VIII. ULUSLARARASI
BİLİMSEL VE MESLEKİ ÇALIŞMALAR
KONGRESİ
(BILMES 2023)
BİLDİRİ KİTABI

VIII. INTERNATIONAL
SCIENTIFIC AND VOCATIONAL STUDIES
CONGRESS
(BILMES 2023)
PROCEEDINGS BOOK

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KONGRE PROGRAMI / CONFERENCE SCHEDULE

ORAL PRESENTATION

23 December 2023 - Saturday

Session 1

Hall Name: BILMES - Meeting Hall

Meeting Hall Chairman : Lect. Umut Saray

Meeting Hall Vice-Chairman: Assist. Prof. Dr. Tolga Yucehan

Time	Title of Study	Authors	Corresponding Author	Presenter
12:00 - 12:10	ACADEMIC REVIEW OF THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN URBAN TRANSFORMATION PROJECTS	VOLKAN GÖNEN, ARZU ÇAĞLAR, HAKAN ÇAĞLAR	ARZU ÇAĞLAR	ARZU ÇAĞLAR
12:10 - 12:20	DIGITAL CULTURAL STORYTELLING: REVITALIZING TRADITIONS AND MYTHS THROUGH ILLUSTRATION IN NEW MEDIA	DİLEK AYDEMİR	DİLEK AYDEMİR	DİLEK AYDEMİR
12:20 - 12:30	FROM INDUSTRY 1.0 TO INDUSTRY 5.0: USER-PRODUCT INTERACTION	ÖZDEN SEVGÜL AYTAR	ÖZDEN SEVGÜL AYTAR	ÖZDEN SEVGÜL AYTAR
12:30 - 12:40	ACADEMIC STUDIES ON THE USABILITY OF PUMICE AND RICE HUSK ASH IN THE PRODUCTION OF BUILDING MATERIALS	SEYİT CAN YILMAZ, HAKAN ÇAĞLAR, ARZU ÇAĞLAR	ARZU ÇAĞLAR	ARZU ÇAĞLAR
12:40 - 12:50	SEISMIC ANALYSIS OF A RC BUILDING IN IZMIR BY RESPONSE SPECTRUM METHOD	EREN YAĞMUR	EREN YAĞMUR	EREN YAĞMUR
12:50 - 13:00	INVESTIGATION OF THE WORK OF ENVIRONMENTAL MEASUREMENT AND ANALYSIS LABORATORIES AND WASTEWATER TREATMENT PLANT OPERATING PERSONNEL IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY	YAKUP ATEŞ, PINAR SARI ÇAVDAR, UĞUR ÇAVDAR	UĞUR ÇAVDAR	YAKUP ATEŞ

Break

Session 2

Hall Name: BILMES - Meeting Hall

Meeting Hall Chairman : Assist. Prof. Dr. Tolga Yucehan

Meeting Hall Vice-Chairman: Assist. Prof. Dr. Dilek Aydemir

Time	Title of Study	Authors	Corresponding Author	Presenter
13:30 - 13:40	IDENTIFICATION OF URBAN TRANSFORMATION AREAS WITH DEEP LEARNING ALGORITHMS: AN IN-DEPTH STUDY	UĞUR BOZDOĞANLIO, ABDURRAHMAN EYMEN	UĞUR BOZDOĞANLIO	UĞUR BOZDOĞANLIO
13:40 - 13:50	INVESTIGATING THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS AND TREATMENT OF ALZHEIMER'S DISEASE	UMUT SARAY, UĞUR ÇAVDAR	UMUT SARAY	UMUT SARAY
13:50 - 14:00	AIR CONDITIONER WITH UV SUPPORTED AIR CLEANING FEATURE, IOT APPLICATION BASED, AIR QUALITY INDICATOR, AMBIENT LIGHT FEATURE (RAIRBOW)	MERT DÜZENLİ, HEKİMHAN AKDENİZ, OĞUZ YILDIRIM, YAĞMUR YAVAŞ YILMAZ	MERT DÜZENLİ	MERT DÜZENLİ

Break

Session 3				
Hall Name: BILMES - Meeting Hall		**Meeting Hall Chairman :** Lect. Umut Saray **Meeting Hall Vice-Chairman:** Assist. Prof. Dr. Tolga Yucehan		
Time	**Title of Study**	**Authors**	**Corresponding Author**	**Presenter**
15:00 - 15:10	GAME-BASED RECRUITMENT AND THE USE OF ARTIFICIAL INTELLIGENCE: REVIEW OF PYMETRICS ARTIFICIAL INTELLIGENCE (AI) RECRUITMENT TOOL	AYŞE ASİLTÜRK	AYŞE ASİLTÜRK	AYŞE ASİLTÜRK
15:10 - 15:20	THE PLACE OF ROBOT JOURNALISM IN THE NEWS IN THE TURKISH PRESS: THE CASE OF INTERNET JOURNALISM	EMRE PANK	EMRE PANK	EMRE PANK
15:20 - 15:30	DIGITAL INSURANCE OPPORTUNITIES AND CHALLENGES: REVIEW PAPER	YÜKSEL AKAY ÜNVAN, NADER MAHMOUD BAHOMAİD	YÜKSEL AKAY ÜNVAN	NADER MAHMOUD BAHOMAİD
15:30 - 15:40	EXAMINING THE EFFECT OF GENERATION Z'S PERCEPTIONS OF INSTAGRAM ADS ON THEIR PURCHASING BEHAVIORS	DERYA FATMA BİÇER, AYŞE ZÜLAL İBİLİ	DERYA FATMA BİÇER	DERYA FATMA BİÇER
24 December 2023 - Sunday				
Session 4				
Hall Name: BILMES - Meeting Hall		**Meeting Hall Chairman :** Lect. Umut Saray **Meeting Hall Vice-Chairman:** Assist. Prof. Dr. Tolga Yucehan		
Time	**Title of Study**	**Authors**	**Corresponding Author**	**Presenter**
12:00 - 12:10	DEVELOPMENT OF A MACHINE COMPATIBLE WITH PRODUCTION PROCESSES FOR ANGLE CARDBOARDS USED IN FURNITURE PACKAGING	ERKAN BAYIR, AHMET AY, KEREM KILIÇ	ERKAN BAYIR	ERKAN BAYIR
12:10 - 12:20	FLOOD BUILDING DAMAGE ASSESSMENT: A CASE STUDY OF THE 2021 BOZKURT FLOOD	MİHRİMAH ÖZMEN, MEHLİKA ERASLAN ÇELIK	MİHRİMAH ÖZMEN	MEHLİKA ERASLAN ÇELIK
12:20 - 12:30	MULTI-MUTATION CLONAL SELECTION ALGORITHM FOR MULTI DEPOT VEHICLE ROUTING PROBLEM IN POST-DISASTER HUMANITARIAN RELIEF LOGISTICS: THE CASE OF THE 06.02.2023 KAHRAMAN MARAŞ TURKIYE EARTHQUAKE	BİLGE KAĞAN DEDETÜRK, BURAK KOLUKISA, MUHAMMED HAMZA DUMAN, MUHAMMED BURAK YÜKSEL, MİHRİMAH ÖZMEN, VEHBİ ÇAĞRI GÜNGÖR	MİHRİMAH ÖZMEN	MUHAMMED HAMZA DUMAN
12:30 - 12:40	NUMERICAL AND EXPERIMENTAL INVESTIGATION OF HEAT EXCHANGER WITH SLIT GEOMETRY FIN STRUCTURE	A. CİHAN ÖZDEMİR, DİLEK KUMLUTAŞ, ÖZGÜN ÖZER, UTKU ALP YÜCEKAYA, ERDEM SARICA, KADİR BOZDEMİR	ABDULLAH CİHAN ÖZDEMİR	ABDULLAH CİHAN ÖZDEMİR
12:40 - 12:50	COMPRESSION ANALYSIS OF CFRP CORES WITH DIFFERENT TOPOLOGIES	CAHİD EŞSİZLER, UMUT ÇALIŞKAN	UMUT ÇALIŞKAN	CAHİD EŞSİZLER
12:50 - 13:00	EFFECT OF POLYMER COATING ON THE BALLISTIC PERFORMANCE OF GLASS FIBER ARMOR PLATE	ÖZGÜR ÖZDEMİR, UMUT ÇALIŞKAN	UMUT ÇALIŞKAN	ÖZGÜR ÖZDEMİR
Break				

Session 5				
Hall Name: BILMES - Meeting Hall		**Meeting Hall Chairman :** Lect. Umut Saray **Meeting Hall Vice-Chairman:** Assist. Prof. Dr. Tolga Yucehan		
Time	**Title of Study**	**Authors**	**Corresponding Author**	**Presenter**
13:30 - 13:40	COMPARATIVE EVALUATION OF LRBA PROTEIN EXPRESSION BY WESTERN BLOT AND FLOW CYTOMETRY IN HEALTHY CONTROLS	MELİKE TUĞBA ERSOY	MELİKE TUĞBA ERSOY	MELİKE TUĞBA ERSOY
13:40 - 13:50	THE IN SILICO INVESTIGATION OF NEWLY DESIGNED A-AMINONITRILE AND A-AMINOACIDS FOR CHOLINESTERASE INHIBITORY ACTIVITY	ADİL ÖZBAY, EMİNE ELÇİN ORUÇ-EMRE, AYŞEGÜL KARAKÜÇÜK-İYİDOĞAN	ADİL ÖZBAY	ADİL ÖZBAY
13:50 - 14:00	EFFICIENT REMOVAL OF INDIGO CARMINE DYE BY MIL-53 (AL)	DUYGU YANARDAĞ KOLA, SERPİL EDEBALİ	DUYGU YANARDAĞ KOLA	DUYGU YANARDAĞ KOLA
Break				
Session 6				
Hall Name: BILMES - Meeting Hall		**Meeting Hall Chairman :** Lect. Umut Saray **Meeting Hall Vice-Chairman:** Assist. Prof. Dr. Tolga Yucehan		
Time	**Title of Study**	**Authors**	**Corresponding Author**	**Presenter**
15:00 - 15:10	CONSTRUCTION OF NEW CHAOTIC FUNCTIONS ON THE SEQUENCE SPACES Σ_2, Σ_2^2, AND Σ_2×Σ_2	İSMAİL ALPER GÜVEY, NEDİM DEĞİRMENCİ	İSMAİL ALPER GÜVEY	İSMAİL ALPER GÜVEY
15:10 - 15:20	ON NON-NEWTONIAN JACOBSTHAL AND JACOBSTHAL-LUCAS NUMBERS	TÜLAY YAĞMUR	TÜLAY YAĞMUR	TÜLAY YAĞMUR
15:20 - 15:30	A STUDY ON FIXED POINT ITERATION METHODS	YUNUS ATALAN, FİKRET IŞIK	YUNUS ATALAN	FİKRET IŞIK
Break				
Session 7				
Hall Name: BILMES - Meeting Hall		**Meeting Hall Chairman :** Lect. Umut Saray **Meeting Hall Vice-Chairman:** Assist. Prof. Dr. Tolga Yucehan		
Time	**Title of Study**	**Authors**	**Corresponding Author**	**Presenter**
16:30 - 16:40	EQUATIONS OF SLIDING GATES DISCHARGE COEFFICIENT WITH THRESHOLDS	HAMIDREZA ABBASZADEH, PARISA EBADZADEH, RASOUL DANESHFARAZ, REZA NOROUZI	HAMIDREZA ABBASZADEH	HAMIDREZA ABBASZADEH
16:40 - 16:50	HYDRAULIC OF SLIDING VALVES WITH THRESHOLD	PARISA EBADZADEH, HAMIDREZA ABBASZADEH, RASOUL DANESHFARAZ, REZA NOROUZI	PARISA EBADZADEH	PARISA EBADZADEH

16:50 - 17:00	EFFECTS OF GAMMA RADIATION AND ELECTRON BEAM ON SAMPLES OF THE PEANUT CANDIES CONTAMINATED WITH ASPERGILLUS FLAVUS	GISELE FERREIRA DE SOUZA, LAITH KHALIL TAWFEEQ AL-ANI	GISELE FERREIRA DE SOUZA	GISELE FERREIRA DE SOUZA

17:00 - 17:10	ANALYSIS OF THE EFFECTIVENESS OF AQUEOUS OZONE IN REDUCING MALONDIALDEHYDE LEVELS IN TREATED CHICKEN MEAT SAMPLES PURCHASED AT MARKETS IN BAGHDAD, IRAQ	MANAL HADI GHAFFOORI KANAAN, SURA SAAD ABDULLAH	MANAL HADI GHAFFOORI KANAAN	MANAL HADI GHAFFOORI KANAAN
17:10 - 17:20	MAXWELL NANOFLUID WITH INDUCED MAGNETIC STRETCHING REGIME FOR BIOTECHNOLOGY AND ENGINEERING APPLICATIONS	FATEH MEBAREK-OUDINA	FATEH MEBAREK-OUDINA	FATEH MEBAREK-OUDINA
17:20 - 17:30	SYNTHETIC FANDOM: A DIGITAL-BASED MODEL PROPOSAL FOR FINANCIAL SUSTAINABILITY IN TURKISH SPORTS CLUBS	ERDEM KANIŞLI	ERDEM KANIŞLI	ERDEM KANIŞLI

DAVETLİ KONUŞMACILAR / INVITED SPEAKERS

MAXWELL NANOFLUID WITH INDUCED MAGNETIC STRETCHING REGIME FOR BIOTECHNOLOGY AND ENGINEERING APPLICATIONS

Fateh Mebarek-Oudina

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Abstract

In this work, the Maxwell nano flow phenomena across a stretched regime, taking into consideration the existence of slip conditions is carried out. The consideration of Newtonian fluids and Maxwell fluids with the application of magnetic field are characterized by a unique set of rheological characteristics [1-2]. The incorporation of nanoparticle into slip nano flows exhibits an opportunity to realize potentially large improvements in the heat transport performance of the system [3-7]. Adequate numerical determinations of the problem are developed for fine precision. Most significantly, the present study is focused on the application of two-phase nanoparticles to enhance weak frictions of machines, poor powering, lower lubrications [8-10].

Keywords: *Nanoparticles, Magnetic Field, Microorganisms, Maxwell Fluid, Bio-Convectio., Heat Transfer.*

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ANALYSIS OF THE EFFECTIVENESS OF AQUEOUS OZONE IN REDUCING MALONDIALDEHYDE LEVELS IN TREATED CHICKEN MEAT SAMPLES PURCHASED AT MARKETS IN BAGHDAD, IRAQ

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Abstract

Background and Aim: Malondialdehyde (MDA, a secondary product of oxidation) is the primary and perhaps the best studied harmful by-product of peroxidation of polyunsaturated fatty acids (PUFA) and has been used as a measure of oxidative rancidity. MDA in animal tissues can be measured using the sensitive thiobarbituric acid reactive substance (TBARS) assay, which is quantified as mg of MDA per kilogram of meat. Poultry is more likely to become contaminated with hazardous microorganisms and spoil quickly than other types of meat because of its high levels of polyunsaturated fatty acids (PUFA). Due to the potential health risks posed by chlorine residues in poultry meat, scientists in the food industry have been looking for disinfecting agents that are just as effective against spoilage and pathogenic bacteria as chlorine and its compounds, but are safer for humans and the environment. Ozone fits the bill. The purpose of this research was to calculate the percentage reduction in MDA (ppm) in broiler meat samples after being exposed to ozonated water (0.5 ppm/30 minutes).

Materials and Methods: Twenty-five samples of chicken flesh were taken from different areas of the province of Baghdad. High performance liquid chromatography (HPLC) was used to determine MDA concentrations. Ozone was produced with an ozone generator (A2Z/AQUA-6, USA), and its concentration in water was measured in parts per million (ppm) with a CHE-Mets®-Kit from the same country.

Results: Prior to treatment, the HPLC results showed that all samples had elevated MDA concentrations (between 1.25 and 2.11 ppm). All samples showed a drop in MDA (ppm) after being treated with ozonated water, with the largest decrease (85%) and the smallest decrease (22%) occurring in the same range. Average MDA levels were 1.69 ± 0.34 before treatment and 0.62 ±0.30 after, representing a 63% drop on average. These differences were statistically significant (P 0.05).

Conclusion: From a public health perspective, this MDA decline is crucial. According to these results, ozone treatment has the potential to form the basis of a new, safe technology for sanitizing meat and meat products before they are consumed.

Keywords: *Aqueous Ozone, Chicken Meat, MDA, Baghdad Markets.*

EFFECTS OF GAMMA RADIATION AND ELECTRON BEAM ON SAMPLES OF THE PEANUT CANDIES CONTAMINATED WITH *ASPERGILLUS FLAVUS*

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Abstract

Peanuts is known usage in making foods and generation of oil in Brazil like peanut candies and potential contaminated with several mycotoxigenic fungi as Aspergillus flavus. Therefore, it is possible *A. flavus* secreting some mycotoxins into contamination peanuts. This study is aimed to determine effects of gamma radiation and electron beam in reduction peanut candies contaminated with *A. flavus*. The samples of peanut candies were included two types of peanut candy, (A) Diet Peanut Candies, (B) Organic Peanuts Candies that divided treatments divided into two groups First: contaminated groups with *A. flavus*, and Second: control without contaminated which receive radiation of 0, 5 and 10 kGy dosage of electron beam EB and gamma radiation GR. Some samples of No inoculation were illuminated with a similar dosage to evaluate the sensors. The results indicated that 0.80 of the samples had an average water capacity. Illumination or irradiation of gamma radiation and electron beam at a dosage of 5 and 10 kGy were able to eliminate the *A. flavus* in the samples of Brazil peanuts. Analyzes of Aflatoxin indicated that electron beam doses of 5 and 10 kGy lowers aflatoxins levels by 53.32 and 65.66% correspondingly. Moreover this same dosage of gamma radiation lowered the levels of toxins by 70.61 and 84.15% respectively as compared to the control groups. The irradiation energy could affect *A. flavus* without change in characterize tastes of peanut candy and potential reduction mycotoxins in this candy.

***Keywords**: Peanut, Mycotoxins, Aspergillus, Aflatoxin*

EQUATIONS OF SLIDING GATES DISCHARGE COEFFICIENT WITH THRESHOLDS

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Abstract

The purpose of this research is to investigate the effect of gate opening and the presence of parallel and non-parallel thresholds on the discharge coefficient. For this purpose, rectangular thresholds with different widths and locations were investigated. In the non-threshold mode, the discharge coefficient decreases with the increase of the gate opening. Non-linear polynomial regression relationships were prepared to calculate C_d in the condition with threshold and without threshold. Results indicated that the RMSE and KGE statistical indices are 0.014 and 0.951 respectively for the condition with threshold and 0.0067 and 0.987 for the condition without threshold.

Keywords: *Sill, Gate, Free Flow, Discharge Coefficient*

SYNTHETIC FANDOM: A DIGITAL-BASED MODEL PROPOSAL FOR FINANCIAL SUSTAINABILITY IN TURKISH SPORTS CLUBS

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Abstract

Sports clubs in Turkey experience difficulties in financial sustainability. Expenditures in foreign currencies, player costs, difficulty in accessing financial resources, the relationship between sports and financial performance, and macro-level problems negatively affect the financial balance of clubs. It is very difficult to establish sustainable financial foundations for sports clubs, which are quite different from companies in the market in terms of their financial and legal structures. Although they diversify their resources in order to reduce and distribute the risk and operate in different areas (e-sports, licensed product sales, infrastructures, facility and real estate investments, etc.), all other activities cannot create as much impact as football.

Investors, sponsors, and advertisers, on the other hand, set goals that are more fan-oriented or fan-oriented. This situation narrows the investor and supporter profile and prevents diversification. In the study, suggestions will be developed regarding the concept of "synthetic fandom", which will spread the fan spirit of football clubs to the financial markets and expand their appearance as supporters, investors and even fans, and the possible effects of the digital-based model will be discussed. The main purpose of the study is to explain the "synthetic fandom" model in sports clubs and to contribute to income diversification strategies.

The concept of synthetic fans will be defined as stakeholders who provide support to the club through digital assets and receive special benefits in return. Thus, partnership will be established through various digital assets that will be created “even if you are not a team fan”, through a return beyond team fandom. Built on blockchain technology, synthetic fandom represents ownership rights and the advantages associated with these rights. While the synthetic fandom model encourages fans to be more interactive with the club, it also aims to generate income by increasing the interaction of fans with the club on social media and other digital platforms. Cryptocurrencies and tokens to be created; It will be used in the purchase of club products, in obtaining a share of possible future sales by supporting the contracts of athletes trained especially in the infrastructure, and in investing in possible returns related to success and participation bonuses. Proceeds from the sale of digital assets will help clubs achieve financial stability. Synthetic fandom will go beyond the emotional ties of fans and enable individual investors unrelated to the team to invest in diversified instruments. In addition to their possible benefits, systems that are not well planned, lack transparency, and lack infrastructure and data security also pose serious risks.

As a result, investing in digital assets will attract the support of non-fan investors and create “synthetic fandom” by combining traditional fandom with the return relationship. While the model will ensure that risk is distributed and returns increased with diversified investment options, systems that are not meticulously established by professionals may pose risks, like all digital assets.

***Keywords**: Sports Clubs, Financial Sustainability, Synthetic Fandom*

SENTETİK TARAFTARLIK: TÜRK SPOR KULÜPLERİNDE FİNANSAL SÜRDÜRÜLEBİLİRLİK İÇİN DİJİTAL TABANLI BİR MODEL ÖNERİSİ

Özet

Türkiye'deki spor kulüpleri finansal sürdürülebilirlik konusunda birçok zorlukla karşılaşmaktadır. Harcamaların yabancı para cinsinden yapılması, oyuncu maliyetleri, finansman kaynaklarına erişim zorluğu, sportif ve finansal performans ilişkisi ve makro düzeydeki sorunlar kulüplerin mali dengelerini olumsuz etkilemektedir. Finansal ve hukuki yapıları bakımından piyasadaki şirketlerden oldukça farklı olan spor kulüpleri için sürdürülebilir finansal temeller oluşturmak oldukça zordur. Riski azaltmak ve dağıtmak için kaynak çeşitlendirme yoluna giderek farklı alanlarda da faaliyet gösterseler de (e-spor, lisanslı ürün satışı, alt yapılar, tesis ve gayri menkul yatırımları vb.) diğer tüm faaliyetler futbol kadar etki yaratamamaktadır.

Yatırımcılar, sponsorlar, reklam verenler ise daha çok taraftar ruhu ile ya da taraftara odaklı hedefler belirlemektedirler. Bu durum yatırımcı ve destekçi profilini daraltarak çeşitlendirmeye gidilmesine engel olmaktadır. Çalışmada futbol kulüplerinin taraftar ruhunu finansal piyasalara yayarak destekçi, yatırımcı hatta taraftar görünümünde genişleme sağlayacak "sentetik taraftarlık" kavramına dair öneriler geliştirilecek ve dijital temelli modelin olası etkileri ele alınacaktır. Çalışmanın temel amacı, spor kulüplerinde sentetik taraftarlık modelini açıklamak ve gelir çeşitlendirme stratejilerine bir katkıda bulunmaktır.

Sentetik taraftarlık kavramı, dijital varlıklar aracılığıyla kulübe destek sağlayan ve karşılığında özel avantajlar elde eden paydaşlar olarak tanımlanacaktır. Böylece takım taraftarlığından öte getiri yoluyla "takımı tutmasa da" oluşturulacak çeşitli dijital varlıklar yoluyla paydaşlık tesis edilecektir. Blockchain teknolojisi üzerine inşa edilmiş olan sentetik taraftarlık, sahiplik haklarını ve bu haklara bağlı avantajları temsil etmektedir. Sentetik taraftarlık modeli, taraftarların kulüple daha etkileşimli olmalarını teşvik ederken sosyal medya ve diğer dijital platformlarda taraftarların kulüp ile etkileşimini artırarak bu mecralardan da gelir elde edilmesini hedefler. Oluşturulacak kripto paralar ve token'lar kullanılarak kulüp ürünleri satın alınabilecek, özellikle alt yapıdan yetişen sporcuların sözleşmelerine destek olunarak ileride gerçekleşecek olası satışlardan pay alınabilecek ve yine başarı ve katılım primleri ile ilgili olası getirilere dair yatırım yapılabilecektir. Dijital varlıkların satışından elde edilen gelirler, kulüplerin finansal stabilite sağlamalarına yardımcı olacaktır. Sentetik taraftarlık, taraftarların duygusal bağlarının ötesine geçerek takımla ilgisi olmayan bireysel yatırımcıların da çeşitlendirilmiş araçlara yatırım yapmasını sağlayacaktır. Muhtemel getirilerinin yanında iyi planlanmamış, şeffaflığı sağlanamamış, alt yapı ve veri güvenliği sağlanmamış sistemler de ciddi riskler oluşturmaktadır.

Sonuç olarak, dijital varlıklara yatırım yapmak taraftar olmayan yatırımcıların desteğini çekecek ve geleneksel taraftarlık ile getiri ilişkisini birleştirerek "sentetik taraftarlık" oluşturacaktır. Model, çeşitlendirilmiş yatırım seçenekleri ile riskin dağıtılmasını ve getirinin artmasını sağlayacağı gibi profesyoneller tarafından titizlikle kurulmamış sistemler de tüm dijital varlıklar gibi risk oluşturabilecektir.

Anahtar Kelimeler: *Spor Kulüpleri, Finansal Sürdürülebilirlik, Sentetik Taraftarlık*

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SÖZLÜ SUNUMLAR
ORAL PRESENTATION

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ABSTRACT PAPERS

MAXWELL NANOFLUID WITH INDUCED MAGNETIC STRETCHING REGIME FOR BIOTECHNOLOGY AND ENGINEERING APPLICATIONS

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Abstract

In this work, the Maxwell nano flow phenomena across a stretched regime, taking into consideration the existence of slip conditions is carried out. The consideration of Newtonian fluids and Maxwell fluids with the application of magnetic field are characterized by a unique set of rheological characteristics [1-2]. The incorporation of nanoparticle into slip nano flows exhibits an opportunity to realize potentially large improvements in the heat transport performance of the system [3-7]. Adequate numerical determinations of the problem are developed for fine precision. Most significantly, the present study is focused on the application of two-phase nanoparticles to enhance weak frictions of machines, poor powering, lower lubrications [8-10].

Keywords: *Nanoparticles, Magnetic Field, Microorganisms, Maxwell Fluid, Bio-Convectio., Heat Transfer.*

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Özet

Türkiye'deki spor kulüpleri finansal sürdürülebilirlik konusunda birçok zorlukla karşılaşmaktadır. Harcamaların yabancı para cinsinden yapılması, oyuncu maliyetleri, finansman kaynaklarına erişim zorluğu, sportif ve finansal performans ilişkisi ve makro düzeydeki sorunlar kulüplerin mali dengelerini olumsuz etkilemektedir. Finansal ve hukuki yapıları bakımından piyasadaki şirketlerden oldukça farklı olan spor kulüpleri için sürdürülebilir finansal temeller oluşturmak oldukça zordur. Riski azaltmak ve dağıtmak için kaynak çeşitlendirme yoluna giderek farklı alanlarda da faaliyet gösterseler de (e-spor, lisanslı ürün satışı, alt yapılar, tesis ve gayri menkul yatırımları vb.) diğer tüm faaliyetler futbol kadar etki yaratamamaktadır.

Yatırımcılar, sponsorlar, reklam verenler ise daha çok taraftar ruhu ile ya da taraftara odaklı hedefler belirlemektedirler. Bu durum yatırımcı ve destekçi profilini daraltarak çeşitlendirmeye gidilmesine engel olmaktadır. Çalışmada futbol kulüplerinin taraftar ruhunu finansal piyasalara yayarak destekçi, yatırımcı hatta taraftar görünümünde genişleme sağlayacak "sentetik taraftarlık" kavramına dair öneriler geliştirilecek ve dijital temelli modelin olası etkileri ele alınacaktır. Çalışmanın temel amacı, spor kulüplerinde sentetik taraftarlık modelini açıklamak ve gelir çeşitlendirme stratejilerine bir katkıda bulunmaktır.

Sentetik taraftarlık kavramı, dijital varlıklar aracılığıyla kulübe destek sağlayan ve karşılığında özel avantajlar elde eden paydaşlar olarak tanımlanacaktır. Böylece takım taraftarlığından öte getiri yoluyla "takımı tutmasa da" oluşturulacak çeşitli dijital varlıklar yoluyla paydaşlık tesis edilecektir. Blockchain teknolojisi üzerine inşa edilmiş olan sentetik taraftarlık, sahiplik haklarını ve bu haklara bağlı avantajları temsil etmektedir. Sentetik taraftarlık modeli, taraftarların kulüple daha etkileşimli olmalarını teşvik ederken sosyal medya ve diğer dijital platformlarda taraftarların kulüp ile etkileşimini artırarak bu mecralardan da gelir elde edilmesini hedefler. Oluşturulacak kripto paralar ve token'lar kullanılarak kulüp ürünleri satın alınabilecek, özellikle alt yapıdan yetişen sporcuların sözleşmelerine destek olunarak ileride gerçekleşecek olası satışlardan pay alınabilecek ve yine başarı ve katılım primleri ile ilgili olası getirilere dair yatırım yapılabilecektir. Dijital varlıkların satışından elde edilen gelirler, kulüplerin finansal stabilite sağlamalarına yardımcı olacaktır. Sentetik taraftarlık, taraftarların duygusal bağlarının ötesine geçerek takımla ilgisi olmayan bireysel yatırımcıların da çeşitlendirilmiş araçlara yatırım yapmasını sağlayacaktır. Muhtemel getirilerinin yanında iyi planlanmamış, şeffaflığı sağlanamamış, alt yapı ve veri güvenliği sağlanmamış sistemler de ciddi riskler oluşturmaktadır.

Sonuç olarak, dijital varlıklara yatırım yapmak taraftar olmayan yatırımcıların desteğini çekecek ve geleneksel taraftarlık ile getiri ilişkisini birleştirerek "sentetik taraftarlık" oluşturacaktır. Model, çeşitlendirilmiş yatırım seçenekleri ile riskin dağıtılmasını ve getirinin artmasını sağlayacağı gibi profesyoneller tarafından titizlikle kurulmamış sistemler de tüm dijital varlıklar gibi risk oluşturabilecektir.

Anahtar Kelimeler: *Spor Kulüpleri, Finansal Sürdürülebilirlik, Sentetik Taraftarlık*

NUMERICAL AND EXPERIMENTAL INVESTIGATION OF HEAT EXCHANGER WITH SLIT GEOMETRY FIN STRUCTURE

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Abstract

Heat exchangers are one of the components used to adjust the ambient temperature in heating-cooling systems. In split air conditioners, two different heat exchangers are used: the evaporator in the indoor unit and the condenser in the outdoor unit. As standardization organizations periodically improve energy consumption regulations, and air conditioners are required to be more efficient. The development of heat exchanger structures is constantly continuing for this reason. In this direction, studies are focused on increasing the thermal efficiency on the fins and copper pipes in heat exchangers. Heat transfer capacity is increased by changing the structure of fin patterns such as slit, wavy and louver type.

In this study, it is aimed to investigate the effect of the newly designed heat exchangers with slit geometry on the performance. Within the scope of this work, 30 different slit fins were numerically modeled and parametrically analyzed using Computational Fluid Dynamics (CFD). According to the results obtained from CFD analysis, although there is no significant change in terms of pressure drop compared to the current slit geometry, the design that shows more heat transfer performance has been produced as a prototype. In addition to the currently used heat exchangers in the slit and non-slit fin structure, the new prototyped slit fin design was experimentally investigated using the Particle Image Velocimetry (PIV) method. The distributions of air flow velocities of these three designs were shown with PIV and the average velocity data of the air passing through the heat exchanger was obtained. Besides, performance tests such as flow rate, capacity, and energy consumption of indoor units with current slit, non-slit and new slit geometry fin heat exchangers were carried out. As a result of the project, a fin structure proposal containing a new slit geometry was presented to increase the heat transfer performance in heat exchangers used in split air conditioner indoor units.

***Keywords**: Slit Fin, Heat Exchanger, Split Air Conditioner, CFD, PIV*

PATLATMALI GEOMETRİ KANAT YAPISI İÇEREN ISI DEĞİŞTİRİCİLERİN SAYISAL VE DENEYSEL OLARAK İNCELENMESİ

Özet

Isı değiştiricileri, ısıtma-soğutma sistemlerinde ortam ısısının ayarlanmasını sağlamak için sıkça kullanılan komponentlerden bir tanesidir. Split klimalarda ise iç ünitede evaporatör ve dış ünitede kondenser olarak adlandırılan iki farklı ısı değiştiricisi kullanılmaktadır. Standardizasyon kuruluşları tarafından enerji tüketim regülasyonlarının belirli aralıklarla iyileştirilmesi nedeniyle, klimaların daha verimli olması istenilmektedir. Bundan dolayı ısı değiştirici yapılarının geliştirilmesine sürekli olarak devam edilmektedir. Bu doğrultuda, ısı değiştiricisini oluşturan kanat ve boru üzerine termal etkinliği artırıcı çalışmalara yoğunlaşılmaktadır. Isı transferi kapasitesinin arttırılmasına yönelik olarak ısı değiştiricisi kanat yüzeyleri patlatmalı, dalgalı, panjur tipi gibi tasarımlarla genişletilmektedir.

Bu çalışmada, tasarlanan yeni patlatma yapısına sahip ısı değiştiricilerinin performansa etkisinin incelenmesi amaçlanmıştır. Çalışma kapsamında; 30 farklı patlatmalı kanat geometri ve dizilimi sayısal olarak modellenmiş ve parametrik olarak Hesaplamalı Akışkanlar Dinamiği (HAD) kullanılarak analiz edilmiştir. HAD analizlerinden elde edilen sonuçlara göre mevcut patlatma yapısına kıyasla basınç düşümü açısından büyük bir değişiklik olmamasına karşın daha fazla ısı transferi performansı gösteren tasarım prototip olarak üretilmiştir. Mevcut durumda kullanılan patlatmalı ve patlatmasız kanat yapısındaki ısı değiştiricilerine ek olarak, prototip üretilen yeni patlatmalı kanat yapısı tasarımı deneysel olarak Parçacık Görüntülemeli Hız Ölçümü (PGHÖ) yöntemiyle incelenmiştir. PGHÖ ile bu üç tasarımın hava akış hızlarının dağılımları gösterilmiş ve ısı değiştiricisinden geçen havanın ortalama hız verileri elde edilmiştir. Ayrıca mevcut patlatmalı, patlatmasız ve yeni patlatmalı kanat geometrisi içeren ısı değiştiricilerinin bulunduğu iç ünitelerin debi, kapasite ve enerji sarfiyatı gibi performans testleri gerçekleştirilmiştir. Proje sonucunda, split klima iç ünitelerinde kullanılan ısı değiştiricilerinde ısı transferi performansını artırmaya yönelik yeni patlatma geometrisi içeren kanat yapı önerisi sunulmuştur.

***Anahtar Kelimeler**: Patlatmalı Kanat, Isı Değiştirici, Split Klima, HAD, PGHÖ*

THE *IN SILICO* INVESTIGATION OF NEWLY DESIGNED A-AMINONITRILE AND A-AMINOACIDS FOR CHOLINESTERASE INHIBITORY ACTIVITY

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Abstract

Alzheimer's disease (AD), the most frequent type of dementia, is a neurodegenerative disorder that begins with a decline in cognitive functions and causes destructive and irreversible changes in the brain. The fact that there is no definitive treatment for AD and that its population is increasing day by day emphasizes the importance of innovations in this field. On the otherhand aminonitriles and amino acids are pharmacologically and biologically active molecules. Inaddition to being involved in acids through hydrolysis. In this study, *in silico* studies such as molecular docking and ADMET were carried out for newly designed aminonitriles and amino acids, targeting the inhibition of acetylcholinesterase and butyrylcholinesterase enzymes, which are associated with Alzheimer's disease pathology. Molecular docking studies of the designed compounds and target enzymes were performed with the AutoDock Vina program, and the docking results were visualized with Discovery Visualizer. Additionally, the binding affinities of aminonitriles and amino acids to target enzymes and ADMET properties were compared.

Keywords: *α-Aminonitrile, Alzheimer's Disease, Cholinesterase*

DIGITAL CULTURAL STORYTELLING: REVITALIZING TRADITIONS AND MYTHS THROUGH ILLUSTRATION IN NEW MEDIA

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Abstract

With the rise of new media, digitalization has spread to all areas of life, and digital cultural storytelling has taken place as a new form of expression in our digitalized lives. By providing visual narration of stories through illustration, it is possible to visualize cultural values, traditions and myths and make them more understandable. The combination of digital storytelling and traditional storytelling techniques with the digital possibilities of new media is a powerful tool for the revitalization of stories and digital storytelling brings a new dimension to stories and myths. At this point, it is important to understand the power of illustrations and digital storytelling in order to understand how we can revitalize traditional narratives and myths and to comprehend their role in preserving cultural heritage and passing it on to future generations.

This paper aims to examine how traditions and myths can be revitalized through illustration by addressing basic concepts such as "The Concept of Illustration" and "Digital Storytelling". Furthermore, examining sample illustrations from Turkish mythology and legends will provide concrete examples of this revitalization process.

***Keywords**: Digital Storytelling, New Media, Illustration*

DİJİTAL KÜLTÜREL HİKÂYE ANLATICILIĞI: YENİ MEDYADA GELENEKLERİN VE MİTLERİN İLLÜSTRASYON YOLU İLE YENİDEN CANLANDIRILMASI

Özet

Yeni medyanın yükselişiyle birlikte dijitalleşme hayatın her alanına yayılmış, dijital kültürel hikâye anlatıcılığı da dijitalleşen hayatlarımız içinde yeni bir ifade şekli olarak yer almıştır. İllüstrasyon ile hikâyelerin görsel anlatımı sağlanarak, kültürel değerlerin, geleneklerin, mitlerin görselleştirilmesi ve daha anlaşılır hale getirilmesi mümkündür. Dijital hikâye anlatıcılığı ve geleneksel hikâye anlatım tekniklerinin yeni medyanın dijital olanaklarıyla birleştirilmesi; hikâyelerin yeniden canlandırılmasında güçlü bir araçtır ve dijital hikayeleme ile hikâye ve mitlere yeni bir boyut kazandırılmaktadır. Bu noktada geleneksel anlatıları ve mitleri nasıl yeniden canlandırabileceğimizi anlamak, kültürel mirasın korunması ve gelecek nesillere aktarılmasındaki rolünü kavrayabilmek için illüstrasyonların gücünü ve dijital hikâye anlatıcılığını kavramak önemlidir.

Bu bildiri, "İllüstrasyon Kavramı" ve "Dijital Hikâye Anlatıcılığı" gibi temel kavramları ele alarak, geleneklerin ve mitlerin nasıl illüstrasyon yoluyla yeniden canlandırılabileceğini incelemeyi amaçlamaktadır. Ayrıca, Türk mitolojisi ve efsanelerinden örnek illüstrasyonların incelenmesi, bu yeniden canlandırma sürecinin somut örneklerini sunacaktır.

***Anahtar Kelimeler**: Dijital Hikaye Anlatımı, Yeni Medya, İllüstrasyon*

EFFICIENT REMOVAL OF INDIGO CARMINE DYE BY MIL-53 (AL)

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Abstract

Metal organic frameworks (MOFs) have garnered significant attention in the scientific community. MIL-53 (Al) is a type of metal organic frameworks known for its high surface area, water stability, and breathing effect. MOFs have been used effectively for many areas, and water treatment is one of them. This study examines the adsorption of indigo carmine by MIL-53 (Al), synthesized through a solvothermal method. The materials were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier-transform infrared spectroscopy (FTIR). The adsorption process was investigated by changing parameters such as pH, adsorbent amount, initial dye concentration, time, and temperature. Additionally, the adsorption isotherm and kinetics models were examined and seen that Langmuir isotherm model and pseudo-second order kinetic model best fit the data. Thermodynamic study showed that indigo carmine adsorption by MIL-53 (Al) had exothermic and spontaneous.

***Keywords**: MIL-53, Adsorption, Indigo Carmine, Isotherm*

THE PLACE OF ROBOT JOURNALISM IN THE NEWS IN THE TURKISH PRESS: THE CASE OF INTERNET JOURNALISM

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Abstract

The rapid development of communication technologies has brought about a major transformation in the field of journalism. This new era, which breaks away from traditional journalistic practices, includes news directed by algorithms and automatically served on the internet. This process is called "robot journalism" and forms the basis of new generation journalism practices. In robot journalism, routine news stories undertaken by reporters are now carried out by automations. Especially leading international media organisations use such software effectively. The world's leading news organisations such as Associated Press, Forbes, Los Angeles Times employ robot journalists and make use of this technology in areas such as earthquakes, sports, public order and finance where numerical data is dense. This study analyses the process from traditional journalism to internet journalism and from there to robot journalists created by algorithms fed by numerical values. Robot journalists, which are frequently used by media organisations in developed countries and play an active role in news production, are examined through news on the internet. Robot journalists, which have made a name for themselves around the world and are used in many fields, are mostly dealt with as a news topic in Turkey. The local media covers these robot journalists, who are products of artificial intelligence, in their news, articles, columns and columns. This situation reveals that robot journalists are in competition with human journalists and how this competition has an impact on a global scale. This transformation provides important clues about the future of the media industry and brings about debates on how the journalism profession will evolve. Robot journalism not only increases productivity but also raises new questions about the ethical and professional standards of journalism. The advantages and potential ethical problems brought by this technology are among the important factors that will shape the future of the media sector.

Keywords: *Robot journalist, artificial intelligence, news, journalism, internet journalism*

ROBOT GAZETECİLİĞİN TÜRKİYE BASININDAKİ HABERLERDE YER EDİNMESİ: İNTERNET GAZETECİLİĞİ ÖRNEĞİ

Özet

İletişim teknolojilerinin hızla gelişmesi, gazetecilik alanında da büyük bir dönüşümü beraberinde getirmiştir. Geleneksel gazetecilik pratiklerinden sıyrılan bu yeni dönem, algoritmaların yönlendirdiği ve otomatik olarak internet ortamına servis edilen haberleri kapsar. Bu süreç, "robot gazetecilik" olarak adlandırılmaktadır ve yeni nesil gazetecilik uygulamalarının temelini oluşturur. Robot gazetecilikte, muhabirlerin üstlendiği rutin haberler, artık otomasyonlar tarafından yapılmaktadır. Özellikle uluslararası öncü medya kuruluşları, bu tür yazılımları etkin bir şekilde kullanmaktadırlar. Associated Press, Forbes, Los Angeles Times gibi dünyanın önde gelen haber kuruluşları, robot gazetecileri istihdam ederek deprem, spor, asayiş, finans gibi sayısal verilerin yoğun olduğu alanlarda bu teknolojiden yararlanmaktadırlar. Bu çalışma, geleneksel gazetecilikten internet haberciliğine ve oradan da sayısal değerlerle beslenen algoritmaların yarattığı robot gazetecilere kadar olan süreci ele almaktadır. Gelişmiş ülkelerde medya kuruluşlarının sıklıkla kullandığı ve haber üretiminde etkin rol oynayan robot gazeteciler, internet üzerindeki haberler aracılığıyla incelenmektedir. Dünya genelinde adından sıkça söz ettiren ve birçok alanda kullanılan

robot gazeteciler, Türkiye'de daha çok haber konusu olarak ele alınmaktadır. Yerel medya, yapay zeka ürünü olan bu robot gazetecileri haberlerinde, yazılarında, köşe yazılarında ve makalelerinde konu edinmektedir. Bu durum, robot gazetecilerin insan gazetecilerle rekabet içerisinde olduğunu ve bu rekabetin küresel çapta nasıl bir etki yarattığını ortaya koymaktadır. Bu dönüşüm, medya endüstrisinin geleceğine dair önemli ipuçları sunmakta ve gazetecilik mesleğinin nasıl evrileceği konusunda tartışmaları beraberinde getirmektedir. Robot gazetecilik, hem verimliliği artırmakta hem de gazeteciliğin etik ve profesyonel standartları açısından yeni soruları gündeme getirmektedir. Bu teknolojinin getirdiği avantajlar ve olası etik sorunlar, medya sektörünün geleceğini şekillendirecek önemli faktörler arasında yer almaktadır.

Anahtar Kelimeler: *Robot Gazeteci, Yapay Zeka, Haber, Gazetecilik, İnternet Gazeteciliği*

SEISMIC ANALYSIS OF A RC BUILDING IN IZMIR BY RESPONSE SPECTRUM METHOD

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Abstract

Nowadays, it is not possible to determine exactly when and at what magnitude earthquakes will occur. Among the precautions to be taken before an earthquake, "Buildings must be built to be resistant to the effects of earthquakes." (https://www.afad.gov.tr) the substance is contained. However, it is also important to know how the existing building stock will respond to the earthquake. Local soil conditions are crucial in determining the seismicity of a region. Structural analysis takes into account the seismicity of the region through spectrum curves, and uses earthquake hazard maps to determine the response spectrum directly depending on soil conditions. The purpose of calculating the response spectrum in structures is to determine the reactions of structures designed to be earthquake-resistant under horizontal load (Hasgür and Gündüz, 1992). However, the calculation of motion equations using recordings of previous earthquakes is a long and complicated situation, and the seismic spectrum is used. (Celep and Kumbasar, 2004). It is mandatory to have information about the earthquake behavior of the existing building stock rather than the new buildings to be built. Because the vast majority of the existing buildings in our country were built in accordance with the provisions of the previous regulations, their performance under earthquake load will directly affect the losses that will be experienced. Based on this point, Izmir province, where the earthquake risk is quite high, was taken into consideration within the scope of the study. It was accepted that a building built in 1985 was built in three different soil conditions in Izmir. Three regions belonging to different soil types, located on the northern shores of Izmir Bay, were determined as the study area. In his study, Eskişar (2008) investigated the ground characteristics of the northern gulf coast of Izmir, which was considered a first-degree earthquake zone in previous regulations, and prepared a soil type map in accordance with the NEHRP regulation. Depending on the mapping in question, settlement areas on three different ground types were determined (Soğukkuyu, Ataşehir (İstasyonaltı), and Mavişehir). Earthquakes of different magnitudes were applied to the building in question, a response spectrum analysis was performed, and the results were shared. As a result of the study, it was seen that the base shear force of the building in question could not meet the base shear force that would occur due to the earthquake effect in earthquakes with a magnitude of $M_w \geq 6.7$ for all three soil types (ZC, ZD, and ZE).

***Keywords**: Earthquake, Response Spectrum, Soil Type*

İZMİR'DEKİ BETONARME BİR BİNANIN TEPKİ SPEKTRUMU YÖNTEMİ İLE SİSMİK ANALİZİ

Özet

Günümüzde, depremlerin tam olarak ne zaman ve ne şiddette meydana geleceği kesin olarak belirlenememektedir. Depremden önce alınması gereken önlemler arasında "Yapılar deprem etkilerine karşı dayanıklı inşa edilmelidir." (https://www.afad.gov.tr) maddesi yer almaktadır. Ancak, mevcut yapı stoğunun depreme karşı nasıl davranacağının da bilinmesi büyük önem arz etmektedir. Bir bölgenin depremselliğinin belirlenmesinde yerel zemin koşulları son derece önemlidir. Yapısal analizlerde bölgenin depremselliği spektrum eğrileri aracılığı ile dikkate alınmakta ve zemin koşullarına doğrudan bağlı olarak belirlenen tepki spektrumları için deprem

tehlike haritaları kullanılmaktadır. Yapılarda tepki spektrumunun hesaplanmasındaki amaç, depreme dayanıklı olarak tasarlanması amaçlanan yapıların yatay yük altındaki tepkilerinin bulunmasını sağlamaktır (Hasgür ve Gündüz, 1992). Ancak, daha önceden meydana gelmiş deprem yer ivme kayıtlarından faydalanılarak hareket denklemlerinin hesaplanması uzun ve meşakkatli bir durum olacağından deprem spektrumlarından yararlanılmaktadır (Celep ve Kumbasar, 2004). Yeni yapılacak binalardan ziyade, mevcut yapı stoğunun depreme karşı davranışı hakkında bilgi sahibi olmak zorunlu bir durumdur. Çünkü, ülkemizde var olan yapıların büyük çoğunluğu geçmiş yönetmeliklerde yer alan hükümlere bağlı olarak inşa edilmiş olup deprem yükü altında gösterecekleri performans yaşanacak kayıpları doğrudan etkileyecektir. Bu noktadan yola çıkılarak, çalışma kapsamında, deprem riskinin oldukça yüksek olduğu İzmir ili dikkate alınmıştır. 1985 yılında inşa edilmiş olan bir binanın İzmir'de üç farklı zemin koşulunda inşa edildiği kabul edilmiştir. Çalışma alanı olarak İzmir körfezi kuzey kıyılarında yer alan, farklı zemin sınıflarına ait üç bölge belirlenmiştir. Eskişar (2008) çalışmasında, geçmiş yönetmeliklerde birinci derece deprem bölgesi olarak kabul edilen, İzmir'in kuzey körfez kıyılarının zemin özelliklerini araştırmış ve NEHRP yönetmeliğine bağlı olarak zemin türü haritasını çıkartmıştır. Söz konusu haritalamaya bağlı olarak üç farklı zemin tipi üzerindeki yerleşim bölgeleri belirlenmiştir (Soğukkuyu, Ataşehir (İstasyonaltı), Mavişehir). Söz konusu binaya farklı magnitüdde depremler etki ettirilerek tepki spektrumu analizi yapılmış ve sonuçlar paylaşılmıştır. Yapılan çalışma neticesinde, söz konusu binanın her üç zemin türü için de (ZC, ZD, ZE) $M_w \geq 6.7$ magnitüddeki depremlerde taban kesme kuvvetinin deprem etkisiyle oluşacak taban kesme kuvvetini karşılayamadığı görülmüştür.

***Anahtar Kelimeler**: Deprem, Tepki Spektrumu, Zemin Sınıfı*

DEVELOPMENT OF A MACHINE COMPATIBLE WITH PRODUCTION PROCESSES FOR ANGLE CARDBOARDS USED IN FURNITURE PACKAGING

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Abstract

Furniture elements produced from raw materials such as wood, mdf, suntalam are used as protectors made of cardboard material for the protection of corners and edges in packaging operations. Protectors that facilitate both alignment and stacking within the package and provide strength can be supplied to appropriate costs. Furniture companies provide customer satisfaction by delivering their products to customers without damage.

Çilek Furniture has adopted the philosophy of lean production since 2008 and carries out studies to improve production processes in this direction. Process of the angle cardboard used in packaging as a process development team were examined. About 71 different sizes of angle cardboard are used. Angle cardboards purchased from the supplier as 1 meter are cut on a horizontal circular saw machine or band saw machine to the size specified for the packages and stacked to be sent to the packaging unit. The risk of injury to the operator arises as a minimum size measure up to 2.5 cm cut is performed. The operator performing the cutting process takes a turn of about 150 meters each time. For each shift, operators spend 166 minutes on this cutting process. The need for unnecessary movement and work to completely eliminate or reduce unnecessary transport has arisen, which is one of the pillars of the philosophy of lean production.

In this study, in order to facilitate the angle cardboard cutting process and to reduce the mud in the process, the machine designed and assembled by the company's own resources has been adapted to the Çilek Furniture production system. With this machine developed and started to implement, possible work accidents have been prevented and processing times have been reduced. Production efficiency is ensured by shortening the walking distance before and after the cutting process. 5S work has been done to make the styrofoam material used with angle cardboard easily available in the production area to ensure the strength in the package. In order to easily find the Styrofoam material used with angle cardboard to provide strength in the package in the production area, 5S work has been done to eliminate unnecessary movement.

***Keywords**: Furniture, Angle Cardboard, Machine, Design.*

MOBİLYA AMBALAJLAMASINDA KULLANILAN KÖŞEBENTLERİN KESİMİ İÇİN ÜRETİM SÜREÇLERİNE UYUMLU MAKİNE GELİŞTİRİLMESİ

Özet

Ahşap, mdf, suntalam gibi ham maddelerden üretilen mobilya elemanlarının ambalajlama işlemlerinde köşe ve kenarların korunması amacıyla karton malzemesinden üretilen kraft köşebentler kullanılmaktadır. Hem paket içerisinde hizalama ve istiflemeyi kolaylaştıran hem de mukavemeti sağlayan kraft köşebentler uygun maliyetlere tedarik edilebilmektedir. Mobilya

firmaları, ürünlerini hasarsız bir şekilde müşterilere teslim etmesiyle birlikte müşteri memnuniyetini sağlamaktadırlar.

Çilek Mobilya 2008 yılından bu yana Yalın Üretim Felsefesi'ni benimsemiş ve bu yönde üretim süreçlerini iyileştirme amaçlı çalışmalar gerçekleştirmektedir. Süreç geliştirme ekibi olarak ambalajlamada kullanılan kraft köşebentlerin üretimdeki süreçleri incelenmiştir. Yaklaşık 71 farklı ölçüde kraft köşebent kullanılmaktadır. Tedarikçiden 1 metre olarak alınan köşebentler paketler için belirtilen ölçüde yatar daire testere makinesi veya şerit bıçkı makinesinde kesilerek paketleme bölümüne gönderilmek üzere istiflenmektedir. Minimum boy ölçüsü olarak 2,5 cm'e kadar kesim işlem yapıldığı için operatörün yaralanma riski ortaya çıkmaktadır. Kesim işlemini gerçekleştiren operatör her seferinde yaklaşık 150 metrelik bir tur atmaktadır. Her vardiyada bu kesim işlemi için operatörler 166 dakika zaman harcamaktadır. Yalın üretim felsefesinin mudalarından olan gereksiz hareket ve gereksiz taşımaların tamamen ortadan kaldırılması veya azaltılması için çalışma yapılması ihtiyacı ortaya çıkmıştır.

Bu çalışmada, kraft köşebent kesim işlemini kolaylaştırmak ve süreç içerisindeki mudaların azaltılması amacıyla firmanın kendi öz kaynaklarınca tasarımı ve montajı gerçekleştirilen makine Çilek Mobilya üretim sistemine adapte edilmiştir. Geliştirilen ve uygulamaya başlayan bu makineyle, olası iş kazalarının önüne geçilmiş, işlem süreleri azaltılmıştır. Kesim işlemi öncesi ve sonrasındaki yürüme mesafesinin kısalmasıyla üretim verimliliği sağlanmıştır. Paket içerisinde mukavemeti sağlama amacıyla kraft köşebent ile birlikte kullanılan strafor malzemesinin üretim alanında kolay bir şekilde bulunması için 5S çalışması yapılarak gereksiz hareket mudası ortadan kaldırılmıştır.

Anahtar Kelimeler*: Mobilya, Kraft Köşebent, Makine, Tasarım.*

CONSTRUCTION OF NEW CHAOTIC FUNCTIONS ON THE SEQUENCE SPACES Σ_2, Σ_2^2, AND $\Sigma_2 \times \Sigma_2$

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Abstract

In the theory of discrete dynamical systems, the concept of topological conjugacy is used to denote both the existence of different functions with the same dynamic properties and the creation of new dynamical systems. Also, sequence (symbol) spaces and shift maps are used as important tools to investigate chaotic dynamical systems.

In this study, firstly, we present some chaotic properties related to the one-sided shift map $S: \Sigma_2 \to \Sigma_2$ and the two-sided shift map $\sigma: \Sigma_2^2 \to \Sigma_2^2$. Furthermore, we show that the product map $S \times S: \Sigma_2 \times \Sigma_2 \to \Sigma_2 \times \Sigma_2$ also exhibits chaotic behavior by using one-sided sequence space Σ_2 and the one-sided shift map $S: \Sigma_2 \to \Sigma_2$. Finally, we show that the spaces Σ_2, Σ_2^2, and $\Sigma_2 \times \Sigma_2$ are homeomorphic, and in this way, new chaotic functions in these spaces are produced by topological conjugacy.

Keywords: *Chaotic Dynamical Systems, Sequence Spaces, Shift Maps, Topological Conjugacy*

COMPARATIVE EVALUATION OF LRBA PROTEIN EXPRESSION BY WESTERN BLOT AND FLOW CYTOMETRY IN HEALTHY CONTROLS

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Abstract

Primary immunodeficiencies (PIs) are genetic disorders of the immune system with heterogeneous and variable clinical phenotypes. Advances in genetics and molecular biology have enabled researchers to identify more than 300 genes associated with different PID phenotypes. Lipopolysaccharide-responsive beige-like anchor (LRBA) deficiency is a primary immunodeficiency characterized by recurrent sinopulmonary infections with hypogammaglobulinemia, lymphoproliferation and immunoregulation and manifested by enteropathy, cytopenias and autoimmune endocrinopathy. Rapid diagnosis of LRBA protein deficiency is especially important for the rapid initiation of life-saving medical therapies and acceleration of hematopoietic stem cell transplantation preparations. Therefore, it is important to identify an accurate, reliable, sensitive and cost-effective test that allows the diagnosis of LRBA deficiency. Polyclonal antibodies generally cause non-protein non-specific binding and may reflect false protein expression. This can lead to missed diagnosis. Other methods should be used to identify patients more reliably and at a higher rate. Among these methods, Western Blot is the most classical protein detection method. In this study, we aimed to compare LRBA protein expression in healthy controls by flow cytometry and western blotting, to determine the weight of the protein by western blotting and to determine the sensitivity of both methods. The study was conducted at Marmara University Faculty of Medicine, Department of Pediatric Allergy and Immunology. In the study, LRBA protein expression was examined by Western Blot and Flow Cytometric Method in 5 healthy controls and it was observed that LRBA protein expression was present in healthy controls. The amount of protein loaded in healthy controls was 10.43, 16.24, 19.11, 14.09 and 19.37 µg and the amounts of PBMCs were 18x106, 16x106, 5x106 and 5x106mm3, respectively. Then, LRBA protein expression was analyzed in 3 healthy controls and 4 patients with primary immunodeficiency (P1, P2, P3, P4) by both methods. In 3 healthy controls, LRBA protein expression was detected and no protein expression was observed in patients P1, P2, P3. In patient P4 with known missense mutation, the protein expression of the mutation was higher than in other patients. Previous studies have shown that flow cytometry is limited in some cases. We think that the main problem here is the polyclonal nature of the antibody used. Considering the results obtained from our study, Western Blot and Flow Cytometry methods were found to be effective in the determination of LRBA protein deficiency, but more studies on healthy controls and patients are needed.

Keywords: *Primary Immunodeficiency, LRBA Protein, Western Blot, Flow Cytometry*

LRBA PROTEİN İFADESİNİN WESTERN BLOT VE FLOW SİTOMETRİ YÖNTEMLERİYLE SAĞLIKLI KONTROLLERDE KARŞILAŞTIRMALI OLARAK DEĞERLENDİRİLMESİ

Özet

Primer immün yetmezlikler (PİY), heterojen ve değişken klinik fenotipleri olan bağışıklık sisteminin genetik bozukluklarıdır. Genetik ve moleküler biyolojideki gelişmeler, araştırmacıların farklı PİY fenotipleri ile ilişkili 300'den fazla geni tanımlamasına olanak sağlamıştır.

Lipopolysaccharide-responsive beige-like anchor (LRBA) eksikliği, hipogamaglobulinemi, lenfoproliferasyon ve immünodüzenleme ile tekrarlayan sinopulmoner enfeksiyonlarla karakterize, enteropati, sitopeniler ve otoimmün endokrinopati ile kendini gösteren birincil bir immün yetmezliktir. LRBA protein eksikliğinde hızlı tanı özellikle hayat kurtarıcı medikal tedavilerin hızlı bir şekilde başlatılması ve hematopoetik kök hücre nakil hazırlıklarının hızlandırılması bakımından önem arz etmektedir. Bu nedenle, LRBA eksikliğinin teşhis edilmesine olanak tanıyan doğru, güvenilir, hassas ve uygun maliyetli bir testin belirlenmesi önemlidir. Yapılan çalışmalarda flow sitometrinin bazı olgularda kısıtlı kaldığı görülmüştür. Biz buradaki esas problemin kullanılan antikorun poliklonal özellik taşımasından kaynaklı olduğunu düşünmekteyiz. Poliklonal antikorlar genel olarak protein dışı non-spesifik bağlanmalara neden olarak yanlış protein ifadesini yansıtabilmektedir. Bu durum tanı anlamında hastalığın atlanmasına neden olabilmektedir. Hastaların daha güvenilir bir şekilde ve yüksek oranda tanınabilmesi için başka yöntemlerin kullanılması gerekmektedir. Bu yöntemler arasında bilinen en klasik protein tayin yöntemi olan Western Blot bulunmaktadır. Bu çalışmada, LRBA protein ifadesinin sağlıklı kontroller üzerinde flow sitometri ve western blot yöntemleriyle karşılaştırılması, Western Blot ile proteinin ağırlığının saptanması ve her iki yöntemin duyarlılıklarının ortaya çıkarılması amaçlanmıştır. Çalışma Marmara Üniversitesi Tıp Fakültesi Çocuk Alerjisi ve İmmünolojisi Anabilim Dalı'nda gerçekleştirilmiştir. Çalışmada öncelikli olarak 5 sağlıklı kontrolde Western Blot ve Flow Sitometrik Yöntem ile LRBA protein ekspresyonuna bakılmış olup sağlıklı kontrollerde LRBA protein ekspresyonunun olduğu görülmüştür. Sağlıklı kontrollerde yüklenen protein miktarı sırasıyla 10.43, 16.24, 19.11, 14.09 ve 19.37 µg olup saptanan PBMC miktarları sırasıyla $18x10^6$, 16x106, $5x10^6$ ve $5x106mm^3$ olarak saptanmıştır. Daha sonra ise 3 sağlıklı kontrol ve 4 primer immün yetmezlikli hasta (P1, P2, P3, P4) üzerinde her iki yöntemle LRBA protein ekspresyonu incelenmiştir. 3 sağlıklı kontrolde LRBA protein ekspresyonu saptanmış olup P1, P2, P3 numaralı hastalarda protein ifadesinin olmadığı görüldü. P4 numaralı missense mutasyon varlığı bilinen hastada ise mutasyonun protein ifadesinin diğer hastalara göre yüksek olduğu gözlemlendi. Çalışmamızdan elde edilen sonuçlar dikkate alındığında LRBA protein eksikliğinin belirlenmesinde Western Blot ve Flowsitometri yöntemlerinin etkili olduğu görülmüş olmakla beraber konuyla ilgili daha fazla sağlıklı kontrol ve hasta üzerinde çalışmalar yapılmasına ihtiyaç vardır.

Anahtar Kelimeler: *Primer İmmün Yetmezlik, LRBA Proteini, Western Blot, Flow Sitometri*

AIR CONDITIONER WITH UV SUPPORTED AIR CLEANING FEATURE, IOT APPLICATION BASED, AIR QUALITY INDICATOR, AMBIENT LIGHT FEATURE (RAIRBOW)

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Abstract

The pandemic conditions, the impact of which we have felt intensely in our world for about 3 years, played an important role in the emergence of the project idea. In these global epidemic conditions, one of the most important measures to be taken to prevent the spread of the virus and to remove this virus from our lives as quickly as possible is undoubtedly air and environmental cleaning. Rairbow is an extremely important product functionally, but it is also a product that attracts attention aesthetically. In addition to its air purification function, Rairbow will be designed to provide ambient lighting at the rear.

The main feature of the Rairbow product to be developed within the scope of the project will be air purification and ambient light functions. An air conditioner that provides feedback with its air purification feature and has an ambient light feature will be developed within the scope of this project. There has never been an air conditioner with this feature before. The Rairbow air cleaning feature will be developed to provide the user with cleaner ambient air and to show how clean the air is. With its multiple filter system, it cleans the air of the environment from dust, pollen, pet hair / dander, etc. from particles of different sizes; formaldehyde, benzene, acetone etc. Volatile Organic Compounds (VOCs) that can harm health; It is planned to purify it from allergens such as pollen and dust mites to a certain extent. In addition, the air cleaning function can be used actively in all modes of the air conditioner. Another important function of the Rairbow product is ambient light. The Rairbow product, which has a PM2.5 air quality indicator, will be designed with ambient lighting on the rear wall. With its ambient light feature, the product creates an aesthetic appearance in the environment by emitting green, turquoise, blue, purple, magenta and red colors, and these colors will also indicate the air quality level of the environment. Ambient light for fresh air can be determined according to user preference, and color selection will be made as a result of customer feedback and trials. The colors to be used at this stage for the air quality indicator are green, turquoise, blue and purple for clean air notification and can be selected according to user preference. While the ambient light is considered to be magenta for moderately clean air, the lighting is planned to be red for polluted air.

The project is also related to the product IoT technologies development leg of digitalization processes, which continues to be on the agenda of all companies with increasing momentum in the recent period. Your air conditioner constantly measures the air quality level of the indoor environment and will inform you both in the form of ambient lighting with the LED lights on it and through the mobile application. It will allow you to adjust the brightness of the said air quality indicator light in 3 levels or turn off the indicator light completely. Rairbow air purifier air conditioner will accurately calculate filter life according to operating time and inform you about filter change and cleaning requirements via the mobile application.

It will increase the potential to take part in international projects thanks to the new skills to be learned in the field of IoT and in the development of electronic card designs within the scope of digital transformation.

***Keywords**: Air Purifier Air Conditioner, Air Quality Control Algorithm, Air Quality Feedback Algorithm*

UV DESTEKLİ HAVA TEMİZLEME ÖZELLİĞİNE SAHİP, IOT UYGULAMA TABANLI, HAVA KALİTESİ GÖSTERGELİ, AMBİYANS ÖZELLİKLİ KLİMA (NEFES)

Özet

Dünyamızda yaklaşık 3 yıldır etkisini yoğun bir şekilde hissettiğimiz pandemi koşulları proje fikrinin çıkmasında önemli rol oynamıştır. Bu küresel salgın koşullarında virüsün yayılmasını önlemek ve en hızlı şekilde bu virüsü hayatımızdan çıkarmak için alınacak en önemli önlemlerden biri şüphesiz hava ve ortam temizliğidir. NEFES işlevsel olarak son derece önemli bir ürün olmakla beraber estetik olarak da dikkat çeken bir üründür. Hava temizleme işlevine ek olarak NEFES, arka tarafta ambiyans aydınlatması yapacak şekilde tasarlanacaktır.

Proje kapsamında geliştirilecek olan NEFES ürününün ana özelliği hava temizleme ve ambiyans ışığı işlevleri olacaktır. Hava temizleme özelliği ile geri bildirim sağlayan ve ambiyans ışığı özelliği olan klima bu proje kapsamında geliştirilecektir. Daha önce bu özellikte bir klima bulunmamaktadır. NEFES hava temizleme özelliği kullanıcıya daha temiz bir ortam havası sunabilmek ve havanın ne kadar temiz olduğunu gösterebilmek üzere geliştirilecektir. Çoklu filtre sistemi ile bulunduğu ortamın havasını toz, polen, evcil hayvan tüyü/kepeği vb. boyutlardaki partiküllerden; formaldehit, benzen, aseton vb. sağlığa zarar verebilecek Uçucu Organik Bileşiklerden (VOC); polen, toz böceği gibi alerjenlerden belirli oranda arındırması planlanmaktadır. Ayrıca hava temizleme işlevi klimanın tüm modlarında aktif olarak kullanılabilecektir. NEFES ürününün bir diğer önemli işlevi ambiyans ışığıdır. PM2.5 hava kalitesi göstergesine sahip NEFES ürünü, arka duvarda ambiyans aydınlatması olacak şekilde tasarlanacaktır. Ambiyans ışığı özelliğiyle ürün yeşil, turkuaz, mavi, mor, magenta ve kırmızı renkler yayarak ortamda estetik bir görüntü oluşturup, aynı zamanda bu renkler ortamın hava kalitesi düzeyini de gösterecektir. Temiz hava için ambiyans ışığı kullanıcı tercihine göre belirlenebilecek olup müşteri geri dönüşleri ve denemeler sonucunda renk seçimi yapılacaktır. Hava kalitesi göstergesi için bu aşamada çalışılacak renkler temiz hava bildirimi için yeşil, turkuaz, mavi ve mor renkler olup kullanıcı tercihine göre seçilebilecektir. Orta düzeydeki temiz hava için ambiyans ışığı magenta olarak düşünülürken, kirli hava için ise aydınlatma kırmızı renkte olması planlanmaktadır.

Proje yakın dönemde yükselen bir ivme ile tüm firmaların gündeminde olmaya devam eden dijitalleşme süreçlerinin ürün IoT teknolojileri geliştirme ayağıyla da alakalıdır. Klimanız iç ortamın hava kalitesi seviyesini sürekli ölçer ve hem üzerindeki led ışıklarıyla ambiyans aydınlatması şeklinde hem de mobil uygulama üzerinden sizi bilgilendirecektir. Bahsedilen hava kalitesi gösterge ışığının parlaklığını 3 seviyede ayarlayabilmenize veya gösterge ışığını tamamen kapatmanıza olanak tanıyacaktır. NEFES hava temizleyici klima, çalışma süresine göre filtre ömrünü doğru şekilde hesaplayacak ve filtre değişim ve temizlik gereksinimleri konusunda da mobil uygulama üzerinden sizi bilgilendirecektir.

IoT alanında ve elektronik kart tasarımlarının dijital dönüşüm kapsamında geliştirilmesi aşamasında öğrenilecek yeni yetenekler sayesinde uluslararası projelerde yer alma potansiyelini arttıracaktır.

***Anahtar Kelimeler**: Hava Temizleyici Klima, Hava Kalitesi Kontrol Algoritması, Hava Kalitesi Geri Bildirim Algoritması*

FLOOD BUILDING DAMAGE ASSESSMENT: A CASE STUDY OF THE 2021 BOZKURT FLOOD

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Abstract

A flood is defined as the accumulation of large water bodies in a streambed in a short time due to sudden changes in air temperature, melting snow and ice masses, and the spreading of accumulated water over a wider area. Floods are the most often happening natural disasters and they result in losses and important sociological problems. Flood disaster management becomes even more important when the destructive characteristics of floods are taken into account throughout the world, especially in Turkey. Flood disaster management includes flood forecasting, detection, mapping, evacuation, and relief activities. Determining building damage by experts takes a long time and could be dangerous. To carry out disaster management activities after an unexpected flood, it is necessary to determine the damage first. In practice, the damage is determined by the experts through one-to-one examination. Although this method is dangerous for experts, it is a costly method that takes a lot of time. In this study, machine learning approaches: Decision Table, C4.5 and Random Forest were performed to the 2021 Bozkurt flood damage dataset. The results showed that damage prediction after a flood disaster could be successfully performed in a shorter time with high accuracy (=0,979). This study shows the possibility of using ML methods for immediate damage prediction by using the information about the flood, climate, vegetation characteristics of the region, and the characteristics of the building (building type, purpose of building usage, location).

***Keywords**: Machine-Learning, 2021 Bozkurt Flood, Flood Disaster Management, Building Damage Prediction*

Funding declaration: This work was supported by research grants from The Scientific and Technological Research Council of Türkiye (Project No: 121E406) and Council of Higher Education 100/2000 PhD scholarship program.

TAŞKIN BİNA HASAR TESPİTİ: 2021 BOZKURT TAŞKINI ÖRNEK OLAYI

Özet

Sel, hava sıcaklığındaki ani değişiklikler, kar ve buz kütlelerinin erimesi ve biriken suyun daha geniş bir alana yayılması nedeniyle büyük su kütlelerinin kısa sürede bir dere yatağında birikmesi olarak tanımlanmaktadır. Taşkınlar en sık meydana gelen doğal afetlerden olup, kayıplara ve önemli sosyolojik sorunlara yol açmaktadır. Başta Türkiye olmak üzere tüm dünyada taşkınların yıkıcı özellikleri dikkate alındığında sel afet yönetimi daha da önem kazanmaktadır. Sel felaketi yönetimi, sel tahminini, tespitini, haritasını, tahliyesini ve yardım faaliyetlerini içerir. Bina hasarlarının uzmanlar tarafından belirlenmesi uzun zaman alır ve tehlikeli olabilir. Beklenmedik bir su baskını sonrasında afet yönetimi faaliyetlerini yürütebilmek için öncelikle hasarın tespit edilmesi

gerekmektedir. Uygulamada hasar bilirkişiler tarafından birebir inceleme yapılarak tespit edilmektedir. Bu yöntem uzmanlar için tehlikeli olsa da maliyetli ve çok zaman alan bir yöntemdir. Bu çalışmada, 2021 Bozkurt sel hasarı veri setine makine öğrenmesi yaklaşımları: Karar Tablosu, C4.5 ve Rastgele Orman uygulanmıştır. Sonuçlar, bir sel felaketi sonrası hasar tahmininin daha kısa sürede ve yüksek doğrulukla (=0,979) başarılı bir şekilde yapılabileceğini göstermiştir. Bu çalışma, taşkın, iklim, bölgenin bitki örtüsü özellikleri ve binanın özellikleri (bina tipi, binanın kullanım amacı, konumu) hakkındaki bilgilerden yararlanılarak ani hasar tahmini için ML yöntemlerinin kullanılabileceğini göstermektedir.

***Anahtar Kelimeler**: Makine Öğrenmesi, 2021 Bozkurt Sel, Taşkın Afet Yönetimi, Bina Hasar Tahmini*

Funding declaration: This work was supported by research grants from The Scientific and Technological Research Council of Türkiye (Project No: 121E406) and Council of Higher Education 100/2000 PhD scholarship program.

MULTI-MUTATION CLONAL SELECTION ALGORITHM FOR MULTI DEPOT VEHICLE ROUTING PROBLEM IN POST-DISASTER HUMANITARIAN RELIEF LOGISTICS: THE CASE OF THE 06.02.2023 KAHRAMAN MARAŞ TURKIYE EARTHQUAKE

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Abstract

Natural disasters have endangered human existence, costing the lives of millions of people since ancient times. For Türkiye, which is particularly exposed to seismic hazards, the stark reality of the significant earthquake that occurred in February 2023 underlined the urgent need for a competent disaster management system. This event left a profound impact, affecting hundreds of thousands and tragically claiming tens of thousands of lives. Beyond the tragic loss of life, these disasters affect badly physical, financial, social, and environmental aspects, disrupt societies, daily life, and human activities. Therefore, researchers are actively engaged in developing systems that not only save lives but also optimize meeting people's needs during emergencies. Effective post-disaster strategies become important to decrease these losses. Among these strategies, humanitarian relief logistics and rapidly delivering aid to disaster-stricken populations play a pivotal role. Addressing these issues this study introduces the multi-depot vehicle routing problem emerges as a pivotal challenge within disaster management systems, demanding innovative solutions. Within the realm of vehicle routing problems, various meta-heuristic models have been explored. This study introduces a novel approach: multi-mutation clonal selection algorithm designed to enhance the effectiveness of the standard clonal selection algorithm in tackling multi-depot vehicle routing problems. To bridge the gap between theory and application, a case study is presented, focusing on the 06.02.2023 Kahraman Maraş Turkiye Earthquake. Through the lens of this real-world scenario, the research aims to validate the efficacy of the developed model in a practical setting. The proposed algorithm was able to meet the relief requests of 11 demand points on 06.02.2023 after the earthquake, with a total route of 7103 km from 8 depots. Therefore, by undertaking this holistic approach, the study contributes to the evolving discourse on disaster management, offering insights and solutions that could significantly enhance the responsiveness and efficiency of relief efforts in the face of unforeseen natural disasters.

Keywords: *Clonal Selection Algorithm, Multi-Mutation, Disaster Management, Multi Depot Vehicle Routing Problem*

Funding declaration: This work was supported by research grants from The Scientific and Technological Research Council of Türkiye (Project No: 121E406).

AFET SONRASI İNSANİ YARDIM LOJİSTİĞİNDE ÇOK DEPOLU ARAÇ ROTALAMA SORUNU İÇİN ÇOKLU MUTASYON KLONAL SEÇİM ALGORİTMASI: 06.02.2023 KAHRAMAN MARAŞ TÜRKİYE DEPREMİ ÖRNEĞİ

Özet

Doğal afetler, eski çağlardan beri insan varlığını tehlikeye atmış, milyonlarca insanın hayatına mal olmuştur. Özellikle sismik tehlikelere maruz kalan Türkiye için, Şubat 2023'te meydana gelen ciddi depremin çarpıcı gerçeği, yetkin bir afet yönetim sistemine acil ihtiyaç olduğunu ortaya koymuştur. Bu olay, yüz binlerce kişiyi etkileyen ve trajik bir şekilde on binlerce kişinin hayatına mal olan derin bir etki bırakmıştır. Bu afetler trajik can kaybının ötesinde fiziksel, finansal, sosyal ve çevresel açılardan olumsuz etkileyerek toplumları, günlük yaşamı ve insan faaliyetlerini aksatmaktadır. Bu nedenle araştırmacılar, yalnızca hayat kurtarmakla kalmayıp aynı zamanda acil durumlarda insanların ihtiyaçlarını karşılamayı optimize eden sistemler geliştirme konusunda aktif olarak çalışmaktadır. Bu kayıpları azaltmak için etkili afet sonrası stratejiler önem kazanmaktadır. Bu stratejiler arasında insani yardım lojistiği ve afet mağdurlarına hızlı bir şekilde yardım ulaştırılması çok önemli bir rol oynuyor. Bu sorunları ele alan bu çalışma, çok depolu araç rotalama sorununun, afet yönetim sistemleri içerisinde yenilikçi çözümler gerektiren çok önemli bir zorluk olarak ortaya çıktığını ortaya koymaktadır. Araç rotalama problemleri alanında çeşitli meta-sezgisel modeller araştırılmıştır. Bu çalışma yeni bir yaklaşım sunmaktadır: çok depolu araç rotalama problemlerinin çözümünde standart klonal seçim algoritmasının etkinliğini arttırmak için tasarlanmış çoklu mutasyonlu klonal seçim algoritması. Teori ve uygulama arasındaki boşluğu kapatmak amacıyla 06.02.2023 Kahraman Maraş Türkiye Depremi'ne odaklanan bir örnek olay çalışması sunulmaktadır. Araştırma, bu gerçek dünya senaryosunun merceğinden bakarak, geliştirilen modelin pratik bir ortamda etkinliğini doğrulamayı amaçlamaktadır. Önerilen algoritma deprem sonrası 06.02.2023 tarihinde 11 talep noktasına ait yardım taleplerini 8 depodan toplam 7103 km rota ile karşılayabilmiştir. Böylelikle çalışma, bu bütünsel yaklaşımı benimseyerek, afet yönetimi konusunda gelişen söylemlere katkıda bulunarak, öngörülemeyen doğal afetler karşısında yardım çabalarının duyarlılığını ve verimliliğini önemli ölçüde artırabilecek içgörüler ve çözümler sunar.

Anahtar Kelimeler: *Klonal Seçim Algoritması, Çoklu Mutasyon, Afet Yönetimi, Çok Depolu Araç Rotalama Problemi*

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ON NON-NEWTONIAN JACOBSTHAL AND JACOBSTHAL-LUCAS NUMBERS

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Abstract

The non-Newtonian calculus, introduced by Grossman and Katz [Non-Newtonian calculus, Lee Press, Piegon Cove, Massachusetts, 1972], is an alternative to the calculus of Newton and Leibniz. In this study, we consider the Jacobsthal and Jacobsthal-Lucas numbers in the sense of non-Newtonian calculus. We examine some properties of non-Newtonian Jacobsthal and non-Newtonian Jacobsthal-Lucas numbers.

***Keywords**: Non-Newtonian Calculus, Jacobsthal Number, Jacobsthal-Lucas Number*

IDENTIFICATION OF URBAN TRANSFORMATION AREAS WITH DEEP LEARNING ALGORITHMS: AN IN-DEPTH STUDY

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Abstract

In contemporary times, our cities and the regions we inhabit constantly face evolving needs. Moreover, the increasing population brings along challenges that necessitate solutions, making urban transformation projects inevitable. However, determining which areas and buildings will undergo urban transformation can be a complex and often subjective process. At this juncture, the utilization of deep learning methods for identifying urban transformation areas can enhance the efficiency of planning and project processes, effectively influencing future endeavors. The deep learning model employed in this study has been trained to predict the probability of urban transformation by utilizing building attributes such as the number of floors, construction year, and apartment count. With advanced scaling and layered structures, the model possesses the capability to accurately determine the suitability of new urban transformation areas. This not only optimizes the planning process but also enables a more effective utilization of resources. The study's results, driven by the model's accuracy rate approaching 95%, vividly highlight the impactful potential of deep learning methods in urban transformation projects.

The solution proposed by this study is not only pertinent for urban planners but also serves as a crucial informational tool for investors and local governments. Deep learning models can play a significant role in identifying buildings that will undergo transformation in future urban areas by utilizing data associated with structures. This not only optimizes the planning process but also facilitates more informed decision-making in future investments by utilizing resources more efficiently. In summary, the outcomes of this study can be valuable material for anyone aiming to manage urban transformation processes more knowledgeably and effectively. The use of new technologies, such as deep learning, offers a new perspective on the sustainability and success of urban transformation projects.

***Keywords**: Deep Learning, Urban Transformation, Prediction Model, Classification*

A STUDY ON FIXED POINT ITERATION METHODS

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Abstract

Iteration methods, called successive approximation methods, are used to analyze the fixed points of certain classes of mappings. These transformations in question can be an integral or differential equation. Therefore, to reach the fixed point of these mappings, in other words, their solutions, iteration methods, and determining the appropriate conditions on the structure under study are among the main targets of fixed-point theory. In this study, some of the fixed-point iteration methods in the literature are presented and the results of strong convergence and data dependence in Banach spaces are analyzed. Finally, delay differential equations are considered as an operator and it is proved that the solution of this operator can be obtained through iteration methods.

***Keywords**: Fixed Point, Iteration Method, Convergence, Data Dependence*

SABİT NOKTA İTERASYON YÖNTEMLERİ ÜZERİNE BİR ÇALIŞMA

Özet

Belirli dönüşüm sınıflarının sabit noktaları incelenirken ardışık yaklaşım metodu olarak adlandırılan iterasyon yöntemleri kullanılır. Söz konusu bu dönüşümler bir integral veya diferansiyel denklem olabilir. Dolayısıyla bu dönüşümlerin sabit noktasına, başka bir deyişle çözümlerine ulaşmak için iterasyon yöntemleri ile birlikte çalışılan yapı üzerinde uygun koşulları belirlemek sabit nokta toerisinin temel hedefleri arasındadır. Bu çalışmada literatürde bulunan sabit nokta iterasyon yöntemlerinin bir kısmına yer verilmiş ve Banach uzaylarında kuvvetli yakınsaklık ile veri bağlılığı sonucu analiz edilmiştir. Son olarak gecikmeli diferansiyel denklemler bir operator olarak göz önüne alınmış ve iterasyon yöntemleri aracılığıyla bu operatörün çözümüne ulaşılabileceği ispatlanmıştır.

***Anahtar Kelimeler**: Sabit Nokta, İterasyon Yöntemi, Yakınsama, Veri Bağlılığı*

EXAMINING THE EFFECT OF GENERATION Z'S PERCEPTIONS OF INSTAGRAM ADS ON THEIR PURCHASING BEHAVIORS

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Abstract

In contemporary society, technological advancements have significantly influenced communication modalities, rendering social media tools an integral aspect of everyday life. Within this context, Instagram's impact on younger demographics, notably Generation Z, has garnered significance. Businesses persist in their endeavors to engage Generation Z through this social platform, utilizing Instagram advertisements accordingly.

The primary objective of this study is to scrutinize the impact of Instagram ads on the purchasing behavior of Generation Z. With a particular emphasis on the effects of advertising content and user attitudes on purchasing processes, the literature review encompasses the attitudes of younger generations toward Instagram ads, Generation Z characteristics, and the influence of social media on purchasing behavior. Additionally, it elucidates factors influencing the receptivity of younger generations to advertisements, the sway of influencers, and the credibility attributed to advertisements and posts.

Grounded in a Generation Z sample, the study conducts a thorough analysis of purchasing behavior, advertising content, and user attitudes, employing diverse statistical methods to evaluate the findings. The research divulges the repercussions of Generation Z's attitudes toward Instagram ads on their impulsive buying behavior. Conclusively, the results indicate the efficacy of Instagram ads on younger generations. Consequently, businesses are advised to tailor their advertising strategies to this platform, enhancing content with both emotional and rational elements to exert a persuasive influence on younger demographics.

***Keywords**: Instagram, Advertising, Perception, Purchasing Behavior*

Z KUŞAĞININ İNSTAGRAM REKLAMLARINA YÖNELİK ALGILARININ SATIN ALMA DAVRANIŞLARINA ETKİSİNİN İNCELENMESİ

Özet

Günümüzde teknolojinin ilerlemesi, iletişim şekillerini derinden etkileyerek sosyal medya araçlarını gündelik yaşamın vazgeçilmez bir parçası haline getirmiştir. Bu bağlamda, Instagram'ın özellikle genç kuşaklar, özellikle de Z kuşağı üzerindeki etkisi önem kazanmıştır. İşletmeler, Z kuşağına ulaşma çabalarını bu sosyal platform üzerinden sürdürmekte ve bu kapsamda Instagram reklamlarını kullanmaktadır.

Çalışmanın temel amacı, Instagram reklamlarının Z kuşağının instagram reklamlarına yönelik satın alma davranışları üzerindeki etkilerini incelemektir. Reklam içeriği ve kullanıcı algısının satın alma süreçlerine olan etkileri ana odak noktasını oluştururken, yapılan literatür taraması genç kuşakların Instagram reklamlarına yönelik algılarını, Z kuşağının özelliklerini ve sosyal medyanın satın alma

davranışları üzerindeki etkilerini içermektedir. Ayrıca, genç kuşakların reklamlara duyarlılıklarını, fenomen etkisini, reklam ve gönderilere güvenilirliklerini etkileyen faktörleri de ortaya koymaktadır.

Çalışma, Z kuşağından oluşan bir örnekleme dayanmakta olup satın alma davranışları, reklam içeriği ve kullanıcı algılarını analiz ederek, bulgular çeşitli istatistiksel yöntemlerle değerlendirilmiştir. Z kuşağının Instagram reklamlarına yönelik algılarının satın alma davranışlarına olan etkilerini ortaya koymaktadır. Araştırmanın sonuçları, Instagram reklamlarının genç kuşaklar üzerinde etkili olduğunu göstermektedir. Bu bağlamda, işletmelere genç kuşakları etkilemek için reklam stratejilerini bu platforma göre düzenlemeleri ve içeriklerini duygusal ve rasyonel öğelerle zenginleştirmeleri önerilmektedir.

***Anahtar Kelimeler**: İnstagram, Reklam, Algı, Satın Alma Davranışı*

TAM METİN BİLDİRİLER
FULL-TEXT PAPERS

EFFECTS OF GAMMA RADIATION AND ELECTRON BEAM ON SAMPLES OF THE PEANUT CANDIES CONTAMINATED WITH *ASPERGILLUS FLAVUS*

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Abstract

Peanuts is known usage in making foods and generation of oil in Brazil like peanut candies and potential contaminated with several mycotoxigenic fungi as Aspergillus flavus. Therefore, it is possible *A. flavus* secreting some mycotoxins into contamination peanuts. This study is aimed to determine effects of gamma radiation and electron beam in reduction peanut candies contaminated with *A. flavus*. The samples of peanut candies were included two types of peanut candy, (A) Diet Peanut Candies, (B) Organic Peanuts Candies that divided treatments divided into two groups First: contaminated groups with *A. flavus*, and Second: control without contaminated which receive radiation of 0, 5 and 10 kGy dosage of electron beam EB and gamma radiation GR. Some samples of No inoculation were illuminated with a similar dosage to evaluate the sensors. The results indicated that 0.80 of the samples had an average water capacity. Illumination or irradiation of gamma radiation and electron beam at a dosage of 5 and 10 kGy were able to eliminate the *A. flavus* in the samples of Brazil peanuts. Analyzes of Aflatoxin indicated that electron beam doses of 5 and 10 kGy lowers aflatoxins levels by 53.32 and 65.66% correspondingly. Moreover this same dosage of gamma radiation lowered the levels of toxins by 70.61 and 84.15% respectively as compared to the control groups. The irradiation energy could affect *A. flavus* without change in characterize tastes of peanut candy and potential reduction mycotoxins in this candy.

***Keywords**: Peanut, Mycotoxins, Aspergillus, Aflatoxin*

1. Introduction

Peanut *(Arachis hypogaea L.)* are legume native to South America, and grown in different Tropical World Regions as São Paulo in Brazil. Peanuts trees in São Paulo are yearly herbaceous plants in the Fabaceae family, whose seeds contain around 25% protein and 45-half of consumable oil (Sanders et al., 2000). They are grown in different species namely; Diet Peanut Candies, Organic Peanuts Candies, and eco-labeling Diet Peanut Candies. They are also produced in various nations around the globe in the north and south side of the equator, both by small family ranchers who use high mechanical dimension. In some Asian countries, peanuts generation is intended to oil, used in cooking. *Aspergillus* as Aspergillus flavus are among the most essential in food spoilage in the QDoce Sabor industry (Pitt and Hocking, 2009). *A. flavus* emerges as critical species in the production of aflatoxins. *A. flavus* states have green and yellow, olive qualities, perhaps displaying unadulterated yellow shading, getting to be dim with age. *A. flavus* is generally circulated in the soil, air (anemophilous), and natural plant materials. It attacks pre-or post-harvest, and thus causes contamination and leads to the creation of aflatoxins in the QDoce Sabor industry. The airborne parasites take an interest in the contamination of grain in the field poisoning tall plants during their growth. The parasitic contamination in the field begins during harvesting, drying, and storage of the substrate. The genus Aspergillus spp. is generally dispersed and frequently happens in tropical and subtropical areas with high humidity. However, it can develop in states of high temperatures and

low water action, along these lines contaminating a wide range of substrates and is therefore found during the storage time frame (Pitt and Hocking, 2009)

Aflatoxin is a cancer-causing harmful substance for people and creatures, which might be available in peanuts and their subsidiaries; It is delivered by organisms of the class Aspergillus and Penicillium that endure usually in the soil and can taint the peanut and produce the poison, both when harvest, and storage. Contaminations by these growths, when peanuts are still in the ground, are mainly supported by times of dry season amid the growth period of the pods. The hindrance of fungus development, especially, *A. flavus*, which is aflatoxigenic in peanuts, is essential to diminish the potential hazard to human wellbeing. In this circumstance, decontamination techniques utilizing ionizing vitality are being considered as choices. Ionizing radiation can lessen *A. flavus* contamination in various peanuts (Assuncao et al., 2015). To mycotoxins, irradiation can diminish aflatoxin content in foods by delivering radicals that follow up on the terminal furan ring of these poisons. Techniques dependent on high energy production provided by machine sources or gamma beams from radionuclides, for example, 60Co, convey enough energy to expel electrons from the circles of atoms, in this method creating ions. This study is aimed to study effects of gamma radiation and electron beam in inhibition A. flavus contaminated the peanut candies.

2. Materials and Methods

2.1. Samples of Brazil Peanut

Samples of peanuts collected from from the cities of Parana and Sao Paulo in Brazil. Samples of peanuts were analyzed. The samples were then placed in a sterile glass dish as they were later stored in sterile plastic boxes (Jager et al., 2013).

2.2. Preparation of Inoculation and Suspension of Spores In Samples of Brazil Peanuts

Toxigenic *A. flavus* that produces AFB1 and AFB2 strain IMI 190 was used in the production of spores. This sample was acquired from the International Mycological Institute located in London in the United Kingdom. Its cultures were cleaned using sterile phosphate buffered saline also known as PBS as well as Tween 80 solution (Jager et al., 2013). The Brazil peanut samples were then covered in twenty drops of one milliliter of *A. flavus* solution.

2.3. Irradiating Peanut In The Qdoce Sabor Industry

The inoculated testers were isolated into three groups namely: Diet Peanut Candies, Organic Peanuts Candies, and eco-labeling and were each separated into two subsamples. The eco- labeling and each subsample comprised of 50 tests of Brazil peanuts (50 g every), which were fixed independently in polyethene bags under vacuum. The control tests were not lighted. The samples of Diet Peanut Candies and Organic Peanuts Candies were lighted with dosages of 5 and 10 kGy, separately, utilizing GR or EB. The GR treatment was done at the Institute of Energy and Nuclear Research Brazil at a temperature of 25 to 28uC utilizing an adjusted 60Co source (Gammacell 220 N, Atomic Energy of Canada Limited).

2.4. Evaluating Sensory In The Qdoce Sabor Industry

Sensory evaluation is the examination of the sensorial qualities of an item that has been exposed to a treatment like the light procedures (Rodrigues et al. 2012). The study is used to improve the quality and advancement of foods, just as to decide consumer approval of the item. The sensory test was performed following EB and GR treatment of noninoculated Brazil peanuts under similar conditions used for the trial tests; the samples were set in white plastic dishes with 3-digit daze codes and exhibited to a board of 30 untrained people.

3. Results and Discussion

Irradiation energy eliminated A. flavus in the Brazil peanut tests at all dosages tried. Light additionally decreased the aflatoxin concentrations in the Brazil peanut tests examined this moment is urgently necessary analysis the QDoce Sabor industry too. Non irradiated samples (control

gathering) limited, on average, 4.75 mg/kg AFB1 (100%), while the concentration of this poison in illuminated samples was specifically corresponding to the radiation portion (Table 1). EB illumination at dosages of 5 and 10 kGy decreased aflatoxin levels by 53.32% (2.21 mg/kg) and 65.66% (1.63 mg/kg), separately, while GR at similar portions diminished toxin levels by 70.61% (1.39 mg/kg) and 84.15% (0.75 mg/kg) as compared to sum in the control samples (Reis et al, 2012). The numerical investigation demonstrated that all radiation treatments were successful in lessening Brazil peanut aflatoxin (P, 0.05). The adequacy of EB and GR light has been exhibited by Shahbazi et al. (2010) in maize samples. Temcharoen and Thilly watched decreases in aflatoxin dimensions of 75 and 100% in shelled peanut samples through the use of doses of 1 and 10 kGy, correspondingly. The radiation can influence cells. These is normally called direct and indirect impacts. As for its direct impact, radiation executes the cells through ionization and excitation of nucleic acids, setting off a chain of occasions that lead to organic changes. Then again, the indirect impact comprises radiation associating with water, creating free radicals that can harm DNA.

TABLE 1. Mean A. flavus counts and aflatoxin levels following treatment of Brazil peanuts with GR or EB

			Amt of aflatoxin (mg/kg)c			
Group a	Dose (kGy)	Mean A. flavus count (CFU/g | 102)b	Mean	SD	Min	Max
Control	0	32.9	0.75 A	4.87	0.77	19.82
GR	5	ND	1.39 B	2.55	0.86	8.94
	10	ND	0.75 B	1.71	0.81	6.75
EB	5	ND	2.21 B	3.33	1.01	15.14
	10	ND	1.63 B	2.87	0.95	14.54

a GR, gamma radiation; EB, electron beam. Each group consisted of 50 samples of Brazil peanuts (50 g each).

b ND, not detected.

c Min, minimum level; Max, maximum level. Means followed by the same letter are not significantly different by Tukey's test (P , 0.05).

4. Conclusions

These new technologies how effects of gamma radiation and electron beam on samples of the Diet Peanut Candies, Organic Peanuts Candies, and eco-labelling in the QDoce Sabor industry are urgently necessary in the QDoce Sabor industry in the candies samples of peanuts currently in Brazil. Have are less expensive and do eliminate aflatoxins totals in peanuts for exportation in the future.

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EQUATIONS OF SLIDING GATES DISCHARGE COEFFICIENT WITH THRESHOLDS

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Abstract

The purpose of this research is to investigate the effect of gate opening and the presence of parallel and non-parallel thresholds on the discharge coefficient. For this purpose, rectangular thresholds with different widths and locations were investigated. In the non-threshold mode, the discharge coefficient decreases with the increase of the gate opening. Non-linear polynomial regression relationships were prepared to calculate C_d in the condition with threshold and without threshold. Results indicated that the RMSE and KGE statistical indices are 0.014 and 0.951 respectively for the condition with threshold and 0.0067 and 0.987 for the condition without threshold.

Keywords: *Sill, Gate, Free Flow, Discharge Coefficient*

1. Introduction

Controlling water resources is one of the most important responsibilities of hydraulic engineers. Therefore, the design of this structure must be done with sufficient accuracy. [1-7]. Correct use of hydraulic structures is important in water distribution in irrigation channels. Nowadays, it is more important to pay attention to the control of water resources. Therefore, hydraulic structures must be used correctly. Estimating the discharge coefficient and consequently determining the flow rate passing beneath a sluice gate are fundamental and crucial issues in hydraulic engineering. In situations where the gate height deviates from a specific design criterion, double or triple gates are used. However, the use of double or triple gates incurs significant costs. One fundamental solution to address this issue is the utilization of a gate-threshold combination [8-15].

Numerous analytical and experimental studies have been conducted on this subject. Henry presented a graph of the upstream depth ratio against the gate opening for estimating the discharge coefficient [16]. Rajaratnam investigated free flow in sluice gates and proposed a relationship for estimating the discharge coefficient [17]. Their experimental results indicated that the flow contraction coefficient is larger than the theoretically predicted value. Salmasi et al. investigated the discharge coefficient of inclined sluice gates using experimental data and various intelligent models, concluding that the discharge coefficient increases with an increase in the gate inclination angle [18]. Providing relations in the calculation of various hydraulic parameters has made calculations easier. Therefore, in this research, the flow coefficient of sliding valves has been investigated by providing an equation.

2. Methodology

In the current study, experiments were conducted using a flume with 5 meters in length, 3.0 meters in width, and 5.0 meters in height. To reduce input water turbulence from the reservoir into the flume, several parallel calming plates were used at the beginning of the flume. In this study,

experiments were performed using thresholds made of polyethylene with a thickness of 5 cm and a height of 3 cm at different widths of 2.5, 5, 7.5, 10, 15, 20, 25, and 30 cm under the gate, tangential to the gate upstream, and tangential to the gate downstream.

In the present study, statistical indices including (RE%), (RMSE), and (KGE) were employed to calculate the relationships.

3. Results and Discussion

In the present study, equations were proposed for predicting the discharge coefficient in both threshold and non-threshold conditions within the current research range. The determination of equations involved defining the corresponding values of dimensionless parameters obtained from dimensional analysis and combining the mentioned data. The equations were calculated according to the following procedure:

Initially, a nonlinear form for the proposed discharge coefficient equations was determined as a function of dimensionless parameters derived from dimensional analysis. The general form of the proposed equations was considered in equations 1 and 2:

$$C_d = a \times \left(\frac{H_0}{G}\right)^b + c \quad (1)$$

$$C_d = a\left(\frac{A_{total}}{B^2}\right)^b + c\left(\frac{H_0}{B}\right)^d + e\left(\frac{Z}{B}\right)^f + z\left(\frac{X}{B}\right) \quad (2)$$

In the above equations, the coefficients a, b, c, d, e, f, and z were constant values and were initially set to unity. Using the Solver tool in Excel, the proposed equations were optimized to achieve an appropriate form with the least error, as per equations 3 and 4:

$$C_d = 1.226 \times \left(\frac{H_0}{G}\right)^{0.039} + 0.672 \quad (3)$$

$$C_d = 0.0137\left(\frac{A_{total}}{B^2}\right)^{-0.7186} + 1.1843\left(\frac{H_0}{B}\right)^{0.0391} - 0.6582\left(\frac{Z}{B}\right)^{0.0819} - 0.0048\left(\frac{X}{B}\right) \quad (4)$$

Figure 1a depicts a comparison graph of computed and experimental values of the discharge coefficient. The results indicate that the trend of discharge coefficient variations obtained from experimental results closely follows the values derived from Equation 3. Specifically, the maximum values for relative error percentage, average relative error percentage, and RMSE are 1.95%, 0.90%, and 0.067, respectively. Furthermore, the parameter KGE has a value of 0.987, indicating its placement in the "very good" range, reflecting the high accuracy of the proposed relationship. In Figure 1b, the obtained coefficients from Equation 3 are substituted to compare the discharge rates resulting from experimental results with theoretical equations. A maximum relative error percentage or, in other words, a maximum deviation of 1.5% was considered. It is observed that a wide range of data falls within the 1.5% deviation band, indicating that the proposed formula has very good accuracy, with over 78% of the data having an error of less than 1.5%.

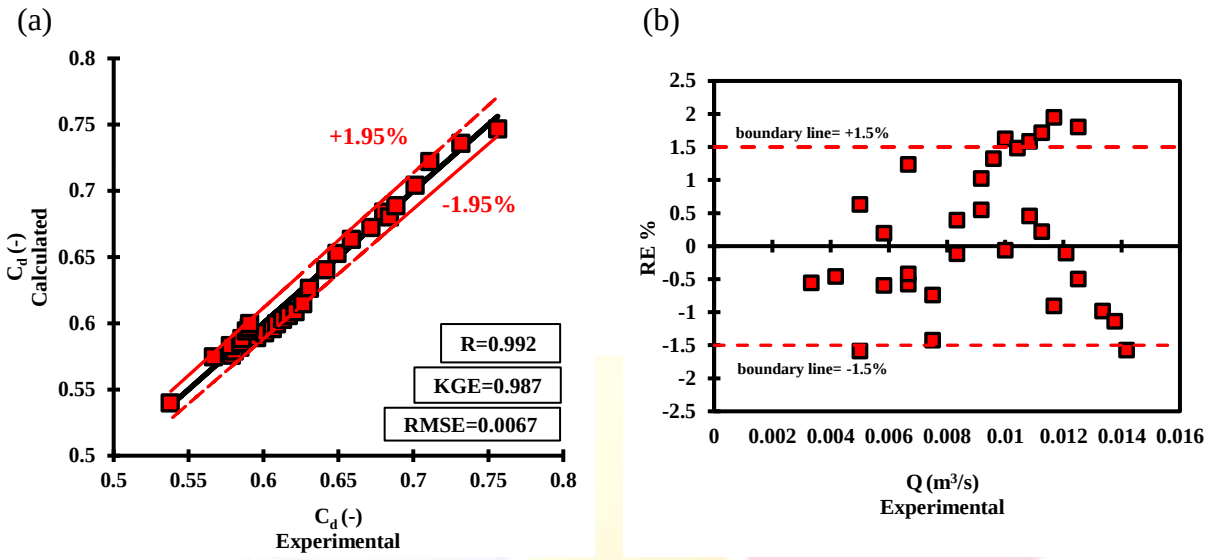
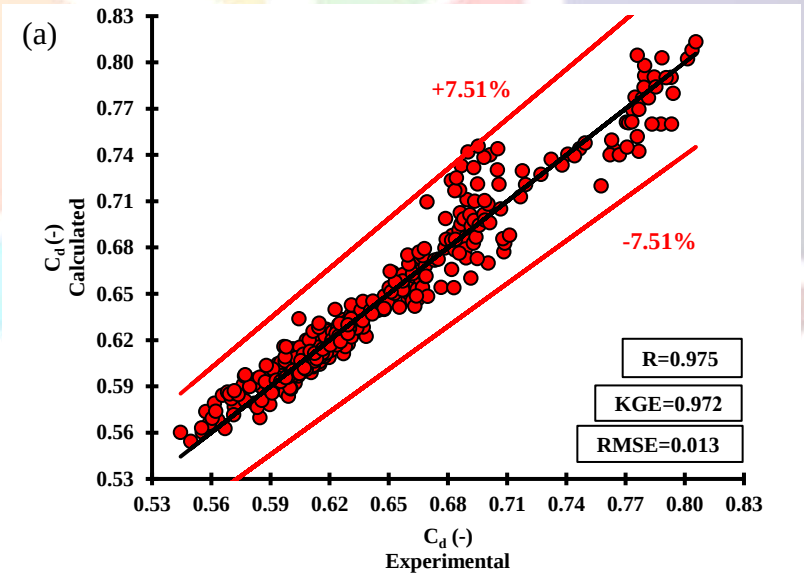


Figure 1- Comparison of calculated and experimental values b) Percentage relative error against the experimental discharge

Equation 4 can be applied for both same-width and non-uniform-width channels in various positions relative to the sluice gate. Figure 2a illustrates a favorable trend in the comparison of computed values with experimental ones. The statistical indices for maximum relative error percentage, average relative error percentage, and root mean square error in comparing results between experimental data and Equation 4 are 1.7%, 1.45%, and 0.13, respectively. The statistical indicator KGE for this relationship is 0.972, falling within the "very good" range, indicating high accuracy. In Figure 2b, the independent parameter H_0/B is plotted against the relative error percentage. Observing the graph reveals that 94% of the data falls within the 4% deviation band, indicating the high precision of the proposed relationship, which can be confidently utilized.



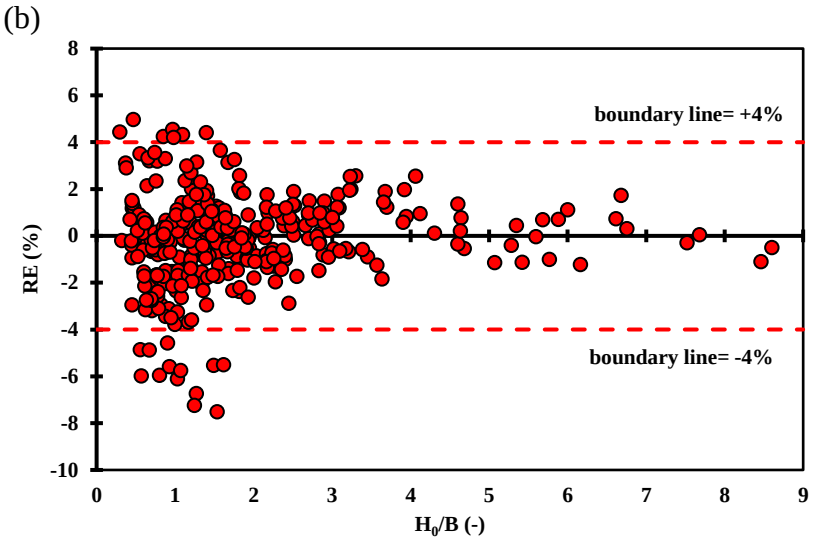


Figure 2- a) Comparison chart of calculated and experimental values of discharge coefficient in openings, width and different positions of threshold placement b) Scatter plot of the relative error

4. Conclusions

In the current study, on average, the C_d for G=1 cm, is 7.75%, 16.51%, and 18.35% higher compared to gate openings of 2 cm, 4 cm, and 5 cm, respectively. Additionally, the maximum increases are 16.62%, 28.9%, and 23.51%, respectively. The most significant factor affecting the sluice gate discharge coefficient in the non-threshold condition is the upstream flow depth, the degree of gate opening, or, in other words, the area of flow passing under the gate. In cases of constant discharge, an increase in the degree of gate opening results in a reduction in the upstream water depth, and the discharge coefficient exhibits a decreasing trend relative to the smaller gate openings. Comparing the results of C_d in threshold and non-threshold conditions showed better performance with the presence of a threshold under the sluice gate and tangents on the upstream and downstream sides of the gate. By replacing all threshold models under and tangents on the gate openings of 4 cm and 5 cm, the flow coefficient increases compared to the non-threshold condition. Furthermore, an increase in the threshold width leads to a reduction in the overall flow area, resulting in an increase in the discharge coefficient. Applying the threshold across all widths studied under the gate and tangents on the gate and comparing the increase in the discharge coefficient suggests that the threshold width parameter has the greatest impact on the discharge coefficient in this study, and the threshold with the smallest width has the minimum discharge coefficient among the thresholds. Comparing the results of the discharge coefficients obtained from applying the threshold under the gate and tangents on the gate indicates that the discharge coefficient is higher in the tangential condition for all flow rates and threshold widths, with the highest value corresponding to the tangential model on the upstream side of the gate. In this research, nonlinear regression equations for calculate the C_d in both threshold and non-threshold conditions were provided based on dimensionless parameters obtained from dimensional analysis. The equations were developed for various positions and dimensions of the threshold width, yielding satisfactory results in terms of statistical indices RE, KGE, and RMSE.

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HYDRAULIC OF SLIDING VALVES WITH THRESHOLD

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Abstract

The necessity of controlling and distributing water in irrigation networks and behind dams requires the utilization of practical and innovative methods. Placing a threshold beneath the slide valve is among the solutions for controlling the C_d. Therefore, this research investigated the flow rate of a slide valve. Numerical solution were done by FLOW-3D software and employing the finite volume method. The results indicate that the gate opening has a significant impact on the discharge coefficient in both threshold and non-threshold conditions. Results showed that the discharge coefficient increases with the reduction of the slide valve opening.

Keywords: *Slide Valve, C_d, Free Flow Condition.*

1. Introduction

One of the key issues concerning slide valve is their discharge, and consequently, their discharge coefficient. Therefore, through extensive study in this field, effective methods for better sluice gate performance can be proposed [1-7].

Alhamid experimentally studied the role of threshold geometry on the hydraulic parameters of flow beneath a slide valve under free-flow conditions [8]. Their results indicated that circular and triangular thresholds have the most significant impact on the discharge coefficient. Golmohammadi et al. presented equations based on energy considerations and the concept of pressure increment to determine the compression coefficient and flow discharge using upstream water depth and gate opening [9]. They provided semi-empirical equations for both sluice and sector gates. Karami et al. examined the influence of geometric parameters of the threshold on the discharge coefficient of sluice gates in free-flow using FLOW-3D software [10]. The results showed that semi-circular and rectangular thresholds placed beneath the sluice gate increase the discharge coefficient. Salmasi et al. investigated the inclined sluice gate discharge coefficient using experimental data and employing intelligent models such as SVM, ANN, GRNN, RF, GP, and RT[11].

Previous studies confirm the role of the threshold on discharge coefficent of slide valve [12-19] .Since the numerical study of threshold width variations on the discharge coefficient has not been conducted so far, and this aspect is missing in the literature, this research focuses on examining and simulating threshold dimensions, including height and width.

2. Materials and Methods

For validation, the data obtained from Alhamid's (1999) laboratory experiments were used under the condition of a threshold-free state. Alhamid conducted experiments in a flume with a length of 9.45 m and a width of 30.5 cm. The flume contained two gates, one at the beginning and the other at

the end, for controlling hydraulic jumps and water surface. They conducted a total of 190 experiments on 12 thresholds with various heights, investigating the influence of threshold shape and height on the flow coefficient. Simulations were conducted with a specified inlet discharge, outlet boundary condition at the end of the channel, and boundary conditions of symmetry at the walls and channel bottom.

In total, 85 models were designed in three scenarios for simulations. In the first scenario, by maintaining the threshold height constant, the effect of different gate openings on the discharge coefficient was studied. In the second scenario, with a fixed gate opening, thresholds at four different heights were placed beneath the gate. In the third scenario, the discharge coefficient was examined by varying the width of the threshold. The discharge range varied from 0.012 to 0.028 m^3/s. Each experiment included measuring the upstream water depth below the gate and calculating the flow coefficient passing through the gate with the threshold.

3. Results and Discussion

To study the effect of gate opening in the threshold-free state, the discharge coefficient was investigated for four different gate openings, including 2 cm, 3 cm, 4 cm, and 5 cm. Increasing the gate opening leads to a reduction in the upstream water depth, causing a decrease in the discharge coefficient with larger gate openings. Therefore, based on the results, the highest discharge coefficient is associated with a gate opening of 2 cm, and the lowest is observed at a gate opening of 5 cm.

In the second scenario, considering a threshold with a thickness of 20 cm, a width of 30.5 cm, and a height of 5 cm, the effect of gate opening on the flow passing through the threshold was studied. Gate openings of 2 cm, 3 cm, 4 cm, and 5 cm were considered, and for each model, discharges ranging from 0.012 to 0.022 m^3/s were applied. Figure (1) illustrates the trend of longitudinal velocity changes upstream and downstream of the threshold.

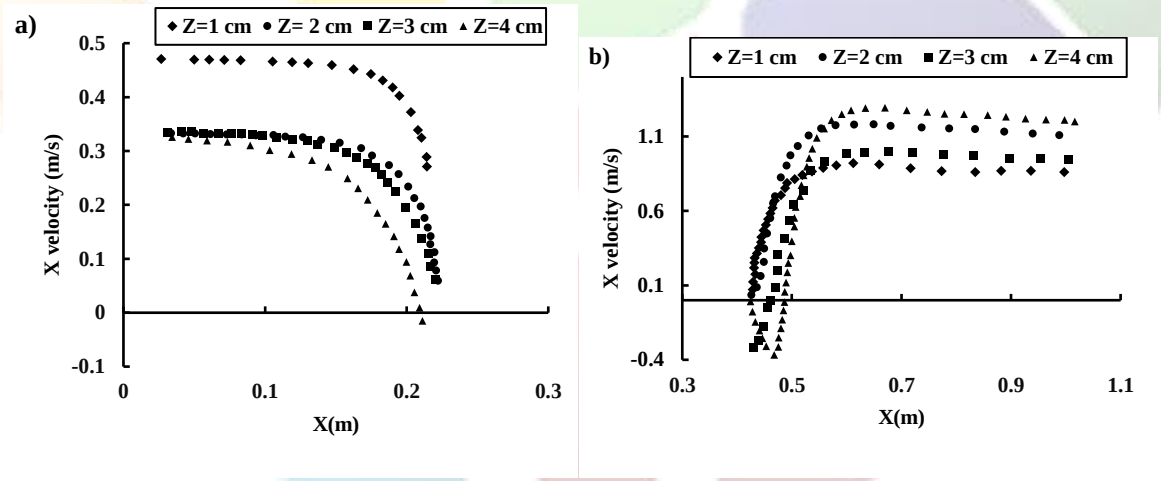

Figure 1. Longitudinal velocity changes in upstream and downstream of sill: a) In upstream of sill, b) In downstream of sill

To examine the discharge coefficient in four threshold models, a graph in Figure (2) was plotted, where the horizontal axis represents the dimensionless ratio of upstream water depth to gate opening, and the vertical axis represents the flow coefficient. In this case, the valve opening consider as 5 cm. The results indicate that the presence of the threshold increases the discharge coefficient in all scenarios. Furthermore, even the threshold with the lowest height causes an increase in the discharge coefficient compared to the threshold-free state.

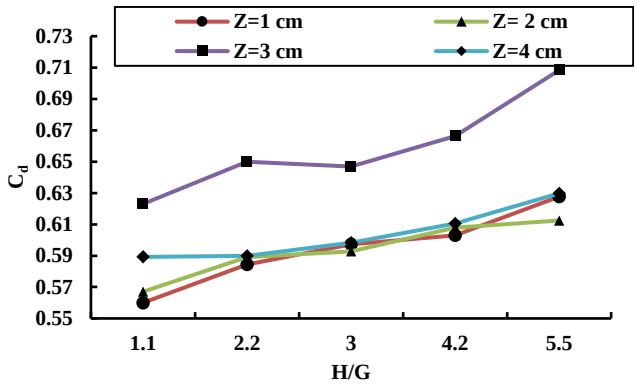

Figure 2. Comparison of sluice gate discharge coefficient with different sill height

The changes in the discharge coefficient with variations in the threshold width are shown in Figure (3), where the horizontal axis represents the dimensionless ratio of b/h, and the vertical axis represents the flow coefficient. By examining pressure and velocity at different widths of the threshold, it became clear that the width of the threshold is one of the most influential factors on flow characteristics. The results show that as the width of the threshold decreases, the discharge coefficient decreases. In a constant discharge scenario, increasing the width of the threshold from 15 cm to 30.5 cm results in a 15% increase in the discharge coefficient.

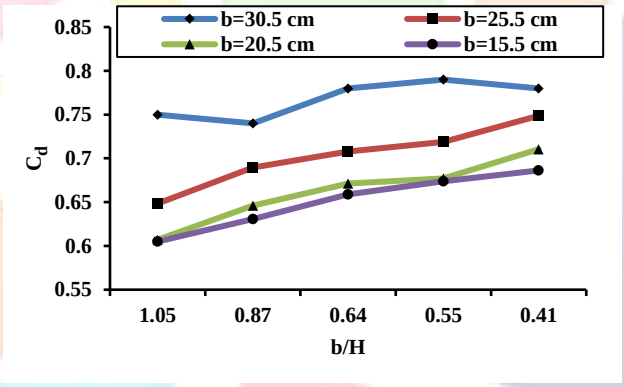

Figure 3. Discharge coefficient changes in different sill widths

4. Conclusion

The present study investigates the discharge coefficient in three scenarios, including variations in gate opening, threshold height, and threshold width. The key findings of the current research can be summarized as follows:

The analysis of gate opening revealed that the flow coefficient in the threshold-free state increases with a decrease in gate opening.

Placing a threshold beneath the gate in various gate openings resulted in a higher discharge coefficient in the presence of the threshold compared to the threshold-free state.

The results demonstrate that a reduction in the width of the threshold affects the pressure, and consequently, the velocity of the flow. As the threshold width decreases, the flow velocity and pressure alongside the threshold decrease, particularly in the vicinity of the flume walls.

This phenomenon influences the discharge coefficient, with the assessment of threshold variations at different widths indicating that a wider threshold leads to an increased discharge coefficient compared to a narrower threshold.

The examination of the discharge coefficient for a threshold with the same width as the flume revealed a 20% increase in the discharge coefficient relative to the threshold-free state. This hydraulic behavior is explained by the fact that a wider threshold reduces the cross-sectional area available for flow, resulting in an augmentation of the discharge coefficient.

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ACADEMIC REVIEW OF THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN URBAN TRANSFORMATION PROJECTS

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Abstract

One of the ways to rebuild the aging face of the city is urban transformation practices. Recently, it has been seen that geographic information systems (GIS) are used when performing these applications. Based on this, this study aims to investigate the usability of GIS in urban transformation applications. In line with this goal, it is aimed to examine recent academic studies on the use of GIS in urban transformation. The study consists of 4 chapters. The first chapter is the introduction. In this chapter, the work done is briefly mentioned. The second chapter is the theoretical framework part. In this chapter, information about urban transformation and GIS is given. In the third chapter, academic studies on the use of geographic information systems (GIS) in urban transformation projects were examined. The fourth and final chapter is the results section. In this chapter, the data obtained as a result of the studies are presented. As a result of the study, it was seen that there are urban areas in almost all cities that have lost their former functions and, accordingly, have suffered economic, physical and social collapse. It has been determined that the use of urban transformation practices is a very good choice to create quality living conditions in sustainable environments by solving the physical/environmental problems of these areas. In addition, it has been reported that the use of the GIS system in urban transformation applications is very effective in the healthy progress of these applications.

Keywords: *Urban Transformation, Geographic Information Systems (GIS), Academic Perspective*

1. Introduction

“Urban Transformation” has become a popular term among the terms that have been frequently mentioned recently in the context of planning. In accordance with the understanding of closely following the developments in the West, which is the most striking feature of Turkish modernization, and bringing them to our country, all the planning innovations made in the world since 1980 have immediately found their place on the country's agenda. The clearest indicator of this is the Habitat II meeting hosted by Istanbul. With this meeting, capacity development, governance, sustainability, etc. terms began to be used frequently (Terzi ve Karaşahin, 2004).

While the term urban transformation and its examples were first seen in the world after World War II, it appeared in our country in the 1980s (Yavuz, 2019). After the 1960s, with the increase in industrialization in Turkey, there was migration from villages to cities. (Çamurdan, 2020). While developing agricultural tools and techniques and studies carried out for industrialization, it has reduced the need for labor in rural areas, it has caused this need to increase in urban centres.

The increase in industrial branches has created a need for sheltering in directly proportional to the need for employees. The overcrowding of city centers has caught cities unprepared. Spontaneous

settlements (slums, slum areas) with inadequate infrastructure, which are described as poor quality and risky structures, have emerged around the cities. (Environment and Urban Ministry, 2023). This situation has caused unplanned urbanization and illegal construction problems without inspection and control. These structures have become worn out over time and have turned into areas that cannot respond to user demands. As a result, the concept of urban transformation has gained importance (Çamurdan, 2020).

Urban transformation is important not only for unsafe residential areas, but also for all kinds of structures that need social, economic, environmental and regional development. Moreover, after the major earthquakes in Turkey, urban transformation has become more widespread because most of these settlements are located in earthquake zones and are at risk of earthquake (Çamurdan, 2020). In this context, the concept of "Urban Transformation" can be defined as all the practices carried out to improve risky areas that have completed their lifespan, as well as to create new living spaces.

Recently, Geographic Information Systems (GIS) have been actively used in urban transformation applications. GIS is a computer-based system that helps map and analyze all kinds of data existing on earth and created subsequently. GIS technology combines common database operations such as querying, viewing, statistical analysis, and geographic analysis displayed on maps. All these features distinguish GIS from other information systems. At the same time, it makes it important in strategy planning, predicting results, explaining events and responding to general and specific processes (Maguire, 1991).

In this study, it is targeted to investigate the usability of GIS in urban transformation applications. In line with this target, it is aimed to examine recent academic studies on the use of GIS in urban transformation.

2. Theoretical Framework

2.1. Urban Transformation

The concept of urban transformation, defined by many disciplines from their own perspectives, is accepted as improving the transformation that has been damaged over time and transforming it into a newer and healthier one. In fact, like every concept, the concept of urban transformation is currently considered equivalent to what action it corresponds to in which areas, rather than what it means within the framework of principles and purpose. For this reason, although urban transformation has an etymological or terminological definition, it has become the general terminology of mostly spatial projects aimed at making cities healthier and more functional in Turkey and in the world (Erbulak, 2023). Many different definitions of urban transformation have been made in the literature.

According to Eyidiker (2021), urban transformation is all the work done to bring back into the city and functionalize the parts of the city that are deteriorated, worn out obsolete and whose use has reached harmful levels.

In the Cambridge University online dictionary, urban transformation is defined as the process of improving the current condition of the buildings in a city or reintroducing them to the city by demolition (Cambridge, 2023).

According to Yılmaz (2019), urban transformation is the solution of the problems of the artifactual built environment and its reconstruction with a new vision.

Even before the emergence of the concept of urban transformation, cities were rebuilt throughout the history of civilization, changed over time, and took on forms that represented the period they passed through (Erbulak, 2023).

In order to make urban transformation in accordance with its purpose, all the building blocks given in Figure 1 must come together. For this, a common denominator should be determined and all building blocks should be gathered to this denominator.

Figure 1. Building blocks of urban transformation

2.1.1. Urban Transformation Methods

Since urban transformation is affected by many factors such as time, place, location, population, building type, legal structure, there is no definitive format for urban transformation (Eğercioğlu, 2016; Şişman and Kibaroğlu, 2009). Nine different formats are used for urban transformation. These;

- ***Renovation;*** It means the reconstruction of all or a part of the buildings in areas where it is not possible to improve living and health conditions in terms of the condition of existing buildings (Hui et al., 2018).
- ***Improvement;*** It is the restoration of the existing structure of the old city fabric and the collapsed areas and making them valuable (Keleş, 1998).
- ***Protection;*** Because of the changes and developments, It is defined as preventing the destruction of the physical structure that reflects with social and economic conditions and cultural values of the society, integrating of urban fabric with contemporary life and rehabilitating cultural values (Yazar, 2006).
- ***Animation;*** It is the elimination of the reasons that cause this situation in the historical and cultural areas of the city, which is experiencing physical, social and economic collapse. Or, it is revitalization through physical, social, economic and environmental changes (Özden, 2008).
- ***Redevelopment;*** It is defined as the demolition of houses whose economic and structural features are damaged (Lai et al., 2017).
- ***Development;*** These are projects which is implemented to develop of the urban area within a certain plan or to prevent uncontrolled developments (Yazgan, 2021).
- ***Urban clearing;*** In urban cleaning, the collapsed area is completely cleared and new structures are built in its place (Lai et al., 2018).
- ***Gentrification;*** It is the renewal of the area by changing the social fabric in order to save the collapsing area (Es, 2012).

- ***Infill Development;*** It is the practice of creating a more valuable and rich environment by adding new buildings and social facilities next to existing buildings in certain parts of the city, without displacing the residents (Erbulak, 2023).

2.1.2. Dimensions of Urban Transformation

Urban transformation has sustainable targets with its economic, environmental, social and cultural dimensions (Figure 2) (Almedia et al., 2018).

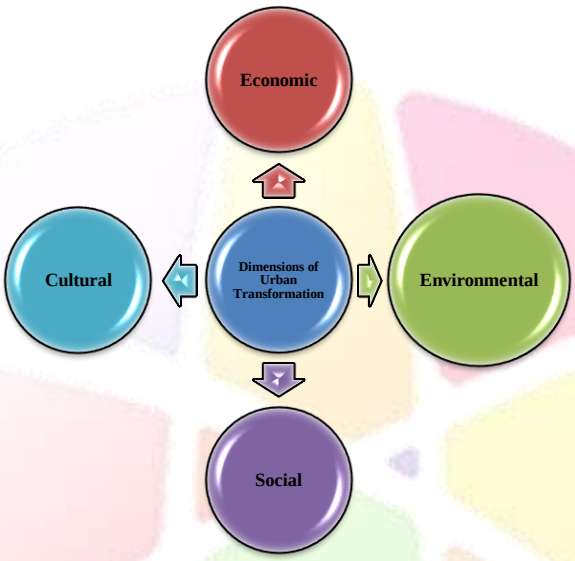

Figure 2. Dimensions of urban transformation

Economic dimension: Cities need to be productive, a sustainable system and economy, countries need to make their external debts manageable, and the imbalance created by the sector that harms industrial production and agricultural production must be eliminated.

Environmental Dimension: Avoiding the use of renewable resources for investment purposes by keeping the basis of the resources to be used constant is an environmentally sustainable system.

Social Dimension: It should ensure to present adequate provision of social services, including a sustainable system, political responsibility, gender equality, health and education and participation.

Cultural Dimension: It can be defined as a concept that includes many dimensions of inter-societal diversity (Nijkamp and Pepping, 1998; Bayram, 2001).

2.2. Geographic Information Systems (GIS)

There are two different approaches to defining Geographic Information System (GIS). The first of these is the technical approach. Geographic Information Science is defined as a field of information science that specializes in the fundamental issues arising from the creation, processing, storage and use of geographic information (Longley et al., 2001). In other words, GIS is technological approach that answers the question “What, where and when?”. The second approach is the theoretical approach that defines GIS as a solution that supports decision-making based on analyzes made on spatial data in order to take better action according to the analysis results (Almashharawi, 2021).

It is not correct to define GIS as just a software system or a method of producing and processing data. GIS is a method that can provide fascinating results because it makes decisions based on objective criteria, gives the desired results in a short time, and can be visualized with maps by allowing the use of geographical data and verbal data together (Türk, 2018).

2.2.1. Components of Geographic Information System

GIS, like any system consisting of parts, can be seen as a combination of several parts that make up the overall system (Tomaszewski, 2014). The core of GIS is fundamentally based on data. For this reason, GIS data always causes significant discussion (Swalehe, 2016). GIS consists of five basic components: human, software, hardware, data and methods/analysis (Figure 3)(Dağhan, 2018).

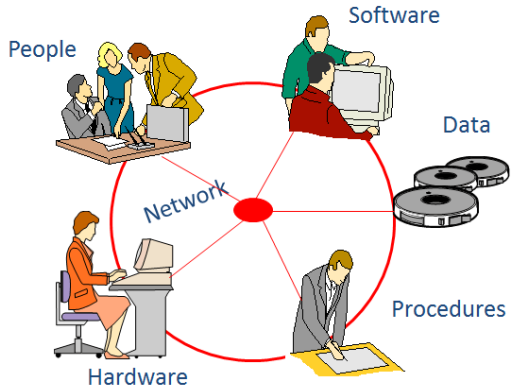

Figure 3. Main components of GIS (Mutluoğlu ve Ceylan, 2004)

- **Hardware**

The computer system on which GIS runs is defined as hardware (Swalehe, 2016). Auxiliary products such as plotter, graphics processor, auxiliary memory, digitizer and scanner constitute to hardware (Bostancı, 2023).

- **Software**

The software defined as the GIS application itself (Almashharawi, 2021) is algorithms written in multi-relational and advanced programming languages used to produce, manage, process geographical data and information into the database, store, analyze, visualize and update spatial data (İnce, 2023).

- **Humans**

One of the most important factors of GIS is human, since human who is creates, manages and develops to GIS projects.

- **Method/Prodecures**

A successful GIS operates according to a well-designed implementation plan and business rules, which are models and operating practices specific to each organization. Maintaining the sustainability and up-to-dateness of GIS can be ensured by the methods to be determined and implemented (Almashharawi, 2021).

- **Data**

The data is available in various formats in the form of digital maps, aerial photographs, space images, digital elevation models, and metadata (Almashharawi, 2021).

2.2.2. Usage Areas of GIS

GIS has the opportunity to be used in a wide variety of fields thanks to the convenience brought by the development of technology (Öz, 2023). GIS, which is among the rapidly developing computer-based technologies, provides faster and more accurate results acording to classical methods. Due to this feature, it is used in a wide variety of areas depending on user requests (Figure 4).

Figure 4. GIS usage areas (Atmaca, 2019)

3. Academic Studies on the Use of GIS in Urban Transformation Projects

In his thesis study, ***Yavuz (2019)*** examined the urban transformation practices in the Ünalan neighborhood of Uşak province using the GIS method. He examined the urban transformation practices carried out using the demolish-build method in the area and compared the current and future situation. As a result of his study;

- 22% of the urban transformation applications carried out in Uşak city center are in the Ünalan neighborhood,
- Green areas and health areas considered according to the proximity function are sufficient to meet the needs,
- Due to the increase with urban transformation number of floors in Ünalan Neighbourhood, there is a population density in the south of Mimar Sinan Street,
- It was determined that the neighborhood population increased by 16% after urban transformation.

Polat and Dostoğlu (2007), in their study, They are scrutinized the issue of urban transformation in their study. In this context, two as-built drawing in regions whose functions have been completed within the borders of Bursa province were examined. As a result of the study, it was reported that the Kükürtlü project met the targets of urban transformation. They reported that the Mudanya project, another project, could not meet the urban transformation targets and did not qualify as an urban transformation project.

In their study, ***Sadioğlu & Ergönül (2020)*** investigated the urban transformation legislation, which has many practitioners and a complex structure. They targeted to properly examine of urban transformation works, which have a worsening image among the public day by day. At the end of the study, they analyzed the data they obtained and interpreted it by adapting it to the theoretical framework in our country.

In his study, ***Lasaiba (2023)*** scrutinized the availablity of land for settlement of field, development priorities and limit factors. She used qualitative and quantitative methods in the study. As a result of the study, She reported that 23592.48 decares of field was not suitable for settlement, while 6033.39 decares of field was suitable for settlement. Three levels have been determined according to suitability for the development of the settlement. These levels;

- Priority I; 3181.34 decares
- Priority II; 2852.05 decares
- Priority III; It has been determined as 8237.89 decares.

She also stated that local governments should implement a strict working system to ensure the sustainability of the fields and to prevent problems that may occur.

In his study, ***Aksu (2007),*** scrutinized Istanbul/Üsküdar/Ünalan, Esatpaşa and Örnek Neighborhoods. He examined the urban transformation projects that carried out in these neighborhoods, which have a valuable location in the city and are an unhealthy socio-economic and physical field. As a result of the study, He prepared the current situation of the field and field maps using the GIS method. Additionally, He measured their satisfaction by conducting a survey of the people living in the region.

In their study, ***Özcan et al., (2020)*** examined Beyler, Mücellit and Kurşunlu Mosque streets and their surroundings located in the urban protected area within the borders of Eskişehir / Odunpazarı. They created a database to collect and preserve cultural heritage data for use in the examination of these areas. As a result of the study, they explained the benefits of GIS in cultural heritage management.

In their study, ***Hasdemir and Demir (1994)*** examined the benefits of using GIS in planning forest roads. As a result of the study, it was reported that approximately one hundred forest road network plans should be implemented annually. They also stated that GIS should be benefit and forest road network plans should be prepared meticulously in order to reach the modern forestry level.

In their study, ***Morova et al., (2010)*** produced the noise map of the outdoor spaces of the Süleyman Demirel University campus using the GIS method. In the study, measurements were made at 96 points and noise maps were created using the numerical data obtained. As a result of the study, using these maps, they determined the areas exposed to noise on the university campus.

In his study, ***Körmeçli (2022)*** reported the connection between land structure and the physical accessibility of transportation road of Çankırı Karatekin University Uluyazı Campus. As a result of the study, they reported that axes with high integration values and low slope percentage overlapped. In addition, it identified the positive and negative aspects of the transportation network.

In their study, ***Taşyürek and Azgınoğlu (2021)*** aimed to use the spatial interaction method instead of the classical relational database for address information system design. For this purpose, he stated that all data received belongs to Kayseri Metropolitan Municipality. As a result of the study, they reported that the spatial interaction method was more successful. They also found that problems occurred in the classical relational method, these problems is not in the spatial interaction method.

Engin (2015) conducted a study on determining suitable residential areas in Malatya city center using the GIS method. Firstly, in the study, he prepared the thematic maps of Malatya province. As

a result of the study, he present that based on the rules of geography the relationship between the user and the natural environment which forms the main basis of geography.

In her study, ***Türk (2018)*** sought a solution to the problem of location selection for the building of a shopping mall in Sivas province by using the GIS method. Within the scope of the study, make a survey was conducted with the participation of 500 people in Primemall in Sivas province. In the results of study; 6 areas have been determined for the location of shopping mall. According to the survey results, it was determined that the most suitable place for the construction of a shopping mall was located near the Diriliş Neighbourhood, in an area with a ring road and mass housing.

Kılıç (2020) conducted a study to determine the most suitable area as a rural settlement in Erzincan Province by using the Geographic Information System. Social, technical, economic and cultural parameters were determined in the selection of the area. Data was collected in the context of these parameters and a database was developed. As a result of the study, it was reported that the best rural settlement area was Çağlayan town in the central district of Erzincan.

In his study, ***Kuvvetli (2023)*** examined the construction costs, planning and arrangement of Zonguldak Regional Directorate of Forestry Saltukova Forest Management Directorate road network and engineering structures using the Geographic Information System. In the results of study;

- 1018 km of the total road, 1002 km of which is planned to be newly built and 620 km of which is existing, is covered in forest,
- The density of the 1018 km road has an area of 429,675 m² within a 4339.50 ha forest area is 0.99%,
- 1002 km of road leveling is planned,
- It was reported that the cost of the 1002 km road line, which is planned to be leveled, is 2,223,060.00 TL.

In their study, ***Aygün & Düzgün (2021)*** made the architectural evaluation of Antalya Kaleiçi using the GIS method and interpreted the obtained data.

In her study, ***Işıklı, (2019)*** evaluated real estate using the GIS method. As a result of the study; It has been determined that GIS is very effective on real estate evaluation, with the GIS system, data can be easily accessed, analysis is made possible, and reliable, accurate and fast results are obtained.

4. Results

Studies on urban transformation and the combined use of GIS were scrutinized. The results obtained are listed below.

- It has been seen that GIS offers practical and fast solutions to data containing large amounts and complex relationships, unlike known methods with the help of computers.
- In the field of planning, accurate, reliable and up-to-date information about cities is needed in order to produce applicable and effective plans. Data obtained by classical methods and maps prepared do not meet the demands of city planners in our rapidly changing age. It has been observed that prolonged processes and high costs are prevented with GIS.
- It has been determined that the problems experienced in classical methods (incorrect, out-of-date, slow information flow) do not occur in GIS.
- It has been observed that analyzes that take a long time with classical methods take less time with GIS. Thus, time will be saved.

- It has been concluded that using GIS is the best solution for urban transformation applications, for map creation, analysis, and accurate and accessible use of island parcel information.
- It has been seen that GIS is actively used in many areas, not only in urban transformation.
- It has been understood that GIS is a method that can be applied in almost every field, from the location selection of a shopping mall to the roads to be built in the forest.

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ACADEMIC STUDIES ON THE USABILITY OF PUMICE AND RICE HUSK ASH IN THE PRODUCTION OF BUILDING MATERIALS

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Abstract

With the development of technology and industry, the biggest problem in the world has become waste. Almost every sector has embarked on various pursuits to combat waste. In this study, it was targeted to investigate the usability of pumice, which is one of our local resources, and rice husk, which is an agricultural waste, in the production of building materials. In line with this target, it is aimed to examine the academic studies on pumice and rice husk added building materials in recent years. The study consists of four parts. In the first chapter, the introduction, brief information about the subject is given. In the second chapter, pumice and rice husk ash are briefly introduced. In the third chapter, academic studies on building materials produced using pumice and rice husk ash are examined in detail. In the fourth and last chapter, the information obtained as a result of the analysis is presented. As a result, it was seen that pumice additive increased the porosity rate and unit volume weight of the building material and decreased its compressive strength. It has been determined that rice husk ash has a positive effect on the compressive strength of the material. Additionally, it was concluded that the use of local materials and agricultural waste in the production of building materials would be an effective solution for waste disposal. Additionally, it was concluded that the use of local materials and agricultural waste in the production of building materials would be an effective solution for waste disposal.

Keywords: *Rice Husk Ash, Pumice, Lightweight Concrete, Building Material*

1. Introduction

Human beings need buildings to meet their shelter needs. The most important element to obtain solid and safe structures is the material (Gül, 2018). In recent years, interest in lightweight construction materials has been increasing in the construction industry. In concrete production, lightweight materials are preferred so that the concrete is light and the loads on the ground are reduced. As a natural lightweight material, pumice is among the most preferred. Pumice is used in the agricultural sector, greenhouse and garden production as a moisture balancer for the water needed by the plant. In addition, it is preferred in the textile industry for lightening and softening colors (Yaşar and Erdoğan, 2001).

In addition to natural resources, organic waste is also included in the production of building materials. One of these is rice husk ash. Rice constitutes half of the nutrition of 1.6 billion people in the world. Rice cultivation is planted in 11% of the arable areas (approximately 145 million hectares). As a result of rice production, an excessive amount of rice husk is produced as waste material. In regions where production is high, it covers large areas and causes environmental pollution (Yıldız et al., 2007).

Disposal of these organic and inorganic wastes causes serious environmental problems. With the advancement of technology, the construction industry has opened a gateway for the transportation of these industrial wastes (Ganjian et al., 2009).

Building and construction technologies require many natural resources. To preserve these resources, sustainable construction has been developed that focuses on the reuse of industrial waste and byproducts. (Tahwia et al., 2021; Abdellatief et al., 2023).

In this study, it was aimed to examine the studies on the usability of pumice and rice husk ash in the production of construction materials. In line with this aim, the studies in the literature have been scrutinized in detail.

2. Theoretical Framework

2.1. Pumice

Pumice, which is started to enter our country's industry in the last 20 years is defined to formed as a result of volcanic events, as a hollow, spongy, porous, glassy volcanic rock and resistant to physical and chemical factors. During its formation, the sudden release of gases in its structure and solidification under rapid cooling create countless pores on both macro and micro scales. (Tanyıldızı and Gökalp, 2023). There are spaces between these pores that are not connected to each other. These voids make pumice a material with low hydraulic conductivity and high sound and heat insulation (Mining Specialization Commission, 2000).

Pumice is differ by other volcanic glassy rocks (perlite, obsidian, pumice-tin) with some unique properties. The pumice which is seen in Figure 1, practically differs from them with its color, porosity and lack of crystal water. (Çirkin, 2023).

Figure 1. Pumice (MTA, 2023)

Türkiye has a very important potential in terms of pumice reserves. It is estimated that there are approximately 3 billion m^3 of pumice reserves in the researched areas (Mining Specialization Commission, 2000). These reserves are seen extensively in Central Anatolia. (Çirkin, 2023).

There are a total of 18 billion m^3 of pumice reserves in the world. Türkiye, Germany, Italy, America, Greece, Iran and Spain are among the countries producing pumice. Figure 2 shows the provinces where pumice reserves are located in Türkiye. According to the figure, half of the pumice in our country is extracted from Bitlis province (Davraz et al., 2005).

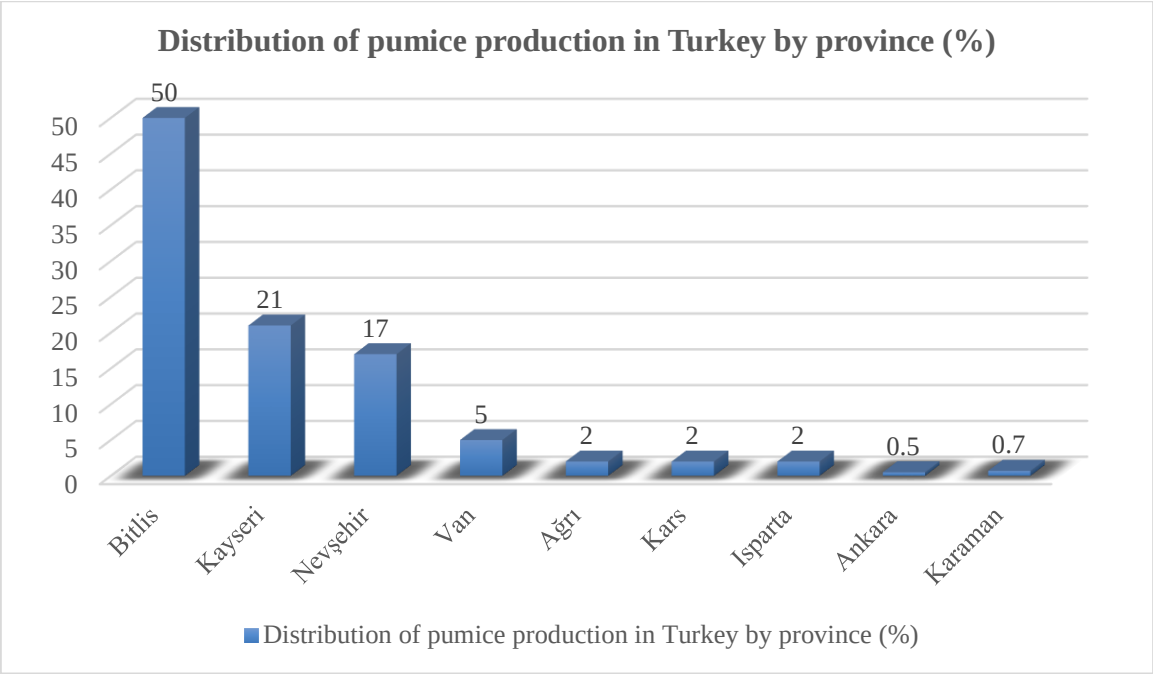

Figure 2. Pumice Reservoirs in Türkiye's Provinces (Davraz et al., 2005).

2.1.1. Classification of Pumice

Volcanic rocks were divided into classes according to their colors and textures until the 1900s. Nowadays, with the development of technology, microscopes have come into play. Thus, the classification is analyzed in detail structural and textural (Erdoğan, 2007). Pumice is classified under 6 headings as seen in Figure 3.

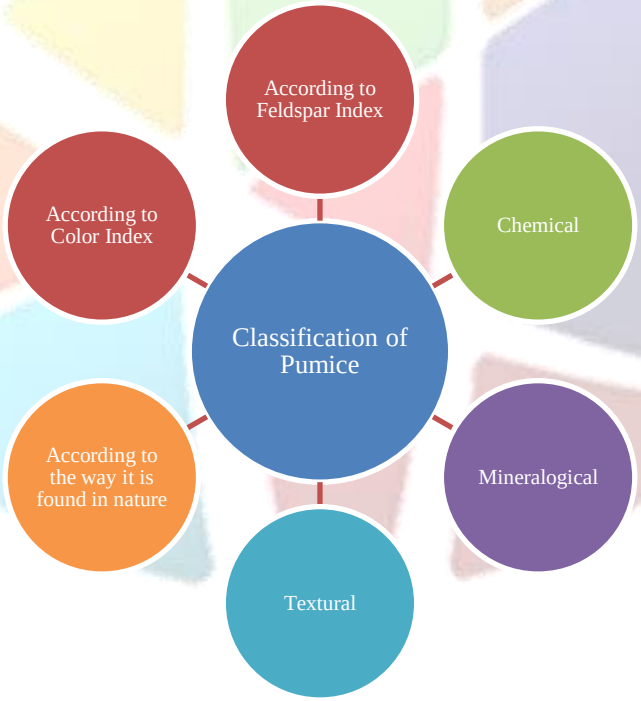

Figure 3. Classification of pumice

Although the classification is made as shown in the figure, pumice is classified according to the SiO_2 ratio in its content. Accordingly, pumice is divided into two: acidic pumice and basaltic pumice.

❖ **Acidic Pumice**

The acidic pumice shown in Figure 4 has a high silica content. The high silica content causes to increase of abrasiveness feature of pumice and its color to be almost white and greyish. Thanks to all these features and low density, acidic pumice is among the most preferred materials in the construction and building industry (Erdoğan, 2007). The unit volume weight of acidic pumice is 0.5-1 g/cm^3 (Kocaman, 2009).

Figure 4. Acidic pumice (Kızıltaş, 2021)

❖ **Basaltic Pumice**

Basaltic pumice has a high density due to the high content of Al, Fe, Ca and Mg elements in its structure. The basaltic pumice shown in Figure 5 has varying shades between brown and black. Due to their structural differences, basaltic pumices are used as floor mat in construction areas that require high strength (Erdoğan, 2007). The unit volume weight of basaltic pumice is 1-2 g/cm^3. The porosity of basaltic pumice is less and its density is higher than acidic pumice (Kocaman, 2009).

Figure 5. Basaltic Pumice (Kızıltaş, 2021)

2.1.2. Physical Properties of Pumice

Industrially, the most obvious physical properties desired in a material are specific gravity, water absorption property and dry unit volume weight. In addition, properties such as porosity, freeze-thaw resistance, capillary water absorption rate, fire resistance, heat conduction coefficient, acoustics and sound absorption are among the physical properties sought in materials. The physical properties of pumice are presented in Table 1. (Davraz et al., 2005).

Tablo 1: Physical Properties of Pumice

Clor	Off-white to light grey
Crystal shape	Amorf
Crystal water	---
Hardness (Mohs)	5,5-6
Dry unit weight (g/cm^3)	0,32-0,97
Specific gravity (g/cm^2)	1,9-2,65
Porosity (%)	45-70
Shrinkagemm/m)	2
Coefficient of thermal conductivity (kcal/mhoC)	0,12-0,20
Acoustic insulation (dB)	40-55
Water absorption (By weight %)	30-70
Vapor Diffusion Coefficient (μ)	5-10

2.1.3. Chemical Properties of Pumice

The most important ingredient in determining the chemical properties of pumice is SiO_2. The chemical properties and components of pumice are given in Table 2. According to the table, chemically pumice contains up to 75% silica. In addition, it consists of Al_2O_3, Fe_2O_3, CaO, Na_2O and trace amounts of TiO_2 and SO_3 (Ulusoy et al., 2004).

Tablo 2: Chemical Properties and Components of Pumice

Chemical Property	
pH	7-7,3
Radioactivity	None
Amount of Substance Soluble in Water (Wt%)	≤0,15
Amount of Substance Soluble in Water (Wt%)	≤2,9
Volatile Matter (Wt%)	None
Flammability Degree (°C)	45-70
Melting Degree (°C)	≥70
Chemical Components (%)	
SiO_2	52-75
AI_2O_3	11-17
Fe_2O_3	0,5-5
CaO	1-8
MgO	0,5-3
Na_2O+K_2O	3-9
TiO_2	≤1
SO_3	≤1
İgnition Loss	1-3

2.1.4. Usage Area of Pumice

Pumice has a wide range of uses around the world. It is used as raw material or additive material in industry (PAUM, 2015). Pumice has various applications both in modern industry and in the historical past, such as construction, textiles, agriculture, chemicals and cosmetics (Varol, 2016; Tanyıldızı, 2022). Figure 6 shows the worldwide usage area and rate of pumice. According to the figure, pumice is used in 5 different sectors: construction, agriculture, textile, chemistry and other sectors. Additionally, it is seen that pumice is mostly used in the construction-building sector.

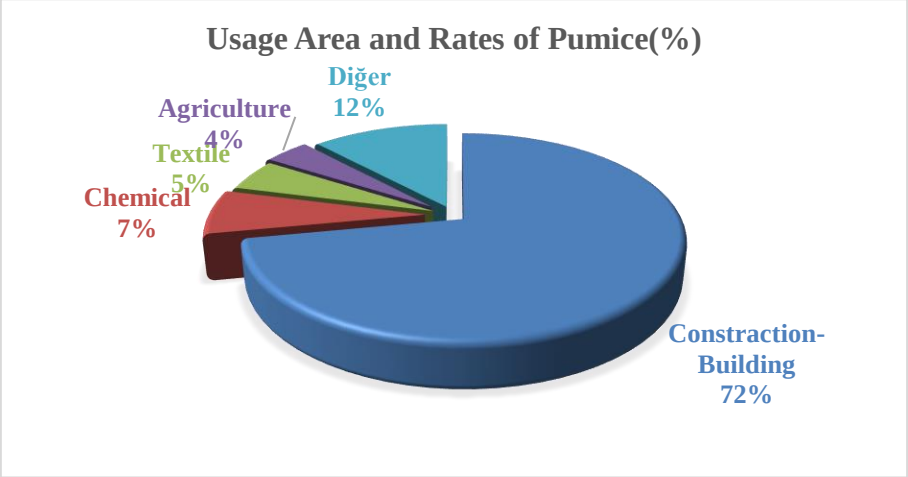

Figure 6. Usage Area and Rates of Pumice

2.2. Rice Husk Ash

1% of the Earth's surface is covered with rice. It is considered one of the most consumed foods in the World (Alganad, 2020). Rice husk is obtained from the outer covering of rice and the inclusion of two connecting parts. It is removed from the rice piece as it is not edible (Talling ve Brandsteter, 1989).

In the 2021/2022 season, approximately 735.4 million tons of rice were produced in the world. In paddy production, China is first with 212 million tons, and India is second with 184 million tons.

Figure 7 shows the map of the provinces where rice production is carried out in Türkiye. According to the map, Edirne is first in rice production. Samsun and Balıkesir are among the provinces that produce high amounts of rice.

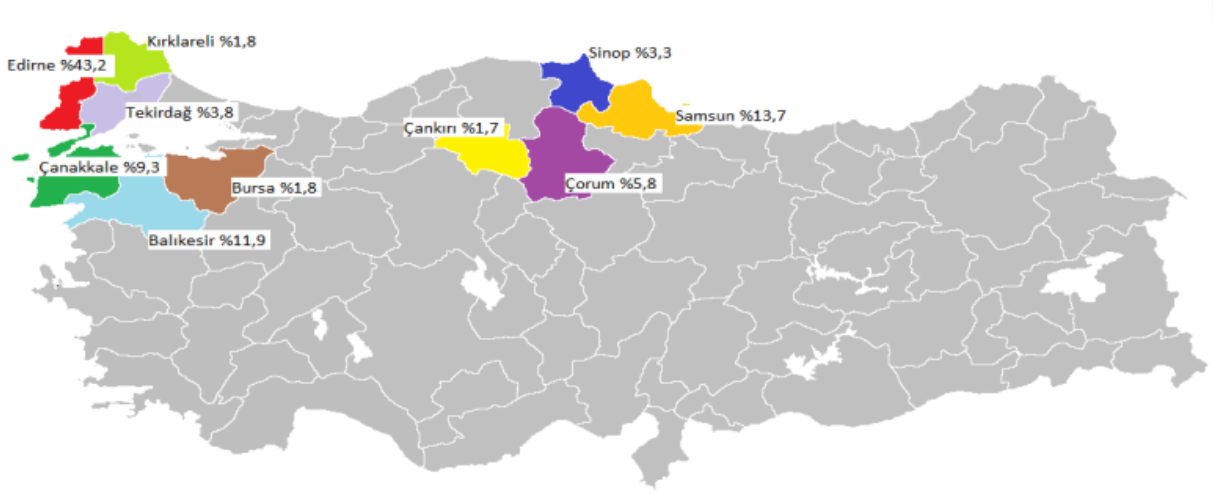

Figure 7. Provinces producing rice in Türkiye (Yazıcı, 2020)

Rice husks are the hard protective coverings of rice grains that are separated from the grains during the milling process. After rice is milled, a large amount of organic waste is obtained (Wang et al., 2020). In the rice milling process, approximately 78% of the weight of rice is rice, broken rice and bran. The remaining 22% is taken as shell. That is, for every 1000 kg of rice milled, approximately 220 kg (22%) of husks are produced (Nagrela et alSa., 2012). This husk contains approximately 30%-50% organic carbon. The bulk density of rice husk is low and is between 90-150 kg/m3. Table 3 presents the chemical and physico-chemical properties of rice husk.

Tablo 3: Chemical and physico-chemical properties of rice husk (Yıldız et al., 2007)

Chemical Properties of Rice Husk	
%	
SiO_2	96,34
K_2O	2,31
MgO	0,45
Fe_2O_3	0,20
Al_2O_3	0,41
CaO	0,41
Physico-chemical properties	
Unit Volume Weight (g/ml)	0,73
Solid Density (g/ml)	1,5
Moisture Content (%)	6,62
Ash Content (%)	45,97
Grain Size (Mesh)	200-16
Surface Area (m^2/g)	272,5
Surface Activity (meq/gm)	0,1
Surface Basicity (meq/gm)	0,45

Rice husk contains approximately 75% organic volatile matter. 25% of the husk weight turns into rice husk ash during the firing process (Alganad, 2020). Rice husk ash contains approximately 85% - 90% amorphous silica (Nagrela et al., 2012). Due to its high silica content, amorphous rice husk ash is highly pozzolanic (Demirbağ, 2021). This type of ashs have been successfully used to produce high strength and high performance concretes, good workability (Mahmud, 2004; Zhang and Malhotra, 1996).

Properties of RHA;

- Firing time
- Composition of rice husk
- Varies depending on combustion temperature (Singh, 2018).

Rice husk ash has a wide range of uses, from the construction sector to the energy sector, due to its high silica content and thermal insulation properties. The main usage areas of ash;

- Construction Sector
- Use for Energy Purposes
- In the production of refractory materials-ceramic-glass
- In chemical production
- As adsorbent
- Textile Dyes production (Şirin, 2014).

3. Academic Perspective on Pumice and Rice Husk Ash Added Building Materials

Münir et al., (2021) conducted a study involving the fabrication of fired clay bricks to investigate the synergistic and individual effects of glass mud (GS), marble mud (MS) and rice husk (RH) on the physical, mechanical, durability and thermal properties of brick samples. The investigation revealed that the incorporation of these waste materials (GS, MS and RH) reduced the shrinkage, unit volume weight and thermal conductivity of brick samples. Notably, all brick samples containing different waste materials indicated flowering well below 10%, and remained free from

any observable cracking even after subjecting them to 50 freeze-thaw cycles. The study findings further indicated that the mass loss of brick samples containing 25% GS was lower than the limit determined by ASTM C67 and were classified as freeze-thaw resistant brick samples. The authors employed scanning electron microscope imagery to supplement their observations, demonstrating a congruence between the microstructural characteristics, porosity, and water absorption tendencies observed in the study. Consequently, the collective evidence led the researchers determined that all waste material combinations considered for the brick samples they produced within the scope of the study can be used in masonry construction. This utilization not only mitigates waste deposition in landfills but also engenders the production of environmentally sustainable bricks.

Khan et al., (2023) sought to advance the development of a novel marble-based binder material by blending rice husk ash and fly ash, with a focus on evaluating its strength characteristics. The synthesis of this marble-based cement involved the burning waste marble dust and clay. In order to find the appropriate value of marble cement, they produced mortar samples by blending them separately with different amounts of fly ash (20, 30 and 40% marble cement by mass) and rice husk ash (20, 30 and 40% marble cement by mass). The produced mortar samples were subjected to various load tests, including compressive and flexural strength, as well as various morphology and microstructural tests, including X-Ray diffraction, thermo-gravimetric and scanning electron microscopy analyses. The findings of the investigation revealed that blended marble cement mortars exhibited improved strength, but were lower than Portland cement mortar. Notably, it was observed that marble cement blended with 30% rice husk ash was marginally higher than ordinary Portland cement mortar. The authors underscored the significance of utilizing marble waste, rice husk ash, and fly ash as integral components in the formulation of construction materials, positing that such practices would not only contribute to sustainable development but also mitigate environmental concerns associated with the disposal of these waste materials.

Chauhan and Sharma (2023) began a research initiative with the objective of substituting traditional clay bricks in construction with Non-Autoclaved Aerated Concrete (NAAC) blocks. Employing an experimental methodology, they adopted an experimental approach on the use of rice husk ash and marble dust as partial replacements for cement in the production of NAAC. Properties of the produced samples such as water absorption, density, compressive strength and splitting tensile strength were examined. The percentage of aluminum powder used to design NAAC blocks with dimensions of 7.06 cm × 7.06 cm × 7.06 cm was prescribed as 0.02 times the total dry weight of the material, with 2/3 of the mold volume being filled. The study's outcomes indicated that the optimum compressive strength value of NAAC could be achieved by the combined replacement of cement with 5% RHA and 5% marble dust (i.e. 5.22 N/mm^2). Furthermore, the research revealed that NAAC blocks can outperform grade C clay bricks due to less water absorption and lower density. The compressive strength attained for the NAAC samples fell within the established range for class C bricks (5 N/mm^2 to 7.5 N/mm^2). Additionally, they stated that the use of NAAC block can reduce the overall construction cost due to its lower density, reduce the overall dead load on the structure, and this will lead to less material requirement.

Varadharajan et al., (2020) used rice husk ash (RHA) in proportions ranging from 0% to 20% instead of cement in the experimental study. Concrete formulations were generated by incorporating marble waste powder (MWP) in quantities ranging from 0% to 30%, serving as a replacement for fine aggregate. Additionally, hooked steel fibers were introduced at the rate of 1.5% of the cement weight to increase the mechanical and permeability properties of the concrete. The study's conclusions are summarized as follows:

- The optimum combination is obtained with 15% Rice Husk Ash, 30% Marble Waste Powder and 1.5% hooked steel fibers,
- The optimal combination exhibited notable increases of 44.4%, 60%, and 46.13% in compressive, tensile, and bending strength, respectively,

- Porosity and water absorption decrease with the addition of Rice Husk Ash, Marble Waste Powder and steel fibers,
- There is a reasonable cost increase with the inclusion of RHA, MWP and steel fibers,
- Beyond the advantageous environmental implications, there is an excellent improvement in mechanical and permeability properties,
- An environmental impact assessment underscored the noteworthy contribution and positive effect of RHA and MWP utilization in minimizing environmental pollution, thereby fostering a sustainable and cleaner environment.

Sabat and Nanda (2011) presented the results of a laboratory study conducted to investigate the effect of marble dusts on the strength and durability of a large soil stabilized with optimum proportion of Rice Husk ash (RHA). Incrementally, up to 30% marble dust was introduced in 5% intervals relative to the dry weight of the soil in conjunction with RHA stabilization. The outcomes of the study are summarized as follows:

- According to Unlimited Compressive Strength (UCS) tests, the optimum RHA percentage is 10%,
- UCS and Wetted CBR of RHA stabilized expansive soil, Marble powder addition increased by up to 20%,
- Further addition of marble powder has a negative effect on these properties,
- Regardless of the percentage of adding Marble powder to RHA stabilized expansive soil, it reduces the Maximum Dry Density (MDD) and Swelling pressure and increases the Optimum Moisture Content (OMC) of the expansive soil,
- The addition of marble powder makes the large soil stabilized with RHA durable,
- The study identified an optimum Soil: Rice Husk Ash: Marble Powder ratio of 70:10:20 as yielding the most effective stabilization results.

Idrees and Jamil (2018) examined the mechanical behavior of the concrete produced by using 10% and 15% waste rice husk ash (RHA) and 10% and 20% MP as partial cement and sand replacement materials, respectively. Rice husk ash was produced by burning rice husks at 750°C for 6 hours. The 7, 28 and 56-day compressive, split cylinder tensile and bending strengths of the concrete samples they produced were compared with normal concrete. As a result; screened (but not ground) RHA caused a slight reduce in the strength of concrete, while MP was found to increase the strength. It has been stated that the combination of MP and RHA increases strength. Additionally, it has been demonstrated that by using RHA and MP in concrete, these waste materials can be effectively disposed of by converting them into useful products, and environmentally friendly, economical and sustainable concretes can be produced by solving the problems of natural resource depletion.

In the experimental study, ***Iqbal et al. (2023),*** aimed to produce self-compacting concrete by substituting marble dust (MP) for some of the cement and RHA for some of the sand. In the study, 0, 10, 20 and 30% MP were used instead of cement, and 20% RHA by weight was used instead of sand. Five types of mixtures were prepared, including a control mixture containing no additives. The assessment encompassed both fresh properties (namely workability, density, and air content) and mechanical characteristics (comprising compressive, splitting tensile, and bending strength) of the resultant concrete. The study yielded the following observations:

- As Marble Pewder and Rice Husk Ash content increases, workability and concrete density increase,

- Compressive, splitting tensile and flexural strength were significantly improved in a mixture ratio containing 20% MP and 20% Rice Husk Ash instead of cement and sand, respectively.
- No additional improvement in hardened concrete properties was detected when sand replaced by Rice Husk Ash was 20% and cement replacement increased up to 30% of Marble Powder,
- It has been reported that by replacing some of the concrete with industrial waste, environmentally friendly concrete can be obtained and can significantly reduce ecological pollution with its improved mechanical properties.

Akyüncü (2019) undertook the production of concrete blocks using pumice obtained from the Talas region of Kayseri province as lightweight aggregate and compared them with concrete with normal aggregate. The produced concrete blocks were exposed to fire in an area of 1m3. The experimental outcomes revealed that the surface temperatures of lightweight concrete blocks were 50% less than normal concrete. Furthermore, it was determined that there was a 6% reduce in the compressive strength of the normal and lightweight concrete blocks exposed to fire, and a 18% decrease in the normal concrete blocks.

Yanık (2007) undertook the formulation of concrete by incorporating fly ash, pumice and chemical additives. The strength, unit volume weight, heat and sound insulation properties of the concrete it produced were investigated. As a result, it was seen that the composition consisting of 43% river sand, 57% basic pumice, 200 kg ash, 350 kg cement, 143 kg water and 1.8% hyperplasticizer by cement weight gave optimum results. This special combination demonstrated reduced weight, superior heat and sound insulation and high strength values.

4. Results

Studies on the usability of pumice and rice husk ash in building materials were examined. The results obtained are listed below.

In the use of RHA;

- When used as a cement replacement material, it increases workability.
- It is very effective in the production of environmentally friendly concrete,
- It improves the thermal properties of building materials,
- It improves the sound and fire insulation properties of brick building material.
- It increases the compressive strength of almost all building materials.
- Contributes to the production of sustainable building materials as well as waste disposal.
- It has been determined that it reduces the water absorption rate

In the use of pumice;

- It reduces the unit volume weight of concrete,
- The sound insulation properties of pumice added concrete are superior to normal concrete.
- Benefits to the economy through the use of local resources
- It has been observed that pumice added building materials have high fire resistance.

The use of agricultural wastes and natural resources in the production of building materials is very effective for both waste disposal and sustainable building material production. It is thought that with the use of both materials, there will be no shortage of raw materials in the production of light building materials.

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GAME-BASED RECRUITMENT AND THE USE OF ARTIFICIAL INTELLIGENCE: REVIEW OF PYMETRICS ARTIFICIAL INTELLIGENCE (AI) RECRUITMENT TOOL

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Abstract

Gamification is used for many purposes in the field of human resources (HR), such as conducting recruitment activities called game-based assessment and making learning processes more fun and attractive for employees. The purpose of this study is to investigate the contribution that the use of artificial intelligence (AI) technology can make in the context of increasing the efficiency of the recruitment process in businesses and eliminating human errors and to evaluate Pymetrics AI as an AI recruitment tool. In this study, which aims to understand the benefits and difficulties that businesses that use and want to use AI in the recruitment process may encounter, literature review and statements and reports of businesses that are AI service providers and clients were used. Within the scope of the study, it is analyzed how AI transforms the methods of recruitment and talent attraction of businesses, Pymetrics AI, a widely used recruitment platform, is examined in detail, and concrete examples and a general evaluation of the experiences of companies using the Pymetrics AI tool and its positive impact on talent management are presented.

Keywords: *Gamification, Game-Based Assessment, Artificial İntelligence Recruiting Tool, Pymetrics AI, Businesses*

1. Introduction

Until recently, and still in many businesses, personality assessments and competency classifications through multiple choice analysis forms were traditionally used in recruitment processes. However, organizations and experts who realized the limitations and inadequacies of these tools began to look for more effective ways for recruitment (Çinçin & Aras Bayır, 2023). Recently, businesses are moving to modern technology and a postmodern, more complex enterprise resource planning software (Stănescu et al., 2020); as technological innovations in e-recruitment systems increase, HR experts are enabled to find the most suitable talents (Veglianti et al., 2023).

In this context, it is seen that AI-based HR applications related to the recruitment and selection process have become not only an auxiliary element but also a vital resource for the HR department. For businesses and managers, these applications for finding the right talent have a strong impact on the results due to ease of use and saving time and effort (Sen et al., 2023); it appears to support HR professionals to evaluate candidates effectively and efficiently (Gupta & Mishra, 2023).

Many businesses outside the sectors containing information technology (IT) and information technology enabled services (ITeS) are just getting acquainted with AI applications, so they cannot yet use AI comprehensively in all recruitment processes (Sen et al., 2023). As a matter of fact, the study of Gupta & Mishra (2023) shows that although many companies have started to use AI tools for recruitment, they have not yet discovered the algorithms that can be used to complete the entire recruitment and selection process.

Another topic in the emerging literature on AI-supported recruitment practices is gamification. Gamification was introduced as a business model in the early 2010s by using game fiction for business purposes. As of 2015, psychometric measurements have been developed and started to be used in the talent management field of business life (Çinçin & Aras Bayır, 2023). It can be argued that the use of game thinking and gamification in organizational life represents a postmodern perspective on the HR function, weakening traditional, taken-for-granted assumptions. Gamification

is used in the field of HR for purposes such as carrying out recruitment activities and making learning processes more fun and attractive for employees (Stănescu et al., 2020).

2. Game-Based Recruitment Applications and the Use of Artificial Intelligence

Since the mid-1990s, there has been an increase in the adoption of data-driven machine learning systems in the recruitment process. Using machine learning to evaluate job applications has the potential to eliminate human biases in the hiring process and lead to more equitable outcomes. As startups that apply machine learning to the recruitment process emerge, legal, conceptual and practical aspects of the subject have begun to be investigated by scholars (Wilson et al., 2021).

Traditional recruitment and evaluation techniques include the use of multiple choice analysis forms and individual or group interviews; candidates' skills, experience, motivation, cultural fit, group decision-making, etc. qualifications are evaluated. In this context, there are exercises in which the teamwork and decision-making skills of several candidates are evaluated in solving a problem or carrying out a task (Terrés Molina, 2023).

However, the effectiveness of traditional recruitment and evaluation techniques is controversial. Despite dozens of questions in multiple choice analysis forms, there are some competencies that cannot be measured. Research is being conducted to show that such competencies can be measured more effectively in psychometric game environments. On the other hand, some researchers decided to develop "psychometric games" in order to deeply understand the competencies and characteristics of the candidates (Çinçin & Aras Bayır, 2023). In this context, behavior-based assessments are largely replacing self-report instruments. A growing body of research points to the use of behavior as a better assessment tool rather than self-report. This is because behavior can be measured objectively, and this direct measurement can be used to eliminate some of the conscious and unconscious biases inherent in human self-report measures. Data-driven approaches, which are more suitable for modeling complex real-life problems, are seen as more successful in dealing with complex data sets, capturing non-linear relationships, and predicting future outcomes (O'Melveny, 2021).

Although gamification applications have become widespread, it is stated in the literature that there are few theoretical and applied studies from a HR perspective on the use and potential of gamification in selection and placement in organizations, and that there is no study that will determine the effectiveness of the application process and selection process (Mutlu & Tefil, 2021). However, academics, activists and regulators are increasingly encouraging businesses to develop and implement fair and impartial socio-technical systems. It could be argued that it would be wrong to assume that machine learning systems in recruitment will automatically be “objective,” “unbiased”. There are even concerns about the potential for machine learning systems to embed, entrench, and compound social biases. These growing concerns about bias in automated systems have led to calls for businesses to establish more fair and transparent systems. The complexity of automated systems requires developers to engage deeply with the social and legal aspects of “fairness” in a particular context; it requires developing software that embodies these values and having the algorithms undergo independent auditing for their technical accuracy and social accountability. It is emphasized that to date there are very few companies that have undertaken these three steps in a transparent manner (Wilson et al., 2021).

Regarding the use of gamification in recruitment, Reveal the Game used by L'Oreal, Multipoly used by PwC Hungary, My Marriot Hotel used by Marriot International, JeuFacteur Academy used by Formapost, Wasabi Waiter used by Knack, Code Jam used by Google and The Shell Explorer Game used by Shell can be given as an example (Mutlu & Tefil, 2021). In this study, Pymetrics AI, released by the Pymetrics company, will be examined.

3. Pymetrics AI Recruiting Tool Review

The company Pymetrics was founded in 2013 by Frida Polli and Julie Yoo from HBS and MIT. Polli and Yoo, who were disappointed by the subjective, inefficient and biased nature of the

recruitment process, started from the question of why there is no equivalent application to find a job in an era where Netflix, Spotify and Amazon platforms offer personalized recommendations (Shah, 2019). Pymetrics is a startup that offers client businesses "a candidate screening service", or "pre-employment assessment", based on data and applied machine learning. Unlike services like Monster.com or Indeed, Pymetrics is not a marketplace where businesses post jobs or job seekers post resumes (Wilson et al., 2021).

Pymetrics AI, on the other hand, is "a game-based recruitment tool" that helps evaluate candidates' social, cognitive and behavioral characteristics such as attention, planning, flexibility and memory (O'Melveny, 2021). Pymetrics AI aims to help businesses screen job candidates more systematically based on the skills required for the job, rather than traditional resumes, letters of intent, and self-reported surveys (Shah, 2019).

Pymetrics AI, "a talent assessment technology platform", uses neuroscience games and AI; It measures the building blocks of cognitive and emotional functioning (BCG, 2019). The development of Pymetrics AI drew directly from cognitive and neuroscience literature. Pymetrics AI utilizes job hunting, job descriptions, and deployed job analysis survey (JAQ) methodology (Agcas, 2019).

Pymetrics company follows the basic principles described below to conduct its work. In realizing these principles, big data and predictive analytics, that is, AI, come into play (Terrés Molina, 2023):

Neuroscientific and cognitive foundations: Pymetrics AI is developed with neuroscience and cognitive research. Neuroscientific and cognitive foundations involve using knowledge from neuroscience and cognitive psychology to determine the skills and characteristics of individuals. This principle is based on the idea that human behavior and cognitive abilities can be objectively assessed by observing patterns and responses to specific tasks.

Scientific validation: Studies and tests are conducted to show that Pymetrics AI assessments are reliable, valid and predictive of business performance; the methods and tools used are supported by scientific verification.

Use of big data and predictive analytics: Pymetrics AI involves the use of big data and predictive analytics. By collecting and analyzing large amounts of data from candidates, predictive analytics techniques are used to identify models and trends that help predict workplace success and adaptability.

Eliminating bias: Focused on eliminating bias and promoting diversity in talent selection. Algorithms and techniques designed to minimize the impact of unconscious bias are used in the evaluation process. The aim here is to ensure equal opportunity and promote diversity in talent selection. Since the ultimate principle of Pymetrics AI is the elimination of bias, the data-driven approach allows for more informed and objective decisions in talent selection. This information created by Pymetrics AI helps businesses make more informed and objective hiring decisions by reducing the impact of subjective biases in the selection process. This promotes greater fairness and diversity in recruitment by evaluating candidates based on their proven skills and abilities rather than factors such as previous experience or irrelevant personal characteristics.

Stating that the aim of every institution is to find the right employee and similarly, the aim of every person is to find the right job, Polli, the founder of Pymetrics, emphasized that with the use of AI, businesses can create a wider candidate pool and aim to determine which candidates can be more successful in a job. Polli stated that a resume only provides information about the hard-skills that the candidate needs to know for the job, while research indicates that soft-skills such as correct habits, communication skills and social grace contribute to job success (Murad, 2021) .

The main purpose of Pymetrics AI is to transform the way businesses attract and select talent. Accordingly, some of the goals of this tool include helping businesses identify the most suitable candidates, increasing the efficiency of the selection process, providing a more objective result and

making an unbiased evaluation. Pymetrics AI uses algorithms and scientific principles to measure and analyze candidate data, providing businesses with valuable information to make informed hiring decisions (Terrés Molina, 2023).

Leveraging neuroscience research and machine learning, Pymetrics AI matches the right qualified job candidates with the right businesses and careers through a gamified process that provides data on candidates' behavioral characteristics (Shah, 2019). Pymetrics AI uses gamified psychological measurement and applied machine learning to assess cognitive and behavioral traits that differentiate high-performing tasks of a role to make predictions about candidates (Wilson et al., 2021). In other words, neuroscience assessment and improvements based on data science analytics and algorithms are offered so that businesses can recruit smarter and find career paths that benefit from the strengths of candidates (O'Melveny, 2021).

Using advanced algorithms powered by AI, the Pymetrics AI platform extracts patterns and correlations between game results and desired characteristics in specific roles, allowing the strengths and weaknesses of candidates to be determined according to job requirements. These algorithms are trained with data from previous candidates and successful employees. As more information is gathered about employees' job performance and results over time, they continue to learn and develop. Thus, the accuracy of algorithms in predicting success in certain roles is increased (Terrés Molina, 2023).

3.1. Content of Pymetrics AI Games

Pymetrics AI uses a new type of game-based assessment to measure candidates' cognitive, emotional and social skills in a more objective and data-driven way. As an innovative alternative to traditional assessment methods, this assessment is specifically designed to provide a more comprehensive picture of candidates' abilities, beyond technical skills and work experience. Each of the online games designed evaluates a specific skill or competency; it is supported by research in neuroscience and psychology, allowing the detection of various characteristics related to job performance (Terrés Molina, 2023). Pymetrics AI tries to avoid disparate influences by identifying candidates with the highest potential, advancing them to the interview stage, and complying with the four-fifths rule for protected demographic groups (Wilson et al., 2021).

Pymetrics AI games use people's behavior to evaluate their cognitive, social, and personality traits (O'Melveny, 2021). Available in web browsers or mobile apps, Pymetrics AI games are translated into more than 20 languages and include built-in accommodations for players with color blindness and/or dyslexia. As of 2021, Pymetrics AI has created a database containing the games of more than 2 million users worldwide and from various industries (Wilson et al., 2021).

Pymetrics AI includes the same set of 12 neuroscience games for all organizations and roles in measuring 90 cognitive, social and emotional traits of candidates. While many traits are said to be acquired on the job, Pymetrics AI focuses on measuring intrinsic traits that do not change over time. Cognitive features include memory, planning, sequencing, attention; risk profile, reward sensitivity, emotional sensitivity and trust can be given as examples of emotional characteristics (Shah, 2019; O'Melveny, 2021).

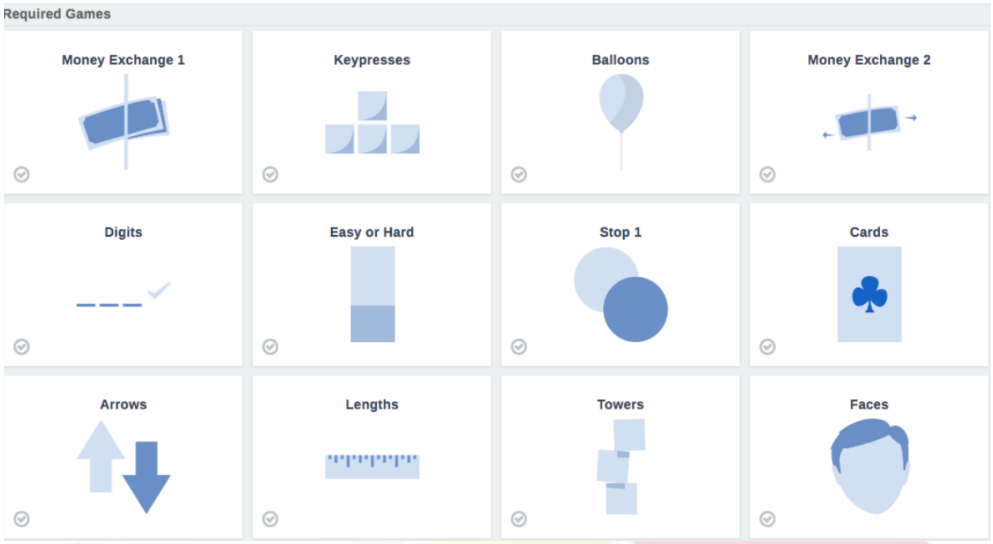

Figure 1: Pymetrics AI games (Butwin & Connerty, 2020)

The competencies targeted to be measured in Pymetrics AI games are mapped as follows (Çinçin & Aras Bayır, 2023):

- Balloons Game: taking risks, trusting your instincts, pattern discovery and following, decision making and implementation
- Arrows Game: learning, attention, adaptation
- Stop 1 Game: attention
- Towers Game: planning
- Money Exchange Game 1: trust and risk taking
- Money Exchange Game 2: sharing and selflessness
- Lengths Game: learning, focusing on details, motivation
- The Cards Game: risk taking, pattern following, and learning
- Easy or Hard Game: effort and persistence, strategic decision making and motivation
- Keypresses Game: understanding and following instructions, motor strength and assertiveness
- Digits Game: memory
- The Faces Game: emotional intelligence and empathy

Figure 1 shows the visuals of Pymetrics AI games. Each game is approximately 1-3 minutes; it takes the candidate 25-30 minutes in total to complete the games. These games, which can be accessed from any computer or mobile phone, take place in multiple sessions, and game data is recorded only after each game is completed. Since games require a lot of attention, it is recommended to play them in a quiet place to minimize distractions. Unlike other online assessments, there are no winning or losing games, no right or wrong answers. How the games are played is important, and behavior-based data is collected and analyzed (O'Melveny, 2021).

Pymetrics AI games go beyond traditional questionnaires; candidates' creativity, problem-solving skills, etc. It aims to evaluate critical competencies within game dynamics. It can be used to prepare a quick short list by eliminating candidates before a face-to-face interview, or to question the competencies of some candidates after a face-to-face interview, in terms of competency suitability and analysis of matches according to positions. As a result, it produces three different results for each candidate: "highly recommended, recommended and not recommended" (Çinçin &Aras Bayır, 2023).

3.2. Pymetrics AI Features

Pymetrics AI, an online recruiting platform, works with more than 80 corporate clients including Linkedin, Accenture, MasterCard and Unilever, while enlisting the current top-performing employees in the business to complete the platform's suite of evaluations.

Pymetrics AI helps candidates make the right hires by looking beyond their experience and skills on their resumes. At the same time, this platform can be used for internal career development; by collecting key emotional and cognitive characteristics for different roles, candidates are matched with the most suitable jobs when they apply to work at another business using Pymetrics AI (Butwin and Connerty, 2020). Pymetrics AI's revolutionary AI behavioral social skills assessments measure candidates' behavior from cognitive and emotional characteristics within an engaging candidate experience and help create diverse teams of top-performing candidates (Çinçin & Aras Bayır, 2023).

Pymetrics AI results are not used as a "filter" to exclude candidates from consideration, but rather as an inclusion tool. Thus, candidates with various backgrounds, education and work experiences who share the behavioral and cognitive characteristics of successful employees can be identified (BCG, 2019).

According to Gallup research, only 12% of employees say they had a memorable and satisfied experience when it came to recruitment and company promotion. Long and boring forms created by ignoring user experience, transferring many questions to digital with the idea that all information is required, forgotten and repeated processes in hybrid interviews designed both "offline" and "online" negatively affect the experience of candidates in the recruitment process (Çinçin &Aras Bayır, 2023).

Pymetrics AI in summary (O'Melveny, 2021; Çinçin and Aras Bayır, 2023):

- provides objective data to consider along with the CV, notes and interviewer feedback;
- measures the qualifications of candidates against the qualifications of successful employees;
- identify quality candidates efficiently and promote fair recruitment;
- reduces multiple forms of bias by overriding some of the implicit biases that naturally creep into the hiring process through an audited AI platform;
- produces an unbiased assessment of candidates' cognitive, social and emotional characteristics;
- levels the playing field by minimizing the impact of gender, race and ethnicity in hiring decisions;
- improves overall talent performance through mobility, reskilling, learning and development strategies;
- It paves the way for reducing the personnel turnover rate.

The key domains of Pymetrics AI are explained as follows (Agcas, 2019):

Qualification: by facilitating the selection process, it reduces recruitment time, recruitment cost and total time spent.

Diversity: evaluating candidates with an objective, data-driven approach; gender, ethnicity etc. It uses audited algorithms to increase diversity.

Efficiency: provides greater predictability and matching power, validated by metrics such as return on offer, retention and performance.

Candidate experience: adopting a candidate-first approach ensures a positive candidate experience through metrics such as completion rates, satisfaction scores and survey feedback data.

According to Terrés Molina (2023), the advantage of using game-based assessments is that it provides candidates with a more interesting and enjoyable experience; this can help reduce the anxiety and stress associated with traditional testing. Another advantage is that games provide

objective and measurable data on candidates' skills and competencies, allowing for more fair and accurate evaluation.

3.3. Pymetrics AI Model and Working System

The stages of Pymetrics company's candidate screening service through AI are explained below (Agcas, 2019; Shah, 2019; Butwin & Connerty, 2020; Wilson et al., 2021):

Phase 1: The client business contracts Pymetrics to develop and implement a predictive model for candidate screening.

Phase 2: A business analyst from Pymetrics researches the client business to understand the target role (job description, seniority level, etc.) and the metrics used to evaluate job performance in that role.

Phase 3: Employees of the client business are invited to play Pymetrics AI neuroscience-based games. Assigned employees complete games in the Pymetrics AI game suite in the context of targeted roles. These employees' current job performance and gaming data are used as training input to build a predictive model.

Phase 4: Pymetrics' data scientist uses a custom Pymetrics tool to develop a predictive model for the client business. Pymetrics AI analyzes trait data from employee games to create a model of success. Pymetrics AI creates business-specific algorithms by running mini games on at least 50 of the business's top performers. This model is then used to compare candidates with similar characteristics. These models are evaluated for predictive performance and compliance with the four-fifths rule for demographic groups using a separate test set that includes demographic information. The prediction model that performs best in meeting the fairness criteria is selected and used. Longitudinal analysis of the predictive model included backtesting to re-evaluate whether fairness criteria for the candidate pool were met and examination of the job performance of hired candidates.

Stage 5: Candidates applying for the open job position are asked to complete Pymetrics AI games during the application process. Pymetrics AI uses a set of cutting-edge machine learning algorithms to detect differences and overlap between candidates in the candidate pool once the top performers are qualified and the results are inspected for bias. A matching algorithm is used to select candidates who are best suited to the role or have similar skills to the best-performing employees in the business. Based on the data, the model predicts which candidates have qualities similar to high-performing employees. Information about candidates with high scores is sent to the client business. Client business can apply additional filters on this data if they wish. This model is used by businesses mostly for recruiting purposes in standard entry and mid-level corporate positions. Pymetrics AI uses AI to match candidates' characteristics with their success patterns, creating a match recommendation and an individual "Recruiter Report".

After the games, candidates can view and download their personalized “Feature Report”. The feature report is not specific to the business, role or model in which they are evaluated (Agcas, 2019). When the games are over, candidates are given the opportunity to view “attention span, process consistency, flexibility, creativity, decision making, giving, learning from mistakes, etc.” A report containing evaluations of 90 different features is presented (Shah, 2019).

3.4. Using Pymetrics AI in Discrimination Auditing

Discrimination resulting from human prejudices in recruitment is a long-standing and widespread problem faced by businesses and candidates (Wilson et al., 2021). Recruiters typically spend an average of six seconds reviewing a resume; many candidates are arbitrarily eliminated at this stage (Shah, 2019).

The US Civil Rights Act of 1964 mentions two types of discrimination that can affect hiring processes. The first is disparate treatment, where people are directly discriminated against based on legally protected characteristics such as race and gender. In the context of machine learning,

avoiding disparate treatment can often be operationalized as preventing protected attributes from being used as input for models. The second type of discrimination, called disparate impact, refers to situations where a neutral process still produces significantly different outcomes for people associated with legally protected characteristics. There are many debiasing techniques that aim to ensure that models do not produce disparate effects. However, researchers have found that not all of these justice goals are mathematically compatible (Wilson et al., 2021).

The new human science is about using advances in the ability to understand and measure behavior and thought processes to match people with opportunities that suit them. The aim here is not only to increase the effectiveness and productivity of organizations, but also to eliminate prejudice and discrimination patterns in the allocation of job opportunities (Polli et al.,2021).

Background checks put women and minorities at a 50-60% disadvantage (Shah, 2019). It appears that algorithm audits are carried out to address concerns about bias. Internal audit is carried out by in-house employees; external audit can be carried out by experts who are not employees of the organization. Collaborative auditing, on the other hand, involves cooperation between internal and external actors (Wilson et al., 2021).

Blind auditions for candidates are carried out in Pymetrics AI games, which aim to create a more ethical, unbiased algorithm supported by AI (Shah, 2019). Searching for bias the data science team tests each of the algorithms to determine whether certain gender and ethnic groups are disproportionately matched by an algorithm. Pymetrics AI also goes a step further, eliminating any sources of bias by checking through Audit AI, an open-source algorithm auditing tool, to ensure true blind auditions before deploying the application (Agcas, 2019). Thus, candidates act anonymously on this platform and the prediction algorithm does not use any demographic information to evaluate career fit; with AI that does not see race or gender, basic job-specific skills can be highlighted (Shah, 2019).

Audit AI is a technology that checks the algorithm to ensure that it does not inadvertently discriminate against the attributes it analyzes (Butwin & Connerty, 2020). If any bias is detected during this process, the weight of the features causing the bias is reduced or completely removed. The process is repeated by changing the algorithms until we are sure that the AI is unbiased and will not cause any negative effects (Agcas, 2019).

After players complete Pymetrics AI games, they are asked to participate in an optional demographic survey about their gender and ethnicity/race. These data are used to create datasets in adverse effects tests. These categories considered protected include male/female in terms of gender and Asian/Black/Hispanic/White/two or more groups in terms of ethnicity. More than 75% of players were found to have completed the demographic survey (Wilson et al., 2021).

Pymetrics AI, unlike other AI recruiting applications (O'Melveny, 2021),

- monitors the “success profile” of the recruiting organization to eliminate any potential gender, racial or ethnic bias;
- The Equal Employment Opportunity Commission (EEOC) uses extensive databases and recognized statistical methods in its predictive model to ensure it meets non-discrimination criteria;
- Following a decision regarding HR in order to comply with employment laws and to implement or defend legal claims, it stores e-mail addresses and game data for certain periods of time in order to prevent users from creating a new account and playing the games again.

There are questions about whether there is a danger that using Pymetrics AI will end up hiring people who share the same behavioral profile. An official from BCG (2019), who uses Pymetrics AI, answered this question as follows: “In our company, we highly value diversity of experience and thought, as well as diversity of gender, race, and ethnicity. Pymetrics AI helps us identify a set of candidates that will enable us to unlock the true power of diversity in our business and culture.

All Pymetrics models are thoroughly reviewed to ensure that their use in the hiring process does not result in biased results for any gender, race or ethnicity."

Harver, one of the industry leaders in helping companies optimize their talent decisions, announced the acquisition of Pymetrics in 2022. This acquisition adds a behavior-based AI methodology to Harver's comprehensive talent assessments, providing client businesses with broader and more in-depth predictive talent decision-making products to meet their professional and hourly recruiting needs (Prnewswire, 2022).

4. Examples of Company Applications

Pymetrics AI is part of the recruitment process for more than 60 companies worldwide, including high-profile multinationals such as Unilever, LinkedIn, Hyatt, Accenture, Loreal, McDonald's, JP Morgan bank, accounting firm PWC and food group Kraft Heinz. Candidates can meet with a HR specialist if they pass this AI software test (Shah, 2019; Wells & Weinstock, 2019; IKMD, 2021; Gupta & Mishra, 2023).

Pymetrics AI games have been played by nearly 1 million job candidates worldwide to gain career guidance. Pymetrics AI clients state that Pymetrics AI offers significant advantages over traditional personality tests such as Myers Briggs, noting time and cost reductions and significant increases in diversity and new hire performance (Wells & Weinstock, 2019). With the use of Pymetrics AI, some companies have more than doubled the percentage of candidates they hire from those they invite to face-to-face interviews; it improves the diversity of HR and eliminates ethnic or gender prejudices by testing them; thus, it was stated that more women and minorities were hired (Shah, 2019).

Below are examples of some companies' use of Pymetrics AI and its results.

4.1. Unilever's Pymetrics AI Experience

In 2016, Unilever began partnering with HireVue and Pymetrics, an AI startup, to design a recruitment and selection system powered by AI (Hu, 2023). It tried an innovative recruitment method based on AI technology between July 2016 and June 2017 in North America (Kafadar, 2017). Unilever is an example of a company that is changing the way it works when it comes to recruiting and selecting talent. This British company has transformed its talent attraction process into a completely digital experience in recent years. This AI-based transformation of Unilever's recruitment process aims to "attract young talent to the business, encouraging and recognizing individual competencies rather than academic knowledge". In the past, Unilever's approach to candidate recruitment and selection was limited to lengthy and time-consuming telephone tests and manual paper-based assessments. This outdated and time-consuming methodology was causing significant challenges to the company in terms of recruiting efficiency and quality. Benefits expected with the transformation include streamlining the evaluation process, saving costs, and promoting workforce diversity (Terrés Molina, 2023).

The functioning of Unilever's AI recruitment process is as follows (Kafadar, 2017; Fortune, 2018; Terrés Molina, 2023):

Data collection: Candidates learn about the job through platforms such as Facebook and LinkedIn. They fill out a form containing their contact information, education and send their LinkedIn profile to Unilever.

Testing phase: Candidates play 12 neuroscience-based games on the Pymetrics AI platform for approximately 20 minutes. The system only selects people with the most relevant results for Unilever.

Interview phase: If candidates' results match the job profile required by a particular position, they are eligible to participate in a digital interview where they answer pre-prepared questions through HireVue's AI. A digital interview is an online interview that selected candidates can record whenever and wherever they want. Selected candidates are asked to record the video on Hirevue.

During this phase, candidates answer questions about how they would handle various situations they might encounter on the job. During the interview, AI evaluates candidates not only on what they say, but also on how quickly they respond and what emotional reactions they show in their facial expressions, and produces evaluation notes for the recruiter.

Final evaluation phase: Candidates who pass the virtual filter are subjected to an evaluation based on a real company sample at Unilever offices. At the end of the day, it is decided by the recruiter or manager whether the candidates invited to the Unilever office to experience the "day in the life" scenario are really suitable for the job.

Pymetrics AI has shown major recruiting gains in the case of Unilever company. The results Unilever achieved with the use of AI technology in the recruitment process are as follows (Kafadar, 2017; Fortune, 2018; Agcas, 2019; Terrés Molina, 2023):

- 280,000 applications were evaluated in 68 countries and 15 languages for the Future Leaders Program; 7 profiles were created based on high-performing candidates in the fields of Marketing, Sales, HR, Information Technologies, R&D and Finance.
- cost savings of over £1 million were achieved.
- after the implementation started, job applications doubled in the first 90 days compared to the same period of the previous year.
- the time required to complete the recruitment process has been reduced by 90%, from 4 months to 4 weeks.
- a 16% increase in new employee diversity was achieved.
- the time spent by recruitment personnel reviewing applications was reduced by 75%.
- the completion rate of candidates in the selection process was increased from 50% to 96%.
- the offer rate given to candidates who made it to the final round increased from 63% to 80% and the acceptance rate of these offers increased from 64% to 82%.
- there was a 57% retention rate.
- there has been a significant improvement in the candidate experience.
- calculated to save candidates over 50,000 hours in total
- while the completion rate of 12 Pymetrics games was 98%, the average score of the entire process was 4.1 out of 5, based on 25,000 candidates in the process.
- a "win-win" situation has occurred in terms of the efficiency of the election process.
- it has been stated that not having physical contact with the candidates until the final stage saves Unilever a lot of time and eliminates prejudice and discrimination.
- an increase in 100% gender and ethnic diversity was observed. After the application, candidates are asked to identify their race, ethnicity, socio-economic status, etc. It has been emphasized that the diversity of the university has increased, allowing many colleges and universities to choose from a pool that is three times more diverse.

(Hu, 2023), who examined the functioning of Unilever's recruitment and selection process, supported by literature, reached the following conclusions:

- making the process of understanding Unilever's values and mission easy and interesting has led to high efficiency in matching candidates with open positions.
- gamifying the primary election made candidates willing to put in the effort because it was practical and time-saving.
- low trial cost reduces the mental burden of collecting and analyzing information from the social networking site.
- Unilever also uses natural language processing (NLP) technique to collect information from existing employees. It has been stated that during the recruitment process, the questions most frequently asked by new employees can be included as job posting information and attract attention for recruitment.

- in the performance evaluation process supported by NLP, certain implicit characteristics and behavioral patterns of successful and competent leaders in the existing workforce can be deciphered through machine learning, according to the text data in the evaluation statement.
- clear criteria can be converted into a selection algorithm to determine the wanted people based on the candidates' performance in gamification selection and video interviews.
- this system can be improved by setting it up in a new business environment to better match vacancy characteristics and applicant characteristics.
- certain linguistic or bodily behaviors, etc., that are associated with a certain number of successful employees. Screening is carried out according to very fair and strict criteria that have sufficient evidence to prove that they are highly correlated with high performance.
- On the other hand, issues such as privacy conditions, gender equality and procedural justice need to be reconsidered.

4.2. PricewaterhouseCoopers Australia's Pymetrics AI Experience

As an accounting organisation, PricewaterhouseCoopers Australia explains their reasons for using Pymetrics AI as “they do not believe CV is a good indicator of future success; they stated that "there is no relationship between academic success and role success, they try to build trust in society and solve important problems." The first issue to be solved with this application is efficiency. Pymetrics AI helps process candidate data more efficiently. In this application, efforts have been made to highlight areas and skills such as technology and analytics, and skill paths have been created. Although productivity data is not yet available, it has been stated that there are many more candidates with potential skills who have progressed to the next stages. On the other hand, in identifying talent that will be successful, a candidate who applies for a particular skill pathway and whose evaluation does not recommend it may be contacted by the recruitment team and asked "We see that you are quite suitable for stream x, would you be interested in stream y instead?" suggestion can be made. From a candidate experience perspective, feature reports offer a remarkable experience in giving good feedback to candidates. From a talent acquisition or recruiting perspective, as it relates to a high-performing talent function, Pymetrics AI has transformed the way it partners with business and gains insight into a candidate in a way that has not been done before. Additional data is very powerful; it helps from a recruiting perspective and further elevates the recruiting team. Examining how to move the team forward, how to distribute the load so as not to burn out the recruiters; promotions and use their time more wisely. This data and this kind of drive for efficiency helps to be strategic in business. Because there is blindness throughout the hiring process, an evaluator is actually at the end of the process when they first meet the candidate. The data ensures a fair and consistent process; it helps to make pragmatic decisions. A positive barrier to action is when recruiters or managers do not see information such as which school or university a candidate attends (Kerrison et al., 2019).

4.3. Untapped Group's Pymetrics AI Experience

Untapped Group co-founder A. Eddy emphasized that their focus is neurodiversity. According to Eddy, current hiring processes do not include neurologically diverse people; individuals with different neurological characteristics have different approaches and evaluations of job postings. For example, an autistic person needs to see that they can do 10 of the 10 skills in the job ad, they cannot interview well because they cannot handle sensory stimulation such as looking into someone's eyes. Therefore, assessment centers and video interviews do not go well for them. In assessment centres, the loudest, most confident candidates usually succeed. For companies that complain about hiring the same type of people, neuroscience and AI are filling this gap and helping find raw talent. When JP Morgan Chase conducted a back-to-back comparison of its two teams in software testing, it found that its neurodiverse team achieved 58% higher productivity. Developed by Untapped Group, the program includes a three-year model that people with autism can develop to help them succeed in the workplace. Employees are brought together so that they can meet other

people on the autism spectrum, have someone who can educate and mentor them, and help develop strategies to be successful at work (Kerrison et al., 2019).

4.4. Some Other Examples

In the letter sent to universities, JP Morgan announced that, starting from 2019, it will end its previous university campus visits and ask candidates to play behavioral scientific games with AI during the recruitment process. With Pymetrics AI, JP Morgan aims to reach many more students throughout the year and enable students from all walks of life to apply for jobs (Menteş, 2019).

A profile based on high-performing sales agents was created for an insurance sales job at a multinational financial services company. According to company evaluations, it has been revealed that there are 33% more sales, 30% lower attrition, 81% positive feedback and 92% employers feel the added value (Agcas, 2019).

A US-based, global food company was looking for ways to increase hiring yield for its Europe, the Middle East and Africa (EMEA) intern program. Pymetrics AI replaced the CV in assessing 2,500 recent graduates in the UK, Netherlands, Spain, Italy, Germany, Portugal, France and the Middle East. As a result, they saw major impacts on hiring efficiency and candidate experience (Agcas, 2019).

5. Results of Using Pymetrics AI

The benefits of using Pymetrics AI to businesses within the framework of HR management and talent management are listed as follows (Terrés Molina, 2023):

- the ability to conduct objective, data-driven assessments through AI algorithms, streamlining the hiring process by eliminating the need for manual, subjective assessments.
- The collected data can be used to optimize the recruitment strategies of businesses and increase the efficiency and quality of the process.
- analytics tools analyze and visualize data related to recruitment and selection processes, helping to identify patterns, trends and opportunities for improvement in attracting and selecting talent.
- through talent analytics, transferable skills and characteristics that facilitate the internal mobility of talent within the organization can be identified.
- saving valuable time and resources by allowing the most suitable candidates for each position to be quickly identified.
- evaluations of candidates are based on objective and measurable data, minimizing the impact of subjective factors such as race, gender or age.
- more diverse and inclusive teams can be created by promoting fairness in the selection of candidates.
- By creating detailed profiles that provide valuable information about candidates' strengths, skills and personal characteristics, more informed recruitment decisions are made based on whether they have the necessary competencies to be successful in different roles.

6. Challenges Encountered in Using Pymetrics AI

AI has been used by recruiters for the last 10 years. A report published in 2019 states that the use of AI software in recruitment will replace 16% of industry jobs before 2029. Pymetrics AI is designed to evaluate various aspects of candidates' personality and intelligence, their risk tolerance, and how quickly they react to situations. It is claimed that with Pymetrics AI, "cognitive and emotional characteristics can be measured fairly and accurately in just 25 minutes" (Murad, 2021).

Although Pymetrics AI has a number of high-profile customers, there are some challenges it may face in the future:

Danger of human judgment dominating the selection process: after shortlisting, there may be an interview process using Pymetrics AI where human judgment will come into play and cause bias

(Shah, 2019). Online retail company Amazon abandoned the use of the AI system it used in recruitment in 2018. Because it has been observed that this system disadvantages female candidates and finds male candidates more preferable due to the frequency of technology industry experience in male candidates' CVs (Murad, 2021).

Difficulty in developing a custom algorithm: the developed algorithm must be specific to roles of the relevant business (Shah, 2019), but developing a tailored algorithm requires time and budget.

Difficulty in obtaining an unbiased dataset: datasets often copy the existing structure of a company, making it difficult to have an unbiased dataset (Shah, 2019).

The danger of reducing organizational diversity: using the same type of algorithms can lead to a decrease in the diversity of ideas in the business, as the candidates hired have similar skills and personality traits (Shah, 2019).

Danger of manipulation: candidates can improve themselves by practicing such games in advance in order to get higher scores in the characteristics required by the job role they will apply for (Shah, 2019). This will pave the way for the game results to be manipulated by the candidates.

Effectiveness of model performance: "Effectiveness of Pymetrics AI games" is one of the issues emphasized in assessing the suitability of candidates. Although these games are based on peer-reviewed and repeated psychological studies, a direct distinction between laboratory experiments and real-world job performance is difficult. Conducting larger-scale observational studies based on longitudinal data collected from customers to evaluate model performance would be valuable to evaluate the effectiveness of games (Wilson et al., 2021). The machine learning objective function is to find the most performing, least biased model. A less performing model may be chosen to meet the fairness standard set by the regulations. However, choosing a less-performing model to meet non-regulatory standards such as intersectional justice can create grounds for legal disputes. For example, Pymetrics AI has expressed interest in exploring the intersectionality of demographic categories of gender and race, but intersectionality is not recognized by regulatory bodies (Wilson et al., 2021).

Affecting the psychology of the candidates: In an evaluation where the AI software cannot interfere with the results of any human being, it is important how the candidates are perceived by evaluating the personality of the candidates and deciding whether they pass the test or not (Murad, 2021). Whether the candidates perceive such an evaluation as fair, how they perceive the company requesting this evaluation, the psychology of the eliminated candidates, etc. emerge as potential future research topics.

The challenge of collaborative auditing: collaborative audits can be achieved between industry stakeholders who want to be transparent and academic researchers who want to improve the general application of machine learning. Collaborative audits can cause stress in participating businesses because they require transparent involvement of industry partners and broad freedoms for auditors. Each company operates within its own legal, regulatory and ownership constraints. Therefore, auditors operating in collaborative mode need to be flexible within these constraints (Wilson et al., 2021).

Privacy of private information: transparency of machine learning service providers is also contextual. Businesses must balance sharing enough private information to be transparent with their users, customers, and watchdog groups, but not sharing enough information to be copied by competitors. Through collaborative auditing, independent experts can gain access without fear of loss of intellectual property of the business or jeopardizing the privacy of data owners (Wilson et al., 2021).

As a result of a qualitative study conducted with five experts working as AI experts in the field of HR technology in different organizations in India, the following conclusions were reached (Sen, 2023):

- The areas where AI is used for recruitment are expressed as "sourcing, screening and selection of candidates".
- most experts think that full technological integration of recruitment processes with AI will never be possible.
- AI-based filters have been highlighted as effective for advertising job descriptions on keywords, creating and shortlisting candidate profiles, using chatbots to communicate with candidates, and distributing offer letters.
- certain factors such as the size of the company and the total financial gain from adopting an AI-based recruiting process also depend on the number of people hired.

7. Conclusion

In this study, the content, features and working system of the Pymetrics AI recruitment tool are explained by mentioning the use of game-based recruitment applications and AI. The approach adopted by Pymetrics AI in auditing bias and discrimination in recruitment was discussed, and examples of cases of companies using Pymetrics AI, especially Unilever, were presented. Based on the information presented by these companies in their statements and reports, the results of using Pymetrics AI and the difficulties encountered were evaluated.

Gamification and game-based evaluation literature within the scope of AI applications in the recruitment process is a newly developing field in the world and in Turkey. There is a need to increase the number of theoretical and empirical studies in collaboration with game developers and user businesses. It is necessary to support the ecosystem that will pave the way for the emergence of initiatives that will develop AI-based recruitment applications in Turkey.

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FROM INDUSTRY 1.0 TO INDUSTRY 5.0: USER-PRODUCT INTERACTION

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Abstract

Technology, defined as the application of techniques and scientific research in industrial products, has developed throughout all civilizations. In civilizations called hunting societies, agricultural societies, industrial societies in the past, information societies today and super smart societies in the future, existing science has always been adapted to industry and will be applied. Industrially produced products have been affected by these technologies that have developed throughout civilizations. Technological developments from past to present have been reflected not only in production methods but also in the design of products, in other words, in user-product interaction. The branch of science that studies this interaction between the user and the product is ergonomics. The primary purpose of ergonomics is to increase the efficiency of the user as a result of interaction with the product. Ergonomics meets not only the physical but also the psychological and mental expectations of the user. The purpose of technology is to make human life easier. One of the design aims is to meet ergonomic conditions, that is, to ensure that the product is suitable for the physical and mental abilities of the user. Throughout all civilizations from the past to the present, existing technologies have been influenced by ensuring compatibility between the user and the product. Considering the technological change, the interaction between the user and the product today extends from physical methods to cognitive methods. Throughout history, the interaction between objects and users has continued manually, mechanically, electronically, digitally, remotely, and virtually. The mental fitness of users becomes more important than their physical fitness. Due to the development of interaction in this direction, current ergonomic standards are inadequate. For this reason, standards need to be developed for users' mental and cognitive fitness. This study aims to examine the new interaction methods between the user and the product and the studies carried out on this subject due to the change in the interaction methods between the user and the product due to the current ergonomic standards in product design. In the study, literature research was conducted and studies on the subject were presented. According to this study, ergonomics studies in product design are mostly done on physical ergonomics, and although there are studies on cognitive ergonomics in product design, no established standard has been identified.

***Keywords**: User-Product Interaction, Cognitive Ergonomics, Technology Design Interaction*

1. Introduction

The purpose of technology is to make human life easier. The design principles, production processes, and usage patterns of industrially produced products have been influenced by these technologies that have developed throughout civilizations. Throughout all civilizations, existing technologies have been effective in design by ensuring harmony between the user and the product. One of the aims of the design is to meet ergonomic conditions, that is, to ensure that the product is suitable for the physical and mental abilities of the user. Considering technological change, the interaction between the user and the product today ranges from physical methods to cognitive methods. Throughout history, the interaction between objects and users has continued manually, mechanically, electronically, digitally, remotely, and virtually. Users' mental condition is becoming more important than their physical condition.

It is necessary to examine the interaction between the user and the product in the history of industrial revolutions. The first three Industrial Revolutions provided production with steam power, modern and highly efficient mass production facilities powered by electric power, and automation in production with computer and communication technologies (Xu et al., 2021; Pessôa and Becker,

2020). Industry 4.0 is communication between cyber-physical systems (Schwab, 2017; Pessôa and Becker, 2020). Each of these revolutions has its unique technologies that change social, economic, and environmental conditions. Every revolution has its unique design (Müller, 2017).

This study aims to examine the interaction methods between the user and the product in product design in the context of technology and industrial revolutions. In this study, the interaction between humans and objects in the world of digitalized objects was examined in terms of cognitive ergonomics. In the study, literature research was conducted and it was discussed how the interaction between the user and the product will be in the future.

According to the study results, it is seen that the interaction between the product and the user has evolved from muscle-oriented to brain-oriented. In this context, it can be said that ergonomics and the user's cognitive features will be more important than anthropometric features in product design. However, the limited amount of research and case studies on cognitive ergonomics in product design results in a lack of information that can guide designers in the field of cognitive ergonomics.

2. Technology from Industry 1.0 to 5.0

In ancient history, needed objects were produced manually or by animals (Yavari and Pilevari, 2020). Industrial Revolution 1.0, which was the mechanization of production using steam power required by rapid population growth and developments in agriculture, first began to appear in Europe in the 18th century. With the Industrial Revolution, there were major changes in the organization of production processes. Steam machines were used instead of muscle-powered looms (George and George,2020). Industry 1.0 has revolutionized not only the change of production processes but also transportation (Yavari and Pilevari, 2020). Industry 2.0 was the use of electricity instead of steam in machines with the invention of electricity in the 19th century. Mass production and assembly lines were created with electric machines, which were easier to use than steam. (Yavari and Pilevari, 2020; George and George, 2020).

Industry 3.0, which reflects the developments in electronics and computer technologies in the 20th century, enabled the implementation of production automation in factories. (Yavari and Pilevari, 2020; George and George, 2020) Industry 3.0 can be thought of as the bringing together of services and goods and the personalization of goods through services (Tien, 2012). Industry 4.0 was first introduced at the Hannover Fair in 2011 (Vogel and Hess, 2016; Xu et al., 2021; Tien, 2012). Industry 4.0 briefly includes smart production methods. Although Industry 4.0 is based on the computer technologies in Industry 3.0, it stands out with the application of information and communication technology to industries. Factories equipped with computer technologies become cyber-physical production systems by being equipped with internet and network systems, and independent smart factories emerge where individuals communicate over a network (George and George, 2020). Trending technologies in Industry 4.0 are the Internet of Things, robotics and artificial intelligence (AI), big data, and cloud computing (Tien, 2012; Demir et al., 2019). Other technologies that support Industry 4.0 include virtual and augmented reality, smart factories, and smart processes.

Unlike Industry 4.0, which uses cognitive computing in production facilities and produces smart factories, Industry 5.0 tries to explore ways in which humans and machines come together again and work together to increase production resources and efficiency (George and George, 2020). Although studies on Industry 5.0 are frequently discussed today, they include technological developments whose reflections on design or related fields cannot yet be predicted.

3. Product Design from Industry 1.0 to 4.0

Industrial revolutions affected all areas of life. Changes in technology and therefore in production have also caused changes in the accompanying chain elements. Pessôa and Becker (2020) state these chain elements as technology that affects the performance of production and products, production performance, sales and marketing that show the performance of new products, production processes and design. Researchers summarized how these elements were affected by

industrial revolutions in Figure 1. The dates highlighted in Figure 1 refer to the important industrial turning points that characterized each period.

In Industry 1.0, where the technology is water and steam energy, with the mechanization of production, studies have been carried out on product development and low-cost simple products have been designed. In Industry 2.0, where technology is electrical energy, new product development is focused on assembly lines and mass production lines, and more complex products are designed where branding is important. In Industry 3.0, where computer technology, information, and communication technologies are used, automation has dominated the factories, integrated product development has been given importance, and complex products with high quality and quantity that are user-centered and focused on meeting the expectations of the users have been designed. Industry 4.0, in which cyber-physical technologies are used, has brought autonomous factories to the fore and aims to design product-service systems that form a complex value chain, where mass individualization is dominant, focused on lean product development, sensing, perception are important, and create a complex value chain.

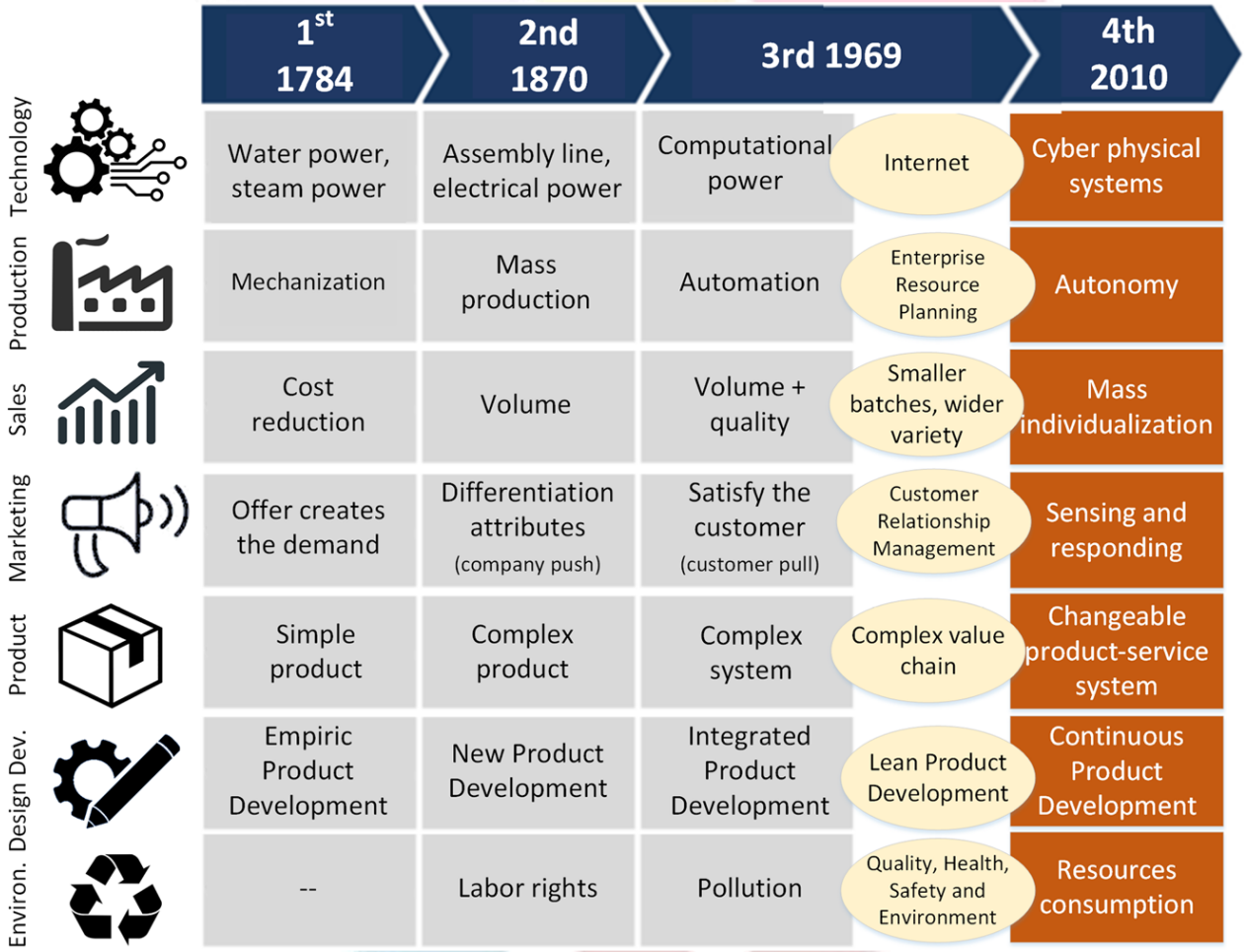

Figure 1: Changes driven by each industrial revolution (Pessôa ve Becker, 2020).

In Figure 2, the design goals of industrial designers are conveyed in connection with Figure 1. Before the 1950s, design was used to produce cheaper products by reducing production costs, after the 1950s, branding gained importance, and design was used to increase sales rates. In the first decade of the 2000s, good products and therefore good design were associated with technology and high quality. With the increase in smart products since 2015, the interface design that enables interaction between the user and the product has become important.

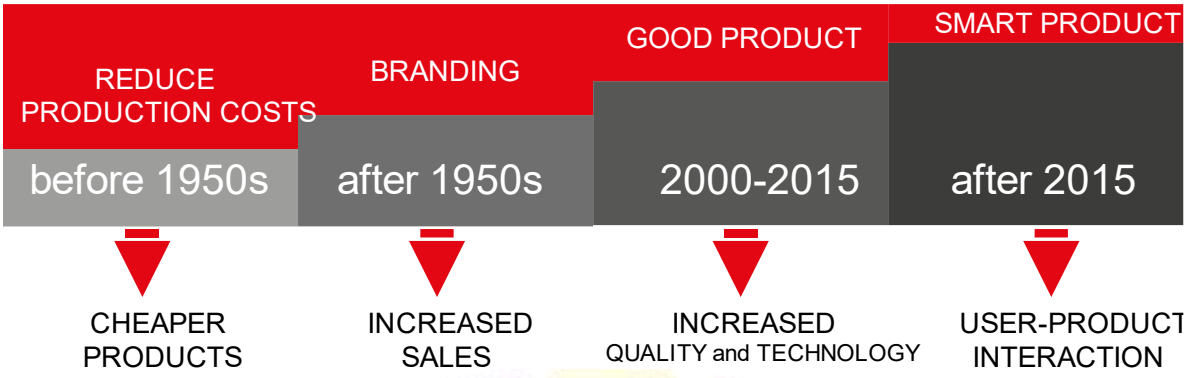

Figure 2: Expectations from industrial designers from past to present

The relationship between people and the products created by these developments has continued to change and develop. The relationship between the product and the human continues manually, mechanically, electromechanically, electronically, digitally, virtually or remotely, and today the next step of these developments, the 'sixth sense', is being discussed.

4. User and Product Interaction from Industry 1.0 to 5.0

In the study, user-product interaction was not considered as interaction design or user experience. User-product interaction, which includes the perception process, is discussed in terms of ergonomics and cognitive difficulty.

Ergonomics is the branch of science that deals with the relationship and interaction between products, objects, and people. Equipment that is designed according to ergonomic principles helps to increase the efficiency of related activities (Kaya and Erkarslan, 2018). Therefore, ergonomics practitioners and ergonomics experts work to harmonize tasks, products, professions, environments, and systems with people's needs, abilities, and limits. Ergonomics meets both physical and psychological expectations of people (Dul and Neumann, 2009). Ergonomics is classified as physical, organizational, and cognitive.

Physical ergonomics; It deals with the design of the physical environment, designs regarding the health and safety of working people, human body measurements, and the best use of the body in a working environment (Özkul and Anagün, 1996). It deals with the physical load on the human body while performing activities. It creates the standards required for appropriate design according to the user's anthropometric measurements.

Cognitive ergonomics; It deals with the mental processes of the products and human-computer interaction. Cognitive ergonomics generally addresses the issue of interface design, and research on this subject is predominantly in this direction. If it is emphasized that cognitive ergonomics covers perception, the physical elements of the product (material, color, form, texture, sound, etc.) are also important since there is a transfer of information in a product design. With these design elements, the cognitive load for the user in physical use can be reduced and the user can be guided. With these design elements, the cognitive load for the user can be reduced or increased, the user can be guided towards use, and the desired emotions/feelings can be created in the user. Just as physical ergonomics deals with the physical characteristics of the user, cognitive ergonomics deals with the user's cognition. Cognitive ergonomics is defined not only as ease of use but also as the feeling it leaves on the user.

Ergonomics is a physical and cognitive holistic approach to product design. However, until now, physical ergonomics has generally been taken into account within the scope of product design. When we look at the research in the field of cognitive ergonomics, it is seen that it is a science that deals mostly with machine interface design. The change of work with computer technology, information and communication technologies has led to the emergence of cognitive ergonomics (Hollnagel, 2001). In other words, with the change in the design of objects and their interfaces with

Industry 3.0, the need for cognitive ergonomics has arisen. Throughout industrial revolutions and technologies, the act of opening a product evolves from the visible to the invisible or from mechanical to remote access. The cognitive load on the user increases. The cognitive fitness of the user becomes more important than the physical fitness. Products contain cognitive load features more intensely than anthropometric features.

Table 2: A Nation's economic evolution (Tien, 2012)

Characteristics	Stages in a Nation's Economic Evolution		
	Mechanical	Electrical	Information
Economic Focus	Agriculture; Mining	Manufacturing; Construction	Services
Productivity Focus	Farming	Factory	Information
Technology Focus	Mechanical Tools	Electromechanical Machines	Computers; Communications
Product Life-Cycle	Decades	Years	Months
Human Power	Muscle	Muscle; Brain	Brain
Living Standard	Subsistence	Quality of Goods	Quality of Life
Impact Scope	Family; Local	Regional; National	Global
Onset in US	Late 1700s	Late 1800s	Late 1900s

Tien (2012), unlike other researchers, discussed the effects of the first 3 industrial revolutions in a different framework. The study reveals the relationship between technology focus manpower parameters and user-product interaction with technology. Tien (2012) stated in his study that the first two revolutions focused on goods and the third revolution focused on services. In Table 1, it is stated that with Industry 1.0, mechanical tools that mostly rely on muscle power are used, with Industry 2.0, electromechanical tools that mostly rely on both muscle and brain power are used, and Industry 3.0 uses computer and communication technologies and mostly relies on brain power.

Table 2: Evaluation of Product Design From Industry 1.0 to 5.0

Parameters	Evaluation of Product Design From Industry 1.0 to 5.0				
	Industry 1.0	Industry 2.0	Industry 3.0	Industry 4.0	Industry 5.0
Technology	Water and Steam Power	Electrical power	Computer (ICT)	Cyber Physical Systems (IoT)	Human-Robotics Co-working
Human Power	Muscle	Muscle-Brain	Brain	Brain	Brain-6th sense
User-Product Interaction	Manuel-Mechanical	Electromechanical-Electronic	Digital	Touch-Remote	Virtual

In Table 2, which was created based on Figure 1, Table 1 and the literature, the change in technology, manpower and product-user interaction as product design parameters in the context of this study, from Industry 1.0 to Industry 5.0, is conveyed.

It is stated in Table 2 that, with the influence of industrial revolutions and technologies, the use of muscle power in the product-user relationship has decreased and the use of brain power has increased. Another parameter listed in Table 2 is the interaction between the user and the product. In proportion to the change from muscle power to brain power, user-product interaction has evolved

as manual mechanical, electromechanical, electronic, digital, touch, remote control, and it can be said that this interaction will be virtual in Industry 5.0. Beyond physical objects, the product is designed by taking into account the service, system and their interactions with the object (Vasantha et al., 2012). Just adding services to the designed product is no longer enough; products, systems and services should be considered together from a holistic perspective (Baines et al., 2007). It can be said that the user who interacts with a physical object manually, mechanically, electromechanically, electronically or digitally will have a virtual or remote interaction in Industry 4.0, and an intangible interaction in Industry 5.0.

5. Discussion

Civilizations that changed with industrial revolutions were primarily periods when existing science was adapted to industry. The technologies used have changed throughout the industrial revolutions. The relationship between the user and the product has also changed throughout these processes. The communication and interaction change in product design tangible to intangible and the next step of these developments, the 'sixth sense', is being discussed today.

As the forms of interaction between the user and the product during the operation of the machine change from past to present, the interaction between the product and the human continues to be physical, but it gains cognitive importance. So today, mental fitness of the person has become more dominant than anthropometric fitness of the person.

Considering that cyber-physical systems and human-robot interfaces can be used with Industry 5.0, standards should be established to design easy-to-use, emotional, aesthetic, functional products, systems or interfaces that require more brain power than muscle power. Cognitive ergonomics standards or models, like physical ergonomics models, are needed to design better products or systems. There are five aspects of ergonomics: safety, comfort, ease of use, productivity/performance, and aesthetics. While physical ergonomics deals with security, comfort, performance and usability expectations, it can be said that it should be examined under the title of cognitive ergonomics for ease of use and aesthetic expectations. Designs need to be tested and analyzed by aligning them with the standards established for cognitive ergonomics. Therefore, measurable objective methods should be established for cognitive ergonomics regarding mental workload.

Standardized cognitive ergonomics models can be created when scientific monitoring methods are used together with objective tests to create scientific models within the scope of cognitive ergonomics in product design. Tools, techniques and technologies, design tools and techniques should support modeling and testing of both planned and unplanned interaction scenarios (Pessôa and Becker, 2020). In human life, where the use of digitalized objects has increased and continues to increase, it is necessary to develop models that will reduce the cognitive load according to the demographic characteristics of the user.

One of the limitations of the study is that the effects of industrial revolutions on product design have been discussed from a production and system perspective rather than a design perspective in the literature. Studies examining the historical processes of interaction between user and product in terms of ergonomics could not be identified. Sample studies should be conducted taking into account the limitations of this study.

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INVESTIGATION OF THE WORK OF ENVIRONMENTAL MEASUREMENT AND ANALYSIS LABORATORIES AND WASTEWATER TREATMENT PLANT OPERATION PERSONNEL IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY

ÇEVRE ÖLÇÜM VE ANALİZ LABORATUVARLARI İLE ATIKSU ARITMA TESİSİ İŞLETME PERSONELLERİNİN İŞ SAĞLIĞI VE GÜVENLİĞİ YÖNÜNDEN ÇALIŞMALARININ İNCELENMESİ

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Abstract

In this study, the issue of examining the working conditions and conditions of Environment and Measurement Analysis Laboratory and Wastewater Treatment Plants in terms of Occupational Health and Safety is discussed. During the examination, the occupational health and safety precautions to be taken were explained in detail for both areas, along with information about the working area and its conditions, machinery and equipment used.

Keywords: *Occupational Health And Safety, Wastewater, Standardization.*

1. Giriş

Çevre kirliliği ülkemizde önemli sorunlardan biridir [1]. Atık su ve arıtma tesislerinde çevre kirliğinin önlenmesi açısından çok ciddi değerlendirilmesi gereken bir yerdedir. Bu kapsamda bir çok [2-8] farklı çalışma yapılmıştır. Bu çalışmada, çevre ölçüm ve analiz laboratuvarlarında çalışan; Çevre Mühendisi ve diğer teknik personellerin "Baca gazı emisyon ve imisyon ile Su ve atıksu numune alımı" ölçümlerinde çalışmaları ile Atıksu arıtma tesisi işletme personellerinin "İş Sağlığı ve Güvenliği" açısından çalışmalarının incelenmesi, ilgili yönetmelik ve mevzuatlara göre değerlendirilmesi planlanmaktadır.

Bu konu hakkındaki terimler detaylı olarak aşağıda anlatılmıştır.

Çevre Laboratuvarı; Çevre ve Şehircilik Bakanlığı ile TÜRKAK tarafından onaylanmış ve denetlenmiş, almış oldukları cihaz ve teçhizata göre, Baca gazı emisyon ve imisyonları, Su ve atıksu analizleri, Arıtma tesisi çamurları analizleri, Atık yağ analizi ölçümleri gibi konulardan yetki almış kurum / kuruluşlardır. Laboratuvarlar TS EN ISO/IEC 17025 "Deney ve Kalibrasyon Laboratuvarlarının Yeterliği İçin Genel Şartlar" standardına ve şartlarına göre Akreditasyon Kurumundan (TÜRKAK) akredite olmak zorundadır [9].

Emisyon; Kelime anlamı ifadesiyle yayılım, dışarı çıkarım, ihraç anlamları bulunmaktadır. Çevresel açıdan ise üretim faaliyeti esnasında kullanılan yakıt ve benzeri ürünlerin kullanılması sonucu bacadan çıkan veya çıkabilecek paritkül, toz, ağır metal vb.… maddelerin atmosfere yayılım göstermesidir.

Emisyon Faktörü; Herhangi bir üretim/ tüketim faaliyetinden veya ekipmanından kaynaklanan belirli bir kirletici veya kirleticilerin birim hammadde miktarı, birim yakıt miktarı, birim hacim miktarı, birim zaman miktarı, birim alan veya alanlar için ortalama emisyon miktarını ifade etmektedir [10].

İmisyon; Atmosfer içerisinde teneffüs edilebilecek durumda bulunan tüm gaz ve partiküllerin tamamına denilir. Atık gazlar: Katı, sıvı veya gaz emisyonların atmosfere gaz halinde salınırlar [10]. Örnekleme; Kirletici parametrelerin, Emisyon ve İmisyon kapsamındaki ölçümlerdir.

Baca; Kirlenmiş havayı iç ortamdan veya kirleticilerin kullanılması sonucu oluşan havayı makine ve benzeri ekipmanın içerisinden vakum veya doğal yolla dışarı atılımını gerçekleştiren yapılardır.

Baca Yüksekliği; Sanayi kaynaklı hava kirliliğinin kontrolü yönetmeliğince kullanılan makine veya teçhizatın konumlandırıldığı noktaya ve ısıl gücüne göre çatıdan en az 1.50 metre olması gerekmektedir. Isıl gücü 50kW ve altında olan makine veya teçhizatlar için bu yükseklik 1.00 metre olabilecektir [11].

Yüksekte Çalışma; Belirli bir noktadan diğer bir nokta arasında dikey olarak mesafe bulunması ve düşme durumlarından kaynaklı yaralanma veya ölüm gibi durumların gerçekleşebileceği ortamlara ve çalışmalara denilmektedir.

Yüksekte Çalışma Eğitimi; Kişilerin belirli bir yükseklik farkı sonucu bu ortamlarda çalışabilmelerini sağlamak amaçlı verilen eğitimlere denilir. Çeşitli teçhizat ve ekipmanlarda alan darlığı, yüksekliği, güvenliği, korunması, kurtarılması gibi çeşitli eğitimleri kapsamaktadır. Temel, İleri seviye, Kurtarma gibi çeşitli eğitimler bulunmaktadır. Bu eğitimleri OSGB (Ortak Sağlık Güvenlik Birimleri) veya akredite olmuş kuruluşlar tarafından verilmektedir.

Su ve Atıksu Numune Alma; Çeşitli endüstri alanlarında çalışma yapan fabrika ya da firmaların kullanacakları içme ve kullanma sularının içilebilir standart değerlerinin kontrol edilmesi ile kullanmış oldukları suyun deşarj edebilmek amaçlı standartlara uygun olup olmadığının deneysel olarak ölçümünün yapılabilmesi için örnek numune alımlarını ifade etmektedir.

Ölçüm Cihazları ve Çeşitleri; Profesyonel ve akredite laboratuvarda genellikle birden çok ölçüm yapabilen ölçüm cihazları kullanılmaktadır. Cihazların doğru ölçüm yapıp yapmadığı kontrol edilir ve akreditesi sağlanır. Cihaz tip ve çeşitlerine göre; CO, SO2, O2, NO, NO2, SO2 gibi çeşitli kirleticilerin ölçümleri gerçekleştirilir. Ayrıca fabrikaların üretim çeşitliliğine göre firmalardan özel toz adı verilen ağır metal ölçümleri de gerçekleştirilebilmektedir. Bu ölçümü yapan cihazlarda da çeşitlilik mevcuttur.

Atıksu Arıtma Tesisi; Evsel veya endüstriyel olarak kullanılmış olan suların, atıksu arıtma tesisine kanalizasyonlar aracılığıyla gelmesi ve burada çeşitli proses adımları ile karşılaşması, temizlenmesi ve doğaya deşarj edilmesi amacıyla kurulmuş ya da kurulacak olan basitten karmaşık sisteme doğru yol alabilen yatırım maliyeti genellikle yüksek olan tesislerdir.

Atıksu Arıtma Tesisi İşletme Operatörü; Atıksu arıtma tesisinde işletme operatörü görev almaktadır. İşletme operatörü genellikle Çevre Mühendisliği alanından mezun olmuş olan kişilerden seçilmektedir. Atıksuyun tesise ilk girişinden temiz hale gelip çıkışına kadar tüm proses adımlarını iyi bilen, kontrol eden, izleyen, diğer personellerle iş birliği içerisinde olan kişilerdir. Atıksu arıtma tesisinde bakım ve onarım personeli ile numune alma ve izleme personelleri de yer almaktadır.

Çevre ölçüm ve analiz laboratuvarlarının Baca emisyon ve imisyon ölçümlerini gerçekleştiren teknik personellerin özellikle bu çalışma yaparken "Yüksekte Çalışma" konusunun İş sağlığı ve güvenliği açısından değerlendirilmesi ile Su ve atıksu numune alımı yapan personellerin iş sağlığı ve güvenliği yönünden karşılaştıkları sorunlar, Atıksu arıtma tesisi işletme personellerinin bakım onarım ve çalışma ortamlarından iş sağlığı ve güvenliği yönünden incelenmesi amaçlanmaktadır.

2. Materyal ve Metod

Laboratuvarlar; sahada aktif olarak çalışan Mühendis veya teknik personellerin güvenliğini ve sağlığını korumak zorundadırlar. Sahada çalışan personellerin kişisel koruyucu donanımlarını (baret, maske, eldiven, çeşitli kurtarıcı ve koruyucu halatlar, işe uygun gözlük) temin ve tedarik etmek zorundadırlar. Sahada aktif olarak çalışacak personellere yüksekte çalışma eğitimi, çatıda ve bacada çalışma eğitimleriyle uyulması gereken kuralların bildirilmesi gerekmektedir.

Düşme gibi durumlarda ciddi sorunlar ve ölüme yol açabilen durumlarla karşılaşılmaktadır.

Ayrıca Laboratuvarlar baca gazı emisyon ve imisyon personellerinin haricinde sadece laboratuvar ortamında çalışan personellerinde aynı şekilde kişisel koruyu donanımlarını temin etmek zorundadır.

Her iki çalışma ortamında acil durumlara müdahale için ilk yardım malzemelerinin bulundurulması gerekmektedir. İlk yardım malzemelerinin kullanım yöntemleri ve uygunlukları kontrol edilmelidir. Kullanılacak kimyasal malzemeler ile makine ve ekipmanların kullanım kılavuzları, malzeme güvenlik bilgi formları, bakım ve onarım bilgi formları bulundurulmalıdır.

İşin yapılacağı alan veya alandaki emniyet koşullarının risk içeren durumda olması veya ölçüm/analiz metodunun yapılabilmesi için gerekliliklerinin sağlanmaması durumlarında, numune/numuneler alma, örnekleme veya ölçümü yapılamayan/uygunsuz kaynaklarla ilgili durumun tutanak alınarak ve karşılıklı imzalanması zorunludur.

Atıksu Arıtma Tesisinde İş Sağlığı ve Güvenliği; İlerleyen adımlarda bu konu ayrıntılı olarak işlenecek olup, Atık Su Arıtma Tesisleri (AAT) de çeşitli makine ve ekipmanlar, elektrik donanımları, laboratuvarlar gibi birbiri ile ilişkili çalışma ortamı bulunmaktadır. Makine ve ekipmanlar her adımda farklılık göstermekte olup bunların bakım ve onarımları, elektrik donanımlarının yerinde olması ve tehlike içermemesi, laboratuvarların ortam güvenliği ile atıksu ile çalışılmasından ötürü kişisel koruyucu donanımların kullanılması gerektiği adımlarını izlemektedir.

Malzeme Güvenliği; Çalışma ortamı veya çalışma ortamına ulaşmada çıkabilecek herhangi bir sorun veya sorunlar toplamında personel güvenliği öncelikli durumdadır, ancak personel güvenli durumunu sağlamış ise kullanılan makine ve ekipmanlarında güvenliği sağlanmalıdır. Ayrıca düşme veya benzeri durumlarda malzemenin güvenliğinin haricinde aşağıda bulunabilecek insanlarında güvenliğinin sağlanması gerekmektedir. Bu durumlardan kaynaklı personelin, malzemenin, aşağıda yer alabilecek insanların ve diğer nesnelerin güvenliğinin sağlanması gerekmektedir.

Baca gazı analizi; bir bacadan atmosfere salınmakta ve atılmakta olan gazlar ve partiküller, bacanın emme verimi ve hızları, bacanın sıcaklığı, bacanın debisi, baca havasının katsayısı gibi çeşitli bilgileri öğrenmek amacıyla yapılan ölçümlerdir. Bu ölçümler denetlenmek üzere veya bilgi amacıyla da yaptırılabilmektedir.

Yakma Isıl Gücü- Isıl Güç- Yakıt Isıl Gücü ve Anma Isıl Gücü; Bir yakma proses tesisinde birim zamanda yakılan yakıt veya yakıtların miktarının yakıt alt ısıl değeriyle çarpılması ve bunun sonucu bulunan KW, MW birimleri ile asıl güç değerinin hesaplanmasıdır (http://esider.org.tr).

Baca gazı analizi, ölçümü sırasında fotoğraflar yazar tarafındn çekilmiş olup, aşağıda bilgi amaçlı yer almaktadır. Baca gazı analizi Toz ölçümü görüntüsü Şekil 1'de ve baca analizi için boy ölçümü Şekil 2'de gösterilmiştir.

Şekil 1. Baca Gazı Analizi – Toz ölçümü

Şekil 2. Baca Analizi İçin Bacanın Boy Ölçümü

3. Bulgular

Baca gazı ölçümlerinde çatıya/bacaya güvenli ulaşımı değerlendirildiğinde; Laboratuvar personelleri baca gazı ölçümü yapılacak olan fabrika/firma veya işletmeye ulaştıkları zaman bacaya ulaşım için yetkili tarafından gösterilen uygun yol ve yöntemi değerlendirmeye almaktadırlar. Yüksekte çalışmalar ve düşmelere karşı firma yetkilileri ve laboratuvar personelleri görevlerini net ve açık şekilde bildirmelidirler.

Çatıya veya bacaya çıkışta güvenli bir şekilde ulaşım için, bina içerisinden bir ulaşım yolu yok ise dışarıdan otomatik yükseltilebilir kaldıraçlar, forkliftler ile çıkışları gerçekleştirilebilmektedir. Ancak bu yol kullanıldığında kişilerin emniyet halatı gibi koruyucular ile kendilerini güvene almaları gerekmektedir.

Atıksu arıtma tesislerinde iş sağlığı ve güvenliği değerlendirildiğinde; 37.00.01 NACE koduyla çalışma gerçekleştiren işyerlerinde (Kanalizasyon (kanalizasyon atıklarının uzaklaştırılması ve arıtılması, kanalizasyon sistemlerinin ve atıksu arıtma tesislerinin işletimi, fosseptik çukurların ve havuzların boşaltılması ve temizlenmesi, seyyar tuvalet faaliyetleri vb.) 2015-2017 yılları arasında bu NACE koduyla çalışma gerçekleştiren ve iş kazaları ile SGK (Sosyal Güvenlik Kurumu) İstatistik Yıllıkları verileri aşağıda yer almaktadır. AAT Eğitim Modülü 2015-2017 yılları arasındaki [12] SGK iş kazası verileri Çizelge 1'de verilmiştir.

Çizelge 1:SGK İŞ Kazası Verileri

YIL	İŞ KAZASI GEÇİREN SİGORTALI SAYISI	ÖLÜMLÜ İŞ KAZALI SAYISI
2017	423	2
2016	353	3
2015	211	4
TOPLAM	987	9

Yukarıda yer alan veriler sadece Atıksu arıtma tesisinde oluşmuş olan kaza verileri değildir. Bu veri bilgisi yukarıda belirtilen NACE kodunun tümünü kapsamaktadır.

Atıksu arıtma tesisi içerisinde meydana gelen kazaların incelenmesi amacıyla aşağıda Çizelge oluşturulmuş olup, yukarıda yer alan verilerden yola çıkılmıştır.

Çizelge 2. İş Kaza Oran Dağılımı Verileri [12].

PROSES BÖLÜMÜ	**KAZALARIN DAĞILIMI (%)**
Tesis Geneli	52,86
Bakım Onarım	11,45
Çamur Susuzlaştırma	8,02
Ön Çökeltme, Havalandırma, Sön Çökeltme ve Bio-P Havuzları	6,49
Terfi Merkezi	5,34
Kaba ve İnce Izgara	4,20
Atölye	2,86
Kum ve Yağ Tutucu Havuzlar	1,91
Depo	1,53
Dezenfeksiyon	1,34
Laboratuvar	1,15
Duşlar ve Soyunma Odaları	0,95
Koku Giderme Ünitesi	0,76
Blower binası	0,57
Çamur Yoğunlaştırma	0,57

Bu kapsamda gerçekleşen kazalar genel olarak 14 grubu kapsamakta olup aşağıda detaylı olarak anlatılmıştır. Tesis Genelinde Kazalar: Yukarıda yer alan verilere göre tesis genelindeki kazaların oranı en yüksek oran durumundadır. Bu oran ayrıntılı incelendiğinde tesis genelinin açık hava ile temasından kaynaklı korozyon, buzlanma, ızgara ve korumalıkların tam yerleştirilmemesi, personelin dikkatsizliği gibi nedenlerden kayma ve düşme çok fazla görülmektedir.

1. Bakım ve Onarım Safhasında Kazalar: Bakım ve onarım işlerinde gerçekleşen kazalar oran olarak ikinci sırada yer almaktadır. Ekipmanların bakımı ve onarımı sırasında parçaların sökümü, dar alanda çalışma, korumalıkların sağlam olmaması, malzeme ve ekipmanların düşmesi, personellerin kişisel güvenliğini almaması gibi konulardan kaynaklı kazalar meydana gelebilmektedir.
2. Çamur Susuzlaştırma İş ve İşlemlerinde Kazalar: Çamur susuzlaştırma işlemlerinde ilk olarak bakım onarım sırasında uzuv sıkışması, takılma ve düşme gibi konulardan kazalar meydana gelmektedir. Ancak sistem çalışır durumda iken; göze çamur ve toz kaçması, kayma ve düşme, çarpma sonucu yaralanma, merdivenlerden inip çıkarken düşmeler, kişisel koruyucu donanımların kullanılmaması gibi durumlar kazalara sebebiyet vermektedir.
3. Havuz ve sistemlerinde karşılaşılan kazalar: Havuzların kontrolü amaçlı iniş ve çıkışlarda kayma ve düşmelerden kaynaklı kazalar en çok görülen kazalardır ancak Havuz sistemlerine müdahale ya da bakım onarım yaparken de çeşitli kazalar olmaktadır. Bunlar; mikser pompa ve vinçlerin denetimleri yapılırken kazalar, kimyasal maruziyetleri, elektrik çarpması, söküm işlerinde yaşanılan sıkışma ve burkulma kazalarıdır. Bunlara karşı ilk olarak önlem veya önlemler alınmalıdır.
4. Su terfi merkezlerinde olabilecek kazalar: Atıksuyun tesise giriş gerçekleştirdiği ve süregelen sistemlere verildiği ilk merkezdir. Burada terfi sistemleri bulunmaktadır. Yaşanabilecek kazalar; uzuv sıkışması yaralanma ve burkulma, elektrik çarpması, kişisel koruyucu donanımların düzgün kullanılmaması veya ihmal edilmesi gibi çeşitli sebepleri bulunmaktadır.
5. Termal Konfor ve Şartlar; Atıksu arıtma tesisleri genel anlamda idari bina hariç açık alanda çalışma gösterilen ortamlardır. Bundan dolayı, sıcaklık soğukluk, nemi hava akımları gibi etkenler çalışma gösteren kişilerin sağlığı ve iş yapma durumlarını etkilemektedir. Koruyucu kıyafetler ve donanımların kullanılması gerekmektedir.
6. Kaba ızgara ve ince ızgaralarda gerçekleşebilecek kazalar: Burada atıksuyun iri taneli atıklardan kurtulması amaçlanır ve burada tutulan atıklar çeşitli konteynerlere konulmaktadır. Bu konteynerlerin düşmesi kazaya sebebiyet verebilir. Izgaraların bakımı ve onarımı sırasında kesilme, burkulma kazaları olabilmektedir.
7. Atölyelerde meydana gelebilecek kazalar: Atölyelerde kullanılan el aletleri; çekiç, çivi, tornavida vb.… gibi malzemelerin kullanımı sırasında meydana gelebilecek kazalar bulunmaktadır. Kullanımlar sırasında dikkat edilmeli ve koruyucu ekipmanlar kullanılmalıdır.
8. Kum tutucu ve yağ tutucularda meydana gelebilecek kazalar: Bu kısımlar genelde kaygan olmasından kaynaklı kazalar meydana gelebilmektedir. Ancak diğer sebeplere bakılacak olursa, burada pompa kullanımı mevcuttur ve pompanın taşınması sırasında kazalar meydana gelebilmektedir ayrıca merdivenden inip çıkarken düşme gibi kazalarda muhtemeldir. Kişisel anlamda dikkat edilmelidir.
9. Depo alanlarında meydana gelebilecek kazalar: Depolarda en çok görülen kazalar genel olarak zeminden kaynaklı kayma ve düşme kazalarıdır. Ancak dikkatsizliklerden kaynaklı uzuv sıkışması, el aletleri kullanımlarından kaynaklı kazalar da meydana gelebilmektedir.
10. Dezenfeksiyon işlemlerinde kazalar: Bu alanda suyun dezenfeksiyonu çeşitli kimyasallarla gerçekleştirilmektedir. Bu nedenden dolayı burada görülen kazalar kimyasal maruziyeti, el

aletleri kullanımından kaynaklı kazalar, Ultraviyole bölgesinde ışına maruz kalma, düşme ve çarpma kazaları görülebilmektedir.

11. Atıksu arıtma laboratuvarında kazalar: Kimyasalların kullanımından kaynaklı kimyasal maruziyeti en fazla görülebilecek kazalardandır. Aynı zamanda aletlerin düşmesi kaynaklı yaralanmalar mevcut olabilir. Alanın genişliği ve ferahlık durumuna göre çeşitli darbelerden de korunulabilir.
12. Koku giderme işlemlerinde kazalar: Koku giderme ünitesinde çeşitli kimyasallar kullanılarak işlemler gerçekleştirilmektedir. Meydana gelebilecek kazalar ve rahatsızlıklar kimyasal kaynaklı olmaktadır.
13. Blower ünitesinde kazalar: Blower ünitesinde özellikle bakım ve onarım esnasında kazalar meydana gelebilmektedir. Elle kaldırma ve taşıma sonucu yaralanmalar, el aletlerinin kullanımları sırasında ki kazalar ve uzuv sıkışması incinmesi meydana gelebilmektedir.
14. Çamur yoğunlaştırma ünitesinde kazalar: Atıksuyun içerisinde yer alan kum veya çamurumsu yapının biriktirildiği ve yoğunlaştırıldığı ünitelerdir. Burada yoğunlaştırma esnasında polielektrolitlerin kullanımları fazladır. Yaşanabilecek maruziyetlerden kaynaklı kazalar olabilmektedir. Aynı zamanda hareket halinde bulunan köprüde uzuv sıkışması gibi nedenlerden kaynaklı kazalar olabilmektedir.

Atıksu arıtma tesislerindeki riskler ve etmenleri; 11 ana gruba ayrılmış olup Çizelge 3'de verilmiştir.

Çizelge 3. Atıksu arıtma tesislerindeki riskler ve etmenleri

1	Kimyasal riskler ve etmenler
2	Malzeme Güvenlik Bilgi Forumları ve Önemi
3	Fiziksel Riskler ve Etmenler
4	Gürültü ve Önlemler
5	Termal Konfor ve Şartlar
6	Biyolojik Riskler ve Etmenler
7	Ergonomik Riskler ve Etmenler
8	Gaz veya Gazların Tehlikeleri
9	Kişisel Hijyen Dikkati ve Sağlığın Korunması
10	Laboratuvarda Çalışma ve Güvenlik Önlemleri
11	Yaya ve Araç Güvenlikleri

İş sağlığı ve güvenliği kapsamında Atıksu arıtma tesislerinde çalışma ve güvenlik prensipleri belirlenmeli ve bu belirlenmiş olan prensiplere uyulmalıdır. Uyulması konusunda ise iç denetimler ve eğitimler verilmelidir. Atıksu arıtma tesislerinde yukarıda anlatılmış olan muhtemel kazalar ile ilgili risk etmenleri bulunmaktadır. Risk etmenlerini kurallara uyum, kişisel koruyucu donanımlar ve tehlike durumlarının ortaya çıkmadan engellenmesi gibi hususlara dikkat ederek yok edilmesi sağlanabilir.

Çok tehlikeli sektörde/sektörlerde yer alan atıksu arıtma tesislerinde oluşan veya oluşabilecek olan sağlık risklerine maruz durumda kalabilecek kitle; makine ve ekipman bakım onarım işlerinde çalışan personeller, inşaat yapıları ve onarımları işlerinde çalışan personeller, elektrik ve elektronik işlerinde çalışan personeller, iş makinelerini kullanan operatörler ve yardımcı personeller, temizlik çalışanları, mühendisler ve laborantlar, denetçiler, güvenlik görevlileri, çevrede yaşayan insanlar, sahaya giren hayvanlar ve bunlarla temas halinde olan veya olabilecek kişiler olarak sıralanabilir. Sağlık riskleri ise virüsler, mikroorganizmalar, mantarlar, ağır metaller, zehirleyici ve boğucu gazlar, tehlikeli kimyasallar, tozlar olarak sıralanabilir.

Atıksu arıtma tesislerinde karşılaşılan önemli risklerden bazıları; Gürültü maruziyetleri (Makine ve ekipmanlar kaynaklı), Bulaşıcı çeşitli hastalıklar (Bakteri ve virüs ortamları), Cilt, solunum hastalıkları (Çamur kurutma ortamları), Havuzlara ve tanklara kayma sonucu düşmeler, Çeşitli gaz maruziyetleri olarak sıralanabilir [13].

Kimyasal riskler ve etmenler: Atık suyun deşarj edilebilir hale getirilme iş ve işlemlerinde çeşitli kimyasallar kullanılmaktadır. Bundan kaynaklı çeşitli kimyasal maruziyetler ile karşı karşıya gelinebilinmektedir. Klor, Hidrojen sülfür ve peroksitler, asetik asit, dihidroklorik asitler gibi örnekler verilebilir. 2013 yılında Kimyasal maddelerle çalışmalarda sağlık ve güvenlik önlemleri hakkında yönetmeliğe uygun şekilde çalışma ortamları hazırlanmalıdır. Atıksu arıtma tesislerindeki kullanılan kimyasallar ve tehlikeleri beş madde de değerlendirebiliriz. Bunları;

a. Tehlikeli miktarlarda ve derişimler de katı maddeler
b. Sıvılar, Buharlar, Gazlar
c. Boğulmalara sebep olabilecek oksijen yetersizlikleri
d. Yangın ve patlamalara yol açan gazlar veya buharlar
e. Görünen veya görünmeyen toz parçacıkları olarak sınıflandırabiliriz.

Tesis içinde veya laboratuvarlar da kullanılan kimyasallarla ilgili hazırlanmış olan, Malzeme güvenlik bilgi formları (MSDS)'lerin açık bir yerde ve herkesin görebileceği şekilde yayımlanması gerekmektedir. Aksi bir durum söz konusu olduğunda müdahale yöntemleri buradan kontrol edilebilmektedir. Kimyasal malzemelerin bulunduğu alana uygun bilgilendirici yazlar asılmalıdır. Kimyasalların kullanımları esnasında minimum düzeyde kullanım sağlanmalıdır, ihtiyaç fazlası alınmamalıdır. Kimyasallarla çalışma öncesinde uygun kişisel koruyucu donanımlar kullanılması ve gerekli işlemlere bu şekilde başlanılmalıdır. Çeşitli sorunlara karşı acil durum eylen planları hazırlanmalı ve bunların bilgilendirmeleri ile eğitimleri personellere sağlanmalıdır.

Malzeme Güvenlik Bilgi Forumları ve Önemi: Atıksu arıtma tesislerinde kullanılan veya kullanılabilecek tüm kimyasalların malzeme güvenlik bilgi formları hazırlanmış olmalı ve tesiste çalışan herkesin ulaşabileceği bir noktada olmalıdır.

Herhangi bir kimyasal ile çalışma esnasında meydana gelen veya gelebilecek kazalara karşı alınacak önlemler bu formlarda yer almaktadır. Kullanılan kimyasalın yayılma hızı, kokusu, reaksiyona girme durumu, biriktirme yol ve yöntemleri bu formda yer almaktadır.

Çevre ve Şehircilik Bakanlığı tarafından 2014 yılında yürürlüğe giren "Zararlı maddeler ve karışımlara ilişkim güvenlik bilgi formları" hakkında yönetmeliğinde belirlenen şekilde malzeme güvenlik bilgi formları hazırlanmalıdır.

Atıksu arıtma tesislerinde sık kullanılan kimyasallar ve tehlike bilgileri aşağıdaki gibidir;

1. Klor gazları: Yeşilimsi sarı renkte bir gazdır, Tahriş edicidir, Oksijen beslemeli maskeler kullanılmalıdır.
2. Kostik Sodalar: Akıcı ve sıvı haldedir, Kimyasal yanıklar oluşturur, Eldiven ve koruyucu maske kullanılmalıdır.
3. Sülfürik asitler: Sıvı haldedir ve düşük ph'lıdır, Kimyasal yanıklar oluşturur, Eldiven ve koruyucu maske kullanılmalıdır.
4. Hidroklorik asitler: Sıvı haldedir ve düşük ph'lıdır, Kimyasal yanıklar oluşturur, Eldiven ve koruyucu maske kullanılmalıdır.
5. Karbondioksitler: Kokusuzdur, Boğulma meydana getirir, Oksijen beslemeli maskeler kullanılmalıdır.
6. Karbon monoksitler: Renksiz, kokusuz ve tatsızlardır. Boğulma, yanıcı ve patlayıcı özelliklidir. Oksijen beslemeli maskeler kullanılmalıdır.

7. Metanlar: Renksiz, kokusuz ve tatsızlardır. Boğulma, yanıcı ve patlayıcı özelliklidir. Oksijen beslemeli maskeler kullanılmalıdır.
8. Hidrojen Sülfürler: Çürük yumurta gibi kokusu vardır, Birkaç dakika içinde ölümler olur. Oksijen beslemeli maskeler kullanılmalıdır.
9. Hidrojenler: Renksiz ve tatsızlardır, Boğulma meydana getirirler, Havalandırma sağlanmalıdır.

Fiziksel Riskler ve Etmenler: Atıksu arıtma tesislerinde çalışılan ve yaşanılan ortamların; sıcaklık, gürültü, basınç, titreşim, aydınlatma, nem, radyasyon gibi fiziksel özelliklerin insan sağlığını nasıl etkilediğinin belirlendiği maddedir.

Atıksu arıtma tesisleri genel olarak açık hava alanlarında çalışılan ortamlardır, sıcaklık en büyük etkendir. Çeşitli makine ve ekipmanların entegre çalışması gürültünün yüksek olduğu ortamları oluşturur. Özellikle akşamları da aktif çalışmaların gerçekleşmesinden ötürü aydınlatmaların da önemli olduğu tesislerdir. Bu riskler ve etmenler göz önünde bulundurularak önlemler ve çalışma ortamları hazırlanmalıdır.

Gürültü ve Önlemler: Atıksu arıtma tesislerinde kullanılan ya da kullanımı paslanmış olan makine ve ekipmanlar belirli bir gürültü çıkarırlar ve bu gürültülerden korunmak için gürültü absorblayıcı kulaklıklar kullanılmalıdır. Gürültüden kaynaklı psikolojik etkiler söz konusu olabilmektedir. İşitme kayıpları ise en çok görülen sorunlardandır. Havalandırma blowerleri, dekantör ve çamur kurutucular, pompalar en çok gürültü oluşumunun söz konusu olduğu makine ekipmanlardır.

Termal Konfor ve Şartlar: Atıksu arıtma tesisleri genel anlamda idari bina hariç açık alanda çalışma gösterilen ortamlardır. Bundan dolayı, sıcaklık soğukluk, nemi hava akımları gibi etkenler çalışma gösteren kişilerin sağlığı ve iş yapma durumlarını etkilemektedir. Koruyucu kıyafetler ve donanımların kullanılması gerekmektedir.

Biyolojik Riskler ve Etmenler : Biyolojik riskler ele alındığında ve incelendiğinde, atıksuyun içerisinde virüsler, bakteriler bulunmaktadır. Atıksular ayrıca çeşitli mikroorganizmaları da içermektedirler.

Atıksu arıtma tesisinde biyolojik etmenler;

Biyolojik etki gösteren aerosoller, Enfeksiyon hastalıklarına yol açan mikroorganizmalar, Temas yoluyla kapılabilecek hastalıklar ve kimyasallar, Çeşitli patojenler (bakteri, virüs, protozoa, mantar vb…)

Ergonomik Riskler ve Etmenler: Atıksu arıtma tesislerinde yük taşıma ve kaldırma, bakım onarım işlerinde en fazla yapılan işlerdir. Bu sırada vücudun fazla yük yüklenmesinden kaynaklı ergonomik riskler ve problemlerle karşı karşıya kalınabilmektedir. Yük taşıma ve kaldırma işlemlerinde makine ve ekipman destekleriyle işlemlerin yapılması daha sağlıklı olmaktadır.

Gaz veya Gazların Tehlikeleri: Atıksu arıtma tesislerinde suyun temizlenmesi süreçlerinde çeşitli kimyasallar bulunmaktadır ve bu kimyasalların kullanımları sırasında çeşitli türde gazlar çıkabilmektedir. Ayrıca çamur kurutma iş ve işlemlerinde güneş enerjisinin direkt kullanımı söz konusudur. Burada kirli hava oluşmaktadır. Kişisel koruyucu donanımlar ile korunma sağlanmalıdır.

Kişisel Hijyen Dikkati ve Sağlığın Korunması: Teknik ve idari personellerin dikkat etmesi gereken sağlık hususları; elleri iyi yıkamak ve gözlerden ağızdan uzak tutmak, Tırnakların uzun olmaması ve arasına herhangi bir yabancı madde girişinin engellenmesi, Herhangi bir yaralanma durumunda verilen ilaç ve diğer maddelerin düzenli kullanılması ve korunmak, çalışma esnasında eldiven ve giysi gibi kişisel koruyucu donanımların aktif olarak kullanılması, İş çıkışında mümkün ise duşa girmek ve temizlenmenin sağlanması, İş kıyafetlerinin iş çıkışında veya sonunda çıkarılması ve düzenli olarak yıkanması temizliğine özen gösterilmesi gerekmektedir.

Laboratuvarda Çalışma ve Güvenlik Önlemleri: Kişiye veya ortama zarar veren/ verebilecek uçucu kimyasallar kullanırken, yalnızca havalandırmalı bir ortamda kullanmaya dikkat etmek gereklidir. Yanıcı ve patlayıcı sıvıları düzgün bir alanda ve patlamaya dayanıklı bir alanda depolamak gerekmektedir. Kimyasalları direkt çıplak elle tutmamak gereklidir. Uygun malzemeler kullanılarak; eldiven, maşa gibi... kimyasallar ile çalışma yapılabilir. Çalışma esnasında gözlere kimyasal sıçraması gibi durumlarla karşılaşıldığında acil göz yıkama istasyonu bulunmalıdır ve laboratuvarda duş almak için alan olmalıdır. Alanda bu şekilde imkanlar yok ise göz yıkamak için şişeler bulundurulmalıdır. Pipetler ile çalışma gerçekleştirileceği zaman otomatik emmeli pipetler kullanılmalıdır. Ağız yoluyla emme yapılmamalıdır. Laboratuvarlarda yemek yeme, sigara içme gibi durumların yapılmaması sağlık açısından ve güvenlik açısından önemlidir. Acil müdahale ekipmanlarının ulaşılabilir olması gerekmektedir. Akma, sızıntı gibi durumlara karşı dikkat edilmeli ve acil müdahale kartlarının görünür yerde olmasıyla, eğitimlerinin verilmesi de ayrıca gereklidir. İş sonrası ise, eller yıkanmalı, eldivenler kutusuna atılmalı ve dikkat edilmelidir.

Yaya ve Araç Güvenlikleri: Çalışma yerleri ve alanları mümkün olduğunca direkt yollarla ulaşılabilir olmalıdır. Yollar düzgün olmalı ve boru hatlarıyla birlikte vanaların çalışmasını engellememelidir. Köprüler kullanılarak geçişler kolaylaştırılmalıdır. Zemin kolay temizlenebilir olmalı. Zemin kaplamaları kaygan hal oluşturmamalıdır. Zemin bozulmalara karşı dayanıklı olmalıdır bu durum göz önünde bulundurularak yapılmalıdır. Zemin döşemeleri bitişik yapılmalı ve aralarında boşluklar olmamalıdır. Yüzeyler her türlü hava koşullarına uygun yapılmalıdır. Acil bir durum yaşandığında yollara konulan güvenlik kapıları ve barikatları dışarıya doğru açılmalıdır. Ulaşım yolları prosesler arası geçişlerde sorun yaşatacak şekilde olmamalıdır. Havuzların içine düşme tehlikesi bulunduğundan kaynaklı koruyucu korkuluklar yapılmalıdır.

Atıksu arıtma tesislerinde tehlike durumları ve önlemler değerlendirildiğinde bunları 7 farklı kategoride değerlendirmek mümkündür. Bu önemleler başlıklar halinde Çizelge 4'de verilmiştir.

Çizelge 4. Atıksu arıtma tesislerindeki riskler ve etmenleri

1	Kaba ve İnce Izgaralarda Tehlike Durumları ve Önlemleri
2	Atıksu Terfi İstasyonlarında Tehlike Durumları ve Önlemleri
3	Kum ve Yağ Tutucu Ekipmanlarında Çalışmada Tehlike Durumları ve Önlemleri
4	Ön Çökeltme, Havalandırma ve Son Çökeltme Havuzlarında Tehlikeler ve Önlemleri
5	Pompa İstasyonlarında Tehlikeler ve Önlemleri
6	Laboratuvarlarda Tehlikeler ve Önlemleri
7	Tesis Genelinde Tehlikeler ve Önlemleri

Kaba ve İnce Izgaralarda Tehlike Durumları ve Önlemler: Izgaraların tıkanmasında elle müdahale halinde, biriken katı atıklarının uzaklaştırılması sırasında biyolojik ajanlara maruziyetler tehlike durumlarıdır.

Izgaralarda mümkünse mekanik olarak temizlemeli ızgara sistemi kullanılmalıdır. Çalışanlara koruyucu su geçirmez iş elbisesi, uygun solunum koruyucu maskeler, gözlük ve eldivenler temin edilmelidir. Koruyucu giysiler de dahil olmak üzere biyolojik ajanlarla kirlenmiş olabilecek giysiler ve koruyucu ekipmanlar, çalışma alanından ayrılmadan hemen önce çıkarılmalıdır. Diğer giysilerden ayrı bir yerlerde muhafaza edilmelidir. Sağlık taramaları da periyodik olarak yapılmalıdır.

Izgaraların bakım ve onarımlarında döner parçalara ve konveyör bantlara uzuvların sıkışması tehlike durumlarındandır.

Ekipmanlara makine koruyucular takılmalı ve konveyör bantlara ise ipli acil durdurma emniyet şalterleri takılması gerekmektedir. Çalışma talimatları makinelerin çeşitlerine göre hazırlanmalı ve çalışanlara gerekli bilgilendirmelerle eğitimler verilmelidir.

Hidrojen sülfür gazıyla, metan ve karbondioksit gazlarına maruziyetler tehlike durumlarındandır.

Çalışma yapılmadan önce seyyar gaz ölçüm cihazları ile gaz konsantrasyonu ölçülmelidir. Cihazların kalibrasyonu düzgünce yapılmalı ve ölçüm yapacak personellere eğitimlerin verilmesi gerekmektedir. Havalandırmalar yapılmalı ve maske kullanımına dikkat edilmelidir.

Koku ve haşere maruziyetleri tehlikelilik durumlarındandır.

Konteyner da toplanan ızgara atıklarının en kısa sürede bertarafı sağlanmalıdır. Çalışanlara uygun koruyucu donanımlar temin edilmelidir.

Atıksu Terfi İstasyonlarında Tehlike Durumları ve Önlemler: Pompaların çalışmasından kaynaklanan gürültü maruziyetleri tehlike durumlarıdır.

Pompa ve ekipmanlarının periyodik bakımları zamanında yapılmalıdır. Pompa ve ekipmanlarının ses yalıtımları sağlanmalıdır. Çalışan özellikle teknik personellere kişisel kulak koruyucu ekipmanları temin edilmelidir.

Giriş ünitelerinin başlangıç noktası kuyu diplerinde bulunan ızgaraların temizlikleri veya pompa arızalarına yapılan işlemler sırasında ortaya çıkabilecek gaz maruziyetleri tehlike durumlarındandır.

Bu alanlarda çalışma yapılmadan önce seyyar gaz dedektörleri konulmalı ve uyarıları dikkate alınmalıdır. Bu alanda sabit havalandırma sistemleri bulunmalı ve gaz sensörlerinin de ayrıca sorunsuz çalıştığı kontrol edilmelidir. Çalışma yapan personellere kişisel koruyucu maskeler ve ekipmanlar temin edilmelidir.

Kapalı olan alanlarda bakımlar, onarımlar ve temizlik çalışmalarında tehlike ile karşılaşılabilecek durumlar mevcut olmaktadır.

Kapalı alanlarda çalışma yapılmadan evvel uyarı işaretleri asılmalı ve bu işaretler görünür yerde olmalıdır. Çalışma yapılmadan evvel çalışma talimatları hazırlanmalıdır. Çalışmayı yapacak personellere oksijen destekli maskeler verilmeli ve kullanımları kontrol edilmelidir.

Çalışan personellere kapalı alanlarda çalışma ile gaz ölçümü ve uyarıları konularında eğitim verilmelidir.

Kum ve Yağ Tutucu Ekipmanlarında Çalışmada Tehlike Durumları ve Önlemler: Özellikle endüstriyel kullanım atıksularının birbirine karışması halinde uçucu organik bileşiklere maruz kalma durumlarında sorunlar olabilmektedir.

Havalandırmalı kum tutuculara havalandırmadan dolayı Uçucu Organik Bileşiklerin oluşumlarına dikkat edilmelidir. Uçucu Organik Bileşiklerin oluşumu, çalışan personeller için sağlık riski teşkil etmektedir. Bu alanların üzeri kapalı tutulmalı ve güvenliğin ilk adımı bu şekilde alınmalıdır.

Havuzlara düşme ve kayma durumları tehlike durumlarındandır. Alınması gereken önlemler olarak, Temizliklerin sıklığı artırılmalı, çalışanlara tabanı kaydırmayan iş ayakkabısı verilmelidir. Kayma ve düşmelere karşı uyarı levhaları asılmalıdır. Yürüme platformlarının üzerinde yapılacak çalışmalar ve kontrollerde emniyet kemerleri takılmalıdır. Yüksek alanlarda korumalıklar olmalı ve kontrolleri sağlanmalıdır.

Açık havada ve alanlarda yapılan çalışmalar sırasında, mevsimlere uygun iş kıyafetleri kullanılmalı ve mevsimlere göre iş planlamaları yapılmalıdır. Aşırı soğuklara karşı sıkı giyim ve korumalı eldiven ve diğer teçhizatlar kullanılmalıdır. Güneş etkisinden korunmak içinde kremler ile kişisel koruyucu donanımların kullanımları sağlanmalıdır.

Çalışanlara uygun iş kıyafetleri ile kişisel koruyucu donanımlar verilmeli, iş kıyafetlerinin yıkanması sırasında gerekli koşullar sağlanmalıdır. Kirliliklerin başka yere taşınması önlenmelidir. Çalışanların temizliği için duş alması amaçlı gerekli koşullar sağlanmalıdır. Atıksuyun yutulması durumunda acil müdahale talimatları uygun noktalarda asılmalı ve uygumalar yapılmalıdır.

Ön Çökeltme, Havalandırma ve Son Çökeltme Havuzlarında Tehlikeler ve Önlemler: Zemin kaynaklı kaymalar, düşmeler tehlike ve önlemleri, Havuz etrafında köpüklerin taşması, kış aylarında buzlanma, kimyasal dökülmesi gibi durumlardan kaynaklı aralıklı temizlikler yapılmalıdır. İlgili uyarı levhaları görünür yerlere asılmalı, çalışanlara ise tabanı kaymayan iş ayakkabıları verilmelidir.

Temizlik ve bakım faaliyetleri sırasında havuzlara düşmelerde tehlikeler ve önlemler, Havuzlara çıkan merdivenlerin düşmeyi engelleyecek şekilde tasarlanması gereklidir. Havuzlara düşmeyi engellemek için korkuluk sistemleri kullanılmalıdır.

Dip çamurunun uzun süre beklemesi sonucunda oluşan gazlara maruziyetler, havuzların dip kısmında biriken çamurların pompalanması gerekmektedir. Çökeltme havuzları yüzeyinde çok miktarda gaz kabarcıkları görülüyorsa çamur, uzun bekletme süresinden dolayı gaz çıkışları ve kokularına sebebiyet vermektedir. Bekletme sürelerinin uzun olmaması gereklidir.

Basınçlı su ile genel temizliğin sırasında boru hakimiyetlerinin kaybedilmesi sonucu basınçlı suya maruziyetler, Çalışma öncesinde hortumların aksamları ve bağlantılarında kaçak veya sızıntı kontrolleri yapılmalı ve önlemler iş başlamadan alınmalıdır.

Pompa İstasyonlarında Tehlikeler ve Önlemler: Pompa bakımı ve onarımı sırasında elektrik çarpmalarının tehlikesi ve önlemleri, Sigortaların tümü kontrol edilmeli, akım kontrollü kesilmeden çalışmaya başlanmamalıdır. Çalışma öncesi kilitle/etiketle bildirimleri ve yöntemleri uygulanmalıdır.

Laboratuvarlarda Tehlikeler ve Önlemler: Kimyasal maruziyetler, çeker ocak laboratuvarda bulunmalı kimyasal kullanımı esnasında çalıştırılmalıdır. Laboratuvar personeline eğitimler verilmeli ve tekrarları yapılmalı, kimyasalların özelliklerine ve tehlikelilik sınıflarına göre güvenli depolanması sağlanmalıdır. Güvenlik bilgi formları erişilebilir yerlerde muhafaza edilmelidir. Kimyasallarla temas sonrası ellerin yıkanması için lavabolar ve temizlik ürünleri bulunmalı, çalışanlara uygun kişisel koruyucu donanımlar temin edilmelidir.

Tesis Genelinde Tehlikeler ve Önlemler: Aydınlatmalar, Tesis genelinde ve özellikle gece çalışmalarında uygun aydınlatmalar sağlanmalı.

Yangınlar ve patlamalar, Patlamadan korunma dokümanları ve acil durum eylem planları hazırlanmalıdır. Görünür yerde olmalıdır. Periyodik olarak acil durum tatbikatları yapılmalı personel eğitilmelidir. Uygun yerlere uygun sayıda ve uygun şartlarda yangın söndürme tüpleri yerleştirilmedir.

Bulaşıcı hastalıkların tehlikelilik durumları ve önlemler, Atıksu ile çalışması ve teması olacak olan personellere uygun kişisel koruyucular verilmelidir. Çalışan personellerin aşıları yapılmalı ve takip edilmelidir. Periyodik olarak ise sağlık taramaları yapılmalıdır.

4. Sonuçlar

Bu çalışmada, çevre ölçüm ve analiz laboratuvarları ile atıksu arıtma tesisi işletme personellerinin iş sağlığı ve güvenliği yönünden çalışmalarının konusu detaylı olarak ele alınmıştır. Çevre ölçüm ve analiz laboratuvarlarında çalışan personellerin çalışma alanları, uyulması gereken İş Sağlığı ve Güvenliği kurallarından bahsedilerek, Atıksu arıtma tesisi gibi büyük ve karmaşık sistemlerde görev alan personellerin İş Sağlığı ve Güvenliği yönünden çalışmalarının incelenmesi ve irdelenmesi ele alınmıştır. Konular ele alınırken çalışma ortamları ve şartları, ilgili makine ve ekipmanların hakkında bilgiler verilmiştir. Bu kapsamda, farkındalık yaratmak amacımızın yanı sıra, saha tecrübelerin aktarılarak, atıksu arıtma tesisleri ve çalışanları için önemli bir kaynak ortaya çıkartılmıştır.

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EFFECT OF POLYMER COATING ON THE BALLISTIC PERFORMANCE OF GLASS FIBER ARMOR PLATE

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Abstract

Studies on armor systems in the field of defense industry basically involve two features. These are to be light enough not to restrict the physical mobility of the vehicle (vehicle armor) or the user personnel (personal protective armor) and the other feature is that it is lightweight and at the same time shows high ballistic resistance against impacts and explosions. In this study, the effect of polymer coating on the ballistic performance of 6 mm thick glass fiber-reinforced composite armor plate was investigated. The polymer coating thickness was approximately 7 mm and the total material thickness was 20 mm. Ballistic tests were carried out using a gas gun system. Ballistic tests using fragment-simulated projectiles were carried out under 400 and 550 m/s projectile velocity for the glass fiber plate and coated glass fiber plate. Under 400 and 550 m/s projectile velocity, the projectile exit velocities of the uncoated glass fiber plate were measured to be approximately 292 and 446 m/s. When the coated specimens were tested, the exit velocities were measured as 92 and 275 m/s under the same projectile velocities. The polyurea coating reduced the exit velocities by 68% and 40% for the 400 and 550 m/s projectile velocity, respectively.

***Keywords**: Glassfiber Armor, Polymer Coating, Ballistic*

1. Introduction

Polyurea, an elastomer, is formed by the reaction of two components, isocyanate and polyamine. The mixing of these two components in equal amounts is carried out under high temperature and high-pressure conditions. Polyurea structure has 2 different regions, hard and soft. Polyurea coatings have been applied to structural components to increase the mechanical durability and strength of a structure [1-2, 3, 4].

Recently, composite materials developed using polymer coating technology have led to the development of lightweight ballistic protection systems. These systems aim to reduce the weight of individual body armor, increase the performance of armored vehicles, and improve the energy absorption capabilities of ballistic armor. These innovations provide a great benefit in terms of users' defense security and mobility. Most of the research so far has focused on how to make glass fibers more resistant to ballistic impacts. However, advances in polymer composites have offered a new perspective to the study of protective armor materials.

Numerous investigations have delved into assessing the ballistic resilience of composite sheets coated with polymers. Wu et al. [5] undertook a comprehensive examination, employing both experimental and numerical approaches, to scrutinize the damage response exhibited by steel plates coated with polyurea (referred to as PCS) under the dual influence of fragments and blast loading. The utilization of steel plate structures exposes them to potential risks associated with external blast and impact loading during their operational lifespan. Application of spray polyurea emerges as a straightforward solution to enhance the impact resistance of existing steel plate components. However, current research predominantly concentrates on single loads, neglecting the impact resistance of polyurea under multiple loads.

To simulate real-world scenarios, cylindrical RDX charges accompanied by tungsten alloy balls were employed to generate fragments and blast waves simultaneously. Field blast tests were subsequently conducted on three variants of PCS plates, each featuring distinct configurations. Interestingly, the PCS plate coated on both sides exhibited a higher degree of damage compared to its single-layer counterpart, while both single-sided spraying methods demonstrated superior performance. Corresponding numerical models were also established to elucidate the dynamic response process of PCS plates subjected to combined fragments and blast loading. The calculated results were then meticulously compared with the 3D scanning test results to validate the accuracy and reliability of the numerical simulations.

Staniszewski et al. [6] introduced a multi-scale, finite element-based approach using laminate mechanics to create a Representative Volume Element (RVE). This approach aims to capture ply-level material nonlinearity and strain-induced fiber reorientation in Ultra-High Molecular Weight Polyethylene (UHMWPE) composite laminates subjected to low-velocity impact (LVI). UHMWPE composites find extensive use in various protective armor systems, and the design of these systems traditionally relies on empirical studies, which can be both costly and time-consuming. Therefore, there is a growing interest in modeling tools that can enhance performance by leveraging the design of layered composite architectures. The study investigates the effects of strain rate on the ply-level material response and the predicted LVI response of UHMWPE composites. A specific LVI methodology is developed to characterize the impact performance of thick-section UHMWPE composite materials. This methodology serves as a valuable tool for evaluating and ranking the impact performance of different UHMWPE composite materials, laminate architectures, and processing conditions. By combining the LVI methodology with the multi-scale RVE approach, the study establishes a comprehensive modeling tool capable of exploring the design of laminate architectures for UHMWPE composite structures. This integrated approach yields ply-level behavior and delamination properties that are dependent on materials and processing conditions, offering valuable insights for optimizing the design of UHMWPE composite systems.

Mohotti et al. [7] conducted a study on the penetration of high-speed projectiles through polyurea-coated AA5083-H116 aluminum alloy plates. The investigation involved seven plate configurations with varying overall thicknesses. These configurations comprised combinations of 5 mm and 8 mm base plates (AA5083-H116) and 6 mm and 12 mm polyurea layers. Close-range firing was carried out using a 5.56 caliber cannon, with targets positioned perpendicular to the projectile flight direction. Two laser velocity displays were employed to measure input and output velocities. The study presents and discusses the efficacy of polyurea coating in terms of reducing residual velocity, elucidating damage mechanisms, absorbing kinetic energy of the plates, and exploring the impact of different layer configurations on residual velocity. Comparative analyses of polyurea coating thicknesses reveal its commendable ability to absorb energy, resulting in a subsequent reduction of projectile residual velocity. The research also highlights the protective function of polyurea coating, demonstrating its capability to act as a shield against flying particles and fragments.

The composite materials produced by combining polymer matrix materials and glass fibers, which are the subject of the study, are called glass fiber composite sheets. Glass fibers are selected as high performance fibers in defense and security fields due to their properties such as high strength and low density. Polymer matrix materials are generally composed of materials such as epoxy, polyester or vinyl ester polymers. Glass fiber composite plates have properties such as high strength, low density, high stiffness and good impact resistance. Thanks to these properties, glass fiber composite plates are frequently used for ballistic protection. The advantages of glass fiber composite plates include high strength and low density, while the disadvantage is that they are susceptible to damage and expensive. Also, the chemical resistance of glass fiber composite plates can be limited. Applying a polyurethane coating to the surface of glass fiber composite plates is called polyurea coating of glass fiber composites. Polyurea coating of glass fiber composites provides an additional protective layer to the surface of the plate. This layer increases the impact strength of glass fiber composite plates and protects their surface against scratches, cracks, chemicals and UV radiation.

In this study, the ballistic behavior of glass fiber armor plate used as a particle shield with a particle simulated projectile was investigated and the effect of polyurea coating on this behavior was examined. Ballistic performance was investigated by examining projectile exit velocities and deformation geometries.

2. Materials & Results

A polyurea compound containing isocyanate (-NCO) and a polyamine compound with two or more primary amino groups (-NH2) react in a 1 to 1 ratio to form polyurea. This material was first marketed in 1989 by Texaco Chemical Company [8,9].

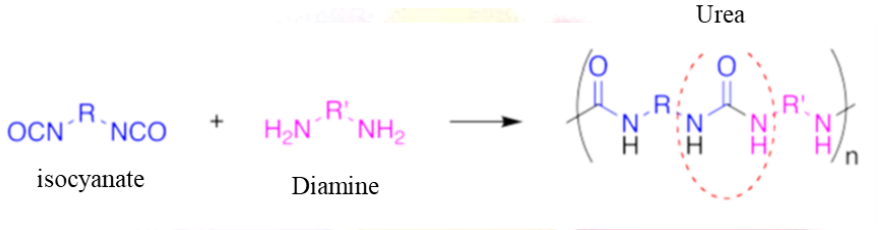

Figure 1. Reaction of polyurea synthesis

Polyurea is a material belonging to the group of elastomeric polymers and is used in various application areas. These include coatings, waterproofing, corrosion prevention, energy absorption, ballistic protection and many more. Especially with the spray coating industry, it has become possible to increase the mechanical durability and strength of a structure by applying polyurea spray coatings to structural components.

Compared to other polymer-based armor materials, polyurea has less physical strength. However, considering that one of the most critical properties for protection against high tensile propulsive loads, such as blast and ballistic, is its high elongation ability, it is clear that polyurea can be used successfully in ballistic areas.

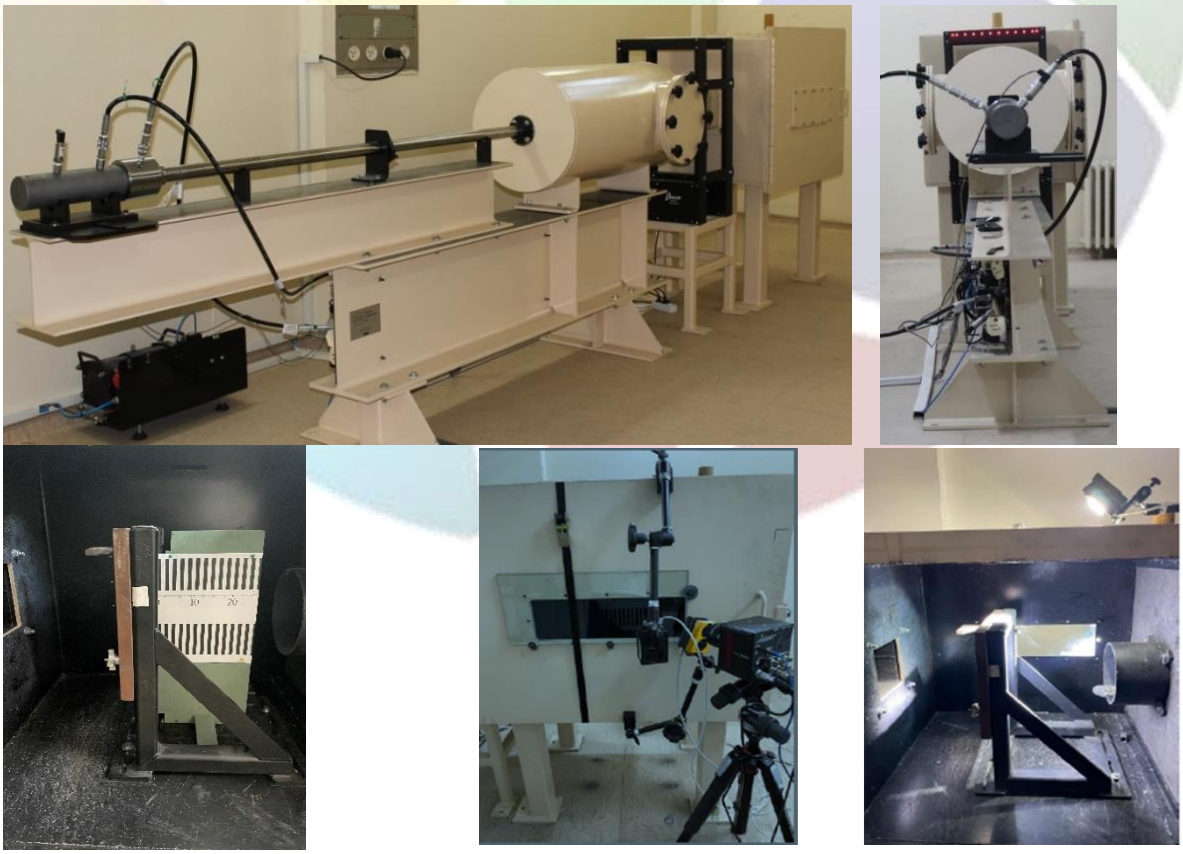

Figure 2. Gas-gun and high-speed camera system

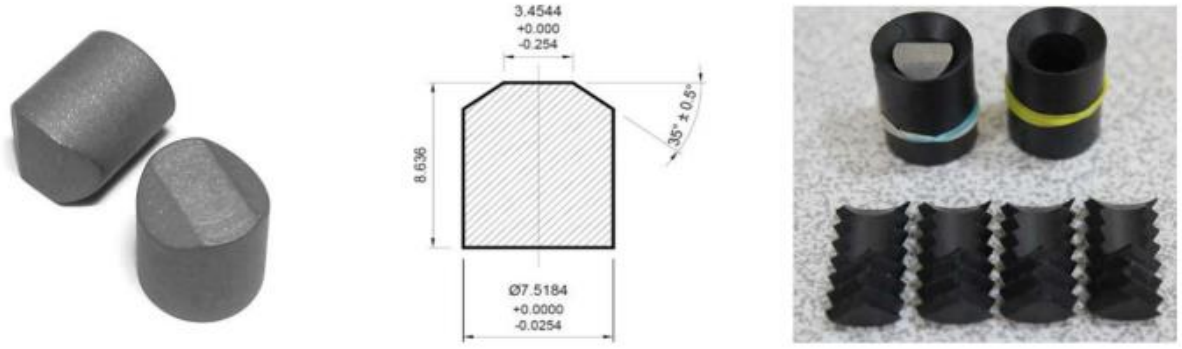

Figure 3. FSP bullet geometry

Polyurea can often elongate up to 100% or more. It also has the advantage of being easy to apply. Polyurea hardens and solidifies in a short period of about 5-15 seconds. It also has the ability to adhere strongly to surfaces. The very high reaction rate prevents the coating from being affected by environmental humidity and temperature. In this way, polyurea coating can be applied to almost any type of surface under any condition.

Polyurea can be easily applied to the surface of structural elements by brush, stick or spray methods. In addition, polyurea is used in industry for coating many different surfaces from tunnels to bridges, roofs to parking lots, storage tanks to cargo ships, truck bodies to many different surfaces because it forms lightweight and fire and abrasion resistant structures and adheres well with a wide variety of substrates such as concrete, metal or timber.

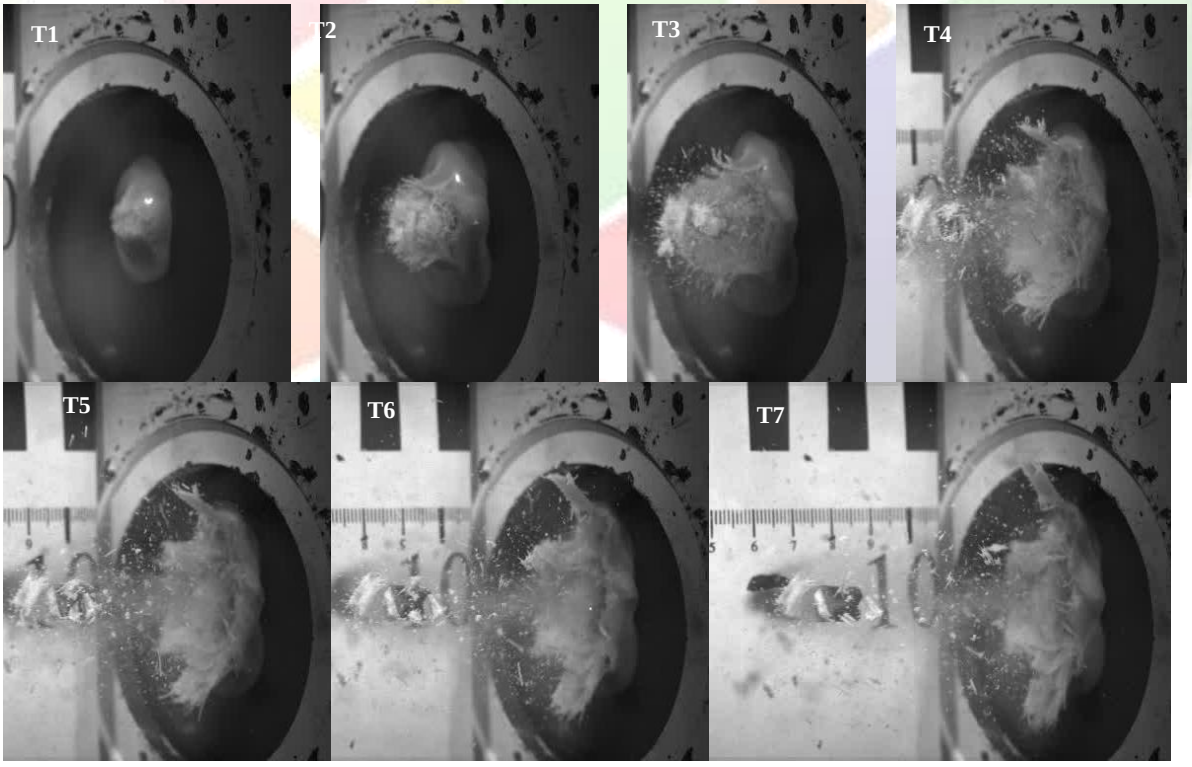

Figure 4. High-speed camera images of glass fiber plate without polyurea coating during ballistic test (V=400 m/s)

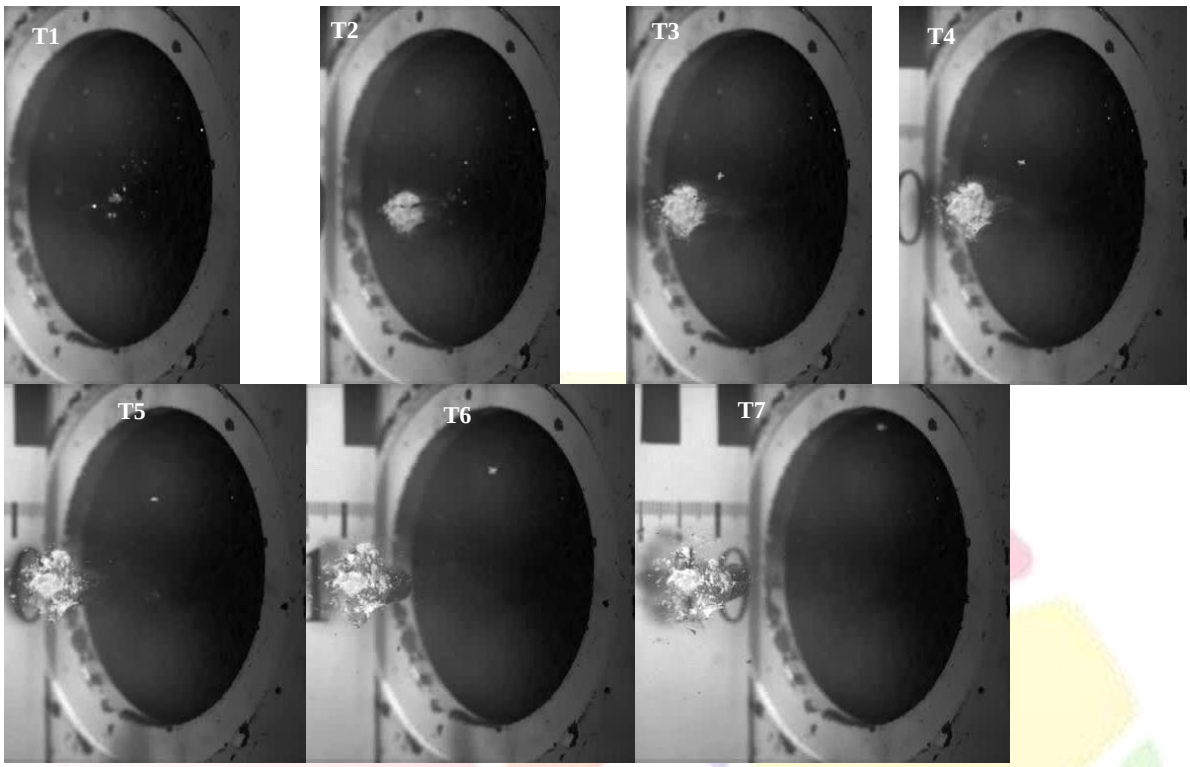

Figure 5. High-speed camera images of glass fiber plate polyurea coating during ballistic test (V=400 m/s)

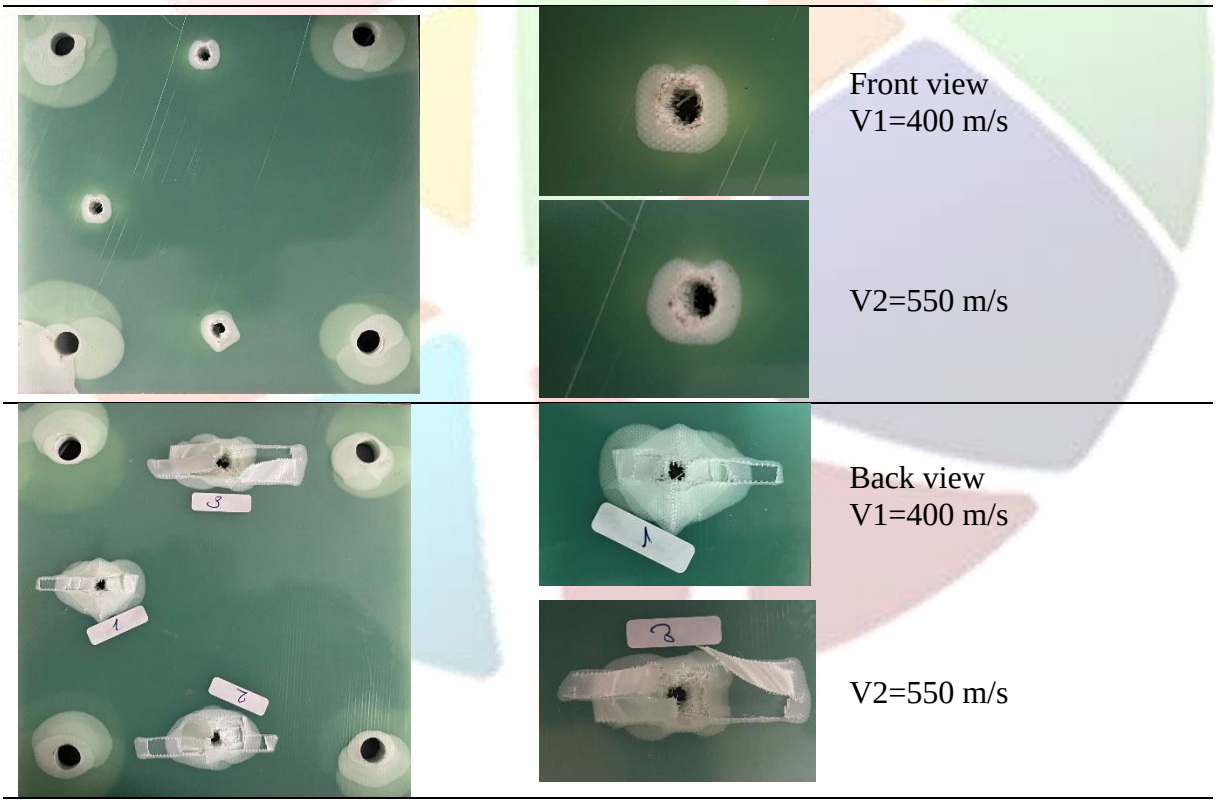

Figure 6. Front and back views of the glass fiber plate after ballistic test

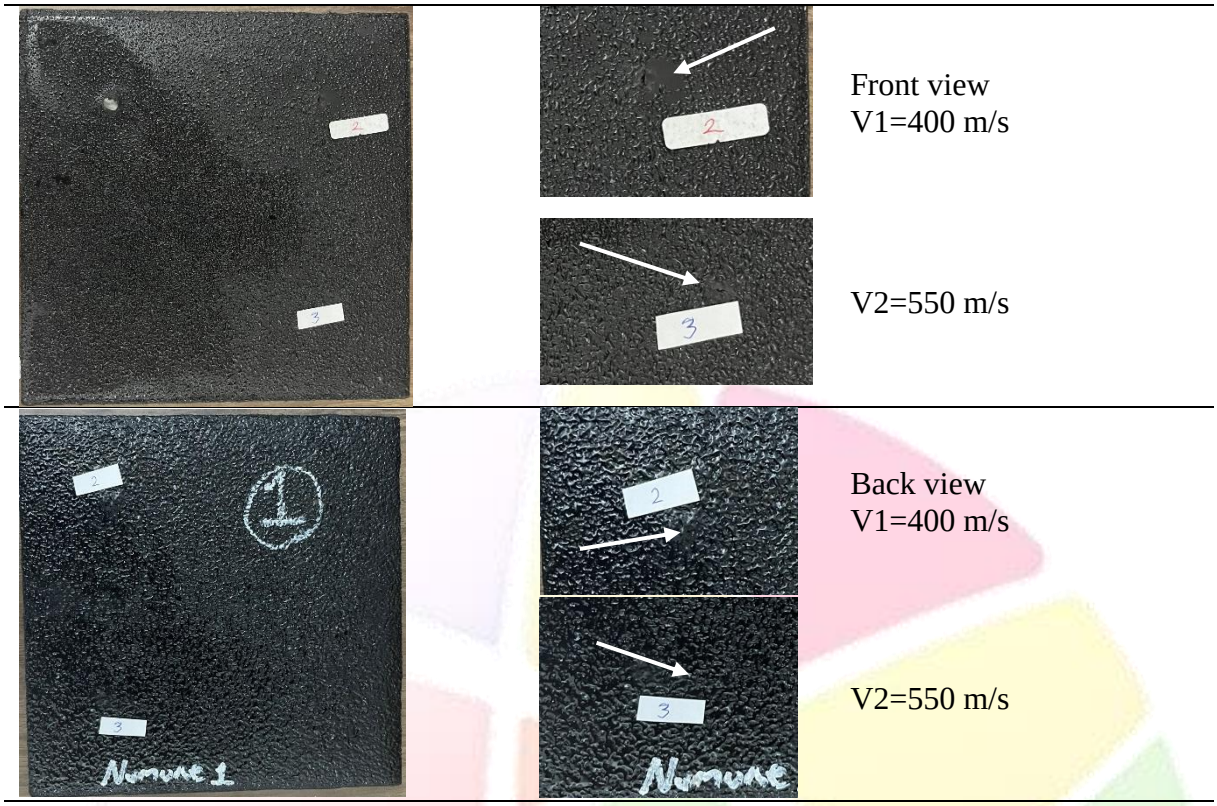

Figure 7. Front and back views of the polyurea coated glass fiber plate after ballistic test

Ballistic tests on glass fiber composite plates, designed as particle shields in armor systems, were conducted at the Mechanical Laboratory of Erciyes University Engineering Faculty using a gas gun system (Figure 2). The deformation patterns on the front and back sides of the samples were carefully examined after-test. These glass fiber composite sheets, with dimensions of 200x200 mm and approximately 6 mm thickness, were manufactured through the hot press method. A particle-simulated bullet, FSP, was employed during the tests (Figure 3). The ballistic experiments were executed at two different velocities: 400 m/s and 550 m/s bullet velocities. Subsequently, each sample underwent a coating of polyurea and was subjected to the same velocities. This procedure allowed for an assessment of the material's behavior post-damage. High-speed cameras recorded the tests, capturing projectile velocities and providing valuable insights into the impact dynamics. The sample clamping apparatuses, illustrated in Figure 2, were integral to the testing process. Projectile exit velocities were measured through image processing methods using high-speed camera software, utilizing reference points for accurate measurements (Figure 2). Figure 3 provides the geometrical dimensions of the FSP projectile. For reference, the uncoated glass fiber plate weighed 477 g with an areal density of 11.9 kg/m2. Following the application of polyurea, the coated glass fiber sample's weight increased to 970 g, with a corresponding areal density of 24.2 kg/m2. These details contribute to a comprehensive understanding of the material's response to ballistic impact and the protective capabilities conferred by the polyurea coating.

Figure 4 shows the images recorded by the high-speed camera during the ballistic test under a projectile velocity of 400 m/s for the glass fiber armor plate. The images given as T1-T7 time interval give a detailed view of the bullet entry and exit interval. Figure 5 shows the images of polyurea-coated glass fiber plates during a ballistic test under the same velocity. When the images captured at the same time interval are examined, it is seen that fiber fracture was prevented by the polyurea coating. Polyurea coating stabilized the deformation geometry. Especially with the projectile exit, the polyurea coating covered the exit hole. Figure 6 shows the front and back images of the glass fiber plates after ballistic test. Damage at the projectile entry and exit points can be seen. While there is no fiber fracture at the projectile entrance, the delamination between the layers is more visible on the back side of the plate. The increase in projectile velocity did not show any

difference in the damage area on the front side of the plate, but increased the damage area on the back side. Figure 7 shows the front and back images of the polyurea coated glass fiber plate after ballistic test for both velocity values. Damage areas are not visible due to the color of the polyurea coating. In addition, projectile entry and exit points are not visible. These locations are indicated by arrows. The effect of the polyurea coating can be examined by measuring the entry and exit velocities as well as the damage areas.

Figure 7 shows the exit velocities of coated and uncoated glass fiber plates under projectile velocities of 400 and 550 m/s using high-speed camera software. The measured exit velocities were measured during ballistic testing using image processing. For the uncoated glass fiber, the average exit velocity was measured as 292 m/s in the test with a projectile velocity of 400 m/s. When the glass fiber plate was coated with polyurea material under the same velocity value, the exit velocity decreased to 92 m/s on average. Therefore, the projectile exit velocity decreased by 68% with polymer coating. This rate corresponds to a high rate in terms of ballistic tests. Under 550 m/s projectile velocity, the average projectile exit velocity from the uncoated glass fiber plate was 446 m/s. With polyurea coating, the exit velocity decreased to approximately 275 m/s. Under 550 m/s impact velocity, the reduction in projectile velocity with polyurea coating was about 40%.

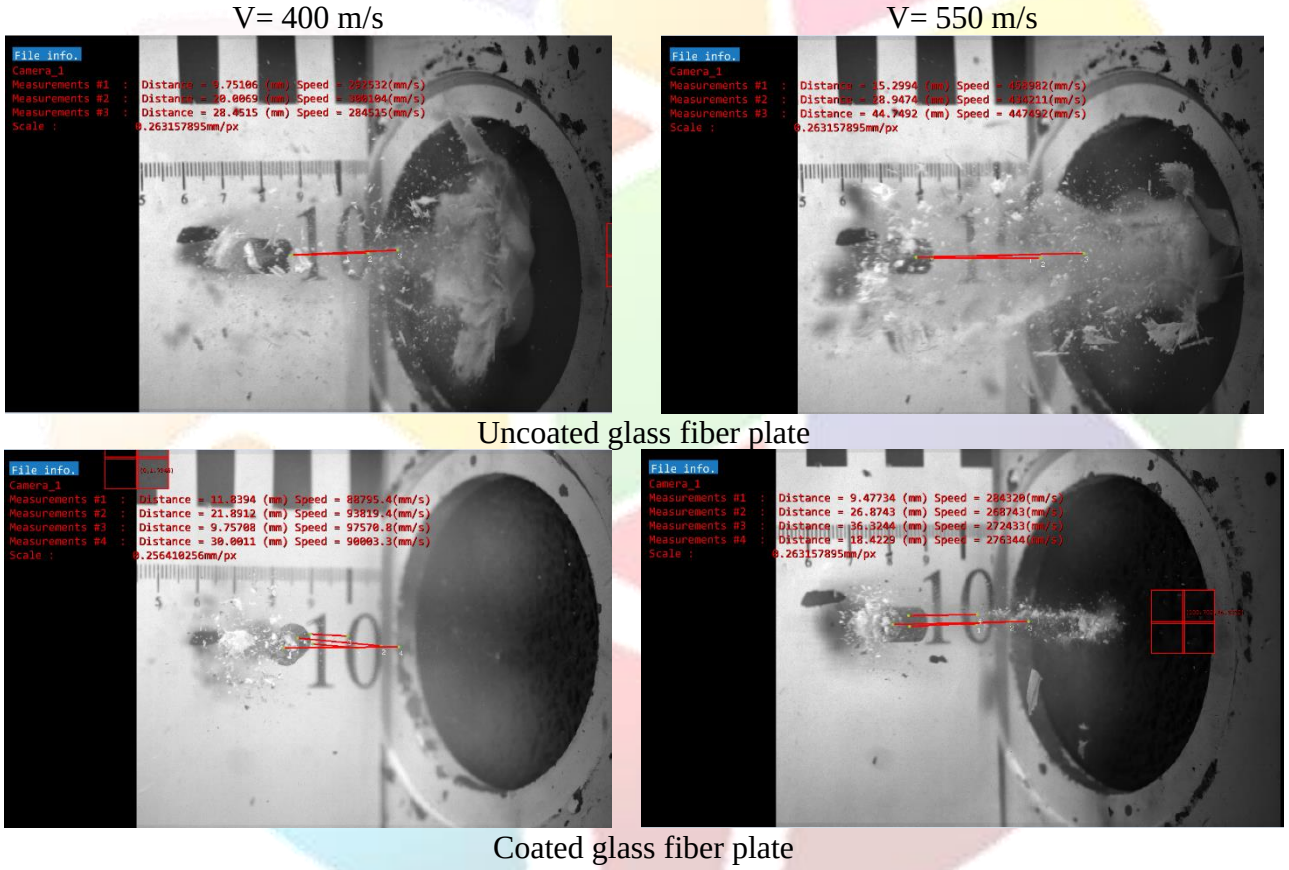

Figure 8. High-speed camera images and velocity measurement during ballistic testing

3. Conclusion

In this study, the ballistic behavior of polyurea coated glass fiber composite sheets was investigated. In ballistic tests using a gas gun system, images and exit velocities during the test were measured using a high-speed camera. Glass fiber composite sheets were produced by the hot press method. Samples with a thickness of 6 mm were then coated with polyurea. The total thickness of the specimens with a polyurea thickness of 7 mm was measured as 20 mm. The areal densities of the coated and uncoated specimens were 24.2 kg/m2 and 11.9 kg/m2. Ballistic tests were carried out using particle simulated projectiles. Two different projectile velocities, 400 and 550 m/s, were used. With the polyurea coating, the projectile velocity decreased by 68% at 400 m/s and 40% at 550 m/s.

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DIGITAL INSURANCE OPPORTUNITIES AND CHALLENGES: REVIEW PAPER

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Abstract

The digital of insurance companies this help the financial institutions to reach to new local and international markets. And help customers to get the insurance products in an easy way and low costs. In this study, attempts to discover the opportunities and determine the challenges that may face the insurance institutions. This research aimed to analysis the nature and determine the component of digital insurance companies. Moreover, the revolution of digital exactly after the corona pandemic help to increase the companies to discover new products and change from traditional products to digital services to reach customers. This paper was depended on review articles and magazine and the websites of big insurance companies to highlight the opportunities and challenges that appeared through changing from the traditional to digital companies. This research found that the insurance companies still not come up with the 4th revolution despite of the other financial institution adopt the digital system. In spite of, there is the low acceptance of digital insurance but increase steadily. This paper found that there are some digital companies start to entrance in the insurance sector and create new competition between them. Also, there are a lot of benefits encourage companies to change from traditional distribution to digital distribution. The paper recommends the insurance companies to analysis the challenges through inter the digital culture in their companies and learn the employees how to use it and interest from the opportunities through use the technical ways to reduce the costs of productions and increase the profits.

Keywords: *Insurance Companies, Digital Changes, Digital Services Challenges And Opportunities.*

1. Introduction

The insurance system is the vital activity support and protect the economic system in the countries. (Rajput, Suraiya & Ahmed, 2022) The insurance companies share to reduce the risks that the individual and companies afraid of it and make them a hindrance to establish new business or invest in new sectors. Furthermore, The rise of fintech, changing on generation behavior, and the changes of circumstances of economic these lead to accelerate the insurance companies to thinking to adopt the digital approach (Molnár, 2020). This revolution in the 21 century, digital effect on a lot of financial institutions like as the banks and investment companies. (Badlo, 2022) This digital revolutions and corona pandemic situation made many companies search a new approach to reach customers and facilitate to provide products and services in his home by using e- commerce (Stanković & Tomić, 2020) .

The revolutions help to spread and abroad the thought of services not only provide the products of insurance. İn addition, to provide more consultant and advices to protect the customers and the best way that help to reduce costs and risks. (OECD, 2015) the insurtech appeared in recent years 2015. That target to revolutionize how insurance is done. The world bank group mentioned that insurance will change more in the next 5 years than in the last 100 years are becoming more frequent. And more than 1,300 global startups are focusing on technology applications to the insurance (Global & Fintech, 2018). So, digital insurance is a phenomena that represent an immense challenge in front of different sectors and especially in the insurance sector. Despite of this challenge which the insurance sector should face it and attempt to avoid it (Cappiello, 2020).

There are several opportunities that companies should focus on to invest on it that mean the interests of the digital revolution and make insurance products and services more available at low costs and a wide range of services for a large sector of the population (Klapkiv & Klapkiv, 2017). Thus, the insurance companies have less affects to the digital according to their regulations and the capital against risk not impregnable (Digital McKinsey, 2017). The other hand the consumers expected that when the services and products comes to the moment of truth the customer will deal with the insurance companies with more easily and directly ways and smoothly and time to time will be natural (Niddam, Michaël & Barsley, Nick & Jean-Gard, Christophe & Cotroneo, 2014). So, satisfaction of the customer is important however when the product is new may the customers will be not satisfied only in sometimes though the customers when know the benefit of the new product will be more satisfying for it.

1.1. The Goals of This Research

This research attempts to:

- Explanation the digital insurance and clarifying the techniques that will be used in insurance application and distributions.
- To discover the opportunities of the new digital system in insurance and to determine the challenges and risk that may face when the companies adopt the digital system.
- To explore more knowledge about the digital systems, cloud computing, blockchain, and chatbots and other terminology.

1.2. Methods

The methods that used to collect information from the previous studies and books that related to the subject also research was depended on the surveys that were published by the government and private organizations. This method was selected because it is more reliable, economical, and efficient in terms of time and resources.

This paper attempted to make exploring the opportunities that will encourage the insurance companies to establish and depend on digital products and immense the ways of distributions. Also, the paper was mentioned the challenges that may be face the companies when they need to change to the digital and to pass the barriers that interrupt the applied the digitalization to be more available. This research divided into four sections, first section mentioned the introduction and method of research. The second section focused on the discussion and define the digital insurance and cite the new distributions that may be more effective than the old one. Third sections discover the challenges and opportunities that may face the digital insurance companies. The final section was mentioned the result of discussion and made some recommendations to consider more about the digital insurance.

2. Previous Studies

There are several studies discussed the opportunities and challenges from different aspects like:

(Susanto, Deny&Hasibuan, Fauzie&Prasetyo, Dedy&Darodjat, 2023) this paper was done in Indonesia. This article analyses the potential and challenges related to the digital insurance contracts. The paper was depended on descriptive research and literature analysis. This paper found that there are some challenges associated to protect customer personal data, data security and legal aspects. This research recommends the regulators to establish an security standards and legal to protect the personal data and grantee the all parties involved in the digital insurance contracts.

(Kajwang Ben, 2022) this paper discussed the opportunities and challenges in the artificial intelligence in insurance companies. This research was used the qualitative approach and depend on the previous studies and the websites This research found that there are lack of culture of artificial intelligence and its very low talent in the creating new services of the insurance sector. The author

recommended the management to increase the investing in the training program and diffuse the culture of artificial intelligence in the companies to take more benefit from it.

(Rajput, Suraiya & Ahmed, 2022) this research discussed some of opportunities and challenge that face the insurance companies in Bangladesh. The paper was depended on the survey of 60 private and public insurance companies in Bangladesh. The result of this research that the digital insurance companies have a slowly and gaining steady acceptance in the current generation. And the government should support the digital environment to increase the digital insurance companies.

(Mentasiti, 2021) this research is an Italian study discussed the changes in banking and insurance changes and adopting the new technical for distributing their services during the period of corona pandemic. This research analysis the information according to identity that provides the digital service security of CIE and SPID and did some interview with the managers of companies. This paper found that, the banking sector adopted the digital techniques. In addition, they have positive towards the two solutions CIE and SPID. While, the insurance sector are mostly not encouraged by the high level of security CIE and SPID concerns regarding user experience and the insurance companies believe that the identification process is not significant enough to carry out and running costs of the two solutions.

(Pillay & Njenga, 2021) this researcher clarified the digital insurance will help to reduce the cost through increase the efficiency operational system. Because the efficient operational system causes to increase the cost of head expense that leads to increase the premium of insurance. This research was depended on case study of one traditional insurance company in South Africa. And this research found that the insurer depended on pre digital methods to operate a business and recommend the companies to adopt the digital system like as internet of things and block chain and artificial intelligent that leading to lower costs and more affordable of productions.

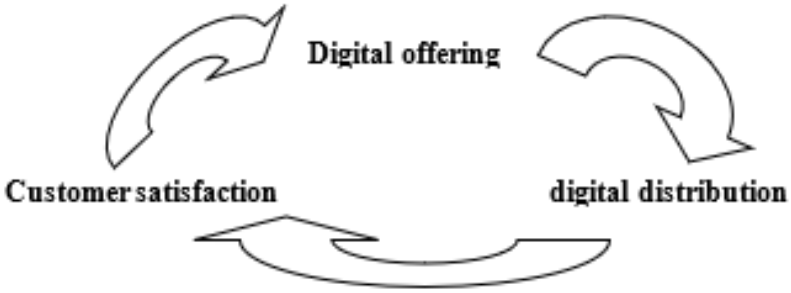
(Stanković & Tomić, 2020) this research was depended on Sustainable Development Goals of the United Nations in the digital insurance companies. This research was conducted by the qualitative approach. The author discussed some of the challenges and opportunities that versus the sustainable development goals and found that the digital insurance gave more relevance products that lead to create a special safety net of services for women and family and groups of people and analysis their risks. The new products will distribute to reduce the poor and enhance the innovation and employment and increase the sustainability and growth of economies.

(Molnár, 2020) The paper focused on only an aspect for digitalization. This research was mentioned the benefits of the big data and the challenges that will face insurance companies. This research used the approach of analysis the information of eco-system and insurance companies. The research found that the emerging techniques have got chance to create synergy between traditional data house and the most recent data lake approach. This synergy creates a good approach to analytic the data on many aspects of financial activities and insurance predicting and forecasting.

(Tarr, 2018) this research highlights the risks and opportunities of distributed ledger technology and blockchain with insurance companies and its risks and found that there are three risks in general ledger transparency risk, cyber risks and operational risks and this paper depended on the legal framework and reviews some of the challenges.

3. Background and Discusion

In the 4th industrial revolution is conformed to digitization and digitalization in the insurance business the digitization course to reduce costs and minimize the error rate and maximize the customer satisfactions. But the effect of digitalization in insurance system can be represented like this following cycle of digitalization:



There are some technical tools were used in the insurance activities divided according to the activities to three groups:

1- First group: the technical tools used to collect and analysis information
   a- Artificial intelligence
   b- Big data:

The definition of artificial intelligence and its benefits:

Insurers use Artificial Intelligence (AI) to optimize their business processes, such as to fast-track claims processing, reduce handling errors, detect fraud, and potentially save thousands of work-hours. (Pillay & Njenga, 2021). And the last 5 to 10 years the Artificial Intelligence (AI) becoming more beneficial and have got a significant impact in the health care industry (Goel et al., 2023).

The definition of big data and its benefits:

The insurance companies will be able to get big data for several groups of products and evaluate the risks of them in different ways, and this will lead to reshape the products in that time reduce the global risk pools (Niddam, Michaël & Barsley, Nick & Jean-Gard,Christophe & Cotroneo, 2014). There are some of dominants that interest from the big data like as:

Pricing and underwriting, estimating to collect information and do some complex process to assess the risks by the actuary to determine the price a policy and this may be faulty or misevaluation however the big data that helps insurance companies to calculate the price a policy in accurate ways and in short time (Molnár, 2020). Also, in settling claims, companies take a lot of time to calculate the damages and loss need to evaluate the risks and it takes a lot of time and more of efforts and this did not provide satisfaction for the parities. However, in the big data system the companies can save the time and the personal effort by using the big data that analysis the complex information in few minutes.

2- Second group the technical tools used to digital storage and preservation
   a- Block chain
   b- Cloud computing

The definition of blockchain and its benefits

Blockchain technology provides ease of automating claims and client verification processes and provides a secure means of transferring data between parties when settling claims, thus introducing efficiencies and reducing costs (Pillay & Njenga, 2021)

The definition of cloud computing and its benefits:

Cloud computing refers to accessing IT infrastructure through a computer network without to install anything on your personal computer (Chunwuemeka, Benneth &Okhuoya, 2022). This system helps companies to store their information in cloud computing and give several advantages likes save time and lower costs, the insurer can deal with information from any place easy to do complex process. In spite of this benefit, the challenges is the fear of data breaches because there are three

parties in this case and the insurer need more guarantee and confidence to adopt like this new technology

3- The third group: the technical tools used for sales and distributions

   a- The application of mobile

   b- Chatbot's: the chat bot's

   c- Robo advisor

   d- Contact media

   e- Internet websites the insurance companies will be able to get big data for several groups of products and evaluate the risk of them in different ways, and this will lead to reshape the products in that time reduce the global risk pools (Molnár, 2020).

   f- YouTube pages

3.1. To Transfer To Digital Insurance

This paper (Hess et al., 2016) mentioned the conceptual framework for formulating a digital transformation strategy identifies the four key dimensions of every digital transformation endeavor:

1. The use of technologies reflects a firm's approach and capability to explore and exploit new digital technologies.

2. Changes in value creation reflect the influence of digital transformation on a firm's value creation.

3. Structural changes refer to the modifications in organizational structures, processes and skill sets that are necessary to cope with and exploit new technologies

4. The financial dimension relates to both a firm's need for action in response to a struggling core business as well as its ability to finance a digital transformation endeavor. And this represents some challenges the company should endeavor to deal with them.

Wile, this research (Alsaid, Reem & Alarabi, 2022) determined six dimensions to transfer to digital insurance represent in this:

1- The effect of digital on the customers: the insurance companies need to understand the behavior of customer and their priorities to design a new product that has acceptable from customers.

2- Sales models and multiple channels of distributions: the customer will expect that the insurance companies strong channel distributions on the internet and applications on other mobile devices.

3- The development process by digital technics: because the digital tech process will be vital activity that distribute to make the process more easily through reduce the time of procedures and increase the time to produce the services in very low faults.

4- Big data and advanced analysis that applied in the whole business: the big data carry out complex procedures and make improvement in different aspects like divide customers, account risks, discover the faults and so on...

5- Enabling digital transformation through technology enhancement: the biggest challenges of supporting the information technology environment in the companies to be more competitive.

6- Enhancing the digital innovation: to be digital innovation this required to create the environment that enhances the innovation and encourage the coordinations between the units of companies.

A manner that is similar to conventional responses from humans, in thoughts, judgment, and motivation (Kajwang Ben, 2022). These computer systems have enabled people to carry out numerous tasks and significantly improving their efficiency and effectiveness. They are also often used to make decisions that require a high level of human expertise and this helps people to anticipate problems or deal with issues as they come up.

3.2. Some of Challenges of The Digital System of İnsurance Companies

1- One of the significant challenges is that many insurers are still hesitating to change their legacy system. These systems are usually being high prices to maintain and upgrade and there are some challenging to integrate with e new cloud base solutions and the Insurance companies store a great deal of sensitive data, and this data must be secure when stored in the cloud(Cag, 2022).

2- There are some challenges face the change to the digitalization these challenges that appeared from the use of digitalization that is the first order effects can be observed in production of ICT. These effects, though, are assessed as negative, since manufacturing processes involved in production of ICT cause pollution and greater usage of energy (Stanković & Tomić, 2020).

3- Trust and privacy concerns like what mentioned in the beginning the insurance not adopt the technical distributes like, chatbots because the information about insurance companies is sensitive and private information. And this information when appeared to other institutions or individuals may lead to hurt customer through financial loss or physical and psychological damage also, there are various strict regulations and legacy for the online systems. (Cardona et al., 2021)

3.3. The Opportunities and Benefit of Digital System

There are some of the opportunities that are special for the insurance companies:

1- The positive effects of ICT are reflected in impacts and opportunities created by the application of ICT to optimize unsustainable energy consuming processes.

2- The third order positive impacts are expected to be achieved due to using ICT as a substitute for lifestyle practices of a large number of people,

3- improving society's overall decision-making capacity to implement sustainability policy with metrics to measure impacts in real time, which can be achieved by using ICT, are characterized as the fourth order effects (Stanković & Tomić, 2020).

In general, the digital identity facilitates the contract between individual and business and society in a positive impact that leads to (Mentasiti, 2021):

1- Time and cost saving:

Digital identity interest from the digital system through reduce the time of registration and waiting for boarding. On the user side, the digital identities save the time to go to the office and reduce the cost by eliminating the intermediaries or brokers.

2- Reduce the fraud: in digital identity can reduce the wide range of frauds and increase the trusts and the theft was becoming more difficult. At the same time build a unique identity to perform procedures.

3- Increase sale of goods and services: digital identities distribute insurance companies to create new products and immense the services and to target larger customers in local and international markets.

4- Greater employment and labour productivity: digital identity no need place to work however, they need only working hours from any place, this case courage digital identities

to demand employees who have good skills to perform the activities that lead to improve the productivity.

5- İncreased tax collections: the digital identity lead to increase the tax was collected by the government and the tax represent the vital effect of economic and source of revenue of countries.

4. Results

This research found some good points through the reading previous studies and the discussion of these studies, there are:

1- The digital revolutions is a good system and the models that made a positive impact on the financial institutions despite off the digital not conformed to the insurance like what happen in financial institutions there are some start up companies are entering into the market and competitive to the traditional companies.

2- There are many benefits of a new technology system that increase the profitability and enhance the quality of services and make accurate complex process and save time at that time there are some risks threat the insurance industry like confidentiality and trust because the sensitivity of insurance information.

3- There are many technique's applications in the insurance industry that realize satisfaction for the costumer and enhance the communication between the insurer and the insured like smart phone application, You Tube, robo advisors, blockchain, and chatbots etc. In spite of some of them contains risks.

4- The new generation who dealing with digital and changes of society in different aspects like banking and economic conditions, and appeared the four revolution all this factors effect of insurance companies to change there traditional distributions and create new ways to attractive new consumers and correspond to the changes in environments and behavior of society.

5- The new models of distribution lead to reduce the cost of products and services through the cut of the agencies and brokers and reach customers directly.

6- The digital information creates new products that lead to increase the profits and reduce the costs of procedures.

7- The customers of insurance companies become easier to reach with product and analysis information and made comparisons between products. At the same time comparing it with the other companies.

5. Recommendation

1- In today's business world, the biggest trend in the working company is the digitization work and the insurance companies should adopt the digitalization in their activities to get more efficient and effective.

2- The insurance sector did not adopt the digitalization in general like the other financial institutions. However, there are some startup companies depend on the digital and will competitive the traditional companies and make good competitive that lead the traditional companies to get out of the market if they not create and adopt digital revolutions.

3- The insurance companies should adopt a new channel to distribute their products and services. Because the recent generation always deal with the digital system and interact with technology and they do not prefer to use the old distributions.

4- The insurance companies should invest more capital on the innovative products and training staff to make them more affordable to use the digital system.

5- It would be beneficial to conduct further studies on improving technology adoption in traditional businesses, as unused technology can aggravate the high expense problem.

6. Conclusions

This study set out to gain abetter understanding of the environment of digital insurance and the suatable digital services that attracive more customers and intrance new local and international markets. So, The insurance companies should adopt the technological innovations because technological innovations will be standard operating procedure tomorrow.

Insurance companies are more engaged and have more opportunities because of digital connectedness for survive in the competitive and growing market. At the same time government of countries should come forward and give support to the insurance industry for the digitalization to share to reduce the challenges.

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COMPRESSION ANALYSIS OF CFRP CORES WITH DIFFERENT TOPOLOGIES

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Abstract

Sandwich structures with different core configurations are used as base materials for weight-sensitive structures such as panels due to their versatility and mechanical efficiency. This is mainly due to the relatively low cost/high performance over the service life of the part, for example, in aircraft or automotive companies. In this study, the compression performance of CFPR composite core structures with different topologies will be compared numerically. The performances of 2 different topological designs of core structures under compression loads are modeled using Abaqus/Standard finite element package program. Compared to the structures currently used in applications, the core structures are designed in topology to give lighter and higher strength and the results are compared. It has been determined that the designed structures give more efficient results.

***Keywords**: Lightweight Structures, Sandwich Structures, CFRP Composites,*

1. Introduction

Structures employing sandwich panels, characterized by robust face sheets and lightweight cellular cores, are commonly employed for bearing bending loads. These cores, often crafted from polymeric substances like Nomex, aluminum honeycombs, or occasionally polymer or metal foams, are generally affixed to lightweight yet sturdy face sheet materials using adhesive bonding. The advent of uncomplicated techniques for fabricating metallic sandwich panels featuring periodic lattice truss cores has sparked considerable interest in exploring alternative core topologies [1]. Enhancing the performance of various vehicles and modes of transport is efficiently achieved through lightweight construction. This reduction in weight is crucial for maximizing payload capacity, improving speed to enhance driving performance, and minimizing fuel consumption. Consequently, the automotive and aerospace industries have consistently prioritized the development of components with high stiffness and strength-to-weight ratios. Sandwich structures, owing to their exceptional versatility, have emerged as viable contenders in the pursuit of designing structures with minimum weight for optimal performance [2].

Chen et al. [3] concentrated on reinforcing carbon fiber composite honeycombs, which outperform other lightweight materials through the implementation of a curved wall topology. The carbon fiber composite curved honeycombs (CCCHs) were produced using a molding and bonding process. The compressive properties in the out-of-plane direction were measured and analyzed for both woven and unidirectional laminated CCCHs. Additionally, the study explored the influence of curvature radius and wall thickness on the compressive strength of laminated CCCHs. Experimental findings revealed that out-of-plane compressive strengths increased with a decrease in curvature radius or an increase in wall thickness. Comparative analysis demonstrated that laminated CCCHs exhibit superior out-of-plane compressive strengths compared to most existing competitive lightweight honeycombs, positioning them as a viable choice for selective lightweight sandwich structures. This presented a potential avenue for honeycomb structures to serve as load-bearing components. Pehlivan et al. [4] investigated the compressive response of carbon fiber-reinforced polymer (CFRP) honeycombs with diverse cell configurations. The corrugation technique was employed to

manufacture CFRP honeycomb specimens, involving the corrugation of prepreg CFRP sheets into specific shapes using corrugated aluminum molds under heat and pressure. Subsequently, the corrugated CFRP sheets were glued and stacked to form honeycomb specimens. A total of twenty-seven groups of specimens were subjected to experimental testing to assess the impact of cell geometry (square, circular, and hexagonal), cell wall thickness, and height on the quasi-static out-of-plane crushing performance. The square, circular, and hexagonal honeycomb specimen groups were designed to have nearly identical weights. The results underscore the significance of cell wall thickness as a crucial parameter affecting the overall crushing response of CFRP honeycombs, with the out-of-plane compressive strength generally being independent of height. Hexagonal specimen groups exhibited superior crushing performance compared to square and circular counterparts, attributed to their large double foil bonding surfaces. Additionally, experimental findings indicated that honeycomb structures with core densities ranging from 157 to 282 kg/m³ could achieve more than a twofold increase in crushing properties through judicious cell configuration selection. Vitale et al. [5] studied the shear performance of ultra-lightweight (ULW) carbon fiber reinforced polymer (CFRP) cores with three-dimensional (3D) geometries. These cores were crafted from machined CFRP laminate, utilizing an interlocking method where CFRP sheets were assembled to form a square pattern. The density of all manufactured cores was maintained below 48 kg/m³. Employing simple analytical mechanical models enables the prediction of panel failure behavior. Finite element analyses (FEA) were conducted to compare and validate the theoretical models, revealing good agreement among theoretical, finite element, and experimental results. The experimental findings highlight that the dominant failure mechanisms involved the shear failure of the base material or debonding, successfully predicted by both numerical and analytical approaches. Furthermore, these cores exhibited favorable comparisons with other well-known competing materials.

Literature research showed that the core material and geometric performance of sandwich structures are of high importance for many industrial applications. In this respect, switching to fiber-reinforced composites as the material increases the cost, but also the weight. Weight savings can be achieved by differentiating the geometries through sociological optimizations. In this study, carbon fiber composite core structures with different proposed geometries are analyzed and compared under compression loads.

2. Materials & Methods

All of the composite materials were designed as CFRP composite sheets with a height of 25 mm and a thickness of 1 mm, and lightweight studies were carried out in 3 different geometries for the analysis. In order to compare these different geometries, a reference model named Flat Structure was included in the analysis. The repeating core structures and their dimensions are given in Figure 1 along with their total weights. Different cell geometries can affect the in-plane strength as well as significantly change the force distribution and mechanical behavior of these structures. In order to be able to observe these factors, the lightweight geometries were realized following a specific strategy.

The clamping system used to join these plates was designed by Côté et al [6] as a system close to the joining of materials in a honeycomb pattern. The models prepared for analysis consisted of an array of 20 mm unit cells 100 mm long and 100 mm wide (Figure 2).

The 1 mm thick composite structure forming these structures was used as 4 layers in 0/90 fiber orientation and the mechanical properties used in the analysis are given in Figure 3.

The Hashin's theory was used to model as the damage initiation criteria for fiber-reinforced composites in Abaqus [7]. This theory consider four different damage initiation mechanisms: fiber tension, fiber compression, matrix tension, and matrix compression. The composite layup section and mechanical properties for the composite plates CFRP are given in Figure 3 [8].

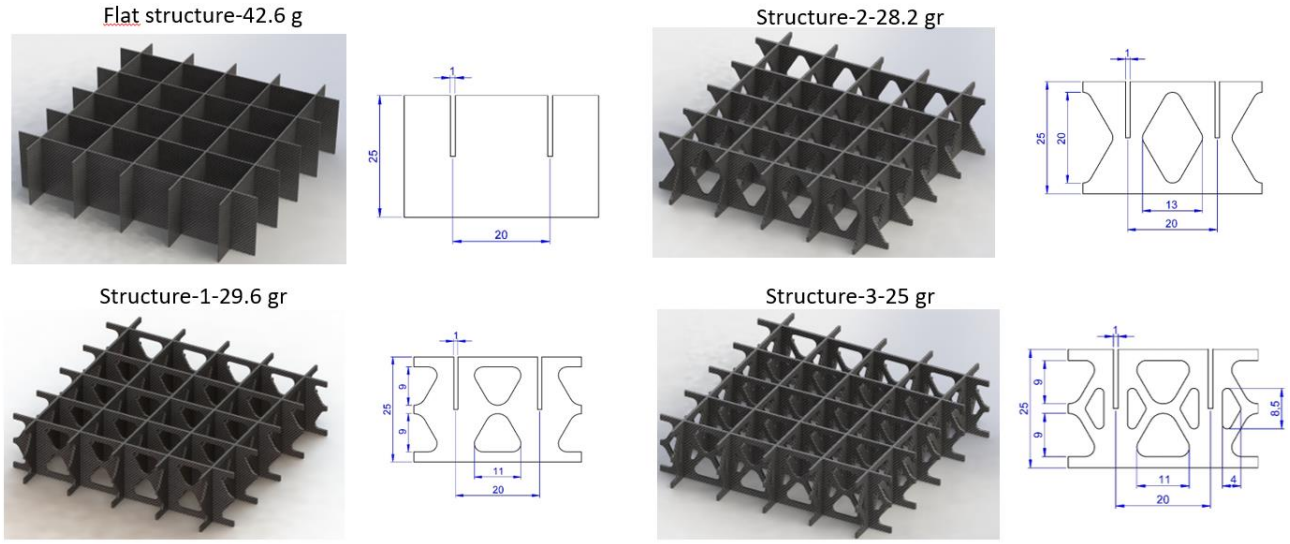

Figure 1. Unit repetitive cell render and core cell patterns

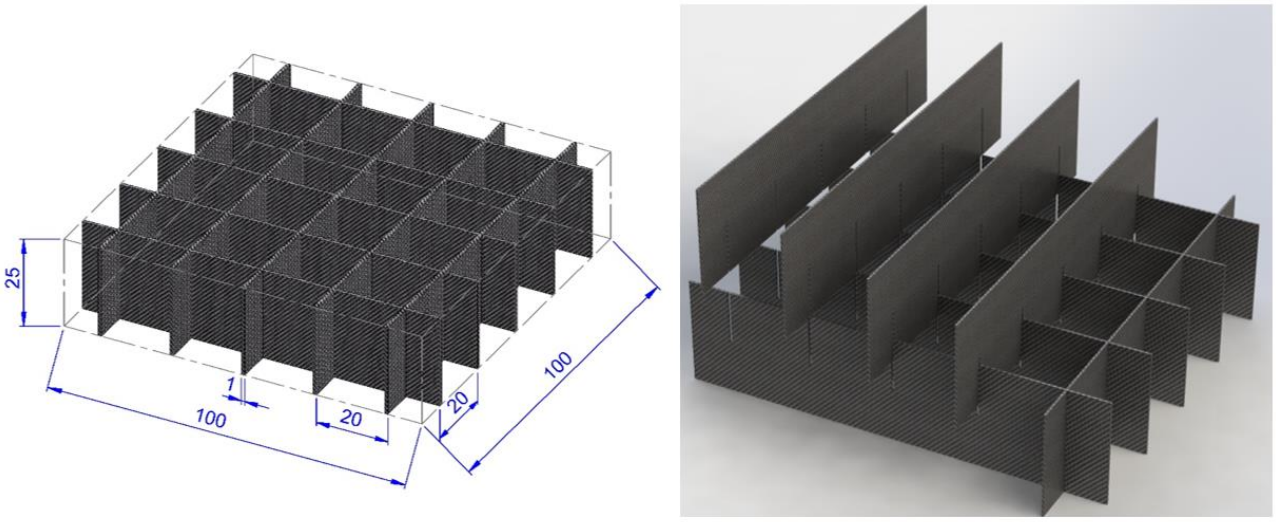

Figure 2. Interlocking manufacturing method

Longitudinal modulus, E_{11}	150.9 (GPa)
Transverse modulus, $E_{22} = E_{33}$	11.2 (GPa)
Shear modulus, $G_{22} = G_{33}$	5.3 (GPa)
Shear modulus, G_{23}	1.4 (GPa)
Volume fraction of fiber, V_f	0.54
Poisson's ratio, $\mu_{12} = \mu_{13}$	0.29
Poisson's ratio, μ_{23}	0.33
Density	1710 (kg/m^3)
Longitudinal tensile strength, X_T	1858.3 (MPa)
Transverse tensile strength, $Y_T = Z_T$	25.4 (MPa)
Longitudinal compressive strength, X_C	576.8 (MPa)
Transverse compressive strength, $Y_C = Z_C$	107.3 (MPa)
In-plane shear strength $S_{12} = S_{13}$	79.5 (MPa)
Interlaminar shear strength, S_{23}	22.9 (MPa)

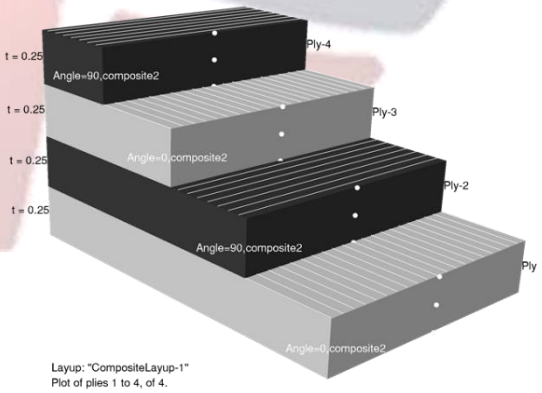

Figure 3. Mechanical Proporties and ply orientations of fiber composite plate.

The initiation criteria have the following general forms:

Fiber tension ($\widehat{\sigma_{11}} \geq 0$)

$$F_f^t = \left(\frac{\widehat{\sigma_{11}}}{X^T}\right)^2 + \alpha\left(\frac{\widehat{\tau_{12}}}{S^L}\right)^2 \quad (1)$$

Fiber compression ($\widehat{\sigma_{11}} < 0$)

$$F_f^c = \left(\frac{\widehat{\sigma_{11}}}{X^C}\right)^2 \quad (2)$$

Matrix tension ($\widehat{\sigma_{22}} \geq 0$)

$$F_m^t = \left(\frac{\widehat{\sigma_{22}}}{Y^T}\right)^2 + \alpha\left(\frac{\widehat{\tau_{12}}}{S^L}\right)^2 \quad (3)$$

Matrix compression ($\widehat{\sigma_{22}} < 0$)

$$F_m^c = \left(\frac{\widehat{\sigma_{22}}}{2S^T}\right)^2 + \left[\left(\frac{Y^C}{2S^T}\right)^2 - 1\right]\frac{\widehat{\sigma_{22}}}{Y^C} + \left(\frac{\widehat{\tau_{12}}}{S^L}\right)^2 \quad (4)$$

$\widehat{\sigma_{11}}, \widehat{\sigma_{22}}, \widehat{\tau_{12}}$ are components of the effective stress tensor, $\hat{\sigma}$, that is used to evaluate the initiation criteria and which is computed from:

$$\hat{\sigma} = M\sigma \quad (5)$$

Where σ is the true stress and is the damage operator:

$$M = \begin{bmatrix} \frac{1}{(1-d_f)} & 0 & 0 \\ 0 & \frac{1}{(1-d_m)} & 0 \\ 0 & 0 & \frac{1}{(1-d_s)} \end{bmatrix} \quad (6)$$

d_f, d_m, and d_s are internal (damage) variables that characterize fiber, matrix, and shear damage, which are derived from damage variables , d_f^t , d_f^c, and , d_m^c corresponding to the four modes previously discussed, as follows :

$$d_f = \begin{cases} d_f^t & if\ \widehat{\sigma_{11}} \geq 0 \\ d_f^c & if\ \widehat{\sigma_{11}} < 0 \end{cases} \quad (7)$$

$$d_m = \begin{cases} d_m^t & if\ \widehat{\sigma_{22}} \geq 0 \\ d_m^c & if\ \widehat{\sigma_{22}} < 0 \end{cases} \quad (8)$$

$$d_s = 1 - (1 - d_f^t)(1 - d_f^c)(1 - d_m^t)(1 - d_m^c) \quad (9)$$

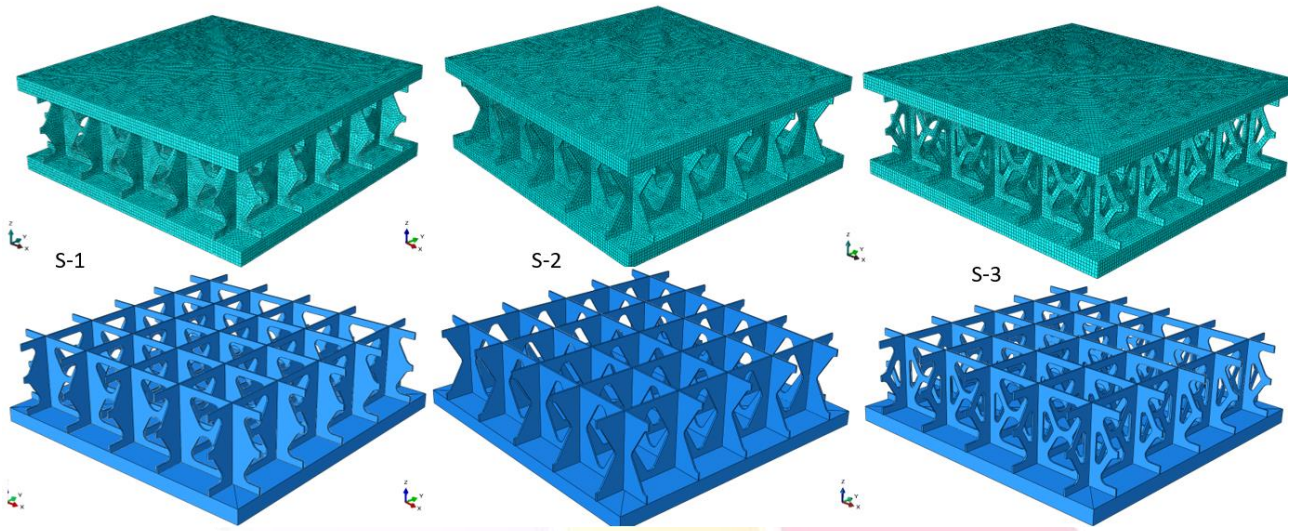

Figure 4. View of different structures employed for analyses

In the analyses, the lower apparatus was kept fixed and the contact force was calculated by displacing the upper apparatus in the compression direction. The plates are force-transmitting spacers between the upper and lower apparatus (Figure 4). The compressive load from the top plate is equally transferred to the core cells.

3. Results

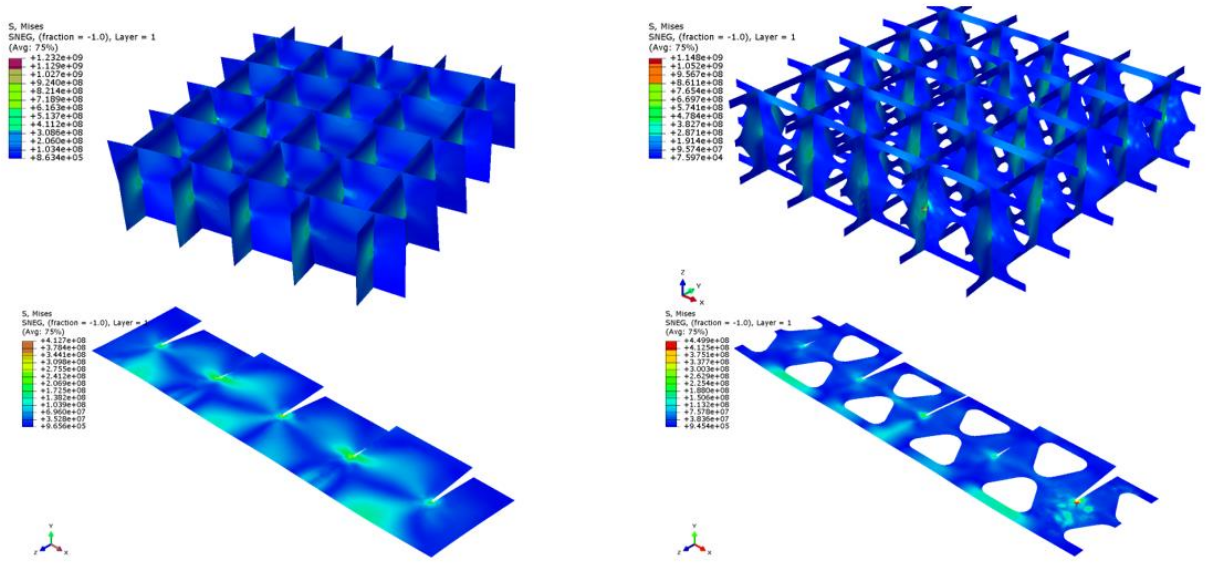

Figure 5. V-misses stress distributions obtained from the simulations for Flat Structure and Structure-1

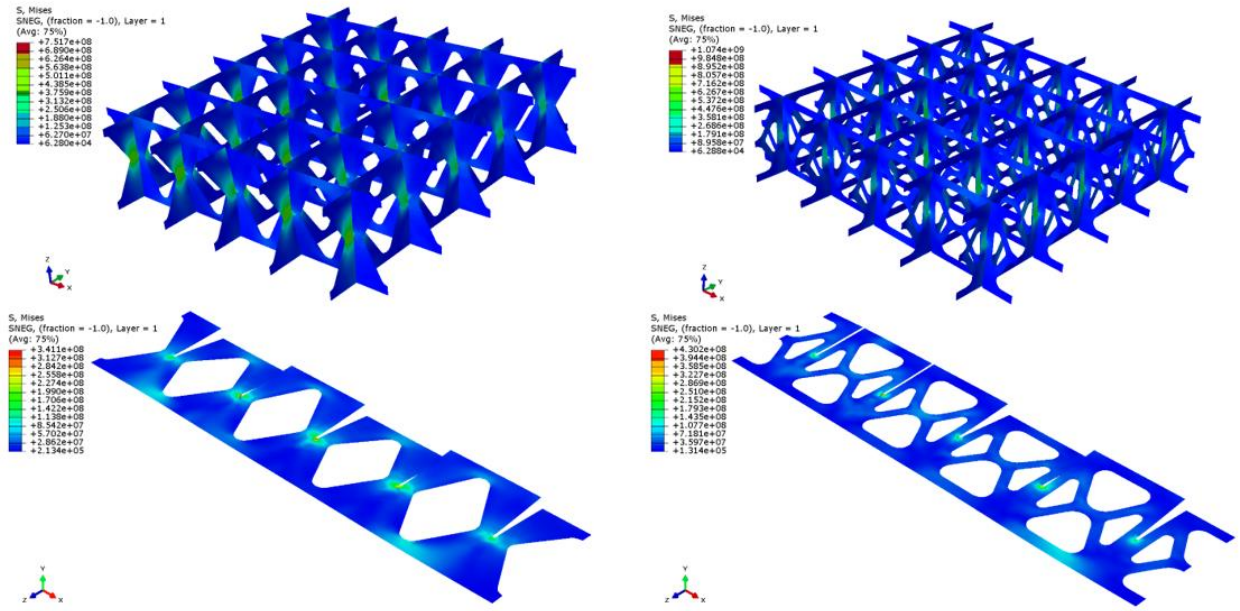

Figure 6. V-misses stress distributions obtained from the simulations for Structure-2 and Structure-3

As a uniform compressive force is applied to CFRP plates, the force is uniformly distributed to all cells and the damage starts close to the localized joints (Figure 5 and Figure 6). The force-displacement curve for different structures is shown in Figure 7. The gradual change of the cores under loading before reaching the maximum compressive strength indicates elastic buckling of the CFRP structure. The maximum force for the reference structure was 21.4 kN, while it was 14.3 kN, 13.5 kN and 10.9 kN for Structures 1, 2 and 3 respectively. After this point, the load drop is gradual rather than sudden and it is estimated that this is the damage due to elastic buckling. After the initial damage, the maximum force is reached by the local strength of the damaged parts. After this stage, the force continues to decrease with increasing displacement. Finally, it follows a non-linear curve with increasing localized damage and sequential crushing of the plates, leading to a decrease in the strength of the cell cores. The inconsistency between the curves reveals that the forces applied to the structures exhibit different behaviors by the cell cores in different geometries.

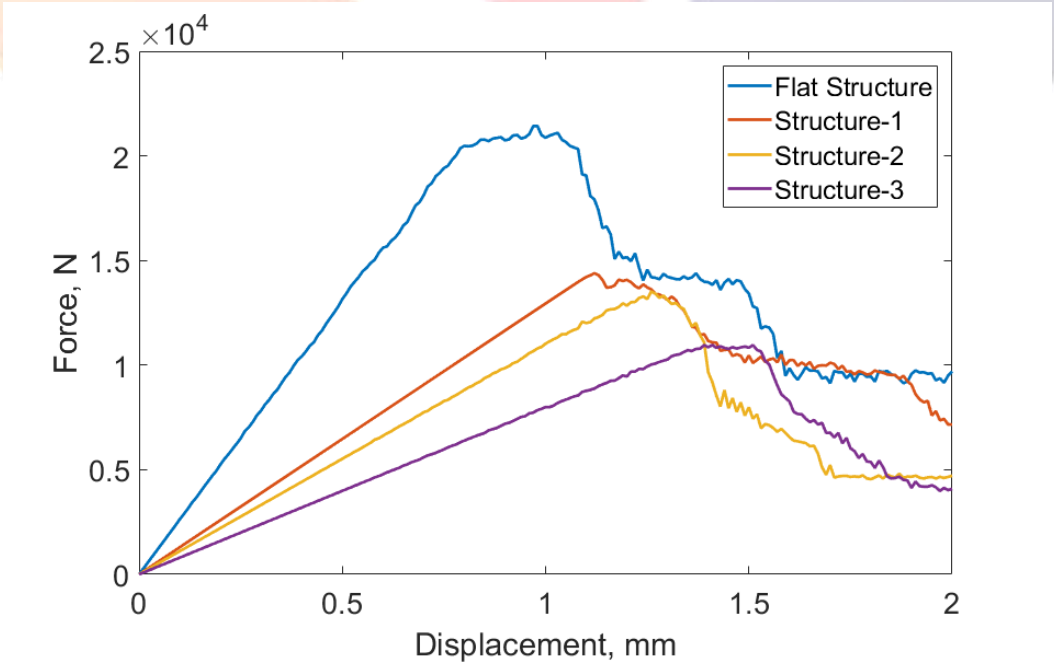

Figure 7. Typical force-displacement curves of reference structure and different structures.

4. Conclusion

In this study, the strength values of carbon fiber composite materials with 3D different core structures under compression were investigated in detail. The compression response of each structure was analyzed and compared with the reference structure. The common goal of all these designs is to obtain findings for the most efficient cell core structure in terms of strength-to-weight. Compared to alternative materials used in the industry, promising results have been obtained that high strength and lightweight structures can be obtained by using CFRP composite materials in cage and sandwich structures. At the same time, considering the cost and expected strength value against the reduced weight, it has been seen that it can facilitate the production of different designs and allow them to be used in industrial applications. Some dissimilar behavior between the curves reveals the importance of geometry designs. It is thought that these structures can be further improved in terms of strength-to-weight by changing parameters such as geometry, plate thickness, layer structure, layer thickness, epoxy, repeat spacing of cell cores, height of cell cores and joining method.

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INVESTIGATING THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS AND TREATMENT OF ALZHEIMER'S DISEASE

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Abstract

Alzheimer's Disease is an incurable brain disease that gradually erodes memory and causes difficulties in daily tasks, especially in activities like speaking and walking. It can become fatal over time and constitutes a major portion (60-80%) of dementia cases. This disease typically begins in middle or old age and is often associated with protein accumulations in the brain. These accumulations lead to continuous deterioration of memory, brain shrinkage, and cell death. This study examines artificial intelligence research used in the diagnosis and treatment of Alzheimer's patients. It is observed in the literature that many deep learning models are used today, and alternative treatment methods are also being researched.

Keywords*: Alzheimer Disease, Artificial Intelligence, Protein Accumulation*

1. Introduction

Alzheimer's disease is defined as a progressive neurodegenerative disorder that particularly affects the elderly, leading to a gradual decline in cognitive functions such as memory, decision-making, and language skills. The characteristic feature of the disease is the accumulation of amyloid plaques and tau tangles in the brain, which disrupts neuronal communication and leads to cell death. The importance of Alzheimer's stems from its profound impact on both patients and their caregivers; it not only diminishes the quality of life of the affected individuals but also imposes significant emotional and financial burdens on families and healthcare systems. With the aging of the population, the prevalence of Alzheimer's disease is increasing, and there is an urgent need for effective treatments and a better understanding of its underlying mechanisms. Due to the progressive nature of the disease, early diagnosis and intervention are of vital importance. Yet, there is still no definitive cure, highlighting the necessity of ongoing research and awareness[1-4].

Artificial Intelligence (AI) is considered a significant advancement in the diagnosis and research of Alzheimer's disease, capable of analyzing complex data sets such as brain imaging, genetic profiles, and cognitive test results with a precision and speed that are unattainable by human experts. This capability plays a critical role in the early detection of Alzheimer's, as subtle changes in brain structure or function may indicate the onset of the disease. Moreover, AI algorithms are able to detect patterns and biomarkers that are invisible to the naked eye, thus enabling earlier and more accurate diagnoses. Beyond diagnosis, AI has the potential to uncover new insights into the progression of the disease and to assist in the development of targeted therapies. Current Alzheimer's research driven by AI includes areas such as predictive modeling, drug discovery, and patient care optimization, offering promising developments in the understanding and management of this complex condition. The intersection of AI and Alzheimer's research is rapidly evolving, showcasing the potential of technology to transform healthcare and provide hope for individuals affected by this debilitating disease[5-7].

1.1. Traditional Alzheimer's Diagnosis and Treatment Methods

Traditional methods for the diagnosis and treatment of Alzheimer's disease encompass clinical evaluation, neuropsychological tests, and imaging techniques. Clinical evaluation thoroughly examines the patient's medical history, symptoms, and family health history, thereby aiding in the exclusion of other disorders. Neuropsychological tests provide a comprehensive assessment of cognitive functions such as memory, attention, language skills, and problem-solving abilities. These tests are capable of detecting subtle cognitive changes even in the early stages of Alzheimer's disease. Imaging techniques, including MRI and CT scans, observe changes in brain structure. These techniques are effective in identifying reductions in brain volume and other changes associated with Alzheimer's. Traditional methods play a critical role in diagnosing Alzheimer's and in monitoring the progression of the disease to develop appropriate treatment plans. However, the limitations of these methods highlight the need for more advanced diagnostic and treatment strategies due to the complex nature of the disease[8-10].

1.2. The Integration and Functionality of Artificial Intelligence in the Alzheimer’s Disease Diagnostic Process

Advanced Imaging Analysis: The use of artificial intelligence (AI) and machine learning models in the analysis of imaging techniques such as Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), and Computed Tomography (CT) allows for the faster and more accurate detection of abnormalities. These advanced level models are critical in the early diagnosis of Alzheimer’s disease and in creating a detailed map of the pathological changes associated with cognitive impairment.

Biomarker Detection: Artificial intelligence plays a significant role in identifying biomarkers related to Alzheimer’s, deeply analyzing the relationship between biological markers and cognitive disorders. This approach provides in-depth knowledge about the pathogenesis of the disease and enables the creation of more precise individual risk profiles.

Opportunities for Early Diagnosis and Intervention: AI systems have the capability to predict the onset of Alzheimer’s disease before symptomatic stages, offering the possibility of early intervention and more effective disease management[11-15].

1.3. The Role of Artificial Intelligence in the Treatment Process:

Personalized Treatment: AI models propose patient-specific treatment protocols and lifestyle modification suggestions based on individual data. This personalized approach promises to improve patient outcomes by aligning therapeutic interventions more closely with the specific needs of each patient.

Drug Discovery: The use of AI in the discovery of potential new treatments and the evaluation of the effects of existing drugs on Alzheimer’s disease is increasingly common. AI accelerates the drug discovery process, significantly reducing the time and costs associated with developing new therapeutic agents[16].

AI-Supported Clinical Decision Support Systems: AI-based tools that guide health professionals in patient management are on the rise. These systems streamline the clinical decision-making process and ensure that patient care is efficient and informed by the latest research findings. Moreover, the use of AI in patient monitoring and tracking of progress promotes a more dynamic and responsive approach to Alzheimer’s care[17].

The integration of AI in Alzheimer’s research and treatment is rapidly evolving, demonstrating the potential of these technologies to significantly change the healthcare landscape and improve the prognosis for individuals affected by this challenging disease.

1.4. The Contribution of Artificial Intelligence to Diagnosis and Treatment in Alzheimer's Disease

The Role of Artificial Intelligence: AI's capacity to analyze extensive datasets and recognize complex patterns offers a potential that transcends conventional methodologies in the diagnosis and monitoring of Alzheimer's disease progression.

Imaging Processing Models: Convolutional Neural Networks (CNNs): CNNs are adept at extracting features from MRI and PET scans, providing the capability to identify early indicators of the disease[18].

Deep Learning Models: The role and efficacy of models such as VGG, ResNet, and AlexNet in diagnosing Alzheimer's disease are of significant interest[19].

Convolutional Neural Networks (CNN): Employed for visual processing tasks such as image classification, feature extraction, and the analysis of brain scans[18].

Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) Networks: These models are particularly suited for time-series data, including medical histories and symptom tracking, and can be instrumental in predicting the progression rate of the disease and the patient's response to treatment[20].

Autoencoders: Utilized for anomaly detection and dimensionality reduction, autoencoders can pinpoint Alzheimer-specific alterations in MRI and PET scan data[20-21].

Generative Adversarial Networks (GANs): GANs can be leveraged for data augmentation and advanced image analyses. For instance, they can enhance brain scans in stages of Alzheimer's where data is scarce[21].

Transfer Learning and Pre-Trained Models: Pre-trained models such as VGG, ResNet, and Inception can be adapted for diagnosing Alzheimer's disease, shortening training durations and achieving more effective results with limited data.

Reinforcement Learning: This can be particularly useful in planning treatment strategies and drug discovery. Models employing reinforcement learning can adaptively identify optimal treatment approaches by monitoring patient responses[22].

This comprehensive exploration into AI's applicability within Alzheimer's disease showcases its potential to revolutionize both diagnostic and therapeutic paradigms, underscoring the critical role of machine learning in advancing medical science.

2. Results

Cognitive Exercise and Educational Games: These types of games target fundamental cognitive skills such as memory, attention, problem-solving, and language, offering personalized difficulty levels and exercises based on individual performance. Platforms like Lumosity, CogniFit, and BrainHQ employ artificial intelligence algorithms to analyze user performance.

Virtual Reality (VR) Applications: VR experiences tailored for Alzheimer's patients can revive past memories or create relaxing and stimulating virtual environments. Artificial intelligence can personalize these experiences based on user reactions and interactions.

Social Interaction Games: Games that encourage social interaction can help reduce feelings of loneliness. They have the potential to strengthen social bonds by facilitating interactions with family members and caregivers.

Patient Monitoring Applications: AI-based systems can track the cognitive status of patients through daily activities. Anomalies in user behavior can be interpreted as early warning signs of health issues.

Daily Routines and Reminders: AI-supported applications provide reminders for medication adherence, appointments, and other daily activities, supporting patients' independence and alleviating the burden on caregivers.

Remote Monitoring and Safety Systems: Features designed to enhance patient safety, such as motion sensors, fall detection, and location tracking, allow caregivers and health professionals to remotely monitor patients and respond promptly in emergencies.

This detailed examination highlights the applications of artificial intelligence in the management of Alzheimer's disease and emphasizes how these technologies can revolutionize both cognitive therapies and the enhancement of patient's daily quality of life.

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