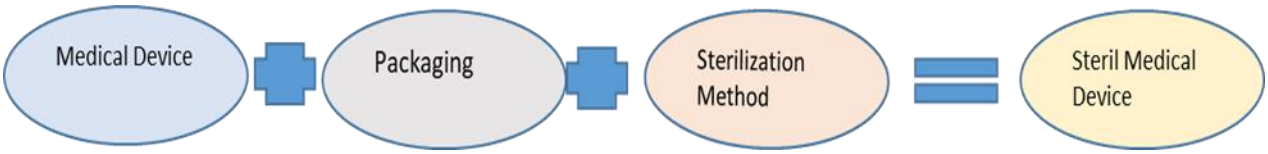


Figure 1. Steril Medical Device Definition

There is no 100% guarantee that there are no microorganisms. The packaging concept is divided into three phases; 1) Primary packaging protects the items from contamination following sterilization. 2) Secondary packaging is used to aid in correct storage and interior conveyance to the consumer. 3) Packing for Transportation External transport of sterile commodities in both primary and secondary packing [1]. The primary packaging protects the product from becoming recontaminated following sterilization. It should offer an effective

microbiological barrier while also allowing air and the sterilizing agent, such as steam, to flow through. Primary packaging is sufficient when there is no risk of dust being deposited on the pack. In dust-free storing or if the goods are to be used immediately. The principal packaging keeps the environment sterile while being stored and transported. The medical paper, two layers of non-woven sheets, a single or double laminated PET/PP, or a box with a sufficient filter are examples of primary packaging (s) [2].

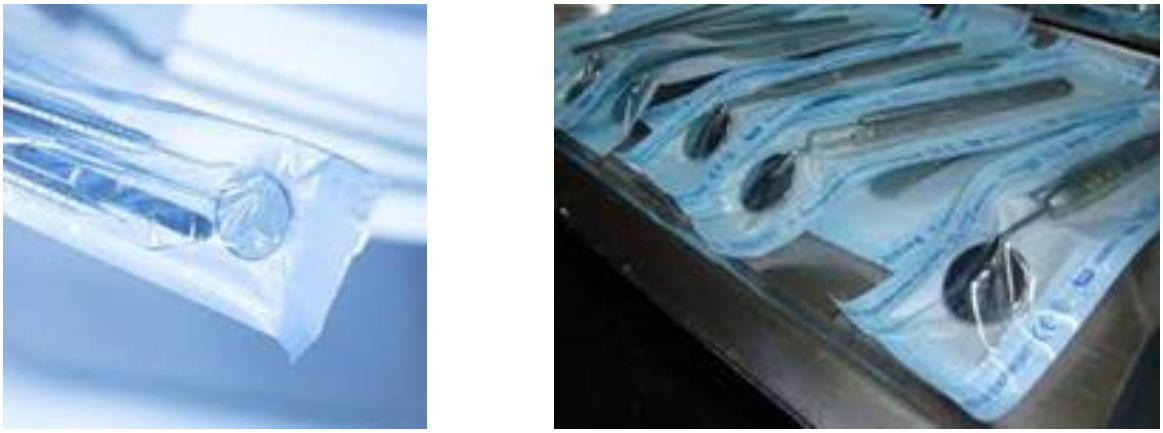


Figure 2. Before Sterilization Samples

Products for sterilization packing reliably and securely guard medical equipment against bacterial and chemical contaminates. The sterilization packaging offers a strong microbiological barrier from the moment of sterilization until the sterile equipment is utilized. The usage instructions and suggested storage conditions must be followed to guarantee high-performance qualities and sterility (3). Sterilization packaging consists of three components. These components are the indicators that show successful results, different weights of medical paper and PET/PP. During sterilized pack storage, permit sterilization while retaining a strong bacterial barrier performance. Bacterial barrier against airborne contamination (airborne, microparticles, dust), Fluids (drops, aerosols). Bacterial barriers work on the principle that bacteria die or burn their energy before crossing the barrier material (Tortuous path). Non-compliant materials include those that are not sufficiently barrier to prevent bacteria from entering. Poor quality medical paper 1) POST-sterilization characteristics 2) Poorly manufactured film-to-paper pouches (no sealing in some areas) 3) Materials with holes or a narrow tortuous path [3].

Figure 3. DUPONT website [4]

The requirements that must be met by medical packaging used during sterilizing procedures; Internationally Recognized as ISO 11607-1 Medical Device Packaging, Part 1 Packaging for a medical device that has undergone terminal sterilization must comply with the ISO 11607-1 requirement for materials, sterile barrier systems, and packaging systems. Process requirements have been noted for forming, sealing, and installation. When sterilization is complete, the SAL value, also known as the Sterility Assurance Level, should be 106 (1/1,000,000). In other terms, it refers to the likelihood that 1x106 sterilized materials contain no more than one live bacterium.

Results

Each medical device used for OR must run through following processes before usage cleaning, disinfection, preparation, packaging, sterilization, storage.

Figure 4. Belimed Infection Control [5]

The Central Sterile Supply Department (CSSD) is critical to sterilization safety. Again, Sterilization Packaging is an important step in the successful conclusion of the sterilization process. As a result, sterilization packages should create a high bacterial barrier by allowing the sterilization agents to penetrate the materials to be sterilized. Its performance should be measured by its SAL value. The performance evaluation criteria of 60gr medical paper, which is widely used in sterilization packaging, are generally listed in Table 1.

Table 1. Sterilization Packaging Evaluation Criteria [5]

Medical Paper Technical Specifications		Unit	60 gr
Tensile Strength (Dry)	MD	N/15mm	110
	CD	N/15mm	50
Tensile Strength (Wet)	MD	N/15mm	18
	CD	N/15mm	9
Burst strength	Dry	kPa	250
	Wet	kPa	50
Water Repeliency	-	sn	25

Discussion

Sterilization packages are evaluated by ISO 11607 -1.2 standards and meet the requirements of the standard. They also prove the reliability of the sterilization method by complying with the internationally accepted SAL (1/1000000) value [6].

References

1. Klumdeth, J., Jantaratnotai, N., Thaweboon, S., & Pachimsawat, P. (2020). Sterility maintenance of reused disposable paper/plastic sterilization pouches in actual clinical practice. *Heliyon*, *6*(3), e03672. https://doi.org/10.1016/j.heliyon.2020.e03672
2. 5th National Sterilization Disinfection Congress – (2007). Validation of Packaging Processes under ISO 11607 Part 2 Hans WOLF Head of Hawo Gmbh, Germany
3. Moldenhauer, J. E., Bass, S. A., Kupinski, M. J., Walters, M. L., & Rubio, S. L. (1996). Microbial barrier assessment of Tyvek stopper packaging for rubber closures. PDA Journal of Pharmaceutical Science and Technology, 50(6), 391-398.
4. https://www.dupont.com.ar/knowledge/microbial-barrier-tyvek.html
5. https://wfhss.com/index.php?pid=665&popup=Y
6. Ansari, I. A., & Datta, A. K. (2003). An overview of sterilization methods for packaging materials used in aseptic packaging systems. Food and Bioproducts Processing, 81(1), 57-65.

Advanced Engineering Days

aed.mersin.edu.tr

Spinal Muscular Atrophy (SMA) and mRNA-based therapy against it

Simay Ayden [*1], **Furkan Ayaz** [1, 2]

[1]*Mersin University, Biotechnology Department, Türkiye, 21140940006@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Ayden, S., & Ayaz, F. (2022). Spinal Muscular Atrophy (SMA) and mRNA-based therapy against it. 4th Advanced Engineering Days, 4-5

Keywords
SMA
Treatment
SMN protein

Abstract

Spinal Muscular Atrophy (SMA), is a genetic disease caused by the loss of nerve cells called motor neurons. It occurs as a result of the inability to produce the SMN protein, which is a motor neuron protein. Currently, no treatment has been found for the complete recovery of people with SMA. However, the symptoms of the disease can be reduced through medications. The main problem, the inability to produce the SMN protein, can be achieved by using mRNA-based therapy. The mRNA-based therapy basically contains the code for the protein we want to be produced, and thus that protein is produced by the body. This is how the missing protein that causes SMA can be rescued.

Introduction

SMA is caused by the impairment of the special nerve cells that are called motor neurons which are in charge of the motor functions such as muscle movement [1]. SMA is a disease that occurs as a result of deletions in the SMN1 gene, The SMN1 gene cannot produce the SMN protein. The SMN2 gene is a paralog of the SMN1 gene. The SMN2 gene encodes the SMN protein, but most of it is non-functional. But it still helps reduce the severity of the disease in most SMA patients who have more copies of the SMN2 gene [2]. Loss of motor neurons affects the muscles involved in the control of the head, arm and leg movement. These impairments are evident in different types of SMA patients. There are 5 types of SMA types. It has in an autosomal recessive manner inheritance mechanism [3].

Results

SMA occurs in 1 out of every 10,000 births. Men and women are affected equally by the disease [2].

There are 5 types of SMA disease.

1. SMA 0: Symptoms are severe weakness and respiratory distress at birth. These infants have severe respiratory failure. Most babies rarely survive beyond 6 months.

2. SMA I: The mean age of onset of symptoms is 2.5 months. Symmetrical muscle weakness, regression of motor functions and lack of motor development, weak muscle tone are among the main symptoms. Most patients survived 24 months with supportive care.

3. SMA II: The mean age of onset of symptoms is 8.3 months. Weak muscle tone is evident at birth or in the first few months. It has symptoms such as developmental delay with impairment of motor skills, proximal muscle weakness, postural tremor of the fingers. 68% of patients are still alive at 25 years of age.

4. SMA III: Occurs after 18 months of age. It has symptoms such as proximal muscle weakness, loss of motor skills, and postural tremor of the fingers. Life expectancy is high for these patients.

5. SMA IV: Unlike other types, it appears with muscle weakness at the age of 20 or 30 years. Among its symptoms is fatigue. It is the least common type and does not affect life expectancy [4].

The SMN protein, consisting of 38 kDa and 294 amino acids, is encoded by 2 genes. However, mutations in the centromeric SMN (SMN(C)) of these genes cause SMA disease [5]. Today, many treatment methods are being developed. Small molecules, oligonucleotides and gene replacement have been attempted to increase SMN protein levels [6].

Discussion

mRNA (messenger RNA) produces protein according to the genetic code it carries. It is possible to fulfill the function of a single protein with protein replacement [7].

The deficiency of the SMN protein that causes SMA can be produced and its functional form can be rescued by the mRNA-based therapy.

References

1. MedlinePlus Genetics (2020). Spinal muscular atrophy
2. NORD (2019). Spinal Muscular Atrophy.
3. GARD (2019). Spinal muscular atrophy.
4. Prior, T. W., Leach, M. E., & Finanger, E. (2020). Spinal muscular atrophy. University of Washington, Seattle, Seattle (WA), PMID: 20301526
5. Coovert, D. D., Le, T. T., McAndrew, P. E., Strasswimmer, J., Crawford, T. O., Mendell, J. R., ... & Burghes, A. H. (1997). The survival motor neuron protein in spinal muscular atrophy. *Human molecular genetics*, *6*(8), 1205-1214.
6. Arnold, E. S., & Fischbeck, K. H. (2018). Spinal muscular atrophy. *Handbook of clinical neurology*, *148*, 591-601.
7. Kowalski, P. S., Rudra, A., Miao, L., & Anderson, D. G. (2019). Delivering the messenger: advances in technologies for therapeutic mRNA delivery. *Molecular Therapy*, *27*(4), 710-728.

Advanced Engineering Days

aed.mersin.edu.tr

Protective effect of flavonoids against the colorectal cancer

Hülya Servi [*1], **Furkan Ayaz** [2]

[1]*Mersin University, Biotechnology Department, Türkiye, hulyaservi582@gmail.com, 19133015@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Servi, H., & Ayaz, F. (2022). Protective effect of flavonoids against the colorectal cancer. 4th Advanced Engineering Days, 6-8

Keywords
Colorectal cancer
Flavonoid
Nutrition

Abstract

Cancer is a disease that can be determined by the independent increase of cells in a random part of the body compared to other surrounding normal tissues, moreover, their infiltration into the surrounding tissues, and a change in the normal differentiation pattern of the tissue resident cells. It also metastasizes to other parts of the body when these cells pass into the circulation. Colorectal cancer, on the other hand, is among the most diagnosed cancers in Turkey, as it continues to exist with high prevalence rates all over the world. It can occur in cases where epithelial cells can benefit from self-renewal and reproduction caused by the epigenetic mutations. With next generation sequencing techniques and genetic studies on tumor cells, cancer-forming and/or tumor suppressor genes have been identified in our digestive tract. The development and differentiation of the treatment methods day by day and the widespread use of screening tests that are being conducted led to a decrease in the incidence of the disease and a decrease in deaths caused by the disease. It is known that phytochemicals in the plant-based foods can be used by taking advantage of their cancer prevention feature. In line with this information, flavonoids have antioxidant properties and are found in many plant-derived foods. In this article, we will focus on the formation of colorectal cancer and how much cancer can be prevented thanks to the flavonoids.

Introduction

Cancer is the formation of cell populations that can reproduce without control, are caused by excessive changes in DNA and gene expression, which also have the ability of spreading to the distant sites in the body [1]. Worldwide, an average of 1 million people is diagnosed with cancer annually, and 500,000 of this die due to the colorectal cancer. On average, 1/3 of these tumors are located in the rectum and 2/3 in other parts of the colon, especially in the left colon [2]. Colorectal cancer usually occurs in people who do not have a family history of colorectal cancer. Influencing factors include diabetes, long-term radiation exposure, age, obesity, smoking and alcohol, malnutrition, and long-lasting intestinal diseases [3]. Colorectal cancer is associated with, hamartomatous and juvenile polyposis syndromes, breast, ovarian and uterine cancers [4]. Many plant-derived agents are being studied in more detail for cancer chemotherapy because they can provide less side effects and have a higher rate of treatment success. These herbal-derived agents are bioactive compounds named as “secondary metabolites” produced by the plants. Flavonoids, phenols, glycosides, alkaloids are among them. In order to elicit anticarcinogenic functions, these compounds must be induced by activating proteins and/or inducing antioxidant functions by inhibiting proteins, signaling pathways and enzymes that affect the occurrence of cancer, or by stimulating the DNA repair mechanism and apoptosis [1]. Flavonoids have antioxidant, antimutagenic, antitumor, antiviral, antiproliferative and anti-inflammatory properties [5]. These properties of phenolic compounds interact with many metabolic pathways and may therefore provide protection against colorectal cancer. However, there is

not enough evidence for this issue [6]. Another feature of flavonoids is that they can act as protective agents of malignant tumors at different stages of formation by protecting DNA against oxidative damage. But stil the flavonoids have many antitumoral functions for the prevention of the cancer. If we focus on some of the properties of the flavonoids, these can be listed as; suppression of the mutagenic genes and antimutagenic effect, antioxidant effect by inactivation of carcinogens, suppression of angiogenesis and the clearance of the free radicals [7]. According to other studies, colorectal cancer development has strong correlation with the diet and nutrition. Especially high-fat diets negatively affect the prognosis of the colorectal cancer. The reason for this is that high-fat diets increase the secretion of the intestinal bile acids and these are effective in intestinal tumorigenesis by causing significant changes in the intestinal microbial composition. As a result of these studies, the protective effect of dietary fibers against colorectal cancer was observed. In addition, dietary fibers reduce the transit time of the colonic content, reducing exposure to carcinogens and creating a healthy intestinal barrier. For this reason, the diet should include plant-based foods and beverages such as fruits and vegetables, whole grains, tea, coffee, and wine in order to increase the prognosis rates of the colorectal cancer [8].

Results

There is a biological mechanism responsible for the genetic and environmental factors that are responsible for the formation of cancer. Proper nutrition is a very important factor in cancer. However, a single nutrient or phytochemical cannot be effective in preventing tumor progression or preventing cancer, but it is very important to take them together with other nutrients in a balanced diet rich in fruits and vegetables. As a result of the research by different study groups, the relationship between flavonols and cancer is contradictory. In some studies, especially in long-term studies, it has been observed that flavonol intake reduces the risk of lung, breast, larynx and colorectal cancers, but in other studies, no significant relationship was found between cancer risk and flavonol intake [7]. In addition, enlightening the society and ensuring participation in screening programs are important points for early diagnosis and treatment of the colorectal cancer [9]. It is important to ensure more participation in these programs and to determine environmental factors for planning [10].

Discussion

Early detection is the primary goal in colorectal cancer. Studies are carried out on phytochemicals in plants as therapeutic agents for the prevention/treatment of cancer [1]. Research continues for chemotherapeutic drugs with the discovery of chemicals in nature due to the resistance of cancer cells to treatments. In order to prevent diseases such as cancer, many natural compounds with effective antitumorogenic properties have been discovered and thus, the tendency towards natural ones has increased. Plants form the basis of traditional medicine, which has many effects for many cancer diseases. There are studies that reveal that the use of plants containing phytochemical complex contents of various chemical-containing structures such as polyphenol, flavanoid, phenolic acid and irinotecan together with chemotherapeutic agents can be effective in reducing the toxic side effects by reducing the effective dose of chemotherapeutics [11]. However, since these studies are new and scarce, more attention should be paid to these studies.

References

1. Yörük, M. (2021). Diosmetinin Kolorektal Kanser Hücrelerinde (HCT 116) Antikarsinojenik Etkinliğinin Araştırılması (Doctoral dissertation, Necmettin Erbakan University (Turkey)).
2. Bayram, D. (2017). Silibinin İn Vitro Ortamda CCL-228-SW 480 Kolon Kanseri Hücre Hattı Üzerine Apoptotik Etkisinin Araştırılması. Süleyman Demirel Üniversitesi Sağlık Bilimleri Dergisi, 8(2), 1-7.
3. Zengin Köksal, H. (2021). Spektroskopik yöntemlerle bazı karayosunu etanol ekstraktlarının hct116 kolorektal kanser hücre canlılığı üzerindeki etkisinin ve moleküler düzey değişikliklerinin incelenmesi (Doctoral dissertation, Kastamonu üniversitesi).
4. Bayhan, Z. (2008). Kolorektal kanserli hastalarda serum Nitrik oksit, Endotelin, Vasküler endotelyal büyüme faktörü, İnterlökin 2, İnterlökin 18 düzeylerinin belirlenmesi, bu düzeylerin tümör evreleriyle ilişkisinin ve VEGF gen polimorfizminin araştırılması.
5. Yalçın, G. T., & Öztürk, B. (2013). Flavonoidlerin kanser hücrelerine etkisi.
6. Atabilen, B., & Akbulut, G. (2019). Kolorektal Kanser Oluşumunda Farklı Mekanizmalar ve Beslenmenin Rolü. Türkiye Klinikleri Tıp Bilimleri Dergisi, 39(1), 89-107.

7. Muhsiroğlu, Ö. (2017). Flavonoller, Kardiyovasküler/Serebrovasküler Hastalıklar ve Kanser. Beslenme ve Diyet Dergisi, 45(2), 178-184.
8. Şerbetçi, B., Çelik, K. E. K., & Palamutoğlu, M. İ. Kolorektal Kanserve Flavonoidlerin İlişkisi.
9. Öztaş, B., İyigün, E., & Can, M. F. (2016). Genel cerrahi polikliniğine başvuran hastaların kolorektal kanser taramasına ilişkin bilgi düzeylerinin belirlenmesi. Süleyman Demirel Üniversitesi Sağlık Bilimleri Dergisi, 7(2), 17-22.
10. Aytepe, U. E., & Donmez, E. (2022). Türkiye'de Kolorektal Kanser Tarama Davranışları, Etkileyen Faktörler ve Taramaya Katılmama Nedenleri: Sistematik Derleme. Halk Sağlığı Hemşireliği Dergisi, 4(1), 56-76
11. Çınar, İ. (2018). Rheum Ribes L. Bitki Ekstrelerinin Kolorektal Kanser Hücre Hatlarinda Antikanserojenik Etkisinin Araştirilmasi (Doctoral dissertation, Necmettin Erbakan University (Turkey)).

Advanced Engineering Days

aed.mersin.edu.tr

Cardiovascular diseases and treatment methods

Umutcan Hendekci [*1], **Furkan Ayaz** [1,2]

[1]Mersin University, Biotechnology Department, Türkiye, 19133005@mersin.edu.tr
[2]Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr

Cite this study: Hendekçi, U., & Ayaz, F. (2022). Cardiovascular diseases and treatment methods. 4th Advanced Engineering Days, 9-11

Keywords
Cardiovascular diseases
CVD treatment methods

Abstract

Cardiovascular diseases (CVD) are responsible for the majority of deaths globally and national scale. The risk factors of the disease can be examined under two groups. Among the modifiable risk factors, cigarette-alcohol use plays a major role. Some of the non-modifiable risk factors can be listed as gender, aging and genetic factors. The main ways to prevent CVD are increasing physical activity and quitting smoking and alcohol. There are new RNA-based approaches as well as biotechnology-based treatment methods for CVD.

Introduction

Cardiovascular diseases are the disease group with the highest mortality rate, especially in middle and advanced ages, and are responsible for approximately 33% of deaths in the world. Although it is 47.3% in Turkey, this rate is increasing day by day. Cerebrovascular diseases, coronary heart diseases, peripheral artery disease, hypertension, congenital heart diseases, rheumatic heart diseases, cardiomyopathies and heart failure are in the CVD group [1].

The main causes of cardiovascular diseases can be examined under two groups as modifiable and non-modifiable risk factors. Modifiable risk factors are cigarette-alcohol use, hypertension, obesity, diabetes mellitus (DM), low physical activity, psychosocial factors, and insufficient consumption of fruits and vegetables. Non-modifiable risk factors are gender, age and genetic factors [2].

Thanks to regular physical activity, a decrease in weight can be observed, a decrease in LDL cholesterol levels and an increase in HDL cholesterol levels. There are studies showing that changes in LDL and HDL cholesterol levels are associated with CVD, and it has been observed that physical activity reduces the risk of CVD. In addition, physical activity plays a positive role in smoking cessation. Studies have shown that the desire to smoke can be eliminated with physical activity. In order to reduce the risk of CVD, there are approaches such as not starting smoking or quitting smoking, weight control, increasing the consumption of fruits and vegetables, and doing sports [3].

Biotechnology based treatment methods are also available in the treatment of CVD. Melatonin level decreases with increasing age. The risk of CVD increases with age. As a result of the studies, it has been observed that melatonin affects the cardiovascular system [4]. Coenzyme Q is a molecule found in all cells that has an important role in mitochondrial respiration and cell metabolism. It is an antioxidant thanks to its membrane regulating property. In studies, positive results of Coenzyme Q supplementation have been observed in the CVD treatment process [4,5]. Studies have suggested that vitamin D deficiency is effective in cardiovascular diseases. In another study, it was determined that cholesterol accumulated in the arteries was associated with vitamin D deficiency [6]. Omega-3 and omega-6 fatty acids are vital for a healthy body. Studies have shown that omega fatty acids reduce CVD mortality. However, these oils should be used to a certain extent and the balance between them should not be

disturbed [7]. Other recent studies have been on netrin-1. However, using Netrin-1 in treatments is quite risky because it can be beneficial as well as harmful. Therefore, it is very important to choose the treatment method according to the patient [8]. Another natural compound used in the treatment of CVD is resveratrol. Resveratrol can be produced by a limited number of plants, some of which are; grapes, peanuts and strawberries. It is produced by the plant's protection mechanism as a result of plants being stressed. Since resveratrol is found in grapes, it is found in significant amounts in red wine. Therefore, an inverse correlation was found between CVD and wine consumption, and this paradox is called the French paradox. There are opinions that resveratrol can prevent CVD and can be used as a treatment [9,10].

Many studies are ongoing to learn the cause of CVD and to develop new treatment methods. A relationship was found between gut microbiota and CVD. It is thought that it may cause disease as a result of the deterioration of the microbiota. Modification of the intestinal microbiota can be achieved with products such as symbiotics, probiotics and prebiotics, and this method can be used as a treatment [11]. Another study is on Rho Kinase (ROCK) and it has been observed that it plays an imperative role in CVD. ROCK plays a role in the functions of cells that are effective in pathogenesis such as smooth muscle contraction, cell adhesion. Positive effects have been observed with prolonged inhibition of ROCK. It is thought that ROCK inhibitors can be used as a treatment method in CVD [12]. Angiotensin converting enzyme (ACE) maintains circulating homoestasis. The polymorphism in the ACE gene causes a change in the expression level and this change is thought to be the cause of CVD. If the correctness of this idea is confirmed, the usability of appropriate treatment methods such as ACE inhibitors is discussed [13]. In recent years, studies have focused on the relationship between long non-coding RNA (lncRNA) and CVD, and in this way, it is aimed to learn the CVD molecule mechanism and to develop treatment for it. A direct correlation was determined between atherosclerosis and the level of ANRIL expression. The ANRIL gene encodes a lncRNA. Knockdown studies have been performed on this gene and it is thought to have a significant relationship with CVD [14]. RNA-based therapies are also being studied. The cancer drug Doxorubicin is thought to cause mitochondrial breakdown and cause CVD diseases. The BRCA1 gene can induce Circ-INSR and increase its expression level, and mitochondrial fragmentation is reduced by the DNA-binding protein SSBP1, thereby protecting the heart from damage [15].

Results

The necessity of a healthy lifestyle to protect CVD has been proven by studies. Deficiency of biotechnology-based nutrients has been associated with CVD [1-15]. These deficiencies should be consumed in the right proportion as a method of protection or treatment from the disease. Although new treatment approaches are not definite yet, they are promising for the future. These methods should be studied more and more precisely [1-15].

Discussion

At global scale, cardiovascular diseases are the leading cause of death [1]. The society's taking into account the modifiable risk factors and living accordingly reduces the risk at a significant level [2,3]. The application of biotechnology-based treatment methods in the diet has a very high effect in the prevention and treatment of CVD. There are many studies on treatment methods [4-11]. Learning the effect that causes the disease at the molecular level will accelerate the finding of a treatment method. In view of the inconsistency of the obtained data, it is necessary to carry out more studies and focus on it [12-15].

References

1. Arslan, S., Gökçe, E., Doğan, S. D., Özgen, R., Şişman, H., Alptekin, D., & Gezer, D. (2020). Kardiyovasküler hastalığı olan bireylerde tamamlayıcı ve alternatif tıp yöntemlerinin kullanımı. *Cukurova Medical Journal*, *45*(4), 1644-1652.
2. Kumsar, A. K., & Yilmaz, F. T. (2017). Kardiyovasküler hastalıklar risk faktörlerinden korunmada hemşirenin rolü. *Online Türk Sağlık Bilimleri Dergisi*, *2*(4), 18-27.
3. Yeşil, P., & Altıok, M. (2012). Kardiyovasküler hastalıkların önlenmesi ve kontrolünde fiziksel aktivitenin önemi. *Türk Kardiyoloji Derneği Kardiyovasküler Hemşirelik Dergisi*, *3*(3), 39-48.
4. Uysal, H. (2016). Kardiyovasküler hastalıklarda tamamlayıcı ve alternatif tıp konusunda güncel yaklaşımlar. *Journal of Cardiovascular Nursing*, *7*(2), 69-83.
5. Sayiner, S., & Kismali, G. (2016). Koenzim Q ve hastalıklar ile ilişkisi. *Atatürk Üniversitesi Veteriner Bilimleri Dergisi*, *11*(2).

6. Yanik, S., Keskinrüzgar, A., Mutan, A. R. A. S., & Çetiner, S. (2015). Vitamin D' nin Biyolojik Önemi Ve Diş Hekimliği İle Olan İlişkisi. *Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi*, *25*(1), 128-134.
7. Konukoğlu, D. (2008). Omega-3 ve omega-6 yağ asitlerinin özellikleri, etkileri ve kardiyovasküler hastalıklar ile ilişkileri. *Türkiye Aile Hekimliği Dergisi*, *12*(3).
8. Görür, A., Ünal, N. D., & Tamer, L. (2018). Kardiyovasküler Hastalıklarda Netrin-1'in Rolü. *Arşiv Kaynak Tarama Dergisi*, *27*(4), 440-458.
9. Çıracı, E., & Kalafat, T. (2021). Resveratrolün kardiyovasküler hastalıklar üzerine etkileri. *Beslenme ve Diyet Dergisi*, *49*(1), 91-99.
10. Sayın, O., Arslan, N., & Guner, G. (2008). Resveratrol ve kardiyovasküler sistem. *Turkish Journal of Biochemistry*, *33*(3), 117-121.
11. Varim, P., Vatan, M. B., & Varim, C. (2017). Kardiyovasküler hastalıklar ve mikrobiyota. *Journal of Biotechnology and Strategic Health Research*, *1*, 141-147.
12. Sari, A. N., Firat, S. Ş., & Tunçtan, B. (2010). Rho kinaz ve kardiyovasküler hastalıklar. *Mersin Üniversitesi Sağlık Bilimleri Dergisi*, *3*(2).
13. Bostan, C., & Karcıer, S. (2002). Anjiyotensin dönüştürücü enzim geni polimorfizmi ve kardiyovasküler hastalıklar. *TiirkKardiyol Dem Arş*, *30*, 441-448.
14. Bayoglu, B., & Cengiz, M. (2017). The Roles of the Long Non-Coding RNA Transcripts in Cardiovascular Diseases. *Bezmialem Science*, *5*(2).
15. Tocchetti, C. G., Ghigo, A., & Hirsch, E. (2022). 'Circulating'RNA-based therapies in Cardio-Oncology. *European heart journal*, ehac407.

Advanced Engineering Days

aed.mersin.edu.tr

Anti-Spot cream with nano silver effect

Nazlı Tekin *[1], **Furkan Ayaz**[1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, 21140940006@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Tekin, N., & Ayaz, F. (2022). Anti-Spot cream with nano silver effect. 4th Advanced Engineering Days, 12-13

Keywords
Coenzyme Q1
Nano silver
Camu Camu
Skin

Abstract

Recently, many stain creams have been produced. Creams are skin care products that should be used, even if there is no issue, to keep the skin's natural balance and stop damage from environmental factors. Cosmetics made using nanotechnology have the benefit of more product variety, increased bioavailability of active substances, and improved aesthetic appeal of cosmetics with long-lasting benefits. Nano silver's antibacterial, antiviral, and antimicrobial qualities make it important for health, and its therapeutic value makes it appealing for usage in medications and lotions. The production of ATP and maintaining membrane integrity are both functions of coenzyme Q10. By lessening oxidative skin damage brought on by UV radiation, it aids in skin protection. Antioxidant miracle Camu camu slows down age-related muscle degradation, protecting skin elasticity and preventing premature aging through cell regeneration. In other words, it results in a skin that is tighter.

Introduction

The basic goals of skin care are to keep the skin healthy and in good shape, to lessen signs of skin aging or to slow the emergence of new symptoms, and to help with the treatment of various skin conditions [1].

Nanotechnology holds a distinct role in the cosmetics industry because smaller particles are more readily absorbed into the skin and can cure damage more quickly and effectively. Nano silver has a size of one millionth of a millimeter. The antibacterial activation of silver that has been shrunk to this size thanks to nanotechnology is enhanced and becomes 100,000 times more potent than the silver we use on a daily basis [2]. Due to their extremely small volume, the nano-sized silver particles in nano silver creams quickly transition under the skin, aid the body in breaking down fat deposits, regardless of how resistant they may be, lessen the look of sagging skin, and have an impact on the body's tightening. The blood circulation quickens in this way. The body breathes more freely and receives nourishment from the vitamins and minerals in the product thanks to the enhanced blood circulation.

A fat-soluble, vitamin-like compound called coenzyme Q10 is present in practically all tissues. It is an effective lipophilic antioxidant and a cofactor of the cell's mitochondrial electron transport chain, both of which are necessary for the generation of ATP. Coenzyme Q10 promotes cell growth and prevents cell death. With its bioenergetic and antioxidative properties, coenzyme Q10 also has a protective effect on cells.

Due to its high vitamin C content, camu camu is frequently utilized to improve the immune system and is employed as an antioxidant.

Results

Silver was utilized in Roman culture as "silver water" to treat diseases and guard against bacteria and other microbes. It was additionally known as "holy water."

To use silver more effectively and efficiently today, it is now reduced to nano size.

The greatest therapeutic approach is nano silver since it quickly penetrates the skin due to its nano-sized particles, has antibacterial and antiviral qualities, has a deodorizing impact, has the ability to cure burns and wounds, and can be used to treat acne

We can keep bacteria and fungi from coming into contact with our body by putting Nano Silver-containing items to it.

Every cell contains coenzyme Q10 (also known as ubiquinol-10 and/or ubiquinone-10), a lipid-soluble substance that functions as a coenzyme in important enzymatic activities during cellular energy synthesis.

The maintenance of membrane stability, cell signaling, gene expression, cell proliferation, and apoptosis regulation are also said to be activities of coenzyme Q10.

Increasing bioavailability can also be achieved by reducing the particle size to the micro- or nanoscale.

The influence of absorption pathway and efficiency was noticed in lowering the particle size to nano size in order to boost bioavailability. Nanoparticle structures also aid in improving the bioavailability of compounds that aren't very soluble in water.

Both ATP generation and oxidative damage may be aided. The skin loses its youthful appearance over time for a variety of causes, including aging, diseases, hormonal changes, and environmental factors. With time, the skin loses its flexibility and its capacity to create collagen as well as to retain moisture. The Coenzyme Q10 antioxidants prevent cellular damage brought on by aging and external causes that harm the skin. It also tightens the skin by activating the collagen fibers because of its refreshing quality [4].

Anthocyanins, yet another form of antioxidant, are abundant in camu camu. This fruit has a high capacity for antioxidants, which makes it preventive against cancer. By lowering oxidative stress, the antioxidants in its composition inhibit the development of numerous cancer types.

This amazing fruit has 200 times the vitamin C of a banana, 56 times the vitamin C of a lemon, and 30–60 times the vitamin C of an orange. Brazilians regard these fruits that resemble red cherries as having the highest vitamin C content of any diet. Vitamin C and other phytochemicals, particularly beta-carotene, are essential antioxidants that support a healthy immune system and defend against bacteria and diseases.

Discussion

Nano silver does not interact with any cells in the human body and does not hurt them because of the cell membrane. As a result, other than providing the intended treatment, the silver ion employed in nanotechnology has no negative effects [5].

The body naturally produces CoQ10, but its production declines as we become older. CoQ10 is therefore externally supplied.

The antioxidant qualities of the camu camu fruit are also naturally exploited due to its high content.

References

1. Altuner, E. E. (2013). Nano kremlerin üretimi. Karaelmas Fen ve Mühendislik Dergisi , *4* (1), 52-57.
2. Ercan, P., & Sedef, E. L. (2010). Koenzim Q10'un beslenme ve sağlık açısından önemi ve biyoyararlılığı. *TÜBAV Bilim Dergisi*, *3*(2), 192-200.
3. Shimamoto, T., & Mima, H. (1979). A model for the evaluation and prediction of preservative activity in oil-in-water emulsions. *Chemical and Pharmaceutical Bulletin*, *27*(11), 2743-2750.
4. Overvad, K., Diamant, B., Holm, L., Hølmer, G., Mortensen, S. A., & Stender, S. (1999). Coenzyme Q10 in health and disease. *European Journal of Clinical Nutrition*, *53*(10), 764-770.
5. Lohani, A., Verma, A., Joshi, H., Yadav, N., & Karki, N. (2014). Nanotechnology-based cosmeceuticals. *International Scholarly Research Notices*.

Advanced Engineering Days

aed.mersin.edu.tr

In vitro fertilization and its applications

Helin Aytar *[1], **Furkan Ayaz** [2]

[1]*Istanbul University, Student in Molecular Biology and Genetic Department, Türkiye, helinaytar1905@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Aytar, H., & Ayaz, F. (2022). In vitro fertilization and its applications. 4th Advanced Engineering Days, 14-15

Keywords
In vitro fertilization
Mitochondrail diseases
Mithochondrial DNA
Genome
CRISPR

Abstract

The basis of research on human reproduction is the search for solutions to infertility treatment. Alternative ways have been sought for couples who cannot have children naturally. In this context, in vitro fertilization studies have started. In vitro fertilization (IVF) is the process of artificial fertilization of sperm and egg taken from parents in the external environment. The first studies on IVF have been conducted in 1960-1970. The first baby born as a result of IVF pregnancy was born in the UK in 1978. Subsequently, studies on IVF have become increasingly widespread. Since the 1990s, IVF studies have gained momentum and developed in many parts of the world. It was aimed that healthier individuals would be born with IVF and it was wanted to prevent the birth of sick individuals with some methods.

Introduction

IVF is the process of artificial insemination of an egg taken from a woman and sperm taken from a man in a laboratory environment [1]. This is an assisted reproductive technique [1]. In vitro fertilization studies began to be studied in the 1960s with the idea that it could cure the infertility problem [2]. In this context, the first baby was born with this technique in 1978 [2]. In vitro fertilization is applied for the purpose of giving birth to healthy babies as well as having children [3]. There are many studies on this. These studies are accepted studies in the medical and scientific world. One of these studies is the study aimed at the prevention of mitochondrial diseases [4]. The genome of the mitochondria is taken from the mother, and all mtDNA copies are identical to each other [4]. When the genomes of the mother's mitochondria are mutated, this is transferred to the baby, and the baby with mitochondrial disease is born. A lot of research is being conducted and developed to prevent this condition [4]. Chinese scientists conducting genetic research in the field of in vitro fertilization have signed new studies in recent years [5]. One of these studies is the study carried out by He Jiankui, in which he inactivated the CCR5 gene that causes the HIV virus in twin babies born in 2018 with CRISPR-Cas9 technology [5]. Although this study is a very important development in the scientific world, it is said that it is not based on a legal basis. In addition, the fact that the CCR5 gene has an important role in brain function has also raised new discussions about this study [5].

Results

In vitro fertilization is an important point in the treatment of mitochondrial diseases. The treatment of mitochondrial diseases is not at the curative level. Due to the lack of a definitive treatment and the difficulty of its diagnosis, it was considered to prevent the transmission of mitochondrial-transmitted diseases by the gene replacement method [4]. For this purpose, in vitro studies have started. Mitochondrial DNA is taken from the

mother. If the mother's mitochondria are mutated, this can be passed on to the baby. In order for the disease to manifest itself in the phenotype, it must pass a certain threshold. So abnormal MTDNA should be in the December range of 60-90% [4]. Some techniques have been developed to prevent this condition. In the first technique, the nuclear genome taken from the mother's pronuclear stage zygote is transferred to the zygote of a nucleeless recipient. The second technique is the transfer of the spindle threads in metaphase II from the unfertilized oocyte of the affected mother to the oocyte of a nucleated recipient [4]. Although the results obtained from these techniques are promising, more reliable and effective research needs to be done before they can be used in the clinic. In 2018, twin babies were born whose genes were altered to make them immune to HIV. He Jiankui; in couples where the male parent has the HIV virus, he inactivated the CCR5 gene that causes HIV, allowing babies with immunity to HIV to be born [5]. He accomplished this using CRISPR technology. Although these results are important development for HIV, the CCR5 gene has raised ethical discussions at the point of its application due to the important role it plays on brain functions. The compliance of the study with the basic laws was discussed. In addition, new discussions have emerged about the use of CRISPR gene technology [5]. Thanks to CRISPR-Cas9 technology, new genes were added, removed and replaced. This is a sign that new genetic variations may occur. This, in turn, gave rise to discussions that genetic changes made to a gene, in addition to being therapeutic for a disease, can also cause other risks [5].

Discussion

As a result of all these studies, in vitro fertilization occupies a very important place in the field of science and medicine. It will both be a hope for parents who want to have children and will pave the way for new studies to bring healthier individuals into the world. Although the issue of ethics is always on the agenda in this field, reliable studies and research are being conducted.

References

1. https://www.acibadem.com.tr/ilgi-alani/tup-bebek-tedavisi/
2. Eskew, A. M., & Jungheim, E. S. (2017). A history of developments to improve in vitro fertilization. *Missouri medicine*, *114*(3), 156.
3. Fishel, S. (2018). First in vitro fertilization baby—this is how it happened. *Fertility and sterility*, *110*(1), 5-11.
4. Amato, P., Tachibana, M., Sparman, M., & Mitalipov, S. (2014). Three-parent in vitro fertilization: gene replacement for the prevention of inherited mitochondrial diseases. *Fertility and sterility*, *101*(1), 31-35.
5. Raposo, V. L. (2019). The first Chinese edited babies: a leap of faith in science. *JBRA assisted reproduction*, *23*(3), 197-199

Advanced Engineering Days

aed.mersin.edu.tr

Dendritic cells: Their functions in immunity and disease

Havva Türkben *[1], **Furkan Ayaz** [1,2]

[1]Mersin University, Biotechnology Department, Türkiye, havvaturkben5153@gmail.com
[2]Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr

Cite this study: Türkben, H., & Ayaz, F. (2022). Dendritic cells: Their functions in immunity and disease. 4th Advanced Engineering Days, 16-17

Keywords
Dendritic cells
Immunity
Immunotherapy
Disease

Abstract

Dendritic cells were first identified among the skin epithelial cells by Langerhans in 1868. Its origin is based on CD34+ cells of the bone marrow progenitor cells or CD14+ cells of the monocytes. It is involved in the formation of primary response and antigen presentation in the immune system. They are also called the professional antigen presenting cells (APC) because their main function is to present antigen. Dendritic cells are generally having the immature intracellular functions in peripheral tissue; in cases where they encounter pathogens such as viruses, bacteria, fungi or tumors, they switch into the mature dendritic cell form to capture the antigen molecule and create an immune response. Due to these effects, dendritic cells are used in cancer immunotherapy applications. In our proceeding review we will further discuss their role in the immunity.

Introduction

Dendritic cells were first identified among the skin epithelial cells by Langerhans in 1868. In the light of this exploration, in a study carried out by Steinman in the early 1970s, its existence was proven in the spleen and lymph nodes in line with their shapes by using light and electron microscopy [1,2].

Antigen-presenting dendritic cells located in the epidermis layer are also called Langerhans cells. This constitutes 5% of all epidermis cells. If a pathogen from any source is evaluated as an antigen and causes inflammation, the secreted interleukins (IL2/IL6) activate Langerhans cells. As a result of this activation, Langerhans cells enter the secondary lymph nodes through the blood and transform into fully differentiated activated dendritic cells. Activated, antigen carrying cells enable T cells to generate a specific antigen-specific response. In this way, dendritic cells present antigen to T cells, enabling T cell activation for an antigen-specific immune response [1-4].

Results

Dendritic cells have their origins as either CD34+ cells of the bone marrow progenitor cells or CD14+ cells of the monocytes. Afterwards, it differentiates with Flt-3L cytokine in tissues such as skin and spleen; it is involved in the formation of primary response in the immune system, antigen presentation, creation of immune response in cancer, expression of MHC class I and class II molecules, stimulation of T cells, activation of B cells, and development of humoral immunity. Since the main function of dendritic cells is to present antigen, they are also called professional antigen presenting cells (APC). Dendritic cells make up the 0.1-1% of mononuclear cells; they are found in all tissues of the body, such as the respiratory and gastrointestinal tract, except the brain, testis and eye. Although there are no peroxidase enzyme activities, ATPase enzyme activities are present in these cells. Their endocytic and phagocytic activities are high, while their pinocytic activities are low. Dendritic cells carry immature

intracellular functions in peripheral tissue; in cases where they encounter pathogens such as viruses, bacteria, fungi or tumors, they migrate to the lymphoid tissues in approximately 48 hours to capture the antigen molecule and form an active mature dendritic cell, which creates an immune response. Chemokines are involved in the differentiation of immature dendritic cells into mature dendritic cells. Chemokines involved in differentiation can be listed as: MIP-1α, MIP-1β, MIP-3α, MIP-5, MCP-3,4, RANTES, TECK, SDF-1, IL-6 Cytokine and MIP-3β [5,6].

Immature and mature dendritic cells have different characteristics from each other. They are actively located on the surface of some organs and tissues in order for immature dendritic cells to detect antigens more easily and contains some activation signals. These activation signals may be caused by pathogens or can also be factors such as cytokines or chemokines secreted from damaged or dead cells [7,8].

Discussion

Using dendritic cells in cancer vaccines has been a trending topic in the field. The concept is based on stimulating CD8+ cytotoxic T cells and CD4+ T cells that can recognize and destroy tumor cells, increasing the cytotoxic activities of NK (natural killer) cells, performing immunomodulatory activations of NK cells correctly and effectively, regulating and strengthening the immune system. Usually, a tumor antigen is loaded on the dendritic cells to make them more tumor specific and given to the system after *ex vivo* treatment to clear the tumor cells by activating the other immune system cells. Currently the main issues can be listed as either over or low activation of dendritic cells and lack of specific antigens for each tumor type [9-11].

Conclusion

Cancer immunotherapy relies on the activation of the immune system specifically against the tumor cells without harming the regular tissue cells. Finding tumor specific antigens to load onto the dendritic cells have been a major issue since these antigens have not been well defined. Future studies should focus on the utilization of the bioinformatics tools to find out the best antigen cocktails to be loaded on the dendritic cells for the cancer immunotherapy applications. In this way a safe therapy regimen can be developed by eliminating the excessive usage of chemotherapy or radiotherapy on the cancer patients [3].

References

1. Sönmez, M. Dendritik Hücre İmmünobiyolojisi. Karadeniz Teknik Üniversitesi, Temel moleküler hematoloji kursu.
2. Söker, S. (2005). Dendritik Hücreler. Dicle Tıp Dergisi, 3, 158-160.
3. Özyurt, E. (2006) Dendritik Hücreler ve İmmünoterapi, Türk Nöroşirürji Dergisi, 16(1), 28-30
4. Steinman, R. M. (1991). The dendritic cell and its role in immunogenicity. *Annu. Rev. bnmunol*, *271*, 296.
5. Pearce, E. J., & Everts, B. (2015). Dendritic cell metabolism. *Nature Reviews Immunology*, *15*(1), 18-29.
6. Wu, L., & Dakic, A. (2004). Development of dendritic cell system. *Cell Mol Immunol*, *1*(2), 112-118.
7. Collin, M., McGovern, N., & Haniffa, M. (2013). Human dendritic cell subsets. *Immunology*, *140*(1), 22-30.
8. Greensmith, J. (2007). *The dendritic cell algorithm* (Doctoral dissertation, University of Nottingham).
9. Steinman, R. M. (2003). Some interfaces of dendritic cell biology. *Apmis*, *111*(7-8), 675-697.
10. Wu, L., & Liu, Y. J. (2007). Development of dendritic-cell lineages. Immunity, 26(6), 741-750.
11. King, P. D., & Katz, D. R. (1990). Mechanisms of dendritic cell function. Immunology Today, 11, 206-211.

Advanced Engineering Days

aed.mersin.edu.tr

Mast cells and their importance for the immune system

Ceren Canatar *[1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, cerencanatar07@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Canatar, C., & Ayaz, F. (2022). Mast cells and their importance for the immune system. 4th Advanced Engineering Days, 18-19

Keywords
Mast cells
Mediators
Immunity

Abstract

Mast cells, which originate from bone marrow tissue, have some important functions and can be located in areas such as respiratory epithelium, gastrointestinal tract, and skin. They play essential roles in many different events such as tissue repair, innate and adaptive immunity, and allergic reactions. Mast cells, which release various mediators as a result of exposure to different stimuli, can take part in both some pathological and some physiological processes thanks to these mediators. Among these mediators, which have some important effects and duties; histamine, some cytokines, leukotrienes, some proteoglycans, prostaglandins, platelet activating factor (PAF) and some neutral proteases. In this review study we will focus on the mast cells and their functions.

Introduction

Mast cells, originating from bone marrow tissue; they are cells that can be located in areas such as respiratory epithelium, gastrointestinal tract, and skin [1-3]. The density and number of granules in the cytoplasm of mast cells, which can have different sizes, are an effective factor on the difference in the size of these cells [4].

Stem cell factor (SCF), which is of great importance for mast cells; It is accepted as a necessary factor in the proliferation and maturation, survival, migration and differentiation of mast cells [3,5,6].

Mast cells with many functions; They are very important cells that can play a role in some allergic reactions, some inflammation events, both innate and adaptive immunity (depending on the body's needs), healing of wounds, angiogenesis, parasitic and bacterial infections, coagulation process, pathophysiology of some diseases, and tissue repair [1,3,7,8]. These cells can recruit immune system cells to the infection site [9].

Results

Many mediators are released as a result of exposure of mast cells to different stimuli. Some microorganisms such as allergens or parasites and bacteria can be given as examples of the stimuli mentioned. Thanks to the released mediators, mast cells are involved in both some pathological and some physiological processes [2,3]. While some neuropeptides and cytokines may play a role in the activation of mast cells, this activation may also occur as a result of binding of IgE antibody and specific receptors on mast cells. The synthesis of IgE antibody occurs as a result of exposure to certain antigens by plasma cells [2,4]. Some chemicals, anaphylatoxins (C3a and C5a), some hormones, radiation and some toxins may also play a role in stimulating mast cells. In other words, activation of mast cells can be made possible by some stimuli (chemical, physical or biological) [3].

Discussion

Examples of mast cell mediators are histamine, some cytokines, leukotrienes, some proteoglycans, prostaglandins, platelet activating factor (PAF) and some neutral proteases. In addition, these mediators have some important effects and duties. Histamine, which is considered a very important mediator; It can play roles in neurogenic vasodilation, both innate and adaptive immunity [2,10]. Some neutral proteases, which are among the mast cell mediators, are known to be involved in tissue repair. Leukotrienes and prostaglandins (released shortly after the stimulation of the mast cells), which are considered lipid mediators, play a role in increasing vascular permeability. In addition to this, leukotrienes have a role in stimulating bronchospasm. The mast cell mediator called platelet activating factor (PAF) is involved in the aggregation of platelets [2,3]. Some proteoglycans, which are among mast cell mediators, play a role in inhibiting some chemokines, and these mediators also have anticoagulant effects [2].

Mast cells may be involved in the development of allergic inflammation. This occurs with some cytokines released by mast cells out of the cell [11]. In addition, various cytokines can take part in both host defense and regulation of the immune system, and the source of some cytokines involved in this context is known as mast cells [9].

Mast cells can also play an active role in acquired immunity through some mediators [2,3]. Mast cells can be the focus of attention in immunotherapeutic approaches, thanks to some of their powerful and important functions to modulate the immune system activities [12,13].

Conclusion

Mast cells are functional in the innate and adaptive branches of the immune system. They are involved in reactions that primarily create the allergies. But they are also found in tumor tissues and their role as anti or pro tumor cell types depends on the mediators that they secrete to the region. Due to their immunomodulatory potential via cytokine, chemokine and other mediator secretion they have been considered as immunotherapy target agents as well. More studies should be conducted to fully decipher their activities and to take advantage of these cells for immunotherapy as well as to develop treatment methods against allergic reactions [1,12,13].

References

1. Krystel-Whittemore, M., Dileepan, K. N., & Wood, J. G. (2016). Mast cell: a multi-functional master cell. *Frontiers in immunology*, 620.
2. Bayramgürler, D., & Demirsoy, E. O. (2013). Mast hücreleri ve aktivasyonu/Mast cells and their activations. *Türkderm: Türk Deri Hastalıkları ve Frengi Arşivi= Turkderm: Turkish Archives of Dermatology and Venereology*, *47*(1), 37-40
3. Erpek, S. (2004). Mast hücreleri. Journal of Turgut Ozal Medical Center, 11(2), 109-120
4. Özkorkmaz, E. G. (2008). Mast hücresi. *Afyon Kocatepe Üniversitesi Fen Ve Mühendislik Bilimleri Dergisi*, *8*(2), 77-85.
5. Ercan, F., & Çetinel, Ş. (2008). Mast Hücrelerinin Enflamasyondaki Rolü: İnsan ve Deneysel Hayvan Modelleri Üzerinde Yapılan Çalışmaların Değerlendirilmesi. Marmara Medical Journal, 21(2), 179-186.
6. Okayama, Y., & Kawakami, T. (2006). Development, migration, and survival of mast cells. *Immunologic research*, *34*(2), 97-115.
7. Göksu Erol, A.Y., & Özdemir, Ö. (2011). Mast Hücrelerinin Cerrahi Hastalıklar ve Cerrahi Tümörlerdeki Yeni Tanımlanan Rolleri/Newly Defined Roles of Mast Cells in Surgical Diseases and Surgical Tumors. Türkiye Klinikleri. Tip Bilimleri Dergisi, 31(4), 969-975.
8. Göksu Erol, A.Y. (2013) Mast Hücrelerinin Kanser ve Anjiyogenezde Yeni Tanımlanan Rolleri. Van Tıp Dergisi, 20(3), 189-193.
9. Özdemir, Ö., & Savaşan, S. (2005). Gözardı edilmiş bir hücrenin dönüşü: Mast hücresi ve hematoloji-onkoloji/immunoloji alanlarında tanımlanan yeni rolleri. Çocuk Sağlığı ve Hastalıkları Dergisi, 48, 85-92.
10. Köycü, A., & Atak Yücel, A. (2021). Immunological Mechanisms of Allergic Rhinitis. GMJ, 32, 337-340
11. Birben, E., & Saçkesen, C. (2014). Allerjik enflamasyon. Çocuk Sağlığı ve Hastalıkları Dergisi, 57(1), 35-49
12. Willows, S., & Kulka, M. (2020). Harnessing the power of mast cells in unconventional immunotherapy strategies and vaccine adjuvants. Cells, 9(12), 2713.
13. Oldford, S. A., & Marshall, J. S. (2015). Mast cells as targets for immunotherapy of solid tumors. Molecular immunology, 63(1), 113-124.

Advanced Engineering Days

aed.mersin.edu.tr

Carcinogens and protective genes against the cancer

Ümmühani Önder [*1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, 20133024@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Önder, Ü., & Ayaz, F. (2022). Carcinogens and protective genes against the cancer. 4th Advanced Engineering Days, 20-22

Keywords
Proto-oncogene
Mutation
Tumor suppressor gene
Modified
Damage
Regulatory gene

Abstract

What is a carcinogen? Substances that cause severe gene damage in cells and trigger mechanisms that lead to cancer are called carcinogens. In short, it means "cancer-causing". While some chemicals found in nature can be carcinogens, there are also carcinogens produced by humans. Carcinogens reduce the functions of cancer-preventing genes and cause mutations that damage DNA repair systems. In this proceeding-review study we focus on some of the carcinogens and also the genes that are protective against the cancer.

Introduction

Changes in DNA that cause defects in tumor suppressor proteins and oncoproteins may predispose the patients to develop tumor cells. Growth, development, and intracellular cycle regulatory genes, key oncogenic mutations involve chromosomal sequences and translocations as well as insertions, deletions and base changes [1]. In addition, the destruction of protective genes in DNA repair systems paves the way for possible mutations. Cells that carry mutations that also affect certain cell cycle regulators and accumulate and trigger the development of the cancer. In addition, some DNA repair mechanisms are prone to error [2]. These repair errors contribute to the tumor formation. The fact that cancer cells keep their genetic makeup intact contributes to the formation of an unevenly distributed colony of tumor cells [3]. Therefore, chemotherapy targeting one gene or several genes are ineffective destroying all harmful cells. The ineffectiveness of the method in this way increases the attention drawn to the treatments that prevent blood flow to reach to the tumor site to eventually induce the death of the tumor cells in the region [4].

The tumor-causing abilities of chemical and physical carcinogens depend not only on their capacity to cause DNA damage in cells, but also on the ability or inability of the cells trying to repair this damage [5-7]. Carcinogens defined as chemical carcinogens are divided into two categories as those with direct effect and those with indirect effect, even though they do not have sharp common characteristics and show widespread distribution they are grouped in these two categories [8].

The number of carcinogens that play a direct role is very few, and they are compounds that seek and interact with centers where electrons are high in other compounds [9]. These compounds can chemically interact with nitrogen and oxygen atoms in DNA, disrupting some of the modifiable and normal base pairing patterns in DNA. If these modified nucleotides are not corrected, they cause mismatching of the nucleotides during replication. Some of these types of carcinogens are ethylmethylsulfonate (EMS), dimethyl sulfate (DMS) and mustard gas [10].

Indirectly acting carcinogens are generally non-reactive, often water-insoluble compounds that cause cancer only after reaching the electrophilic centers. Cytochrome found in animals, P450 enzymes are found in the ER of many cells and are particularly abundant in the liver. P450 enzymes normally bind some electron rich center such as hydroxyl groups to non-polar unspecified chemical such as some treatment drugs, rendering them water-soluble and allowing them to be removed from the body. On the other hand, P450 enzymes can convert some inert chemicals into carcinogens. Many chemical carcinogens have a low mutagenic activity before being modified by cellular enzymes [11].

Results

Even in the absence of exogenous carcinogens or mutagens in cells, normal cellular processes can produce large amounts of damaged DNA. DNA damage is due to depurination and alkylation reactions that alter DNA and reactive oxygen derivatives. It is estimated that 20000 changes occur in the DNA of each cell every day, caused by reactive oxygen derivatives and depurination, so DNA repair mechanisms are important defense mechanisms [12].

The usual function of protective genes is to prevent or repair damage to the DNA. There is a link between the loss of DNA repair systems and the likelihood of developing cancer. For example, some cancers are more likely to develop in people who have an inherited mutation in their protein that performs base mismatch or base excision repair [13]. Individuals with xeroderma pigmentosum (XP) or transmitted between generations nonpolyposis colorectal cancer (HNPCC) lacking the necessary DNA repair mechanisms are likely to have mutations in some important genes involved in cell division and proliferation. People with XP are 1000 times more likely to develop skin cancer than those with normal pigments. Seven of the eight known XP genes encode proteins involved in this base excision repair, and when this mechanism is absent, the genes that control the cell cycle in the cells and regulate the vital activities in these processes are mutated. Colorectal cancer genes encode components of mismatch in the DNA repair system. Changes in these components increase the incidence of the colon cancer. The process from benign polyp to cancer progresses much faster than normal cells because cells do not have repair systems, so there is constant mismatch mutagenesis [14].

The DNA polymerase enzyme family of DNA repair mechanisms functions to abolish DNA damage. Nine of these constructs, including DNA polymerase β, can correct errors involving DNA damage and other chemical modifications. These polymerases are also known as lesion bypass polymerases. Each member of this family can repair a different type of damage. These polymerases can tolerate damage because any repair is better than no repair, and lesion bypass polymerases are the last resort when appropriate and ubiquitous polymerases fail to do their job [15]. Thus, they successfully maintain a mutagenic replication function. DNA polymerase β has no error-correcting properties and is highly expressed in some tumors. Perhaps overexpression of this enzyme in the tumor may be necessary for these over-mutated cells to continue dividing. Error-prone repair systems can correct the carcinogenic effect of chemicals or radiation if there is no inherited mutation. There is evidence that DNA mutations in polymerase β are tumor-associated. When two mutant forms of polymerases were sent into the mouse cells, these mice were shown to have a transformed appearance. It was also revealed that foci were formed in mice and these foci were found independently [16].

Protective genes protect the integrity of the chromosome by encoding DNA-repairing enzymes or cause the death of the cell where DNA damage occurred. Changes in the protective genes ensure the survival of the cells that need to die, change in the cell cycle control, and the continuation of mutagenesis in the genome and ultimately the formation of cancer. Inherited DNA repair mechanism disorders detected in some human diseases increase the susceptibility of people to some types of cancer. Cancer cells; similar to the stem cells and germ cells, unlike modified cells, produce telomerase, which prevents the chromosomes from shrinking while DNA makes its own copy, thus preventing the cells from breaking down [17].

Understanding that cancer is a genetic disease led to the development of new approaches to prevent and treat this disease. Today, it is known that carcinogens have an effect on some steps involved in the cell cycle control. By identifying the faults that may have occurred in the components of the checkpoints and repair systems that serve to detect and repair damaged DNA, we can examine the mechanism of cancer in more details. In order for a normal cell to turn into a malignant tumor cell, there are many changes that must occur in the cell. Identifying mutant genes related to cancer can show us at which point we should target the drugs we will use in the treatment [18]. Diagnostic medicine is changing as the possibilities for displaying cellular features increase. Some of the traditional methods used to identify possible tumor cells focus on microscopy of labeled cells, measuring the expression of hundreds of genes, or specific genes that can be good indicators of disease diagnosis and cell growth. Recent DNA microarray analyzes have made it possible to measure the transcription of genes. In the future, techniques that can perform all the important systematic measurements of the cellular stages, such as protein production, change and location, will allow us to get a better portrait of the cell [19]. Therefore, mutations that may occur, such as errors in the DNA repair system are detected, increasing the possibility of preventing cancer with the developed methods and techniques.

References

1. Armanios, M., & Greider, C. W. (2005, January). Telomerase and cancer stem cells. In *Cold Spring Harbor Symposia on Quantitative Biology* (Vol. 70, pp. 205-208). Cold Spring Harbor Laboratory Press.
2. Bailey, S. M., & Murnane, J. P. (2006). Telomeres, chromosome instability and cancer. *Nucleic acids research*, *34*(8), 2408-2417.

3. https://avesis.gazi.edu.tr/yayin/b51cdbea-f42c-4084-af84-fc95a78f2403/gen-polimorfizmi-ve-kansere-yatkinlik/document.pdf.
4. https://www.sciencedirect.com/science/article/pii/S030372070500273X?casa_token=0HPFbMd2LfsAAAAA:WQ0ejxdHnNlQvIbx1E9rCes6BFJxMkJYyMEVxqZxERrVKTadxI1MheXGujk4g1jXHYDlgaqucnET.
5. Batty, D. P., & Wood, R. D. (2000). Damage recognition in nucleotide excision repair of DNA. *Gene*, *241*(2), 193-204.
6. Blackburn, E. H. (2005). Telomerase and cancer: Kirk A. Landon-AACR prize for basic cancer research lecture. *Molecular cancer research*, *3*(9), 477-482.
7. Cleaver, J. E. (2005). Cancer in xeroderma pigmentosum and related disorders of DNA repair. *Nature Reviews Cancer*, *5*(7), 564-573.
8. D'Andrea, A. D., & Grompe, M. (2003). The Fanconi anaemia/BRCA pathway. *Nature Reviews Cancer*, *3*(1), 23-34.
9. Flores-Rozas, H., & Kolodner, R. D. (2000). Links between replication, recombination and genome instability in eukaryotes. *Trends in biochemical sciences*, *25*(4), 196-200.
10. Friedberg, E. C. (2003). DNA damage and repair. *Nature*, *421*(6921), 436-440.
11. Hoeijmakers, J. H. (2001). Genome maintenance mechanisms for preventing cancer. *nature*, *411*(6835), 366-374.
12. Jiricny, J. (2006). The multifaceted mismatch-repair system. *Nature reviews Molecular cell biology*, *7*(5), 335-346.
13. https://www.genome.gov/genetics-glossary/Carcinogen.
14. https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/carcinogen.
15. https://breast-cancer-research.biomedcentral.com/articles/10.1186/bcr1029.
16. https://www.jbc.org/article/S0021-9258(20)86430-8/abstract.
17. Müller, A., & Fishel, R. (2002). Mismatch repair and the hereditary non-polyposis colorectal cancer syndrome (HNPCC). *Cancer investigation*, *20*(1), 102-109.
18. Somasundaram, K. (2003). Breast cancer gene 1 (BRCA1): role in cell cycle regulation and DNA repair—perhaps through transcription. *Journal of cellular biochemistry*, *88*(6), 1084-1091.
19. Kitagawa, R., & Kastan, M. B. (2005, January). The ATM-dependent DNA damage signaling pathway. In Cold Spring Harbor symposia on quantitative biology (Vol. 70, pp. 99-109). Cold Spring Harbor Laboratory Press.

Advanced Engineering Days

aed.mersin.edu.tr

Use of the gene drive system in harmful species' suppression in the ecosystem

Gülseven Aleyna Yatmaz [*1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, aleynayatmaz2002@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Yatmaz, G. A., & Ayaz, F. (2022). Use of the gene drive system in harmful species' suppression in the ecosystem. 4th Advanced Engineering Days, 23-24

Keywords
Gene drive system
CRISPR
Ethic
Ecosystem

Abstract

In this review proceeding, we will discuss what gene drive is and how it can be used. Should gene drive be used, or not in many aspects? How ethically correct is it to apply gene editing techniques? Should people implement crspr method that could have big impacts on the ecosystem? These questions will be discussed in more details in our study.

Introduction

Firstly, let's look at what a gene drive is, gene drivers: It is a biased inheritance system that ensures or increases the probability of transmission of a desired trait to a local population and all populations associated with this species through sexual reproduction between generations of any DNA sequence. If we examine the content of how the gene drive works in more detail; in of the examples, it is a system based on gene driven HEGs, that is, a guided endonuclease gene. The way HEGs work is based on cutting both strands of the DNA helix at a particular knee. The organism uses homology-directed DNA repair (HDR) to repair the cut sites. Thus, the organism can copy and use any similar sequence in the cell to fill in these gaps. In this way, we can create deliberate gaps so that the organism can copy and use the correct sequence. This trait is passed on from generation to generation. The targeted gene is transported to fixation within a short period of time instead of settling in the gene with long evolutionary processes [1]. Although the use of the gene drive system has very useful promises, the deliberate or accidental release of only one genetically modified organism into the environment carries great risks for the ecosystem, as it may affect the genetics of an entire species and even related species. For this reason, it has always been a matter of debate whether it should be used or not since its discovery. If we talk about the possible risks of using gene drive in general, it may cause an unknown downstream effect on the entire ecosystem, or countries may deliberately use treacherous gene drive to release a genetically modified organism into nature for warfare. Gene drive use poses some ethical dilemmas. On the other hand, using gene drive, disease-carrying insect vectors can be destroyed, agricultural pests can be suppressed without harming the environment and non-target organisms, or it can offer the opportunity to counter invasive species that have formed in the ecosystem or to provide the opposite effect for endangered species [2]. As an example of the use of gene drivers for pest control, we can take the pest problem in New Zealand. The pest problem is a big problem in many parts of the world and needs to be solved for the good of humanity and the world. The pest infestation in New Zealand has been going on for a very long time. Although many studies have been tried to solve this problem, none of them have brought a permanent solution. New Zealand needs special treatment due to its location and a few other features. Many pests enter this country intentionally or accidentally from many overseas countries. It has become a necessity to use the gene drive system for the suppression of vespin hornet and brush-tailed rat species, which have caused great damage to the country and require urgent intervention, especially recently. As New Zealand is an island country, it is a suitable field environment for biological research and testing new technologies. On the other hand, there are reasons why this should be done as early as possible, for example, some drugs and methods used by the public for pest control (sodium fluoroacetate) cause great harm to the ecosystem, species can become resistant to these drugs. For such reasons, these methods are not permanent and sustainable solutions. In fact, the use of these drugs can directly

harm people, as well as the environment. Trying new technologies becomes mandatory for many reasons such as using them in the context of adequate and detailed research and applications [1-3].

Discussion

Throughout the article, we have discussed what gene drive is and what it can be used for. Although the use of many gene drive systems is under intense discussion for their utilization to improve our production and life styles, there are also those who argue that we should not interfere with the functioning of the environment itself. Human beings have already influenced and disrupted the way the world works. According to many studies, the world we live in has ceased to be sustainable a while ago and is faced with risks such as exceeding irreversible thresholds day by day. In this case, if something is not done and if we exceed certain threshold values on behalf of our resources and living things, it may not be reversible. For such reasons, the use of the gene drive system comes to the fore. However, when the system is started to be used, the risks that may occur should be considered and proceed in this direction. In addition, studies should be viewed from an ethical point of view. At this point, certain ethical codes can be created. For every action to be taken, these codes must be followed and the approval of the public must be obtained. In order to establish ethical codes, some institutions such as NASEM have started to work on creating an independent expert panel. With such moves, possible environmental risks and bioterrorism can be prevented [3]. Humanity has to keep up with the changing world. As Charles Darwin said, "Throughout the long history of humanity (and the animal kingdom), those who have learned to cooperate most effectively and adapt themselves have prevailed," this is part of evolution. If we have a chance to suppress mosquitoes that carry diseases such as malaria, which has been the great enemy of generations, and to save millions of lives, we must establish certain rules by conducting the necessary research, experiments and examinations, and step into this new world within the framework of these rules and requirements [1-3].

References

1. Dearden, P. K., Gemmell, N. J., Mercier, O. R., Lester, P. J., Scott, M. J., Newcomb, R. D., ... & Penman, D. R. (2018). The potential for the use of gene drives for pest control in New Zealand: a perspective. *Journal of the Royal Society of New Zealand*, *48*(4), 225-244. https://doi.org/10.1080/03036758.2017.1385030
2. Annas, G. J., Beisel, C. L., Clement, K., Crisanti, A., Francis, S., Galardini, M., ... & Joung, J. K. (2021). A code of ethics for gene drive research. *The CRISPR Journal*, *4*(1), 19-24. https://doi.org/10.1089/crispr.2020.0096
3. Collins, J. P. (2018, July). Gene drives in our future: challenges of and opportunities for using a self-sustaining technology in pest and vector management. In *BMC proceedings* (Vol. 12, No. 8, pp. 37-41). BioMed Central. https://doi.org/10.1186/s12919-018-0110-4

Advanced Engineering Days

aed.mersin.edu.tr

Enzymes in the food industry

Besime Gül Hizmetçi [*1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, hizmetcibesime@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Hizmetçi, B. G., & Ayaz, F. (2022). Enzymes in the food industry. 4th Advanced Engineering Days, 25-29

Keywords
Food,
Enzyme,
Enzyme Sources,
Enzymes in Food

Abstract

Enzymes are used in the food industry by making use of plants, animals and microorganisms. It is used not only in food but also in other industries. By utilizing the properties of enzymes, improvements in foods, that is, consumption conveniences, can be achieved. For example, softening the meat, delaying the staling of the bread, ripening the cheese, making the juices clearer. The purpose of using enzymes in this field is not only because of the feature, durability and activity of the enzyme, but also to obtain and price. In this proceeding review we will focus on the utilization of the enzymes in the food industry.

Introduction

Food products; they are multi-component products with complex structure and texture, the quality of which is determined by consumer demands [1]. It is defined as any processed, partially processed or unprocessed substance that is eaten, smoked or expected to be smoked by humans, excluding live animals, feed, medicinal products used for therapeutic purposes, unharvested plants, cosmetics, tobacco and tobacco products that are not directly offered for human consumption [2].

Enzymes are protein catalysts that increase the rate of a chemical reaction and are not consumed during the reaction [3] substrate; They are substances that react in a reaction catalyzed by an enzyme [4]. These molecules bind to a specific region of the enzyme [4]. This region is called the active region and catalysis takes place in this region [4]. The enzyme gets its specificity from the three-dimensional shape of an enzyme and the structure of its active region [4]. Only a few substances are compatible with the active site, but not with different shapes and functional groups [4]. Only a few substances are suitable for the active site; Carrying different shapes, different properties and functional groups does not show conformity [4]. Enzymes take their names according to their functions and often end with the suffix "az".[4] The activity of an enzyme, that is, how efficiently the enzyme exerts its effect, is affected by the parameters such as temperature and pH [5]. Each enzyme has a different set of efficiently working conditions; we call these optimum conditions [5]. Optimal conditions ensure that the enzyme molecule is most active [5]. Enzymes have an optimum temperature where the reaction rate is most active [5]. And this temperature enables the highest rate of molecular collisions and more efficient reactant conversion rate into the product molecules without denaturing the enzyme [5]. Enzymes have an optimum pH as well as an optimum temperature, although many enzymes have optimal pH values of 6-8, there are some exceptional cases [5].

Factors affecting enzyme activity in foods

Temperature

We mentioned earlier that enzymes are heat sensitive [6]. Heat treatments can cause the catalytic properties of enzymes to decrease or disappear [6]. Increasing the temperature increases the activity of enzymes, however, the rate of inactivation of enzymes increases at high temperatures [6].

pH

Enzymes work with different activities at different pH values [6]. Enzymes show activity in a limited pH range [6]. However, the pH-activity profile is not sufficient to define an enzyme [6]. Optimum pH value varies depending on different substrates [6].

Radiation

The radiation created by electromagnetic waves affects the enzyme and its activity. As a protection method, irradiation with ionizing radiation is used in food processes [7,8]. However, inactivation of enzymes requires the application of microorganisms in an inappropriately higher dose than the applied radiation [6].

Pressure

High hydrostatic pressure was applied on enzymes such as pectinesterase, lipase, polyphenol oxidase, lipoxygenase, peroxidase, phosphatase and catalase, and when the enzymes were examined, it was found that the enzymes were inactivated [9].

Humidity

Since the solid medium prevents the diffusion of the enzyme or substrate at low humidity levels, only the substrate, which is intertwined with the enzyme, is hydrolyzed, especially in hydrolytic reactions [10].

Enzymatic reactions in grains stored in a humidity environment of less than 16% depend only on the natural enzyme effect of the grains [11]. However, enzymes originating from molds formed on grains in high humidity environments are also important in hydrolytic reactions [11].

Use of enzymes in the food industry

α-Amylase

Bakery products are shown at the beginning of the important application areas [6]. Hydrolysis of starch granules and insoluble pentosans, which are fragmented with the help of α-amylase and pentosanase, improves bread quality [6].

Amyloglucosidase (Glucoamylase)

Further breakdown of dissolved starch molecules by α-amylase with amyloglucosidase [12]. The fungal-derived amyloglucosidase enzyme is used specifically in the brewing industry to break down dextrins left over, to flavor beer after fermentation, and in distilled products for saccharification purposes [12].

Pectinase

They are mixtures of fungal origin (Aspergillus niger) that contain several enzyme activities [13,14]. At the top of the application areas of these enzymes are the clarification of unclear fruit juices such as apple juice, the reduction of viscosity in concentrates and purees, the increase of fruit juice yield, the facilitation of the filtration function and the peeling of the fruit skin [13,14]. Pectin enzyme in wine production. It is also used to increase fruit juice yield, color extraction-purification- and clarification [6].

Cellulase

The most important microbial sources are Trichoderma viride and Aspergillus niger [15,16]. Production of glucose from the remaining residues containing cellulase is used in the processing of garlic and softening of mushrooms; these are some application areas of this enzyme [15,16].

Hemicellulase

Cellulase preparations also contain hemicellulase enzyme [17]. Hemicellulase is used to improve the quality of bread, especially since it prevents staling by breaking down the pentosan molecules present in wheat flour [17].

Invertase

Invertase hydrolyzes sucrose to glucose and fructose, this process provides the formation of natural sugar required for jam making [6]. Natural sugars prevent crystallization at higher concentrations, which crystallize at a lower rate than sucrose [6].

Lactase (β-galactosidase)

Lactose can be produced by mold, yeast and bacteria [18]. This enzyme hydrolyzes lactose to glucose and galactose, and as a result, it provides flavor to milk [18]. At the same time, this conversion of lactose is important for the health of individuals who cannot tolerate lactose [18]. Another important role is to prevent lactose crystallization, which may occur in ice cream, by breaking down lactose [6].

Protease

Papain and other plant-derived proteases (bromelain and ficin) have application areas such as tenderizing meat, preventing beer from being clear in the cold, and producing protein hydrolysates [19]. Fungal-derived ones are used to modify wheat gluten, especially in the bakery industry [19]. It is also used infrequently for tenderizing meat and obtaining protein hydrolysates [19]. Trypsin is mostly used in the production of protein hydrolysates, while rennin and its different source pepsin are used to precipitate casein in cheese making [19].

Another protease enzyme from Aspergillus Niger is used in the clarification of kiwi juice [19]. With this enzymatic method, better results were obtained in terms of clarity and quality than clarification using bentonite [19].

Although proteases, which are a source of bacteria, are not widely used in the food production process, they are used in the maturation of products such as cheese, sausage and sausage [6].

Papain

Its source is a herbal protease [20]. It is obtained by isolating the immature papaya fruit (Carica papaya) [20]. It has application areas such as ensuring the clarity of the beer and softening the meat [20]. Although its effect is low in raw meat, it is effective on collagen, muscle fibers and some elastin in pre-cooked meat [20]. It is used in the beer industry [20]. It is used together with proteases of fungal or bacterial origin to ensure the clarity of beer [20].

Trypsin and cymotrypsin

These enzymes are obtained from bovine pancreas [6]. They can be used for many purposes such as digestion, injury and fracture treatments [6]. Saymotrypsin is also used as an alternative treatment to surgery in the treatment of cataracts [6].

Pepsin

This enzyme is isolated from bovine gastric mucosa [6]. It is used for digestion purposes and for breaking down cereals (amylase + pepsin) and baby foods (trypsin + pepsin) [6]. In addition, pepsin ensures the clarity of beer and is also used in cheese making together with rennin [6].

Rennin

Raw rennin (rennet) has the property of coagulating milk [6]. It has an important place in the field of cheese production application [6].

Lipase

These enzymes can be obtained from different sources [21]. It is used for the formation of the desired taste and odor in processed chocolate and cheese, and it is applied for the rapid maturation of cheeses [21]. Lipases increase the foaming property of egg white by creating conditions that provide monoglyceride and diglyceride formation [21].

Glucosoxidase/Catalase

Glucosoxidase is of fungal origin [22] and in the presence of oxygen and water, it oxidizes glucose to gluconic acid and hydrogen peroxide [22].

Glucosoxidase and catalase enzymes function in the application of removing both glucose and oxygen from the environment in the food industry [22]. Beer, fruit juices, wine, dried foods, canned milk powders and mayonnaise can be among the foods that remove oxygen [22]. It is also seen in the production of gluconic acid, which has a low-calorie value and is used as a sweetener [22].

Lipoxidase

It is usually found in wheat germ [6]. During the milling of wheat, it is separated from the flour [6]. Lipoxidase added to soy flour acts as a whitening agent in bread making [6]. Its function is to remove the effect of carotene pigment in the presence of oxygen and linoleic acid [6]. It also causes oxidation of thiol components in gluten and thus improves bread quality positively [6].

Glucose isomerase

It is of bacterial or fungal origin [6]. It enables the conversion of glucose to fructose and enables the production of natural sugars from glucose [6]. Fructose sucrose, which is sweeter than glucose, is used as a sweetening option [6].

Enzyme sources

Enzyme production is generally carried out using fermentation techniques, mold, yeast and bacterial species [6]. However, some enzymes are obtained from animal tissues (rennin, pepsin, cymotrypsin, trypsin), plants (papain, bromelain, ficin) and microbial sources [6]. However, in most of these organisms, fluctuations can be observed due to various factors with slow growth rate and low production [23]. Therefore, researchers working on enzymes closely follow developments in fields such as molecular biology, genetics, and protein engineering in order to obtain more efficient ways to produce enzymes, to improve the properties of existing methods, and to make completely new enzymes [23].

Studies conducted in this direction have proven that recombinant DNA technology, together with other techniques of genetic engineering and biotechnology, has a significant potential for microbial production of genes encoding a specific enzyme with recombinant DNA techniques [23]. By selecting genetically modified and recombinant organisms, it increases the efficiency in enzyme production and enables the creation of more useful enzymes [6]. It is possible to increase the amount of enzyme produced by a particular microorganism by induction [6]. Enzymes found naturally in foods affect the processes of the products to be created with them in different ways [6].

The darkening reactions caused by the prophenol oxidase enzyme in fruits and vegetables, the degradation of lipase and peroxidase in wheat germ, or the gelling of peptic enzymes in citrus juices can be given as examples of how they affect food processes in different ways [6]. For this reason, it is necessary to inactivate these kinds of enzymes in foods by heat treatment or inactivation processes [6]. However, some naturally occurring enzymes can be considered beneficial [6]. For example, the amylase enzyme in potatoes can add flavor to fried products. The peptic enzymes in apples and grapes are important in clarifying fruit juices [6].

Conclusion

Protein encompasses most of the enzyme structure and contains an acid chain. The acid chain is present in all living cells. Therefore, enzymes are present in many different food industries. They have been in the food industry for years, such as bakery products, fruit juices, dairy products. It is increasing day by day in the production processes of the enzyme in the food industry. Biotechnology will spread to a wider spectrum with fields such as molecular biology and genetics.

References

1. Yüksel, Z., & Erdem, Y. K. (2007). Gıda endüstrisinde transglutaminaz uygulamaları: 1. Enzimin genel özellikleri. *Gıda*, *32*(6), 287-292.
2. https://kutahya.tarimorman.gov.tr/Belgeler/Gıda%20ve%20Güvenilir%20Gıda.pdf
3. Ferrier, D. R. (2020). Görsel Anlatımlı Çalışma Kitapları: Biyokimya, Nobel Tıp Kitapevleri, 54

4. David, S., David, M., Hiliis, H., Craig, H., & May, R. (2014). Berenbaum,Yaşam Biyoloji Bilimi, Prof. Dr.Ertunç Gündüz, Prof. Dr.İsmail Türkan (Palme Yayınevi,2014)157
5. Jane B. Reece, Lisa A., Urry, Michael, L. Cain, Steven A. Wasserman, Peter V. Minorsky, Robert B. Jackson (2013). Campbell Biyoloji, Prof. Dr. Ertunç Gündüz, Prof. Dr.İsmail Türkan,(Palme Yayınevi), 155-156
6. F. Sibel, E. Osman,5 Eylül-Ekim 2004, Gida Sanayiinde Enzimlerin Önemi, 393-400,
7. Erkmen, O. 2000. Kainell ve güvenli gıda üretimi için ginama yöntemi, Gids, 2000, 2, 58-41,
8. Reed, G. (1966). Enzymes in food processing. Eds M. L. Anson, C. O. Chichester, E. M. Mrak, G. F. Stewart, Academic Press, New York
9. Seyderhelm, I., BOGUSLAWSKI, S., MICHAELIS, G., & KNORR, D. (1996). Pressure induced inactivation of selected food enzymes. *Journal of Food Science*, *61*(2), 308-310.
10. Zaks, A., & Klibanov, A. M. (1988). The effect of water on enzyme action in organic media. *Journal of Biological Chemistry*, *263*(17), 8017-8021.
11. Lang, K. W., & Steinberg, M. P. (1980). Calculation of moisture content of a formulated food system to any given water activity. *Journal of Food Science*, *45*(5), 1228-1230.
12. Fleming, L. D. (1988). Amyloglucosidane: a-14-glucanglycohydrolase (E.C.3.2.1.3). in Starch and its derivatives. Fourth ed. Eds. J. A. Radley, Chapman and Hall, London
13. Hart, M. R., NG, K. C., Hanni, P. F., & Huxsoll, C. C. (1994). Effect of enzymes on microfiltration of apricot puree. 1. *Journal of food process engineering*, *17*(1), 19-32.
14. Sreenath, H. K., Nanjundaswamy, A. M., & Sreekantiah, K. R. (1987). Effect of various cellulases and pectinases on viscosity reduction of mango pulp. *Journal of Food Science*, *52*(1), 230-231.
15. Sreekantiah, K. R., Jaleel, S. A., & Rao, T. R. (1971). Utilization of fungal enzymes in the liquefaction of soft fruits and extraction and clarification of fruit juices. *Journal of Food Science and Technology*, *8*(4), 201-203.
16. Sreenath, H. K., Frey, M. D., Radola, B. J., & Scherz, H. (1984). Degradation of a washed carrot preparation by cellulases and pectinases. *Biotechnology and bioengineering*, *26*(7), 788-796.
17. Voragen, F.G.J., Krist, R., Heutink, R., Pilnik, W. 1980. Apple cell wall digestion by polysaccharide degrading enzymes. In Food Process Engineering Eds. P.Linko and J. Larinkari, Applied Science Publishers, London
18. Ray, B. 1996. Fundamental Food Microbiology. CRC press, Inc., New York, pp. 169-180
19. Dawes, H., Struebi, P., Keene, J. (1994). Kiwifruit juice clarification using a fungal proteolytic enzyme. J. Food Sol, 59 (4)858-861
20. Peterson, D. W. (1977). Effect of polyphosphates on tenderness of hot cut chicken breast meat. J. Food Sol., 42, 100-101
21. Welsh, F. W., Ross, E. W., Kathryn, H. D. (1980). Lipase mediated synthesis of low molecular weight flavor esters. J. Food Sc., 55 (6), 1679-1882
22. Dondero, M., Egaña, W., Tarky, W., Cifuentes, A., & Torres, J. A. (1993). Glucose oxidase/Cqtalase improves preservation of shrimp (Heterocarpus reedi). *Journal of food science*, *58*(4), 774-779.
23. Hamit, K., Sedat, D., Hazım, Ö. (1989). Rekombinant DNA teknolojisinin gıda enzimlerinin üretiminde kullanılma olanakları, 43-49

Advanced Engineering Days

aed.mersin.edu.tr

The role of the soil bacteria on the plant immunity

Özge Ceyhan *[1], **Furkan Ayaz**[2,3]

[1]*Erzurum Technical University, Molecular Biology and Genetics Türkiye, ozge.ceyhan04@erzurum.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*
[3]*Mersin University, Department of Biotechnology, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Ceyhan, Ö., & Ayaz, F. (2022). The role of the soil bacteria on the plant immunity. 4th Advanced Engineering Days, 30-31

Keywords
Rhizobacteria
Plant Immunity
Plant Growth
Soil Bacteria

Abstract

Root bacteria construct the majority of microorganisms that are in a colonized state in the roots of plants and are in a symbiotic connection with plants and are considered as biocompatible organisms to increase the yield. Microorganisms generally live on the surface on the plants but when they are applied to the seed and the soil, they start colonizing the root surface and internal tissues of the plant and in turn they stimulate the plant growth through different mechanisms. Rhizobacteria (PGPR) that enhance the plant development are known as soil bacteria that occupy the perimeter or surface of the root. PGPR bacteria's type, and availability of different nutrients and elements for these bacteria affect their nitrogen fixing capacity which eventually affects the plant growth rates and yield. Moreover, these bacteria can also stimulate the plant resistance by either strengthening the plant immunity or by producing secondary metabolites that in turn fight against the pathogenic microorganisms. In the studies that we are reviewing we will be discussing PGPR bacteria, their mechanism of action and their potential to be utilized as fertilizers or plant growth stimulants.

Introduction

The recent global climate change has negatively affected the biodiversity, vegetation cover and agricultural activities. The number of researches related to the use of bacteria that contribute to plant development in order to increase productivity in agriculture, resistance to the stress conditions and to ensure the increased plant immunity is also becoming more and more popular [1]. Plant growth promoting bacteria usually colonize the host in a form that creates rhizosphere (PGPR) and can be listed as Acetobacter, Acinetobacter Substituted, Aereobacter, Agrobacterium, Alcaligenes, Bacillus, Burkholderia, Clostridium, Enterobacter, Erwinia, Flavobacterium, Klebsiella, Micrococcus, Pseudomonas, Rhizobium, Serratia and Xanthomonas bacteria that belong to species that are effective in terms of providing stress tolerance [2]. It is known that plants have a symbiotic relationship with microorganisms in the soil. The most well-known of these are the arbuscular microsomal fungi (AMF) [3]. In agricultural production, abiotic and biotic stress conditions are a factor that significantly affect the overall yield. Plants growing under stress conditions face many harmful factors such as susceptibility the pathogens, hormonal and nutritional imbalance in the growth of plants and physiological disorders. It is noted that PGPR and AMF protect the plants against these factors and promote plant development [4].

Results

One of the implementations made to increase the yield in agricultural production and to prevent the threats that chemicals may pose has been the use of bacteria that promote plant development. In a study with PGPR bacteria, it was determined that some bacteria increased the stem weight in wheat, which was achieved by

applying P. polymyxa with the highest root and stem weight, followed by P. putida and B. Megaterium [5]. Studies on bacteria living in the soil are gradually increasing.

In the study, the effects of different PGPR bacteria in different growing environments on the root and stem development of wheat and corn plants were examined. In a recent research, soil material was used as a control and 13 different growing environments including other materials were prepared. Four different PGPR bacteria were used and these were Pantoe Agglomerans, Pseudomanas Putida, Bacillus Suptilis and Arthrobacter Agilis, which have nitrogen- binding and phosphorus- dissolving properties. Compared to the control groups, the usage of these bacteria significantly increased the health, growth and the yield of the studied plants. PGPR's may be more important for young plants in terms of rapid root formation, lateral and capillary root development, for efficient water and nutrient uptake from roots and increasing root viability [6].

Discussion

Rhizobacteria applied to the seeds or soil increase the root growth, nutrient uptake, and nitrogen fixation [7]. The root system is very important because, plants can develop and receive many of the nutrients necessary for their growth thanks to their roots. In the process of obtaining nutrients and sufficient water, the root tips in the plant root system have vital importance [8]. Studies suggest that utilization of microorganisms during the seeding might increase the plant immunity, plant growth and plant resistance to the stress conditions [9]. The future perspective is that these microorganisms can replace the excessive usage of the fertilizers as biocompatible and organic counterparts, to increase the plant health and the yield so that the impact of the global warming can be overcome to provide food for the humanity. Future studies will shed lighter on the microorganism types and their effects on different plants.

References

1. Marulanda, A., Barea, J. M., & Azco´n, R. (2009). Stimulation of plant growth and drought tolerance by native microorganisms (AM Fungi and Bacteria) from dry environments: mechanisms related to bacterial effectiveness. Journal of Plant Growth Regulation, 28, 115-124
2. Çakmakçı, R. (2005). Bitki gelişimini teşvik eden rizobakterilerin tarımda kullanımı. Atatürk Üniversitesi Ziraat Fakültesi Dergisi, 36 (1), 97-107
3. Tüfenkçi, Ş., Demir, S., Şensoy, S., Ünsal, H., Demirer, E., Erdinç, Ç., Biçer, Ş., & Ekincialp, A., (2012). The effects of arbuscularmycorrhizal fungi on the seedling growth of four hybrid cucumber (CucumissativusL.) cultivars Turkish Journal of Agriculture and Forestry, 36,317-327
4. Nadeem, S. M., Ahmad, M., Zahir, Z. A., Javaid, A., & Ashraf, M. (2014). The role of mycorrhizae and plant growth promotingrhizobacteria (PGPR) in improving crop productivity under stressful environments. Biotechnology Advances,32, 429-448
5. Cakmakci, R., Donmez, M. F., & Erdoğan, U.G. (2007). The effect of plant growth promoting rhizobacteria on barley seedling growth, nutrient uptake, some soil properties, and bacterial counts. Turkish Journal of Agriculture and Forestry 31, 189-199.
6. Türk M, Bayram G, Budaklı E, Çelik N, 2003. Farklı Yetiştirme Ortamlarının Arpa Bitkisinin Kök ve Gövde Gelişimi Üzerine Etkileri. Türkiye 5. Tarla Bitkileri Kongresi, 2, 26-30, Diyarbakır.
7. Cakmakci, R., Donmez, F., Aydın, A., & Sahin, F. (2006). Growth promotion of plants by plant growth-promoting rhizobacteria under greenhouse and two different field soil conditions. Soil Biology and Biochemistry 38, 1482-1487.
8. Kacar, B. (1996). Bitki Fizyolojisi. Ankara Üniversitesi Ziraat Fakültesi, Toprak Bölümü. 1447, 427
9. Marulanda, A., Barea, J. M., & Azco´n, R. (2009). Stimulation of plant growth and drought tolerance by native microorganisms (AM Fungi and Bacteria) from dry environments: mechanisms related to bacterial effectiveness. Journal of Plant Growth Regulation, 28, 115-124

Advanced Engineering Days

aed.mersin.edu.tr

A review on phage as biocontrol agent in food industry

Qadar Ahmed Isse [*1], Furkan Ayaz [2], Hatice Korkmaz Güvenmez [3] Mete Karaboyun [1]

[1]Çukurova University, Biotechnology Research and Application Center, Türkiye, qisse@student.cu.edu.tr; mkaraboyun@student.cu.edu.tr
[2]Mersin University, Biotechnology Department, Türkiye, furkanayaz@mersin.edu.tr
[3]Çukurova University, Biotechnology Department, Türkiye, hkorkmaz@cu.edu.tr

Cite this study: Isse, Q. A., Ayaz, F., Güvenmez, H. K., & Karaboyun, M. (2022). A review on phage as biocontrol agent in food industry. 4th Advanced Engineering Days, 32-35

Keywords
Dairy Product
Biocontrol
Phage

Abstract

Foodborne illnesses due to bacterial pathogens pose a significant threat to public health, resulting in tens of thousands of deaths worldwide annually. In the United States, cost of healthcare related to foodborne disease are estimated to be $75 billion per year with combining multiple financial losses from food scraps, culled farm animals, and food recalls. Conventional biological control of pathogenic bacteria had also depended on broad-spectrum approaches such as antimicrobials or pasteurization, which differ in efficacy, have an impact on food natural microflora, and can negatively impact quality of food. Hence researchers looking for alternative approach while using phage. The most ubiquitous and diverse biological species in the biosphere are bacteriophages (phages). In the last ten years, multi-drug resistant bacterial strains have become more prevalent, which has sparked interest in phages. The potential of bacteriophages and their derivative in the fields of healthcare and biotechnology is a topic of current investigation. Currently, phage treatments that target dangerous food-borne bacteria are used to treat and decontaminate crops and livestock as well as a biocontrol tool after harvest. So we take a look to see how deep researchers go in the topic and their findings in their literature.

Introduction

Biofilms are sessile populations of bacteria; biofilms develop on surfaces and are enmeshed in an extracellular matrix that they are self-replicate [1]. They are made up of multiple bacteria adhered to the surface, which are enveloped in an extracellular matrix made up of a variety of proteins, polysaccharides, and extracellular DNA. Bacterial biofilms must be controlled in the food industries since its existence on the instrument surface and in the facilities can seriously impair people's health. Antibiotic and disinfectants are ineffective against bacteria fixed in biofilms even more than against planktonic bacteria [2]. It is worthy to note that biological control with bacteriophages in the milk products have already had varying degrees of achievement. Despite the fact that the mechanism remains unclear, studies have discovered that certain milk constituents play a significant role in bacteriophage activities in dairy foods and products [3]. On the contrary, studies indicate that phage effectiveness is heavily influenced by the composition of a food material. The diary food (product) is typically complicated matrix whose microstructures alter due to the storage and processing of dairy, that potentially influencing phage-bacterial cell interaction [4]. Foodborne outbreak is frequently caused by processed foods. For instance, hemolytic uremic syndrome and hemorrhagic colitis caused by *E. Coli O157:H7*, *Listeriosis,* and *Salmonellosis* outbreaks have indeed been connected to foods such as sausages, processed meat, yoghurt, and milk powder [5]. Keeping these foods free from foodborne pathogens paved the way for the application of phages as biocontrol, emphasizing the variety of the foods that can be applied with bacteriophages as well as versatility of the phage as antimicrobials [6].

Results

By producing surface-ripened reddish mozzarella and infecting it with small amounts of *Listeria Monocytogenes* at the beginning of the ripening process, virulent *P100 Listeriophage* demonstrated its effectiveness as an antibacterial agent. It infects and kills the large bulk of Listeria Monocytogenes. During the peel washings, *P100 Listeriaphages* were applied to the surfaces. The researchers saw a significant decrease of the *Listeria Monocytogenes* bacteria tend to range from 3.5 logs to fully elimination based on the intervals, repetitions, and doses of the bacteriophage applications. Researchers noted *no Listeria Monocytogenes* resistant cells in the samples they examined [7, 4]. This study suggested that phages can be used to manage *Listeria Monocytogenes* surface contamination on cheeses, which has been the root of numerous *listeriosis* outbreaks in cheese [8]. Modi et al., investigated the impact of phages on the continued existence of *S. Enteritidis* during the production and stockpiling of cheddar cheese [9]. The researchers discovered that adding phages to raw and pasteurized milk greatly decreased the number of *S. Enteritidis* in cheddar cheese products from the milk [6]. Milk, in addition is a biological fluid that serves as a food source in which so many immunoglobulins and biologically active molecules that are naturally produced. Those biomolecules are essential in the immune mechanism against a variety of microorganisms, including viruses and bacteria. Antibodies are quite well understood for their capacity to suppress phage-bacteria interactions by anchoring to bacteriophage tail. These interactions between phages and antibodies, however, don't always indicate a reduction in viability of phage [3]. A review article of phage endolysins have shown potential novel agent for the biological control of food - borne pathogens, especially in preservation of food and processing applications [10]. Due to its strong host specificity, they are only able to manage the targeted pathogens and not the good bacteria, such probiotics in food. Endolysins should, however, be used with caution because their enzymatic characteristics can alter depending on a variety of physicochemical factors, including NaCl concentrations, temperature and pH. Additionally, endolysins can stop the global problem of bacteria that resistant to antibiotic from developing [11, 15]. Endolysins could be used on the surfaces of facilities that produce food because they can also remove biofilm. Although there have historically been issues with endolysin use, particularly in Gram negative bacteria, numerous studies now developed unique techniques that employ endolysins as biological controls against Gram negative infections. As a result, endolysins have the promise to be potent enzymes that reduce the risk of foodborne illness and increase food science safety [12]. Gram negative bacteria are resistant to exterior endolysins in contrast to Gram positive bacteria because they have an outside barrier on their cell wall which blocks the contact between peptidoglycan layer and endolysins [10]. Even though Gram positive endolysins that have been employed as biocontrol agents, more recently research has revealed ways to lyse and kill Gram negative bacteria by breaking through the outer membrane barrier [13]. The most popular method for enhancing the efficiency of Gram negative endolysins as biological control agents is the use of outer membrane-permeabilizing chemicals like chelators. For instance, citric and malic acids and chelators like ethylenediaminetetraacetic acid (EDTA) have typically been employed as permeabilizers of the outer membrane. Particular evidence derives from the endolysin OBPgp279, which when combined with EDTA was said to exhibit bactericidal effect of about a 1-log reduction in activity within 30 min against *Salmonella Typhimurium* cells [1].

Another study on salmonella phages have done for the purpose of effectively reducing the growth of *Salmonella spp*. on a range of fresh and fresh fruit and vegetables, many phages that are unique to *Salmonella spp* have been studied [14]. Using only *phage-l**A*** on mustard seeds led to a 1.37 Log decrease in *Salmonella* growth, but combining *phage-**A*** and *phage-**B*** led to a 1.50 Log decrease in CFU of *Salmonella* growth in the soaking water of broccoli seeds. Kocharunchitt et al. employed two *Salmonella* phages, *SSP5* and *SSP6*, to reduce *Salmonella Oranienburg* on alfalfa seeds because chemical disinfectants did not work well. Spricigo et al., also conducted tests on freshly cut romaine lettuces for the presence of *Salmonella enterica serovars Enteritidis* and *Typhimurium* [15]. The *Salmonella* concentration was greatly decreased by the phage cocktail. *Salmonella enterica Enteritidis* populations in freshly cut melons and apples were examined by Leverentz et al. using lytic phages [16]. A common zoonotic bacterial infection, such as *Campylobacter Jejuni*, is found in raw poultry. *C. Jejuni* is harmless to birds and is a normal component of their gut microbiota [17]. The bacterium contaminates the meat when birds are slaughtered because it is expelled from the intestines. The foods that have been cross-contaminated while being processed with meat can give humans diarrhea and in rare instances, post-infectious consequences like rheumatism and peripheral nerve damage [18].

Table 1. Provides a summary of how endolysins have been used to combat different foodborne pathogens in foods [1]

Endolysins	Organism	Food application	Characteristics
Ctp1L	*Clostridium Perfringens*	Caw milk	About 1-log CFU/mL reduction in 2 h.
LysZ5		Soy milk	Reduction of more than 4-log CFU/mL in 3 hours at 4 °C.
Ply500	*Listeria*	Iceberg	
Plyp100	*Monocytogenes*	lettuce	Effect of nisin with bacteria in a synergistic manner.
		Queso fresco	24-hour reduction of about 4-log CFU at 25 °C (free or immobilized endolysins).
PlyP825			
		Milk	3.5-log CFU/g reduction at 4 °C during a period of 4 weeks.
		Mozzarella	Combined with high hydrostatic pressure, antibacterial action.
LysH5.		Milk	At 37 C, there is an immediate 8-log CFU/mL reduction in6 hours.
Ply187AN -KSH3b			
λSA2-E-LysO-SH3b.			
λSA2-E-LysK- HydH5Lyso.		Milk	Nisin has a synergistic antibacterial action.
HydH5SH3b, CHAPSH3b.		Caw milk	At 37 C, there is an immediate 3-log CFU/mL reduction.
LysSA97			
LysSA11	*Staphylococcus aureus*	Milk	At 37 degrees Celsius, the drop in CFU/mL is around 3-log.
Phi11-481		Milk, Beef	
			After 15 minutes of CHAPSH3b treatment at 37°C, there
		Milk, Ham	was a 4-log CFU/mL reduction.
			Carvacrol has a synergistic antibacterial action.
		Milk	At 25°C, the decrease is around 4-log CFU/cm3 in 15 minutes.
			At 2-3 mM CaCl2, there was a lot of activity.

Table 2. lists of commercially available phages products for application in food and animal products [16]

Product	Application	Characteristic	Company
AgriPhage Food	Food (tomato)	Targets Xanthomonas campestris pv. Vesicatoria or Pseudomonas syringae pv. Vesicatoria bacterial specks or spots on crops.	Omnilytics, Inc. USA
EcoShield	Food	Aims to reduce Escherichia coli O157:H7 contamination in food and food processing plants.	Intralytix, Inc. USA
ListShield	Food	*Targets Listeria Monocytogenes Contamination within food and food production sites.*	Intralytix, Inc. USA
SalmoShield	Food	*Targets the contamination of specific highly pathogenic Salmonella-serotypes in food and food production sites.*	Intralytix, Inc. USA
Shigashield	Food	*Targets the contamination of foods and food production sites by Shigella spp…*	Intralytix, Inc. USA
Listex P100	Food	Target contamination with L. monocytogenes on food goods.	Micreos Netherlands
Ecolicide	Animal feeds	Targets infection with Escherichia coli O157:H7 on live animal before slaughter.	Intralytix, Inc. USA
SalmoLyse	Animal feeds	Targets *Salmonella* contamination in pet food	Intralytix, Inc. USA
BioTector	Animal feeds	Salmonella control in the poultry	CheilJedang Co. Korea
SalmoFresh	Food	Targets *Salmonella Enterica* in various foods	Intralytix, Inc. USA

References

1. Chang, Y. (2020). Bacteriophage-derived endolysins applied as potent biocontrol agents to enhance food safety. Microorganisms, 8(5), 724.
2. Huss, P., & Raman, S. (2020). Engineered bacteriophages as programmable biocontrol agents. Current opinion in biotechnology, 61, 116-121.
3. García-Anaya, M. C., Sepulveda, D. R., Sáenz-Mendoza, A. I., Rios-Velasco, C., Zamudio-Flores, P. B., & Acosta-Muñiz, C. H. (2020). Phages as biocontrol agents in dairy products. Trends in Food Science &Technology, 95, 10-20.
4. Ushanov, L., Lasareishvili, B., Janashia, I., & Zautner, A. E. (2020). Application of Campylobacter jejuni phages: challenges and perspectives. Animals, 10(2), 279.
5. Endersen, L., & Coffey, A. (2020). The use of bacteriophages for food safety. Current Opinion in Food Science, 36, 1-8.
6. Goodridge, L. D., & Bisha, B. (2011). Phage-based biocontrol strategies to reduce foodborne pathogens in foods. Bacteriophage, 1(3), 130-137.
7. Dy, R. L., Rigano, L. A., & Fineran, P. C. (2018). Phage-based biocontrol strategies and their application in agriculture and aquaculture. Biochemical Society Transactions, 46(6), 1605-1613.
8. Villar, R. G., Macek, M. D., Simons, S., Hayes, P. S., Goldoft, M. J., Lewis, J. H., ... & Mead, P. S. (1999). Investigation of multidrug-resistant Salmonella serotype Typhimurium DT104 infections linked to raw-milk cheese in Washington State. Jama, 281(19), 1811-1816.
9. Modi, R., Hirvi, Y., Hill, A., & Griffiths, M. W. (2001). Effect of phage on survival of Salmonella enteritidis during manufacture and storage of cheddar cheese made from raw and pasteurized milk. Journal of food protection, 64(7), 927-933.
10. Endersen, L., O'Mahony, J., Hill, C., Ross, R. P., McAuliffe, O., & Coffey, A. (2014). Phage therapy in the food industry. Annual review of food science and technology, 5, 327-349.
11. Cof fey, B., Mills, S., Coffey, A., McAuliffe, O., & Ross, R. P. (2010). Phage and their lysins as biocontrol agents for food safety applications. Annual review of food science and technology, 1, 449-468.
12. Stone, E., Pennone, V., Reilly, K., Grant, I. R., Campbell, K., Altermann, E., & McAuliffe, O. (2022). Inhibition of Listeria monocytogenes by Phage Lytic Enzymes Displayed on Tailored Bionanoparticles. Foods, 11(6), 854.
13. Kuek, M., McLean, S. K., & Palombo, E. A. (2022). Application of bacteriophages in food production and their potential as biocontrol agents in the organic farming industry. Biological Control, 165, 104817.
14. Hassan, A. Y., Lin, J. T., Ricker, N., & Anany, H. (2021). The age of phage: friend or foe in the new dawn of therapeutic and biocontrol applications?. Pharmaceuticals, 14(3), 199.
15. Spricigo, D. A., Bardina, C., Cortés, P., & Llagostera, M. (2013). Use of a bacteriophage cocktail to control Salmonella in food and the food industry. International journal of food microbiology, 165(2), 169-174.
16. Oh, J. H., & Park, M. K. (2017). Recent trends in Salmonella outbreaks and emerging technology for biocontrol of Salmonella using phages in foods: a review. Journal of Microbiology and Biotechnology, 27(12), 2075-2088.
17. Pirttilä, A. M., Mohammad Parast Tabas, H., Baruah, N., & Koskimäki, J. J. (2021). Biofertilizers and biocontrol agents for agriculture: How to identify and develop new potent microbial strains and traits. Microorganisms, 9(4), 817.
18. Hagens, S., & Loessner, M. J. (2014). Phages of Listeria offer novel tools for diagnostics and biocontrol. Frontiers in Microbiology, 5, 159.

Advanced Engineering Days

aed.mersin.edu.tr

Effects of microplastics on the biological systems

Harika Topal Önal [*1], **Furkan Ayaz** [2,3]

[1] *Toros University, Medical Laboratory Techniques, Vocational School of Health Services, Türkiye, harika.topal@toros.edu.tr*
[2] *Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*
[3] *Mersin University, Biotechnology Department, Türkiye*

Cite this study: Önal, H. T., & Ayaz, F. (2022). Effects of microplastics on the biological systems. 4th Advanced Engineering Days, 36-38

Keywords
Microplastics
Oxidative stress
DNA
Genotoxicity

Abstract

Microplastics are the byproducts of the plastics that enter our lives in all areas such as health, food and drinking water, with various effects. The effects of exposure to microplastics on human health have been a matter of curiosity, and *in vivo* and *in vitro* studies have been conducted in this area. Considering the whole biological system, microplastics cause oxidative stress, inflammatory conditions, DNA breaks, chromosomal damages and genotoxicity in the cell. It can create inflammatory effects by affecting the immune system and trigger the formation of neoplasia. Further studies are needed to determine human exposure levels to microplastics and their association with chronic diseases. In our current proceeding review we are focusing on the microplastics and their effects on the cells.

Introduction

Microplastics have a size range of (MP) 1µm to 5 mm. They are created as a result of physical, chemical and mechanical decomposition of plastics with the effect of wind, ultraviolet, and water waves. With the increase in the plastic use in recent years, a significant increase has been observed in the amount of microplastics in the biosphere. MPs cause unfavorable impacts on the health of the organisms after being taken into the body with food and digested further to get into the organs, tissues and cells [1-2]. In recent studies, it has been reported that MPs are abundant in oceans and seas, drinking water, sea salt and products. It is thought to be the main component of the environmental pollution, as the most polystyrene microplastics are found in the environment [3]. Polystyrene is a type of plastic that is frequently used in the production of plastic-containing products and packaging [4]. Apart from polystyrene, polyethylene, polyethylene terephthalate, polyvinyl chloride and polypropylene are the plastic types that people are most frequently exposed to. Many studies have been conducted on the effects of MPs on the digestive system as well as, their cellular, chromosomal and cytotoxic effects.

Results

MPs have been found in the colectomy samples, lung tissue, circulation and stool, human placenta which have been investigated to have negative effects on the organismal health. Skin route might be another way of exposure to MPs, but studies supporting this are not available in the literature. Apart from the environmental exposure, it has been reported that medical prostheses containing plastic deteriorate over time and affect human health [5-7]. The cytotoxic effects of MPs on the cell basis were wondered, and it was noted that microplastics enter cells through endocytosis that eventually lead to the cytotoxicity [8].

In a study investigating the *in vivo* and *in vitro* effects of the polystyrene microplastics (1, 4 and 10 µm), it was reported that *in vivo* data did not show an inflammatory response on the tissue basis analysis. *In vivo* data suggested that MP had no histologically detectable lesions and inflammatory responses, and was even easily

digested by the macrophages. It has been reported that no cell activation or differentiation was observed after exposure of the human macrophage cell line THP1 with polystyrene [9].

The effects of polyethylene, polyethylene terephthalate, polyvinyl chloride and polypropylene, which we are exposed to through foods, were studied on the Caco-2, the human intestinal cells. Since the intestine is the first organ to be affected by the cytotoxicity of orally ingested microparticles, studying the colon cells would be informative about the effects of the MPs. As a result of the study, it was reported that Polyethylene microparticles (PEM) of 1-4 µm were transported significantly to the intestinal epithelium. Microplastic varieties have been reported to cause cytotoxic effects at high concentrations [10]. PEMs are thought to be in the clastogen potential to cause DNA strand breaks by causing abnormalities in DNA double strand break repair [11]. In addition, it has been determined that it has anogenic effect by causing defects in the chromosome separation in the anaphase stage. It has also been proven that chromosome kinetochores fail to attach to the spindle fibers during mitosis in the presence of MPs [12-13].

MPs (10–45 µm), which are not small enough to enter the cell nucleus, cause oxidative stress by disrupting the chemical reactions in the cells when they come into contact with the cell membrane, and as a result, they produce reactive oxygen species (ROS) [14]. Poma et al. reported that polystyrene microplastics increased ROS production in the Hs27 fibroblast cell line [15]. In a recent study, it was indicated that microplastics cause physical injury to the cell and cause a biochemical response, resulting in the inflammatory lesions [16].

Conclusion

In recent years, microplastics that we use and are exposed to in all areas of our lives have been investigated at molecular and cellular levels. They can cause molecular and cellular damage and cause genomic abnormalities that eventually lead to cancer and various other chronic diseases. *In vitro* and *in vivo* studies have been carried out to determine the effects of microplastics, and according to their results, cellular damage occurs depending on the MP type, concentration and exposure time. The results will be clearer if the studies conducted increase the sample size for the MP exposure to determine the defects on the chromosomes and DNA structure. More studies should be done to determine the human exposure levels to the MPs and their relationship to the chronic diseases.

References

1. Prata, J. C., da Costa, J. P., Lopes, I., Duarte, A. C., & Rocha-Santos, T. (2020). Environmental exposure to microplastics: An overview on possible human health effects. Science of the total environment, 702, 134455.
2. Rummel, C. D., Escher, B. I., Sandblom, O., Plassmann, M. M., Arp, H. P. H., MacLeod, M., & Jahnke, A. (2019). Effects of leachates from UV-weathered microplastic in cell-based bioassays. Environmental science & technology, 53(15), 9214-9223.
3. Von Moos, N., Burkhardt-Holm, P., & Köhler, A. (2012). Uptake and effects of microplastics on cells and tissue of the blue mussel Mytilus edulis L. after an experimental exposure. Environmental science & technology, 46(20), 11327-11335.
4. Kik, K., Bukowska, B., & Sicińska, P. (2020). Polystyrene nanoparticles: Sources, occurrence in the environment, distribution in tissues, accumulation and toxicity to various organisms. Environmental Pollution, 262, 114297.
5. Minoda, Y., Kobayashi, A., Iwaki, H., Miyaguchi, M., Kadoya, Y., Ohashi, H., ... & Takaoka, K. (2003). Polyethylene wear particles in synovial fluid after total knee arthroplasty. Clinical Orthopaedics and Related Research®, 410, 165-172.
6. Doorn, P. F., Campbell, P. A., & Amstutz, H. C. (1996). Metal Versus Polyethylene Wear Particles in Total Hip Replacements: A Review. Clinical Orthopaedics and Related Research (1976-2007), 329, S206-S216.
7. Danopoulos, E., Twiddy, M., West, R., & Rotchell, J. M. (2021). A rapid review and meta-regression analyses of the toxicological impacts of microplastic exposure in human cells. Journal of Hazardous Materials, 127861.
8. Shang, L., Nienhaus, K., & Nienhaus, G. U. (2014). Engineered nanoparticles interacting with cells: size matters. Journal of nanobiotechnology, 12(1), 1-11.
9. Stock, V., Böhmert, L., Lisicki, E., Block, R., Cara-Carmona, J., Pack, L. K., ... & Lampen, A. (2019). Uptake and effects of orally ingested polystyrene microplastic particles in vitro and in vivo. Archives of toxicology, 93(7), 1817-1833.
10. Stock, V., Laurisch, C., Franke, J., Dönmez, M. H., Voss, L., Böhmert, L., ... & Sieg, H. (2021). Uptake and cellular effects of PE, PP, PET and PVC microplastic particles. Toxicology in Vitro, 70, 105021.

11. Kim, Y., Jeong, J., Lee, S., Choi, I., & Choi, J. (2020). Identification of adverse outcome pathway related to high-density polyethylene microplastics exposure: Caenorhabditis elegans transcription factor RNAi screening and zebrafish study. Journal of hazardous materials, 388, 121725)
12. Cimini, D., & Degrassi, F. (2005). Aneuploidy: a matter of bad connections. Trends in cell biology, 15(8), 442-451.
13. Guttenbach, M., & Schmid, M. (1994). Exclusion of specific human chromosomes into micronuclei by 5-azacytidine treatment of lymphocyte cultures. Experimental cell research, 211(1), 127-132.
14. Hwang, J., Choi, D., Han, S., Choi, J., & Hong, J. (2019). An assessment of the toxicity of polypropylene microplastics in human derived cells. Science of the Total Environment, 684, 657-669.
15. Poma, A., Vecchiotti, G., Colafarina, S., Zarivi, O., Aloisi, M., Arrizza, L., ... & Di Carlo, P. (2019). In vitro genotoxicity of polystyrene nanoparticles on the human fibroblast Hs27 cell line. Nanomaterials, 9(9), 1299.
16. Çobanoğlu, H., Belivermiş, M., Sıkdokur, E., Kılıç, Ö., & Çayır, A. (2021). Genotoxic and cytotoxic effects of polyethylene microplastics on human peripheral blood lymphocytes. Chemosphere, 272, 129805.

Advanced Engineering Days

aed.mersin.edu.tr

Thyroid diseases in primary care

Begüm Çelik *[1], **Furkan Ayaz** [2]

[1]*Mersin University, Biotechnology Department, Türkiye, begumclk.37@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Çelik, B., & Ayaz, F. (2022). Thyroid diseases in primary care. 4th Advanced Engineering Days, 39-40

Keywords
Thyroid
Hypothyroidism
Hyperthyroidism
Hashimoto's disease
Graves disease

Abstract

Thyroid is the largest endocrine gland in the human body. It provides physical and mental balance thanks to the hormone it secretes. It is used as a marker in the diagnosis of thyroid disease in primary care with Triiothyronine, Thyroxine, and TSH. One of the most sensitive reasons for the progression of the disease is iodine deficiency or excess, environmental conditions, as well as genetics. Some factors such as psychological and age affect the progress of the disease. Levothyroxine is used in the first-line treatment of the hypothyroidism. One of the most common causes of the hypothyroidism is Hashimoto's thyroid. In the treatment of the hyperthyroidism, anti-thyroidal medication, radioactive iodine ablation and thyroidectomy are used. Hyperthyroidism is the basis of the Graves' disease. In our study we will give a brief review about the thyroid diseases.

Introduction

Thyroid is an endocrine gland consisting of the right and left lobes in the neck [1]. The thyroid glands have a weight of 20 grams and are the largest gland in the human body [1]. The pituitary gland stimulates the thyroid gland by secreting the hormone called TSH [1,2]. Through the function of the TSH, the thyroid gland begins to produce hormones [3-5]. The hormones stimulated by the thyroid gland are responsible for the basic functioning of the body [1]. Triiothyronine and Thyroxine are secreted by the thyroid gland [2,3].

The primary reason for the thyroid deficiency is the iodine deficiency or excess levels of it [4,5]. Graves' disease is an autoimmune disease together with the hyperthyroidism [8,9]. The most prominent side effects of the Graves' disease are enlargement of the eyes, swelling in the throat, hair loss, sharpness of the nail and flesh separation on the nails, rapid weight loss and trembling in the hands and feet [3,10]. It is thought that genetic predisposition affects Graves' disease more. [8,9] In addition to its genetic predisposition, HLA, DR3, cytotoxic T lymphocyte antigen 4 affects polymorphisms. [8,9] Interferon alpha and anti-CD52 antibodies have been proven to be associated with the pathogenesis of the Graves' disease [8,9].

As a result of the decrease in thyroid's effect on the peripheral target tissue, "Hypothyroidism" is observed [2,3,5]. The side effects of hypothyroidism are generally slowed heart rate, fatigue, aggressive attitudes and forgetfulness [5,6]. One of the most common results of hypothyroidism is "Hashimoto thyroid" [8,9]. Another name for Hashimoto disease is "Lymphocytic Thyroid" [12]. Possible side effects of Hashimoto's disease are voice changes, chills, and skin dryness. However, since these side effects are seen in many diseases, it is difficult to detect Hashimoto's disease [5,12]. T lymphocytes activated in the Hashimoto's thyroiditis interact with the B lymphocytes and lead to the secretion of multiple cytokines including interferon-gamma. Iodine stimulates the formation of B and T lymphocytes. There is overproduction of Fas and Fas L ligand, which causes apoptosis, which is involved in the other pathogenesis of Hashimoto's thyroid [8,9].

Apart from the iodine deficiency or excess, there are causes such as environmental conditions, genetics, and air pollution for the development of the thyroid-based diseases [1,2]. Thyroid disease covers 30% of the young and old population in our country [7].

In the diagnosis of thyroid disease, primarily blood tests and the reference range of hormones are checked [6,7]. In addition to blood tests, thyroid ultrasound (TU), thyroid scintigraphy (TS) and thyroid fine needle aspiration biopsy methods are also utilized [7].

In the primary thyroid diagnosis, free T3, free T4 and TSH hormones should be within the reference range of the healthy individuals' blood tests [5,8].

Discussion

Thyroid disease has an autoimmune pathogenesis.[1] It is treated with oral anti-thyroid, sulfonamides, lithium, phenylbutazone, PAS and oral hypoglycemic agents in order to prevent weakness, depression, anorexia, basal metabolism not working fast or slowly, malaise, rapid weight loss or gaining seen in thyroid disease progression [5,12].

In the treatment of hyperthyroidism, reduction of the thyroid hormone secretion and application of β-adrenergic blockade have been recommended [14]. While recommending total thyroid ablation or glucocorticoid therapy in patients diagnosed with Graves' disease, no treatment option can be applied in the absence of ophthalmopathy [10,11]. Surgery or radioactive ions can be applied in addition to anti-thyroid drugs for the Graves' disease [10]. In recent years, it has been thought that oxidative stress also affects the pathogenesis of Graves' disease [11,14].

Levothyroxine is used in the treatment of hypothyroidism. According to studies conducted in recent years, it has been stated that it should be done with LT4 [6,14]. It is thought that vitamin D or calcium should be given in addition to this treatment method [14].

In Hashimoto's disease, daily thyroid hormone is given. The main purpose in Hashimoto's disease is to supplement the deficient hormones [12]. It has been determined that thyroid autoantibodies are found in the serum on Hashimoto's disease [12,14].

Conclusion

Diagnosis of thyroid diseases in primary care and determination of the pathology provide how the houses in secondary and tertiary care will proceed for an effective treatment. After thyroid diagnosis is made, thyroid auto antibodies and anti-peroxidase are examined [5,7].

After diagnosis, levothyroxine is administered in the treatment of hypothyroidism. Levothyroxine is taken by mouth or given by intravenous injection [5,7]. Thyroid hormone (levothyroxine) is given in the treatment of Hashimoto's disease, which is one of the most common causes of hypothyroidism. However, there is no definitive treatment [12].

In the treatment of hyperthyroidism, treatment with antithyroid drugs (propycill and thyromazole), radioactive iodine treatment and thyroidectomy have been used [2,5]. Graves disease caused by the hyperthyroidism can be treated with anti-thyroid or radioactive iodine as effective treatment methods [3,10,11].

References

1. Gül, S. S., Kutlutürk, F., & Esen, M. (2020). Tiroit.
2. Demir, M. (2020). Tiroit hastaliklarinin böbrek üzerine etkileri
3. Durgun, Z., Yazici, C., & İnan, A. O. (2019). Tiroit Hormonları ve Hastalıkları. *Akdeniz Spor Bilimleri Dergisi*, *2*(1), 28-40.
4. Rişvanli, A., Aydin, M., Kaygusuzoğlu, E., & Timurkan, H. (2003). The effect of thyroidectomy on sexual cycle and pregnancy rates in rats. *Turkish Journal of Veterinary & Animal Sciences*, *27*(4), 873-877.
5. Solmaz, R. (2013). Tiroit hastaliğinin teşhisinde.
6. Tiroit hastalıkları tanı, tedavi ve izlem kılavuzu, Türkiye Endokrinoloji ve Metabolizma Derneği, ISBN NO: 978-605-4011-15-5, 2012.
7. Amaç, I. (2003). Tiroit sintigrafisi uygulama k› lavuzu. *Turk J Nucl Med*, *12*, 178-180.
8. Gül, U. D. N., & Alagöl, F. (2010). Tiroid Nodüllerinin Patogenezinde Apoptozun Rolü.
9. Üçgün, S. (2016). Otoimmün tiroid hastalarında erythrovirus B19 (parvovirus B12) sıklığının araştırılması.
10. Saklamaz, A., Sivrikoz, O., & Çökmez, A. (2012). Graves hastalığında rastlantısal saptanan papiller karsinom: Olgu sunumu. *Türk Jem*, *16*, 102-104.
11. Yalav, O., Demircan, O., & Sakman, G. (2012). Graves hastalığında tedavi seçenekleri. *Journal of Dialog in Endocrinology/Endokrinolide Diyalog Dergisi*, *9*(4).
12. Çorapoğlu, D. (1996). Hashımoto tiroiditli olgularımızın klinik ve laboratuvar değerlendirilmesi.
13. Derhem, B. (2019). Birinci basamakta tiroid disfonksiyonuna yaklaşım ve tarama. *Anadolu Güncel Tıp Dergisi*, *1*(3), 72-76.
14. Çeçen, P., & İmamoğlu, N. (2013). Tiroid Bezi Hastaliklari Ve Farmakolojik Tedavisindeki Güncel Gelişmeler.

Advanced Engineering Days

aed.mersin.edu.tr

The importance of CTLA-4 and PD-1 pathways in the cancer treatment

Şule Merve Aslan [*1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, 2102030171002@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Aslan, Ş. M., & Ayaz, F. (2022). The importance of CTLA-4 and PD-1 pathways in the cancer treatment. 4th Advanced Engineering Days, 41-42

Keywords
CTLA-4 inhibitor
PD-1 inhibitor
Immune system
Cancer

Abstract

For 30 years, chemotherapy method has been used in end-stage cancer treatments, the biggest obstacles are that this method has too many side effects and limited number of therapeutics for treatment. With the increasing information about the immune system, the interest in immune cells and immune response has increased. Although the immune response from cancer patients is kept under control, the immune system is not effective, because the cancer cells have developed more than one resistance mechanism (such as the inhibition of regional immunity). However, cancer cells can escape from many obstacles that prevent the immune response, including immune checkpoints. Taking advantage of this information, the idea developed that T cell activation checkpoints could be more effective for cancer treatment. The first of these checkpoints, the cytotoxin T lymphocyte-associated protein-4 known as CTLA-4, and the second important pathway PD-1 (programmed cell death pathway-1) are the most effective. In addition, it is known by researchers that immune checkpoints are more effective in fighting cancer than the most known treatment techniques. In this review proceeding we will be focusing on these two pathways for the cancer treatment.

Introduction

One of the biggest problems in the immune system is the disorder in the immune tolerance. Immune tolerance is able to distinguish the body's own cells from antigens. But cancer cells can escape immune tolerance. The main reason for this is that cancer cells are composed of self-cells and immune cells cannot recognize such cells. Therefore, the immune system is being investigated more in cancer treatments. It is very important that the standard methods in cancer treatment become ineffective and the development of treatments that prevent the recurrence of cancer for cancer patients [1]. Treatment strategies aiming to benefit from the body's immune system are being developed in cancer treatments. It is known that immune checkpoints, one of these methods, are more effective than the most known treatment techniques [2].

Results

The immune checkpoint-based treatment methods have become increasingly widespread today and positive progress has been achieved in many cancer types. One of these treatment methods can enable immune cells to distinguish cancerous cells from normal cells by blocking immune checkpoints with monoclonal antibodies. In other words, they are signals that regulate and inhibit immune responses. Some of the immune checkpoints are as follows, there are many such as TIM-3, CTLA-4, LAG-3, and PD-1, but the most important and most studied immune checkpoints are CTLA-4, PD-1 [3]. These two receptors regulate T cell expression negatively. The working mechanism of the receptors is to prevent tissue damage and autoimmune diseases by preventing excessive immune response. By advancing in the opposite direction of the working mechanisms of these inhibitors, the

researchers increased the importance of immune cells in cancer treatment by preventing the proliferation of cancerous cells and enabling them to be differentiated [4].

The first immune checkpoint clinical studies were conducted on the CTLA-4 receptor. The CTLA-4 inhibitor is in the immunoglobulin superfamily member, is expressed on T cells, and is the protein that controls immune responses. It binds to a protein known as B7, inhibiting the functioning of T cells, preventing the destruction of many cells, including cancer cells [5]. Anticancer drugs have been developed that inhibit the CTLA-4 receptor in order to increase the efficiency in the destruction of cancer cells. In this way, T cells work more effectively to destroy cancer cells. One of the biggest disadvantages of CTLA-4 blockade has been observed in many studies that it is not very effective when only this blockade is used in the treatment, and its effectiveness is increased when the combination is used [5]. The first immune checkpoint inhibitor, ipilimumab, got approval from the FDA in 2011, making advances in the treatment of the late-stage melanoma cancer [6].

PD-1 receptor, T cells and natural killer cells (NK), B lymphocytes, monocytes, dendritic cells act on immune system cells, and cytokine release limits immunological activity. PD-1, PD-1L and PD-2L show its effectiveness by interacting with these two ligands found on cancer cells and antigen presenting cells. Tumors containing these ligands bind to PD-1, inhibiting the immune response and evading the immune system [7]. In 2015, nivolumab and pembrolizumab got approved by the FDA so that they can be used against non-small cell lung cancer (NSCLC) [8]. It is known that PD-1 inhibitors are more effective than other methods in advanced melanoma and many cancer types (bladder cancer, digestive system cancers, pancreatic cancer, brain tumors).

Discussion

The purpose of using the immune system in cancer treatment methods is to create a more effective anticancer response by strengthening the immune system. While methods in cancer treatment directly target cancer cells, immunotherapy methods aim to improve the cancer microenvironment by utilizing the immune system. Today, studies on immune checkpoints have become more popular. Immune checkpoints have important roles in controlling autoimmune diseases, that is, immune tolerance, but they cause cancer cells to escape by suppressing the immune system [9, 10]. For this reason, it is very important to focus on this area in cancer treatment. In the treatments studied on CTLA-4 and PD-1, their efficacies alone are low, but the combination of their targeting with the most known treatment techniques such as radiotherapy and chemotherapy, and the combination of the two receptors with each other increased their efficacy more [10]. Therefore, more attention should be paid to studies on the combination of these receptors with traditional methods and with each other.

References

1. Chen, D. S., Irving, B. A., & Hodi, F. S. (2012). Molecular Pathways: Next-Generation Immunotherapy—Inhibiting Programmed Death-Ligand 1 and Programmed Death-1Next-Generation Immunotherapy: PD-L1/PD-1 Inhibition. *Clinical cancer research*, *18*(24), 6580-6587.
2. Topalian, S. L., Hodi, F. S., Brahmer, J. R., Gettinger, S. N., Smith, D. C., McDermott, D. F., ... & Sznol, M. (2012). Safety, activity, and immune correlates of anti–PD-1 antibody in cancer. *New England Journal of Medicine*, *366*(26), 2443-2454.
3. Parry, R. V., Chemnitz, J. M., Frauwirth, K. A., Lanfranco, A. R., Braunstein, I., Kobayashi, S. V., ... & Riley, J. L. (2005). CTLA-4 ve PD-1 reseptörleri, farklı mekanizmalarla T hücre aktivasyonunu inhibe eder. *Moleküler ve hücresel biyoloji*, *25* (21), 9543-9553.
4. Medina, P. J., & Adams, V. R. (2016). PD-1 Pathway Inhibitors: Immuno-Oncology Agents for Restoring Antitumor Immune Responses. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *36*(3), 317-334.
5. Wolchok, J. D., & Saenger, Y. (2008). The mechanism of anti-CTLA-4 activity and the negative regulation of T-cell activation. *The oncologist*, *13*(S4), 2-9.
6. McCain, J. (2013). MAPK (ERK) yolu: BRAF mutasyonlu metastatik melanomun tedavisi için araştırma kombinasyonları. *Eczacılık ve Terapötikler* , *38* (2), 96.
7. Raedler, L. A. (2015). Opdivo (Nivolumab): second PD-1 inhibitor receives FDA approval for unresectable or metastatic melanoma. *American health & drug benefits*, *8*(Spec Feature), 180.
8. Brahmer, J. R., Tykodi, S. S., Chow, L. Q., Hwu, W. J., Topalian, S. L., Hwu, P., ... & Wigginton, J. M. (2012). Safety and activity of anti–PD-L1 antibody in patients with advanced cancer. *New England Journal of Medicine*, *366*(26), 2455-2465.
9. La-Beck, N. M., Jean, G. W., Huynh, C., Alzghari, S. K., & Lowe, D. B. (2015). Immune checkpoint inhibitors: new insights and current place in cancer therapy. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *35*(10), 963-976.
10. Pardoll, D. M. (2012). The blockade of immune checkpoints in cancer immunotherapy. *Nature Reviews Cancer*, *12*(4), 252-264.

Advanced Engineering Days

aed.mersin.edu.tr

Antibiotic Resistance: How it develops and affects the public health

Neslihan Çiflik *[1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, neslihanciflik1@gmail.com*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Çiflik, N., & Ayaz, F. (2022). Antibiotic Resistance: How it develops and affects the public health. 4th Advanced Engineering Days, 43-44

Keywords
Antibiotics,Antibiotic resistance, Bacteria, Infection

Abstract

The inclusion of antibiotics in clinical practice was considered one of the most beneficial methods in the fight against infectious diseases. The incorporation of antibiotics into clinical practice has saved the lives of many patients. At the same time, the ability of bacteria of the same species to survive at concentrations of antibiotics that inhibit or kill other bacteria has created the bacterial resistance to antibiotics, called the antibiotic's ability to survive. Resistant bacteria are more advantageous than non-resistant bacteria, and only the presence of resistant bacteria is detected in the antibiotic containing environment over time. In this proceeding review we will be discussing the antibiotic resistance and its possible effects on the public health systems.

Introduction

The increase in antibiotic resistance, which causes hundreds of thousands of deaths in a year, has been identified as a global health threat [1]. In addition, according to a recent report, it is estimated that antibiotic resistance will cause approximately 300 million premature deaths by 2050 and cause serious damage to the economy [2, 3]. This situation leads to the emergence of almost incurable infections by destroying the large areas of treatment of antibiotics, resulting in the absence of a reliable and different option in the treatment of infected patients. Many antimicrobial compounds are produced naturally, and the survival mechanisms of bacteria living with these compounds have developed. These organisms are called "self-resistant" because they are resistant to too many antimicrobials. Another resistance is the term "acquired" resistance to a population of bacteria sensitive to the antimicrobial compound in clinical settings [4].

Results

From an evolutionary perspective, bacteria use two important genetic methods to resist antibiotic attacks. The first of these is called antibiotic resistance caused by mutations and the other is called horizontal gene transfer [5]. Mutation resistance develop when antibiotics are given to a population of bacteria that are not resistant to the antibiotic over time mutations occur in some of the genes where the antibiotic exerts its effect [6]. In antibiotic containing environment, antibiotic-resistant bacteria became more dominant than non-resistant ones, leading to the extinction of non-resistant bacteria. These mutations in genes have enabled bacteria to develop resistance to antibiotics [7].

It should not be overlooked that with the emergence of resistance to all antibiotics used in clinical methods, the possibility of developing resistance to a new antibiotic in the future is high. In clinical practice, antibiotics are used primarily to prevent the spread of infection rather than to combat bacterial infection [8]. If antibiotic use is compromised, there are not many options for an infected patient other than palliative care. As another way, bacterial infections can be avoided and it is thought that different methods can be developed apart from the use of prophylactic antibiotics.

Creating a new antibiotic is extremely costly. Discovery of a new antibiotic in clinical practice is a constantly demanded situation. The reason for this is that it is thought that the effects of current methods will be lost. The use of all antibiotics should be clinically minimized so that resistance formation does not progress so rapidly [9].

Discussion

In summary, procedures should be established to reduce the effects of antibiotic-resistant bacteria arising from the use of antibiotics. Places where antibiotics are frequently used in clinical settings should be made hygienic and should be going regularly through infection control systems.

If the use of antibiotics becomes endangered, it will be impossible to offer aseptic conditions for long-term recovery times. A different prophylactic procedure will be required for major surgical procedures. Another method that can be developed is the production of vaccines that will protect against the most common nosocomial infections. Resistant bacterial species pose a global problem as they can spread very quickly throughout the world. Trainings should be applied under the name of raising awareness about this important problem.

References

1. O'Neill, J. (2014). Review on antimicrobial resistance. *Antimicrobial resistance: tackling a crisis for the health and wealth of nations*, *2014*(4).
2. CDC, A. (2019). Antibiotic resistance threats in the United States. *US Department of Health and Human Services: Washington, DC, USA*.
3. O'neill, J. Antimicrobial resistance: tackling a crisis for the future health and wealth of nations. London: Review on Antimicrobial Resistance; 2014.
4. Wayne, P. A. (2008). Performance Standards for Antimicrobial Susceptibility Testing, Ninth Informational Supplement.
5. Munita JM, Arias CA. (2016). Mechanisms of Antibiotic Resistance. Microbiol Spectr. 4(2). VMBF-0016-2015. PMID: 27227291; PMCID: PMC4888801.
6. Woodford, N., & Ellington, M. J. (2007). The emergence of antibiotic resistance by mutation. *Clinical Microbiology and Infection*, *13*(1), 5-18.
7. Martínez, J. L. (2012). Bottlenecks in the transferability of antibiotic resistance from natural ecosystems to human bacterial pathogens. *Frontiers in microbiology*, *2*, 265.
8. Nordmann, P., & Poirel, L. (2002). Emerging carbapenemases in Gram-negative aerobes. *Clinical Microbiology and Infection*, *8*(6), 321-331.
9. Toleman, M. A., Bennett, P. M., & Walsh, T. R. (2006). IS CR elements: novel gene-capturing systems of the 21st century?. *Microbiology and molecular biology reviews*, *70*(2), 296-316.

Advanced Engineering Days

aed.mersin.edu.tr

Female sex hormones and their effects on the immune system

Tanya Beril Korkmaz [*1], **Furkan Ayaz** [1,2]

[1]*Mersin University, Biotechnology Department, Türkiye, tanyaxbrl@gmail.com*
[2]*Mersin University, Biotechnology Department, Türkiye,furkanayaz@mersin.edu.tr*

Cite this study: Korkmaz, T. B., & Ayaz, F. (2022). Female sex hormones and their effects on the immune system. 4th Advanced Engineering Days, 45-47

Keywords
Sex Hormones
Female
Immunity
Autoimmune Diseases
Allergies

Abstract

Sex hormones assign the gender features of person but it is not their only function. While doing that, those hormones also affect other functions of cells and organs. Some particular cells express sex hormone receptors and when they are exposed to those hormones, the hormone-receptor binding occurs and some specific pathways may get blocked or activated. Female sex hormone system is really complex and the hormone levels vary during menstruation cycle, in other words most of the life time of a woman witnesses constant hormonal changes. The changes in the level of female sex hormones affect the whole body during menstrual cycle as stated above. One of the most critical body systems which can be influenced by the hormonal changes is the immune system. Changes in the immune system organs, cells and their functions affect the whole body and women's life quality during some particular stages of the menstruation. Understanding the hormonal changes and their impact on the immune system may be a huge help to develop treatment methods for the autoimmune diseases, infectious diseases, hormonal allergies, healthy pregnancy and even cancer.

Introduction

Female sex hormones such as progesterone, estrogen and estradiol are generally assumed as reproductive hormones. In reality, they are also responsible for the nervous system functions, cardiovascular functions, muscle and skeletal development, hair growth and immune system regulation [1,2]. During a lifetime of a healthy woman, level of those hormones changes regularly and the changes of those hormone levels regulate some bodily functions [1,2]. For example, during the first days of menstrual cycle, if there is no fertilization, while progesterone level decreases, estrogen level increases. With these changes, body knows that person is not pregnant and prepares body for the menstruation.

The changes in the hormone levels during the menstruation cycle, immune cells can be triggered as well. Numerous studies show that hormones such as estrogen and progesterone affect the immune system cytokines' levels such as interferons and interleukins. In particular, hematopoietic cells, thymus stromal cells, bone marrow and lymph nodes express estrogen receptors (ER); which results in the immune system regulation by the estrogen hormone [1]. Estrogen binds those receptors and triggers some of the signaling pathways related to the immune system.

Estrogen/estradiol hormone levels always change during the menstrual cycle. Its levels are high during pregnancy, whereas its low after menopause. Lymphoid tissue cells, lymphocytes, dendritic cells and macrophages express estrogen receptors and with changes in the level of the hormone, those receptors interact with estrogen differently. After interaction, those cells' numbers, functions, activities or responses change [3,4].

Progesterone hormone is produced by the placenta at high levels during pregnancy. During menstrual cycle this hormone is produced and released from the corpus luteum. Progesterone receptors are expressed by the

Natural Killer cells, T cells, Macrophages and Dendritic cells and with an interaction of those receptor and hormones, also these immune system cells functions, activity, numbers and responses change [3,4].

Androgens also occur in women in post-pubertal age. NK cells and Macrophages also express androgen receptors and when interaction happens between hormone and the receptor, those cells' functions also change [3,4].

Table 1. Female sex hormones and their effects on the immune system cells, molecules and regulators during the menstrual cycle. While the ∧ symbol shows the increase, the ∨ symbol shows the decrease of the parameters [3]

Immuno Component	Effect of the Hormones		
	Estradiol	Progesterone	Androgens
Toll Like Receptors	TLR4, TLR7, TLR9∧	TLR3, TLR7 ∨	TLR4 ∨
Macrophages	TLR4 ∧	Inducible Nitric Oxide Synthase, Nitric Oxide∨ FIZZ1, YM1 ∧	Inducible Nitric Oxide Synthase, Nitric Oxide∨ TNF ∨
Nuclear Factor-κB	Activity∨	Activity ∨	Activity ∨
Dendritic Cells	Activity∧ TLR7, TLR9 ∧ CC-Chemokine Ligand2 ∧ CXC-Chemokine Ligand10 ∨ IFNα∨	CD40, CD80, CD86 ∨ CD110 ∧ IL-18, IL-10 ∧	Not Defined
Neutrophils	Numbers ∧ Degranulation ∧ Elastase release ∧	Not Defined	Numbers ∧ Kinases and leukotriene formation ∨
Natural Killer Cells	IFNγ∧ Granzyme B ∧ FASLigand∨	Numbers ∧ Caspase dependent apoptosis ∧	Not Defined
Eosinophils	Numbers ∨ Mobilization ∨	Numbers ∧	Not Defined
Inflammatory Cytokines	/ Low estrogen / IL-1beta, IL-6, TNF ∧ / High estrogen / IL-1β, IL-6, TNF ∨	TNF, IFNγ∨ IL-6 ∧	IL-1β, IL-2 ∧ TNF ∨
Suppressive Cytokines	IL-4, IL-10, TGFβ∧	IL-4, IL-5, TGFβ∧	IL-10, TGFβ∧
Chemokines	CC-Chemokine Ligand2 ∨ CXC-Chemokine Ligand1 ∧	CXC-Chemokine Ligand2 ∨	CC-Chemokine Ligand3 ∨
T_H1 cells	/ Low estradiol / Activity ∧	Activity ∨	IFNγ ∨
T_H2 cells	/ High estradiol / Activity ∧	Activity ∧	IL-4, IL-5 ∨ GATA3 ∨
T_H17 cells	Numbers ∨ IL-17 ∨	Percentages ∨	IL-17 ∧
Treg cells	Numbers ∧	Percentages ∧	Numbers ∧
$CD8^+$T cells	Response ∧	Response ∨	Numbers ∨ Activity ∨
B cells	IgG, IgM ∧	CD80, CD86 ∨	Not Defined
Antibody response	Response ∧	Total antibody ∧ Autoantibodies ∨	Response ∨

Results

The female immunity mainly depends on the effects of the sex hormones on the immune system cells and other target organs. Sex hormones regulate the innate immune system and adaptive immune system mechanisms. Especially estrogen mostly triggers molecular mechanisms of the immune-mediated diseases. While estrogen has protective effect for MS (Multiple Sclerosis) and RA; for SLE, it has pathogenic effect [5,6]. For the treatment, blocking estrogen receptors may provide better outcomes but still more research about this topic should be conducted. Leptin hormone also has a role as immune-stimulatory, so treatment may include targeting this hormone as well. On the other hand, progesterone and androgens have immune-protective role and they can be considered as immunotherapy candidates [5].

Allergies are also another case related to the sex hormones in females. Studies showed that estrogen may trigger allergic reactivity. Generally, under hormone therapies, when estrogen level increases, estrogen binds estrogen receptors on mast cells and causes histamine release. Because of that, during pregnancy or menstruation, allergic reactions may peak. For the treatment of these type of hormone allergies immunotherapy may be the safest one. The other ones may require birth control practices like surgery or IUD. For immunotherapy, bioidentical hormones which are obtained from the natural sources are diluted with different chemicals. Concentration may

differ from patient to patient. This type of treatment may not end the allergy but it can relieve or stop the allergy symptoms [7].

A study showed that women were more likely to have autoimmune diseases than men. Sjogren syndrome, thyroid diseases, scleroderma, myasthenia gravis and systemic lupus erythematosus diseases are more common in women. Developing immunotherapy methods which are specialized for women can be the solution for these autoimmune diseases. Also, women have more dramatic immune response for the infectious diseases. At the first glance, it may seem like an advantage but in reality, during the infection, women can show increased symptoms and they may be severe in some cases [8].

Discussion and Conclusion

Immune system plays an important role in the healthy cell functions, auto-immune diseases, tumor progression and cancer [6]. Female sex hormones affect the immune system differently so disease progression in females differ from those in the males. Understanding the female sex hormones and their interactions with the body during the certain phases of the menstruation is the key point for the treatment of the immune system related diseases. Some of the available treatment methods can cause damage to the patient over time, and are not specific enough. Also, research about this area is very limited, despite the knowledge of menstrual cycle being the key of mammalian life. In conclusion, focusing on this topic can improve female life quality in general.

References

1. Khan, Deena. & Ahmed, S., A. (2016). The Immune System Is a Natural Target for Estrogen Action: Opposing Effects of Estrogen in Two Prototypical Autoimmune Diseases. Frontiers in Immunology. https://doi.org/10.3389/fimmu.2015.00635
2. Khan, D., Cowan, C. & Ahmed, A. (2012). Estrogen and Signaling in the Cells of Immune System. Advances in Neuroimmune Biology. DOI: 10.3233/NIB-2012-012039
3. Klein, L. S. & Flanagan, L. (2016). Sex Differences in immune responses. Nature vol 16. https://doi.org/10.1038/nri.2016.90
4. Ysrraelit, M., C. & Correale, J. (2018). Impact of sex hormones on immune function and multiple sclerosis development. The Journal of Cells, Molecules, Systems and Technologies vol 156. doi:10.1111/imm.13004
5. Moulton, V., R (2018) Sex Hormones in Acquired Immunity and Autoimmune Disease. frontiers in Immunology vol 9. doi: 10.3389/fimmu.2018.02279
6. Schafer, J., M., Xiao, T., Kwon, H., Collier, K., Chang, Y., Abdel-Hafiz, H., Boolyard, C., Chung, D., Yang, Y., Sundi, D., Ma, Q., Theodorescu, D., Li, X. & Li, Z., (2022). Sex-biased adaptive immune regulation in canccer development and theraphy. iScience Review vol 25. https://doi.org/10.1016/j.isci.2022.104717
7. Ortona, E., Pierdominici, M. & Rider, V. (2019). Editorial: Sex Hormones and Gender Differences in Immune Responses. frontiers in Immunology vol 10. doi: 10.3389/fimmu.2019.01076
8. Wang, S., Cowley, L., A. & Liu, X. (2019). Sex Differences in Cancer Immunotherapy Efficiancy, Biomarkers and Therapeutic Strategy. Molecules vol 24. https://doi.org/10.3390/molecules24183214

Advanced Engineering Days

aed.mersin.edu.tr

Material deteriorations occurring on the facades of the Mor Sergios Bakhos Church

Lale Karataş*[1], Aydın Alptekin [2], Murat Yakar [3]

[1]*Mardin Artuklu University, Department of Architecture and Urban Planning, Türkiye, karataslale@gmail.com*
[2]*Mersin University, Geological Engineering Department, Türkiye, aydinalptekin@mersin.edu.tr*
[3]*Mersin University, Geomatics Engineering Department, Türkiye, myakar@mersin.edu.tr*

Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (2022). Material deteriorations occurring on the facades of the Mor Sergios Bakhos Church. 4th Advanced Engineering Days, 48-51

Keywords
Cultural Heritage
Historical Buildings
Stone Deteriorations
Terrestrial Laser Scanning
Orthophotograph

Abstract

Mor Sergios Bakhos Church is an important monument having significant tangible and intangible cultural heritage value regarding the geographical context, where it is located. However, various material problems have occurred on the stone structure as a result of various conditions today and the structure encountered the risk of being destroyed. Within this context, the aim of the study is to determine and document the material deteriorations of Mor Sergios Bakhos Church, which is one of the symbolic values for the city of Mardin. Ground laser scanning technique was used in order to achieve this purpose and orthophotographs were obtained from the point cloud data via the various programmes. Facade drawings of the building were achieved with the help of the scaled orthophotographs obtained. In the final stage, material deterioration schedules were processed on the facade drawings obtained and the damage maps of the building were obtained. Most frequent material deterioration seen on the facades of the building is the use of cement and paint arising from the faulty repairs, according to the findings. Within this context, it was concluded that preventing the human-originated faulty repairs, which was the greatest problem seen on the building, is important within the context of ensuring sustainability.

Introduction

Conservation concept is a complex process containing decisions regarding how the cultural heritage is interpreted and preserved [1]. Stone structures are the works of art occupy a great space in the world in the field of cultural heritage. However, they expose to material deteriorations in time and encounter with the risk of extinction. Material deteriorations occurring on the stone structures constitute a serious risk regarding to lose the architectural elements and details that characterize the building customs and skills for centuries [2-3]. An integrated approach intended for conservation not only requires the instant treatment of the physical, chemical and biological deterioration problems, but also requires the periodic documentation and monitoring of the material problems seen on the stone, in order to understand the causes of the problems seen in anywhere completely. Various conservation interventions to be carried out on the stone structure must be carried out considering the phases exposed by the stone [4-6]. Because the stone material reacts against the current environmental conditions in various forms depending on the deteriorations and repairs it has undergone, which is called "memory effect". With this point of view, in literature it is emphasized that the periodic determination and documentation of the stone materials is important [7-8]. Within this context, the aim of the study is to determine and document the material deteriorations of Mor Sergios Bakhos Church, which is one of the symbolic values for the city of Mardin.

Location and History of the Building

Mor Sergios Bakhos Church is located in Mardin Province, Midyat County, Anıtlı (Hah) Neighbourhood, on Block Nr. 104 and Plot Nr. 57. The immovable, which has the characteristic of monumental architecture, was determined

as "1st Group Building". The church of the monastery is dated to the 7th century. The entrance to the courtyard of the monastery is provided by a door, which is placed on the southwest corner and built in a relatively small size. Church section of the monastery is located on the northeast of the courtyard and the courtyard is surrounded by additional venues on the east, west and north directions. Although the most of the additional venues located on the west side have been destroyed today, the venues located on the north and east of the courtyard have survived with various repairs [9].

Material and Method

Initially, the structure was investigated on-site, and stone material deteriorations were mapped on the schedule prepared. Determination schedule is presented in "Table 1".

Table 1. Problems encountered on construction elements made of masonry material in Mardin / Mor Sergios Bakhos Church

Problems Encountered on Construction Elements Made Of Masonry Material In Mardin / Mor Sergios Bakhos Church																												
NATURAL STONE CONSTRUCTION ELEMENTS					Loss of surface	Fragmentation	Formation of gap/ hole	Pitting	Cracks	Spalling	Foliation	Discharge of jointing	Surface contamination	Shell formation	Efflorescence	Crystallization	Formation of plant	Formation of moss	Corrosion (Rust stain)	Tear	Loss of form	Colour change	Faulty Repairs: Use of cement	Faulty Repairs: Fall of plaster	Faulty Repairs: Other
VERTICALBEARINGS	**SINGLE BEARINGS**	Leg																										
		Column																										
	CONTINUOUS BEARINGS	Wall			-	X	-	-	X	-	-	X	-	-	-	-	X	-	-	-	-	-	X	X	-
HORIZONTAL BEARINGS	**FLOORINGS**	Flat			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Curvilinear	Vault		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			Dome																						
WALL OPENINGS	Window	Lintel/jamb			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Sill			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Door	Lintel/jamb			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Sill			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Arch				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AUXILIARY ELEMENTS	Network Moulding				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gargoyle				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chimney																								
	Element for passage to the cover																								

In this stage, external wall scanning was conducted using laser scanning device (Faro Focus Laser Scanner) and point clouds were obtained in the scanning procedure. In recent years, photogrammetry and point cloud technology has been used in cultural heritage studies [10-21]. The point clouds that were obtained in laser scanning procedure were transformed into the 3-dimensional images of the building using the software named PointCab Origins 4.0. Orthophotographs (vertical photos) were produced regarding the building by taking sections from the desired points on the 3-dimensional images using the software named PointCab Origins 4.0. AutoCAD software was used in creating the drawings of the facades ("Fig. 1").

Figure 1. Obtaining the scaled orthophotographs of the building in the programme named PointCab Origins 4

Results

Facade drawings of the building were achieved with the help of the scaled orthophotographs obtained from the point cloud. Material deteriorations were processed on the facade drawings obtained and the damage maps of the building were obtained. According to these maps, the problems of fragmentation, discharge of jointing, cracks, use of cement, formation of plants, plaster deterioration are seen on the **south facade**. Problems of discharge of jointing, cracks, use of cement, formation of plants, and plaster deterioration are seen on the **north facade**. Problems of fragmentation, discharge of jointing, cracks, use of cement, formation of plants, use of paints, and plaster deterioration are seen on the **east facade**. Problems of fragmentation, discharge of jointing, cracks, use of cement, formation of plants, and plaster deterioration are seen on the **west facade** (''Fig. 2'').

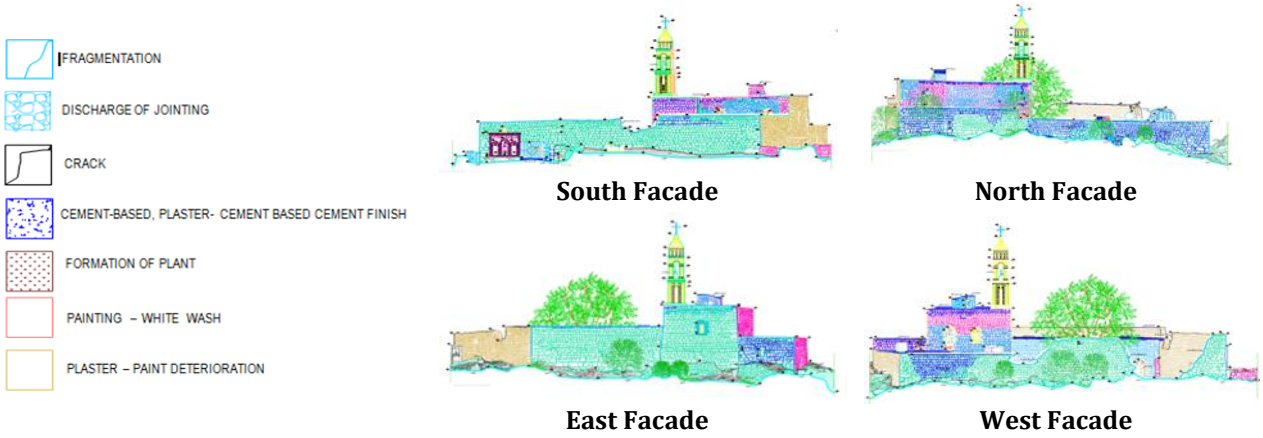


Figure 2. Mapping of material deteriorations on the facades

Conclusion

In the study, material deteriorations of Mor Sergios Bakhos Church, which is one of the symbolic values for the city due to reflecting the tangible and intangible cultural heritage of Mardin city, were documented using the drawings obtained by transforming the data obtained from the ground laser scanning into orthophotographs. According to the findings, most frequent material deterioration seen on the facades of the building is the use of cement and paint arising from the faulty repairs. These deteriorations are followed by fragmentation, discharge of jointing, cracks, formation of plant, and plaster deterioration respectively. Within this context, it was concluded that preventing the human-originated faulty repairs, which was the greatest problem seen on the building, is important within the context of ensuring sustainability.

References

1. The Getty Conservation Institute (2000). Values and Heritage Conservation. Research Report, The GettyCenter, Los Angeles.
2. Watt, J., Tidblad, J., Kucera, V. & Hamilton, R. (2009). The Effects of Air Pollution on Cultural Heritage; Springer: Berlin,Germany,
3. Siegesmund, S. & Snethlage, R. (2014). Stone in Architecture: Properties, Durability, 5th ed., Springer: Berlin, Germany.
4. Riegert, M., & Turkington, A. (2003). Setting stone decay in a cultural context: conservation at the African Cemetery, 38(9-10), 1105–1111. https://doi.org/10.1016/s0360-1323(03)00087-8

5. Smith, B. J. & Warke, P. A. (1996). Processes of urban stone decay. Donhead Publishing LTD, London, p. 274.
6. Gaffikin, P. (1999). Set in stone: a geological guide to the building stones of Belfast. Environment and Heritage Service, Belfast.
7. Vleugels, G., Dewolfs, R. & Van Griecken, R., 1993, On the memory effect of limestone for air pollution: Atmospheric Environment, v. 27A, p. 1931–1934
8. Hoke, G. D. & Turcotte, D. L. (2002), Weathering and damage: Journal of Geophysical Research B: Solid Earth, 107(10), 1–6.
9. Elyiğit, U. (2019). Monastery tradition in the architecture of Tur Abdin Christian religion. Atlas Journal, 5, 283-308. https://doi.org/10.31568/atlas.315.
10. Karataş, L., Alptekin, A., Kanun, E., & Yakar, M. (2022). Tarihi kârgir yapılarda taş malzeme bozulmalarının İHA fotogrametrisi kullanarak tespiti ve belgelenmesi: Mersin Kanlıdivane ören yeri vaka çalışması. *İçel Dergisi*, *2*(2), 41-49.
11. Alptekin, A., & Yakar, M. (2021). 3D model of Üçayak Ruins obtained from point clouds. *Mersin Photogrammetry Journal*, *3*(2), 37-40.
12. Kanun, E., Alptekin, A., & Yakar, M. (2021). Cultural heritage modelling using UAV photogrammetric methods: a case study of Kanlıdivane archeological site. *Advanced UAV*, *1*(1), 24-33.
13. Doğan, Y., & Yakar, M. (2018). GIS and three-dimensional modeling for cultural heritages. *International Journal of Engineering and Geosciences*, *3*(2), 50-55.
14. Mirdan, O., & Yakar, M. (2017). Tarihi eserlerin İnsansız Hava Aracı ile modellenmesinde karşılaşılan sorunlar. *Geomatik*, *2*(3), 118-125.
15. Alptekin, A., Çelik, M. Ö., & Yakar, M. (2019). Anıtmezarın yersel lazer tarayıcı kullanarak 3B modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 1-4.
16. Alptekin, A., Fidan, Ş., Karabacak, A., Çelik, M. Ö., & Yakar, M. (2019). Üçayak Örenyeri'nin yersel lazer tarayıcı kullanılarak modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 16-20.
17. Alyilmaz, C., Yakar, M., & Yilmaz, H. M. (2010). Drawing of petroglyphs in Mongolia by close range photogrammetry. *Scientific Research and Essays*, *5*(11), 1216-1222.
18. Yakar, M., & Doğan, Y. (2017). Silifke Aşağı Dünya Obruğunun İHA Kullanılarak Üç Boyutlu Modellenmesi. *Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, *17*(4), 94-101.
19. Şasi, A., & Yakar, M. (2017). Photogrammetric modelling of sakahane masjid using an unmanned aerial vehicle. *Turkish Journal of Engineering*, *1*(2), 82-87.
20. Kanun, E., Alptekin, A., & Yakar, M. (2021). Documentation of cultural heritage by photogrammetric methods: a case study of Aba's Monumental Tomb. *Intercontinental Geoinformation Days*, *3*, 168-171.
21. Yilmaz, H. M., Karabork, H., Yakar, M. (2000). Yersel Fotogrametrinin Kullanım Alanları, Niğde Universitesi Mühendislik Bilimleri Dergisi, 4(1), 18-28

Advanced Engineering Days

aed.mersin.edu.tr

Contribution of architectural design of ancient city Dara's water cisterns to the water efficiency of the city

Lale Karataş*[1], Aydın Alptekin [2], Murat Yakar [3]

[1]*Mardin Artuklu University, Department of Architecture and Urban Planning, Türkiye, karataslale@gmail.com*
[2]*Mersin University, Geological Engineering Department, Türkiye, aydinalptekin@mersin.edu.tr*
[3]*Mersin University, Geomatics Engineering Department, Türkiye, myakar@mersin.edu.tr*

Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (2022). Contribution of architectural design of ancient city Dara's water cisterns to the water efficiency of the city. 4th Advanced Engineering Days, 52-54

Keywords
Cultural Heritage
Historical Buildings
Architectural Design
Sustainability
Mardin

Abstract

Drought and difficulty in accessing to water is one of the problems encountered by Mesopotamia region for centuries. Insufficiency of the water resources has brought forth the need of storing water and necessitated the construction of the cisterns in this region in the past. Application of the correct design techniques in the architectural design of the cisterns shall provide saving in storing, transporting and transferring the water. Within this context, starting with the fact that the cisterns have a significant place within the immovable culture heritage of Mesopotamia region, the aim of this study to determine the contribution of architectural and technical design of water cisterns of ancient city Dara to the water efficiency of the city in the past. Within the scope of the study, it is adopted to conduct literature review, to identify the cisterns on-site, and to document the current statuses of them via photographs as method. Within the scope of the study, it is seen that the design of the cisterns is shaped according to the topography and the working principle is coincided with the principle of computational fluid exactly. It is determined that this system provided great saving in storing, transporting and transferring the water in Mesopotamia region, where it is necessary to use the water in the most efficient manner.

Introduction

People have designed various architectural elements in order to access water easily. Cisterns are the architectural designs designed as open or closed, where the fresh water is stored. Stored water is transported to the place in need of water in the city via the watercourses. Water and water supply is in the lead of the most important problems for Mesopotamia regions, which is located on the south, for centuries. Construction of the cisterns was commenced in order to store the fresh water resource and to bring it to the city through a watercourse. When the design of the cisterns is made in a true manner, a significant amount of water shall be saved in storing, transporting and transferring the water. The cisterns of the ancient city of Dara, which is the subject of our article, are among the unique examples of Roman and Byzantium architecture world in the world's architecture history in terms of both technic and design. Within this context, the aim of this study is to investigate the architectural design of ancient city of Dara's water cisterns in terms of technic and design, and to research the contribution of the system established to the water efficiency of the city in the past. As a result of the study, it shall be revealed whether the correct design techniques have been used and to what extent the water has been used efficiently.

Location and History of the Building

Ancient city of Dara, where the subject of the article takes place, is located on 30 km southeast of Mardin Province, and is an ancient border settlement in Oğuz village. It is located on approximately 8 km north of Nusaybin highway and at the point, where the Mesopotamia plain and Mountains of Tur combine [1, 2].

Dara has been established in A.D. 505-507 by Roman Emperor Anastasius (A.D. 491-518) as a garrison city in order to protect the east border of the empire from the Sasanians. The city is being referred as "Dara-Anastasiopolis" with the name of the founder emperor. The fortification walls of the city, which have been built by the 1st Anastasius, have been repaired in the period of the emperor Justinianus (527–565), and the cisterns have been built within this period [3].

Dara city has large water systems. The city is meshed with the defence structures such as its fortification walls, internal castle, bastions, and gutters. The existence of these water systems has been effective in the resistance of the army, which has taken refuge in the city for longer periods during the long-lasting envelopment periods. Most of the ruins, which have reached from the ancient city of to present, belong to the early Byzantine period. However, the structures of late Roman, Byzantine, Seljuk and Ottoman are seen together in the city. These structures are consisted of agora, columned avenue, big church, building with mosaics, baldachin planned structure, bridges, cisterns, sets, necropolis area, city's fortification walls, and doors, and tombs, sepulchral monuments and the mosque, which are the ruins of Islamic period. Dara's most remarkable characteristic is having large water systems. Water systems have been built as part of the defence strategy, except the daily use. The existence of these water systems has been effective in the resistance of the army, which has taken refuge in the city for longer periods during the long-lasting envelopment periods. The water systems, which are stored through flowing from the high mountains and distributed to the entire city via the channels in order to meet the water need, had an important place also in the defence of the city. The city has resisted for a while thanks to these water resources particularly within the periods of envelopment by Sasanians, when it did not have contact with the outside [4] ("Fig. 1").

Architectural design of a cultural heritage has been frequently performed using photogrammetry and point clouds in the last decade [5-16].

Figure 1. Images of the water cisterns of ancient city of Mardin-Dara

Material and Method

Within the scope of the study, it is adopted to conduct literature review, to identify the cisterns on-site, and to document the current statuses of them via photographs as method. Plan diagrams were drawn by taking the current measures, and the findings are presented below.

Results

A rectangular plan diagram is seen as the venue layout of Mardin Dara city. Topographic structure of the settlement has determined the design of the water cisterns, and the cisterns have been shaped so as to comply with the sloping land. Cistern is consisted of eleven venues. It is formed completely from the main rock on the ground. It has been completed with the small stones on the upper part and the upper cover has been created for the cells. There are small cavities on the points corresponding to the upper parts of the walls creating the cells. Water coming from the upper cell can pass to the other cell by means of these small cavities. Upper part is covered with barrel vault. The walls and the upper cover have been built with the masonry system, in the manner usual in the traditional Mardin architecture. Construction elements have been created with the stone materials. There is a round arch on the part covering the retaining walls, over the cisterns.

The stones in the arch have been bonded according to the reverse potential technique. Key block is located on the exact crown. The height of the retaining walls is seven – seven and a half meters. Barrel vault, of which the top is covered, is at an elevation of 9.35 meters. The principle of water flow has been adjusted so as to coincide with the **principle of computational fluid** exactly (Fig. 3). The rainwater falling onto the vault flows into the cisterns through the filling holes located on the point, where the wall and the vault joints. Thus, the cells, which have elevation difference, fill each other with the help of filling holes. There are chimneys on the part, where the upper cover is located, for treatment. After the water passes into the cells, it is subjected to treatment, afterwards the water is stored in the underground cistern and it is distributed.

Conclusion

In the study, the architectural and technical designs of ancient city of Dara's water cisterns have been investigated and the contribution of the system to the water efficiency of the city in the past was searched. As a result of the study, it is seen that the design of the cisterns is shaped according to the topography and the working

principle is coincided with the principle of computational fluid exactly. It is determined that this system provided great saving in storing, transporting and transferring the water in Mesopotamia region, where it is necessary to use the water in the most efficient manner.

As a result of the investigations made under the study, it was concluded that Dara's cisterns must undergone a general maintenance and repair process as soon as possible. In the selection of the materials and methods to be applied in cleaning, strengthening and conservation, not damaging the current structure must be essential. For this, the necessary analyses must be conducted on the original materials before the application.

References

1. Aslan, H., Cengiz, E. & Cengiz, C. (2017). Preservability of archaeological and rural architecture heritage combination: Case study of ancient city of Oğuz/Dara. Electronic Social Sciences Journal, 16, 1063-1063. https://doi.org/10.17755/esosder.318330.
2. Demirelli, E. & Suata Alpaslan, F. (2018). Anthropological analysis of Dara ancient city's frames. Hitit University Journal of Social Sciences Institute, Special Issue of Hüsbed Anarsan, 1583-1606. https://doi.org/ 10.17218/hititsosbil.458453
3. Metin, H. (2021). Excavation findings of Dara's (Anastasiopolis) agora (2020): burnt earthenware oil lamps of early Byzantine period. Amisos, 6, 87-99.
4. Kütük, A. (2013). Alternative rampier city of Byzantine Empire: Establishment of Dara Anastasiopolis and its status until today. Fırat University, Journal of Middle East Researches, 8 (2), 69-85.
5. Karataş, L., Alptekin, A., Kanun, E., & Yakar, M. (2022). Tarihi kârgir yapılarda taş malzeme bozulmalarının İHA fotogrametrisi kullanarak tespiti ve belgelenmesi: Mersin Kanlıdivane ören yeri vaka çalışması. İçel Dergisi, 2(2), 41-49.
6. Alptekin, A., & Yakar, M. (2021). 3D model of Üçayak Ruins obtained from point clouds. Mersin Photogrammetry Journal, 3(2), 37-40.
7. Kanun, E., Alptekin, A., & Yakar, M. (2021). Cultural heritage modelling using UAV photogrammetric methods: a case study of Kanlıdivane archeological site. Advanced UAV, 1(1), 24-33.
8. Doğan, Y., & Yakar, M. (2018). GIS and three-dimensional modeling for cultural heritages. *International Journal of Engineering and Geosciences*, *3*(2), 50-55.
9. Mirdan, O., & Yakar, M. (2017). Tarihi eserlerin İnsansız Hava Aracı ile modellenmesinde karşılaşılan sorunlar. *Geomatik*, *2*(3), 118-125.
10. Alptekin, A., Çelik, M. Ö., & Yakar, M. (2019). Anıtmezarın yersel lazer tarayıcı kullanarak 3B modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 1-4.
11. Alptekin, A., Fidan, Ş., Karabacak, A., Çelik, M. Ö., & Yakar, M. (2019). Üçayak Örenyeri'nin yersel lazer tarayıcı kullanılarak modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 16-20.
12. Alyilmaz, C., Yakar, M., & Yilmaz, H. M. (2010). Drawing of petroglyphs in Mongolia by close range photogrammetry. *Scientific Research and Essays*, *5*(11), 1216-1222.
13. Yakar, M., & Doğan, Y. (2017). Silifke Aşağı Dünya Obruğunun İHA Kullanılarak Üç Boyutlu Modellenmesi. *Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, *17*(4), 94-101.
14. Şasi, A., & Yakar, M. (2017). Photogrammetric modelling of sakahane masjid using an unmanned aerial vehicle. *Turkish Journal of Engineering*, *1*(2), 82-87.
15. Kanun, E., Alptekin, A., & Yakar, M. (2021). Documentation of cultural heritage by photogrammetric methods: a case study of Aba's Monumental Tomb. *Intercontinental Geoinformation Days*, *3*, 168-171.
16. Yilmaz, H. M., Karabork, H., Yakar, M. (2000). Yersel Fotogrametrinin Kullanım Alanları, Niğde Universitesi Mühendislik Bilimleri Dergisi, 4(1), 18-28

Advanced Engineering Days

aed.mersin.edu.tr

Investigation of Molla Hari (Halil) Süleyman Paşa Mosque's material deteriorations

Lale Karataş*[1], Aydın Alptekin [2], Murat Yakar [3]

[1]*Mardin Artuklu University, Department of Architecture and Urban Planning, Türkiye, karataslale@gmail.com*
[2]*Mersin University, Geological Engineering Department, Türkiye, aydinalptekin@mersin.edu.tr*
[3]*Mersin University, Geomatics Engineering Department, Türkiye, myakar@mersin.edu.tr*

Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (2022). Investigation of Molla Hari (Halil) Süleyman Paşa Mosque's material deteriorations. 4th Advanced Engineering Days, 55-57

Keywords
Cultural Heritage
Historical Buildings
Material Deterioration
Sustainability
Mardin

Abstract

Molla Hari (Halil) Süleyman Paşa Mosque, which is located within the Mardin urban archaeological site and of which the conservation has importance due to reflecting the traditional monumental characteristics of the geography in terms of the architectural characteristics, has been exposed to material deterioration with the effects of various conditions and the building has encountered the risk of being destroyed. Within this context, the aim of the study is to investigate the types and causes of the material deteriorations of Molla Hari (Halil) Süleyman Paşa Mosque, which is located within the Mardin urban archaeological site and of which the conservation has importance for the region. Within the scope of the study, literature review, determination of the building on-site, and determination of current material deteriorations visually, and documentation with photographs were adopted as the methods. It was determined in the findings that most frequent material deterioration seen on the building is the use of cement arising from the faulty repairs. This result demonstrates that human-originated material deteriorations must be prevented immediately on the monumental structure.

Introduction

Factors such as air pollution, climate changes, etc. increasing with the development of the industry and technology, have caused negative effects on the stone structures in the world. When the deterioration factors of the stone structures in the world are considered, it is seen that the most problems are air pollution, presence of the soluble saline, and biologic degradation. Cause of these problems is the exposure of the structure to water generally [1]. Types of the deteriorations on the stone materials can only be diagnosed correctly at the end of close monitoring process. For instance, a grey colour change on the stone may occur with the impact of air pollution or with the penetration of a pollution, which flows from the roof, into the stone. In order to diagnose these types of deteriorations correctly, not only some part of the building, but also the environmental conditions and deterioration factors that have effect on the whole must be assessed. Otherwise, the interventions to be made shall only be intended to save the moment, and the essential factor causing the material deterioration shall not be removed [2]. Within this context, the aim of the study is to investigate the types and causes of the material deteriorations of Molla Hari (Halil) Süleyman Paşa Mosque, which is located within the Mardin urban archaeological site and of which the conservation has importance for the region.

Location, History of the Building and Use of Material

Molla Halil Mosque, which was built in the 14th century, is located in Mardin Province, Şehidiye Neighbourhood, on Plot Nr. 64. Excluding the mosque, which has an old appearance and square plan, all of the other additional structures belong to the late period, and majority of the enclosure wall of the building was rebuilt with stone using concrete mortar. The building has a rectangular plan and the main venue and its attachments constitute the building body. Mosque section is single-storey [3-4] (Fig. 1).

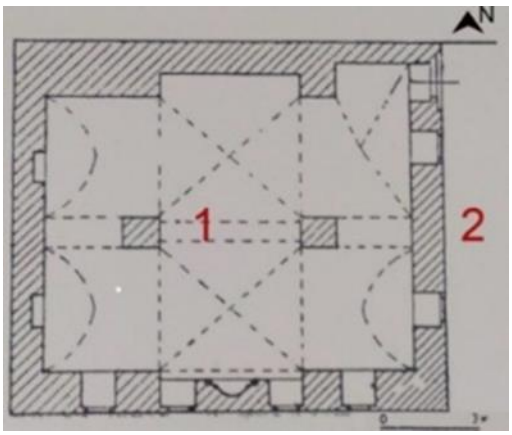


Figure 1. ground floor scheme of Molla Hari Mosque [3]

Stone, wood, metal, and mortar are the other original materials that have been used, and wooden material has been used on the windows and doors. Metal material has been used on the door hinges – sashes, door locks and slides, and on the socket fences. Use of local "ınkara" mortar (powder of limestone (fine sieve sand) + hydrated lime) is seen on the door as the binding mortar, and use of plaster is not seen [5].

Material and Method

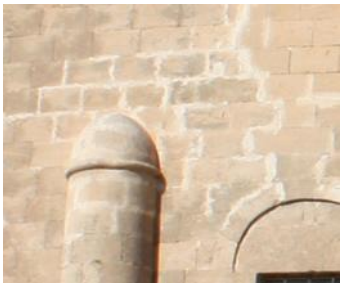
Within the scope of the study, literature review, determination of the structure on-site, observational determination of the current material deteriorations and documentation via photographs were adopted as method. Architectural design and deterioration of a cultural heritage has been frequently performed using point clouds in the last decade [6-17].

Results

Use of face stone is seen on the structure. Discharge of jointing, colour change, and faulty repairs caused by the use of cement are the types of the material deterioration existing on the walls of the building, material deterioration is not seen on the flat flooring. Material loss in the plaster exists on the vaults [5].

Figure 3. Colour change, use of cement on the wall of façade nr. 2

(a) Discharge of jointing, Colour change



(b) Use of cement

Figure 2. Deteriorations on façade nr. 1

Figure 4. Material loss in the plaster on vaults

Use of lancet arch is seen interior the mosque and round arches are seen above the windows on the façade. Faulty repairs were determined on the arches.

Conclusion

Within the scope of the study, types and causes of material deteriorations of Molla Hari (Halil) Süleyman Paşa Mosque, which is located within the Mardin urban archaeological site and of which the conservation has importance due to reflecting the traditional monumental characteristics of the geography in terms of the architectural characteristics, were documented with the methods of literature review, investigation on-site, observational determination of current material deteriorations, and photographing. In the findings, it was determined that the material deterioration most frequently seen on the building was the use of cement caused by the faulty repairs. This result demonstrates that human-originated material deteriorations must be prevented immediately on the monumental structure.

As a result of the investigations conducted within the scope of the study, it was concluded that the building must be subjected to a general maintenance and repair process as soon as possible. Preventing damage to the current structure must be essential in the selection of the materials and methods to be applied in cleaning, strengthening and conservation. For this, the necessary analyses must be conducted on the original materials before the application.

References

1. Charola, A. E., Wendler, E. (2015). An overview of the water-porous building materials interactions. Restoration of Buildings and Monuments, 21(2-3), 55-65.
2. Charola, A.E. (2017). Stone Deterioration Characterization for Its Conservation. Geonomos. https://doi.org/10.18285/geonomos.v24i2.836
3. Altun, A. (1971). Architecture of Turkish Period in Mardin. Acar Basım, İstanbul, 168 s.
4. Altun, A. (2006). Notes on the Plan Schemes of the Madrasah's of Artuquids Age in Anatolia. Journal of Foundations, 10(), 231.
5. Karataş, L. (2016). A Research on the Use of Material and Problems on the Praying Structures Within the Urban Archaeological Site of Mardin. Master's Thesis, Uludağ University, Institute of Science, Bursa, 340p.
6. Karataş, L., Alptekin, A., Kanun, E., & Yakar, M. (2022). Tarihi kârgir yapılarda taş malzeme bozulmalarının İHA fotogrametrisi kullanarak tespiti ve belgelenmesi: Mersin Kanlıdivane ören yeri vaka çalışması. İçel Dergisi, 2(2), 41-49.
7. Alptekin, A., & Yakar, M. (2021). 3D model of Üçayak Ruins obtained from point clouds. Mersin Photogrammetry Journal, 3(2), 37-40.
8. Kanun, E., Alptekin, A., & Yakar, M. (2021). Cultural heritage modelling using UAV photogrammetric methods: a case study of Kanlıdivane archeological site. Advanced UAV, 1(1), 24-33.
9. Doğan, Y., & Yakar, M. (2018). GIS and three-dimensional modeling for cultural heritages. *International Journal of Engineering and Geosciences*, *3*(2), 50-55.
10. Mirdan, O., & Yakar, M. (2017). Tarihi eserlerin İnsansız Hava Aracı ile modellenmesinde karşılaşılan sorunlar. *Geomatik*, *2*(3), 118-125.
11. Alptekin, A., Çelik, M. Ö., & Yakar, M. (2019). Anıtmezarın yersel lazer tarayıcı kullanarak 3B modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 1-4.
12. Alptekin, A., Fidan, Ş., Karabacak, A., Çelik, M. Ö., & Yakar, M. (2019). Üçayak Örenyeri'nin yersel lazer tarayıcı kullanılarak modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 16-20.
13. Alyilmaz, C., Yakar, M., & Yilmaz, H. M. (2010). Drawing of petroglyphs in Mongolia by close range photogrammetry. *Scientific Research and Essays*, *5*(11), 1216-1222.
14. Yakar, M., & Doğan, Y. (2017). Silifke Aşağı Dünya Obruğunun İHA Kullanılarak Üç Boyutlu Modellenmesi. *Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, *17*(4), 94-101.
15. Şasi, A., & Yakar, M. (2017). Photogrammetric modelling of sakahane masjid using an unmanned aerial vehicle. *Turkish Journal of Engineering*, *1*(2), 82-87.
16. Kanun, E., Alptekin, A., & Yakar, M. (2021). Documentation of cultural heritage by photogrammetric methods: a case study of Aba's Monumental Tomb. *Intercontinental Geoinformation Days*, *3*, 168-171.
17. Yilmaz, H. M., Karabork, H., Yakar, M. (2000). Yersel Fotogrametrinin Kullanım Alanları, Niğde Universitesi Mühendislik Bilimleri Dergisi, 4(1), 18-28

Advanced Engineering Days

aed.mersin.edu.tr

Documentation of Mardin Kadife Ertem Mansion's architectural characteristics

Lale Karataş*[1], Aydın Alptekin [2], Murat Yakar [3]

[1]*Mardin Artuklu University, Department of Architecture and Urban Planning, Türkiye, karataslale@gmail.com*
[2]*Mersin University, Geological Engineering Department, Türkiye, aydinalptekin@mersin.edu.tr*
[3]*Mersin University, Geomatics Engineering Department, Türkiye, myakar@mersin.edu.tr*

Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (Year). Documentation of Mardin Kadife Ertem Mansion's architectural characteristics. 4th Advanced Engineering Days, 58-60

Keywords
Cultural Heritage
Historical Buildings
Architectural Characteristics
Sustainability
Mardin

Abstract

Kadife Ertem Mansion is a traditional masonry building, which is located within Mardin's urban archaeological site and of which is important to maintain its sustainability due to the fact that it reflects the characteristics of the traditional buildings of the geographic context it is located in, in terms of the architectural characteristics. However, today it is seen that various deteriorations occurred on the building and the structure encountered the risk of being destroyed. Within this context, the aim of the study is to document the architectural characteristics and material problems of the building, within the context of maintaining the sustainability of Mardin Kadife Ertem Mansion, which is located within Mardin's urban archaeological site and of which its conservation has great importance for the regions. Within the scope of the study, the following stages were followed: literature review, investigation of the building on-site, and obtaining the plan and façade analytic relievos of the building. It was determined in the findings that the most frequent material deterioration seen on the building is the use of cement arising from the faulty repairs. This result demonstrates that human-originated material deteriorations must be prevented immediately on the monumental structure.

Introduction

Conservation and rehabilitation of the historical centres of the country, renewal of the old buildings, and interaction within the urban social areas have achieved a significant growth in recent years. The acts of intervention, which have been made, have considered the perceptual wear, regaining the identity, building and the meaning. One of the basic antecedents is removing the causes of deterioration before the restoration [1]. When the stone structure located within the urban archaeological site of Mardin is considered, it is seen that deteriorations have occurred on the traditional housings with the impact of environment and various conditions. If a constructive intervention process is not carried on the current structures, then the structures display deteriorations at advanced levels, which shall continue to increase. Therefore, documentation and conservation of the structures of the city in terms of architecture gain importance. It is seen that various material problems continue increasingly on Mardin Kadife Ertem Mansion, which is located in Mardin's urban archaeological site and having an important cultural heritage value in terms of reflecting the traditional characteristics of Mardin houses [2]. Within this context, the aim of the study is to document the architectural characteristics of Mardin Kadife Ertem Mansion, which is a traditional masonry house.

Material and Method

Within the scope of the study, literature review, determination of the structure on-site, observational determination of the current material deteriorations and documentation via photographs were adopted as method. Architectural design and deterioration of a cultural heritage has been frequently performed using photogrammetry and point clouds in the last decade [3-14].

Results

The historical house, which is located in Artuklu County, Şar Neighbourhood of Mardin, is consisted of basement, ground and the first floor. Although the building has maintained its original state, partial interventions have also been made. Façade of the building maintains its original status. Iwans, original abat-jour, original arches, and original wooden doors are present in the building. The building is consisted of basement, ground and the first floor. The building has been built in the **'Type of Plan with Inner Court'**. Access to the ground floor is provided through the wooden door on south frontage, and access to the first floor is provided from the west frontage and courtyard. On the first floor of the building, there are attached units. The building maintains its original status. The prominent architectural order of the building is the building type having arches and windows. Ceiling of the units have been built as groined vault. The basement is consisted of 4 units. Units are used as iwan, courtyard, room and bathroom (Fig. 2). Ground floor is consisted of 6 units. Units are used as courtyard, room, and WC. Wet areas have been added into some units on this floor, due to the need (Fig. 3). The first floor is consisted of 9 units. Units are used as terrace, room, WC, hall and kitchen. Some of these units are within the attached building, which have been built later, and the others are within the original building (Fig. 4).

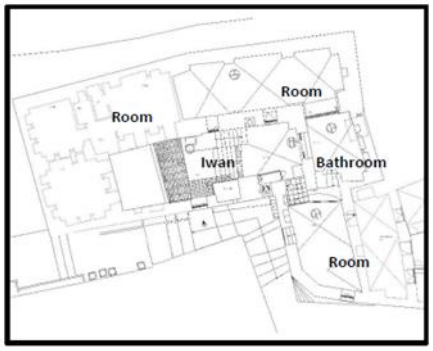


Figure 2. Plan of the basement floor

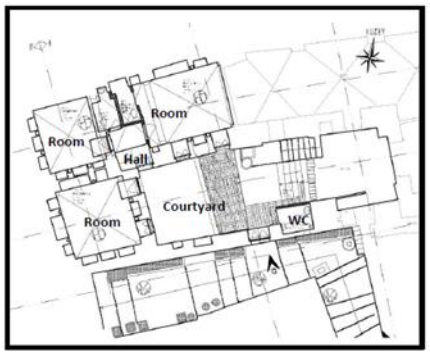


Figure 3. Plan of ground floor

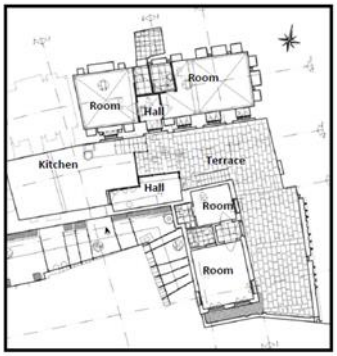


Figure 4. Plan of the first floor

The south façade of the building maintains its original status. One original wooden door, which leads to the roof of the building, is present on the south facade of the building. Jerry-built painted attachment, which was built later, is seen on the right side of the facade. Iron railings are present on the roof of the jerry-built attachment. Blackening is present on some parts of the façade. Illuminations and window boxes are present on the right and left side of the entrance door (Fig. 5).

Figure 5. South frontage

One original wooden door, which leads to the roof of the building, is present on the west facade of the building. The facade wall is consisted of face and rubble stone. Iron railings are present on the roof of the jerry-built attachment. Blackening is present on some parts of the façade. Illuminations and window boxes are present on the right and left side of the entrance door (Fig. 6).

It is the north façade of the building. The exterior façade maintains its original status. A metal ventilation window of Room Nr. ZK07, a metal door, which provides entrance on the ground floor and a snow window, which is closed with a metal cover, are present on the right wing of the façade. Parapet wall is present on the left wing of the building. On this façade, blackening, wear, and jerry-built attachments are present.

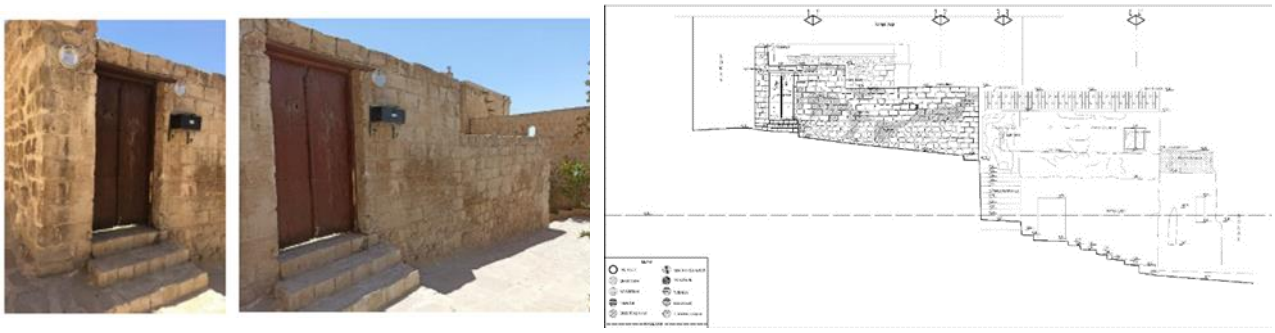


Figure 6. West frontage

Conclusion

Within the scope of the study, the architectural characteristics of Mardin Kadife Ertem Mansion, which is located within Mardin's urban archaeological site and of which its conservation constitutes great importance for the region, were documented within the context of maintaining its sustainability. As a result of the studies conducted within the scope of the study, it is concluded that the building must be subjected to a general maintenance and repair process as soon as possible. Cleaning of the plant formations, which have been / are being developed on the construction elements, must be carried out primarily. Interventions for those in herbaceous and woody nature among these plant formations must be carried out using mechanical methods (herbicides).

References

1. Ministerio de Instrucción Pública(1972). Carta del Restauro, circular N° 117. Ministerio de Instrucción Pública.
2. Karataş, L (2016). A Research on the Use of Material and Problems on the Praying Structures Within the Urban Archaeological Site of Mardin. Master's Thesis, Uludağ University, Institute of Science, Bursa, 340p (in Turkish).
3. Karataş, L., Alptekin, A., Kanun, E., & Yakar, M. (2022). Tarihi kârgir yapılarda taş malzeme bozulmalarının İHA fotogrametrisi kullanarak tespiti ve belgelenmesi: Mersin Kanlıdivane ören yeri vaka çalışması. İçel Dergisi, 2(2), 41-49.
4. Alptekin, A., & Yakar, M. (2021). 3D model of Üçayak Ruins obtained from point clouds. Mersin Photogrammetry Journal, 3(2), 37-40.
5. Kanun, E., Alptekin, A., & Yakar, M. (2021). Cultural heritage modelling using UAV photogrammetric methods: a case study of Kanlıdivane archeological site. Advanced UAV, 1(1), 24-33.
6. Doğan, Y., & Yakar, M. (2018). GIS and three-dimensional modeling for cultural heritages. *International Journal of Engineering and Geosciences*, *3*(2), 50-55.
7. Mirdan, O., & Yakar, M. (2017). Tarihi eserlerin İnsansız Hava Aracı ile modellenmesinde karşılaşılan sorunlar. *Geomatik*, *2*(3), 118-125.
8. Alptekin, A., Çelik, M. Ö., & Yakar, M. (2019). Anıtmezarın yersel lazer tarayıcı kullanarak 3B modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 1-4.
9. Alptekin, A., Fidan, Ş., Karabacak, A., Çelik, M. Ö., & Yakar, M. (2019). Üçayak Örenyeri'nin yersel lazer tarayıcı kullanılarak modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 16-20.
10. Alyilmaz, C., Yakar, M., & Yilmaz, H. M. (2010). Drawing of petroglyphs in Mongolia by close range photogrammetry. *Scientific Research and Essays*, *5*(11), 1216-1222.
11. Yakar, M., & Doğan, Y. (2017). Silifke Aşağı Dünya Obruğunun İHA Kullanılarak Üç Boyutlu Modellenmesi. *Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, *17*(4), 94-101.
12. Şasi, A., & Yakar, M. (2017). Photogrammetric modelling of sakahane masjid using an unmanned aerial vehicle. *Turkish Journal of Engineering*, *1*(2), 82-87.
13. Kanun, E., Alptekin, A., & Yakar, M. (2021). Documentation of cultural heritage by photogrammetric methods: a case study of Aba's Monumental Tomb. *Intercontinental Geoinformation Days*, *3*, 168-171.
14. Yilmaz, H. M., Karabork, H., Yakar, M. (2000). Yersel Fotogrametrinin Kullanım Alanları, Niğde Universitesi Mühendislik Bilimleri Dergisi, 4(1), 18-28

Advanced Engineering Days

aed.mersin.edu.tr

Restitution suggestion for Mardin TatlıDede Mansion

Lale Karataş*[1], Aydın Alptekin [2], Murat Yakar [3]

[1]*Mardin Artuklu University, Department of Architecture and Urban Planning, Türkiye, karataslale@gmail.com*
[2]*Mersin University, Geological Engineering Department, Türkiye, aydinalptekin@mersin.edu.tr*
[3]*Mersin University, Geomatics Engineering Department, Türkiye, myakar@mersin.edu.tr*

Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (Year). Restitution suggestion for Mardin TatlıDede Mansion. 4th Advanced Engineering Days, 61-63

Keywords
Cultural Heritage
Historical Buildings
Restitution
Sustainability
Mardin

Abstract

Tatlıdede Mansion is a traditional masonry building, which is located within Mardin's urban archaeological site and of which is important to maintain its sustainability due to the fact that it reflects the characteristics of the traditional housings of the geographic context it is located in, in terms of the architectural characteristics. However, although today the house maintains its original status, partial interventions have been carried out on the building. The stages undergone by Mardin Tatlıdede Mansion, which is a historical building, and its historical background must be revealed and documented, in order to ensure the sustainability of building's original state. Within this context, the aim of this study is to investigate the stages undergone by Mardin Tatlıdede Mansion, which is a traditional masonry house, and its historical background and to present a restitution suggestion intended for its original state. Methods of literature review, complementing with the information received from the building, of which the location, trace, and material is clear, complementing as a result of comparative studies, and complementing as a result of architectural requirement were used in order to obtain the drawings regarding the original state of the building. As a result of the investigations carried out under the study, it was concluded that numerous sections must be completed in order to restore the building to its original state. With reference to this result, the building must undergo a general maintenance and repair process as soon as possible.

Introduction

Conservation intervention, which has to be applied for a monument or a historical building, requires particularly the diagnosis of the causes of building's material deteriorations correctly. The second important stage is the requirement of investigation stages undergone by the building and its historical background well. The next stage is the documentation of building's current status, thus the status investigation. All of these are the subjects required to be researched in the first stage in order to develop a conservation strategy. The final stage is to determine the type of deterioration and develop the conservation interventions accordingly [1].

The historical Mardin TatlıDede Mansion, which is located in Artuklu County, Ulucami Neighbourhood of Mardin, reflects the characteristics of the traditional houses of Mardin, in terms of the architectural characteristics and adornments [2, 3]. However, although today the house maintains its original status, partial interventions have been carried out on the building. The stages undergone by Mardin Tatlıdede Mansion, which is a historical building, and its historical background must be revealed and documented, in order to ensure the sustainability of building's original state. Within this context, the aim of this study is to investigate the stages undergone by Mardin Tatlıdede Mansion, which is a traditional masonry house, and its historical background and to present a restitution suggestion intended for its original state.

Location and Architectural Characteristics of the Building

The historical house, which is located in Artuklu County, Ulucami Neighbourhood of Mardin is consisted of ground, first, second, and mezzanine floors. Although the building maintains its original status, partial interventions have been carried out. Facade of the building maintains its original status. Iwans, original stone motives, original hand-drawn, stone columns and stone arches with motives are present in the building. Attached

walls are present in some parts of the buildings, which have been built later due to the need. Entrance to the building is provided from the east and north frontages.

Material and Method

Methods of literature review, complementing with the information received from the building, of which the location, trace, and material is clear, complementing as a result of comparative studies, and complementing as a result of architectural requirement were used in order to obtain the drawings regarding the original state of the building. In recent years, photogrammetry and point cloud technology has been used in cultural heritage studies [4-15].

Results

As a result of the Ground Floor Plan examination, areas, of which its location, trace and materials are clear and completed with the information from the building, were determined as the arcaded areas, floor covering, niche, and feeder. There are wooden doors and windows known as a result of the comparative studies. There are stone stairs and iron railings completed as a result of the architectural requirement (Fig. 1). As a result of examination of the first floor plan there are parapet, walls, ground flooring, and stone wall, of which the location, trace and materials are clear and are completed with the information from the building. There are wooden doors and windows known as a result of the comparative studies (Fig. 2). As a result of second floor examination, there are parapet wall, ground flooring, stone wall, groined vault and stone arch, of which its location, trace and materials are clear and completed with the information from the building. There are wooden doors and windows known as a result of the comparative studies (Fig. 3). As a result of mezzanine floor examination, there is ground flooring, of which its location, trace and materials are clear and completed with the information from the building. There are wooden doors and windows known as a result of the comparative studies (Fig. 4) (Fig. 5).

Figure 1. Plan of ground floor

Figure 2. Plan of the first floor

Figure 3. Plan of the second floor

Figure 4. Plan of mezzanine floor

Figure 5. Restitution suggestion regarding the floor plans

North Frontage; Stone column and rubble stone wall are present, of which the location, trace, and material are clear and which are completed with the information from the building. There are wooden doors and windows known as a result of the comparative studies. There are stone stairs and iron railings completed as a result of the architectural requirement. East Frontage; Stone column and rubble stone wall are present, of which the location, trace, and material are clear and which are completed with the information from the building. There are wooden doors and windows known as a result of the comparative studies.

Conclusion

Within the scope of the study, the architectural characteristics of Mardin Tatlıdede Mansion, which is located within Mardin's urban archaeological site and of which its conservation constitutes a great importance for the region, were investigated within the context of maintaining the sustainability of the original status of the building, a restitution suggestion was presented regarding the building. As a result of the studies conducted within the scope of the study, it is concluded that numerous sections must be completed in the building, in order to restore the building to its original state. With reference to this result, the building must undergo a general maintenance and repair process as soon as possible.

References

1. Charola, A.E. (2017). Stone deterioration characterization for its conservation. Geonomos. https://doi.org/10.18285/geonomos.v24i2.836.
2. Alioğlu, F. (2000). Texture of Mardin City and Houses. Publication of Turkish Economic and Social History Foundation, İstanbul.
3. Dalkılıç, N. (1999). Typology of Plan, Frontage and Construction Elements in Traditional Diyarbakır Houses, Unpublished Master Thesis, Gazi University, Institute of Science, Ankara.
4. Karataş, L., Alptekin, A., Kanun, E., & Yakar, M. (2022). Tarihi kârgir yapılarda taş malzeme bozulmalarının İHA fotogrametrisi kullanarak tespiti ve belgelenmesi: Mersin Kanlıdivane ören yeri vaka çalışması. İçel Dergisi, 2(2), 41-49.
5. Alptekin, A., & Yakar, M. (2021). 3D model of Üçayak Ruins obtained from point clouds. Mersin Photogrammetry Journal, 3(2), 37-40.
6. Kanun, E., Alptekin, A., & Yakar, M. (2021). Cultural heritage modelling using UAV photogrammetric methods: a case study of Kanlıdivane archeological site. Advanced UAV, 1(1), 24-33.
7. Doğan, Y., & Yakar, M. (2018). GIS and three-dimensional modeling for cultural heritages. *International Journal of Engineering and Geosciences*, *3*(2), 50-55.
8. Mirdan, O., & Yakar, M. (2017). Tarihi eserlerin İnsansız Hava Aracı ile modellenmesinde karşılaşılan sorunlar. *Geomatik*, *2*(3), 118-125.
9. Alptekin, A., Çelik, M. Ö., & Yakar, M. (2019). Anıtmezarın yersel lazer tarayıcı kullanarak 3B modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 1-4.
10. Alptekin, A., Fidan, Ş., Karabacak, A., Çelik, M. Ö., & Yakar, M. (2019). Üçayak Örenyeri'nin yersel lazer tarayıcı kullanılarak modellenmesi. *Türkiye Lidar Dergisi*, *1*(1), 16-20.
11. Alyilmaz, C., Yakar, M., & Yilmaz, H. M. (2010). Drawing of petroglyphs in Mongolia by close range photogrammetry. *Scientific Research and Essays*, *5*(11), 1216-1222.
12. Yakar, M., & Doğan, Y. (2017). Silifke Aşağı Dünya Obruğunun İHA Kullanılarak Üç Boyutlu Modellenmesi. *Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, *17*(4), 94-101.
13. Şasi, A., & Yakar, M. (2017). Photogrammetric modelling of sakahane masjid using an unmanned aerial vehicle. *Turkish Journal of Engineering*, *1*(2), 82-87.
14. Kanun, E., Alptekin, A., & Yakar, M. (2021). Documentation of cultural heritage by photogrammetric methods: a case study of Aba's Monumental Tomb. *Intercontinental Geoinformation Days*, *3*, 168-171.
15. Yilmaz, H. M., Karabork, H., Yakar, M. (2000). Yersel Fotogrametrinin Kullanım Alanları, Niğde Universitesi Mühendislik Bilimleri Dergisi, 4(1), 18-28

Advanced Engineering Days

aed.mersin.edu.tr

The study of land use and slope role in flow coefficient determination

Ayse Yeter Gunal [*1], **Ruya Mehdi** [1]

[1]*Gaziantep University, Civil Engineering Department, Turkey, agunal@gantep.edu.tr ; rz11005@mail2.gantep.edu.tr*

Cite this study: Gunal, A. Y., & Mehdi, R. (2022). The study of land use and slope role in flow coefficient determination. 4th Advanced Engineering Days, 64-66

Keywords
Fuzzy Logic
Land Use
Slope
SMRGT Method

Abstract

Floods, one of the most destructive risks on the planet's surface, are difficult to forecast using an accurate model. In Turkey, floods are the second most costly natural disaster after earthquakes. By determining the flow coefficient, which is the most effective factor in flood flow, the existing problems will be greatly reduced. There are numerous techniques for modeling flow coefficients available in the existing literature. However, the majority of them are based on black-box methodologies that cannot be generalized. In this study, a new approach called Fuzzy SMRGT Method, which takes into account the physics of the event, was chosen. The data containing the land use and slope details of the Aksu river basin were used. The model's output was compared to actual data.

Introduction

Flooding is among the most destructive natural hazards, endangering people and property on a large scale. It is critical to identify flood risk areas to manage this area optimally. The number of such disasters registered in the last few decades has increased as a result of global climate change [1]. The number of impervious surfaces incorporated into development patterns is a major factor when considering the relationship between land conditions and flooding. Natural landscape transformation to urban or suburban development can minimize the functionality of hydrological processes. Large sections of the impermeable area can lessen precipitation infiltration into the soil and increases the surface discharge into nearby streams and rivers [2]. Several studies used machine learning and deep learning models to examine the predictive outcomes of multiple models in fields such as hydrology and hydraulics [3]. In this study, the flow coefficient under the influence of land use and the slope are determined and modeled by using the fuzzy SMRGT method.

Material and Method

Aksu river basin located between 36◦ -38◦ north latitudes, and 30◦ -31◦ east longitude in a Mediterranean Sea region, was chosen as a study area. It is one of the 10 sub-basins of the Antalya basin and has an area of about 7505 km^2 according to the measurements in the GIS environment. The data of land use and slope were taken into account in the modeling. The flow coefficient calculation should be as accurate as possible, therefore, in this research the flow coefficient of the basin was determined using Simple Membership functions and fuzzy Rules Generation Technique (SMRGT), which is first introduced by Toprak [4]. To establish the model MATLAB'2019b package program and the Fuzzy Logic are used. It is possible to explain the procedure in eight steps: (1) the independent and dependent variables that influence the current event was chosen. (2) For each independent variable, five membership functions were defined (Very low, Low, Medium, High, and Very high) (Fig.1) & (Fig.2). (3). The shape of the membership functions (MFs) was chosen to be triangular. The first and last membership functions should be right-angled triangles, while the MFs in the middle should be an isosceles triangle. (4) The number of key values was determined to be equal to the number of MFs for each independent variable. (5) Package programs, such as MATLAB, were configured to include the fuzzy set. (6) The Excel program makes it easier to complete all of the procedures mentioned in the first five articles. It is important to note that the above operations are only for the model's installation (calibration). The input and output data files using calibration data in the relevant package program were prepared. (7) The fuzzy system was created with the help of the relevant package

programs. A simple subprogram was used to run the program and evaluate the results. (8) If the output membership functions are overly intertwined, they must be reduced by combining two or more membership functions into one [4-5].

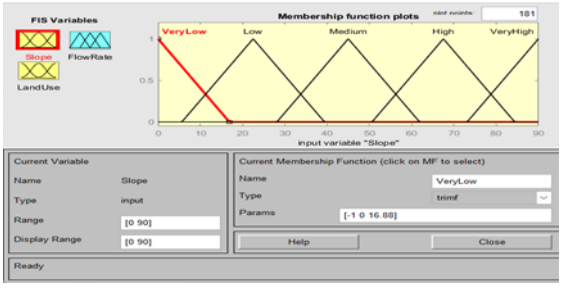


Figure 1. Membership functions for the slope (input1)

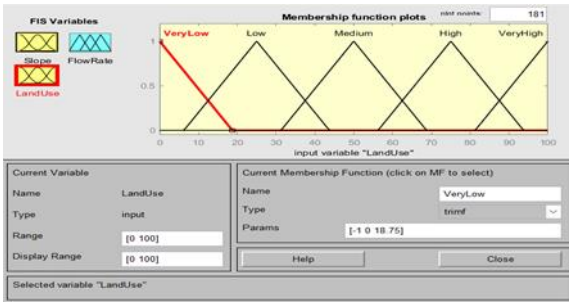


Figure 2. Membership functions for the land use (input2)-

Results

The scatter diagram of the model and the data are presented in (Fig.3). the values are scattered rather impartially (with an angle of 45) and linearly. As can be seen in (Fig.3), & Table 1. The determination coefficient (R^2) was calculated as 0.997. The mean absolute relative error (MARE) was calculated as 13.44%. Table 1 shows that the model results and key values are generally good predictions of the model, with a low mean absolute relative error (MARE).

Table 1. Fuzzy rules generation

Rules No	Slope Numerical Verbal	Land use Numerical Verbal	Flow Coefficient (data)	Flow Coefficient (model)	MARE (Mean absolute relative error)	Rules No	Slope Numerical Verbal
1	5.625	Very low	6.25	Very low	0	1	5.625
2	5.625	Very low	25	Low	2	2	5.625
3	5.625	Very low	50	Medium	5.3	3	5.625
4	5.625	Very low	75	High	10.2	4	5.625
5	5.625	Very low	93.75	Very high	12.75	5	5.625
6	22.5	Low	6.25	Very low	20	6	22.5
7	22.5	Low	25	Low	22.5	7	22.5
8	22.5	Low	50	Medium	26.2	8	22.5
9	22.5	Low	75	High	32.65	9	22.5
10	22.5	Low	93.75	Very high	34	10	22.5
11	45	Medium	6.25	Very low	35.2	11	45
12	45	Medium	25	Low	42.1	12	45
13	45	Medium	50	Medium	47.3	13	45
14	45	Medium	75	High	51.25	14	45
15	45	Medium	93.75	Very high	54.7	15	45
16	67.5	High	6.25	Very low	59.4	16	67.5
17	67.5	High	25	Low	66	17	67.5
18	67.5	High	50	Medium	66.25	18	67.5
19	67.5	High	75	High	69.2	19	67.5
20	67.5	High	93.75	Very high	75.2	20	67.5
21	84.375	Very high	6.25	Very low	81.95	21	84.375
22	84.375	Very high	25	Low	84.3	22	84.375
23	84.375	Very high	50	Medium	88.6	23	84.375
24	84.375	Very high	75	High	91.7	24	84.375

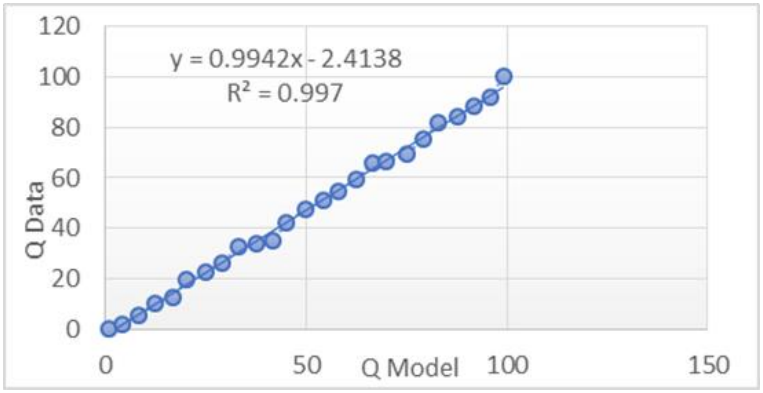


Figure 3. Scatter diagram of the data and the model

Discussion

From the results, we can clearly notice that when the slope and the land use are low the flow coefficient is (0.869%), also when the slope and the land use are very high, the flow coefficient is (99.1%), this confirms a physical result that land use and slope have an effect on permeability, and high permeability reduces flow. This is also a good indication that the model gives realistic results. The three-dimensional relationship between dependent and independent variables is shown in (Fig.4).

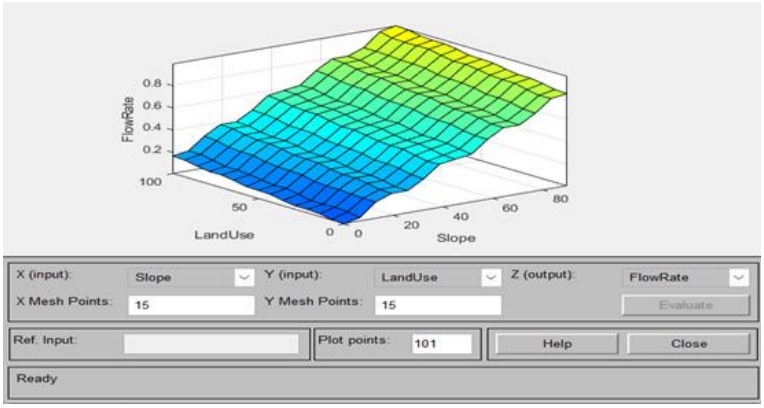


Figure 4. The changing of the output as a function of inputs

Conclusion

It is concluded that when determining flow coefficients, it is critical to consider all aspects of the study area, such as meteorological features, land use, and soil properties. Rather than relying on values from pre-made tables. It is important to study the precipitation-flow relationship, which is a hydrological event, using fuzzy logic because it contains uncertainties. The fuzzy SMRGT method is a very practical and effective method of determining the flow coefficient. The number of variables and fuzzy sets and the shape of membership functions can be easily determined. On the other hand, the SMRGT method considers the physical cause-and-effect relationship, therefore, it can be generalized to any basin or region.

References

1. Alfieri, L., Dottori, F., Betts, R., Salamon, P., & Feyen, L. (2018). Multi-model projections of river flood risk in Europe under global warming. Climate, 6, 6.
2. Gill, S.E., Handley, J.F., Ennos, A.R. & Pauleit, S. (2007). 'Adapting cities for climate change: the role of the green infrastructure', Built Environment 33, pp. 115-33.
3. Ali, A. S. A., Ebrahimi, S., Ashiq, M. M., Alasta, M. S., & Azari, B. (2022). CNN-Bi LSTM Neural Network for Simulating Groundwater Level. Environmental Engineering, 8, 1-7.
4. Toprak, Z. F. (2009). Flow Discharge Modeling in Open Canals Using a New Fuzzy Modeling Technique (SMART). CLEAN – Soil, Air, Water, 37(9): 742–752.
5. Toprak, Z. F, Toprak A, & Aykac, Z. (2017). Practical applications of fuzzy SMRGT method, Journal of DU Engineering Faculty, 8(1), 123-132.

Advanced Engineering Days

aed.mersin.edu.tr

Joints in rigid pavements

Muhammed Tanyıldızı *[1]

[1]Bitlis Eren University, Civil Engineering Department, Türkiye, mtanyildizi@beu.edu.tr

Cite this study: Tanyıldızı, M. (2022). Joints in rigid pavements. 4th Advanced Engineering Days, 67-70

Keywords
Road
Flexible Pavement
Rigid Pavement
Joint
Cracks

Abstract

Road pavements are generally divided into two groups as flexible pavements and rigid pavements and they are named according to the material used as a binder in the construction phase. In flexible pavement, bitumen is used as a binder material. On the contrary, Portland cement is the binder agent in the rigid pavement. Rigid pavements are constructed in situ in three different types: Jointed Plain Concrete Pavement (JPCP), Jointed Reinforced Concrete Pavement (JRCP), and Continuously Reinforced Concrete Pavement (CRCP). In this study, joint types in rigid pavements were addressed. The joint types and their applications were investigated and presented apprehensible within the scope of this study.

Introduction

Roads are structures that transfer the loads applied to them to the sub-structure and can effectively withstand unfavorable environmental effects efficiently [1]. Road pavements are generally divided into two groups: Flexible and Rigid pavements. They are named depending on the material used as binding in the construction. The bitumen used as a binder in the construction of pavement is flexible or asphalt pavement. On the other hand, in the construction of rigid or concrete pavements, Portland cement is used as a binder material. The asphalt roads consist of three main parts. These are sub-base, base, and pavement. The rigid pavements are constructed on a subgrade or sometimes subbase and behave like a rigid concrete beam when transferring the loads. The pavement types change according to the high and low standards of road. If the daily number of commercial vehicles in one direction on a road is more than 5000, it is highly recommended by many institutions to build pavement as rigid [2]. In this study, joint types in rigid pavements were handled. The joint types and their applications were investigated and presented apprehensible within the scope of this study.

Joints in Rigid Pavements

Rigid pavements are generally constructed in three types in situ. These are Jointed Plain Concrete Pavement (JPCP), Jointed Reinforced Concrete Pavement (JRCP), and Continuously Reinforced Concrete Pavement (CRCP). The jointed plain concrete pavements are generally constructed in square blocks shape that is formed by connecting each other with tie and dowel bars to restrain the natural cracks. In jointed reinforced concrete pavement, the joint distances are enlarged by adding reinforced steel bars. The number of reinforced bars has an important role to restrain the cracks in the pavement. Even though there is reinforcement in steel-reinforced concrete blocks, tie and dowel bars come into play when the reinforcement is insufficient. In continuously reinforced pavement, both transverse and longitudinal reinforced bars are used to ensure the transfer of loads. This type of road pavement that does not contain transverse joints is high cost with higher comfort in driving [3].

Rigid pavements are generally constructed as jointed plain concrete pavement types because of being less costly, and their schematic diagram is presented in Figure 1 [3-4].

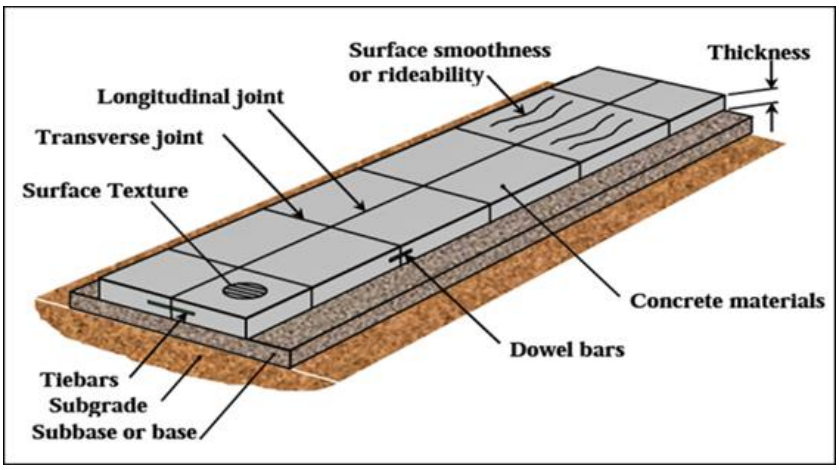


Figure 1. A schematic diagram of JPCP

Joints are deliberately placed discontinuities along a rigid pavement surface. They are generally constructed in two directions: transverse and longitudinal [5].

Transverse Joints

Transerve joints are constructed to restrain the transverse cracks. Transverse joints are placed perpendicular to the center line along the full width of pavement as shown in Figure 1. This type of joint is mainly divided into three parts. These are contraction joints, expansion joints, and construction joints. These joints are formed in two ways. Contraction joints are generally sawed after the placement of rigid pavement. Other joints are created by formwork before constructing the pavement.

Contraction Joints

Contraction joints are the most common type of joint in the rigid pavement, so the generic term "joint" generally refers to a contraction joint [5]. Contraction joints are created to minimize the tensile stresses formed by heat, moisture, and friction, thus keeping cracks under control. It is sawed in the rigid pavement to create a weakened part to regulate the location of cracking resulting from dimensional change of different parts of the concrete structures [6]. If such joints are not created, random cracks will form on the pavement surface. The width of contraction joints is generally 1 cm, and height is approximately 1/3 or 1/4 of the thickness of pavement [4]. A schematic diagram of the contraction joint is presented in Figure 2 [3]. In traverse joints, dowel bars are placed to provide a mechanical connection between adjacent slabs without restricting horizontal joint movement and it is given in Figure 3. Dowel bars increase load transferability from one slab to an adjacent slab and reduce joint failure and corner cracking [5]. A dowel bar is commonly used as 50 cm in length and 32-38 mm in diameter and it is preferred in general that the distance between two dowel bars be 30 cm. Dowel bars should be flat iron painted/oiled with anti-corrosion paint [3].

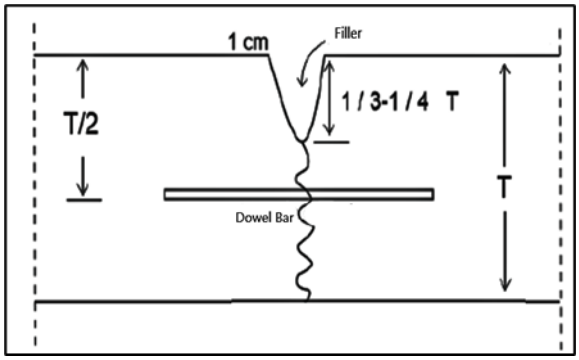


Figure 2. A schematic diagram of contraction joint

Figure 3. Dowel bars used in transverse joints

Expansion Joints

One of the main aims of expansion joints is to minimize the compressive stresses by permitting the expansion of pavement and thus preventing the buckling of pavement. These types of joints are full joints type and they are created along the full depth of the pavement. In this type of joint, also dowel bars are used to supply the load

transfer between adjacent slabs. The joints should be filled with a compressible filling material. The filling material should not deteriorate under variations of moisture and temperature. In general, cork materials can be used as bottom filling material and bituminous materials can be used for top filling [3]. The schematic view of an expansion joint is presented in Figure 4 [3].

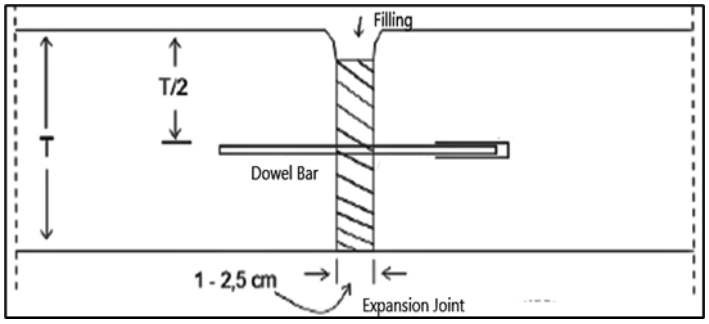


Figure 4. A schematic diagram of expansion joints

Construction Joints

A construction joint is an interface between concrete placements deliberately created to ease construction. In the construction of rigid pavements when the pouring of concrete is stopped at the end of the day or concrete paving is suspended due to any other reason, a construction joint is created. In other words, a construction joint is a joint type that results when concrete slabs are constructed at different times. The construction joints can be created either along the transverse or longitudinal direction. A schematic diagram of the construction joint is presented in Figure 5 [3].

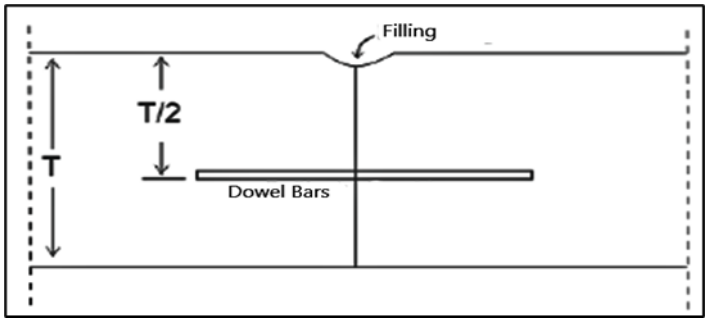


Figure 5. A schematic diagram of construction joints

Longitudinal Joints

The longitudinal joints are created to restrain the longitudinal cracks. These joints are provided longitudinally in rigid pavements that have a width of more than 5 meters. The 7th International Road Congress that took place in 1934 accepted the usage of longitudinal joints when a road has a width of more than 5 meters in principle. And, if the road width is more than 9 meters, it should be used two longitudinal joints along the width of the pavement. Insulation material is applied on the surface of longitudinal joints to prevent the sticking of slabs. In longitudinal joints, tie bars are used to prevent lanes from separation and differential deflection to reduce transverse cracking. Tie bars are chosen as ribbed bars. In general, it is common to use tie bars as 80 cm in length and 12-14 mm in diameter. The distance between two tie bars is generally 80 cm. The schematic diagram of the longitudinal joint is presented in Figure 6 [3].

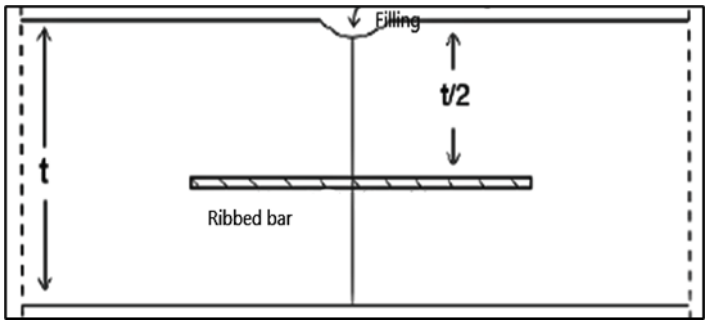


Figure 6. A schematic diagram of longitudinal joints

Conclusion

This study focused on the joints applied in the rigid pavement. The main aim of the joints created in the rigid pavement is generally to restrain the formation of cracks. The knowledge about the joints applied in the rigid pavement presented here is crucial in understanding them and their applications. And also, it is important to look for other parameters that can be learned through comprehensive experience and knowledge.

References

1. Tanyıldızı, M., & Karaca, E. O. (2021). The superiorities of concrete roads over asphalt roads. 1st Advanced Engineering Days, 48-50.
2. Tunç, A. (2007). Yol Malzemeleri ve Uygulamaları. Nobel Yayın Dağıtımcılık, 2. Baskı.
3. Karayolları Esnek Üstyapılar Projelendirme Rehberi. (2008). Teknik Araştırma Dairesi Başkanlığı Üstyapı Şube Müdürlüğü, Ankara.
4. Asbahan, R. (2009). Effects of the built-in construction gradient and environmental conditions on jointed plain concrete pavements. Engineering, Material Science.
5. pavementinteractive.org. Available: 09.08.2022.
6. ACI PRC-224.3-95: Joints in Concrete Construction (Reapproved 2013)

Advanced Engineering Days

aed.mersin.edu.tr

Examination of District Süleymanpaşa/Kumbag, province Tekirdag in terms of geotechnics

Aykut Akdağ *[1], **İsa Kul** [1]

[1]KTO Karatay University, Faculty of Engineering and Natural Sciences, Department of Civil Engineering, Türkiye
aykut_akdag@hotmail.com; isa.kul@karatay.edu.tr

Cite this study: Akdag, A., & Kul, İ. (2022). Examination of District Süleymanpaşa/Kumbag, province Tekirdag in terms of geotechnics. 4th Advanced Engineering Days, 71-73

Keywords
Geotechnics
Ground İmprovement
Structure
Swelling
Liquefaction
Earthquake

Abstract

As in the whole world, the rapidly increasing construction in our country in recent years causes an increase in the demand for construction areas. With this demand, the construction areas may not respond to the structures we will make as ground strength. As a result, in such floors, the floor improvement process or the property of the structure to be built must be changed. Therefore, structures cannot be considered separately from the ground on which they will be built. It needs to be planned as a whole. Due to the fact that our country is a country located in the earthquake zone, ground surveys should be carried out before the structures are built. Although these ground surveys have been conducted more in the provinces, there are not many geotechnical studies that address the district-based structure-ground relationship and detail the ground infrastructure of the region by examining it. Therefore, in this study, we aim to eliminate this deficiency by considering the Kumbağ region of the Suleymanpaşa district of Tekirdağ from this point of view. For this purpose, ground survey reports prepared in the last few years in the region have been discussed, as well as the static and dynamic loads of the structures planned to be built, as well as the suitability of the structure to be built in terms of the strength of the ground, the seats that may occur on the ground have been calculated. Liquefaction conditions that will occur on the floors in the scenario of an earthquake with a magnitude of 7.0 in the region have been studied. It is discussed what kind of works will be carried out on the ground in case of adverse situations that may occur before and after construction in the region. As a result, a geotechnical infrastructure knowledge base of the region has been revealed.

Introduction

One of the natural disasters in the world and in our country is earthquake. It is known that many earthquakes have occurred in seismically active regions since the formation of the earth, resulting in the death of many people and the destruction of millions of buildings. Our country is located on one of the most active earthquake zones in the world.

According to the Earthquake Zones Map, it is known that 92% of our country is in earthquake zones, 95% of our population lives under earthquake risk, and 98% of large industrial centers and 93% of our dams are in earthquake zones.

In today's technology, it is not possible to prevent the occurrence of earthquakes or to predict when they will occur. However, it is possible to minimize the damage to life and property caused by earthquakes. The ground problem, on the other hand, is the excess of the building stock, which is almost everywhere in our country or built on problematic soils, further increasing the danger in an earthquake.

In Turkey, there are many studies to evaluate the lands from the geotechnical point of view in regions with soil problems [1-5].

Due to all these reasons, it was felt necessary to carry out such a study and a study was carried out on the Kumbağ region of Süleymanpaşa District of Tekirdağ province. Our region is located in a very risky region in terms of seismicity. Faults that may cause earthquakes within the borders of Tekirdağ Province; These are the fault fragments located on the edges of the Saroz - Gazi village fault and the depressions in the Marmara Sea.

The fault, which caused many earthquakes in the past, lastly caused an earthquake of 7.3 magnitude on 09.08.1902.

In this study, our aim is to examine the Soil Survey Reports (Geological and Geophysical Reports) made previously in Tekirdağ Province Süleymanpaşa District Kumbağ region, to evaluate these parcels separately from the geotechnical point of view and to reveal the ground condition of the region, to determine the soil bearing capacity of the examined parcels, the settlement under load acting on the structure. determine the amount and ground conditions. to analyze the liquefaction state.

Material and Method

Our study area is located in the Southern part of the Thrace Basin in Tekirdağ province Süleymanpaşa district Kumbağ region. It is surrounded by Malkara in the west, Muratlı and Çorlu in the north, and the Marmara Sea in the south. There is a 0-5% Topographical Slope. It is possible to study in any season. Study area Marmara region climate type provisions. Summers are hot and dry; winters are mild and rainy.

There is no mass movement (landslide, rockfall, collapse, crypt, soil flow) and potential, swelling, collapse potential, avalanche potential due to the structure of geological units (rock/ground), and it is a region with a very high earthquake risk when considered from an earthquake point of view.

By examining the previous Soil Survey Reports in this region; As a result of its location, field and laboratory experiments, and seismic studies, many data on the ground were obtained.

In the light of the data obtained from the Soil Survey Reports, the carrying capacity analysis, sudden and consolidated settlement analysis and liquefaction analysis of the region were carried out with the help of the Jeo Cad v3.9 analysis program. As a result of the calculations, it will be discussed whether a ground improvement process will be carried out by having information about the ground condition of these parcels.

Geotechnical analysis results

In order to define the soil and determine the soil parameters, fifteen boreholes were drilled in five different plots and measurements were made with the seismic refraction technique. Natural Unit Weight, Hydrometric Sieve Analysis, Triaxial Compression Test on Soil, and Direct Shear Tests on Soil were performed on the samples taken from the drilled wells in the soil laboratory. Groundwater was encountered at 2 - 3 meters in the study area. Information about the investigated area is given in Table 1. Analysis results are given in Table 2.

Tablo 1. Information about the study area

Parcel İnformation	Coordinates	Vs Vp Vs30	Ground water level (m)	Earthquake Data Ss/S1/PGA/PGV/Fs/F1/Sds/Sd1	Ta-Tb-Tl	Building İnformation BKS, I, DTS, BYS, Area
Kumbağ 220/7	40.8695 27.4574	116 234 247.9	3	1.462/0.393/0.593/38.102/1.00/1.907/0.749/1.462	0.103/0.513/6.00	3/1/1/6/176
Kumbağ 220/3362	40.8744 27.4570	191 700 280	2.30	1.437/0.388/0.583/37.428/1.00/1.912/1.437/0.742	0.103/0.516/6.00	3/1/1/6/132
Kumbağ 399/12	40.8690 27.4586	198 1506 239.8	2	1.466/0.394/0.594/38.220/1.00/1.906/0.751	0.102/0.512/6.00	3/1/1/6/303
Kumbağ 390/17	40.8670 27.4574	385 782 479.6	2.15	1.474/0.396/0.598/38.448/1.20/1.50/1.769/0.594	0.060/0.336/6.00	3/1/1/6/195
Kumbağ 262/121	40.8734 27.4559	211 467 380.3	2.50	1.441/0.388/0.584/37.536/1.20/1.50/1.279/0.582	0.067/0.337/6.00	3/1/1/6/433

Tablo 2. Analysis results

Parcel İnformation	Floor Group	Bearing Power Analysis	Seating Analysis		Liquefaction Analysis
			Sudden Sitting	Consolidation Settlement	
Kumbağ 220/7	ZD	192<197 (X) İnsufficient	0.151>0.04(X) İnsufficient	0.217>0.04 (X) İnsufficient	0.208<1.1 (X) There is liquefaction
Kumbağ 220/3362	ZD	217.45<239 (X) İnsufficient	0.191>0.04 (X) İnsufficient	0.262>0.04 (X) İnsufficient	0.211<1.1 (X) There is liquefaction
Kumbağ 399/12	ZD	235.28<265 (X) İnsufficient	0.199>0.04 (X) İnsufficient	0.303>0.04 (X) İnsufficient	0.218<1.1(X) There is liquefaction
Kumbağ 390/17	ZC	181.75<183 (X) İnsufficient	0.011>0.04 (X) İnsufficient	0.221>0.04 (X) İnsufficient	0.02<1.1 (X) There is liquefaction
Kumbağ 262/121	ZC	180.10<264 (X) İnsufficient	0.621>0.04 (X) İnsufficient	0.297>0.04 (X) İnsufficient	0.267<1.1 (X) There is liquefaction

Conclusion and Suggestions

As a result of the examinations and researches made with the help of the JeoCad program, it has been seen that the soils in the region are insufficient in terms of bearing capacity. Soil group in our region. It has been determined that it is in the ZC, ZD class. Soil improvement is required on the ground where the structure will be built.

There is no definite limitation for settlement in the Turkish Building Earthquake Code. There are many scientists working in this field, and each seems to have different interpretations.

As a result of the analyzes we made in the JeoCad Program, it was seen that the settlement was above the acceptable limits.

When the liquefaction analyzes in the soils are examined, it has been observed that the ground water level of the structures in the range of 2.00 – 3.00 meters is below the groundwater level.

In the light of all these data, it is necessary to make improvements on the grounds on which the structures will be built.

Acknowledgement

We thank KTO Karatay University and my teacher İsa KUL for their support in the completion of the master's thesis.

References

1. Durukan, S., & Sarıkaya, E. (2020). Türkiye Bina Deprem Yönetmeliğine (2018) Göre Sıvılaşma Potansiyeli Analizi ve Sığacık (Seferihisar/İzmir) Örneği. Doğal Afetler ve Çevre Dergisi, 6(2), 304-318.
2. Oyan, E. (2019). Salihli (Manisa) kent merkezinin sıvılaşma potansiyelinin değerlendirilmesi (Master's thesis, Fen Bilimleri Enstitüsü.
3. Keleş, Z. (2006). Düzce ili mikrobölgesel zemin parametrelerinin haritalanması. Master's thesis, Sakarya Üniversitesi.
4. Toktanış, A., & Semir, Ö. V. E. R. Konarlı Mahallesi'nde (İskenderun) Sıvılaşma Pilot Çalışması. Geosound, 54(1), 1-14.
5. Şengül, T., & Karabaş, B. Kütahya Merkez İlçesinde Sıvılaşma Potansiyelinin Coğrafi Bilgi Sistemi ile İncelenmesi. Bilecik Şeyh Edebali Üniversitesi Fen Bilimleri Dergisi, 8(2), 817-825.

Advanced Engineering Days

aed.mersin.edu.tr

Investigation of the effects of using steel cross and reinforced concrete shears earthquake performance in buildings

Muhammed Mustafa Eser [*1], **Hüsnü Can** [2]

[1]*KTO Karatay University, Faculty of Engineering and Natural Sciences, Department of Civil Engineering, Konya, Türkiye, muhammed.mustafa.eser@ogrenci.karatay.edu.tr*
[2]*Gazi University, Faculty of Engineering, Department of Civil Engineering, Ankara, Türkiye, husnucan@gazi.edu.tr*

Cite this study: Eser, M. M., & Can, H. (2022). Investigation of the effects of using steel cross and reinforced concrete shears earthquake performance in buildings. 4th Advanced Engineering Days, 74-77

Keywords
Reinforced concrete
Steel cross
Earthquake
Time history analysis
Finite element method
TBDY 2018

Abstract

Most of Türkiye on the seismic belt and it causes serious loss of life and property. To prevent this, quake proof structures should be developed and more research should be studied. While reinforced concrete curtains are common in earthquake resistant buildings in Türkiye, steel usage has not spread. Reinforced concrete structures, which are more known in project design and application used frequently. Steel structures have been used typically world-wide since the old years while different and innovative methods have been developed and new studies are continuing. Within the scope of this study, five different system models were designed including a reinforced concrete system without curtain, a reinforced concrete system with a curtain on the outermost axis, reinforced concrete system with a curtain on the one axis inner, a reinforced concrete system with a steel cross on the outermost axis, and reinforced concrete system with a steel cross on the one axis inside then examined. The analyzes are modeled in the SAP2000 program which is internationally accepted and frequently used in academic studies and it will be designed according to the Turkish Building Earthquake Code (TBDY-2018). Modeled buildings were analyzed using the equivalent earthquake load and time history calculation method.

Introduction

68% of all earthquakes in the world are located in the Pacific belt, 21% are in the Mediterranean - Himalayan belt and the remaining 11% are located in other continents. Türkiye is located in the Mediterranean-Himalayan belt [1]. It is a fact that we will suffer great loss of life and property due to frequent earthquakes in the future, just as there have been many devastating earthquakes in our country in the past. According to the Türkiye Earthquake Hazard Map, it is known that 92 of our country is in earthquake zones, 98 of our population lives under earthquake risk, and 98 of our large industrial centers and 93 of our dams are located in earthquake zones. In the last 58 years, 58,202 citizens have lost their lives, 122,096 people have been injured, and approximately 411,465 buildings have been destroyed or severely damaged by earthquakes. As a result, it can be said that an average of 1.003 citizens die and 7,094 buildings are destroyed every year due to earthquakes [2].

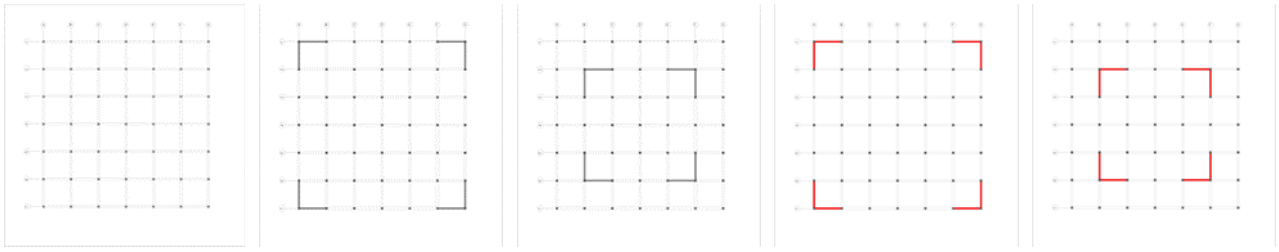
In the buildings built in our country, importance is given to aesthetics and architecture as well as to the economic and robustness of the building. Since our country is in an earthquake zone, one of the most important forces affecting our buildings is earthquake. Earthquake is a reality for our country and we engineers need to do various researches and studies for this. In this study, it is aimed to compare the performances of reinforced concrete (RC) shears used in large areas in our country and steel cross against earthquakes. In addition, it is aimed to expand the scope of the study and to find detailed results for wider data by taking the placement of both reinforced concrete shears and steel braces to be used instead of curtains in different places.

Reinforced concrete curtain wall structures are used very frequently in our country and in the world. In addition, different studies have been carried out on reinforced concrete. Steel plate structures have been widely used in the United States, Canada and Japan since the 1970s, and these structures have not suffered serious damage as a result of earthquakes [3]. Common strengthening methods are based on two basic approaches. The first of these is to strengthen the structure by adding steel diagonal elements or shear walls, and the other is to increase the strength of structural elements such as column beams in reinforced concrete structures or to increase the performance of the structure by strengthening the column-beam junctions [4]. In similar studies, it has been observed that the reinforcement area decreases in reinforced concrete sections when steel braces are used. In addition, when calculating the approximate costs of the structures, he concluded that the cost is 3.09% more economical if steel braces are used [5].

Material and Method

In order to ensure that the reinforced concrete buildings, which are used extensively in our country, are reliably strong, some regulations are used while static calculations are made. TBDY-2018 is the regulation that should be taken as a basis in order to determine earthquake forces and to build resistant structures in Türkiye [6]. Earthquake forces can be determined by dynamic analysis, taking into account ground accelerations and the mass, stiffness and damping properties of the structure [7]. Earthquake forces cannot be taken as a constant load for every structure and situation because they are not a constant force. Many approaches and methods have been developed on this subject.

Two of the three most commonly used methods were used in this study. The methods used are the equivalent earthquake load method and the calculation method in the time history. The equivalent earthquake load method is based on the first mode of the building and it is assumed that the earthquake forces acting on the floors are proportional to the floor mass and the height of the floor from the foundation. Since the mass of the building is taken into account in the calculation of the vibration period and the distribution of the earthquake load, this method can be considered as a dynamic method based on the first degree of freedom of the building [8]. The purpose of the calculation method in the time history is to integrate the equation of motion of the system step by step, taking into account the nonlinear behavior of the carrier system. During the analysis, the displacement, plastic deformation and internal forces occurring in the system at each time increment and the maximum values of these magnitudes corresponding to the earthquake demand are calculated [9]. In this method, according to (TBDY-2018), at least 11 earthquake records should be used and the two horizontal components of these acceleration records should be acted simultaneously in the direction of the X and Y principal axes of the carrier system. In addition, maximum three acceleration records from the same earthquake should be used [6-10]. The structure was modeled in the Sap2000 program with earthquake records from the Pacific Earthquake Engineering Research Center (PEER) ground motion database [11–12]. Column sections of the modeled building are 50x50cm, beam dimensions are 50x30cm, slab thickness is 15cm and braces are HE120A steel profile.



(a) Model 1 (b) Model 2 (c) Model 3 (d) Model 4 (e) Model 5

Figure 1. Bearer system plans of the building (a) RC system without curtain (b) RC system with a curtain on the outermost axis (c) RC system with a curtain on the one axis inner (d) RC system with a steel cross on the outermost axis (e) RC system with a steel cross on the one axis inside

Results

The mode values obtained as a result of the analysis of our structure are shown in “Fig. 2” is shown. Since the first two modes of our structure are symmetrical, the first modes are equal in the x and y directions, and the third mode is torsion.

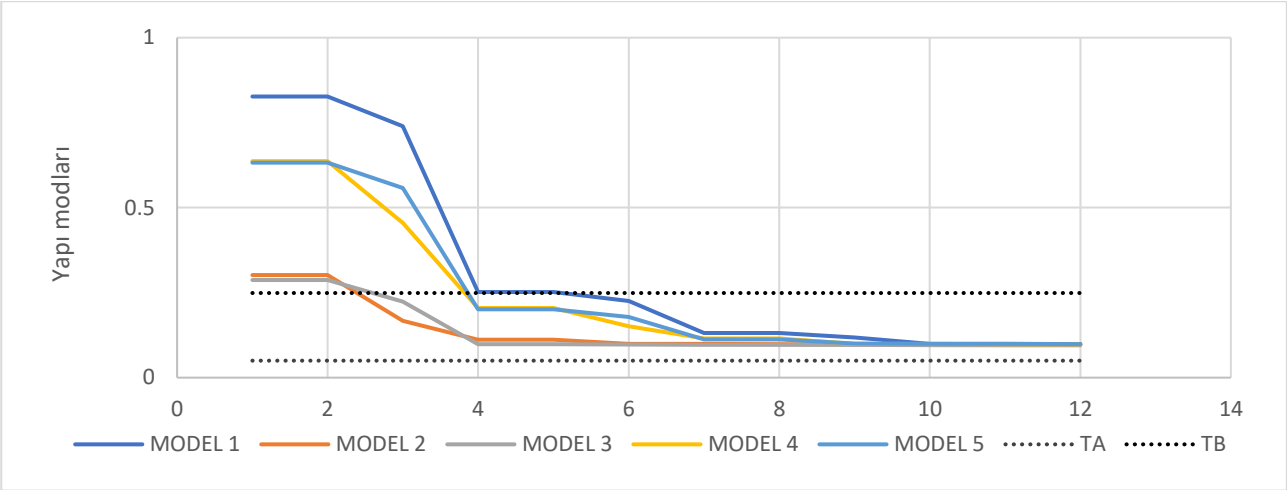


Figure 2. Modes of analyzed systems

Base shear forces determined as a result of 11 different earthquake records of the building are given in Table 1. Decreases in the base shear forces are observed in the models in which cross steel elements are used instead of reinforced concrete curtains.

Table 1. Base shear forces determined as a result of 11 different earthquake records of the building

Models	Fx + (kN)	Fx - (kN)	Fy + (kN)	Fy - (kN)
Model 1	734.98	703.56	1030.9	1263.65
Model 2	4164.33	4153.07	4397.34	4520.31
Model 3	2649.73	2663.61	2672.68	2747.18
Model 4	1724.63	1802.44	1826.72	1930.43
Model 5	1211.8	1277.58	1353	1266.2

As a result of 11 different earthquake recordings of the building, the section effects affecting the corner arm at the ground level are given in Table 2.

Table 2. Section effects of the building determined as a result of 11 different earthquake records

Models	P + (kN)	P – (kN)	V2 + (kN)	V2 - (kN)	V3 + (kN)	V3 - (kN)	M2 + (kNm)	M2 - (kNm)	M3 + (kNm)	M3 - (kNm)
Model 1	937.49	937.49	15.82	16.62	28.06	22.48	62.02	49.93	32.23	33.20
Model 2	937.50	937.51	14.69	14.99	15.23	15.12	31.98	31.81	30.64	31.21
Model 3	938.10	938.10	5.84	5.79	5.98	5.84	13.80	13.49	13.46	13.33
Model 4	937.50	937.50	29.52	27.98	31.60	29.39	64.48	60.76	61.98	57.68
Model 5	937.49	937.49	21.78	20.04	21.11	22.22	41.75	44.26	43.16	40.31

Conclusion and Discussion

As a result of the limited research and analysis, the reinforced concrete system model without curtain, the system model with reinforced concrete curtain wall and the system models in which steel cross are used instead of curtains in reinforced concrete structures have been examined. The analyzes made give us many parameters and provide data that can lead to many researches. As a result of the data obtained from the analyzes, it is seen that there are situations where steel can better meet the earthquake effects in structures in systems where steel cross is used instead of curtains in reinforced concrete buildings. By developing these models and similar models, the structures can be strengthened against earthquakes by using steel elements in reinforced concrete structures. As a result, more earthquake resistant buildings can be constructed.

References

1. Ketin, N. (2005). Genel Jeoloji Yerbilimine giriş. ISBN: 9789757463092
2. AFAD (2018). Turkish Earthquake Code for Buildings. The Disaster and Emergency Management Authority of Türkiye, Ankara, Türkiye.
3. Kıymaz, G., & Coşkun, E. (2001). Steel plate shear structures, https://docplayer.biz.tr/12451175-Celik-levha-perdeli-yapilar.html
4. Yön, B., & Sayın, E. (2011). Comparation of Reinforcing with Reinforced Concrete Shear Walls and Steel Bracings, 6th International Advanced Technologies Symposium. Elazığ, Türkiye. (237-242)
5. Naimi, S. (2019). Reinforcement of Reinforced Concrete structures with steel cross members. AURUM Journal of Engineering system and Architecture 3(2), 191-204.
6. TBDY. (2018). Turkish Building Earthquake Code. Official Newspaper. T.C. Ministry of Environment, Urbanisation and Climate Change
7. Özuygur, A., R. (2020). ACI 318 TS 500 Karşılaştırmalı Betonarme. ISBN: 9786254023705
8. Uçar, T., & Merter, O. (2012). A Study on Lineer Elastic Methods Used for Seismic Analysis Buildings. Ordu University Journal of Science and Tecnology 2(2), 15-31.
9. Sunca, F. (2016). Investigating Seismic Performance of The Semi-rigid Connected Prefabricated Structures. Master Thesis, Karadeniz Technical University the Graduate School of Natural and Applied Sciences Civil Engineering Graduate Program, Trabzon.
10. Sunca, G., Ç., K. (2019). Determining Seismic Performances of Reinforced Concrete Structures with Infill Walls for Different Ratio and Configuration. Master Thesis, Gümüşhane University the Graduate School of Natural and Applied Sciences the Graduate School of Natural and Applied Sciences, Gümüşhane.
11. PEER. (2014). Pacific Earthquake Engineering Research Center (PEER) Ground Motion Database.
12. SAP2000. (2015). Integrated Finite Element Analysis and Design of Structures, Computers and Structures Inc., Berkeley, California, USA.

Advanced Engineering Days

aed.mersin.edu.tr

Creating digital elevation model with Google Earth Pro

Vahdettin Demir [*1], **Ramazan Doğu** [2]

[1]KTO Karatay University, Civil Engineering Department, Konya, Turkey, vahdettin.demir@karatay.edu.tr, rdogu27@gmail.com

Cite this study: Demir, V., & Doğu, R. (2022). Creating digital elevation model with Google Earth Pro. 4th Advanced Engineering Days, 78-80

Keywords
ArcGIS
DEM
Elevation Point
Google Earth Pro
Mount Ararat

Abstract

The aim of this study is to obtain the Digital Elevation Model (DEM) data, which is needed in many engineering projects, and constitutes the basic data of the projects, in ArcGIS software with the help of Google-Earth Pro software. Mount Ararat, located in the provincial borders of Ağrı and Iğdır, was chosen as the study area and DEM data were created for three different areas. These areas are square areas of 1x1 km, 10x10 km and 100x100 km. The data of the study areas were obtained by converting the data in the Google-Earth Pro software, which was obtained by remote sensing technique, into point format. These data were then converted to *.GPS format and then to *.shp format and DEM data was obtained in ArcGIS software. Consequently, DEM data for an exemplary study area was obtained economically and quickly.

Introduction

Digital Elevation Model (DEM) is a 3D digital graphic representation of the physical earth, including location and height information based on a defined vertical datum (reference). With DEM, the slope of the land, the aspect of the land, drainage networks, basin boundaries, flow paths and relief maps can be made. DEM is used by numerous disciplines that use a geographic basis, including engineering, geomorphology, hydrology, landscape architecture, and archaeology [1-4]. Nowadays DEM is produced from UAV photogrammetry.

In this study, the digital elevation model data, which is needed in many engineering projects and constitutes the basic data of the projects, was obtained in the ArcGIS environment with the help of Google-Earth Pro. In engineering projects, elevation models, which are generally measured by local governments, are preferred because of their sensitivity and accuracy. While these data are generally available within the city limits, they are not available in the regions outside the city limits. For these regions, data obtained by remote sensing methods are generally used because it is faster and more economical. In this study, DEM was obtained for the regions outside the city center. Taurus Mountain was chosen as the study area and DEM data was created.

Material and Method

ArcGIS software and Google Earth Pro software were used in the study. Study area boundaries are square polygons in shapefile (*.shp) format created in the ArcGIS software. 3500 random points were defined in these square polygons. This process was carried out using the "Add Path" icon in the Google Earth Pro software. These points were converted to shape file format and transferred to ArcGIS software and then DEM data were obtained for three areas.

ArcGIS is commercially developed software, but it is also freely available to government agencies and universities/students [5]. With ArcGIS, maps, and imaging, spatial analyzes can be made. In addition to accessing the world's largest collection of imaging, ArcGIS includes tools for satellite imagery, aerial imagery, drone and full motion video [6]. ArcGIS is also generally preferred in solving engineering problems.

Google Earth Pro is a powered version of Google Earth and was made available for free in 2015. Google Earth Pro allows simultaneous mapping of multiple points and accessing demographic and graphical data layers. With Google Earth Pro, advanced measurements can be made on the image, high-resolution printouts can be made, tables, geographic information system files (ESRI shapefile (.shp)) can be created [1]. The fact that the Google Earth Pro program is free and easy to access increases its use for engineering, academic and everyday purposes. Google Earth Pro, together with other Geographic Information System software, contributes to the accessibility, automation, and digital production of geographic information [7-12].

Study Area

Mount Ararat, located in the province of Iğdır-Ağrı, was chosen as the study area and DEM was created for three different sized areas. These areas are square areas of 1x1 km, 10x10 km and 100x100 km. The study area is shown in Figure 1.

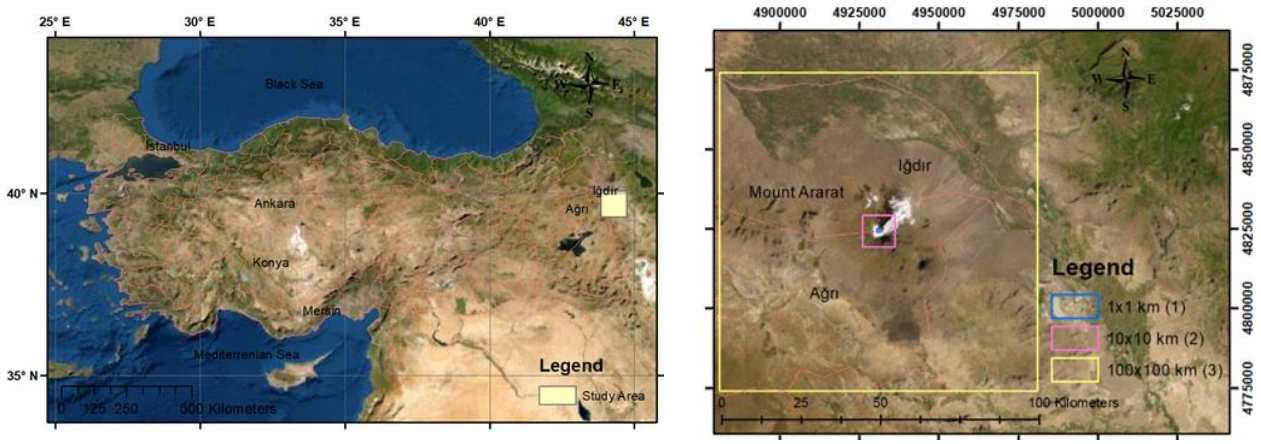


Figure 1. Study area and sample areas

Results

In the application of the study, first, point data obtained from Google Earth Pro was recorded in *.kmz format. Then, GPS data conversion was performed on the web (https://www.gpsvisualizer.com/elevation). Thus, the elevation points have been converted to GPS format. Then, a file in point format was obtained with the Conversion Tools-From GPS-GPX to Features option in ArcGIS software. An elevation map of these points can be obtained by users with the Spatial Analyst Tools-Interpolations option via Arc Toolbox. In addition, Aspect, Contour, Slope or Hillshade maps can be created with the 3D Analyst Tools- Raster Surface option. DEM data from point data was created by defining "Point Elevation" in the Type field in the 3D Analyst Tools- Raster Interpolation- Topo to Raster option. The DEM data obtained by this process are shown in Figure 2 for 3 different sized areas.

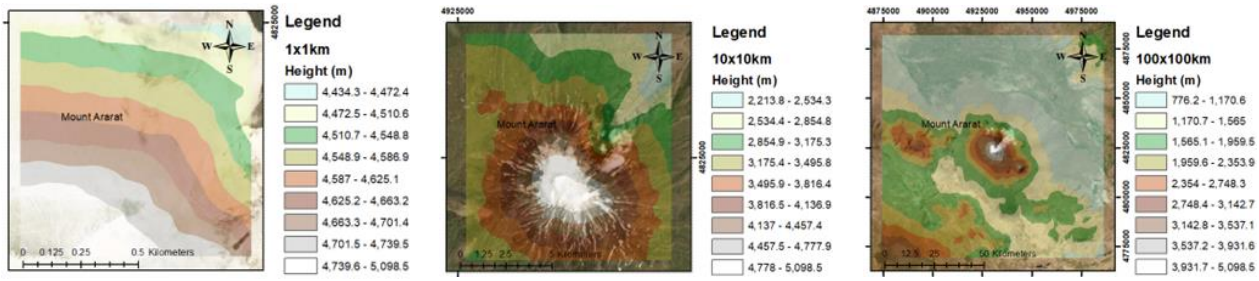


Figure 2. DEM data for three fields

Discussion

DEM accuracy increases with the dot density and the randomness of the dots. However, dense point data is both time-consuming and means more detail than necessary, which causes the computer used to process slower. For this reason, the optimum area and number of points should be determined according to the problem to be studied. In addition, point scans should be determined at a fixed number and fixed height sight level in studies to be compared. In this study, 3500 points were randomly defined. These points are limited as they are the basis for future estimation studies.

Conclusion

In this study, DEM data were obtained in ArcGIS software for three different sized areas. These areas are located around Mount Ararat and are square areas with dimensions of 1x1 km, 10x10 km, and 100x100 km. The data used in the study were provided in Google-Earth Pro software and DEM maps were created in the ArcGIS software. Thus, a sample study has been made for DEM data, which forms the basis of engineering projects. The fact that this data is available especially for areas outside the city limits accelerates engineering projects.

In future studies, the performance comparison of different remote sensing platforms obtained for the same region and the estimation of similar DEM data obtained for different areas will be investigated by machine learning techniques.

References

1. Dervisoglu, A., Atik, Ş. Ö., Kuçak, R. A. & Selbesoğlu, M. O. (2021). Google Earth Pro Verilerinden Oluşturulan Sayısal Yükseklik Modelleri ve Global Sayısal Yükseklik Modellerinin Doğruluk Değerlendirmesi. Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi, 21 (5), 1125-1136. https://doi.org/10.35414/akufemubid.936431
2. Yakar, M., Yilmaz, H. M., & Yurt, K. (2010). The effect of grid resolution in defining terrain surface. Experimental Techniques, 34(6), 23-29.
3. Yakar, M. (2009). Digital elevation model generation by robotic total station instrument. Experimental Techniques, 33(2), 52-59.
4. Yilmaz, H. M., Yakar, M., Mutluoglu, O., Kavurmaci, M. M., & Yurt, K. (2012). Monitoring of soil erosion in Cappadocia region (Selime-Aksaray-Turkey). Environmental Earth Sciences, 66(1), 75-81.
5. Tona, A. U., Demir, V., Kuşak, L. & Yakar, M. (2022). Su Kaynakları Mühendisliğinde CBS'nin Kullanımı. Türkiye Coğrafi Bilgi Sistemleri Dergisi, 4 (1), 23-33. DOI: 10.56130/tucbis.993807
6. ESRI (2022). Work More Efficiently with ArcGIS. https://www.esri.com.tr/tr-tr/arcgis-hakkinda/genel-bakis, Access date: 19.09.2022.
7. Atak, V. O., (2019). Google Earth Uydu Görüntülerinin Konumsal Doğruluğu. Harita Dergisi, 85(161), 11-25.
8. Alptekin, A., & Yakar, M. (2020). Heyelan bölgesinin İHA kullanarak modellenmesi. Türkiye İnsansız Hava Araçları Dergisi, 2(1), 17-21.
9. Alptekin, A., Çelik, M. Ö., Doğan, Y., & Yakar, M. (2019). Mapping of a rockfall site with an unmanned aerial vehicle. Mersin Photogrammetry Journal, 1(1), 12-16.
10. Kusak, L., Unel, F. B., Alptekin, A., Celik, M. O., & Yakar, M. (2021). Apriori association rule and K-means clustering algorithms for interpretation of pre-event landslide areas and landslide inventory mapping. Open Geosciences, 13(1), 1226-1244.
11. Ünel, F. B., Kuşak, L., Çelik, M., Alptekin, A., & Yakar, M. (2020). Kıyı çizgisinin belirlenerek mülkiyet durumunun incelenmesi. Türkiye Arazi Yönetimi Dergisi, 2(1), 33-40.
12. Çelik, M. Ö., Alptekin, A., Ünel, F. B., Kuşak, L., & Kanun, E. (2020). The effect of different flight heights on generated digital products: DSM and Orthophoto. Mersin Photogrammetry Journal, 2(1), 1-9.

Advanced Engineering Days

aed.mersin.edu.tr

Implementing unmanned aerial systems equipped with Sniffer4D payloads for volcanic gas detection and data analysis used for forecasting volcanic eruptions

Ian Godfrey [*1], José Pablo Sibaja Brenes [1], María Martinez Cruz [2]

[1]*Universidad Nacional, Laboratory of Atmospheric Chemistry Costa Rica, Igodfrey@mail.usf.edu; Jose.sibaja.brenes@una.cr*
[2]*Universidad Nacional, Volcanological and Seismological Observatory of Costa Rica, Costa Rica, Maria.martinez.cruz@una.cr*

Cite this study: Godfrey, I., Brenes, J. P., & Cruz, M. M. (2022). Implementing unmanned aerial systems equipped with Sniffer4D payloads for volcanic gas detection and data analysis used for forecasting volcanic eruptions. 4th Advanced Engineering Days, 81-84

Keywords
Gas Detection
Atmospheric Chemistry
Volcanology
Climate Change
Volcanic Plume
Sniffer4D

Abstract

A consistent volcanic monitoring program is crucial to the safety of the population and the efficiency of the nation. Costa Rica´s National Commission for Risk Prevention the CNE helps manages this responsibility. Universidad Nacional Costa Rica the National Observatory for Volcanoes OVSCORI-UNA and the Atmospheric Chemistry Laboratory LAQAT-UNA all have a strategic interest in monitoring and tracking volcanic activity. One aspect of monitoring volcanoes is tracking the active emissions being released from the craters and fumaroles. For this study the Sniffer4D gas detection payload was deployed on an UAS and flown directly into the active West Crater of the Turrialba volcano in 2022 for readings of active emissions. The Turrialba volcano is located 40 km or 25 miles East of San José the Capital city of Costa Rica where the majority of the population live. In 2017 an eruption column emerged 3,000 meters or 9,842.5 feet above the summit crater of the Turrialba volcano and dispersed ash in the capital resulting in airport closures. So monitoring the Turrialba volcano is of great importance to the country. The UAS system deployed carried the Sniffer4D which tested for Temperature, Humidity and 9 additional parameters - Sulfur Dioxide SO_2 (µg/ m^3), Volatile Organic Compounds VOCs (ppm), Carbon Monoxide CO (mg/m^3), Carbon Dioxide CO_2 (%), Ozone O^3(µg/ m^3), Nitrogen Dioxide NO_2 (µg/ m^3), O^3+NO_2 and Particulate Matter - PM 1.0, 2.5 & 10. Particulates – also known as atmospheric aerosol particles, atmospheric particulate matter, particulate matter (PM), or suspended particulate matter (SPM) – are microscopic particles of solid or liquid matter suspended in the air. The term aerosol commonly refers to the particulate/air mixture, as opposed to the particulate matter alone. The main objective of launching this payload into the West Crater of Turrialba was completed by Ian Godfrey in 2022.

Introduction

Volcanic eruptions have long term effects of the atmospheric chemistry of the Earth. Water vapor H_2O, Carbon dioxide CO_2, are the two most abundant gases being released from active volcanoes. These two gases along with Sulfur dioxide SO_2, Hydrogen chloride HCI, Hydrogen fluoride HF, Hydrogen sulfide H_2S are the most common volcanic gases being emitted from active volcano vents. Still there are other trace species such as Hypobromite BrO, One-carbon molecules, Nitrogen dioxide NO_2, Carbon monoxide CO, Carbon oxysulphide COS, Silicon tetrafluoride or tetrafluorosilane SiF_4 [1].

Researching all aspects of Sulfur dioxide and secondary sulfate aerosols is of strategic importance to the Laboratory of Atmospheric Chemistry because the microphysical dynamics of these particles in active eruption columns is essential to comprehending the radiative properties of these natural volcanic emissions and this is a

key to understanding how they affect climatic changes across our planet. Measuring volcanic gases offers insight into subterranean processes happening deep within the Earth's interior [2].

The data collected with the Sniffer4D does contribute to the collective knowledge of the entire scientific community, and the SO_2 tracking data can be cross referenced to the NASA Atmospheric Chemistry and Dynamics Laboratory, Copernicus Atmospheric Monitoring Service European Commission and Global Network of Observation of Volcanic & Atmospheric Change (NOVAC). Active volcanoes releasing emissions have a direct impact on the Earth's atmospheric chemistry, and climatic patterns; therefore, monitoring eruption columns with UAS and gas detection payloads is of extreme importance to climatologists.

H_20 is normally the most abundant gas deriving from a magmatic source and like CO_2 it is relatively abundant in the atmosphere of the Earth. Other volcanic gases such as SO_2, HCI & HF derive from the same source but are not normally present in the atmosphere unless there is an eruption vent releasing these gas species into the nearby proximity. CO_2 is the second most common gas species being naturally emitted from volcanoes. At the Poás and Turrialba volcanoes in Costa Rica diffuse degassing of CO_2 represents approximately 10% of total emissions abundant in magmatic gas. Diffuse degassing occurs when gas species pass through openings from porous volcanic edifice permeable to rainwater [3].

Material and Method

The Sniffer4D was attached to the Mavic 3 with an integration kit created with a 3D printer. The Sniffer4D is placed upside down and the 3D printed mounting bracket is placed on top of the bottom of the device. The mounting bracket is then attacked with 4 M2.5*6 screws in each corner. The Sniffer4D and attached mounting bracket are then placed onto the Mavic 3 drone and the assembly is permanently connected via 2 additional M2.5*6 screws at the bottom. The Sniffer4D is powered by the same battery as the UAS itself, via a power cable. The power cable aligns to the two outermost power connectors of the Mavic 3 battery. The power cable is secured with three small pieces of double-sided tape and is then attached to the Sniffer4D.The system has a total flight time of around 20 minutes depending on environmental conditions. There are two Sniffer4D Systems one designed for HAZMAT response the S4D and the other to log volcanic emissions S4V which can measure;

S4D - NO_2, SO_2, O_2, VOC's, CO_2, CO, PM 1.0, PM 2.5, PM 10, O_3, NO_2+O_3

S4V - SO_2, CO_2, H_2S, HF, HCI, CO, CxHy/CH_4/LEL, H_2

The Sniffer4D software program is named Mapper which can showcase the air quality and pollution dispersement as a grid, isoline or 3D plot. The drone was launched from the main lookout point of the Turrialba volcano on the southern edge of the Central Crater. The Sniffer4D can be used to showcase air quality data in real time via a SIM chip and associated data plan placed in the device which is connected to the local cellular network, allowing for real time pollution tracking. Monitoring the SO_2/CO_2 gas ratio is dangerous work, especially during times of increased activity.

In 2022 our team reached the summit of the Turrialba volcano on a dry day with clear visibility and no wind or any other harsh environmental conditions. We were caught in the mud about 4 kilometers or 2.4 miles from the summit crater. After a climb we reached the half-way point where we launched the drone to observe the last stretch of our pathway and make sure there was no significant degassing or explosive activity at the active West Crater. After the first UAS mission we continued our assent and reached the main lookout point for the Turrialba Volcano National Park. UAS remote sensing approaches have shown exponential potential in the field of volcanology; UAS applications at the Turrialba volcano are a perfect example. The main objective of our UAS survey was to observe the crater interior which we estimated to have crater walls which have slopes of approximately 55^o. The depth of the West Crater was estimated to be 410 feet to 722 feet or 125 meters to 220 meters. The West Crater was estimated to have a width of 620 feet or 189 meters.

The Sniffer4D and Mavic 3 system deployed at Turrialba can help reveal additional valuable data concerning volcanic degassing and emission levels. This measurement system is very useful to the entire scientific community concerning volcanic monitoring and gas emission tracking, volcanic unrest and hazard assessment. Drones using GNSS system fixed waypoints can maneuver around the fumarole location this strategy allows the system to periodically check areas of significant volcanic emission activity and return to the exact same location when necessary. H_2S/SO_2 gas ratios fluctuate depending on temperature, pressure and redox conditions. Significant amounts of SO_2 and H_2S emissions deriving from hydrothermal sources are controlled by this chemical equation: $H_2S + 2H_2O \rightarrow SO_2 + 3H_2$. Increase in SO_2/H_2S represents a potential increase in magmatic influence relative to volcanic emissions [4]. SO_2 emissions represent magmatic intrusion from within the volcanic edifice itself.

Figure 1&2. Sniffer4D Mapper Report from the Turrialba Volcano and Associated UAS Image

Results

Toxic gas emissions such as Sulfur dioxide or SO_2 which are the direct result of burning fossil fuels contribute to climate change and acid rain in the region. SO_2 is also released from active volcanoes during periods of eruption and UAS are positioned to greatly assist volcanologists measuring these gases from safe distances. UAS capabilities can now greatly assist climate scientists by providing an aerial observation perspective which allows for increased data collection with improved safety. UAS also reduce risks associated with climbing and venturing into regions of increased volcanic activity such as an active crater. The Sniffer4D detected and provided real time data to team of volcanologists and showcased 9 different gas emissions from one flight into the Turrialba volcano crater. The device also records temperature and humidity making it an extremely valuable UAS payload for volcanology. Total payload weight was less than 500 grams and can be deployed with gas sampling module which can retrieve volcanic ash and particulate matter which can then be analyzed in the lab. Quantifying total gas flux from an eruption column serves a greater importance than measuring general gas concentration because total gas flux corresponds to volcanic activity [5].

Discussion

UAS are allowing scientists to deliver new scientific equipment into the most extreme environments and take physical samples of water along with atmospheric parameters yielding a vast amount of valuable information not previously accessible before the implementation of UAS.

Conclusion

Ambient air monitoring and HAZMAT response have become some of the most prominent applications for miniaturized hardware payloads designed for UAS. Data of the volcanic plume and its effects of atmospheric chemistry are easily collected by the Sniffer4D and analyzed by the software program Sniffer4D Mapper which provides a quick, sustainable, safe and reliable way to quantify these emissions and develop a national baseline for volcanic activity in Costa Rica. Quantifications of critical ratios of gas emissions from the volcanos in Central Costa Rica showed no increased levels of activity. This investigation outlines UAS volcanic applications designed to detect and quantify different gases of volcanic origin in order to assist volcanologists with their eruption forecasts.

Acknowledgement

Ian Godfrey is a passionate explorer of the natural world, a writer, a Part 107 Remote Pilot and Thesis Advisor to the Laboratory of Atmospheric Chemistry Universidad Nacional Costa Rica. He has flown UAS into several high altitude active volcanic craters and a variety of industrial sites.

References

1. Platt, U., Bobrowski, N., & Butz, A. (2018). Ground-based remote sensing and imaging of volcanic gases and quantitative determination of multi-species emission fluxes. *Geosciences*, *8*(2), 44.
2. Xi, X., Johnson, M. S., Jeong, S., Fladeland, M., Pieri, D., Diaz, J. A., & Bland, G. L. (2016). Constraining the sulfur dioxide degassing flux from Turrialba volcano, Costa Rica using unmanned aerial system measurements. *Journal of Volcanology and Geothermal Research*, *325*, 110-118.
3. Epiard, M., Avard, G., De Moor, J. M., Martinez Cruz, M., Barrantes Castillo, G., & Bakkar, H. (2017). Relationship between diffuse CO2 degassing and volcanic activity. Case study of the Poás, Irazú, and Turrialba Volcanoes, Costa Rica. *Frontiers in Earth Science*, *5*, 71.
4. Mori, T., Hashimoto, T., Terada, A., Yoshimoto, M., Kazahaya, R., Shinohara, H., & Tanaka, R. (2016). Volcanic plume measurements using a UAV for the 2014 Mt. Ontake eruption. *Earth, Planets and Space*, *68*(1), 1-18.
5. Harvey, M. C., Rowland, J. V., & Luketina, K. M. (2016). Drone with thermal infrared camera provides high resolution georeferenced imagery of the Waikite geothermal area, New Zealand. *Journal of Volcanology and Geothermal Research*, *325*, 61-69.

Advanced Engineering Days

aed.mersin.edu.tr

Introducing an integrated evaluation index for recreational beaches in Albania aiming at improvement of assessment and integrated approach

Edjona Bici [*1], **Spase Shumka** [2], **Anilda Kokali** [3]

[1]*Institute of Public Health, University of Medicine, Tirana, Albania, edjonabici@yahoo.com*
[2]*Agricultural University of Tirana, FBF, Department of BFS, Tirana, Albania, sprespa@gmail.com*
[3]*Institute of Public Health, Tirana, Albania, tobi_ani@yahoo.com*

Cite this study: Bici, E., Shumka, S., & Kokali, A. (2022). Introducing an integrated evaluation index for recreational beaches in Albania aiming at improvement of assessment and integrated approach. 4th Advanced Engineering Days, 85-88

Keywords
Coastal beaches
Integrated approach
Pollution
Climate changes
Ecological indicators

Abstract

Within last three decades coastal and continental sand beaches of Albania are becoming among the most valuable ecosystems used for outdoor recreation activities. At the current circumstances the incorporation of the values as: parks, relaxed activities are common at beach areas. The main purpose of this survey is to introduce an innovative approach in assessment of the recreational beaches of Albania following the integrated considerations. An integrated index to evaluate recreational sand beaches is using descriptive beach indicators, beach user's perception and indicators of beach economic value. The design of the integrated index is based on best practices and advanced referenced translated into Albanian context. Each of these 74 descriptive records appraises the aptness of the beach for recreational activities using water and sand intensively, in addition to other activities such as sunbathing, walking, swimming, reading, etc.

Introduction

The aim of this paper is to present an integrated index to evaluate recreational sand beaches. Within last three decades coastal and continental sand beaches of Albania are becoming among the most valuable ecosystems used for outdoor recreation activities. Different activities such as walking or practicing water sports, relaxed activities, reading, etc. are common at beach areas [1]. As a natural resource of the coastal zone, sand beaches are perfect laboratories for the implementation of coastal zone management paradigms. The sand beaches are considered multifaceted study objects that can be managed by designing environmental management instruments with an integrated approach, meaning integrating physical, biological, socio cultural and economic values [2]. Coastal beaches play an important role in defining the development of large projects of tourist infrastructure, that yield large economic inflow which benefits both local and international businesses. Nevertheless, and particularly in traditional beach countries, economic values have targeted a unidirectional development, largely dominated by mass tourism [3, 4] which has caused beach development to drift from sustainability [5]. Some environmental impacts reported are pollution, erosion, and landscape loss e the latter essentially being the main motive to start the development itself [4, 6]. Most sand beach evaluations are based on either simple or complex combinations of characteristics for beach classification and recommendations for common management. In the last 10 years, important attempts have been made to evaluate sand beaches to seek beach awards as a promotional tool [7]. Most sand beach evaluations are based on either simple or complex combinations of characteristics for beach classification and recommendations for common management. Beach evaluations are used for international certification [5, 8, 9] and are based on the fulfillment of specific criteria for sand beaches. They are related to water quality, environmental information and education programs, compliance with environmental laws and the presence of safety corps and other services.

For coastal sand beaches of Albania, has not been an evaluation of the beaches using the integrated beach value index (IBVI).

The index will be applied to five coastal beaches in Albania (from Velipoja to Vlora) in order to identify the main factors affecting the integral quality of recreational beaches in different socio-economic status (Figure 1).

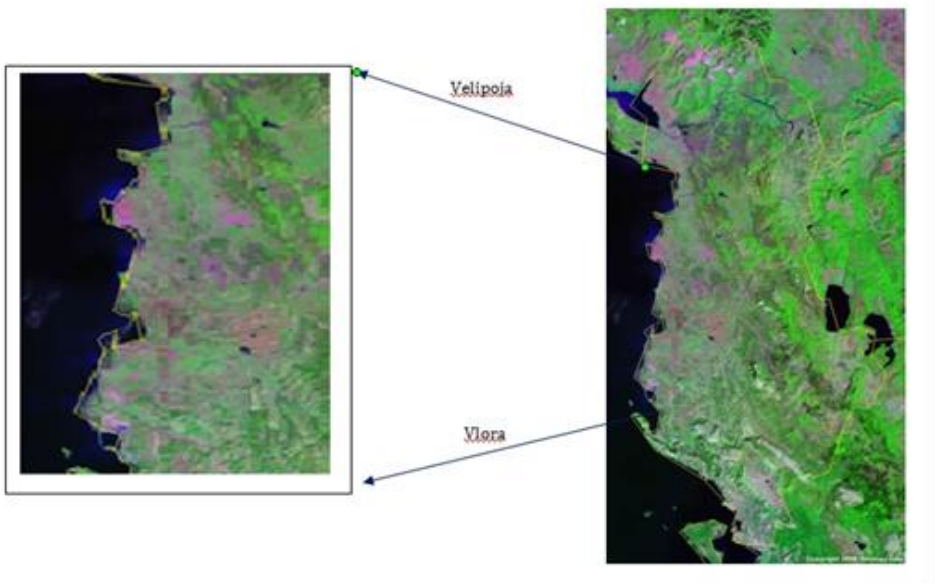


Figure 1. Study area

Material and Method

The integrated index for sand and recreational beach will be used, which includes: descriptive beach indicators, beach user's perception and indicators of beach economic value. Beach Index (BI) describes and evaluates the aptness of the beach for recreational purposes. A descriptive matrix of each urban sandy beach considers 36 ecological indicators of biophysical features (sand colour, texture, water temperature, etc.) and environmental issues (dirty sand and water, bad smells, urban waste, trash, etc.); it also considers 38 socio economic indicators describing infrastructure and services (parking lots, restaurants, safety corps, etc.). Each of these 74 descriptive records appraises the aptness of the beach for recreational activities using water and sand intensively (for instance motorized vehicles both terrestrial and aquatic), in addition to other activities such as sunbathing, walking, swimming, reading, etc.

From the observation, all the features of the beaches and sands will be described and analyzed by qualifying them in three categories, assigning the value 3 if it was favourable, 2 if it was indifferent and 1if it is unfavourable for recreational activities (BI) [10, 11, 12].

Results and Discussion

In this study, the evaluation will be done in the coastal areas (Velipoja beach, Shëngjin beach, Durrës and Gjiri Lalsit beach, Kavaja beach, Vlora beach) based on the descriptive matrix of the indicators.

This matrix consists of the integration of three descriptive indicators that will provide information related to BI – beach index (expresses the recreational capacity of the beach according to its biophysical and environmental attributes and its infrastructure and services) (Table 3); KI – knowledge index (evaluates opinion and the attitude of the users on the beach) (Table 1); and MI - monetary index (estimates the economic value of the beach in monetary terms) (Table 2). The findings of this study will give us a descriptive picture for quality of recreational beaches in Albania.

Conclusion

Receiving national information will motivate the researchers, consultants and decision makers to design models, suggest sets of variables, select indicators and develop integrated schemes to collect beach data in comparable ways, which will identify the best beaches in Albania.

This integrated approach compares beaches in Albania without taking into considering physiognomy, social or economic differences. Therefore, this evaluation index will be used mainly for sandy beaches, with particular cultural and socio-economic features that would make them seem not very comparable.

In conclusion, this method allows comparing rather different beaches and obtaining results that may be applied in all the beaches of Albania.

Table 1. KI – Knowledge Index

Knowledge Index (KI)					
Index	Categoria	Question	Answer	Favorability	Classes
Opinion	Beach conditions	Water temperature	Nice/normal pleasant	3	High
			Warm	2	Medium
			Cold	1	Low
	Beach public services	The public services (restrooms showers etc.) of this beach are:	Adequate	3	High
			Inadequate	2	Medium
			Nonexistent	1	Low
Attitude	Recreation habits	You prefer to come to the beach on	Weekends	2	Medium
			Both	3	High
			Weekdays	1	Low

Table 2. MI - Monetary Index

Monetary Index (MI)		
Property tax	Low	1
	Medium	2
	High	3
Real Estate	Low	1
	Medium	2
	High	3
Room rates	Low	1
	Medium	2
	High	3
Rank **MI**		

Table 3. BI – Beach Index

Beach Index (BI)						Given value for recreational beach aptitude
Biophysical and pollution indicators						
Beach width (m)	<5	5-10	10-30	50-80	>80	1, 2 or 3
Sediment color	Dark	Grey	Brown	Light Gold	White	1, 2 or 3
Morphodynamics	Reflective		Intermediate		Dissipative	1, 2 or 3
Vegetation cover (%)	<10	10-20	20-30	<30	Absent	1, 2 or 3
Dangerous animals	Present				Absent	1, 2 or 3
Trash	Too much	Moderate	Few	None		1, 2 or 3
Sewage outfalls	Present				Absent	1, 2 or 3
Infrastructure and services indicators						
Beach use intensities	Saturated		Moderate		Low	1, 2 or 3
Garbage collectors	None	1-5	6-10	>10		1, 2 or 3
Public restrooms	None	1-3	3-5	>5		1, 2 or 3
Sport facilities	Absent			Present		1, 2 or 3
Car parking distance	>500	200-500	100-200	<100	>500	1, 2 or 3
Favorable (3), indifferent (2), unfavorable (1) attributes for active and passive recreation.						

References

1. Kline, J. D., & Swallow, S. K. (1998). The demand for local access to coastal recreation in southern New England. *Coastal Management*, *26*(3), 177-190.
2. James, R. J. (2000). From beaches to beach environments: linking the ecology, human-use and management of beaches in Australia. *Ocean & coastal management*, *43*(6), 495-514.
3. León, C. (2004). Piezas de un rompecabezas: dimensión socioeconómica de las costas de México. *Arriaga E, Azuz I, Villalobos G. El manejo costero en México. Epomex, Semarnat, Universidad Autónoma de Campeche*, 5-26.
4. Rábago, N. L. B. (1999). Políticas de desarrollo turístico en dos zonas costeras del Pacífico mexicano. *Región y sociedad*, *11*(17).
5. Cervantes, O., & Espejel, I. (2008). Design of an integrated evaluation index for recreational beaches. *Ocean & Coastal Management*, *51*(5), 410-419.
6. Micallef, A., Williams, A. T., Radic, M., & Ergin, A. (2004). Application of a novel bathing area evaluation technique—a case study of Croatian island beaches. *World Leisure Journal*, *46*(4), 4-21.
7. Nelson, C., Morgan, R., Williams, A. T., & Wood, J. (2000). Beach awards and management. *Ocean & coastal management*, *43*(1), 87-98.
8. FEE. (2002). Blue flag campaign. In: Official web page for foundation for environmental education; 40 p.
9. Seaside Award. (2006). In: Official web page for Quality Coast Award; www.qualitycoast.org
10. Cendrero A. (1989). Planificacio´n ambiental y ordenacio´n de usos del territorio. In: Ayala F, Jorda´ J, editors. Geologı´a Ambiental. Madrid: ITGE, 25-33.
11. Espejel, I., Fischer, D. W., Hinojosa, A., García, C., & Leyva, C. (1999). Land-use planning for the Guadalupe Valley, Baja California, Mexico. *Landscape and Urban Planning*, *45*(4), 219-232.
12. Bermu´dez-Zavala R, Ferma´n-Almada JL, Delgado-Gonza´lez, Garcı´aGastelum A, Seingier G. Ana´lisis del cambio de uso de suelo a partir de ima´genes de sate´lite: caso de estudio municipio de playas de Rosarito, Me´xico: Aula y Ambiente, in press.

Advanced Engineering Days

aed.mersin.edu.tr

Geological and geochemical signatures of the calcite quarry in the southeast of Biga (Çanakkale, Turkey)

Mustafa Kaya [1], Cihan Yalçın [*2], Mustafa Kumral [1]

[1]*Istanbul Technical University, Geological Engineering, Türkiye, kayamusta@itu.edu.tr, kumral@itu.edu.tr*
[2]*Ministry of Industry and Technology, General Directorate of Industrial Zones, Ankara, Turkey, cihan.yalcin@sanayi.gov.tr*

Cite this study: Kaya, M., Yalçın, C., & Kumral, M. (2022). Geological and geochemical signatures of the calcite quarry in the southeast of Biga (Çanakkale, Turkey). 4th Advanced Engineering Days, 89-92

Keywords
Calcite
Quarry
Geochemical
Industrial raw material
Biga

Abstract

Calcite is a significant industrial raw material used in many fields owing to its properties. For this reason, determining the calcite quarry's geological and geochemical characteristics promotes the sector. This study was carried out to explain the geological and geochemical properties of the marble blocks of Paleozoic metamorphics located in the Biga peninsula. The length of this area, operated as a calcite quarry, is 350 meters, and its width is around 50 meters. Although alterations are partially observed due to the effect of faulting, the alteration is quite low in the main production area. Secondary minerals are rarely seen in fractures and cracks in marbles that display texturally granular texture. In geochemical analyzes, CaO values are around 55%, and MgO values are quite low. These data show that the calcite quarry suggests remarkably useful properties in terms of industrial raw materials.

Introduction

Limestone consists of calcite, whose chemical formula is $CaCO_3$ (calcium carbonate). It is largely used in many sectors in aggregate, powder, block, etc., owing to its physical and chemical properties [1]. The most important sectors are the metal, paper, ceramics, chemistry and construction sectors. For this reason, it is inevitable to research limestone, an extremely remarkable industrial raw material, and determine its physical and chemical properties.

The quality of the calcite mineral is determined by its grain diameter, colour and chemical purity [2-3]. The hardness of pure calcite is three according to Moh's scale, and its specific gravity is around 2.6-2.7 g/cm^3 at 20°C [3]. Carbonate rocks consisting of calcite with these properties are generally used as aggregates. In order to satisfy this need, the geological and geochemical characteristics of the calcite quarries should be explained.

When the geological framework of Turkey is reviewed, significant carbonate belts stand out. While some belts spread in relatively long and continual areas, a block or lenticular structure occurs in some areas for tectonic reasons. This study explained the geological and geochemical properties of the limestones in the Biga (Çanakkale) peninsula in Western Anatolia.

Material and Method

A 1/10,000 scaled geological map of the study area was drawn up. The contact relations of the units were completed in the field and redrawn in the Corel Draw program. In supplement, thin sections of the samples collected from the calcite quarry were made in ITU-JAL and examined under a polarizing microscope. Eventually, the geochemical analyzes of the samples were carried out with the X-ray fluorescence (XRF) spectrometer method. The data gathered were described in the office.

Geological Background

Pre-Tertiary rocks in the district crop out in tectonic belts, which spread in a NE-SW direction [4]. These tectonic zones consist of the İzmir-Ankara zone, Sakarya zone, Çetmi melange and Ezine zones from east to west, respectively.

The study area is located in the Sakarya zone defined by Şengör and Yılmaz [5]. Kazdağ metamorphics and Karakaya complex come together with tectonic contact. According to the Turkish Tectonic Units [6], the study area is located within the Paleozoic-Early Mesozoic subduction-subduction complex.

The base of the study area is the Kalabak Unit. Within this unit, there are Torasan formations and Çamlık Metagranodiorites are observed. The Torasan formation, which mainly includes phyllites, schists, metarhyolite, marble blocks and metaserpentinite blocks, is cut by the Çamlık Metagranodiorites. As a result of the deformations that occurred in the province, these two units belonging to the Kalabak Unit came together in some areas with a tectonic contact. The Karakaya formation of the Karakaya complex overlies this basement unit with angular unconformity. The contact of this unit, which consists of metamorphic rocks, with the basic units is generally tectonic (Figure 1).

Detailed investigations were implemented in the calcite quarry area, which is included in these lithologies and defined as the Marble member. The mineralogy, petrography and geochemistry of the rock, along with the structural relationship of the marble contact, are explained.

Characteristics of Calcite Quarry

The study area has an already operated calcite quarry in the east of Değirmen creek. This quarry operated using the calcite mineral belonging to the Marble blocks in the Torasan formation. Located on the site in a northwest-southeast direction, this marble block is approximately 350 meters long and 50 meters wide. This unit is cut by two NE-SW and NW-SE direction faults.

In the enterprise opened at 540 m elevations of the unit, it is observed that it is bordered by a fault along the dry stream and is in the form of a lens in the Torasan formation (Figure 2). Its weathering color and morphological features are easily recognized in the field. In the continuation of the unit towards the northeast, it is observed that the alteration color turns dark grey-blackish grey.

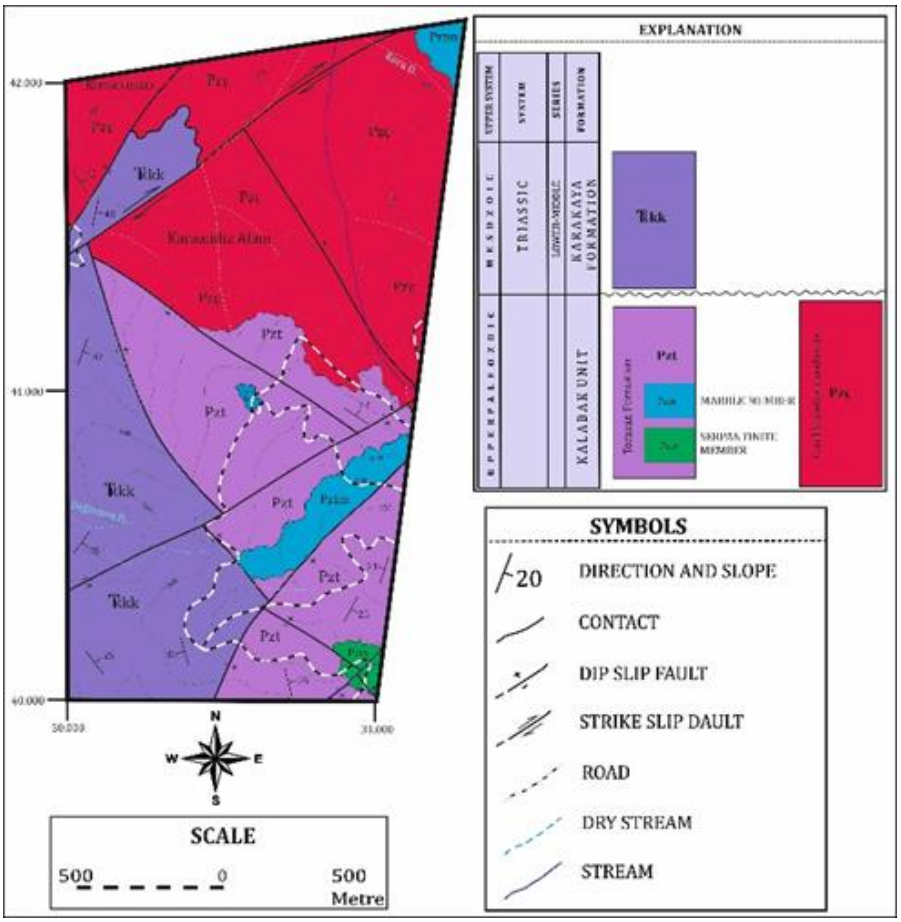


Figure 1. Geological map of the study area

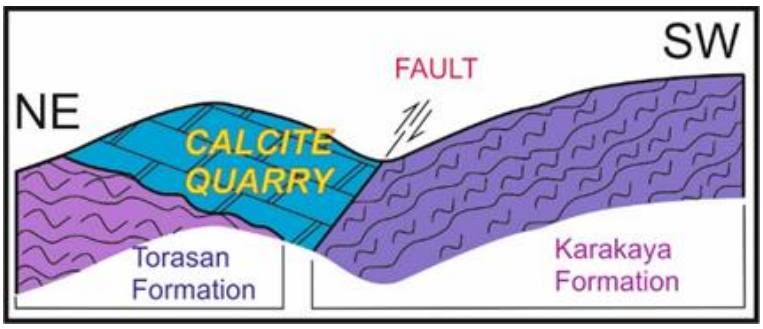


Figure 2. Geological cross-section of the calcite quarry district (without scale)

Petrography

Thin sections of the same samples were examined under a polarizing microscope. The examination determined that the rock has a crystalline mosaic texture (Figure 3). The rock is monomineralic and consists entirely of calcite crystals. Opaque minerals and quartz-type silicate minerals are remarkably rare. No alteration-decomposition is observed except for the iron oxide yield. The frequency of fissures and cracks is low in micro terms of the rock. It is seen as very plain and homogeneous regarding mineral content and structural elements (Figure 3).

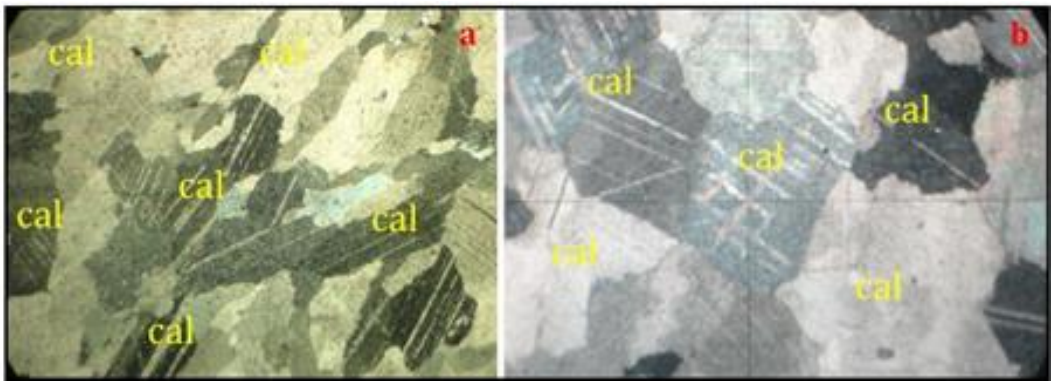


Figure 4. Microphotograph of marble (Abr: cal, calcite)

Geochemistry

It is recognized that the SiO_2 concentration in the samples is between 0.1-1%, the MgO concentration is between 0.27-0.66%, and the CaO concentration is around 55%, respectively.

Conclusion

The geological and geochemical characteristics of the Marble member of the Torasan formation located on the Biga peninsula were explained. The contact relationships of the Marble member, considered a calcite quarry, were determined. This unit, which extends approximately NE-SW, has a length of approximately 350 meters and a width of approximately 50 meters. Petrographic and geochemical explanations of calcite, a useful mineral in the marble member, were carried out. As a result of the study, it was determined that the calcite in the quarry, which was observed as a block, was medium-coarse crystalline, was less affected by deformations in terms of fractures and cracks, the alteration was at low levels, the CaO value was around 55%, and the MgO content was quite low.

Structural geology studies should also be done for the geological features of this area, which is used as a calcite quarry. The physical parameters of the calcites in the quarry, which are planned to be used as aggregates or similar material, should also be explained.

Acknowledgement

This study is a part of Mustafa Kaya's PhD Thesis.

References

1. Sanjeevi, S. (2008). Targeting limestone and bauxite deposits in southern India by spectral unmixing of hyperspectral image data. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *37*(B8), 1189-1194.
2. DPT-Devlet Planlama Teşkilatı. (2001). Madencilik özel ihtisas komisyonu raporu, Endüstriyel Hammaddeler Alt Komisyonu Genel Endüstri Mineralleri I, 8.Kalkınma Planı (2001-2005), Yayın No: 2618, ISBN 975- 19-2853-2, Ankara, Türkiye.
3. Şahin, N. (2008). Kalsit hakkında bazı bilgiler. *Madencilik Bülteni*, *86*, 48-51.
4. Okay, A. I., Siyako, M., & Bürkan, K. A. (1990). Biga Yarımadası'nın jeolojisi ve tektonik evrimi. *Türkiye Petrol Jeologları Derneği Bülteni*, *2*(1), 83-121.
5. Şengör, A. C., & Yilmaz, Y. (1981). Tethyan evolution of Turkey: a plate tectonic approach. *Tectonophysics*, *75*(3-4), 181-241.
6. Şengör, A. M. C., Yılmaz, Y. & (Ketin), İ. (1982). Remnants of a Pre-late Jurassic Ocean in Northern Turkey, Fragments of Permian-Triassic Paleo-Tethys? Reply, Geological Society of America Bulletin, 93, 932-936.

Advanced Engineering Days

aed.mersin.edu.tr

Geological and Geochemical characterization of the radiolarite hosted Mn mineralization in Taşdemir (Pazarcık, Kahramanmaraş, Turkey)

Cihan Yalçın [*1], **Mustafa Tekin Akkütük** [2], **Yusuf Uras** [2]

[1]*Ministry of Industry and Technology, General Directorate of Industrial Zones, Türkiye, cihan.yalcin@sanayi.gov.tr*
[2]*Kahramanmaraş Sütçü İmam University, Geological Engineering, Türkiye, mtekinakkutuk@gmail.com, yuras@ksu.edu.tr*

Cite this study: Yalçın, C., Akkütük, M. T., & Uras, Y. (2022). Geological and Geochemical characterization of the radiolarite hosted Mn mineralization in Taşdemir (Pazarcık, Kahramanmaraş, Turkey). 4th Advanced Engineering Days, 93-95

Keywords
Karadut Complex
Radiolarite
Manganese
Taşdemir

Abstract

Along the Southeast Anatolian Orogenic Belt, units existing to the Arabian plate and series of Ophiolitic Melange overlain by tectonic contact are observed. In the Upper Cretaceous aged thrust belt, the Koçali Complex is situated at the base and the Karadut Complex is at the top, respectively. Throughout this belt, Mn mineralizations are identified in the lithologies of the Karadut Complex. Around Taşdemir Village (Pazarcık-Kahramanmaraş), units existing to the Koçali and Karadut Complex are frequently observed. Haydar and Germav formations overlie these units with angular unconformity. All units are covered with Middle-Upper Eocene aged limestones existing to the Midyat Group with angular unconformity consequently. In this district, Mn mineralizations linked with the radiolarites of the Karadut Complex are observed. Stratiform type Mn mineralization is observed in the form of lenses between the layers. Reddish brown and dark gray forms have been identified. Major oxide and trace element analyzes of samples gathered from the ore zone were carried out. As a result of the analysis, the MnO range was detected as 7.42-32.76% (average20.65) and the SiO2 range was detected as 60.68-83.52% (average72.88). Fe/Mn rate is considerably lower than 0.1 In order to highlight the origin of manganese mineralization, major and trace elements are evaluated in the diagrams. These evaluations indicate that the mineralization is of hydrothermal origin.

Introduction

In addition to being a strength-enhancing substance in the iron and steel industry, manganese is also widely used in battery technology in relation to the green energy growth in recent years. The need for manganese, which contains significant physical and chemical properties, is increasing day by day. For this reason, mineral deposit exploration is also widespread.

Mn deposits observed in many geological environments are classified corresponding to their geological, tectonic, mineralogical and geochemical properties. These are; (1) hydrogenous (2) hydrothermal and (3) diagenetic deposits respectively [1-3]. In these classifications, Fe/Mn contents also offer significant clues about the origin of the deposit [4]. Since manganese deposits in Turkey are related to the evolution of the Tethys Ocean, the deposits have been described in different geological environments [5-9]. The belts that stand out from these deposits are the İzmir Ankara Erzincan Suture Belt and the Southeastern Anatolian orogenic belt. These belts contain hydrothermal and hydrogenetic manganese deposits associated with radiolarian cherts [7, 9]. There are many manganese mineralizations in the Southeastern Anatolian Orogenic Belt, where the study area is located, in the literature [10-11].

Kahramanmaraş has attracted the attention of many geoscientists due to its geological features. Important geological structures are observed in the Kahramanmaraş region, which is an important area where the Taurus Orogenic Belt and the Arabian Plate are sutured. Because of this complex structure, Gül [12] defined these regions as the Orogenic belt and the Arabian plate belt and divided the units belonging to these two belts into sub-belts. Taşdemir (Pazarcık, Kahramanmaraş) manganese mineralization is orogenically located in two important tectonic units such as the Southeast Fold Belt and the Eastern Taurus Orogenic Belt. According to Gül [12], the study area

is located in the margin fold belt at the northern end of the Arabian plate. Mn mineralizations are observed in the sedimentary rocks outcropping in the Taşdemir (Pazarcık) region. In this paper, the geological, mineralogical and geochemical characters of the mineralization are revealed.

Material and Method

Observational geological investigations were carried out in the ore zone. As a result of the observations, sampling was made in the ore zone in order to conduct mineralogical and geochemical studies. Major oxide and trace element analyzes of these samples were performed at ITU-JAL using XRF and ICP-MS methods. XRD analyzes were also performed for mineralogical identification.

Geological Background

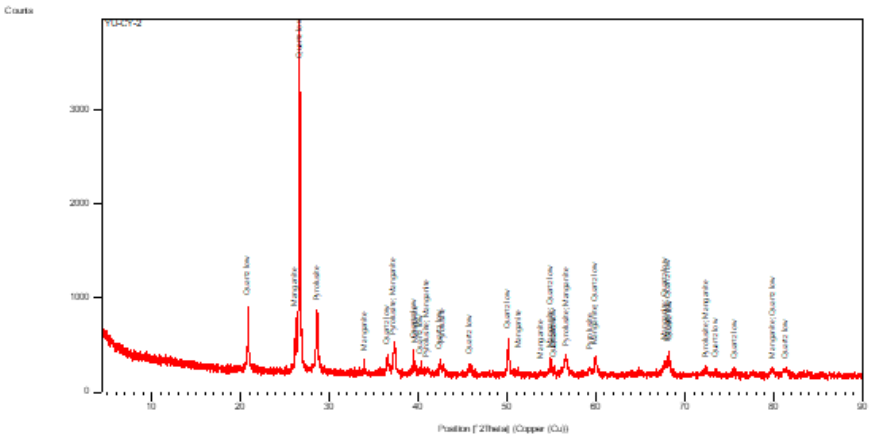
Around Taşdemir Village (Pazarcık-Kahramanmaraş), units belonging to the Koçali and Karadut Complexes are commonly observed. Haydar and Germav formations overlie these units with angular unconformity. All units are covered with Middle-Upper Eocene aged limestones belonging to the Midyat Group with angular unconformity. The contacts of the melange in the study area are generally tectonic. Thrust zones are cut by dip-slip faults in places and by strike-slip faults in places. In this region, Mn mineralizations associated with the radiolarites of the Karadut Complex are observed.

Ore geology

The mineralization consists of short and medium sized lenses in conformity with the layers (Figure 1a). It is commonly exposed at different levels of the layers of the succession. This formation continues along a zone of approximately 250 m. The ore lenses, which can be clearly identified in the field with their blackish color, have also been altered in places (Fig 1b).

XRD study was carried out for the mineralogical identification of the samples taken from this ore zone. As a result of the analysis, pyrolusite and manganite minerals were determined (Figure 2).

Figure 1. General view of ore zone



Ref. Code	Mineral Name	Chemical Formula
98-000-5737	Pyrolusite	Mn1 O2
98-003-9931	Manganite	H1 Mn1 O2

Figure 2. XRD diagram

Geochemistry

According to the analysis, the amount of SiO_2 is rather rich. The reason for this is the intense exposure of radiolarites. MnO values at ore levels are between 7.42-32.76%. When the other major oxide values are examined, there is no substantial anomaly. No alternative metallic enrichment is observed in samples with high manganese.

In the Si–Al discrimination diagram [13], the mineralization is distributed within the hydrothermal field due to low Al and high Si content. Likewise, in the triangular diagram [14], which is a different diagram, in which trace elements such as Co, Zn and Ni are compared relative to each other, they show distribution in the hydrothermal area.

Conclusion

One of the basic approaches for the identification of manganese deposits is the Fe/Mn ratio of the ore. In studies on manganese mineralization of various types [15-16], the Fe/Mn ratio of mineralization is 1 in hydrogenetic deposits that slowly precipitate from seawater. In the submarine hydrothermal deposits around the region, <0.1 (manganese-rich) and >10 (rich in iron) was determined. Very low Fe/Mn ratios are explained by the rapid precipitation of hydrothermal solutions in submarine hydrothermal centers. Fe/Mn ratios in this study are considerably lower than 0.1 and resembles submarine hydrothermal deposits.

Acknowledgement

This study was supported by Kahramanmaraş Sütçü İmam University Scientific Research Projects Coordination Unit. Project No: 2020/6-2 YLS

References

1. Roy, S. (1992). Environments and processes of manganese deposition. *Economic Geology*, *87*(5), 1218-1236.
2. Hein, J. R., Koschinsky, A., Halbach, P., Manheim, F. T., Bau, M., Kang, J. K., & Lubick, N. (1997). Iron and manganese oxide mineralization in the Pacific. *Geological Society, London, Special Publications*, *119*(1), 123-138.
3. Polgári, M., Hein, J. R., Vigh, T., Szabó-Drubina, M., Fórizs, I., Bíró, L., ... & Tóth, A. L. (2012). Microbial processes and the origin of the Úrkút manganese deposit, Hungary. *Ore Geology Reviews*, *47*, 87-109.
4. Hein, J. R., Gibbs, A. E., Clague, D. A., & Torresan, M. (1996). Hydrothermal mineralization along submarine rift zones, Hawaii. *Marine georesources & geotechnology*, *14*(2), 177-203.
5. Öygür, V. (1990). The Views on Geology. *Deposition and Genesis of Manganese Deposit in Cayırlı (Ankara-Haymana) Bullettin of MTA*, *110*, 29-43.
6. Öztürk, H., & Frakes, L. A. (1995). Sedimentation and diagenesis of an Oligocene manganese deposit in a shallow subbasin of the Paratethys: Thrace Basin, Turkey. *Ore Geology Reviews*, *10*(2), 117-132.
7. Öztürk, H. (1993). Manganese mineralizations in Turkey: Processes of formation and types. *Istanbul University Eng. Fac. Geological Engineering Pub*, *43*, 24-33
8. Öztürk, H. (1993). Characteristics and formations of fossil manganese nodules in the Koçali Komplex, Adıyaman, Turkey. *Geol Bull Turk*, *36*, 159-169.
9. Öztürk, H., Kasapçı, C., & Özbaş, F. (2019). Manganese deposits of Turkey. In *Mineral Resources of Turkey* (pp. 261-281). Springer, Cham.
10. Altunbey, M., & Sağıroğlu, A. (1995). Properties and origins of Koçkale-Elazığ manganese mineralizations. *Bulletin of the Mineral Research and Exploration*, *117*, 139-148.
11. Şaşmaz, A., Türkyilmaz, B., Öztürk, N., Yavuz, F., & Kumral, M. (2014). Geology and geochemistry of Middle Eocene Maden complex ferromanganese deposits from the Elazığ–Malatya region, eastern Turkey. *Ore geology reviews*, *56*, 352-372.
12. Gül, M.A., (2000). Kahramanmaraş yöresinin jeolojisi. Hacettepe Üniversitesi, Fen Bilimleri Enstitüsü, Doktora Tezi, 304 s.
13. Peters, T. (1988). Geochemistry of manganese-bearing cherts associated with Alpine ophiolites and the Hawasina formations in Oman. *Marine Geology*, *84*(3-4), 229-238.
14. Choi, J. H., & Hariya, Y. (1992). Geochemistry and depositional environment of Mn oxide deposits in the Tokoro Belt, northeastern Hokkaido, Japan. *Economic Geology*, *87*(5), 1265-1274.
15. Bonatti, E., Zerbi, M., Kay, R., & Rydell, H.S., (1976). Metalliferous deposits aphenine ophiolites. Geol. Soc. Am. Bull. 87, 83.
16. Crerar, D. A., Namson, J., Chyi, M. S., Williams, L., & Feigenson, M. D. (1982). Manganiferous cherts of the Franciscan assemblage; I, General geology, ancient and modern analogues, and implications for hydrothermal convection at oceanic spreading centers. *Economic Geology*, *77*(3), 519-540.

Advanced Engineering Days

aed.mersin.edu.tr

Petrographic and geochemical characterization of sandstones in upper level of ophiolitic melange in Central Pontides

Cihan Yalçın [*1], **Nurullah Hanilçi** [2], **Mustafa Kumral** [3], **Mustafa Kaya** [3]

[1]*Ministry of Industry and Technology, General Directorate of Industrial Zones, Ankara, Turkey, cihan.yalcin@sanayi.gov.tr*
[2]*İstanbul University-Cerrahpaşa, Geological Engineering, İstanbul, Turkey, nhanilci@gmail.com*
[3]*İstanbul Technical University, Geological Engineering, İstanbul, Turkey, kumral@itu.edu.tr, kayamusta@itu.edu.tr*

Cite this study: Yalçın, C., Hanilçi, N., Kumral, M., & Kaya, M. (2022). Petrographic and geochemical characterization of sandstones in upper level of ophiolitic melange in Central Pontides. 4th Advanced Engineering Days, 96-99

Keywords
Ophiolitic Melange
Sandstone
Çalarasın formation
Geochemical
Central Pontide

Abstract

Tectonic slices of different origins are observed in eastern of Kargı (Çorum). These slices, occurred via metamorphic units and lithologies of ophiolitic mélange which are observed with tectonic contact. The Çalarasın formation is observed at the upper levels of the ophiolitic mélange, which extends to the east of Kargı (Çorum) in the Central Pontides. The formation is composed of thin-bedded siltstone intercalated sandstone-shale and mudstone alternations. The sandstones of the formation include quartz, plagioclase, calcite, biotite, chlorite and volcanic rock particles. The sandstones were analyzed for geochemical properties and provenance traces, respectively. According to these analyzes, SiO_2 % is found between 26.46-71.78%, Al_2O_3% 5.22-10.86, Fe_2O_3% 2.89-7.11 and CaO% 6.13-36.02 respectively. When trace elements are evaluated, Sc content ranges from 76.13-201.03 ppm, and Y content ranges from 9.54-55.11 ppm. The sandstones are poor in terms of REE. It was determined that the sandstones were fed from the intermediate and mafic magmatic sources and tectonically represented the active continental margin and the island arc area.

Introduction

By acknowledging the geochemistry of sedimentary rocks, significant data can be obtained about the tectonic location, geochemical composition, origin and source area of the rocks [1-5]. In supplement, environmental interpretations can be represented by acknowledging petrographic characters. In these surveys, sandstones in sedimentary succession are usually preferred.

Pontides were established as part of the Alpine-Himalayan belt by Ketin [6], and Okay et al. [7] separated it into Istanbul, Strandja and Sakarya zones, respectively. The Pontides are geographically distributed as western, central and eastern Pontides. Yılmaz et al. [8] stated that the Pontides are the orogenic belt related to the opening and closing of the Tethys Ocean in the northernmost part of Turkey. As a result of this tectonic movement, a submarine turbidite basin was formed in the Central Pontides during the Early Cretaceous [9]. East of Kargı (Gökçedoğan), located in the Central Pontides, there are specific tectonostratigraphic sequences dwelling of lower and upper tectonic slices [10]. These slices are Pelitözü, Gölköy and ophiolitic melange slices respectively [11-12]. In the upper levels of the ophiolitic mélange, the Çalarasın formation consists of sedimentary rocks. This study revealed the petrographic and geochemical properties of the sandstones of the Çalarasın formation.

Material and Method

Thin sections and geochemical analyses of 7 samples collected from sandstone in the Çalarasın formation were performed in ITU-JAL (Table 1). The analysis results obtained were evaluated in diagrams.

Geology

The study area is located in a district where the Middle Jurassic and Cretaceous accretionary prism is still called the Central Pontides Supercomplex [13-15]. To the east of Kargı is in the Middle Jurassic accretionary complex, which has the Kirazbaşı complex consisting of ophiolitic mélange, and the Domuzdağ complex, whose metamorphic conditions change towards the north [16-17].

The Ophiolitic Melange of the Kirazbaşı complex consists of dunite and serpentinite at the base, and spilitic lava, metadiabase, meta basalt, radiolarite, chert, mudstone and pelagic limestones [16, 18] on the gabbro. At the top levels of the succession, there is the Çalarasın formation [18], which consists of alternating siltstone, sandstone, shale and mudstone respectively. The sandstones observed in the vicinity of Çalarasın district are brownish, reddish grey on the weathered surface, bright black in areas where the fresh fracture surface is altered, and brown and grey in localities where alteration is observed, unstable, medium-hard, fossil-free, poorly sorted and ungraded.

Petrography and Geochemistry

In the thin section review of the sandstones in Beşpınar, it is recognized that there are many volcanic rock fragments in the rock. There are mainly quartz, plagioclase, calcite and rock particles. Grains are medium well, rounded, poorly sorted and ungraded. Quartz exists as monocrystalline. Calcite is in the matrix, and secondary quartz and iron oxide minerals are emplaced in its fractures and cracks. It was observed to be fed from volcanic rocks during the deposition. Corresponding to Folk [19], the rock was determined as lithic arenite because the quartz content is less than 90%, the rock particle is more than feldspar, and the matrix ratio is less than 15%.

To reveal the provenance traces of the sandstones, the diagram was prepared using the main oxide values [20]. According to the prepared diagram, it was determined that the sandstones were fed from intermediate and mafic magmatic sources (Figure 2). For sandstones, most of the samples examined in the (Fe_2O_3+MgO)−TiO_2 diagram [1] are distributed outside the defined areas (Figure 3a). Only one specimen is located in the active continental margin area. In the (Fe_2O_3+MgO)−(Al_2O_3/SiO_2) diagram [1], many samples fall into the active continental margin area (Figure 3b). In the La/Th variation diagram developed by Bhatia and Crook [2], the samples fall into the island arc area (Figure 3c). The samples fall into the island arc area in the Th-Co-Zr/10 diagram (Figure 3d).

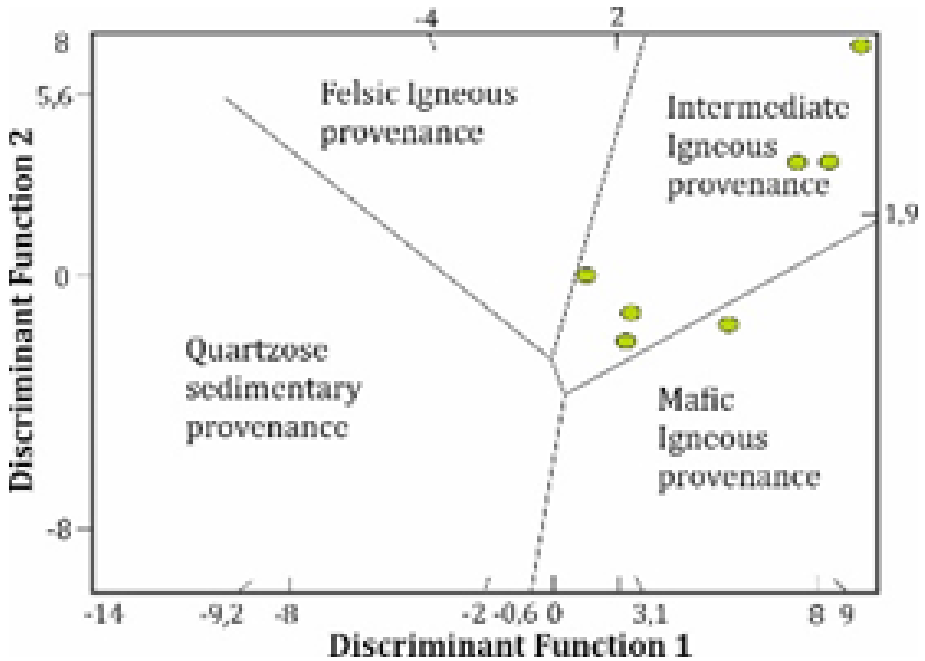


Figure 2. Geotectonic discrimination diagram for provenance of sandstones by major elements [20]

Conclusion

The petrographic and geochemical characteristics of the sandstones, which are located in an extremely complex area and represent the upper levels of the lithologies belonging to the ophiolitic melange, have been revealed. As a result of the study, it was determined that the sandstones interpreted as lithic arenite were fed from intermediate and mafic magmatic sources and concentrated in the tectonically active continental area and island arc area. More detailed environment interpretations will be possible by increasing the analysis in different diagrams.

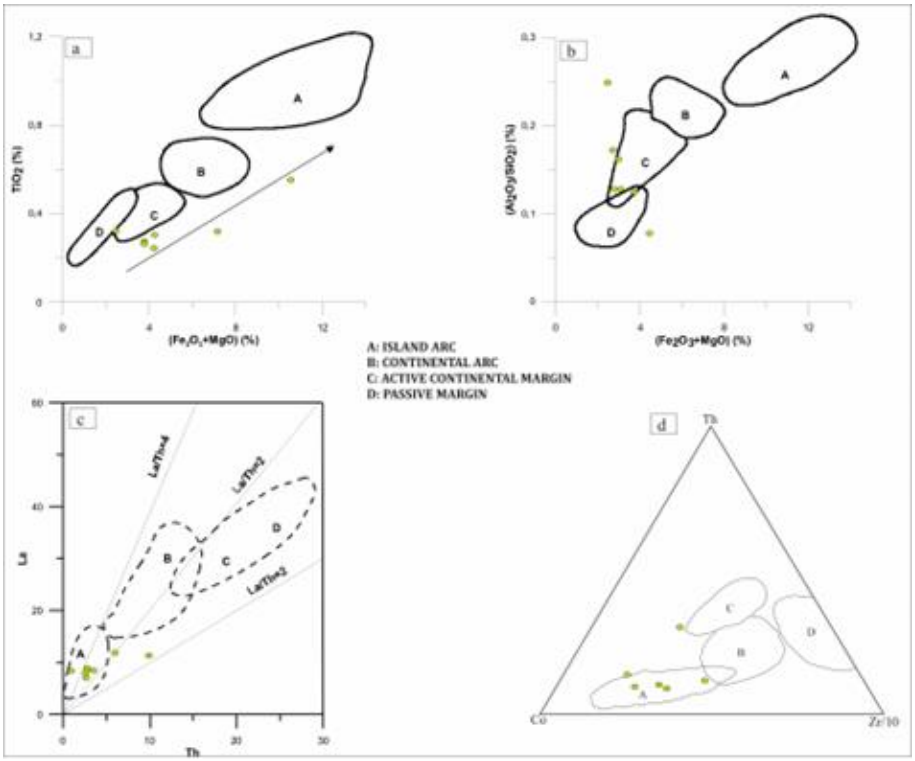


Figure 4. Geotectonic diagrams of sandstones

References

1. Bhatia, M. R. (1983). Plate tectonics and geochemical composition of sandstones. *The Journal of Geology*, *91*(6), 611-627.
2. Bhatia, M. R., & Crook, K. A. (1986). Trace element characteristics of graywackes and tectonic setting discrimination of sedimentary basins. *Contributions to mineralogy and petrology*, *92*(2), 181-193.
3. Roser, B. P., & Korsch, R. J. (1988). Provenance signatures of sandstone-mudstone suites determined using discriminant function analysis of major-element data. *Chemical geology*, *67*(1-2), 119-139.
4. Mclennan, S. M. (2018). Rare earth elements in sedimentary rocks: influence of provenance and sedimentary processes. In *Geochemistry and mineralogy of rare earth elements* (pp. 169-200). De Gruyter.
5. Armstrong-Altrin, J. S., & Verma, S. P. (2005). Critical evaluation of six tectonic setting discrimination diagrams using geochemical data of Neogene sediments from known tectonic settings. *Sedimentary Geology*, *177*(1-2), 115-129.
6. Ketin, İ. (1966). Tectonic units of Anatolia (Asia minor). *Bulletin of the Mineral Research and Exploration*, *66*, 23-34.
7. Okay, A. I., Celal Sengor, A. M., & Görür, N. (1994). Kinematic history of the opening of the Black Sea and its effect on the surrounding regions. *Geology*, *22*(3), 267-270.
8. Yılmaz, Y., Tüysüz, O., Yigitbas, E., Genç, S.C. & Şengör, A.M.C., (1997). Geology and tectonic evolution of the Pontides, in Robinson, A.G. (ed). Regional and Petroleum Geology of the Black Sea and Surrounding Region, vol. 68. Bullettin of American Association Petroleum Geology, pp. 183–226.
9. Akdoğan, R., Okay, A. I., Sunal, G., Tari, G., Meinhold, G., & Kylander-Clark, A. R. (2017). Provenance of a large Lower Cretaceous turbidite submarine fan complex on the active Laurasian margin: Central Pontides, northern Turkey. *Journal of Asian Earth Sciences*, *134*, 309-329. https://doi.org/10.1016/j.jseaes.2016.11.028.
10. Uğuz, M. F., & Sevin, M. (2009). 1/100000 Ölçekli Türkiye Jeoloji Haritaları No: 115 Sinop F-33 Paftası. *MTA, Jeoloji Etütleri Dairesi, Ankara*.
11. Yalçın, C. (2018). Geology and formation of the Gökçedoğan (Kargi-Çorum) Cu ± Zn mineralization. PhD Thesis, İstanbul University, Institute of Graduate Studies in Science and Engineering, 301.
12. Yalçın, C., Hanilçi, N., Kumral, M., & Kaya, M. (2022). Formation and Tectonic Evolution of Structural Slices in Eastern Kargi Massif (Çorum, Turkey). Bulletin of the Mineral Research and Exploration. https://doi.org/10.19111/bulletinofmre.1067604.
13. Marroni, M., Frassi, C., Göncüoğlu, M. C., Di Vincenzo, G., Pandolfi, L., Rebay, G., ... & Ottria, G. (2014). Late Jurassic amphibolite-facies metamorphism in the Intra-Pontide Suture Zone (Turkey): an eastward

extension of the Vardar Ocean from the Balkans into Anatolia?. *Journal of the Geological Society*, *171*(5), 605-608. https://doi.org/10.1144/jgs2013-104.K

14. Okay, A. I., Sunal, G., Sherlock, S., Alt ner, D., Tüysüz, O., Kylander-Clark, A. R., & Aygül, M. (2013). Early Cretaceous sedimentation and orogeny on the active margin of Eurasia: Southern Central Pontides, Turkey. *Tectonics*, *32*(5), 1247-1271.
15. Okay, A. I., & Nikishin, A. M. (2015). Tectonic evolution of the southern margin of Laurasia in the Black Sea region. *International Geology Review*, *57*(5-8), 1051-1076.
16. Aygül, M., Okay, A. I., Oberhänsli, R., & Sudo, M. (2016). Pre-collisional accretionary growth of the southern Laurasian active margin, Central Pontides, Turkey. *Tectonophysics*, *671*, 218-234. https://doi.org/10.1016/j.tecto.2016.01.010
17. Günay, K., Dönmez, C., Oyan, V., Yıldırım, N., Çiftçi, E., Yıldız, H., & Özkümüş, S. (2018). Geology and geochemistry of sediment-hosted Hanönü massive sulfide deposit (Kastamonu–Turkey). *Ore Geology Reviews*, *101*, 652-674.
18. Yılmaz, Y., & Tüysüz, O. (1984). Kastamonu-Boyabat-Vezirköprü-Tosya arasındaki bölgenin jeolojisi (Ilgaz-Kargı masiflerinin etüdü). *Ankara, Turkey: MTA Raporu (in Turkish)*.
19. Folk, R. L. (1962). Spectral subdivision of limestone types in classification of carbonate rocks, W.E. ham. (ed), AAPG Bull., 1, 62-82.
20. Roser, B. P., & Korsch, R. J. (1988). Provenance signatures of sandstone-mudstone suites determined using discriminant function analysis of major-element data. *Chemical geology*, *67*(1-2), 119-139.

Advanced Engineering Days

aed.mersin.edu.tr

Investigation of stress in rotating cylinders with gray irons (Grade G4000) materials by mathematical programming

Hüseyin Fırat Kayıran *1

[1]ARDSI, Mersin Provincial Coordination Unit, Mersin, Türkiye, huseyinfiratkayiran@tkdk.gov.tr

Cite this study: Kayıran, H. F. (2022). Investigation of stress in rotating cylinders with gray irons (Grade G4000) materials by mathematical programming. 4th Advanced Engineering Days, 100-102

Keywords
Cylinder
Mathematical Modeling
Gray irons (grade G4000)

Abstract

In this study, the elastic stresses occurring in a rotating cylinder made of Gray Irons (Grade G4000) material were investigated analytically. Elastic ranges were calculated analytically with reference to the Von Mises yield criterion. Obtained results are shared in graphics. It was determined that the rotating cylinder was inversely proportional to the increase in the rating parameter

Introduction

Cylinders are the reason for quite a lot of preference in the machine parts to be designed. Rotating cylinders of different sizes are used in integrated machine parts. It is important for engineering to know the stresses that occur in rotating parts exposed to high temperatures. Together with the literature search; In a study, stresses and deformations occurring in a rotating disk of different thickness were investigated. The results obtained were compared with each other [1]. In another study, the rotating ring disk stresses evaluated functionally were investigated. Different states of the disks mechanical cases displacement and recycling are indicated. The radial displacement and stresses of the proposed FGM disc are smaller than the conventionally homogeneous one disc .It it has been determined that the radial displacement and stresses of the proposed FGM disc are less than the traditionally homogeneous disc [2].In other similar studies, respectively; Thermomechanical properties of a rigid body-bodyless, functionally graded, uniform disc and stresses occurring in FGM cylinders were investigated, and the results obtained were shared with the literature in graphical form [3-4].Radial and tangential stresses formed in discs consisting of different materials have been investigated in different studies and compared with the literature [5-8].

Analytical Solution

The material of the cylinder to be analyzed is Gray Irons Grade G4000 selected from the appropriate material. Gray Irons Grade G4000the mechanical properties are given in Table 1.

Table 1. Mechanical properties of cylinder material [9]

Gray Irons Grade G4000	Modulus of elasticity	w	Density	Cylinder Inner half diameter	Cylinder Outer semi-diameter
	138 GPa	75 rad/sn	7150 kg/m3	30 mm	80 mm

Stress analysis in cylinders

Two-dimensional equilibrium equation in cylindrical coordinates [10];

$$\frac{d(\sigma_r)}{dr} - \frac{1}{r}\frac{(d\tau_{r\theta})}{d\theta} + \frac{(\sigma_r - \sigma_\theta)}{r} + R = 0 \quad (1)$$

For the stress analysis equation in rotating cylinders;

$$r^2\frac{d^2F}{dr^2} + r\left[1 - r\frac{E'(r)}{E(r)}\frac{dF}{dr}\right] + \left[v(r)\frac{E'(r)}{E(r)} - 1\right]F = \rho(r)\omega^2 r^3[r\frac{E'(r)}{E(r)} - \frac{\rho'(r)}{\rho(r)} - 3 - -\frac{v}{1-v} \quad (2)$$

$$\sigma_r = C_1 r^{(n+k-2)/2} + C_2 r^{(n-k-2)/2} + Ar^{(2+\gamma)} \quad (3)$$

$$\sigma_\theta\,(\mathrm{MPa}) = \frac{n+k}{2}C_1 r^{\frac{n+k-2}{2}} + \frac{n-k}{2}C_2 r^{\frac{n-k-2}{2}} + (3+\gamma)Ar^{(2+\gamma)} + \rho(r)\omega^2 r^2 \quad (4)$$

According to the formulas above; r=et transformation is performed, E_0, modulus of elasticity, ρ_0 density reference value, n and γ are optional constants.C1 and C2 are integral constants. For boundary conditions;

Findings

The radial stress, tangential stress and axial stresses that occur in a cylinder rotating at a speed of w=50 rad/sec with Gray Irons (Grade G4000) material are given in Figure 1-3.

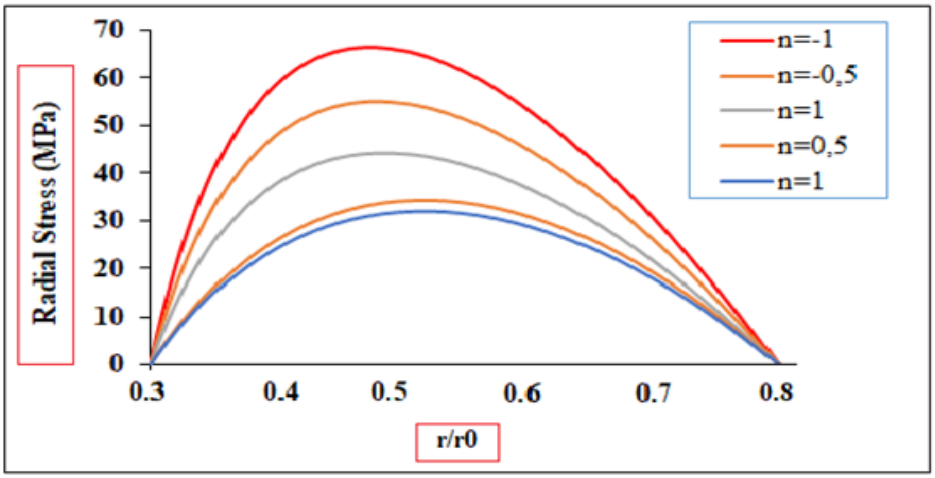


Figure 1. Radial stresses occurring in a cylinder rotating at a speed of w=50 rad/sec with Gray Irons (Grade G4000) material

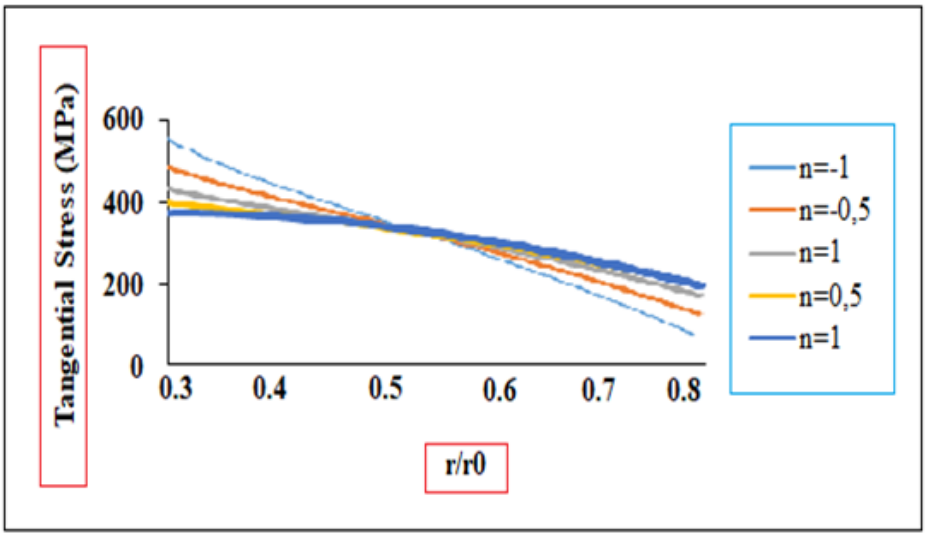


Figure 2. Tangential stresses occurring in a cylinder rotating at a speed of w=50 rad/sec with Gray Irons (Grade G4000) material

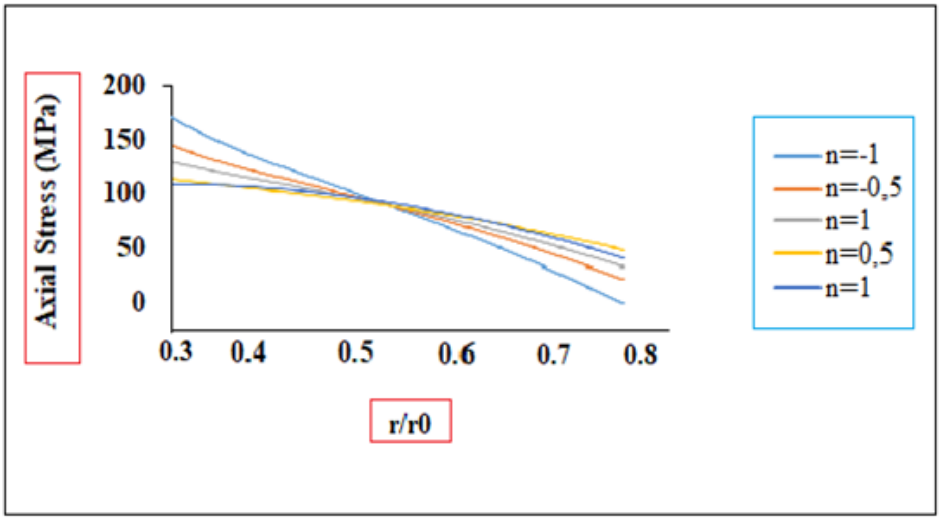


Figure 3. Axial stresses occurring in a cylinder rotating at a speed of w=50 rad/sec with Gray Irons (Grade G4000) material

Conclusion

In this study, the stresses occurring in a cylinder with Gray Irons (Grade G4000) material rotating at a hungry speed of w=50 rad/sec were numerically investigated. Gray Irons (Grade G4000) radial stresses on the innermost and outermost parts of the cylinder are zero. It was seen that the stresses were inversely proportional to the increase in the rating parameter in the cylinders. Gray Irons (Grade G4000) maximum radial stresses occurred in the central regions closer to the inner part of the cylinder. It has been observed that the tangential stress occurring in the cylinder is approximately 300% more than the axial stress.

References

1. Nayak, P., & Saha, K. (2016). Elastic limit angular speed of solid and annular disks under thermomechanical loading. *International Journal of Engineering, Science and Technology*, *8*(2), 30-45.
2. Lin, W. F. (2020). Elastic analysis for rotating functionally graded annular disk with exponentially-varying profile and properties. *Mathematical Problems in Engineering*, *2020*.
3. Yildirim, V. (2019). Thermomechanical characteristics of a functionally graded mounted uniform disc with/without rigid casing. *Journal of Aerospace Technology and Management*, *11*.
4. Salehi Kolahi, M. R., Karamooz, M., & Rahmani, H. (2020). Elastic analysis of shrink-fitted thick FGM cylinders based on linear plane elasticity theory. *Mechanics of Advanced Composite Structures*, *7*(1), 121-127.
5. Kayiran, H. F. (2021). Numerical analysis of composite disks based on carbon/aramid–epoxy materials. *Emerging Materials Research*, *11*(1), 155-159.
6. Kayıran, H. F. (2021). Numerical analysis of displacements in circular discs applied with different materials. *Asia Mathematika*, *5*(1), 168-177. https://doi.org/10.5281/zenodo.4734242
7. Kayiran, H.F., (2022). Usabilitiy of Chebyshev Pseudospectral method with finite element method on circular discs. Asia Mathematika, 6(1), 46–53. https://doi.org/10.5281/zenodo.6580397
8. Kayıran, H. F., & Kayiran, H. F. (2020). Investigation of elastic tensile behavior of thermoplastic discs reinforced with steel wires. *Akıllı Sistemler ve Uygulamaları Dergisi*, *3*(2), 73-76.
9. Amesweb, (2022). https://amesweb.info/Materials/Modulus-of-Elasticity-Metals.aspx
10. Timoshenko, S. P., & Goodier, J. N. (1970). Theory of Elasticity 3rd ed., 567.

Advanced Engineering Days

aed.mersin.edu.tr

Development of individualized education system with artificial intelligence fuzzy logic method

Hüseyin Fırat Kayıran [*1], **Ufuk Şahmeran**[2]

[1]*ARDSI, Mersin Provincial Coordination Unit, Mersin, Türkiye, huseyinfiratkayiran@tkdk.gov.tr*
[2]*Uskudar American Academy, Istanbul, Türkiye, usahmeran23@my.uaa.k12.tr*

Cite this study: Kayıran, H. F., & Şahmeran, U. (2022). Development of individualized education system with artificial intelligence fuzzy logic method. 4th Advanced Engineering Days, 103-105

Keywords
Composite materials
Artificial intelligence
Fuzzy logic method
Nano technology

Abstract

The importance of artificial intelligence is indisputable today. With the development of artificial intelligence, computers, smartphones and other electronic devices have become indispensable to human life. With the fuzzy logic method under the heading of artificial intelligence, many mathematical problems can be easily solved. Artificial intelligence is briefly a computer science. Artificial intelligence can be explained as the ability to exhibit human-like behavior. The aim of this study is to develop an individualized teaching practice in which each student can improve himself/herself by using the fuzzy logic principle. Thanks to this designed educational technology, each student will see questions about their own level of success and move their learning level up as much as possible. For the fuzzy logic application, the inputs are determined as the time to solve the question and the accuracy rate, and the output is determined as the difficulty of the problem.

Introduction

Within the scope of this study, it is planned to develop an individualized teaching system with the fuzzy logic method, which is the sub-branch of artificial intelligence. In general, mamdani inference was used in the study, and AND and OR rules were determined to cover each different condition. In the light of these rules, it is aimed that the program will show difficult questions to students who solve the questions they have shown before quickly and with a high accuracy rate, and reduce the difficulty of the question as they go to higher times and low accuracy rates. In this context, graphs were created for each input and output and the blur degrees of the inputs and outputs were calculated. Calculations were made with 6 randomly selected samples using graphs and determined AND and OR rules. As a result of these calculations, the program has given the expected level of difficulty for the expected students. It has been determined that a functional individualized training program can be made using the fuzzy logic principle. Studies on the progress of composite material materials and derivatives with artificial intelligence.

Artificial Intelligence (AI)

Artificial intelligence is very important nowadays. Coordinated studies in health, law and other departments, especially in the field of artificial intelligence and mechanics, are academicians by continuing. The topics discussed around artificial intelligence, the components are artificial neural networks, expert systems, fuzzy logic, genetic algorithms. There are many disciplines that adopt artificial intelligence. Some of them are computer engineering, philosophy, cognitive science, electronic sciences [1]. By giving importance to the study of intelligence automation with computers, the foundations of artificial intelligence were laid. In the 1950s and 1960s, when the definition of

intelligence and artificial intelligence was discussed, artificial intelligence gained usability in every field in the society we live in [2-3]. Artificial intelligence is the process by which the human brain, non-organic systems (computer, program, robot, etc.) Based on its functions. In short, artificial intelligence is a set of systems that think like a human, perceive like a human, interpret like a human, analyze like a human and make decisions like a human after all these stages. Scientists have defined artificial intelligence differently. For example, artificial intelligence is the science of computer programs that simulate intelligent behavior, and artificial intelligence is the science of converting things into machines that require intelligence when done by humans [4-5]. When the literature is scanned, it is possible to come across different studies with artificial intelligence and sub-branches. For example, in a study conducted; Student academic performance estimation was made by artificial intelligence using machine learning algorithms of students. At the end of the study; the decision tree algorithm gives the best accuracy rate with a maximum depth value of 2 for 649 student data. The random forest algorithm gives the best accuracy with 649 student data. The logistic regression algorithm was found to give the best accuracy with 395 student data [6]. In different studies, the importance of the development of artificial intelligence in the field of food, epidemics and pandemics and its applicability in the field of health have been investigated. The literature findings were shared in the results section [7-9].

Fuzzy Logic

In 1965, Prof. Fuzzy logic was mentioned in the work by Lotfi Askar Zadeh [10]. The concepts of fuzzy logic and fuzzy sets were first introduced in 1965 by Lotfi A. It is set out in an article published by Zadeh. Later, in his notes published in 1973, Zadeh proposed the idea that fuzzy set theory has a structure that can be modeled on the human decision-making system with the best approximation [11]. In classical logic, the limitations are certain, an element is either a member of a set or it is not. There is a logic of 0 and 1 in classical sets. In fuzzy logic, on the other hand, there is partial membership. In this way, it can operate in vague and approximate situations similar to human logic. Fuzzy logic is currently used in many fields such as the automotive industry, electronic control systems, and home electronics. Especially with the use of electrical appliances, energy has been saved and such tools have been smartened up [12]. An example fuzzy logic diagram is shown in Figure 1.

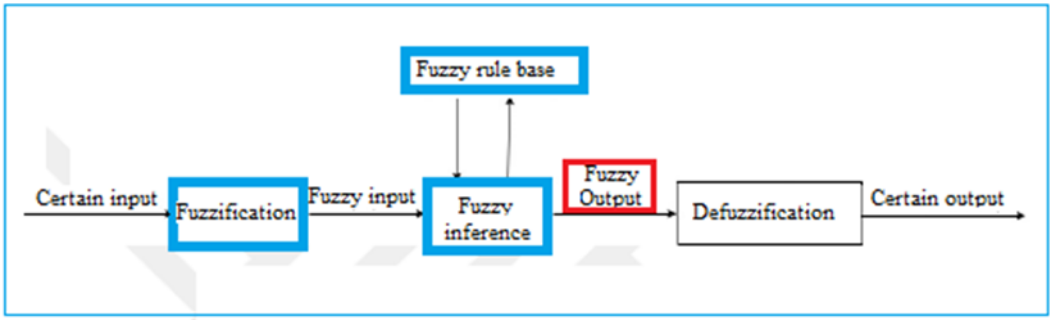


Figure 1. Operation of the fuzzy system fuzzy logic system [13]

Method

The difficulty level of each problem in the study will be calculated by fuzzy logic. Two different inputs will be subjected to the rules and the difficulty level of the problem will give the output. Mamdani inference will be used in the study. When the student starts using the system, he will be shown 10 leveling questions, which are shown to everyone. These questions will be selected by educators and will consist of different difficulties. It is very important to have selective questions. According to the percentage of wrong / right that arise as a result of these questions and the time spent per question on these questions, the questions will begin to be shown to him according to his academic level. With each question it solves, the time and accuracy will be updated according to previous calculations. In this way, it is aimed to gradually increase the student's learning level by increasing the difficulty level.

Results

The inputs were defined as the time to solve the questions and the accuracy rate of the questions. In the question solving time graph, the Y-axis shows the membership status, while the X-axis gives the time to solve the question

in seconds.: The graph of the students' question solving speed is given in Figure 2.

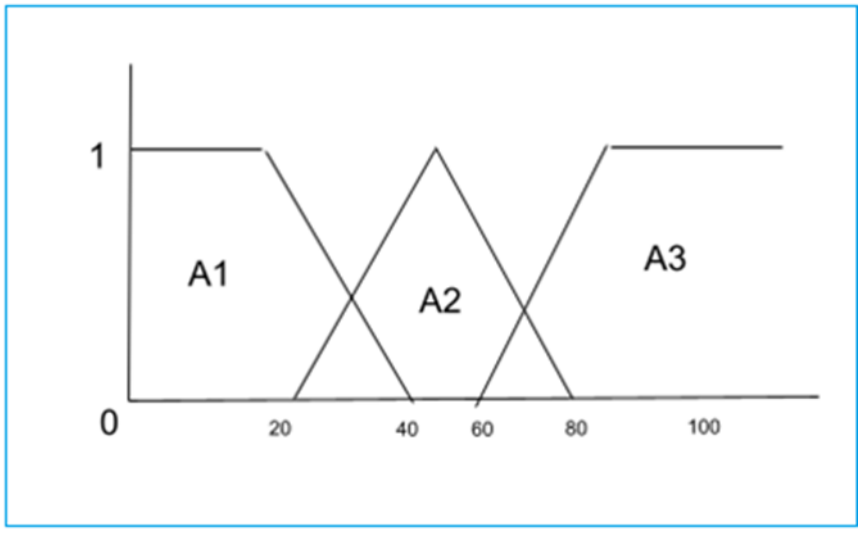


Figure 2. Students' question solving speed graph

Conclusion

In this study, the aim of this study, which I started on the idea of adjusting the question difficulty while studying, is to create an individualized education system by applying the fuzzy logic principle in order for students to get maximum efficiency. As a result of the literature review, it was found that the two important factors that indicate that a student is academically successful in a subject and that he has completely learned that subject are the accuracy rate in the questions and the time to solve the questions. Rules have been created with fuzzy logic and these rules have been poured into graphs and output has been provided. The principle of operation of this program is illustrated by example cases. It has been determined that the program works as desired.

Recommendations

- This system is also recommended to be used in classrooms, especially for students preparing for high school and university exams.
- By designing this system in the form of a mobile application, it can also be ensured that it works better on tablets and phones, thus increasing mobility.
- If the study wants to be more detailed, new parameters can be added to the entries.

References

1. Pirim, H. (2006). Artificial Intelligence, Yaşar University E-Journal, 1(1), 81-93.
2. Luger, F. G. & William, A. (1993). Stubblefield, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 2nd ed. Harlow, England: Addison-Wesley.
3. Nilsson, N. J. (2009). The Quest for Artificial Intelligence: A History of Ideas and Achievements. California, United States: Cambridge University Press.
4. Minsky, M. (1960). Steps towards artificial intelligence. Lexington, Lincoln Laboratory.
5. Brooks, R. A. (1991). Artificial intelligence without representation. Elsevier, 139-159.
6. Bastem, H. N. (2021). Prediction of student academic performance using artificial intelligence via machine learning algorithms, Çankaya University Institute of Sciences, Computer Engineering, Master's thesis, 68p.
7. Kayıran, H. F. (2022). Investigation of the applicability of artificial intelligence and machine learning in the field of health. *Advanced Engineering Days (AED)*, *3*, 16-19.
8. Kayiran, H. F. (2020). Use of Artificial Intelligence in Food Engineering, 4th International Mersin Symposium, Mersin.
9. Kayiran, H. F., Gökalp, H. (2020). Epidemiology Artificial Intelligence (Robots) and Law, 4th International Mersin Symposium, Mersin.
10. Zadeh, L. (1965). Fuzzy sets, Information and Control, 8(3), 338-353.
11. Güray, P. (2019). bControl with Fuzzy Logic Guraysonugur.aku.edu.tr guraysonugur.aku.edu.tr/wp-content/uploads/sites/11/2019/03/BMK-Ders-2.pdf.
12. Drinker & Boiler (2007). Modeling the dishwasher with fuzzy logic. Engineer and Machine, 48, 565, 3-8.
13. Yellow, M., Murat, Y., & Kirabali, M. (2005). Fuzzy Modeling Approach and Applications, Journal of Scientific Reports-A.

Advanced Engineering Days

aed.mersin.edu.tr

Evaluation of silicon nitride reinforced silica aerogel composites for radom application

İlhan Enes Çetin*[1], Öyküm Başgöz [1], Gökhan Açikbaş [1,2], Nurcan Çaliş Açikbaş[1]

[1]*Mersin University, Department of Metallurgical and Materials Engineering, Mersin, Türkiye*
[2]*Mersin University, Department of Nanotechnology and Advanced Materials, Mersin, Türkiye*

ilhanncetinn201@gmail.com, oykumbasgoz@mersin.edu.tr, gokhanacikbas@mersin.edu.tr, nurcan.acikbas@mersin.edu.tr

Cite this study: Çetin, İ. E., Başgöz, Ö., Açıkbaş, G., & Açıkbaş, N. Ç. (2022). Evaluation of silicon nitride reinforced silica aerogel composites for radom application. 4th Advanced Engineering Days, 106-110

Keywords
Si_3N_4 aerogel composites
Radom
Aviation
Defense industry
Advanced materials

Abstract

Thanks to its lightness and superior mechanical properties, advanced technology composite materials have a wide range of use in aviation, not only in interiors, but also in the production of structural parts. The radom in the nose of the aircraft is one of the areas of use of advanced technology composite materials. Silica aerogels with high specific surface area (500–1200m^2/g), low density (approx. 0.003–0.5 g/cm^3), low thermal conductivity (0.005–0.1 $Wm^{-1}K^{-1}$), ultra-low dielectric constant (1.0–2.0) and low dielectric loss (10^{-2} – 10^{-4}) are potential materials for use in radom application. Recently, with the rapid development of aviation technologies, the speed of aircraft has improved significantly. This situation revealed the necessity of increasing the high temperature performance of silica aerogel radomes. Silicon nitride is a promising structural-functional reinforcement phase for silica aerogel radomes due to its excellent thermo-mechanical and dielectric properties. In this study, studies and results of silica aerogel composites reinforced with Si_3N_4 are presented and discussed.

Introduction

The radomes part of the nose of the aircraft is one of the areas of use of advanced technology materials (Figure 1). The radom is the structure used to protect the antennas from the effects of the outside world. It is an electrically transparent material to electromagnetic energy, where power loss in transmission must be minimal. Therefore, the dielectric constant and loss tangent of the material significantly affect the conduction loss. Radomes have walls separated by a core, as in a solid wall or sandwich structure. The wall configuration of the radom varies according to the application areas. One of the radom types is a graduated porous structure where the porosity lowers the dielectric constant and thus has high power transfer efficiency. This layer can be damaged by moisture due to its porous structure. Radomes are produced from dielectric materials in a way that will least affect the electromagnetic performance of the antennas they contain. In addition, the permeability of radom is often inversely related to its mechanical strength. Carbon has detrimental effects on radom performance because it absorbs electromagnetic radiation and water has a high dielectric constant relative to the radom material itself. The dielectric constant and loss tangent of the material also affect the transmission loss during electromagnetic radiation. In addition to low dielectric constant and loss, high strength, high thermal shock resistance and high thermal stability are the desired basic properties [1].

In radomes, engineering plastics such as glass fiber reinforced epoxy, or ceramic-based composites are used, especially in radomes that will be exposed to high temperatures. The general use temperatures of glass fiber reinforced composites are below 147 ^oC. In addition, low modulus of elasticity and compressive strength are other factors limiting their use in aviation. The low modulus of elasticity causes excessive stress in the plastic matrix, which causes fractures when stress is applied, thus shortening the fatigue life. Therefore, there is a need for materials that will show high performance, especially at high temperatures [1].

Figure 1. Representation of the radom in the nose of the aircraft [2]

Radomes should be made of materials that can protect internal electronic equipment from high temperatures, are wave-transparent and provide thermal insulation. Silica aerogels with high specific surface area (500–1200m^2/g), low density (approx. 0.003–0.5 g/cm3), low thermal conductivity (0.005–0.1 Wm-1 K-1), ultra-low dielectric constant (1.0–2.0) and low dielectric loss (10^{-2} – 10^{-4}) are potential materials for use in this field [3-4-5]. Aerogels are mostly used in the field of thermal insulation due to their low thermal conductivity values, and there are many studies on this subject [6]. However, these applications are limited to non-bearing structures due to fragility [7-8]. Therefore, great efforts are made to produce high-strength aerogel [9]. The incorporation of ceramic fiber into the aerogel not only improves the mechanical properties, but also reduces the radiative heat transfer of the aerogel at high temperature, making it possible to use the aerogel as a load-bearing insulation material as a Thermal Protection System (TPS). It is important to examine the creep behavior of aerogel composite insulation materials with load bearing capacity.

Recently, with the rapid development of aviation technologies, the speed of aircraft has improved significantly. This situation revealed the necessity of increasing the high temperature performance of radomes. Silica aerogels can be used as a radom due to the above-mentioned properties; but their strength is low. In addition, the mesoporous structure of silica aerogels deteriorates above 800°C and the thermal insulation performance deteriorates. It has been reported in the literature that silica aerogels with a density of 0.12 g/cm^3 deteriorate under a stress of 31 kPa [10]. In addition, although cross-linked polymer aerogels are suitable for this field, their use is limited in high temperature applications due to thermal pyrolysis of the polymer above 800°C.

To overcome these problems, it is necessary to improve the strength and thermal stability of silica aerogels. There are some methods are reported in literature: Structural strengthening [11-13], fiber reinforcement [9, 14-15], polymer crosslinking [16-18] or chemical/physical strengthening [19-21] procedures have been reported in the literature. Silicon nitride is a promising structural-functional material for radomes due to its excellent thermo-mechanical and dielectric properties [22-26]. By adding Si_3N_4 particles into the aerogel matrix, it is possible to improve the termo-mechanical properties while maintaining low dielectric constant and low dielectric loss properties.

Si_3N_4 Reinforced Silica Aerogel Composites

In the literature, there are limited studies on the production of Si_3N_4 reinforced silica aerogel composites [27].

Si_3N_4 particle reinforced silica aerogel composites were produced by sol-gel method by drying at ambient pressure by Yang et al. [16]. The microstructure, thermal insulation, mechanical and dielectric properties of the composites were investigated. The effect of the amount of Si_3N_4 (0, 2, 5, 10, 15,20 vol%) on the microstructure and properties is explained. The obtained mesoporous composites were found to have low thermal conductivity (0.024–0.072Wm^{-1} K^{-1}), low dielectric constant (1.55–1.85) and low dielectric loss (0.005–0.007). As the Si_3N_4 content increased from 5% to 20% by volume, the compressive strength and flexural strength of the composites increased from 3.21 to 12.05MPa and 0.36 to 2.45MPa, respectively. It has been reported that the obtained composites show significant promise in radom applications with the functional integration of wave transparency and thermal insulation. High temperature properties and interface evolution of Si_3N_4 fiber reinforced silica matrix wave transparent composite materials were investigated by another research group [16]. Here the matrix is silica, not aerogel. In the study, Si_3N_4 fiber reinforced silica matrix composites were produced by using the sol-gel method together with the filament winding method in order to improve the high temperature performance of wave transparent materials for high speed aircraft applications. The mechanical properties and interfacial development of the composites at high temperatures were investigated. The properties were evaluated by sintering the composites in two different furnace atmospheres (air and nitrogen). The results showed that composites sintered in a nitrogen atmosphere retained a flexural strength of 210 MPa up to 1200°C, while their air-prepared counterparts held up to approximately 73 MPa. In another study [27], Si_3N_4 particles embedded in the nano-network of silica aerogel prevent aerogel crystallization at high temperatures, thus increasing the strength. In

order to reduce the radiative thermal conductivity, it is additionally doped with the opacifier TiO_2. TiO_2 containing Si3N4/SiO2 aerogel composites were heat treated at 900, 1100, 1200 and 1300 °C for 2 hours. The schematic production process flow chart of the TiO_2 incorporated Si_3N_4/SiO_2 aerogel composites were given in Figure 2.

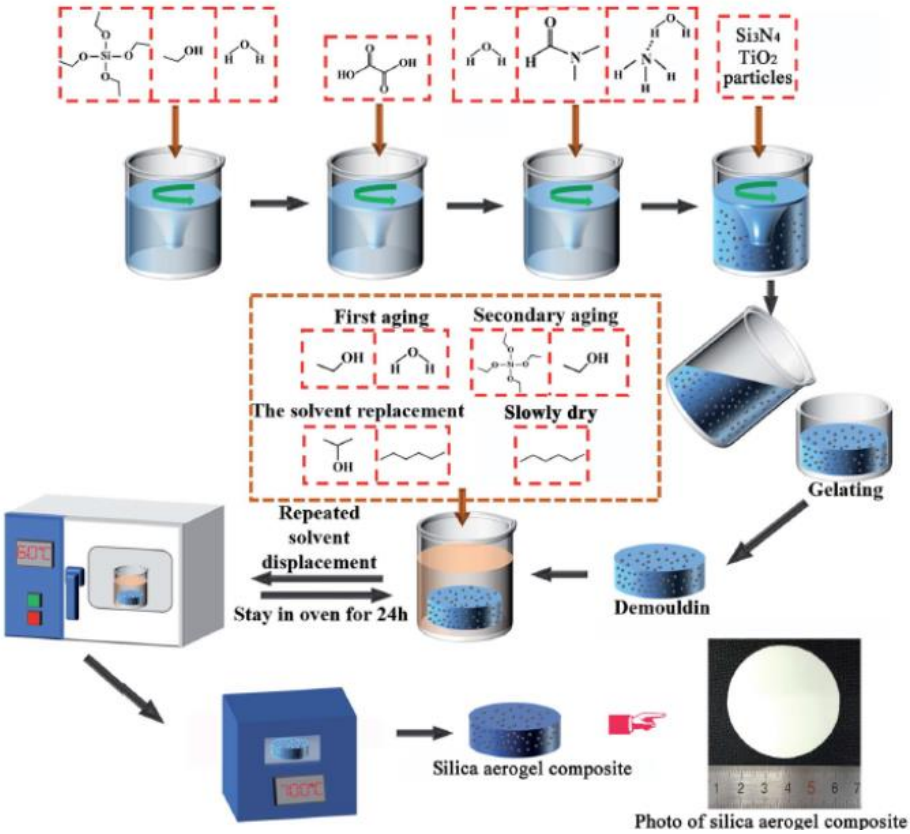


Figure 2. Schematic image of the sample preparation process [27]

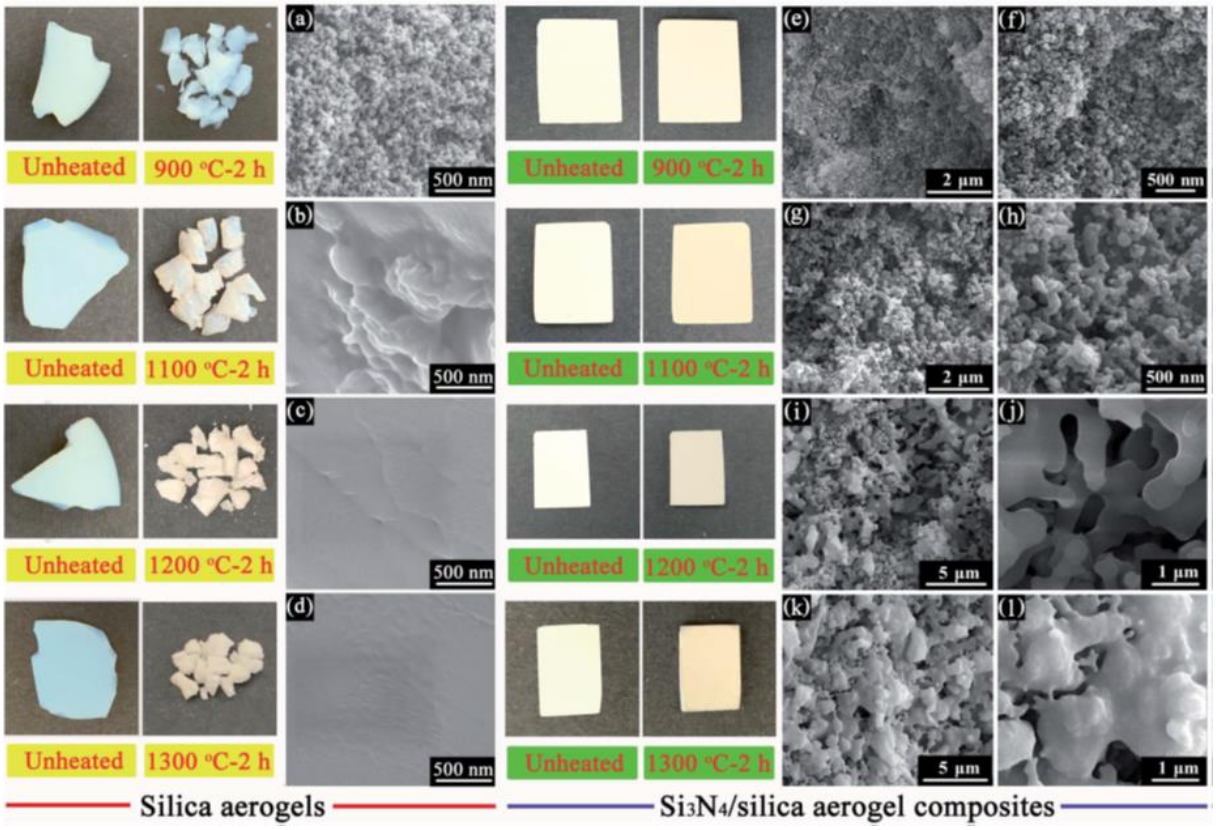


Figure 3. Photographs and SEM images of Si_3N_4-aerogel composite samples heat treated at different temperatures before and after heat treatment [27]

Photographs and SEM images of TiO_2 incorporated Si_3N_4-aerogel composite samples heat treated at different temperatures before and after heat treatment are shown in Figure 3. As seen from the images, after the heat treatment at 900 °C, the pure aerogel sample is brittle. At higher heat treatment temperatures, the silica aerogel within the composite material gradually crystallizes, and the fusion of micro pores causes pore shrinkage and increase in pore size. After heat treatment at 1300 ˚C, Si_3N_4 particle reinforced composites remained intact without cracks. Si_3N_4 particle addition increased the strength.

Conclusion

When the limited studies in the literature are evaluated, the addition of Si_3N_4 improves the thermo-mechanical properties of silica aerogels. However, there is a need for new production techniques that can be produced on a pilot/large scale so that Si_3N_4 reinforced silica aerogel composites can be used commercially in radom applications.

References

1. Kenion, T., Yang, N., & Xu, C. (2021). Dielectric and Mechanical Properties of Hypersonic Radome Materials and Metamaterial Design: A Review. Journal of the European Ceramic Society.
2. https://ucaklar.org/radom/
3. Hrubesh, L. W., Keene, L. E., & Latorre, V. R. (1993). Dielectric properties of aerogels. Journal of materials research, 8(7), 1736-1741.
4. Jain, A., Rogojevic, S., Ponoth, S., Agarwal, N., Matthew, I., Gill, W. N., ... & Simonyi, E. (2001). Porous silica materials as low-k dielectrics for electronic and optical interconnects. Thin Solid Films, 398, 513-522.
5. Maleki, H., Durães, L., & Portugal, A. (2014). An overview on silica aerogels synthesis and different mechanical reinforcing strategies. Journal of Non-Crystalline Solids, 385, 55-74.
6. Schmidt, M., & Schwertfeger, F. (1998). Applications for silica aerogel products. Journal of non-crystalline solids, 225, 364-368.
7. Parmenter, K. E., & Milstein, F. (1998). Mechanical properties of silica aerogels. Journal of non-crystalline solids, 223(3), 179-189.
8. Deng, Z., Wang, J., Wu, A., Shen, J., & Zhou, B. (1998). High strength SiO2 aerogel insulation. Journal of non-crystalline solids, 225, 101-104.
9. Yang, X., Sun, Y., & Shi, D. (2012). Experimental investigation and modeling of the creep behavior of ceramic fiber-reinforced SiO2 aerogel. Journal of non-crystalline solids, 358(3), 519-524.
10. Bertino, M. F., Hund, J. F., Sosa, J., Zhang, G., Sotiriou-Leventis, C., Leventis, N., ... & Terry, J. (2004). High resolution patterning of silica aerogels. Journal of non-crystalline solids, 333(1), 108-110.
11. Rao, A.V., S.D. Bhagat, H. Hirashima, G.M. Pajonk, Synthesis of flexible silica aerogels using methyltrimethoxysilane (MTMS) precursor, J. Colloid Interface Sci. 300 (2006) 279–285.
12. Nadargi, D. Y., Latthe, S. S., Hirashima, H., & Rao, A. V. (2009). Studies on rheological properties of methyltriethoxysilane (MTES) based flexible superhydrophobic silica aerogels. Microporous and Mesoporous Materials, 117(3), 617-626.
13. Aravind, P. R., & Soraru, G. D. (2011). High surface area methyltriethoxysilane-derived aerogels by ambient pressure drying. Journal of Porous Materials, 18(2), 159-165.
14. Yuan, B., Ding, S., Wang, D., Wang, G., & Li, H. (2012). Heat insulation properties of silica aerogel/glass fiber composites fabricated by press forming. Materials Letters, 75, 204-206.
15. Shi, D., Sun, Y., Feng, J., Yang, X., Han, S., Mi, C., ... & Qi, H. (2013). Experimental investigation on high temperature anisotropic compression properties of ceramic-fiber-reinforced SiO2 aerogel. Materials Science and Engineering: A, 585, 25-31.
16. Yang, H., Kong, X., Zhang, Y., Wu, C., & Cao, E. (2011). Mechanical properties of polymer-modified silica aerogels dried under ambient pressure. Journal of non-crystalline solids, 357(19-20), 3447-3453.
17. Guo, H., Meador, M. A. B., McCorkle, L., Quade, D. J., Guo, J., Hamilton, B., ... & Sprowl, G. (2011). Polyimide aerogels cross-linked through amine functionalized polyoligomeric silsesquioxane. ACS applied materials & interfaces, 3(2), 546-552.
18. Sabri, F., Marchetta, J., & Smith, K. M. (2013). Thermal conductivity studies of a polyurea cross-linked silica aerogel-RTV 655 compound for cryogenic propellant tank applications in space. Acta Astronautica, 91, 173-179.
19. Cai, J., Liu, S., Feng, J., Kimura, S., Wada, M., Kuga, S., & Zhang, L. (2012). Cellulose–silica nanocomposite aerogels by in situ formation of silica in cellulose gel. Angewandte Chemie, 124(9), 2118-2121.
20. Boday, D. J., Stover, R. J., Muriithi, B., Keller, M. W., Wertz, J. T., DeFriend Obrey, K. A., & Loy, D. A. (2009). Strong, low-density nanocomposites by chemical vapor deposition and polymerization of cyanoacrylates on aminated silica aerogels. ACS applied materials & interfaces, 1(7), 1364-1369.

21. Hu, L., Wang, C. A., & Huang, Y. (2011). Porous YSZ ceramics with unidirectionally aligned pore channel structure: Lowering thermal conductivity by silica aerogels impregnation. Journal of the European Ceramic Society, 31(15), 2915-2922.
22. Lukianova, O. A., & Sirota, V. V. (2017). Dielectric properties of silicon nitride ceramics produced by free sintering. Ceramics International, 43(11), 8284-8288.
23. Chen, F., Cao, F., Pan, H., Wang, K., Shen, Q., Li, J., & Wang, S. (2012). Mechanical and dielectric properties of silicon nitride ceramics with high and hierarchical porosity. Materials & Design, 40, 562-566.
24. Pham, T. A., Li, T., Shankar, S., Gygi, F., & Galli, G. (2011). Microscopic modeling of the dielectric properties of silicon nitride. Physical Review B, 84(4), 045308.
25. Acikbas, G., & Calis Acikbas, N. (2021). The effect of sintering regime on superhydrophobicity of silicon nitride modified ceramic surfaces. Journal of Asian Ceramic Societies, 9(2), 734-744.
26. Mandal, H., & Acikbas, N. C. (2013). Processing, characterization and mechanical properties of SiAlONs produced from low cost β-Si3N4 powder. KONA Powder and Particle Journal, 30, 22-30.
27. Yang, H., & Ye, F. (2022). Microtexture, microstructure evolution, and thermal insulation properties of Si 3 N 4/silica aerogel composites at high temperatures. RSC advances, 12(19), 12226-12234.

Advanced Engineering Days

aed.mersin.edu.tr

Direct pouring system design and optimization in steel castings

Mustafa Murat Zor [*1], Serdar Kesim[1], Buğra Erbakan[1], Ferhat Tülüce[1], Alper Yoloğlu[1], Kazım Çakır[1]

[1]*ÇİMSATAŞ Çukurova Construction Machinery IND. TRADE. A.S. Mersin, Turkey, foundry@cimsatas.com*

Cite this study: Zor, M. M., Kesim, S., Erbakan, B., Tülüce, F., Yoloğlu, A., & Çakır, K. (2022). Direct pouring system design and optimization in steel castings. 4th Advanced Engineering Days, 111-115

Keywords
Steel casting
Direct pouring system
Modeling and simulation
Casting defects
Filtration

Abstract

In this study, a computer-aided design solid modeling program was used in the design of the Kalpur direct pouring sytem, non-filter bottom direct pouring system, and filtered direct pouring system for steel castings. The flow and solidification simulation of the different direct pouring systems of the casting parts were made in magma flow and solidification program. The study clearly shows that the kalpur direct pouring system has revealed that it plays a significant role in preventing non-metallic casting defects in steel castings, such as sand, gas, and slag. In addition, it has been revealed in the study that the non-filter bottom direct pouring system prevents non-metallic casting defects in steel castings such as the kalpur direct pouring system. Kalpur direct pouring system is recommended to be used in ferrous based castings by FOSECO, was used for the first time in the ÇİMSATAŞ foundry in the steel castings and the appropriate result was obtained.

Introduction

Non-metalic inclusions are important defect in steel casting process. Inclusion defects of steel castings are defects such as slag of oxide and other substances generated in the pouring ladle by the reaction, and sand of molds and cores that flake away and are included in the molten metal, flowing into casting parts and appearing on the surfaces of parts as non-metalic inclusions. In order to reach desirable quality casting part, well design pouring system is the first step. Dimensions of the pouring system need to be calculated according to casting part geometry beceause of each casting part has different shape and an incorrect design is the root cause of the casting defects onto casting parts, mostly. High casting quality depends on a reasonable pouring system design [1-6].

Filtration technology is evolving as the demand for clean, quality castings with high yield, low scrap rates, and low process costs increases. The benefit of filters, especially reticulated foam filters, besides their turbulence-reducing effect, is to prevent non-metallic inclusions such as sand and slag from entering the casting part during pouring the liquid metal into the sand mold [7-15].

Material and Method

The direct pouring system designs of the bearing casting part are based on the modulus and geometry of the casting part. In the study, the material of the part was determined according to the EN 10293 standard and material of the casting part was selected G20Mn6N. The part with three different direct filling systems was molded in the flaskless resin moulding system and cast in the ÇİMSATAŞ foundry. The nominal chemical composition of the casting part was selected as shown in table 1 and the image of the bearing casting part is shown in Figure 1.

Table 1. Chemical composition of the bearing casting part

Content	**% C**	**% Mn**	**% Si**	**% P**	**% S**	**% Cr**	**% Ni**	**% Mo**	**% V**
	0,199	1,593	0,432	0,014	0,007	0,191	0,065	0,035	0,013
Content	**% Cu**	**% B**	**% Ti**	**% Sn**	**% Al**	**% Zr**	**% Nb**	**% Pb**	**% Sb**
	0,071	0,00018	0,001	0,003	0,048	0,002	0,008	0,001	0,000
Content	**% Fe**	**% CEQ**	**% Zn**	**% Ce**	**% Bi**	**% W**	**% As**	**% Co**	**% N**
	97,264	0,528	0,002	0,001	0,000	0,000	0,007	0,008	0,008

Figure 1. Schematic representation of the bearing casting part

In the first direct pouring system study, filtered direct pouring system was designed by placing a dimension of Stelex Pro Ø150x30 mm 10 PPI graphite-based filter was placed inside the BGK6 exothermic feeder in the cope side of the part solid data. Then, the flow and solidification simulation of the part was made at 1600 °C by choosing lip pouring ladle. According to simulation results, filtered direct pouring system was assembled to the casting part model.

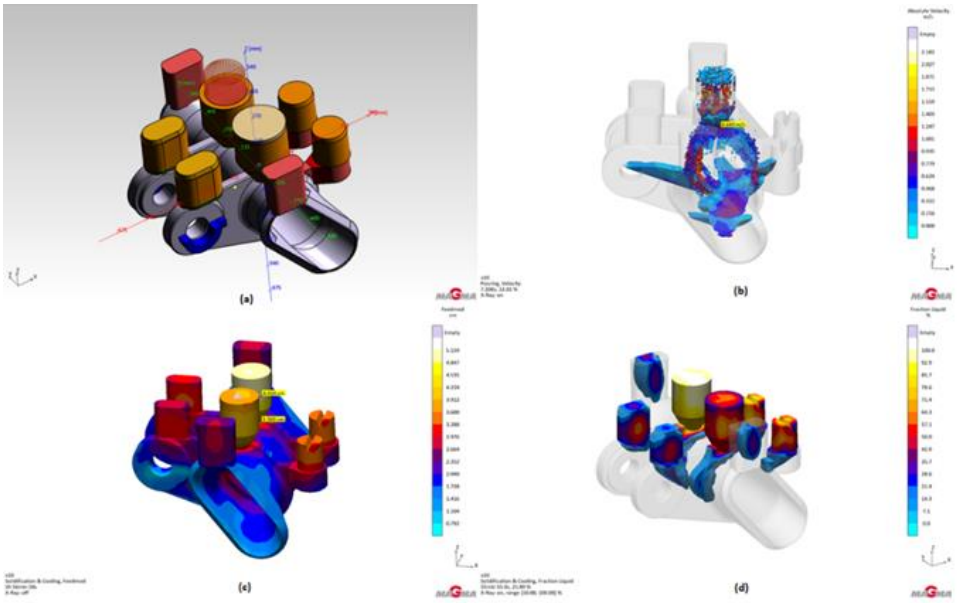


Figure 2. a); The image of the casting part geometry**, (b);** The image of the metal flow and filling simulation of the casting part, **(c);** The image of the feeding mod of the casting part, **(d);** The image of the friction liquid mod of the casting part

After simulation results, one part was molded in the flaskless resin moulding system in the ÇİMSATAŞ foundry and the casting was carried out with a lip pouring ladle at 1600 °C and 38 second. Total weight of the casting part is 590 kg.

Figure 3. The image of poured casting part with the filtered direct pouring system

The part that was poured with the filtered direct pouring system was examined and then a design change was made in the part. In the casting part design, Stelex Pro Ø150x30 mm 10 PPI graphite-based filter was placed inside the Kalminex ZTAE PPE 18/20 exothermic feeder and the filling point of the casting part was revised as kalpur direct pouring system. Kalpur direct pouring system was placed at the lowest point of the cope side in the casting part solid data and flow and solidification simulation was made at 1600 °C by choosing bottom pouring ladle. According to simulation results, kalpur direct pouring system was assembled to the casting part model.

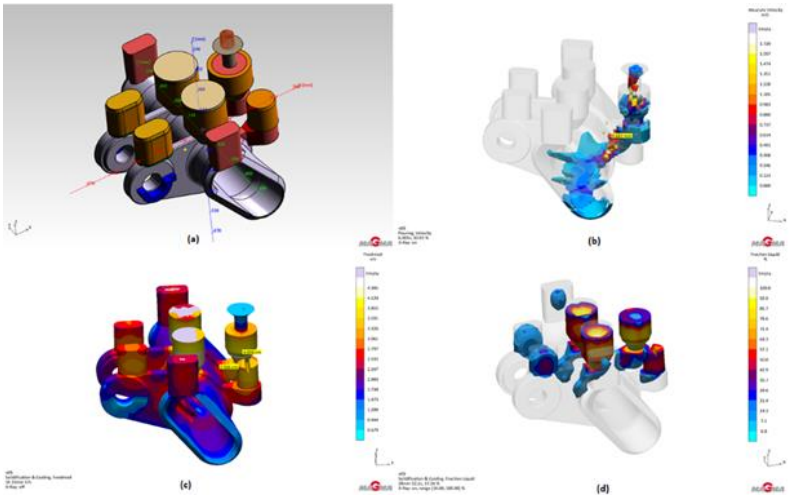


Figure 4. (a); The image of the casting part geometry**, (b);** The image of the metal flow and filling simulation of the casting part, **(c);** The image of the feeding mod of the casting part, **(d);** The image of the friction liquid mod of the casting part

After simulation results, one part was molded in the flaskless resin moulding system in the ÇİMSATAŞ foundry and the casting was carried out with bottom pouring ladle at 1609 °C and 32 second. Total weight of the casting part is 613 kg.

Figure 5. The image of poured casting part with the kalpur direct pouring system

After examining the poured part with the Kalpur direct casting system, the part design was revised as non-filter bottom direct pouring system. In the casting part design, Stelex Pro Ø150x30 mm 10 PPI graphite-based filter was not placed inside Kalminex ZTAE PPE 18/20 exothermic feeder as the casting practice of the ÇİMSATAŞ foundry. The filling point of the casting part was chosen as the same region as the kalpur direct pouring system. Flow and solidification simulation of the casting part was made at 1600 °C by choosing bottom pouring ladle. According to simulation results, non-filter bottom direct pouring system was assembled to the casting part model.

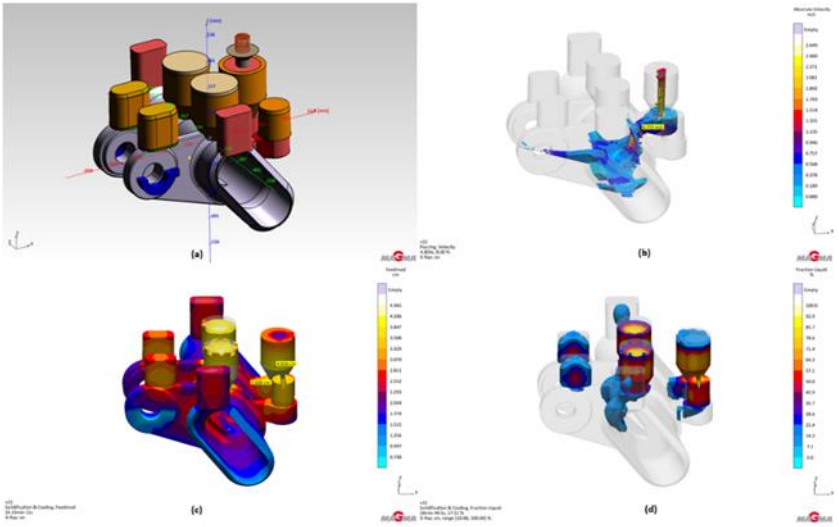


Figure 6. (a); The image of the casting part geometry**, (b);** The image of the metal flow and filling simulation of the casting part, **(c);** The image of the feeding mod of the casting part, **(d);** The image of the friction liquid mod of the casting part

After simulation results, one part was molded in the flaskless resin moulding system in the ÇİMSATAŞ foundry and the casting was carried out with bottom pouring ladle at 1582 °C and 20 second. Total weight of the casting part is 613 kg.

Figure 7. The image of poured casting part with the non-filter bottom direct pouring system

Results

In this article, casting parts were designed according to the simulation results with different direct pouring system versions in steel castings. The findings were obtained from the simulation and casting results of the parts.

- It is found that the simulation results highly represent the actual casting results.
- Cold shut defects were detected as well as non-metallic inclusions on the surface of the part poured with the filtered direct pouring system. And filling time of the casting part is 38 second.
- Poured with kalpur direct pouring system and non-filter bottom direct pouring system, the gross weight of the casting parts has increased from 590 kg to 613 kg. In total, gross weight of the casting parts have increased by 23 kg.
- It has been revealed that pouring design of the casting part and the selection of the pouring region is very important for the surface quality of the casting part.

- With the kalpur direct pouring system, a remarkable improvement has occurred on the surface quality of the casting part.
- With the non-filter bottom direct pouring system, the need for Stelex Pro Ø150x30 mm filter used in the moulding of the part has been eliminated. It has been observed that clean parts can be poured with this system by using bottom pouring ladle too.
- While the filling time of the poured part with the kalpur direct pouring system is 32 seconds, the filling time of the poured part with the non-filter bottom direct pouring system is 20 seconds.
- It has been observed that the surface qualities of the poured parts are close to each other with the kalpur direct pouring system and the non-filter bottom direct pouring system.
- It has been observed that the surface qualities of the poured part are worst with filtered direct pouring system.

Conclusion

Although non-filter bottom direct pouring system for steel castings minimizes the escape of non-metallic inclusions from ladle into the casting part during sand mould filling, the use of ceramic foam filter inside the non-filter bottom direct pouring systems are very important for the scrap rate of the foundries. With the design of the different version of the direct pouring systems in the ÇİMSATAŞ foundry, the surface quality of the casting part has improved positively by design of the kalpur direct pouring system and non-filter bottom direct pouring system. Ceramic foam filters are cost-effective and efficient way to reduce casting defects. The results of the study show that the kalpur direct pouring system and non-filter bottom direct pouring system have best given positive and reliable results in the steel casting process.

Acknowledgements

We would like to thank ÇİMSATAŞ General Manager Mr. Fatih ERDOĞAN, ÇİMSATAŞ Production Group Manager Mr. Necmettin ACAR, ÇİMSATAŞ Foundry Finishing Engineer Mr. Mert DEMİRDÖĞEN, ÇİMSATAŞ Foundry Production Engineer Mr. Vedat UZ, ÇİMSATAŞ Foundry Production Foreman Mr. Sabahattin KAYA, ÇİMSATAŞ Foundry Finishing Foreman Mr. Erdal YALÇIN, ÇİMSATAŞ Foundry Finishing Foreman Mr. Halil Deniz ÇOBAN, ÇİMSATAŞ Foundry Model Shop Foreman Mr. Ahmet AVCI, FOSECO Simulation Engineer Mr. Volkan EVNİ, and FOSECO Sales Engineer Mr. Halis ARTUT

References

1. Campbell, J. (2015). *Complete casting handbook: metal casting processes, metallurgy, techniques and design*. Butterworth-Heinemann.
2. Campbell, J. (2004). *Casting Practice The 10 Rule of Castings. Butterworth-Heinemann*
3. Campell, J. (2012). Stop Pouring, Start Casting. International Journal of Metal Casting Research, 6(3), 7-18
4. Melendez, A. J., Carlson, K. D., Beckermann, C. (2010). Modelling of Deoxidation Formation in Steel Casting, International Journal of Casting Metal Research, 23(5), 278-288
5. Renukananda, K. H., & Ravi, B. (2016). Multi-gate systems in casting process: comparative study of liquid metal and water flow. *Materials and Manufacturing Processes*, *31*(8), 1091-1101.
6. Brown, J. (Ed.). (2000). *Foseco ferrous foundryman's handbook*. Butterworth-Heinemann.
7. Modaresi, A., Safikhani, A., Noohi, A. M. S., Hamidnezhad, N., & Maki, S. M. (2017). Gating system design and simulation of gray iron casting to eliminate oxide layers caused by turbulence. *International Journal of Metalcasting*, *11*(2), 328-339.
8. Janiszewski, K., & Kudliński, Z. (2006). The Influence of Non-Metallic Inclusions Physical State on Effectiveness of the Steel Filtration Process. *steel research international*, *77*(3), 169-176.
9. Foseco Foundry International, SEDEX, the Ceramic Foundry Filter with Foam Structure. Staffordshire, England, 1999.
10. Hsu, F. Y., Jolly, M. R., & Campbell, J. (2009). A multiple-gate runner system for gravity casting. Journal of Materials Processing Technology, 209(17), 5736-5750.
11. Janiszewski, K. (2013). The slenderness ratio of the filter used in the process of liquid steel filtration as the additional parameter of the filter form. *steel research international*, *84*(3), 288-296.
12. Ogawa, K., Kanou, S., & Kashihara, S. (2006). *Fewer Sand Inclusion Defects by CAE* (Vol. 52, No. 158, pp. 1-7). Komatsu Technical Report.
13. Hrabina, D. Effective Filtration of Steel Castings. 7th International Ankiros Foundry Congress, 11-13 September, Istanbul, Turkey
14. Jezierski, J. Dojka, R. & Jenerka, K. (2017). Optimizing Gating System for Steel Castings, 5th International Conference on Modern Manufacturing Technologies in Industrial Engineering, 14-17
15. Foseco Foundry (1999). International, SEDEX, the Ceramic Foundry Filter with Foam Structure. Staffordshire, England.

Advanced Engineering Days

aed.mersin.edu.tr

The water footprint of Bursa province

Afnan Mohsin [*1], **Sinan Uyanik** [1]

[1]*Bursa Technical University, Environmental Engineering, Türkiye, afnan.kamel@yahoo.com, sinan.uyanik@btu.edu.tr*

Cite this study: Mohsin, A., & Uyanık, S. (2022). The water footprint of Bursa province. 4th Advanced Engineering Days, 116-118

Keywords
Water footprint
Bursa
Domedtic
Agricultural
Industrial
Gri water footprint
Blue water footprint

Abstract

Water is the most important environmental resource and is invaluable because it is an important factor for the continuation of life. The proposed water footprint as an indicator for assessing the allocation of freshwater resources to a producer or consumer and it takes into account direct and indirect water consumption and helps in managing water resources. The WF of Bursa province was calculated. Its total surface area is 11,027 square kilometers. The total population of the province in 2021 is 3 million 56 thousand. In the calculations, domestic, agricultural and industrial water footprints water footprints were evaluated separately.The average WF of Bursa province was found 105,417 billionm3. Throughout the province, 77% of the WF is composed of WF Industrial, 21% is WF domestic and 2% is WFagricultural. The average per capita water footprint of Bursa province was found to be 7220 m3 year-1. The total water footprint of the industrial sector has been calculated as 80.952 billion m3. The amount of industrial gray water footprint in Bursa has been calculated as 80.822 billion m3. Total domestic water footprint is calculated as 22.0645 billion m3. Gray water footprint was determined as the majority of the domestic water footprint (75%). Direct and indirect water footprints account for 24% and 1% of the total domestic water footprint, respectively. It is important to reduce the use of blue water in agriculture, domestic and industrial sectors.

Introduction

Water is the most important environmental resource and is invaluable because it is an important factor for the continuation of life as a result of the need for living organisms to survive. Only 0.3% of the total fresh water resources are suitable for human use on a global scale [1]. Therefore, many scientists and researchers have studied this subject and how to reduce water waste with the increase in global warming, the lack of rain and the increase in the population. The proposed water footprint as an indicator for assessing the allocation of fresh water resources to a producer or consumer from a virtual water perspective [2]. The water footprint is divided into three components: the blue, green and gray water footprint. The blue water footprint is the volume of fresh water that has evaporated from surface and ground water resources. The green water footprint is the volume of water evaporated from rainwater stored in the soil. Gray water footprint is the volume of water required to dilute pollutants [2]. Muradoğlu analyzed the water footprint in the Diyarbakir region between 2008 and 2019. He found that the water footprint in the agricultural sector consumes most of the region's water resources [3]. Zhao and others. They assessed the water footprint of Leshan City in China from 2001 to 2012. They found that the production of crops and animal products are among the most important sectors that consume large amounts of water [4]. The aim of this study is to calculate and analyze the water footprint of production and consumption in Bursa, and to calculate green, blue and gray water footprints by evaluating plant and animal production and domestic and industrial water use separately. The purpose of water footprint calculation and evaluation is to see the impact of certain activities or products on water scarcity and pollution, and formulate responses to these effects to prevent them and avoid unsustainable water use.

Material and Method

In calculating the water footprint of any area, the accuracy of the analyzes is directly related to the quality of the data used. In this study, many data obtained from national and international institutions and databases in Bursa province were used. The water footprint approach developed by Hoekstra It was used in this work to calculate the water footprint [2]. The total area water footprint (WFtotal) consists of the crop production water footprint (WFcrop), the livestock water footprint (WFlivestock), the domestic water footprint (WFdomestic) and the industrial water footprint (WFindustrial).

Water footprint analysis of crop production and livestock production

The agricultural products data for Bursa province for the year 2020 were obtained from [5]. The water footprint of each agricultural product was calculated using the method of Chapagain and Hoekstra [6]. The CROPWAT program developed by the Food and Agriculture Organization of the United Nations was used [7]. ETO, reference evapotranspiration values were obtained by entering climatic data into the CROPWAT software using the Penman-Monteith method [8]. Monthly mean climate and precipitation data were obtained from the long-term CLIMWAT database for the period (1971-2000) [9]. The vegetative evapotranspiration (ETc) values of the herbal products were calculated by entering the coefficient (Kc), growth period lengths, ET0 values and rainfall data into the CROPWAT 8.0 software. The blue and green ET values were estimated using equation 1, 2. Equation (3) was used to calculate the consumption of blue and green plant water, m^3/ha (CWU). The green and blue water footprint of each vegetable product (m3/ton) was calculated using equation (4). Y is crop yield. The green and blue water footprint for each product was done by using the tons of the plant production using equation (5). The water footprint of plant production was calculated by collection the green and blue water footprints of all plants. To calculate the animal's water footprint, the total number of each of cattle, sheep, and poultry raised in the region [5], and the global average water footprint, were calculated from the literature published by Mekonnen and Hoekstra [10]. An animal's water footprint was calculated by multiplying the average annual water footprint of an animal by its annual number.

$$ET_{blue}=\max(0,ETc-P_{eff}) \quad (1)$$

$$ET_{green}=\min(0,ETc,P_{eff}) \quad (2)$$

$$CWU_{blue,green} = 10 \times \sum ET_{blue,green} \quad (3)$$

$$WF_{blue,green}= CWU_{blue,green}/ Y \quad (4)$$

$$WF_{blue,green}= WF_{blue,green} \times \text{production} \quad (5)$$

Water footprint of domestic and Water Footprint of Industries

When calculating the household water footprint, the direct use of water and the indirect use of water by individuals must be taken into account. The direct water footprint of individuals was calculated by means of a questionnaire that includes the number and duration of activities people use on a daily or annual basis such as showering, washing dishes, watering the garden and flushing the toilet. The amount of effluent water was obtained directly for each activity from the literature [11]. By collection the volumes of water flowing for each activity, the direct water footprint of each person was calculated. The indirect water footprint is the use of water related to the production of goods and services used by the consumer such as food consumption, clothing consumption and energy consumption. The quantities of each individual's diet and other consumables such as clothes, shoes and household energy consumption were done by making a questionnaire to know the quantities consumed annually by the individuals. The average global water footprint of the diet consumed by a resident of Bursa governorate was used [10]. In this study, the total amount of ground and surface water allocated to industry throughout the province (including districts) was used to calculate the blue water effects of industries in Bursa. to calculate the gray water footprint of the industrial and domestic sector, the total amount of wastewater from industries was taken and homes and the concentrations of pollutants it contains used [12]. Equation (6) was used to calculate the gray water footprint of the domestic and industrial sectors.

$$WF_{gri}=\frac{W}{C_{max}-C_{net}} \quad (6)$$

W is the amount of pollutant load, C_{Max} (ton\year) is the maximum acceptable pollutant concentration, C_{nat}(ton\year), is the natural concentration in the receiving water body.

Results

The average annual water footprint for the Bursa region was determined to be 105.417 billion cubic meters for the year 2021. The industrial sector is the most water consuming sector as it is responsible for 77% of the total water footprint. The total industrial water footprint reached 80.95 billion cubic meters. The domestic sector ranks second in terms of water consumption. The household water footprint amounted to 22.06 2,604 billion cubic meters / year, which constitutes 22% of the total water footprint of the governorate, and the gray household water footprint was the first contributor in terms of water consumption required to reduce the number of pollutants in wastewater. Food was the second most important contributor. The water footprint from food consumption was 1,580 m3/year in indirect water consumption. The agricultural water footprint amounted to 2.429 billion cubic meters/year. Wheat is the most important crop in plant production, being responsible for 18% of water consumption in the vegetable sector, followed by olives. The water footprint of livestock production is 0.865 billion cubic meters/year. Cattle are the largest consumer of water in livestock production, as they are responsible for 55% of water consumption.

Conclusion

The results show that industrialization, rapid urbanization and population increase in Bursa require a large amount of fresh water resources. It was found that the water footprint in the industrial sector is the largest sector in water consumption. It was found to have a high-water footprint compared to the literature and other regions, due to the fact that Bursa has as many factories as it contains 7000 factories. It was found that the water footprint in domestic consumption is the second largest in water consumption, due to the bulk of the water consumption needed to dilute pollutants in wastewater. Food is the main component in the indirect consumption of water. Therefore, it is important to know that a food ingredient has a higher water footprint that can be avoided, reduced, or substituted. Where meat is considered to have a higher water footprint, this is due to the consumption of feed which has a higher water footprint. As for direct use, it was found that a large part of it is due to long periods of showering. As for the agricultural sector, it was found that the consumption of water from rain water is approximately equivalent to the consumption of surface and ground water. As for the animal sector, the highest water footprint is found from livestock, and the reason is due to livestock consumption of feed with a higher water footprint. The high-water footprint of the region depends mainly on the characteristics of the climate, the hypothetical water content of the produced products used, the lifestyle, and food habits of the inhabitants of the region.

References

1. The State of Food and Agriculture (2020). The State of Food and Agriculture 2020. Overcoming water challenges in agriculture. Rome, Italy. https://doi.org/10.4060/cb1447en.
2. Mekonnen, M. & Hoekstra, A. Y. (2011). National water footprint accounts: The green, blue and grey water footprint of production and consumption. Volume 1: Main Report. Available: https://digitalcommons.unl.edu/wffdocs
3. Muratoğlu, A. (2019). Üretimin su ayak izinin incelenmesi: Diyarbakır ili için bir vaka çalışması. *Gazi Üniversitesi Mühendislik Mimar. Fakültesi Dergisi*, 35(2), 845–858, https://doi.org/ 10.17341/GAZIMMFD.543933.
4. Zhao,R. He,H. & Zhang, N. (2015). Regional water footprint assessment: A case study of Leshan City. Leshan . *Sustainability (Switzerland)*, 7(12). 16532–16547. https://doi.org/10.3390/su71215829.
5. Bursa İl Tarım ve Orman Müdürlüğü. (2020). Brifing Dosyasi Bursa Valiliği İl Tarım ve Orman Müdürlüğü.Bursa. https://bursa.tarimorman.gov.tr/Link/37/Faaliyet-Raporlari
6. Chapagain, A. K. & Hoekstra, A. Y. (2004). Water footprints of nations Value of Water. Research Report Series No. 16. PublisherUnesco-IHE Institute for Water Education.
7. FAO. Crop Water and Irrigation Requirements Program of FAO (CROPWAT) Food and Agriculture Organization. Rome. https://www.fao.org/land-water/databases-and-software/cropwat/en/.
8. Yu Xu, C. & Chen, D. (2005). Comparison of the Thornthwaite method and pan data with the standard Penman-Monteith estimates of reference evapotranspiration in China. China. https://www.academia.edu/15576553.
9. FAO Land & Water. CLIMWAT. Climatic Database to be Used with CROPWAT. https://www.fao.org/land-water/databases-and-software/climwat-for-cropwat/en/ .
10. Mekonnen, M. M. & Hoekstra, A. Y. (2012). A Global Assessment of the Water Footprint of Farm Animal Products. *Ecosystems*, 15(3), 401–415. https://doi.org/10.1007/S10021-011-9517-8/TABLES/4.
11. DeOreo, W. B., Inc, A., & Kiefer, J. (2016). Residential End Uses of Water, Version 2: Executive Report. Published by Water Research Fouandation. https://www.circleofblue.org/wp content/uploads/2016/04/WRF_REU2016.
12. Bursa Çevre ve Şehircilik İl Müdürlüğü. (2020). Türkiye Cumhuriyeti Bursa Valiliği Çevre ve Şehircilik İl Müdürlüğü Bursa İli 2019 Yili Çevre Durum Raporu. https://webdosya.csb.gov.tr/db/ced/icerikler/bursa_2019_cevre_durum_raporu-20201217210215.pdf.

Advanced Engineering Days

aed.mersin.edu.tr

Consolidation characteristics of clayey soils improved with rice husk ash

Abuzer Buluş Karakurt *[1], **Özgür Lütfi Ertuğrul** [1]

[1]*Mersin University, Civil Engineering Department, Türkiye, buluskarakurt@gmail.com, ertugrul@mersin.edu.tr*

Cite this study: Karakurt, A. B., & Ertuğrul, Ö. L. (2022). Consolidation characteristics of clayey soils improved with rice husk ash. 4th Advanced Engineering Days, 119-122

Keywords
Soil Improvement
Reinforcement
Rice Husk Ash
Consolidation

Abstract

Rice husk is a by-product of the rice milling process. About one hundred million tons of rice husk per year are produced worldwide. In order to reduce the volume of waste, rice husk is burned as a fuel in ovens for rice drying, the burning effect volatilizes the organic compounds and water of the rice husk, and about 20% of the mass remains as rice husk ash. Rice hush ash has pozzolonic effect and can be used as an additive in concrete. Besides, the improvement of soils through addition of rice husk ash and lime was studied in several researches. In the current study, consolidation characteristics of soils improved with rice husk ash, an organic pozzolanic waste product, were investigated through laboratory studies.

Introduction

One of the consequences of increasing urbanization is the increase in building loads. The stresses caused by the structural loads on the soils cause compression. As a result of the compression and displacement of soil particles under load, settlement occurs in the ground. Time dependent settlements due to decrease in volume of water in the voids is called consolidation settlement [1].

Depending on soil type, various amounts of deformations are likely to develop in building foundations. These deformations cause the stress conditions of the soil under the structure to change. Due to the increase in stress conditions, settlements occur in the ground under the structure. Contrarily, swelling can also be observed as a result of the decrease in the stresses in the soil mass for any reason or the changes that may occur in the water levels. Engineering structures built on soils with high potential for settlement and swelling are exposed to forces arising from the swelling properties of soils. This affects the load bearing elements of the buildings while causing further deformations in the structure. Changes in the volume of the soil mass due to settlement and swelling properties are one of the most influential factors in geotechnical design [2].

In this study, the use of rice husk ash obtained by burning rice hulls, which is an organic waste product, in soil improvement works will be studied. Rice husk is an organic waste product resulting from the removal of the grains of rice. About one hundred million tons of rice husk per year are produced worldwide. In order to reduce the volume of waste, rice husk is burned as a fuel in ovens for rice drying, the burning effect volatilizes the organic compounds and water of the rice husk, and about 20% of the mass remains as rice husk ash. Rice husk ash, one of the pozzolanic additives, is obtained by burning rice husks. Clayey soils have significant potential of consolidation settlements and swelling problem depending of the type of clay minerals dominant in the soil mass. It is well known that clayey soils do not respond the immediate compactive activities but exhibits time dependent settlement [2]. When the clayey soils with low water permeability are subjected to vertical loads, the porosity decreases due to water escaping out of the soil voids. There are many studies in the literature concentrating on the consolidation characteristics of clayey soils [3-6]. The aim of this study is to investigate the consolidation characteristics of low plasticity clays after mixing with rice husk ash as an additive material.

Material and Method

The phenomenon of compaction of soils under constant stresses by removing the water in their bodies, depending on time, is called consolidation. Over a period of time, the gradual increase in effective stress in the soil layer will cause settlement. This event is referred to as consolidation. This process continues until the excess pore water pressure caused by an increase in total stress is completely dissipated. The simplest consolidation case is one-way consolidation under the condition of zero lateral deformation. The swelling process, which is the opposite of consolidation, is a slow increase in the volume of a soil under negative excess pore water pressure [7]. The consolidation coefficient (C_c) is determined by a test apparatus called as oedometer.

The consolidation test begins by placing the soil samples in the consolidation ring with sufficient compression. The surfaces of the samples placed in the consolidation rings are smoothed and weighed with the help of a balance. Then, the soil sample placed in the ring is placed in the consolidation cell, bounded by porous stones from the bottom and top, and the cell is filled with water. The cells filled with water are placed in the consolidation instrument and a reading clock is placed on it to read the vertical deformations. Then, the necessary loads are placed on the lever arm of the consolidation tool and the loading process is started and the deformations are read at regular intervals for 24 hours. At the end of 24 hours, the next load is placed on the lever arm of the consolidation tool and the loading is started again and the readings are taken again for 24 hours. In our experiment, appropriate weight loadings were made corresponding to 25, 100, 400 and 1600 KPa pressures and the necessary readings were taken.

After the loading tests are completed, the soil samples removed from the consolidation tool are weighed with the help of scales and left to dry in the drying oven for 24 hours. As a result of all these experiments, the desired value is obtained by drawing the vertical stress versus void ratio graphs.

In this study, the effect of rice husk ash on the consolidation settlement and swelling characteristics of low plasticity clayey soils was investigated by adding 5% and 10% by weight rice husk ash to the natural soil sample, respectively. The soil samples we used in the experiment were cured for 3 days by keeping the humidity constant in the desiccator. None of the samples were mixed with lime or cement within the scope of this study.

Results

Based on the data obtained from the tests performed, the vertical stress versus void ratio graphs of the natural sample and the samples with 5% rice husk ash and 10% rice husk ash added, respectively, are depicted in Figs 1, 2 and 3. The compression (C_c) and swell (C_s) indices calculated from the graphs are shown in Table 1.

Table 1. Test results to compare the compression and swell indices for the tested samples

Test Name	Compression coefficient (C_c)	Swelling coefficient (C_s)	Water Contents (%)
Natural soil sample	7.152E-05	1.542E-05	13.15
%5 rice husk ash added sample	8.553E-05	1.497E-05	15.94
%10 rice husk ash added sample	9.637E-05	1.507E-05	18.55

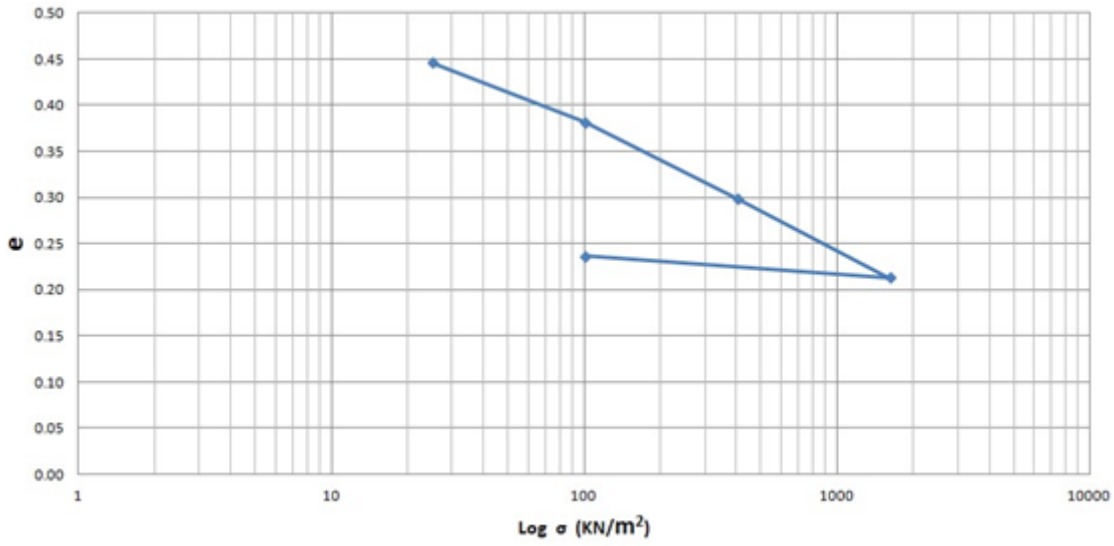


Figure 1. The vertical stress versus void ratio graph for the natural soil sample

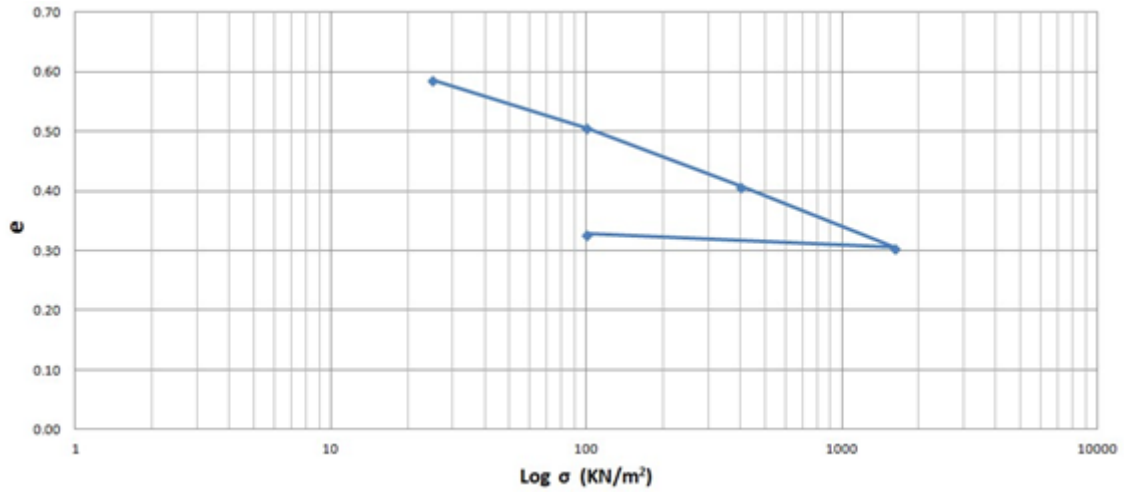


Figure 2. The vertical stress versus void ratio graph for the %5 rice husk ash added clayey soil

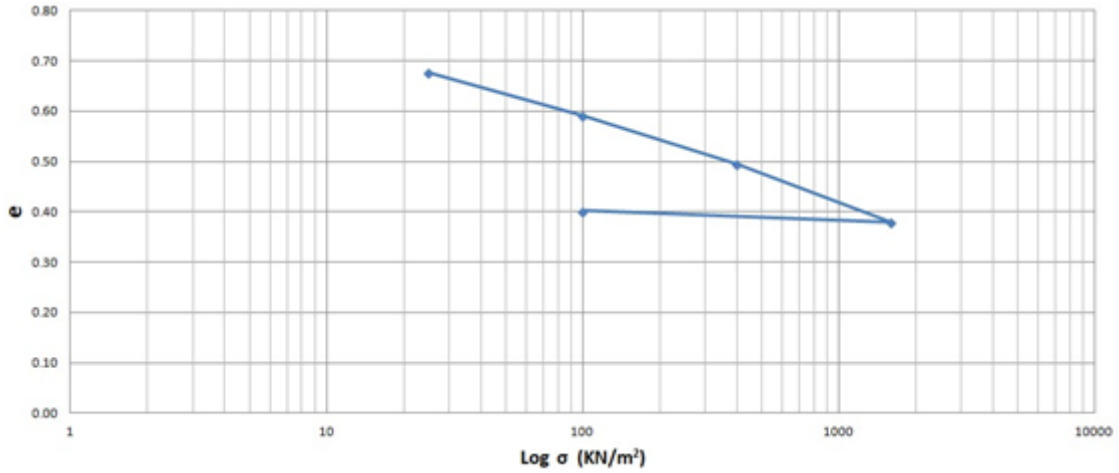


Figure 3. The vertical stress versus void ratio graph for the %10 rice husk ash added clayey soil

When the results of the consolidation test were investigated, it was observed that the smallest compression coefficient (C_c) was obtained in the natural sample and the highest compression coefficient was obtained in the 10% rice husk added sample. This can be explained with the high-water content of the %5 and %10 rice hush ash added soils. As the water content of the samples increases, the amount of dry mass decreases and the void ratio increases. Increasing void ratios cause an increase in the settlement coefficients in the experiments. In the consolidation test we have performed, it is observed that the settlement coefficients tend to increase because the water contents of the samples are different and higher than each other. In order to reduce this increase, it is necessary to keep the water contents constant or close to constant.

Conclusion

In the consolidation tests performed; it is seen that rice husk ash has some effect on the consolidation characteristics of low plasticity clayey soils. However, it is not realistic to come to solid conclusions regarding the effect of rice hush ask additive on the consolidation characteristics of the soils since there is a discrepancy in the water content of the samples in this study. However, it is clear that rice hush ash is modifying the consolidation indices of clayey soils due to its pozzolanic effect which can provide some amount of improvement in the soils.

The number of tests should be increased to get more realistic conclusion for this. As an anticipated future study, it is planned to carry out further consolidation tests on the samples with identical water content.

References

1. Aysu, Ş. (2020). Yüksek plastisiteli kil zeminlerde cam lifi katkısının zeminin mukavemet, permeabilite ve konsolidasyon özelliklerine etkisi. Konya teknik Üniversitesi Fen Bilimleri Enstitüsü.
2. Yılmaz, M., & Çelik, S. (2013). Kil zeminin şişme basıncı ve konsolidasyon özelliklerine öğütülmüş kumun etkisinin araştırılması. Kahramanmaraş Sütçü İmam Üniversitesi Mühendislik Bilimleri Dergisi, 15(2), 32-36.
3. Altundağ, Y. (2016). Siltli zeminlerin konsolidasyon karakteristikleri. Sakarya Üniversitesi Fen Bilimleri Enstitüsü.
4. Erşan, H., & Yıldırım, H. (2011). Tekrarlı yüklemeler etkisi altında zeminlerin konsolidasyonu. İTÜDERGİSİ/d, 5(3).
5. Dong, Y., Lu, N., & Fox, P. J. (2020). Drying-induced consolidation in soil. Journal of Geotechnical and Geoenvironmental Engineering, 146(9), 04020092.
6. Kar, R. K., Pradhan, P. K., & Naik, A. (2012). Consolidation characteristics of fiber reinforced cohesive soil. Electronic Journal of Geotechnical Engineering, 17, 3861-3874.
7. Yılmaz, I., Keskin, İ., & Yıldırım, M. (2014). Zemin mekaniği: laboratuvar deneyleri ve problemler. Seçkin Yayıncılık.

Advanced Engineering Days

aed.mersin.edu.tr

An investigation on the consistency limits of cohesive soils improved with rice husk ash

Abuzer Buluş Karakurt *[1], **Özgür Lütfi Ertuğrul** [1]

[1]*Mersin University, Civil Engineering Department, Türkiye, buluskarakurt@gmail.com, ertugrul@mersin.edu.tr*

Cite this study: Karakurt, A. B., & Ertuğrul, Ö. L. (2022). An investigation on the consistency limits of cohesive soils improved with rice husk ash. 4th Advanced Engineering Days, 123-126

Keywords
Rice Husk Ash
Consistency Limits
Liquid limit
Reinforcement
Soil İmprovement

Abstract

Superstructure loads are transferred to the ground via foundations. If the ground is not capable of supporting the high building loads, serious structural problems may arise. In order to overcome these problems, ground improvement works are considered as the first alternative before using deep foundations since deep foundation constructions cause significant additional cost to the project budgets. Soil improvement is a generalized definition for the applications-based targeting to increase the engineering properties of the soils. Consistency limits are the water content values of cohesive soils at which the behavior changes from liquid to plastic or plastic to solid. These values significantly affect the mechanical behavior of soils. For this reason, ground improvement methodologies specifically developed to alter the consistency behavior of soils can be an economic alternative in construction projects. Within the scope of this study, the consistency limits of the cohesive soils improved with rice husk ash, an organic waste product, were investigated by laboratory studies.

Introduction

Any structure transfers the superstructure loads to the ground through foundations. If the ground has sufficient bearing capacity, it will be able to meet the loads coming from the superstructure without any problems. However, in some cases, the foundation soils may not have enough strength to withstand these loads from the superstructure. In such cases, it is necessary to carry out a number of ground improvement to make the soils sufficient in terms of bearing capacity.

Rice husk is an organic waste product resulting from the removal of the grains of rice (Figure-1). Rice husk ash, one of the natural pozzolanic additives for concrete, is obtained by burning rice husks [1]. As can be seen in Table-1, rice husk ash contains high amount of silicon oxide [2]. In this study, the use of rice husk ash, which is an organic waste product having pozzolanic character, in soil improvement works will be examined.

Tablo 1. Content of rice husk ash

Constituents	Rice husk ash (%)
SiO_2	89.18
Al_2O_3	1.75
Fe_2O_3	0.78
CaO	1.29
MgO	0.64
K_2O	1.38
Weight loss after burning	2.05

Figure 1. Rice husk ash

There are studies in the literature regarding the use of rice husk ash in soils. Based on these studies, it can be told that there is an increase in CBR and unconfined compressive strength as well as the shear strength and cohesion values of the soils [1-4].

Material and Method

Consistency limits are the limits of water content used to describe soil behavior. If too much water is given to the cohesive soil, it behaves as liquid, in this case it has no shear resistance. If the soil is left to dry, it gains a certain shear resistance. The water content of the soil at this time of transition is called the liquid limit [5]. The liquid limit in this context is defined as the water content of the soil at the moment when it changes from a plastic consistency to a flowing form. The liquid limit can be estimated with two different laboratory tests namely Atterberg Limits Test (Casagrande test) or fall cone test. Within the scope of this study, liquid limit values were obtained by the Casagrande method.

In Casagrande test, firstly, cohesive soil samples are mixed with water and a homogeneous mixture is formed as shown in Figure-2. Sample is placed in the plate of the Casagrande instrument and its surface is leveled parallel to the base with the help (Figure-3). With the help of the flattened specimen grooving knife, a 2 mm wide cavity is opened from top to bottom as in Figure-4. The arm of the Casagrande tool is dropped from a height of 1 cm at a rate of 2 revolutions per second. As soon as the length of the opened cavity is closed by approximately 13 mm, the experiment is finished and the number of strokes is noted (Figure-5). A quantity of sample is taken into the aluminum container and the water content is determined. The test is repeated 5 more times using the same sample while increasing the water content. At the end of the test, a graph is drawn and the water content corresponding to 25 hits in the graphs is considered as the liquid limit of the sample used.

Figure 2. Soil sample

Figure 3. Placed soil sample

In this study, firstly, a liquid limit test was carried out on the soil sample formed by using 50% by weight of clay and sand. Then, 10% by weight of rice husk ash was added on the same sample and the experiment was repeated and the results were presented.

Figure 2. Soil sample to ready for test

Figure 3. Soil sample to end of test

Results

Based on the data obtained from the tests, liquid limit graph of the natural sample and the 10% by weight rice husk added sample are shown in Figs. 6 and 7.

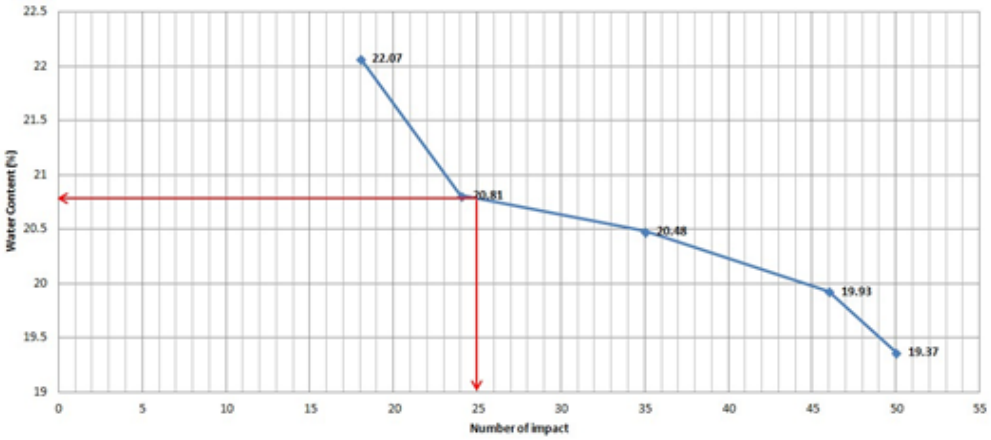


Figure 4. Casagrande test results for the soil without rice husk ash

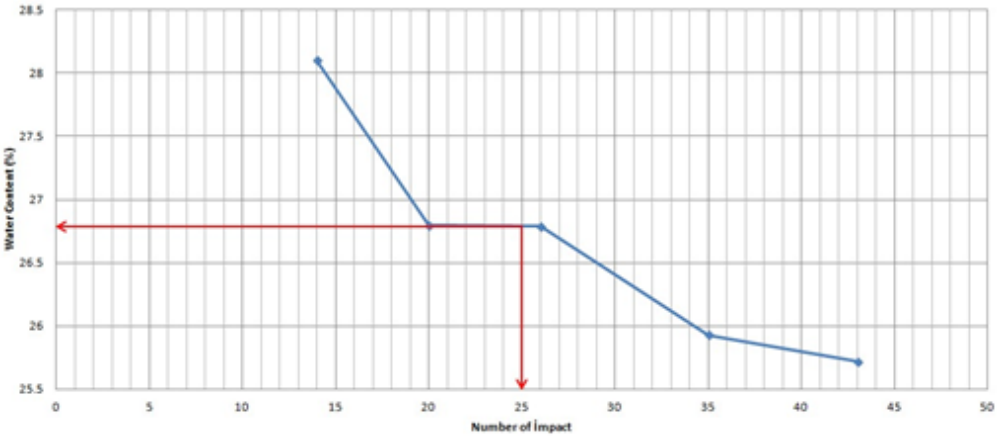


Figure 5. Casagrande test results for the soil with rice husk ash

As can be seen from these figures, liquid limit of the natural soil is found as approximately 20.8% whereas the liquid limit value of the soil sample with rice husk additive is obtained as 26.8%. Test results indicated that the plastic limit for the clayey soils with rice hush ash is higher compared to the unimproved soil. The water absorbtion capacity of the rice husk ash is significantly high causing the soil sample to behave liquid at relatively high-water content values. Plastic limit of the fine-grained soils is an important parameter defining how soils behave at different water contents. Therefore, this effect should be considered in ground improvement projects performed with using rice husk ash.

References

1. Aygün, T. (2019). Siltli bir zeminin kireç ve pirinç kabuğu külü ile iyileştirilmesi. Kırklareli Üniversitesi Fen Bilimleri Enstitüsü.
2. Muntohar, A. S., Widianti, A., Hartono, E., & Diana, W. (2013). Engineering properties of silty soil stabilized with lime and rice husk ash and reinforced with waste plastic fiber. Journal of materials in civil engineering, 25(9), 1260-1270.
3. Basha, E., A., Hashim, R., Mahmud, H., B., Muntohar, A., S., (2004). "Stabilization Of Residual Soil with Rice Husk Ash and Cement." Construction Of Building Materials, 19.6, 448-453.
4. Çelik, F. (2016). An İnvestigation Of Rheological and Mechanical Properties of Cement Base Grout Mixed with Rice Husk Ash. Doktora Tezi, Gaziantep Üniversitesi Fen Bilimleri Enstitüsü, Gaziantep.
5. Küçük, F. (2021). Yüksek Performanslı polipropilen fiber katkısının kil zeminin drenajsız kayma direncine Etkisinin Incelenmesi. Sakarya Üniversitesi Fen Bilimleri Enstitüsü.

Advanced Engineering Days

aed.mersin.edu.tr

Comparison of the performance of single energy piles and group energy piles in summer mode

Fatma Dülger Canoğulları [*1], **Özgür Lütfi Ertuğrul** [2]

[1] *Toros University, Civil Engineering Department, Türkiye, fatma.dulger@toros.edu.tr*
[2] *Mersin University, Civil Engineering Department, Türkiye, ertugrul@mersin.edu.tr*

Cite this study: Canoğulları, F. D., & Ertuğrul, Ö. L. (2022). Comparison of the performance of single energy piles and group energy piles in summer mode. 4th Advanced Engineering Days, 127-129

Keywords
Energy pile
Finite element method
Geothermal energy

Abstract

Nowadays, the exploration for new energy sources has accelerated because of the increase in the world population and the decrease in current fossil fuel-based energy sources. Interest in geothermal energy is increasing day by day in terms of being both environmentally friendly and economical. Another application that has become common in recent years, especially in European countries, is thermal energy recovery systems that take advantage of the heat energy potential that is already included in shallow soils. As a multi-purpose engineering solution, energy piles can be applied as a variation of the mentioned heat exchanger systems. In this study, comparison of the performance of single energy pile and group energy piles in summer season mode (heat storage mode) was investigated using GeoStudio TEMP/W and SEEP/W Finite Element Method Software.

Introduction

Solar and wind energy have considered as the primary renewable energy sources in the current decades. However, the geothermal heat potential of the earth is also another important renewable energy source. Generally, the temperature of shallow soils from a certain depth is stable during the year and is not submitted to seasonal effects. This advantage allows the heat potential available to be used for both heating and cooling purposes in buildings [1]. To take advantage of this stable thermal medium, shallow ground heat recovery systems have been developed. These systems aim to use the heat potential with energy transfer pipes placed on the ground horizontally or vertically. The heat systems called energy piles have emerged as a variation of the mentioned heat recovery systems [2]. A conceptual sketch showing the geothermal pile system is depicted in Figure 1.

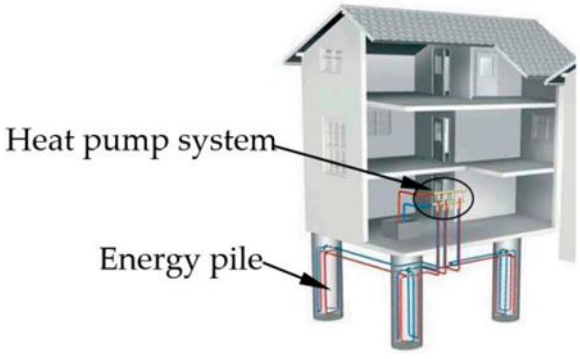


Figure 1. Schematic drawing of geothermal piles system [3]

Material and Method

In recent years, studies on energy piles have been increasing rapidly. Most of the studies are focused on numerical modeling because the experimental investigation of energy piles is both demanding and economically disadvantageous [4]. In this study, it is aimed to evaluate the energy performance and efficiency of energy piles produced in single and group styles for the summer period, based on the numerical method. Single energy pile and energy piles group's model geometries designed in TEMP/W and SEEP/W [5-6] are shown in Figs. 3 and 4.

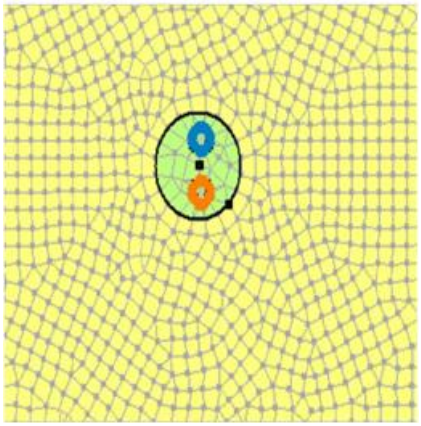


Figure 2. Single energy pile [6]

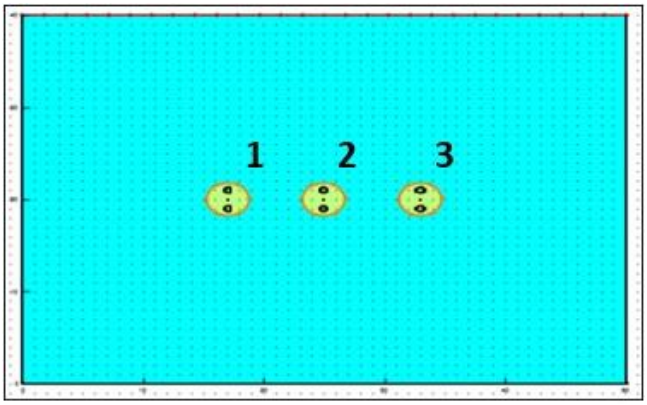


Figure 3. Energy piles group [6]

Results and Discussion

Within the scope of this study, the efficiency obtained from single energy piles and group energy piles were analyzed in summer mode (heat storage mode) using TEMP/W and SEEP/W software. It is seen in Figure 5 that the temperature contours move in the flow direction depending on the flow direction in the aquifer for plan analysis. The percentages of energy efficiency of single energy pile depending on time in summer mode are shown in Table 2.

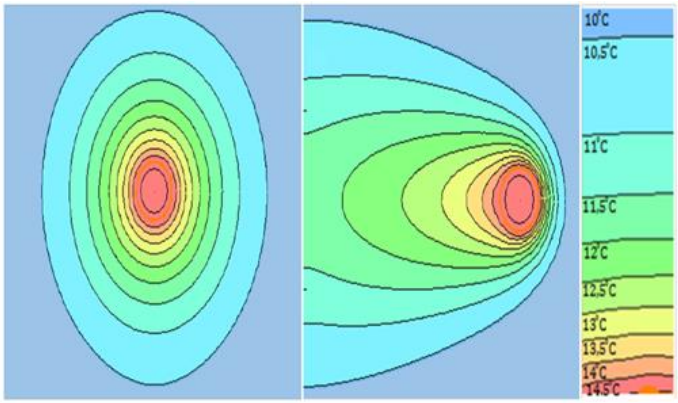


Figure 4. Single energy pile in summer mode (heat storage mode) a) Temperature profile after 360 days (no groundwater flow) b) Temperature profile after 360 days (ground water flow)

Table 2. Percentages of energy efficiency of single energy pile depending on time in summer mode (heat storage mode)

	Energy Efficiency (%)	
Time (day)	**no groundwater available**	**ground water available**
0	100	100
30	52,886	58,551
60	42,726	51,658
360	27,399	47,969

Temperature profile of group energy piles is shown in Figure 6 and percentages of energy efficiency of group energy piles depending on time are given in Table 3.

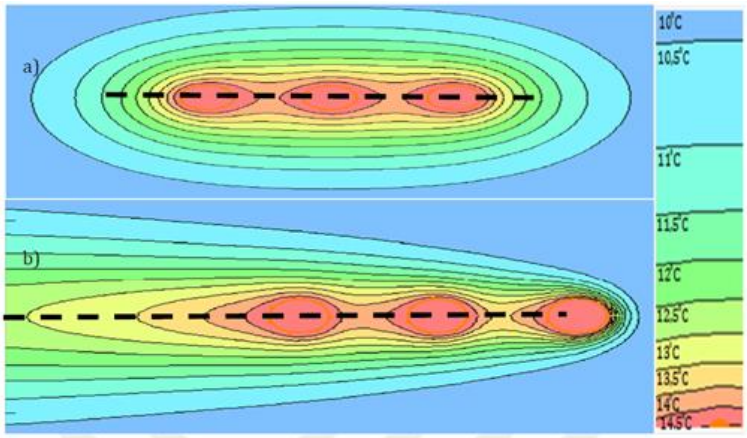


Figure 5. Group energy piles working in summer mode (heat storage mode) a) Temperature profile after 360 days (no groundwater flow) b) Temperature profile after 360 days (ground water flow)

Table 3. Percentages of energy efficiency of group energy piles depending on time in summer mode

	Energy Efficiency (%)					
Time (day)	**no groundwater available**			**ground water available**		
	First Pile	**Second Pile**	**Third Pile**	**First Pile**	**Second Pile**	**Third Pile**
0	100	100	100	100	100	100
30	50,528	48,158	50,541	63,376	49,305	48,914
60	38,940	35,120	38,956	58,396	37,091	35,599
360	20,698	14,411	20,703	56,776	28,656	22,503

Conclusion

Energy piles have attracted a lot of attention in the recent decades due to their multi-purpose use in civil engineering. In this study, the thermal capacities for single and group energy piles working in summer mode (heat storage mode) were compared. Analyses results indicated that in the absence of groundwater, higher energy efficiency was achieved from the single energy pile compared to the energy piles in the group at all periods.

References

1. Banks, D. (2008). An Introduction to Thermogeology: Ground Source Heating and Cooling. Blackwell Publishing: USA.
2. Sutman, M., Speranza, G., Ferrari, A., Lassalle, P. & Laloui, L. (2020). Long-term performance and life cycle assessment of energy piles in three different climatic conditions. Renewable Energy 146, 1177-1191.
3. Geothermal Piles. Available online: http://www.esru.strath.ac.uk/EnvEng/Web_sites/11-12/GROUP2/MyWebSpace/piles.html (accessed on 27 January 2017).
4. Canogullari, F. D. (2018). Enerji kazıklarının performans analizi. Master's Thesis, Mersin University.
5. GeoStudio, (2007). TEMP/W User Manual. GEO-SLOPE International Ltd.
6. GeoStudio, (2007). SEEP/W User Manual. GEO-SLOPE International Ltd.

Advanced Engineering Days

aed.mersin.edu.tr

Friction stir welding of plastics

Emre Kaygusuz *[1]

[1]*Bingol University, Mechanical Engineering Department, Türkiye, emrekygsz03@gmail.com*

Cite this study: Kaygusuz, E. (2022). Friction stir welding of plastics. 4th Advanced Engineering Days, 130-132

Keywords
Friction Stir Welding
Similar Materials
Dissimilar Materials
Plastics

Abstract

Friction stir welding (FSW) frequently produces a superior microstructure and mechanical properties than conventional methods for welding nonferrous materials and alloys. Plastic materials are used in many areas in industry because they offer excellent physical and corrosion properties, high degree freedom of processing and design. In this paper, the application of the FSW method in plastic materials is examined.

Introduction

The importance of joining materials in industrial applications has been gradually increasing. Electric power plants, the chemical, petrochemical and nuclear industries, space aeronautics and the electronic industry require materials of different properties to be joined [1–4].

FSW process firstly used for Al alloys (lower heat input than conventional joining methods) and invented at The Welding Institute (TWI) in UK (1991). Plastic materials are widely used in industry and FSW joining method firstly used at plastics at 1997. Plastics can be joined with various process methods like adhesives, solvents, hot plate, hot gas, extrusion, friction, ultrasonic, resistance (implant) and Friction Stir Welding (FSW) [5].

Choi et. al. [6] investigated dissimilar friction stir welding of pure Ti and carbon fiber reinforced plastic plates. They indicated that the silane coupling agent treatment helped to fabricate the sound dissimilar Ti/CFRP joint.

Vidakis et. al. [7] investigated optimization of friction stir welding parameters in hybrid additive manufacturing: weldability of 3d-printed poly (methyl methacrylate) plates. The feasibility of joining 3D-printed Poly (methyl methacrylate) (PMMA) specimens via FSW was verified in their work.

Rudrapati [8] investigated effects of welding process conditions on friction stir welding of polymer composites. They indicated that to achieve optimal welding economics in FSW of polymers, processing conditions such as tool rotation speed, welding speed, as well as precision tool design are the most significant factors to consider.

Wilkins and Strauss [9] investigated influence of tool thread pitch during friction stir welding of high-density polyethylene plate.

Material and Method

Schematic diagram of FSW process has shown in Fig.1. Pin geometry, tool rotation speed, shoulder geometry, traverse speed, offset diameter of materials to AS (Advancing side) or RS (Retreating Side) (if applied in dissimilar materials) are very important parameters in FSW to achieve good welding quality. FSW method don't need preparation and have less total process time comparing to another plastic joining techniques. FSW method don't need consumables and have lower cost than hot-plate, friction and ultrasonic welding methods (Table 1).

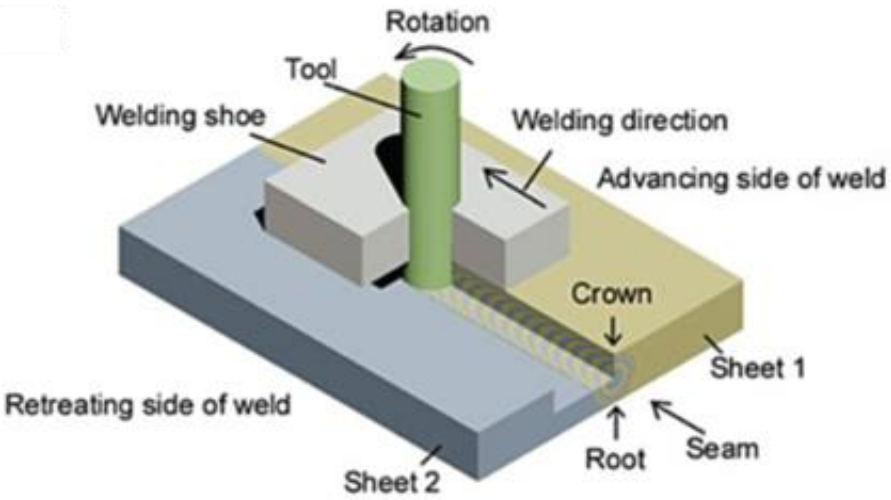


Figure 1. The schematic diagram of FSW process [10]

Table 1. Process requirement comparison of common plastic joining techniques [5]

Process	Preparation	Process Time	Total Time	Consumables	Machine/ Tool, consumable cost
Ultrasonic	energy directors	1-3 sec.	5-10 min.	none	$30000
Hot-plate	none	30-40 sec.	60-90 sec.	none	$47000
Hot-gas	v-groove	8-10 min.	15 min.	gas, filler	$3500
Extrusion	v-groove	8-10 min.	15 min.	gas, filler	$5500
Friction	flatten face	10-15 sec.	6-8 min.	none	$89000
Adhesives	clean	3 min.	2-3 hours	cleaner, adhesive	$3000
FSW	none	2 min.	3 min.	none	$11000

Conclusion

Industry needs faster welding speed, sound welding zone and good welding quality (without porosity, cracks etc.). FSW method is a new technique for joining plastics and is advantageous over other methods due to its low heat input and low costs. Researchers need to do more studies in order to become widespread FSW of plastics.

Appropriate selection of welding input parameters in FSW can enhance the properties of light-weight plastic weld joints. Process parameters selection plays important role to conduct FSW efficiently [8].

References

1. Mehta, K. P., & Badheka, V. J. (2016). A Review on Dissimilar Friction Stir Welding of Copper to Aluminum: Process, Properties, and Variants. *Materials and Manufacturing Processes*, *31*(3), 233–254. https://doi.org/10.1080/10426914.2015.1025971
2. Shojaei Zoeram, A., Mousavi Anijdan, S. H., Jafarian, H. R., & Bhattacharjee, T. (2017). Welding parameters analysis and microstructural evolution of dissimilar joints in Al/Bronze processed by friction stir welding and their effect on engineering tensile behavior. *Materials Science and Engineering: A*, *687*, 288–297. https://doi.org/10.1016/j.msea.2017.01.071
3. Zhang, W., Shen, Y., Yan, Y., & Guo, R. (2017). Dissimilar friction stir welding of 6061 Al to T2 pure Cu adopting tooth-shaped joint configuration: Microstructure and mechanical properties. *Materials Science and Engineering: A*, *690*, 355–364. https://doi.org/10.1016/j.msea.2017.02.091
4. Cakan, A., Ugurlu, M., & Kaygusuz, E. (2019). Effect of weld parameters on the microstructure and mechanical properties of dissimilar friction stir joints between pure copper and the aluminum alloy AA7075-T6, *61*(2), 142–148. https://doi.org/10.3139/120.111297
5. S. Strand. (2003). Joining plastics - can friction stir welding compete? In *Proceedings: Electrical Insulation Conference and Electrical Manufacturing and Coil Winding Technology Conference (Cat. No.03CH37480)* (pp. 321–326). Presented at the Proceedings: Electrical Insulation Conference and Electrical Manufacturing and Coil Winding Technology Conference (Cat. No.03CH37480). https://doi.org/10.1109/EICEMC.2003.1247904
6. Choi, J.-W., Morisada, Y., Liu, H., Ushioda, K., Fujii, H., Nagatsuka, K., & Nakata, K. (2020). Dissimilar friction stir welding of pure Ti and carbon fibre reinforced plastic. *Science and Technology of Welding and Joining*, *25*(7), 600–608. https://doi.org/10.1080/13621718.2020.1788814

7. Vidakis, N.-P., MarkosAU-Mountakis, NikolaosAU-Kechagias, John D. TI-Optimization of Friction Stir Welding Parameters in Hybrid Additive Manufacturing: Weldability of 3D-Printed Poly (methyl methacrylate) Plates. (2022). Optimization of Friction Stir Welding Parameters in Hybrid Additive Manufacturing: Weldability of 3D-Printed Poly (methyl methacrylate) Plates. *Journal of Manufacturing and Materials Processing*, *6*(4). https://doi.org/10.3390/jmmp6040077
8. Rudrapati, R. (2022). Effects of welding process conditions on friction stir welding of polymer composites: A review. *Composites Part C: Open Access*, *8*, 100269. https://doi.org/10.1016/j.jcomc.2022.100269
9. Wilkins, L. T., & Strauss, A. M. (2022). Influence of Tool Thread Pitch During Friction Stir Welding of High-Density Polyethylene Plate. *Journal of Manufacturing Science and Engineering*, *144*(12). https://doi.org/10.1115/1.4055118
10. Gao, J., Cui, X., Liu, C., & Shen, Y. (2017). Application and exploration of friction stir welding/processing in plastics industry. *Materials Science and Technology*, *33*(10), 1145–1158. https://doi.org/10.1080/02670836.2016.1276251

Advanced Engineering Days

aed.mersin.edu.tr

Hydrophobic surfaces found in nature

Serhat Akinci*[1], Filiz Karaömerlioğlu[1,2]

[1]*Mersin University, Nanotechnology and Advanced Materials, Türkiye, serhatakinci1903@gmail.com*
[2]*Mersin University, Engineering Faculty, Electrical Electronics Engineering, Türkiye, filizkrm@mersin.edu.tr*

Cite this study: Akıncı, S., & Karaömeroğlu, F. (2022). Hydrophobic surfaces found in nature. 4th Advanced Engineering Days, 133-135

Keywords
Hydrophobic Surfaces
Hydrophilic Surfaces
Superhydrophobic

Abstract

With the 21st century technology, we have more knowledge about the structures found in nature. With technological developments, we discover many structures and features that are already presents in our nature and that we have not been able to explore in such detail before. With more powerful microscopes and studies, nano-scale engineering and nanotechnology studies are gaining momentum. Hydrophobia, which is one of these nanotechnological studies, has emerged by examining the structures found in nature on a smaller scale. This type of structure, which is found in the leaves of some flower species, on the feet of some insect species and even on the wings of butterflies, attracts a lot of attention. The structures and methods designed and inspired by these types will contribute to the solution of problems in many sectors and fields. The number of studies in the field of nanotechnology, which is seen as the technology of the future, is increasing day by day. With the new studies and the accumulated literature knowledge, hydrophobia studies are getting more and more exciting every day.

Introduction

With today's technological developments, our awareness of nature and structures in nature is increasing. With more sensitive microscopes and technological devices, these structures are better understood and their properties are determined more clearly. These discovered features aim to meet unlimited needs with limited resources and to find more environmentally friendly engineering solutions. Nanotechnology, which has opened the door to many studies by being named in our recent history, with the control of shape and size at the nanoscale; deals with the design, characterization, manufacture and development of structures, tools and systems.

Nanotechnology is the development of functional materials, devices and systems for the purpose of understanding and controlling physical, chemical and biological phenomena at the nanometer scale; In general terms, it is defined as the processing, creation and manipulation of various tools, materials and structures at the molecular level. Superhydrophobicity, which is one of the nanotechnological studies, is the subject of many studies today.

Material and Method

Hydrophobic and Hydrophilic Surfaces

In Greek, “hydro” means “water”, “phobos” means “fear” and “philia” means “friendship”. In this context, hydrophobic; avoid of water (repels water); On the other hand, hydrophilic means friends with water (holding water). Superhydrophobic and superhydrophilic mean that it does not hold water and retains a lot of water. These surfaces are named according to the contact angle they make with water. These angle values determine how much water it holds or how much it pushes [1].

Natural Hydrophobic Surfaces

One of the best-known examples we can give from nature to superhydrophobic surfaces is the lotus flower (Fig. 1.). The leaves of the lotus flower are always clean and free of dust. These leaves are covered with small nodules 5-10 micrometers in diameter, located 10-15 micrometers apart. The water on these surfaces in nature forms small beads with a high contact angle of more than 150° and when the surfaces are tilted slightly, they quickly roll away, removing dust-like contaminant. This interesting event spurred extensive research to make artificial superhydrophobic surfaces and use them for a variety of applications [2]. In addition to these, the entire surface is covered with a hydrophobic layer with a diameter of 1 nanometer. This rough structure on the surface is called the "Lotus Effect". When water droplets come into contact with the leaf surface, they form a contact angle of close to 170 degrees due to both the hydrophobic coating and the surface roughness [3].

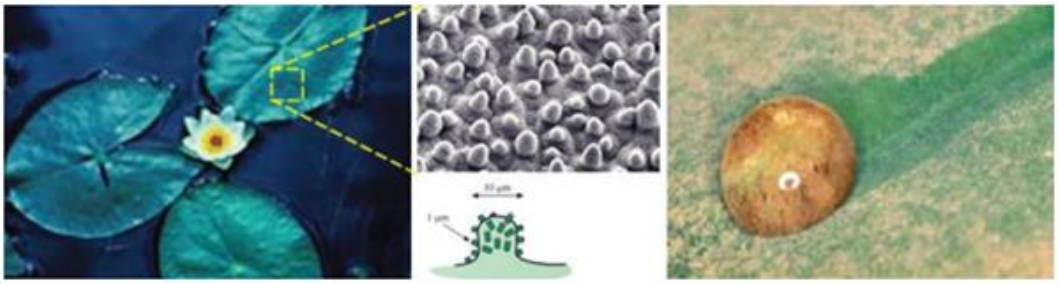


Figure 1. Lotus flower leaf [1]

Superhydrophobic surfaces are also present in many poultry. The wing structure of the Morpho Aega butterfly is superhydrophobic and has the ability to easily clean itself in aqueous environments [4]. The wings of some butterflies, on the other hand, have nanostructures that repel water, as well as nanophotonic lattices that reflect or scatter light falling on them. Thanks to these regular weaves (nanophotonic crystal), the butterfly's wing looks colorful [1].

Figure 2. Gerridae: Ptilomera tigrine [5]

Insects in the family called Water Runners (Gerridae) can move by holding on to the water surface thanks to their water-repellent leg structures [5, 7]. The desert beetle, called "Stenocara gracilipes", absorbs the water it needs thanks to its back tissue, which consists of hydrophobic and wax-free hydrophilic regions covered with wax. can be supplied by the loaded winds. This ridge structure allows water droplets with a diameter of several tens of micrometers in the fog to accumulate on the hydrophobic regions, and the water mass reaching a certain size flows towards the hydrophilic regions and is absorbed by these regions [8]. Although superhydrophobic surfaces can be produced by many different methods inspired by the low-energy biological surfaces with micro and nano structure of these living species, it is seen that these man-made surfaces cannot maintain their water-repellent property for a long time in outdoor conditions. The problem of developing water-repellent surfaces resistant to outdoor conditions will continue to be the subject of research and discussion in the coming years.

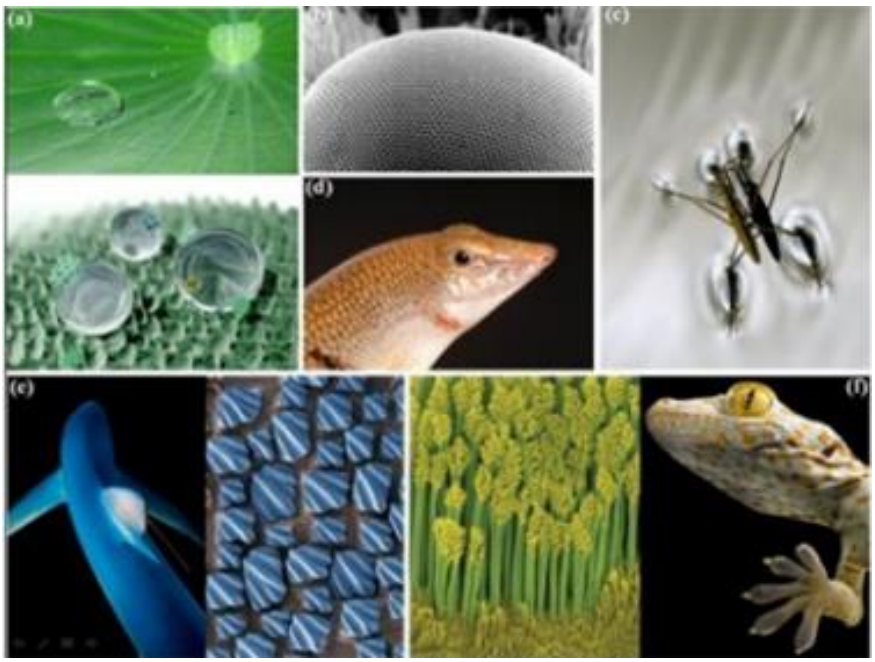


Figure 3. Some examples of hydrophobic and hydrophilic structures from nature. (a) lotus leaf, (b) moth's eye, (c) water scraper, (d) sand skin, (e) shark skin, (f) gecko [2]

Conclusion

Superhydrophobia, which is one of the working groups in the field of nanotechnology, is inspired by many structures existing in nature and offers solutions to problems in many sectors today. These solutions will revolutionize the textile, automotive industry, defense industry, construction, pharmaceutical industry and new treatment methods. Frictionless surfaces created by nanotechnology will eliminate the problem of changing engine oil in vehicles. Dirt-repellent fabrics may be able to put washing machines out of use. With the new studies and the accumulated literature knowledge, the studies of superhydrophobia arouse more and more excitement every day.

References

1. Taşbaş, S. D. (2014). Polyester Dokumanin Çok Katmanli Nanokompozit Süperhidrofobik Yüzey İle Kaplanmasi Ve Islanmazlik Özelliklerinin İncelenmesi, Master's Thesis, Gazi University.
2. Törün, İ. (2018): Yüksek Mekanik Dayanimli Saydam Süperhidrofobik Kaplamalarin Üretilmesi ve Karakterizasyonu. Master's Thesis. Erciyes University.
3. Özdoğan, E., Demir, A., Seventekin, N. (2006). Lotus Etkili Yüzeyler. Tekstil ve Konfeksiyon Dergisi, 16(1), 287-290.
4. Zheng Y., Gao X., Jiang L. (2007). Directional Adhesion of Superhydrophobic Butterfly Wings, Soft Matter, 3 (2), 178–182.
5. William L. Hilsenhoff, W. L. (2001) Diversity and Classification of Insects and Collembola, Ecology and Classification of North American Freshwater Invertebrates (Second Edition), Academic Press, Pages 661-731 https://doi.org/10.1016/B978-012690647-9/50018-1.
6. Gao, X., Jiang, L. (2004) Water-Repellent Legs of Water Striders, Nature, 432 (7013), 36–36.
7. Hu, D. L., Chan, B., Bush, J. W. M. (2003). The Hydrodynamics of Water Strider Locomotion, Nature, 424, 663–666.
8. Furstner, R., Barthlott, W., Neinhuis C. & Walzel, P. (2005). Wetting and Self-cleaning Properties of Artificial Superhydrophobic surfaces. Langmuir 21, 956-961.

Advanced Engineering Days

aed.mersin.edu.tr

Graphene doped metal oxide based thermoelectric materials production method

Serhat Koçyiğit*[1,2], Arda Aytimur[1], İbrahim Uslu[3]

[1]*Gazi University, Department of Advanced Technologies, Teknikokullar, Türkiye, skocyigit@bingol.edu.tr*
[2]*Bingöl University, Project Coordination Application and Research Center, Türkiye, arda.aytimur@bilecik.edu.tr*
[3]*Gazi University, Department of Chemistry Education, Teknikokullar, Türkiye, iuslu@gazi.edu.tr*

Cite this study: Koçyiğit, S., Aytimur, A., & Uslu, İ. (2022). Graphene doped metal oxide based thermoelectric materials production method. 4th Advanced Engineering Days, 136-138

Keywords
Electrospinning
Graphene
Metal oxide
Nanocomposites
Thermoelectric

Abstract

Thermoelectric energy conversion is the process of converting heat energy directly into electrical energy or electrical energy into heat energy with the highest efficiency. Thermoelectric energy conversion is provided by thermoelectric modules made of p-type and n-type semiconductor materials. Thanks to the heat entering the module, the energy levels of some electrons increase and as the electrons are released, they leave holes in the semiconductor material. Electrons are carried from n-type, holes are carried from p-type semiconductor material. Thus, the circuit is completed. Important results have been obtained in the production of thermoelectric systems with nanotechnological methods. For this reason, materials with the highest homogeneity are produced in the electrospin mechanism, which is a nanotechnologic method. One of the important factors in increasing homogeneity is the preference of additives that enter between metal oxide particles. The best example of this is provided by the graphene doping. Efficiency is also expected to be high in the production of graphene-doped metal oxide-based thermoelectric-materials.

Introduction

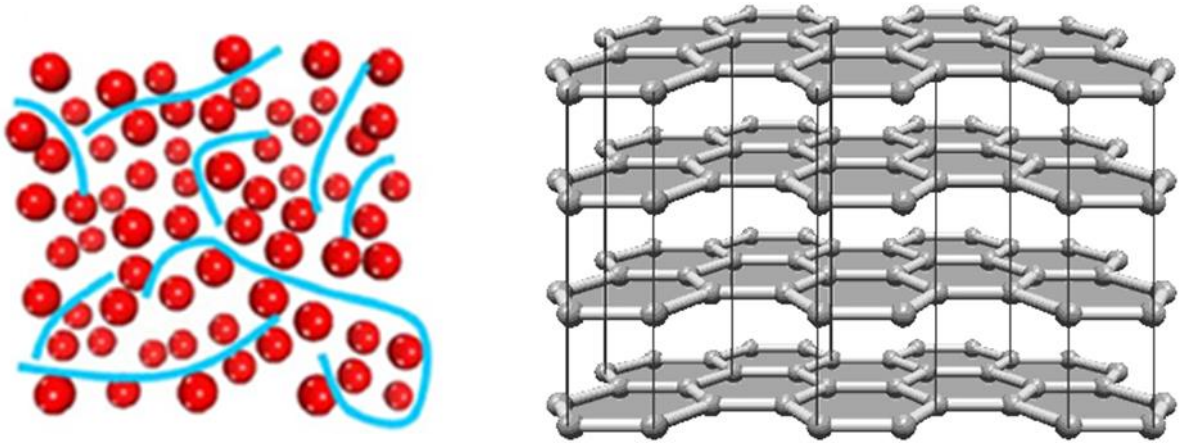
Thermoelectric energy conversion is the process of directly converting heat energy into electrical energy or reversely, converting electrical energy into heat energy with the highest efficiency.

Thermoelectric energy conversion is provided by thermoelectric modules, and the modules consist of a combination of two p-type and n-type semiconductors. The heat entering the module increases the energy levels of some of the electrons in the module. As electrons become free, they leave holes (holes) in the semiconductor material. Electrons are carried from n-type and holes are carried from p-type semiconductor material. As long as there is a temperature difference in the heat exchangers at the top and bottom of the modules, electrons and holes are constantly displaced, producing electricity.

Thermoelectric materials should be selected from materials with high electrical conductivity and low thermal conductivity. For this reason, one-dimensional nano-rod, nano-wire and nano-fiber materials are focused on. In recent years, semiconductor metal oxide materials have started to be preferred instead of the frequently used Bi2Te3 based semiconductors. The method of obtaining composite metal oxides with chemical compounds are doped with thermoelectric bismuth-based alkaline earth metals and a material with high thermoelectric properties such as graphene and the method of obtaining these nanostructures as thermoelectric energy. related to increasing the conversion efficiency.

Graphene are materials with extraordinary two-dimensional properties. The elements that make up the composite to be prepared in this project will be selected by examining their superior thermoelectric properties. In addition, when graphene is added to these materials, it is aimed to increase the thermoelectric efficiency significantly. One of the most important factors in the preference of graphene is the huge thermoelectric effect of graphene. The importance of graphene as a thermoelectric property is stated in the article of Dragoman et al. [1].

When graphene is used, metal structures are placed between the graphene layers (Figure 1). Thus, when we form a nanocomposite, we increase the electrochemical performance of the material by filling the gap between the layers. This provides a great advantage in terms of the importance of the contribution.



(a) (b)

Figure 1. (a) Graphene sheets and metal oxide particles (b) Layered graphene sheets

In order for a thermoelectric material to have high thermoelectric performance, its electrical conductivity must be high and its thermal conductivity must be low. For this reason, thermoelectric materials should be selected from materials with high electrical conductivity and low thermal conductivity. In order to increase the thermoelectric performance measure, it is necessary to reduce the phonon contribution that affects the thermal conductivity, and this is made possible by nanostructures formed by various methods.

Previously, composites such as Bi2Te3, PbTe, Si-Ge were produced [2,3]. The high toxicity of thermoelectric materials, being quite expensive, and most importantly, their unstable structure that can corrode at high temperatures, especially in air, has prevented the commercialization of these materials [4]. In recent years, various metal oxide ceramic materials have been produced to develop thermoelectric materials. Because these materials are resistant to high temperatures, non-toxic and low cost [5].

Experimental Method

Firstly, PVA solution with deionized water is prepared by dissolving the PVA powder in ultrapure distilled and deionized water and heating it at 80 °C while stirring for 3 h, then it is cooled to room temperature (Figure 2a). Then, metal acetates and nitrate are solved into ultrapure water and acetic acid solution were produced. Graphene is added to these solutions. Then, PVA is added into all of the solution, so the solutions which will be used electrospinning process are produced. Nano-sized fibers are produced from these solutions by electro-spinning technique (Figure 2b).

The obtained fibers are dried and subjected to heat treatment in the calcination furnace. At the end of this process, nano-sized powdered metal oxide is obtained. These powders are sintered into pellets and thermoelectric properties are measured.

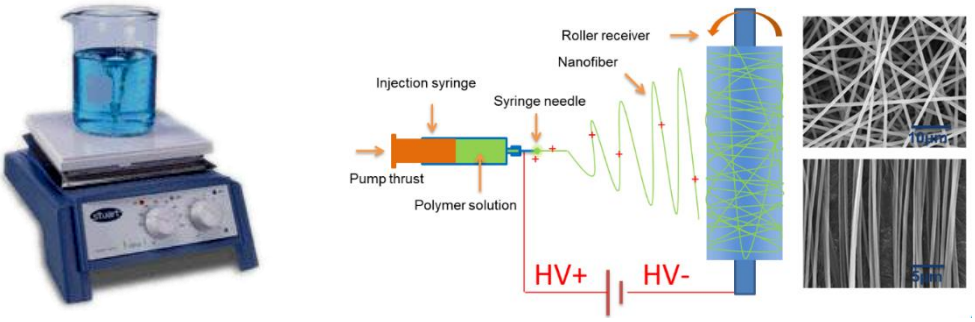


Figure 2. (a) Preparing polymer-metal salts solution (b) Schematic diagram of the electrospinning method [6]

Conclusion

Homogeneous distribution of metal oxide materials and particle size are very important in terms of efficiency in the production of solar cells and thermoelectric modules. The most important advantage of the method is that it allows the particles to be produced in nano size and to obtain a 99% homogeneous distribution. In addition, the production process is easy and low cost. It does not contain toxic substances harmful to the environment and human health.

References

1. Dragoman, D., Dragoman M., (2007). Giant thermoelectric effect in grapheme, Applied Physics Letter, 91, 203116.
2. Huang, Z. Y., Zhang, H., Yang, L., Zhu, B., Zheng, K., Hong, M., ... & Chen, Z. G. (2018). Achieving high thermoelectric performance of Ni/Cu modified Bi0. 5Sb1. 5Te3 composites by a facile electroless plating. *Materials today energy*, *9*, 383-390.
3. Cao, S., Huang, Z. Y., Zu, F. Q., Xu, J., Yang, L., & Chen, Z. G. (2017). Enhanced thermoelectric properties of Ag-modified Bi0. 5Sb1. 5Te3 composites by a facile electroless plating method. *ACS applied materials & interfaces*, *9*(42), 36478-36482.
4. Ohta, H., Sugiura, K., & Koumoto, K. (2008). Recent progress in oxide thermoelectric materials: p-type Ca3Co4O9 and n-type SrTiO3−. *Inorganic chemistry*, *47*(19), 8429-8436.
5. Koçyiğit, S., Aytimur, A., & Uslu, I. (2020). Graphene-doped Ca0. 9Er0. 1Mn1. 5Oα thermoelectric nanocomposite materials: Temperature-dependent thermal and Seebeck properties. Ceramics International, 46(5), 6377-6382.
6. https://www.nanofiberlabs.com/solutions/introductory-tutorial-for-electrospinning.html

Advanced Engineering Days

aed.mersin.edu.tr

Investigation of the usage of coconut shells in epdm rubber as biodegradable filling material

Ahmet Güngör[*1]

[1]*Mersin University, Department of Chemical Engineering, Türkiye, ahmet.gungor@mersin.edu.tr*

Cite this study: Güngör, A. (2022). Investigation of the usage of coconut shells in epdm rubber as biodegradable filling material. 4th Advanced Engineering Days, 139-141

Keywords
Ethylene Propylene
Diene Monomer
Coconut shell
Waste Management
Bio-based Filler

Abstract

Ethylene propylene diene monomer rubber (EPDM) is an organic synthetic rubber that we often use in our daily lives. Ethylene propylene diene monomer rubber has entered our daily life as an indispensable material due to its ultraviolet stability, thermal stability and hydrophobic structure. Different filling materials such as accelerating agents, anti-aging agents, cross-linking agents are used to strengthen ethylene propylene diene monomer rubber and increase its usage area. The main purpose of our study is to integrate natural and biodegradable materials into EPDM structure instead of fillers that are used in EPDM and have negative effects on the environment. In this study, Ethylene Propylene Diene Monomer (EPDM) composites with different coconut shell contents were synthesized and the effect of CS filler material on the final composites were investigated. Mechanical properties were characterized in terms of elastic modulus and elongation at break values. Consequently, analyses results showed that the composite of EPDM rubber and coconut shell has good compatibility.

Introduction

Ethylene–propylene–diene monomer rubber (EPDM) rubber is among the most commonly used synthetic rubber types owing to its low cost, high mechanical properties and great filling capacity [1–4]. It is widely used in many different fields such as electronic materials, exterior insulation, sports equipment [5, 6].

Despite all these advantages, rubber materials can remain undissolved in nature for many years. Moreover, it has negative environmental effects due to non-environmentally friendly filling materials such as carbon black it contains [7, 8]. Therefore, in recent years, bio-composite synthesis has been increasing with the use of biodegradable materials as fillers in the rubber industry [9, 10].

Biocomposites are materials consisting of biodegradable polymers (matrix) and biodegradable reinforcing materials. Biodegradable material is substances that can be degraded by living organisms. The fillers used in biocomposites are generally biofibers. During the last 20 years, there has been increasing interest in the development of biocomposite material [11, 12]. One of the most significant properties of biocomposite materials after end-use - being biodegradable, increases the importance of these polymer composites.

Natural plant-derived waste filling materials are low cost and contain shells or unused parts of natural products in waste state. The main advantages of bio-based filler material compared to conventional filling materials are high tensile properties and good biodegradability. Coconut shell as a bio-based filler material is a good candidate in order to obtain the production of environmentally friendly biocomposite materials [13, 14].

In this study, coconut shell wastes (CS) were added to the EPDM matrix in different proportions as a filler and its effect on mechanical properties was investigated. In this way, the usability of CS as a potential biodegradable filler will be analyzed.

Material and Method

Coconut used as a biodegradable filling material in the study was obtained from a local market. In order for the coconut to be used as a filling material in EPDM, the purchased coconuts were washed and cleaned and then kept in a laboratory oven at 50 ˚C. The dried shells were passed through a ball mill and reduced in size and 500 µm coconut shells were obtained as a result of the sieving. Only coconut shells (CS) under 500 microns were used in the study.

The materials used to synthesize the EPDM/CS composite material are presented in Table 1. The chemicals used were used as purchased and were not subjected to any purification process.

Table 1. The recipe of coconut sheell containing EPDM composites

Material	Amount (phr)
EPDM Rubber (Keltan 9650Q)	100
Carbon Black	100
Paraffinic oil	82
ZnO	5
Stearic acid	1.5
Kezadol	2
Peroxide (Perkadox 14–40)	7
Coconut Shell (CS)	0-10-20 (wt, %)

In the preparation of EPDM/CS composite materials, a kneader type mixer was used to mix the chemicals given in Table 1 homogeneously and EPDM paste was prepared. A two-roll mill was used to prepare the EPDM paste as a 2 mm plate. EPDM paste in the form of a 2 mm plate was cross-linked using a heat press at 180 ˚C and under 20 MPa pressure.

The mechanical properties of the synthesized EPDM/CS composite materials were performed according to ASTM D412 standards. The mechanical properties of the specimens (bow-tie shaped) prepared in accordance with ASTM D412 standard were determined with a Shimadzu brand AGS-X model universal tester. In addition, the effect of CS, which is used as a biodegradable filling material, on the crosslink density of the composite material was also examined by swelling analysis. For this purpose, Soxhlet extraction method was applied and hexane was used as solvent. Crosslink densities of composite materials were calculated according to Equation 1 (wi and wf = initial and final weight).

$$Gel\ content\ (\%) = wf/wi * 100 \quad (1)$$

Results and Discussion

The mechanical properties of rubber materials are one of the most significant factors in evaluating the usability of the material. Elongation at break (mm) amount and elastic modulus (MPa) value of EPDM/CS composite materials were examined and the results are given in Figure 1. As can be seen from Figure 1, while the elongation at break of the material with the addition of coconut was similar to that of raw EPDM, a significant increase was observed in the elastic modulus value. It was concluded that CS can be used as a filling material in EPDM in terms of mechanical properties.

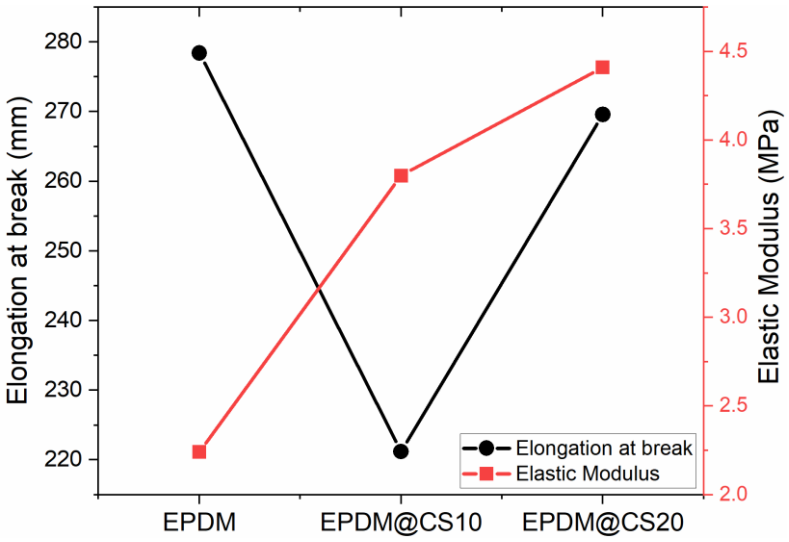


Figure 1. Mechanical properties of EPDM/CS composites

Conclusion

In this study, the usability of coconut shell as a bio-based and biodegradable filling material in EPDM was investigated considering the mechanical properties. For this purpose, CS particles, which were washed and sieved and brought to a particle size below 500 microns, were added to EPDM at different ratios and the mechanical properties of the synthesized EPDM/CS composites were analyzed. With the addition of CS, the elastic modulus values of the material increased significantly, while the elongation at break showed similar values with pure EPDM. Regarding the mechanical properties, it is concluded that CS can be used as an environmentally friendly and biodegradable filling material in EPDM.

References

1. Güngör, A., Akbay, I. K., & Özdemir, T. (2019). Waste walnut shell as an alternative bio-based filler for the EPDM: Mechanical, thermal, and kinetic studies. *Journal of Material Cycles and Waste Management*, *21*(1), 145-155. https://doi.org/10.1007/s10163-018-0778-6
2. Özdemir, T., Güngör, A., Akbay, I. K., Uzun, H., & Babucçuoglu, Y. (2018). Nano lead oxide and epdm composite for development of polymer based radiation shielding material: Gamma irradiation and attenuation tests. *Radiation Physics and Chemistry*, *144*, 248-255. https://doi.org/10.1016/j.radphyschem.2017.08.021
3. Ravishankar, P. S. (2012). Treatise on Epdm. Rubber Chem Technol, 85, 327–349. https://doi.org/10.5254/rct.12.87993
4. Da Maia, J. V., Pereira, F. P., Dutra, J. C. N., Mello, S. A. C., Becerra, E. A. O., Massi, M., & da Silva Sobrinho, A. S. (2013). Influence of gas and treatment time on the surface modification of EPDM rubber treated at afterglow microwave plasmas. *Applied surface science*, *285*, 918-926. https://doi.org/10.1016/j.apsusc.2013.09.013
5. Çavdar, S., Özdemir, T., & Usanmaz, A. (2010). Comparative study on mechanical, thermal, viscoelastic and rheological properties of vulcanised EPDM rubber. *Plastics, rubber and composites*, *39*(6), 277-282. https://doi.org/10.1179/174328910X12647080902970
6. Ethylene-propylene P Ethylene - Propylene Rubbers & Elastomers (EPR / EPDM). 1–4
7. Zhang, Y., Ge, S., Tang, B., Koga, T., Rafailovich, M. H., Sokolov, J. C., ... & Nguyen, D. (2001). Effect of carbon black and silica fillers in elastomer blends. *Macromolecules*, *34*(20), 7056-7065. https://doi.org/10.1021/MA010183P
8. Surya, I., & Ismail, H. (2016). The effect of the addition of alkanolamide on properties of carbon black-filled natural rubber (SMR-L) compounds cured using various curing systems. *Polymer testing*, *50*, 276-282. https://doi.org/10.1016/j.polymertesting.2016.01.014
9. Kim, W., Argento, A., Flanigan, C., & Mielewski, D. F. (2015). Effects of soy-based oils on the tensile behavior of EPDM rubber. *Polymer Testing*, *46*, 33-40. https://doi.org/10.1016/j.polymertesting.2015.06.015
10. Karaağaç, B. (2014). Use of ground pistachio shell as alternative filler in natural rubber/styrene–butadiene rubber-based rubber compounds. *Polymer Composites*, *35*(2), 245-252. https://doi.org/10.1002/pc
11. Akbay, İ. K., Güngör, A., & Özdemir, T. (2018). Using fish scales (Sardina pilchardus) within ethylene-propylene-diene ter monomer rubber as bio-based filler. *Journal of Applied Polymer Science*, *135*(39), 46698. https://doi.org/10.1002/app.46698
12. Mokhothu, T. H., John, M. J., & John, M. J. (2016). Bio-based fillers for environmentally friendly composites. *Handbook of Composites from Renewable Materials; Vijay, KT, Manju, KT, Michael, RK, Eds*, 243-270. https://doi.org/10.1002/9781119441632.ch10
13. Tomczak, F., Sydenstricker, T. H. D., & Satyanarayana, K. G. (2007). Studies on lignocellulosic fibers of Brazil. Part II: Morphology and properties of Brazilian coconut fibers. *Composites Part A: Applied Science and Manufacturing*, *38*(7), 1710-1721. https://doi.org/10.1016/j.compositesa.2007.02.004
14. Geethamma, V. G., Kalaprasad, G., Groeninckx, G., & Thomas, S. (2005). Dynamic mechanical behavior of short coir fiber reinforced natural rubber composites. *Composites Part A: Applied Science and Manufacturing*, *36*(11), 1499-1506. https://doi.org/10.1016/j.compositesa.2005.03.004