FACULTY OF ENGINEERING AND ARCHITECTURE

2nd ISEDIR 2025

2nd INTERNATIONAL SYMPOSIUM ON ENGINEERING, DESIGN AND INNOVATIVE RESEARCH 2025

ABSTRACT BOOK

-SINOP UNIVERSITY PUBLICATIONS-

SINOP UNIVERSITY

2nd INTERNATIONAL SYMPOSIUM ON ENGINEERING, DESIGN AND INNOVATIVE RESEARCH

ABSTRACT BOOK

14-15 MAY 2025 / SINOP

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ABSTRACT BOOK

14-15 MAY 2025 / SINOP

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PREFACE

The 2nd International Symposium on Engineering, Design, and Innovative Research (2nd ISEDIR 2025) was held on May 14-15, 2025, organized by the Faculty of Engineering and Architecture at Sinop University. This symposium aimed to provide a platform for researchers, professionals, and students to exchange ideas, discuss challenges, and explore innovative solutions in various engineering and design fields.

During the symposium, a total of 69 oral presentations were delivered, covering a wide range of disciplines including Nuclear Energy Engineering, Environmental Engineering, Computer Engineering, Metallurgical and Materials Engineering, Mechanical Engineering, Aerospace Engineering, Civil Engineering and Architecture, Energy Systems Engineering, and Fisheries Engineering. The multidisciplinary nature of the symposium encouraged cross-disciplinary collaboration and fostered an environment of knowledge-sharing and innovation.

The abstracts of the presented papers were published in this "Abstract Book," ensuring the dissemination of the valuable findings and insights shared during the symposium. Furthermore, participants have the opportunity to publish their full papers in peer-reviewed journals affiliated with Sinop University, providing a broader platform for their research contributions.

We would like to express our sincere gratitude to all authors, reviewers, session chairs, participants, and organizing committee members whose dedication and efforts have made ISEDIR 2025 a memorable and impactful event. Their contributions have been pivotal in fostering academic and professional growth through this symposium.

Dr. Mustafa Can CANOĞLU
May 2025

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Abstract

Conventional energy sources are increasingly at odds with contemporary environmental sustainability objectives; hence, there is a growing interest in renewable and environmentally friendly alternatives. Biodiesel is characterized by low toxicity, high biodegradability, and little emissions; yet, it is susceptible to oxidative breakdown because of its polyunsaturated fatty acid content. This circumstance reduces the fuel's storage lifespan and adversely impacts engine performance. A natural phenolic compound called *Tobacco* extract was used in this study to make biodiesel-diesel (50% biodiesel + 50% diesel) blends more resistant to oxidation. The extract from the soxhlet process was mixed into the fuel at a concentration of 3000 ppm, and its effects were compared to those of TBHQ, a man-made antioxidant. We tested the antioxidant activity using FT-IR (Fourier Transform Infrared Spectroscopy), TGA (Thermogravimetric Analysis), and DSC (Differential Scanning Calorimetry), which are thermal and chemical methods for characterizing things. We tested the extract's ability to remove free radicals using DPPH and ABTS methods. The results show that *Tobacco* is a strong natural antioxidant that greatly slows down the oxidative breakdown of the biodiesel-diesel mix. *Tobacco* possesses significant promise as a natural addition in biofuel technology.

Keywords: *Tobacco,* Biodiesel, Natural Antioxidant, Oxidative Stability, DPPH and ABTS Assays

Effect of PAL (Porpoise ALert) Device to Reduce of Bycatch of Harbor Porpoise, *Phocoena phocoena relicta* (Mammalia: Cetacea) and Black-Throated Diver, *Gavia arctica* (Aves: Gaviiformes) in The Turbot Gill Net Fishery, Black Sea

Sabri BİLGİN[1*], Süleyman ÖZDEMİR[1], Romulus-Marian PAİU[2], Ümit AYDIN[3], Kerim CEVAHİR[3] and İlyas Demir BİLGİLİ[1]

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Abstract

This study was conducted to determine the effect of PAL (Porpoise ALert) devices on reducing the incidental catch of marine mammals and sea birds in turbot gillnets between March and June 2022 around the Sinop peninsula, Black Sea. A total of six specially designed PALs were used as acoustic deterrents. The active net was prepared by attaching six PALs at 200 m intervals along a 1 km-long net. Another net of the same characteristics and length was used as a control net.

In the control nets (10 trials), a total of 80 turbots (*Scophthalmus maximus*), 79 thornback rays (*Raja clavata*), 53 harbor porpoises (*Phocoena phocoena relicta*), and 66 black-throated divers (*Gavia arctica*) were caught. In contrast, the nets equipped with PALs caught 112 turbots, 226 thornback rays, 1 common stingray (*Dasyatis pastinaca*), 8 common dolphins (*Delphinus delphis ponticus*), 33 harbor porpoises, and 8 black-throated divers.

The CPUE value for harbor porpoises was 0.219±0.1147 km/day (95% conf. interval: -0.0405 to 0.4785 km/day) in active nets, while it was 0.323±0.0826 km/day (95% CI: 0.1662 to 0.5098 km/day) in control nets. The CPUE value for black-throated divers was calculated as 0.376±0.1634 km/day (95% CI: -0.0064 to 0.7456 km/day) in active nets, whereas it was 0.052±0.0269 km/day (95% CI: -0.0088 to 0.1128 km/day) in control nets.

The number of harbor porpoises caught in the PAL-equipped nets decreased by 61.6%, while the number of black-throated divers decreased by 89.2%. However, PALs did not have a significant positive effect in reducing the bycatch of common dolphins.

These results demonstrate that PALs significantly reduced the incidental catch of seabirds and harbor porpoises.

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Keywords: Porpoise Alert Device, Harbor Porpoise, Black-Throated Diver, Turbot Gillnet, Bycatch.

The Role of Wireless Sensor Networks in Military Operations: A Survey

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Abstract

Wireless Sensor Networks (WSNs) are today a key technology of contemporary military applications due to their cost-effectiveness, scalability, and ability to provide real-time actions. WSNs are widely used in military applications for intelligence, surveillance, reconnaissance, environmental monitoring, and battlefield awareness thanks to the spatially distributed autonomous sensor nodes that sense, process, and transmit important information. So that they can provide enhanced decision support, minimal operational risks, and enhanced mission accomplishment. Although they have advantages, the application of WSNs in hostile and dynamic military operations is confronted with many challenges. Security, privacy, fault tolerance, real-time operation, scalability, and self-organization are of utmost importance in this respect. Apart from, energy efficiency, node mobility, data reliability, and attack tolerance are key factors influencing their operational usability. Current research works have proposed various solutions, like AI-integrated data processing, block chain-based security mechanisms, and bio-inspired optimization algorithms to address the above issues. The aim of this work is to provide a detailed overview of the application of WSNs in military application, their building blocks, types of applications, and operational requirements. It also explains the state-of-the-art technology development at present and critically examines existing solutions to overcome main limitations. Through the examination of the recent, and future works, this research offers a better comprehension of how WSNs can evolve into more adaptive, secure, and effective military systems. The research findings are expected to serve as a roadmap for researchers and practitioners who seek to design next-generation military sensor networks.

Keywords: Wireless Sensor Networks, Military Applications, Surveillance Systems, Battlefield Monitoring

Investigation of the Wind Speed Effect on the Reflected GNSS Signals

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Abstract

Sea level rise is one of the most important impacts of global climate change. It also has significant effect on the environmental, social, and economic along with coastal areas. Sea level can be observed using the reflected signal thanks to Global Navigation Satellite System Interferometric Reflectometry (GNSS-IR). GNSS antennas receive both the direct signal from GNSS satellites and the reflected signal from surrounding surfaces. The effect of wind speed on the reflected GNSS signal was investigated in this study. The sea level was estimated from the Signal-to-noise ratio (SNR) recorded at the International GNSS Service (IGS) permanent station, MERS, located in Erdemli, Mersin, on the Mediterranean coast of Türkiye. SNR data at the MERS site was collected over three years. GPS signals were used in the study. In addition, this study uses the ERA5 reanalysis measurements (CDS 2021) as the daily wind speed dataset. The northwards component of the 10 m wind (V10) and the eastwards component of the 10 m wind (U10) are used to assess the effects of wind speed on the reflected signals. The results suggest that the wind speed could have an impact on the MERS site, especially in the winter.

Keywords: Sea Level, Global Navigation Satellite System Interferometric Reflectometry, Wind Speed

Investigation of the Effects of Textile Waste Fabric Fibers on the Behavior of Concrete

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Abstract

The energy absorption capacity of concrete is a highly significant parameter for this material. Due to the brittle nature of concrete, sudden failure or collapse is observed when the capacity is exceeded. By increasing the energy absorption capacity, improvements in the behavior of the concrete matrix during sudden failure or collapse can be observed. This can be achieved by modifying the parameters that constitute the concrete matrix. The water/cement ratio, aggregate structure and composition, choice and usage rates of additives, and the presence of fibers are identified as parameters that strengthen the concrete matrix. To prevent crack propagation, there has been a focus on mechanisms to enhance toughness, and the concrete design has been carried out in light of RPB and other studies in line with the working objectives. With the increased energy absorption capacity, the ductility and deformation limits of concrete rise. This approach has the potential to prevent sudden collapses during earthquakes, thereby safeguarding lives and property. This study aims to enhance the toughness of concrete by making modifications in the areas of aggregates, additives, and especially fibers. Fabrics produced from textile waste have been chosen as fibers, and during the experiments, the structure, usage rates, and effects of fibers derived from textile waste on the concrete matrix have been investigated.

Keywords: Concrete Matrix, Fiber, Textile Waste, Fabric, Toughness

Effect of Structure Height, Concrete Class and Soil Class on Structure Displacement in Reinforced Concrete Structures

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Abstract

Reinforced concrete structures are subjected to horizontal loads such as earthquake and wind from time to time during their economic life. The structure makes horizontal displacement under these loads. Considering that our country is located in an earthquake zone, it has become mandatory for structures to receive engineering services in order to reduce the loss of life. As the most important factors affecting the displacement of the structure, the parameters of building height, concrete class and soil class were preferred among the main analysis factors within the scope of the study. At the same time, the increasing population in our country and in the world has increased the need for high-rise buildings. With increasing building height, the mass of the structure increases and the horizontal forces acting on the structure also increase. This situation also increases the amount of displacement that will occur in the structure. The reinforced concrete structural system elements of the analyzed building are designed in an optimum manner and in accordance with the 2018 Turkey Building Earthquake Regulations. The analyzed building is located in Konya province of Central Anatolia, where there are still active fault lines and earthquake risk should not be ignored. Within the scope of the study, 8, 7, 6, 5-storey buildings with different building heights, different concrete classes C30, C40 and different soil classes ZC, ZD parameters and ZC-C30, ZC-C40, ZD-C30, ZD-C40 combinations were used to calculate the peak displacements and relative storey drifts for the hammering effect in adjacent buildings using 3D IdeCAD Static analysis program and the calculated values were evaluated by comparing them with the boundary conditions of section 4.9 of the 2018 Turkey Building Earthquake Code.

Keywords: Building Displacement, Building Height, Concrete Class, Soil Class, Horizontal Loads.

The Dimensions and Causes of Urban Decay in Old Kabul

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Abstract

Afghanistan’s capital, Kabul, stands as one of the key centers of the country’s cultural identity with its deep historical background and architectural heritage. The Old Kabul district, in particular, has long served as a convergence point for various civilizations and a space enriched with strong socio-cultural interactions. However, the prolonged political conflicts, wars, and instability over the past forty years have deeply disrupted the physical structure and social fabric of this historic area. Massive waves of migration, economic hardship, and unregulated urbanization have led to a significant loss of the district's historical value.
This study aims to examine the processes of urban decay and social disintegration in Old Kabul from a multidimensional perspective. Based on field observations and literature review, the analysis addresses the physical, social, economic, environmental, and administrative aspects of urban deterioration in the region. The destruction of adobe architectural structures, collapse of infrastructure, and disappearance of traditional economic activities represent the most visible signs of physical and economic decay. Meanwhile, weakened social ties, population mobility, and fading cultural memory further deepen the extent of social disintegration. A key barrier to overcoming these issues is the lack of coordination in urban management and institutional capacity.
The findings emphasize that spatial interventions alone are not sufficient for the revitalization of Old Kabul. Instead, a comprehensive and participatory restructuring strategy that includes the city's social, economic, and administrative dimensions is needed. In this context, preserving the unique historical identity of the region, ensuring economic sustainability, and strengthening social resilience are proposed as fundamental principles for future interventions.

Keywords: Historic Fabric, Urban Decay, Restoration, Conservation, Old Kabul

Sustainable Usage of Used Herbal Tea as a Color Removal Agent for Textile Wastewater

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Abstract

The color originating from dyestuff in streams is a major problem that causes several problems for aquatic organisms and the people who use these sources for water supply. So, this problem should be solved in the source. One of the most important treatment methods for removing color from wastewater is the adsorption technique. In this study, a novel adsorbent material, used herbal (sage) tea (UHT), was utilized to remove a basic dye which was frequently used in the textile industry. UHT was collected from used tea bags. The color of the tea was removed by boiling in distilled water several times until the natural color of the tea was fully eliminated. After drying the tea particles, they were crushed into powder form and then dried again. The textile dye (BB41) used in the studies was dissolved in distilled water to prepare the textile dye solution prior to the adsorption process. The supernatant containing dye and adsorbent particles was mixed in a shaker to provide sufficient contact time (1 day) for the adsorption process. After that time, the treated solution was analyzed using a spectrophotometer operating at 610 nm. The adsorption performance of the UHT was found to be nearly the same at all investigated pH values except pH 2. The highest adsorption efficiency was obtained at pH 4 as above 98%. The most practicable pH seems to be 8 (adsorption efficiency > 97%) because of the higher pH nature of real textile wastewaters. The maximum uptake capacity of this adsorbent was also found to be above 300 mg/g, which was quite a high capacity for this kind of material. Consequently, this adsorbent presented promising results for the adsorption of basic dyes from textile wastewaters. UHT seems to be an eco-friendly adsorbent material that supports sustainable waste management.

“Pamukkale University, Scientific Research Coordination Unit was financially encouraged this study with a project number of 2023FEBE023.”

Keywords: Textile Wastewater, Basic Dyestuff, Adsorption, Herbal Tea Residual

Determination of Gamma Radiation Shielding Parameters of Some Thermo-Sensitive Polymers

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Abstract

Thermo-sensitive polymers, which are smart polymers, have the ability to respond to temperature changes. These polymers are generally soluble in water at low temperatures and become insoluble at higher temperatures. There are many applications that are interested in thermo-sensitive polymers due to their ability to change their physical properties in response to temperature stimuli, such as drug delivery, surface coating, films and membranes, actuators and water treatment. In the present study, the gamma radiation shielding capacities of Poly(N-isopropylacrylamide) (PNIPAM), Poly(methylvinylether) (PMVE), Poly(vinylcaprolactom) (PNVC) and Poly(ethylene oxide) (PEO) thermo-sensitive smart polymers were investigated. The studies were carried out with the help of WinXCOM interface in the energy range of 0.015 to 15 MeV. The obtained gamma-ray shielding parameters are mass and linear attenuation coefficients, half and tenth value layers and effective atomic number. When the results of these parameters were examined, it was observed that PEO had a superior gamma radiation shielding capacity than the other studied thermo-sensitive polymers in the low energy region where the photoelectric effect is dominant. In the medium energy region where Compton scattering is dominant, it was observed that PMVE had a better this property. These polymers can be preferred in water-cooled nuclear reactors.

Keywords: Thermo-Sensitive Polymers, WinXCOM, Gamma Ray Shielding

Monitoring and Prediction of Seawater pH Changes in Sinop Coastal Waters with Machine Learning Based Models

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Abstract

A critical indicator for global climate change, acidification has an immense and irreversible impact on biodiversity hotspots. These effects ultimately result in the collapse of ecosystems and profound alterations to life as it is known. Acidification in the Black Sea, which is isolated from the oceans, may cause serious ecosystem damage. Recently, the monitoring of acidification in the seas is highly remarkable. The focus of this study is to determine the concentrations of pH, dissolved oxygen (O_2), carbon dioxide (CO_2), temperature, and analyze their relationships with seawater pH.

This research aimed to monitor the changes in the pH levels of the Black Sea seawater over the province of Sinop and predict them using machine learning-based prediction models. For the study, the Copernicus satellite provided the seawater data for the Black Sea Region (Sinop province) on a daily basis between June 1, 2022, and March 28, 2025. The Copernicus Marine Environment Monitoring Service (CMEMS) strives to raise awareness about the condition of the marine environment and its transformations by publishing annual reports on the health of the oceans and European regional seas. In the analysis part of the study, the comparison of the analyzed models was compared with the values of MAPE, RMSE and R^2. Features such as seawater temperature and surface partial pressure of carbon dioxide ($spCO_2$) of the seawater which actively determine the pH and its changes were considered for model development. The results obtained provide important contributions in terms of monitoring seawater chemistry at regional scales and early detection of possible environmental changes.

Keywords: Seawater, pH, Machine Learning, Black Sea, Acidification

Impact of Global Warming on Marine Ecosystem: Prediction of pH Changes by Machine Learning

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Abstract

An increase in temperature along with an increase in carbon dioxide (CO_2) concentration poses a challenge for the marine environment. Sometimes changes in seawater pH level which cannot be measured using common techniques can lead to ecological dangers being ignored. The reduction (acidification) of pH in oceans has direct impacts like loss of species and indirect impacts like alteration of dominant species, realignment of ecological functions, and shifting community organization patterns. This study aimed to track and reliably forecast changes in pH of the ocean using machine learning techniques. Sea water data of the Black Sea Region (Giresun province) obtained daily by the Copernicus satellite (01.06.2022-28.03.2025) were used as a dataset. It was carried out to estimate the pH concentration using important parameters such as temperature and surface partial pressure of carbon dioxide ($spCO_2$) in seawater. The study's analytical section compared the models that were examined to the MAPE, RMSE, and R^2 values.

The main objective of this study is to accurately predict pH changes in seawater off the coast of Giresun province with machine learning algorithms; in addition, it is aimed to evaluate the effects of climate change, contribute to the protection of marine ecosystems, develop early warning systems, provide scientific data for environmental policies and examine the adaptability of artificial intelligence-based monitoring methods to regional conditions.

Keywords: Machine Learning Algorithms, Seawater, pH, Black Sea, Acidification

A Study on the Gamma-Ray Shielding Capacity of Some Hydrophobic Polymers

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Abstract

The studies were carried out on 4 different hydrophobic polymers, namely Polyvinylpyrrolidone (PVP), Polystyrene (PS), Polytetrahydrofuran (PTHF) and Polyisoprene (PI), which are frequently preferred in many areas from clothing technology to car tires in systems/areas where water is not desired. In the study, the mass attenuation coefficient, linear attenuation coefficient, half-value length, mean free path and effective atomic number of gamma radiation shielding parameters at 24 different photon energies ranging from 0.015 to 15 MeV were investigated with the EpiXS program. It was noted that the highest LAC value at 0.015 MeV among the investigated polymers belonged to PVP polymer with 1.1703 $cm^{-1.}$ Again, the highest effective atomic number value at 0.015 MeV photon energy was found to belong to PVP polymer with 5.6249. PVP polymer can be preferred in areas where water removal is important and especially in nuclear power plants.

Keywords: Gamma Shielding, EpiXS, Hydrophobic Polymers

Artificial Intelligence Applications in the Construction Sector

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Abstract

Artificial intelligence (AI) studies, which are becoming more widespread on a daily basis in many different industries, are also increasing their utilisation in the construction sector. In addition to providing a comprehensive overview of AI technologies in the construction industry, this study investigates how they can be integrated into several subfields, including transportation systems, geotechnical studies, structural analysis, hydraulics, material sciences, and construction management. AI technologies widely used in the construction industry—techniques such as machine learning, deep learning, neural networks, fuzzy logic, and image processing—enable more effective solutions in many areas, especially project planning, risk management, real-time monitoring, and resource optimization. Today, construction sites have become safer and more efficient due to the use of drones, autonomous systems and smart machines. It is anticipated that it will develop even more with the development of AI. The scope of this study is to examine the market trends and economic implications of AI-powered robotic technologies in the construction industry. The study illustrates the growing scholarly and commercial interest in AI-driven construction innovations through a review of the literature from databases such as Scopus (2000–2025). The conclusion drawn from the research is that applications of AI not only increase sustainability and productivity but also open the door to a technologically sophisticated construction ecosystem.

Keywords: Artificial Intelligence, Machine Learning, Robotics, Autonomous Systems

Theoretical Calculation of Gamma Radiation Shielding Properties of Some Biomedical Polymers

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Abstract

Through a process known as polymerization, big organic molecules (macromolecules) are joined by repeating small structural units (monomers) to form polymers. Every molecule is made up of thousands of atoms joined by covalent chemical bonds; the forces that pull molecules together in a polymer vary depending on the kind of polymer. In the present study, gamma-ray shielding characteristics of biomedical polymers like Chitosan ($C_{18}H_{35}N_3O_{13}$), Cellulose ($(C_6H_{10}O_5)_n$), Polycaprolactone ($(C_6H_{10}O_2)_n$), and Polyglycolide ($(C_2H_4O_3)_n$) were determined. Chitosan may be used as a flocculant, in protein precipitation, encapsulating agent and aqueous thickener. Forms gels with multivalent anions. Gives clear solutions that dry to strong, clear films. Cellulose is used as a bulking agent, opacifier, anti-caking agent, extrusion aid and stabilizer for foams and emulsions. High purity cellulose powders are preferred for partition chromatography. Due to its excellent toughness, biocompatibility, and cost-effectiveness, polycaprolactone, a semi-crystalline hydrophobic biodegradable polyester, is extensively used as a drug delivery vehicle. A biodegradable copolymer for use in implants can be made using polyglycolide and polylactide. There have been reports of the fabrication of biopolymer/carbon nanotube composites with polyglycolide fiber as one of the composite's ingredients.

The mass attenuation coefficients (μ/ρ), linear attenuation coefficients (μ), half value layer (HVL), mean free path (MFP), and effective atomic number (Z_{eff}) for these biomedical polymers in the gamma-ray energy range of 0.015-15 MeV were calculated. EpiXS program was used to investigate the gamma-ray shielding characteristics of these biomedical polymers. The μ, HVL and MFP parameters were determined using the leading parameter, the mass attenuation coefficient. The order of the linear attenuation coefficients of the investigated biomedical polymers was generally determined Polyglycolide > Cellulose > Polycaprolactone > Chitosan. In other words, it was observed that Polyglycolide is a better gamma-ray radiation shielding material than the other studied biomedical polymers.

Keywords: Biomedical Polymer, EpiXS, Mass Attenuation Coefficient, Half Value Layer

Investigation of the Effect of Jute Mesh Use on Thermal Insulation in Buildings

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Abstract

When thermal insulation is applied in buildings, we want each material used in the application to contribute to insulation. In addition, the materials used should be able to save energy, not be dependent on fossil fuel resources, not cause carbon emissions and be sustainable. When insulation is applied to external walls, the layers of the building component are, wall, plaster, thermal insulation board, plaster, mesh and plaster. When insulation calculations are made, the thickness and thermal resistance of these building elements are considered, and the heat permeability coefficient of the building component is calculated. However, when insulation calculations are made, the mesh used to prevent cracks that may occur due to thermal stress at the joints of the boards is not included in the calculations.

In this study, the effect of using jute mesh, which is a material that will contribute to thermal insulation, on the insulation and environment, instead of the fossil-based mesh that is mostly used today, was investigated. For this study, thermal insulation calculations were made for the new building of Sinop University Faculty of Engineering and Architecture where traditional thermal insulation materials were applied, and then the same calculations were made according to the use of jute mesh. For both different cases, the amount of annual heating energy and CO_2 emissions were compared.

According to the results, it was determined that the annual heating energy requirement was reduced by 646 kWh and CO_2 emissions by 164.29 kg in the case of using jute mesh compared to using traditional mesh. Although the difference is small, the fact that jute mesh is plant-based creates a more sustainable situation in terms of the environment. Moreover, it is considered important in terms of not being fossil-based and providing new support to the agricultural economy.

Keywords: Jute Mesh, Thermal Insulation, Sustainability

Investigation of Interactions of DNA Bases with Gamma-Rays

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Abstract

Living things are constantly exposed to several physical and chemical substances that might harm the cells' RNA, DNA, lipids, and proteins. Deoxyribonucleic acid (DNA) is a prominent target for the biological impacts of ionizing radiation, as is evident from the study of radiation-chemical effects on DNA. In this study, the interaction of the organic bases of DNA, Adenine, Thymine, Guanine and Cytosine, with gamma rays were discussed.

The mass attenuation coefficients (μ/ρ), linear attenuation coefficients (μ), effective atomic numbers (Z_{eff}), exposure buildup factors (EBF), and energy absorption buildup factors (EABF) for these DNA organic bases in the gamma-ray energy range of 10-150 keV were calculated. WinXCOM program was used to investigate the gamma-ray interaction parameters of these DNA organic bases. This interface is a straightforward Windows-based application that is commonly utilized in these kinds of investigations.

When the mass attenuation coefficients of the studied DNA organic bases were ranked, it was determined that the Thymine organic base interacted with gamma-rays more than the other bases in the low energy region. Considering the linear attenuation coefficient results in all energy regions, it was observed that the Guanine organic base interacts with gamma-rays more than the others. Also, it was observed that the EBF and EABF results reached maximum values in the 60-100 keV photon energy range.

Keywords: DNA Organic Bases, WinXCOM, Mass Attenuation Coefficient, Energy Absorption Buildup Factor.

A Comparative Analysis of Başakşehir Earthquake Housing and Metrokent Site in the Context of Housing and Apartment Standards

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Abstract

Başakşehir Earthquake Housing, which was built to provide permanent housing after the 1999 Earthquake, was declared an on-site transformation area. In this context, new plan proposals were presented where the density in the area was increased. In this study, a quality comparison was made with the densely populated Metrokent Site located in the neighboring parcel of the area. Thus, it was aimed to evaluate the quality and necessity of the transformation by comparing the area with a region with similar characteristics after the transformation.

The comparison is based on the Housing and Apartment standards determined by METU; MATPUM and TOKİ and the standards covering the immediate surroundings and structural features. Literature research, document analysis, interviews and fieldwork were used in this study.

While Başakşehir Earthquake Housing is more successful in terms of vehicle and pedestrian path design, orientation to entrances, ventilation and building density; Metrokent Housing is more successful in terms of common areas, storage areas, wet area design and accessibility. While there is no bicycle path in both residences, Earthquake Housing is better in terms of sports area location selection. While the main landscape in Metrokent is designed in parts, the central landscape design on a block basis in Earthquake Housing draws attention. While the bedrooms in Earthquake Housing are more efficient and healthy in terms of natural light, the population and building density of the mass housing area of Metrokent is approximately 3 times that of Earthquake Housing.

Considering the building density opportunity of Earthquake Housing, the current texture and qualities of Başakşehir Earthquake Housing should be preserved, and the rearrangement of missing elements such as accessibility and common area use will increase spatial quality. As a result, a more economical and ecological approach has been proposed that will prevent the loss of existing strengths after the transformation.

Keywords: MATPUM, Earthquake Housing, Spatial Quality, Urban Transformation, Reserve Area

Chlorination Before Wastewater Reuse: A Solution or New Environmental Problem?

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Abstract

The reuse of treated wastewater for agricultural irrigation is increasingly advocated as a sustainable strategy to mitigate water scarcity, particularly in regions facing intensifying climatic and demographic pressures. While microbial safety is typically ensured through disinfection processes, the persistence of residual micropollutants -including pharmaceuticals, personal care products, and endocrine-disrupting compounds- in treated effluents raises critical concerns regarding potential long-term risks to environmental and human health. Among the available disinfection methods, chlorination is widely employed due to its operational simplicity and cost-effectiveness; however, its application for water reuse purposes requires careful investigation, particularly in light of its limited efficacy in removing micropollutants and its potential to generate transformation products (TPs) with unknown or elevated toxicity.

Empirical evidence indicates that although chlorination can achieve moderate removal of selected micropollutants, it simultaneously facilitates the formation of a diverse array of chlorinated and non-chlorinated TPs. The reuse of chlorinated effluents for irrigation has been associated with adverse impacts on soil ecosystems. In particular, studies have demonstrated that exposure to chlorinated wastewater under conditions of elevated chlorine doses and extended contact times can elicit harmful effects on soil invertebrates, even in the absence of detectable parent compounds. These observations suggest that chlorination-induced TPs, or chemical interactions within the wastewater matrix, may substantially contribute to soil ecotoxicity.

Overall, while chlorination remains effective in enhancing microbial safety, it is evident that it may concurrently introduce significant environmental risks through the formation of toxic TPs. As the global adoption of wastewater reuse for agricultural purposes continues to expand, these findings underscore the need for a critical assessment of chlorination's environmental sustainability. Further research is essential to elucidate the long-term impacts on soil biota and ecosystems, and the suitability of chlorination as a method for ensuring safe water reuse remains an important subject of ongoing investigation.

Keywords: Disinfection, Micropollutants, Transformation Products, Ecotoxicity

Comparison of Needle Penetrometer and Uniaxial Compressive Strength Test Results for the Ignimbrites of Cappadocia Region

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Abstract

Ignimbrites, which are widespread in the Cappadocia Region of Türkiye, have been carved and used as living spaces from past to the present thanks to their easy-to-process structure. Rock-hewn structures used as churches, underground cities, dwellings, warehouses in the past are now serving as accommodation facilities, restaurants and museums with the development of tourism in the Cappadocia Region. In order to determine the strength of the ignimbrites surrounding the rock-hewn spaces, which are different from well-known construction techniques such as reinforced concrete, steel and wood, the samples taken on site are transported to the laboratory and subjected to uniaxial compressive strength test. Nevertheless, determining the uniaxial compressive strength of rocks is a very laborious and time-consuming process due to the necessity of preparing samples in standard sizes. It is sometimes impossible to directly determine the uniaxial compressive strength of pyroclastic rocks due to the difficulties in sample preparation, especially in low strength rocks. At this stage, non-destructive test methods are preferred and uniaxial compressive strength is determined indirectly.

Due to the abovementioned limitations, a non-destructive test instrument namely Needle Penetrometer is widely used for the estimation of uniaxial compressive strength of weak rock materials. Needle penetration test is a non-destructive index test that can be applied both in the field and in the laboratory and does not require special specimen preparation.

In this study, a total of 155 ignimbrite specimens were collected from 16 different locations in the Cappadocia Region and subjected to both Needle Penetrometer and Uniaxial Compressive Strength tests. Consequently, an experimental relationship with a determination coefficient of 0.79 was developed based on the test results. Finally, the uniaxial compressive strength of ignimbrites in this cultural heritage site can be well-estimated by the proposed equation using the Needle Penetrometer test results.

Keywords: Needle Penetrometer Test, Uniaxial Compressive Strength, Pyroclastic Rocks

Prediction of Potable Water Using Random Forest Model

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Abstract

Accurate detection of drinking water quality is critically important for public health. This study evaluates the performance of the Random Forest model applied to classify water potability. The results obtained show that the overall accuracy of the model is at an acceptable level (69.36%), but there is potential for improvement, especially in identifying potable water (38.11% sensitivity). ROC curve analysis reveals that the model has a moderate discrimination ability (AUC = 0.69). The abundance of false negative predictions necessitates the improvement of this aspect of the model, as it can lead to the incorrect rejection of safe water sources. Consequently, enhancing the effectiveness of the Random Forest model in drinking water quality classification or trying different models is of great importance for the sustainable management of water resources and the protection of public health.

Keywords: Random Forest Model, Machine Learning, Drinking Water Quality, Public Health

Comparison of Magnetic Field Formation on Coil Using Ganfet and Mosfet Switching Elements

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Abstract

Magnetic field generation is of critical importance in industrial and military applications, especially in PI-based metal detectors. In this study, simulation analysis of the effect of coil induction and magnetic field generation will be performed by switching GANFET and MOSFET elements with pulse signals.

Under the same electrical conditions, coil switching will be performed by applying a pulse signal to the coil. The effects of two different semiconductor elements on the system will be examined. The magnitude of the magnetic field created, its effect on system efficiency, physical changes on the switching element and coil will be discussed. Within the scope of this research, simulation analysis will be performed for both elements with computer-aided programs.The data obtained from the simulation will be compared and prepared as a report.

Keywords: PI detector, Magnetic Field, Coil Switching, Semiconductors, GanFET

A Situation Assessment on Water Efficiency in Türkiye

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Abstract

Türkiye is located in the Mediterranean zone where the effects of global climate change are intensely felt and is considered among the high-risk countries. With climate change, rapid population growth, increasing industrialization and other environmental problems, the future of water, the source of life, and therefore humanity, is under threat. Our country is not rich in water, on the contrary, it is among the regions under water stress with the usable water amount per person being 1,313 m^3 per year. It is necessary to take action on a national scale and take urgent measures regarding water efficiency. Unless necessary measures are taken to protect and use water resources efficiently, Türkiye is expected to be among the countries experiencing water shortages by 2030. In this study, the current status of water resources in our country and studies on efficient use of water were evaluated. More efficient use of alternative water resources was investigated with methods such as reducing water losses, rainwater harvesting, use of grey water, and reuse of treated wastewater. The current situation of our country and what needs to be done regarding the use of efficient technologies in agriculture, industry, and individual water use and the dissemination of conscious production have been evaluated.

Keywords: Climate Change, Water Efficiency, Water Resources

Nuclear Waste Management Strategies at Akkuyu Nuclear Power Plant

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Abstract

Türkiye started the works with the establishment of a commercial nuclear power plant 30 km southeast of Gülnar district of Mersin province as a result of field studies and feasibility studies in 1970. With the agreement signed between the governments of Russia and Türkiye on May 12, 2010, it was aimed to establish a commercial nuclear power plant in Akkuyu region. With the agreement in question, works were started to establish 4 VVER 1200 type pressurized water reactors in Akkuyu region. Nuclear power plants are facilities that produce electricity commercially by subjecting fuels placed in reactor cores to fission reactions with various methods. When the fuels used in these facilities lose the fuel feature required for nuclear fission over time, new fuels are added to the reactor core instead and the used fuel is removed from the reactor core. Radioactive wastes removed from the power plants are first kept in spent fuel pools in the power plant area for a certain period of time in order to be cooled. It is expected that the temperature of the radioactive wastes will decrease and reach a radiologically safe level with this process. After being kept in the pools for a sufficient time, the wastes are taken to pre-disposal and processing facilities and made suitable for long-term storage. The management of these radioactive wastes inherent in nuclear energy is of great importance in terms of environmental sustainability and public health. In this study, the nuclear waste management strategies to be implemented at the Akkuyu nuclear power plant were examined in detail. Current practices on temporary storage of spent fuels, their return to Russia, processing of low and medium-level wastes, and storage under appropriate conditions were discussed.

Keywords: Akkuyu Nuclear Power Plant, Nuclear Waste Management, Radioactive Waste, Nuclear Energy in Türkiye, Radiological Safety

Exploring the Potential of Waste-to-Energy Residues for Water Treatment Applications

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Abstract

The increasing generation of waste-to-energy residues (fly ash and bottom ash) has prompted investigations into their potential reusability in environmental applications. In this study, we explore the utilization of waste-to-energy residues as a functional material in water treatment, focusing on its structural characteristics and reactivity. Literature findings indicate that waste-to-energy residues, depending on their origin and treatment processes, can serve as adsorbents for heavy metals and organic pollutants, coagulant aids for particle removal, sources of alkalinity, and even catalysts in advanced oxidation processes such as Fenton-like reactions. Particularly, ashes rich in iron content are promising for promoting hydroxyl radical generation when combined with hydrogen peroxide. In the second part of this study, preliminary experimental investigations were conducted to evaluate the leaching behavior of metal ions from the fly ash and bottom ash and its potential to act as a catalyst in Fenton-based treatment systems. Initial results demonstrate that iron and other transition metals can be mobilized from the ash matrix under controlled conditions, creating opportunities for in situ hydroxyl radical production. Moreover, adsorption experiments suggest a moderate capacity for pollutant removal without additional modifications. These findings highlight the dual potential of waste-to-energy residues as both a reactive and adsorptive material in water treatment. Overall, this study underscores the importance of further research into the physicochemical optimization of ash-derived materials to enhance their efficiency and safety in environmental applications.

Keywords: Incineration Ash, Water Treatment, Fenton Process, Adsorption

Microplastic Pollution in Mountain Ecosystems: Its Spread, Sources, and Potential Environmental Impacts

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Abstract

Microplastics (MPs) have become a significant focus of attention in both society and scientific research in recent years due to their potential impacts on ecological systems and human health. Microplastics have been found in various parts of the world, including the atmosphere, oceans, rivers, soil, freshwater, and even food. Mountain ecosystems are recognized indicators of global change. In the analysis of the impacts caused by local or global human activities, microplastic pollution is a critical environmental concern for mountain ecosystems. In these high-altitude regions with no permanent settlements, pollution mainly originates from mountain tourism activities such as climbing, trekking, hiking, and skiing. As a result, air, water, soil, and the landscape are at risk of degradation. Mountaineering activities create various impacts on the natural environment of high mountains, including changes in land relief, fauna and flora, and pollution. The human-induced effects on high mountain areas will soon lead to consequences in downstream basins as well. Therefore, it is extremely important to reduce anthropogenic impacts on mountains. Tourists, trekkers, and mountaineers are polluting highland routes, either voluntarily or involuntarily, through plastic-based pollutants such as food packaging, tin cans, and plastic bottles, and as a result, they are releasing large amounts of microplastics into the environment. Studies on the impact of tourism on microplastics, especially in high mountain regions, are limited worldwide. This study is one of the first to aim at examining microplastics in snow samples from mountainous areas and seeks to bring together existing studies on this topic in the literature.
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Keywords: Microplastics, Mountain, Plastic-Based Pollution

Detecting Synthetic Voices with Deep Feature Fusion and Ensemble Learning

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Abstract

Recent advances in text-to-speech (TTS) and voice-conversion (VC) technology threaten audio realism by demanding reliable detectors. We introduce a two-stage methodology that fuses deep-CNN representations of Mel-spectrograms with temporal features including MFCCs, Δ, chroma, spectral contrast, and tonnetz, and classifies speech with an ensemble of Random Forest, XGBoost, and LightGBM models combined by majority vote. Speech from 135 students was captured at either 44.1 kHz or 48 kHz and recorded in mono or stereo, depending on the session, and for every sentence, three synthetic samples were generated with CoquiTTS, DiffVC, and FreeVC. An ablation study shows that CNN features alone are insufficient (9.3% accuracy), while combining all temporal features improves the performance to 100%. In five-fold cross-validation, the final EfficientNet-B0+ feature fusion model achieved 0.92-0.98 accuracy on the most challenging folds, and a stacked ensemble achieved 1.00 accuracy and F1 for each dataset variant. These results generalized across various CNN architectures, including EfficientNet-B1, EfficientNet-B4, EfficientNet-V2-S, EfficientNet-V2-M, Xception, ResNet-50. Results indicates that the performance ceiling depends on feature design rather than architecture. Grad-CAM visualizations confirm that the model pays attention to distinctive phonetic regions that differ subtly between real and synthetic speech. This work demonstrates that deep hand-crafted feature fusion combined with ensemble learning offers a simple yet transferable defense against emerging TTS and VC attacks.

Keywords: Synthetic Speech Detection, Audio Feature Fusion, Ensemble-Based Classification, CNN Architectures

Explainable Multi-Modal CNN–Radiomics Ensemble for Dental Lesion Detection

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Abstract

Accurate detection of periapical lesions in dental radiographs remains clinically vital yet technically challenging. We introduce an explainable multi-modal methodology that couples convolutional neural-network (CNN) representations with handcrafted radiomic descriptors and classical machine-learning (ML) ensembles. A dataset of 2286 greyscale intra-oral images (1193 lesion, 1093 healthy) was partitioned 70%, 15%, and 15% for training, validation and testing. Six fine-tuned CNN architectures (EfficientNet-B1/B4, EfficientNet-V2-S/V2-M, ResNet-50, and Xception) produced Grad-CAM attention maps that localised candidate lesions, from which 107 first-order and second-order radiomic features were extracted with PyRadiomics. Concatenated deep–radiomic vectors, optionally compressed via SelectKBest or principal-component analysis, were classified with Random Forest, support-vector machine, and XGBoost. End-to-end CNNs alone yielded ≤ 50% accuracy because of class imbalance, whereas the hybrid approach boosted performance dramatically. The Xception + radiomics + XGBoost model achieved 98% accuracy with an area under the ROC curve of ≈ 0.99 on the test set. A feature-level ensemble of Xception and ResNet-50 further improved robustness, maintaining about 98% accuracy under varied test-time augmentations. SelectKBest discarded more than 90% of features with negligible (< 1%) loss in accuracy. SHAP analysis revealed that texture-related radiomic attributes dominated lesion predictions, while CNN features supplied complementary anatomical context, enhancing interpretability. The proposed CNN–radiomics ensemble is data-efficient, resilient to augmentation and readily transferable to other small-sample medical-imaging tasks, offering a practical, explainable route toward decision support in dental practice.

Keywords: Periapical Lesion Detection, Dental Radiographs, CNN–Radiomics Fusion.

Information Privacy on Digital Maps

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Abstract

Today, the importance of geographical data is increasing in many areas from military planning to civil infrastructure projects. In particular, map data contains strategically important information and it has become critical to store and transmit these data securely. In this study, the use of steganography techniques for information hiding on maps is proposed. Steganography is the process of hiding data in the pixel values of the image with various methods.

In particular, by storing data such as military operation plans, sensitive coordinates, information belonging to public institutions and organisations or confidential infrastructure information invisibly on digital maps, unauthorised access to information is prevented and the operational load is reduced by reducing the need for external data transfer. In addition, this method simplifies data transfer formats, preserves file integrity and provides efficiency in terms of storage space.

In this study, an information hiding technique based on the LSB (Least Significant Bit) method on digital maps is proposed and analysed in terms of visual quality loss, data hiding capacity and security performance. In the future, it is evaluated that artificial intelligence supported dynamic steganography techniques can produce more powerful solutions in this field.

Keywords: Steganography, Map, Information Security, LSB, Data Hiding

From Notion to Space: Formal Reflections in Basic Design

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Abstract

The design process in interior architecture education is a multifaceted endeavor where abstract ideas are transformed into tangible spatial solutions through creative intelligence. Within this process, the terms “notion” and “concept” are often used interchangeably; however, they hold distinct theoretical differences. A notion provides an intellectual framework that allows individuals to interpret their environment, whereas a concept refers to the transformation of this framework into a formal and functional response to a design problem. While notions are grounded in intuition, experience, and metaphor, concepts are systematic interpretations of these ideas. Thus, a notion serves as the abstract starting point, while a concept guides the development of spatial form through elements such as color, texture, and form. This study explores the relationship between notions and concepts within interior architecture design studio education and examines how notion-based approaches contribute to students’ design processes. Specifically, the research analyzes how notional thinking is transformed into formal, sensory, and functional spatial qualities through student projects. The study employs an exploratory sequential design under the mixed-method strategy, integrating both qualitative and quantitative data. In the first phase, conducted with 53 first-year interior architecture students, the transformation of notional thinking into spatial constructions was observed over an eight-week period. Students’ design processes were evaluated through document analysis, drawings, and models. The findings indicate that students effectively translated abstract notions into spatial elements and developed functional designs suited to user profiles. Additionally, working through the challenges of materializing abstract ideas enhanced students’ skills in critical thinking, problem-solving, and achieving design coherence. The experience fostered creative approaches to design problems. In the upcoming second phase, the relationship between notion and concept will be examined through comparative analyses supported by student surveys, offering deeper insights into their interaction within the design education process.

Keywords: Notion, Concept, Basic Design, Space, Design Education

Influence of Dislocation Strain Fields on Surface Morphology

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Abstract

Internal stress fields, especially those produced by dislocations, essentially affect surface shape in crystalline solids. This work investigates computationally how edge dislocation-induced strain fields influence surface topography evolution via stress-coupled diffusion. We model a range of scenarios including single and multiple dislocations with different orientations and distributions by combining an indirect boundary element method and discrete dislocation model to resolve long-range elastic interactions with a continuum surface diffusion framework.

The results reveal that the order and presence of dislocations produce somewhat distinct morphological effects. Tensile sections encourage material buildup and bulging; compressive fields can cause acute depressions or crack-like characteristics. Multiple dislocations generate complicated surface modulations including persistent undulations and asymmetric patterns by their interacting strain fields. Although approximated through anisotropic mobility parameters, the directional dependence of surface diffusion does not change the final morphology but has a major effect on the rate and symmetry of pattern development.

This work offers a quantitative knowledge of how surface evolution is shaped by dislocation geometry, strain field intensity, and diffusion anisotropy taken all together. With consequences for surface engineering, crystal development, and defect-guided nano-structuring, the insights acquired support the larger endeavor to control surface structures via internal mechanical fields.

Keywords: Surface Morphology, Discrete Dislocation Model, Elastic Stress, Anisotropic Diffusion

Advantages and Limitations of Metal and Metal Oxide Nanoparticles as Fuel Additives

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Abstract

Nanoparticles have attracted great interest in recent years as fuel additives. The use of nanoparticles as fuel additives represents a significant breakthrough in fuel technologies in terms of efficiency and environmental sustainability. Due to their nanoscale size, high surface area, and catalytic properties, nanoparticles improve fuel combustion characteristics, reduce emissions, and enhance engine performance. The most commonly used nanoparticles in fuel technologies are metal oxides, pure metals, and carbon-based nanomaterials. Metal oxide and metal nanoparticles offer distinct advantages as fuel additives. Metal oxide nanoparticles (CeO_2, Al_2O_3, TiO_2, Fe_3O_4) stand out particularly due to their oxygen storage and catalytic properties. These nanoparticles can achieve homogeneous dispersion within the fuel. They enhance fuel combustion efficiency while reducing harmful emissions such as NO_x, HC and CO. Due to their high thermal stability and low cost, these particles are predicted to be suitable for use in diesel/gasoline engines. However, metal oxide residues may contribute to engine wear. In contrast, pure metal nanoparticles (Al, B, Cu, Ag) are notable for their high energy density. They are particularly used in rocket fuels and military applications. While metals enable high flame speeds, this characteristic requires careful control. Aluminum nanoparticles react with water to generate additional energy but are prone to oxidation and have high production costs. Another drawback is their tendency to aggregate in fuel, which may complicate filtration systems. Metal oxides are generally safer in terms of toxicity, whereas metal nanoparticles may pose inhalation risks. In conclusion, metal oxides are ideal for sustainable, low-emission solutions, while pure metals are preferred for high-performance specialized applications. The choice between the two should consider energy requirements, cost constraints, and environmental impacts.

Keywords: Nanomaterials, Nanofuels, Combustion, Emission

Hydrogen Production from Urea by Electrochemical Reforming

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Abstract

Hydrogen production from urea by electrochemical reforming has emerged as a promising alternative to conventional water electrolysis, owing to its significantly lower theoretical cell potential (0.37 V compared to 1.23 V) and its capacity for simultaneous waste remediation. In this study, the electrochemical reforming of urea was systematically investigated under various alkaline conditions to improve hydrogen production. Experiments were carried out in a two-electrode electrochemical system using Zn, Ni, Co, and Pt electrodes in KOH solutions ranging from 1M to 6M, and with urea concentrations varying between 0.05 M and 0.5 M. The effects of temperature (20°C, 30°C, and 40°C) and various electrode pairings (e.g., Zn/Zn, Ni/Pt, Co/Ni) were systematically investigated. Among all conditions tested, the highest current density of 263.7 mA/cm² was obtained with a Zn/Zn electrode pair in 5M KOH containing 0.33 M urea at 20°C. Increasing the temperature to 40°C further increased the current density to 292.4 mA/cm² while preserving electrochemical stability. Notably, the Ni/Pt electrode configuration exhibited superior long-term performance, reaching a peak current density of 243.2 mA/cm² at 2.0 V and outperforming all other alternatives. These findings highlight the critical influence of electrolyte composition, temperature, and electrode selection on maximizing current density and ensuring long-term stability in sustainable hydrogen production from urea. Although hydrogen has a high calorific value, its storage remains a significant challenge. This study lays the groundwork for using solid urea as a safe hydrogen storage medium.

Keywords: Hydrogen, Urea, Electrochemical Reforming, Renewable Energy

Investigation of Lithium Recovery Methods from Seawater

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Abstract

Global energy demand is expected to double within the next two decades. However, the limited reserves and environmental impact of fossil fuels present major challenges to sustainable energy supply. The Paris Agreement, adopted in 2016, targets limiting global temperature rise to 1.5 °C above pre-industrial levels, requiring rapid carbon emission reductions and greenhouse gas balance by the second half of the 21st century. Consequently, alternative energy sources such as wind, solar, wave, and nuclear energy are gaining strategic importance. The effectiveness of renewables depends on advances in energy storage technologies. Lithium-ion batteries have emerged as environmentally friendly energy storage solutions. Lithium has become a critical material due to its growing use in energy storage and nuclear applications. The lithium-6 isotope, in particular, plays a vital role in nuclear fusion as a fuel source through tritium production.

Lithium is the 25th most abundant element in the Earth's crust, with a concentration of about 0.006%, and about 20 ppm in seawater. Currently, lithium is primarily extracted from geothermal brines, salt lakes, clays, and rocks, with global resources estimated between 55–98 million tons. Over half of lithium production today comes from brine sources. However, increasing demand and limited reserves have driven interest in alternative sources. Although lithium concentration in seawater is low (~0.17 ppm), oceans are estimated to contain approximately 230 billion tons of dissolved lithium, offering significant long-term potential. Research on lithium extraction from seawater has intensified, aiming to identify sustainable, cost-effective methods.

This study reviews and compares the main methods of lithium recovery from seawater in terms of technical, economic, and environmental aspects, with particular emphasis on their strategic importance for nuclear fusion. Additionally, the current potential of Turkey in the lithium sector is assessed.

Keywords: Lithium, Energy Storage, Seawater

Comparison of Hydrogen Fuel Cell and Electric Motor Propulsion Systems for Buses

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Abstract

Electric vehicles are growing in popularity day by day. Electric vehicles have a simple structure consisting of a battery and an electric motor. Electric motors get their power from the battery. Batteries are charged with an external energy source. Electric vehicles are more environmentally friendly than vehicles using fossil fuels, but they have brought with them new problems. The most important of these are range problems and refueling (charging) times. In addition, battery performance degrades at variable temperatures, leading to greater range problems. Therefore, the idea of using hydrogen energy, which constitutes ninety percent of our universe, has emerged. Vehicles that use hydrogen energy are called FCEV (Fuel cell electrical vehicles). This study also examines the subject with its advantages and disadvantages. As a result, detailed comparision is given with new published studies results in this mini review study.

Keywords: Hydrogen, Electric Vehicles, Fuel Cell, Bus

Modeling, Analysis and Control of CUK Converter with Coupled Inductor

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Abstract

This study aims to investigate the dynamic behavior of the CUK converter with coupled and uncoupled inductor, which can operate in step-up and step-down mode, and to develop control strategies. The nonlinear model derived by the state-space averaging method is validated in MATLAB/Simulink and linearized by small signal analysis. It is experimentally demonstrated that the use of coupled inductors significantly reduces input current ripple and improves system efficiency. Transfer functions are derived to characterize the duty cycle-output voltage relationship and the system stability is investigated in detail by frequency domain analysis. The proposed method for closed-loop control is proven to be practically applicable by supporting it with experimental tests.

Keywords: CUK Converter, Coupled Inductor, State-Space Modeling

Main Techniques and Strategies in Bioremediation Processes

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Abstract

Bioremediation refers to the removal of pollutants from the environment using living organisms, primarily microorganisms and plants. This removal process takes place by converting pollutants into substances with low toxicity and/or removing them from the environment. Bioremediation is a favored process because it is environmentally friendly, relatively low cost and also sustainable. In order to increase the efficiency of bioremediation, it is important to apply the most appropriate strategy. Therefore, bioremediation processes can vary in terms of the location, the biological agent used and the preferred technique. To date, several studies have been conducted to reduce pollution from heavy metals, hydrocarbons, pesticides and even low-level radioactive wastes by bioremediation. In this study, it is aimed to review the main techniques and strategies, scientific studies and future trends for bioremediation processes.

Keywords: Bioremediation, Removal of Pollutants, Environment.

Numerical Investigation of Constant Surface Heat Flux Boundary Condition in Thick-Walled Microtubes Using Nanofluids

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Abstract

In recent years, extensive research has been conducted on the use of nanofluids with high heat transfer performance in micro-scale tubes. Heating or cooling through microtubes has been successfully applied in many small-sized electronic devices across various fields. In this study, the variation in thermal performance was numerically investigated using water-based Al_2O_3 nanofluid inside a thick-walled microtube. A microtube of infinite length was considered; the upper flow region of the tube was assumed to be completely insulated, while the lower flow region was subjected to a constant surface heat flux. A parametric study was conducted by taking into account the thermophysical properties of nanofluids at different concentrations. The governing flow and energy equations were non-dimensionalized in cylindrical coordinates for a two-dimensional laminar flow. The finite difference method was used for the numerical solution, and the equations were discretized using the central difference scheme. In this study, a slip boundary condition was adopted on the tube wall for a more realistic approach, and a viscous dissipation term was included in the analysis. The results indicate that using nanofluids instead of conventional fluids such as water positively enhances thermal performance. The effects of wall conduction and axial conduction in the fluid increase with higher values of d', Br, k_{wnf} and a_{wnf} and with lower values of Pe. The influence of parameter variations is more pronounced during the initial stages of the transient regime and decreases as the system approaches the steady-state regime. The parameter λ was found to significantly contribute to improved heat transfer performance due to its role in reducing surface friction.

Keywords: Thick-Walled Microtubes, Nanofluids, Slip Velocity, Concentration

Performance Evaluation of TiDB Under Varying Cluster Sizes and Consistency Levels Using Sysbench

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Abstract

In this study, the performance of TiDB, a distributed NewSQL-based database, is experimentally evaluated under various cluster configurations. TiDB stands out as one of the most popular NewSQL databases thanks to its horizontal scalability, strong consistency, high availability, and MySQL compatibility.

TiDB clusters with 3, 6, 9, and 12 nodes were set up on Google Cloud. The replication factor was adjusted to match the cluster size: 2 for 3 nodes, 4 for 6 nodes, 6 for 9 nodes, and 8 for 12 nodes. The benchmarking process was conducted using sysbench across four workload types read/write-AC1/AC2,which represents different combinations of read/write operations under eventual consistency (AC1) and strong consistency (AC2). The primary metrics collected include throughput (transaction per second), average latency and 95th percentile latency. Additionally, write-intensive workloads consistently showed lower latency compared to read-intensive workloads, demonstrating TiDB's better efficiency in handling frequent writes. Also, when we compare the ratios of the TiDB (computing node) node to all nodes in the cluster, it was determined that the delay and efficiency of the second experiment, which is proportionally the highest, was better.

It has been concluded that majority vote (AC1) works faster than all vote (AC2) and that writing operations are faster than reading operations also increasing the ratio of TiDB node number to total number increase the throughput , therefore using the TiDB database would be more consistent in performing operations such as IoT, sensor and log.

Keywords: TiDB, Distributed Database, Sysbench, MySQL

Innovative Methods in the Treatment of Textile Wastewater

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Abstract

One of the most interesting aspects of modern life is the fast fashion trend. The textile industry has grown tremendously due to the high demand created by this trend. However, the textile industry is water-intensive and produces large quantities of wastewater every year, which contributes significantly to environmental pollution. For this reason, environmental damage caused by the industry has recently become one of the most criticised issues. Textile wastewater is characterised by varying concentrations of chlorides, sulfates, chemical oxygen demand (COD), biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), total dissolved solids (TDS), high pH, and dye content. Numerous chemicals such as heavy metals, phthalates, chlorophenols, dyes used in the textile industry have been shown to have carcinogenic, mutagenic, ecotoxic and cytotoxic potential in studies. Wastewater discharged untreated into water bodies has the potential to increase turbidity, disrupt oxygen transport and photosynthetic activity in water, and thus rapidly pollute our clean water resources. As a result, water quality deteriorates and becomes unsuitable for all uses. To protect the environment and public health, textile wastewater must be highly treated before discharge. Conventional treatment methods are often unable to achieve this. In addition to meeting discharge standards, increasing water scarcity and environmental risks are forcing the textile industry to focus on alternative and innovative wastewater treatment solutions to reduce its water footprint.In recent studies, various wastewater treatment methods have been reported for the treatment of textile wastewater. These methods include membrane filtration techniques, ion exchange, adsorption methods, coagulation, advanced oxidation processes such as ozonation and catalytic ozonation, and electrochemical processes. Nowadays, treatment technologies for textile wastewater are coming to the forefront that adopt a strategic approach that offers significant prospects for saving energy, reducing carbon emissions and reusing treated water.

Keywords: Textile Wastewater, Wastewater Treatment, Innovative Methods

The Use of Macroinvertebrate Communities as Bioindicators in Water Quality Monitoring

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Abstract

The sustainable management of freshwater and coastal ecosystems requires the integration of biological indicators into water quality monitoring frameworks. In this context, macroinvertebrates (e.g., Ephemeroptera, Plecoptera, Trichoptera, Amphipoda) have emerged as reliable bioindicators due to their habitat preferences, pollution tolerance, and responses to environmental stressors. This study examines the role of macroinvertebrates in water quality assessment within the framework of the EU Water Framework Directive and similar ecological classification systems. The effectiveness of biotic indices such as BMWP, ASPT, and EPT is discussed, with case studies from various watersheds presented. Findings demonstrate that macroinvertebrate-based evaluations offer more integrated and long-term insights into ecosystem health compared to physico-chemical methods. Overall, macroinvertebrates are emphasized as indispensable tools for ecological status assessment and environmental management of aquatic systems.

Keywords: Ecological Monitoring, Biotic İndices, Freshwater Ecosystems, Environmental Assessment, Diversity

Prioritizing Integrated Green, Lean and Agile Supply Chain Strategies

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Abstract

Companies have to consider factors such as sustainability and flexibility simultaneously in order to gain competitive advantage and achieve sustainability goals. The lean supply chain approach aims to simplify by reducing waste, the green supply chain approach focuses on minimizing environmental impacts, and the agile supply chain approach aims to respond flexibly and quickly to changing customer demands. The integrated application of these approaches provides multifaceted benefits such as cost reduction, fulfillment of environmental responsibilities, and increased customer satisfaction. This study aims to guide practitioners by addressing the integration of lean, green, and agile supply chain approaches. First, strategies for achieving a lean, green, and agile supply chain were addressed separately and a total of 30 criteria were determined. These criteria were then integrated and reduced to 16 criteria. The SWARA (Step-by-Step Weight Assessment Ratio Analysis) method, one of the Multi-Criteria Decision Making techniques, was used to determine the priority levels of the strategies in which the three approaches were integrated. The relative importance of each criterion was evaluated and ranked by obtaining three different expert opinions. According to the method results, “ensuring sustainable supplier relationships”, “increasing government incentives”, “ensuring technological integration”, “increasing flexibility and adaptability” and “developing a culture of continuous improvement” are obtained as the 5 most important criteria. As a result, it reveals the determination of strategies for the joint implementation of lean, green and agile supply chain approaches and the order of importance of strategies for achieving sustainable competitive advantage.

Keywords: Lean Supply Chain, Green Supply chain, Agile Supply Chain, SWARA Method

Review of Neutronic and Thermal-Hydraulic Challenges in the Design of Space Nuclear Reactors

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Abstract

Energy generation in space missions must be reliable and sustainable, particularly for long-duration manned and unmanned operations. Nuclear microreactors are particularly noteworthy in this regard as small, light, and extremely effective power generating devices. The neutronic and thermal hydraulic designs of nuclear microreactors intended for use in space are thoroughly covered in this review study, along with the ways and reasons that these systems vary from reactor designs on Earth's surface. Reactor shape, fuel type (such as UO_2, UN, or UC), enrichment level, and moderator usage are assessed from a neutronic standpoint. The heat transport mechanism, passive cooling systems, thermal conductivity requirements, and radiative heat dissipation are the main emphasis of a thermal hydraulic approach in space nuclear reactors. Furthermore, the impact of compact design specifications on safety analyses and reactor control systems is examined. By emphasizing the engineering constraints and creative design approaches of space microreactors, this study seeks to serve as a foundational resource for next investigations and technological advancements.

Keywords: Space reactors, Micro Reactors, Neutronic Design, Thermal Hydraulic Analysis

The Impact of Climate Change on Drought Dynamics in Semi-Arid Regions: A Case Study from Erfelek District, Sinop

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Abstract

In the contemporary era, with the escalating impacts of climate change, drought has emerged as one of the most critical environmental challenges on a global scale. Particularly in countries such as Turkey, which lie within semi-arid climatic zones, drought affects not only water resources but also has direct implications for agricultural production, energy supply, and social welfare. As such, drought is regarded as a multifaceted crisis, encompassing meteorological, hydrological, agricultural, and socio-economic dimensions, thereby necessitating the adoption of integrated management strategies. This study presents an analysis of drought conditions in the Erfelek district of Sinop Province for the period spanning from 1989 to 2023. Drought analyses are conducted using the Standardized Precipitation Index (SPI) and Standardized Precipitation Evapotranspiration Index (SPEI) at time scales of 1, 3, 6, 12, and 24 months. The regional drought situation is assessed, and solutions are proposed based on scientific evidence. In the coastal areas of the district, winters are mild, summers are hot, and precipitation is evenly distributed throughout the year, while in the southern mountainous regions, a transitional climate prevails. In these areas, summers are characterized by high temperatures and drought, while winters are cold and rainy. These climatic variations play a significant role in the evaluation of the temporal and spatial distribution of drought indices.

Keywords: Climate Change, Semi-Arid Climate Zone, Water Resources, Environmental Issues

Advanced MOF-Integrated Membrane Technologies for Efficient CO_2 Separation

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Abstract

The urgent need to mitigate CO_2 emissions, a primary driver of global climate change, has intensified research on carbon capture and utilization (CCU) technologies. Among the available methods, membrane-based separation offers distinct advantages due to its low energy demand, modularity, and environmental friendliness. This study focuses on the development and application of mixed matrix membranes (MMMs) incorporating metal-organic framework (MOF) composites to enhance CO_2 separation performance. The integration of MOFs, known for their high surface area and tunable pore functionalities, with polymeric matrices creates a synergistic effect that improves gas selectivity and permeability. Our experimental work involved synthesizing and characterizing various MOF composites, embedding them into polymer matrices, and evaluating their CO_2/N_2 separation performance. Results demonstrate that these advanced MMMs exhibit significantly enhanced CO_2 uptake capacity, improved selectivity over nitrogen, and robust performance under both dry and humid conditions. The findings highlight the potential of MOF-based membranes as promising candidates for industrial carbon capture applications, contributing to the broader goal of reducing anthropogenic greenhouse gas emissions. Future work will focus on scaling up membrane fabrication and integrating these materials into pilot-scale carbon capture systems. This research not only advances the material science of membrane technology but also provides a feasible pathway toward sustainable and efficient CO_2 mitigation strategies.

Keywords: CO_2 Separation, MOF, membrane.

Elimination of Harmful Organisms in Agricultural Applications Using Sound Waves

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Abstract

One of the primary reasons for the decline in agricultural production in our country is the sharp increase in production costs and the simultaneous decrease in yield. Major contributors to these costs include chemical fertilizers, pesticides, seed expenses, fuel, equipment, and irrigation. Encouraging farmers to return to agriculture is of vital importance for the national economy. Therefore, it is crucial to develop sustainable and cost-effective alternatives to conventional pest control methods, which typically rely on chemical applications that require frequent reapplication and offer only temporary protection.

This study aims to develop a novel product that provides continuous protection against agricultural pests from the moment of initial application. The proposed solution utilizes variable frequency triggering to effectively deter harmful organisms across different field sizes. Unlike traditional chemical methods, this approach offers a low-maintenance, non-chemical, and long-lasting alternative, representing a promising advancement in sustainable agricultural practices.

Keywords: Agriculture, Insects, Yield, Pest Control, Sound Waves

Effect of Casting Parameters on the Fluidity of Aluminium Alloys

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Abstract

Aluminium and its alloys are among the most widely used metals in industry, with applications ranging from automotive to aviation, due to their superior properties such as a high strength-to-weight ratio and excellent electrical and thermal conductivity. These alloys can be manufactured using various methods, including rolling, forging, and extrusion. One of the most commonly used manufacturing methods is casting, which includes techniques such as high-pressure die casting, sand mold casting, and permanent mold casting. An important—and sometimes limiting—parameter in aluminium casting is the fluidity of the liquid metal. The fluidity of liquid metal significantly influences the castability and the properties of the final product. It is an important factor in determining the minimum wall thickness and the surface finish of the final casting.

Fluidity can be defined as the distance that liquid metal can flow in a mold cavity with a constant cross-section before it solidifies. The fluidity of alloys is affected by numerous factors. One major category involves variables related to the liquid metal itself. These include chemical composition, trace elements, metal viscosity, casting temperature (melt superheat), surface tension and oxide film formation, and overall metal cleanliness. Additional influencing factors are grain refinement and modification, as well as the size, shape, agglomeration, and volume fraction of any reinforcement particles present in the alloy. Mold characteristics also play a significant role in determining fluidity. These include the type of mold material, mold temperature, surface coatings, and the permeability of the mold. All these factors collectively influence how far the molten alloy can flow before solidifying.

Keywords: Aluminium Alloys, Fluidity, Casting Parameters

Redesign of Valves Used in Milking Systems with Polymer-Based Materials: A Practical Study Aimed at Reducing Production Costs

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Abstract

Valves are essential mechanical control components used in pipelines carrying fluids such as liquids, gases, or steam. Their primary function is to control, direct, stop, or regulate the flow of these fluids. Valve systems, which are widely used in industrial applications and food technologies, directly affect both functional efficiency and economic performance by influencing production and operational costs.

This study focuses on the redesign of brass-based valves used in milking machines through the use of polymer-based materials, aiming to eliminate the disadvantages associated with high production costs and complex manufacturing processes. Within the scope of the study, it was determined that the brass valves currently in use lead to increased operational costs due to their high raw material cost, requirement for specialized production equipment, and processing difficulties.

As an alternative solution, polymer-based valves were developed with careful consideration of mechanical strength and food contact safety requirements. During the design process, engineering polymers such as Polyamide 6 (PA6), Polycarbonate (PC), Thermoplastic Elastomer (TPE), and Nitrile Butadiene Rubber (NBR) were utilized. The newly developed valve, consisting of six components, underwent 3D modeling, prototyping, and functional compliance testing. Subsequently, plastic injection molds were produced, and the necessary manufacturing infrastructure for mass production was established.

According to the results obtained, the use of polymer-based valves—with a unit cost of approximately 9 TRY—in place of brass valves—with a unit cost of around 150 TRY—resulted in a 94% cost reduction. In a system with an annual requirement of 20,000 valves, this transformation corresponds to an annual cost saving of approximately 3 million Turkish Liras. These findings demonstrate that polymer-based engineering approaches can offer significant economic and manufacturing advantages compared to traditional metal-based components.

Keywords: Valve Design, Engineering Polymers, Cost Optimization, Plastic İnjection Molding, Food safety

The Impact of Curing Methods on the Compressive Strength of Ready-Mixed Concrete

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Abstract

Turkey is the leading producer of ready-mixed concrete in Europe. Ready-mixed concrete is a composite building material produced by mixing cement, water, aggregates, and, when necessary, admixtures in specific proportions at a ready-mix concrete plant. The most crucial mechanical property of ready-mixed concrete is its compressive strength. Compressive strength is critical for the safety and longevity of structures. Therefore, building concrete is expected to meet specific standards and achieve the required strength class. Several factors must be considered to ensure the desired compressive strength, including the water/cement (W/C) ratio, maximum aggregate size, and type of admixtures. Additionally, when the concrete reaches the construction site, it must be poured within an appropriate time frame, compacted using vibration, and cured properly to ensure compressive strength and durability. This study investigates the impact of curing conditions on the compressive strength of concrete produced at a ready-mixed concrete plant in Kastamonu/Bozkurt. Concrete cubes with dimensions of 15x15x15 cm and a compressive strength class of C20 were created with a fixed W/C ratio of 0.53. The specimens were cast on two different days with varying air temperatures and in two sets. The first set was cured in a curing pool, while the other was left under natural outdoor conditions for 28 days. After a 28-day curing period, the specimens were tested for compressive strength. According to the results, the average compressive strength of the samples cured in the curing pool increased by 15%-29% compared to those exposed to natural outdoor conditions. This result indicates that the curing conditions significantly affect the compressive strength of concrete. This study highlights the importance of curing methods applied after concrete pouring for the strength of concrete. Future studies should investigate the effects of different environmental conditions, especially varying air temperatures, on the compressive strength of different concrete grades.

Keywords: Ready-Mixed Concrete**,** C20 Concrete Class, Different Curing Conditions, Compressive Strength

Comparatıve Analysıs of Wave Energy and Nuclear Energy Systems: An Evaluatıon of the OWC Model and the VVER-1200 Reactor

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Abstract

In the global transition towards sustainable and low-carbon energy systems, wave energy has emerged as a promising yet underutilized resource. Among wave energy technologies, the Oscillating Water Column (OWC) model is recognized for its relatively simple structure and environmentally benign operation. This study presents a comparative techno-economic analysis between the OWC wave energy system and the VVER-1200 pressurized water nuclear reactor, focusing on capital cost, capacity factor, energy yield, and payback period. The analysis reveals that while OWC systems have higher levelized capital costs and limited energy output, they offer advantages in modular deployment, low environmental risk, and shorter construction time (1–3 years). In contrast, VVER-1200 reactors, with significantly higher energy output and lower LCOE (Levelized Cost of Electricity), require multi-billion-dollar investments and extended commissioning periods exceeding 7 years. Despite their differing scales, both technologies demonstrate potential roles in future energy portfolios: VVER-1200 as a stable baseload provider, and OWC as a viable solution for decentralized coastal energy needs. This comparative framework aims to inform policymakers, engineers, and investors in aligning technology choices with environmental and economic objectives.

Keywords: Wave Energy, Nuclear Energy, OWC Model, VVER-1200 Reaktor

Evaluation of Behavioral Patterns of Consumers Shopping on Electronic Commerce Sites Using FP-Growth Algorithm

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Abstract

Today, due to the impact of technological developments, there are significant changes in the shopping habits of consumers; in addition to traditional shopping methods, shopping through electronic commerce (e-commerce) sites is also becoming increasingly common. The time and place independence, product variety and easy comparison opportunities offered by e-commerce have increased consumers' tendency towards online shopping. In this study, consumers' shopping behaviors on e-commerce sites were analyzed using the FP-Growth algorithm, which is one of the data mining techniques.

The data to be used in the study were collected through a questionnaire consisting of 10 questions and applied to 122 participants aged 18 and over. The collected data were processed and analyzed using RapidMiner software. The FP-Growth algorithm is an effective method for detecting frequent item clusters and association rules between these clusters, especially in large data sets. As a result of this analysis, a total of 230 association rules with a confidence level above 50% were obtained.

These rules provide important information about consumers' online shopping habits; they provide important insights about the tendency to purchase certain product groups together and patterns in shopping behavior. The limited number of studies examining consumer behavior on e-commerce sites in the literature increases the importance of such analyses. Therefore, increasing similar research will both contribute to the academic field and provide businesses with the opportunity to better understand customer behavior and develop strategies.

Keywords: E-Commerce, Consumer Behavior, Association Analysis, FP-Growth Algorithm

A Comprehensive Analysis of the Internal Ballistic Effects of Rifled Barrels

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Abstract

This study aims to examine the internal ballistic behavior of rifled barrels, a fundamental component of firearms, using the ANSYS software. Internal ballistics represents a critical research area that encompasses the physical processes occurring within the barrel during the firing sequence. Rifled barrel designs incorporate significant engineering features that enhance the projectile's stability and trajectory. In this context, analyzing the dynamic effects of rifling within the barrel, its influence on projectile acceleration, and the performance variations arising from different geometric configurations is of utmost importance.

Within the scope of the study, various barrel designs are evaluated using ANSYS software to assess their impact on internal ballistic phenomena. Parameters such as pressure distribution inside the barrel, temperature variations, and mechanical loads on the material are examined in detail. The analysis results aim to facilitate engineering improvements in firearm design, contributing to the development of more efficient and high-performance weapons in the defense industry. Furthermore, the findings are expected to serve as a foundation for future academic studies in the fields of ballistics science and weapon technology.

Keywords: Ballistics, ANSYS, Defence, Barrel, Rifling

Identification and Analysis of Microplastics Using Artificial Intelligence Methods

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Abstract

Microplastics (MPs) are currently among the most prominent environmental pollutants, attracting the attention of international organizations and academia. MPs' identification, analysis, and removal present significant challenges due to their small size and complex interactions with environmental matrices. MPs accumulate organic matter, form biofilms, and bind with natural particulates, making them difficult to isolate and identify, particularly in samples with high organic loads. Conventional identification methods, which primarily rely on microscopy and spectroscopy (such as FTIR and Raman), are time-consuming, labor-intensive, and prone to human error. However, recent studies emphasize the potential of artificial intelligence (AI), particularly machine learning (ML) and deep learning (DL) algorithms, to overcome these limitations. Integrating AI with imaging and spectroscopic techniques has been shown to automate the detection and categorization of MPs, minimizing manual effort. Image processing technologies, powered by DL algorithms such as Mask R-CNN and Faster R-CNN, have enabled the automated identification and quantification of MPs in marine environments with high accuracy. Similarly, YOLOv5 and CNN models trained on μ-Raman spectra have achieved outstanding detection rates in freshwater and wastewater contexts. In soils and sediments, hyperspectral imaging combined with ML facilitates rapid, non-destructive polymer type identification. Atmospheric MPs, often found at low concentrations, have been effectively analyzed using segmentation algorithms like U-Net and Mask R-CNN. Moreover, portable AI-powered imaging and FTIR-CNN models applied to food and biological samples have demonstrated up to 98% identification accuracy. Overall, AI-driven approaches offer transformative potential for improving the speed, accuracy, and scalability of MP analysis across diverse environments. This study aims to systematically investigate the applicability and performance of these emerging AI methods in detecting MPs within complex and heterogeneous matrices.

Keywords: Microplastics, Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Environmental Monitoring

Effects of Different Engine Loads on Combustion Characteristics, Engine Performance, and Emissions in a Methanol-Fueled RCCI Engine

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Abstract

Today, the increasing global energy demand and the gradual depletion of fossil fuel reserves necessitate the exploration of sustainable and environmentally friendly alternative energy sources. The widespread use of fossil fuels not only increases economic costs but also leads to serious environmental problems due to the high levels of harmful exhaust emissions produced by internal combustion engines. Consequently, research on alternative fuels that produce low carbon emissions and can be derived from renewable sources has intensified. Alcohol-based fuels have attracted attention due to their high knock resistance and superior thermal efficiency under specific engine operating conditions compared to gasoline.

In this context, Reactivity Controlled Compression Ignition (RCCI) engines, which represent one of the low-temperature combustion strategies, stand out among alternative power generation technologies by offering significant advantages in terms of fuel efficiency and emission reduction. In this experimental study, a conventional diesel engine was modified to operate under the RCCI combustion concept. Combustion characteristics, engine performance, and emission behavior were investigated by comparing methanol fuel with conventional diesel fuel. The experiments were conducted on a four-cylinder, turbocharged, water-cooled, common-rail direct injection RCCI engine.

As a result of the experiments conducted at four different partial engine loads (40, 60, 80, and 100 Nm) it was observed that cylinder pressure, heat release rate, and pressure rise rate increased with engine load. In tests performed with methanol fuel, specific fuel consumption decreased due to improved combustion efficiency compared to conventional diesel fuel. Furthermore, specific fuel consumption exhibited a decreasing trend as engine load increased. In terms of emissions, significant reductions in nitrogen oxide (NO_x) and carbon dioxide (CO_2) levels were achieved with the use of methanol.

Keywords: RCCI, Methanol, Combustion, Engine Performance, Emissions

Reconceptualizing Terrain Vague Through New Materialism: An Ontological and Conceptual Expansion in Architecture

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Abstract

In contemporary cities, the concept of "terrain vague" offers a critical lens for understanding neglected, abandoned, or undefined spaces. Highlighted by Ignasi de Solà-Morales in 1995, the term refers to urban areas that remain outside the cultural, social, and economic flow of urban. These spaces, often former industrial zones or infrastructural remnants have traditionally been seen as static voids. However, emerging theoretical frameworks, particularly New Materialism, challenge this perspective.

By highlighting the interrelatedness of materiality, time, and relationality, New Materialism reconfigures the ontological view of "terrain vague", reimagining it not as inert, passive voids, but as dynamic and evolving entities. It emphasizes the agency of these spaces -rusted metal, crumbling concrete, and wild vegetation, etc.- transforming them from mere symbols of decay into active forces in the production of space. Within this framework, the "terrain vague" is conceived as a site of continuous transformation, where materiality and both human and non-human agents converge and interact.

This study engages in a critical theoretical analysis that situates architectural discourse within New Materialist philosophy. Drawing on the works of Jane Bennett, Gilles Deleuze, Félix Guattari, Graham Harman, and Karen Barad, it proposes a framework to reassess the ontological status of materiality, agency, and spatial formations. Complementing these philosophical foundations, Ignasi de Solà-Morales's reflections on *terrain vague* provide a critical perspective on the marginal, liminal spaces in the urban landscape, questioning their supposed passivity and uncovering their potential as sites of transformation and agency.

Along these lines, this research contributes to architectural theory by foregrounding material agency, non-human forces, and spatial indeterminacy, while critically questioning conventional notions of void, decay, and marginality. Through its ontological and conceptual reframing of architecture, it is expected to establish a theoretical foundation for alternative spatial practices and design approaches, thereby contributing to the advancement of critical architectural discourse.

Keywords: Terrain Vague, New Materialism, Space and Onthology, Urban Space

Backpack Radiation Detectors: Key Tools for Monitoring and Emergency Response

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Abstract

Radiation monitoring plays a vital role in ensuring the safety of both personnel and the environment in facilities dealing with radioactive materials, such as the International Atomic Energy Agency (IAEA) Laboratories at Seibersdorf. To ensure effective radiation monitoring, different devices are utilized—among them Electronic Personal Dosimeters (EPDs), handheld detectors, backpack units, and radiation portal monitors. Among these tools, backpack detectors are particularly notable for their portability and for being equipped with gamma radiation sensors that enable real-time assessment of radiation levels while personnel move through wide areas. Rapid radiation detection is essential for initiating timely safety measures during both normal operations and emergency scenarios. Given their capabilities, backpack detectors are regarded as essential instruments for ensuring timely action in critical situations. This research explores the role of these devices in ensuring the safety of personnel and the surrounding environment.

Keywords: Radiation Monitoring, Backpack Radiation Detectors, Radiation Safety, Gamma Radiation Detection

Investigating the Effect of Feature Selection on Machine Learning Based Early Prediction of Gallstone Disease

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Abstract

Gallstone disease occurs when solid masses accumulate in the bile fluid in the gallbladder. These stones can cause various symptoms when they settle in the gallbladder or block the bile ducts. Although the most common diagnostic method is ultrasonography, in some cases, access to ultrasound may be difficult. In such cases, diagnosis can be made using bioimpedance data and laboratory test results. The aim of this study is to predict the presence of gallstones using machine learning methods using bioimpedance and laboratory data and to determine the features that are most effective in the accuracy of this prediction. A gallstone dataset consisting of 319 samples taken from the UCI platform was used in the study. This dataset contains 38 features. Ranker was used as the "search method" for feature selection and Principal Component Analysis (PCA) was used as the "attribute evaluator", and a total of 26 features were selected. Among the machine learning algorithms, Support Vector Machines (SVM), Multilayer Perceptron (MLP), Random Forest, Logistic Regression and K-Nearest Neighbor (KNN) were used for classification. These algorithms provided 67.39%, 67.08%, 68.33%, 70.21% and 57.05% classification accuracy, respectively. After reducing the number of features using feature selection algorithms, the classification accuracy obtained with some machine learning algorithms increased, while a decrease in accuracy was observed with some algorithms.

Keywords: Feature Selection, Machine Learning, Gallstone Disease, Early Detection

Analyzing User Interface Interaction in Metal Detectors: Conrad Engineering Examples

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Abstract

Industrial design plays a vital role in shaping not only the physical characteristics of complex products but also the user interaction experience. This study explores user interface (UI) interaction within the context of metal detectors, focusing on how interface design influences user performance, satisfaction, and perception. The research analyzes three metal detector models (GR-3 Plus, GR4, and A2) developed by a design center, each reflecting different user profiles, functions, and usage scenarios.

Qualitative research methods, including field observations and semi-structured interviews, were utilized to evaluate various aspects of the UI such as ergonomics, navigation, visual hierarchy, and feedback mechanisms. These methods provided insights into how users interact with both physical and digital components of the interface.

The primary goal of the study is to address the lack of user experience research in the field of metal detectors. A literature review indicates a significant gap in studies addressing UI and usability in this specific domain. By filling this gap, the study aims to contribute to academic discourse and serve as a reference for future design and engineering efforts in the sector.

The findings emphasize that UI design in industrial products like metal detectors should not be approached merely as a technical challenge but rather as a multidimensional issue involving user cognition, task flow, and cultural context. Designers are encouraged to integrate these dimensions into the development process to improve usability and overall user satisfaction. Insights gained from this study may also inform the design of other high-functionality devices, especially those used in field environments, where intuitive interaction is critical.

Keywords: User Interface, Metal Detector, Usability, Industrial Design, User Experience

Wearable Technologies for the Diagnosis of Sleep Apnea

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Abstract

This study reviews the literature on the applicability of wearable technologies that incorporate the core parameters of the polysomnography (PSG) system traditionally used in the diagnosis of sleep apnea. Sleep apnea is a serious sleep disorder characterized by repeated interruptions in breathing during sleep. Obstructive sleep apnea (OSA) is the most common subtype and is associated with various health problems such as cardiovascular diseases, hypertension, and cognitive impairments. The definitive diagnosis of sleep apnea is generally made using polysomnography (PSG); however, this method has several disadvantages due to its high cost, time-consuming process, and discomfort for the patient. In this context, wearable technologies have recently emerged as a more accessible and comfortable alternative for the diagnosis of sleep apnea. Recent studies have shown that wearable devices are effective in detecting the risk of sleep apnea by monitoring various biophysiological parameters such as heart rate, blood oxygen saturation (SpO_2), respiratory rate, body movements, and sleep position. Nevertheless, there are some limitations regarding the use of wearable technologies in clinical diagnosis. Key issues include the accuracy of devices, user compliance, data security, and lack of standardization. Furthermore, inconsistencies between algorithms used by different devices and the incomplete clinical validation of these technologies continue to pose challenges. The general trend in the literature suggests that wearable devices are primarily being used as pre-diagnostic screening tools for sleep apnea. With the integration of artificial intelligence-based analysis systems, it is expected that the diagnostic accuracy of these devices will improve and contribute significantly to patient monitoring processes.

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Keywords: Obstructive Sleep Apnea (OSA), Polysomnography (PSG), Health Technology, Artificial Intelligence

Structural Optimization and Strengthening Analysis of the Long-Distance Coach Body Framework

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Abstract

The structural integrity of long-distance coaches plays a crucial role in ensuring passenger safety, comfort, and operational efficiency. This study investigates the structural optimization and reinforcement strategies employed on the body framework of long-distance coaches. The primary aim is to evaluate the effectiveness of various reinforcement techniques in enhancing the strength and durability of the coach body framework while maintaining weight efficiency. Using finite element analysis (FEA), different structural framework designs and materials were tested under simulated load conditions to assess their performance. The findings demonstrate that a well-balanced combination of material placement and geometric design improves load distribution, fatigue resistance, and vibration control. Additionally, specific reinforcement techniques contribute to better crash energy management and increased overall safety. These results provide valuable insights for the design of more durable, lightweight, and energy-efficient long-distance coach structures and supporting advancements in sustainable transportation.

Keywords: Structural Optimization, Structural Reinforcement Strategies, Safety in Transportation, Long-Distance Coach Design, Coach Body Framework

Bidirectional Electric Vehicle Charging Station Modeling and Simulation in MATLAB/Simulink Environment

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Abstract

This study presents the modeling and simulation of a bidirectional electric vehicle (EV) charging station using MATLAB/Simulink. The proposed system integrates multiple power electronic stages, including a connection control unit, a bidirectional AC/DC-DC/AC converter, a buck-boost converter for DC voltage regulation, and a battery-side DC-DC converter equipped with a PI controller. The system is designed to operate in both Grid-to-Vehicle (G2V) mode, where the battery is charged from the grid, and Vehicle-to-Grid (V2G) mode, where stored energy is delivered back to the grid. In the buck-boost stage, a PID controller is employed to achieve a fast and stable transient response to voltage changes, while the battery-side PI controller ensures smooth current regulation for safe and efficient battery operation. Although Phase-Locked Loop (PLL) synchronization is commonly used in grid-connected systems, it was excluded in this model by assuming an ideal and stable grid. The simulation scenarios include various charge and discharge cycles, mode transitions, and control responses. Simulation results indicate that the model successfully manages bidirectional power flow, maintains current stability during dynamic operation, and ensures voltage compatibility between the grid and the EV battery. This work provides a practical framework for developing smart and reliable EV charging infrastructures that can support future grid-interactive energy systems.

Keywords: Bidirectional Charging, Electric Vehicle, V2G, Simulink, Power Electronics

The Evolution of Implant Technologies: From Early Applications to Advanced Material Integration

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Abstract

Implants have long served as a bridge between medical necessity and material innovation. While modern systems benefit from precision engineering, the concept dates back nearly two millennia. Ancient societies, including the Romans, Chinese, and Aztecs, employed materials like gold, ivory, and wood in early dental and prosthetic applications. Though primitive by today's standards, these efforts reflect an enduring desire to restore bodily integrity.

The introduction of aseptic surgical practices in the late 19th century significantly improved implant safety, enabling more ambitious applications in the decades that followed. By the mid-20th century, bone plates, acrylic fillers (PMMA), and early heart valve implants had entered clinical use. Orthopedic breakthroughs in the 1960s and 1970s—such as hip, knee, and jaw implants—marked a shift toward long-term mechanical solutions using stainless steel, cobalt-based alloys, and biocompatible polymers.

In current practice, titanium remains the material of choice for both dental and orthopedic implants due to its excellent osseointegration and corrosion resistance. Polyethylene coatings improve joint mobility, while cobalt-chromium alloys enable thinner, stronger implant structures. Cardiovascular implants, including drug-eluting stents and pacemakers, further highlight the growing role of functional materials in therapy.

Looking ahead, next-generation implants aim not just to replace but to integrate. Research into cell-loaded surfaces and tissue-mimicking architectures points to a future where implants behave more like living systems than inert structures. The synergy between biology, materials science, and engineering will define this next leap—where biocompatibility is not simply tolerated, but actively designed.

Keywords: Implant Technology, Biocompatible Materials, Medical Device Evolution, Titanium Implants, Tissue Integration

Effects of Boundary Conditions and Material Properties on the Vibration Behavior of Single-Lap Adhesive Joints

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Abstract

This study numerically investigates the free vibration behavior of single-lap adhesively bonded beams. Initially, several analytical models from the literature are reviewed, and their underlying assumptions are discussed. A three-dimensional finite element model based on Euler-Bernoulli beam theory is developed using ANSYS software, incorporating the adhesive layer explicitly. The model is tested under various boundary conditions, such as free-free and clamped-free configurations.

A parametric analysis is conducted to evaluate the influence of the adhesive's elastic modulus and Poisson's ratio on the natural frequencies and mode shapes. For this purpose, a user-defined macro is developed in ANSYS, allowing the systematic variation of adhesive properties across a wide material range. Additionally, models are constructed using the geometric and mechanical properties from previously published experimental and numerical studies to validate the simulation accuracy.

The results indicate that both the mechanical properties of the adhesive and the boundary conditions significantly affect the dynamic response of single-lap adhesively bonded beams. These findings highlight the importance of proper adhesive selection in designing lightweight bonded structures with optimized vibration performance.

Keywords: Vibration Analysis, Adhesive Joint, Natural Frequency, ANSYS, Mode Shape

A Comparative Study of Deep Learning Architectures for Pneumonia Classification: Inception V3, EfficientNet B0, and MobileNetV2

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Abstract

This study presents a comparative evaluation of three state-of-the-art deep learning models (Inception V3, EfficientNet B0, and MobileNetV2) for pneumonia detection from chest X-ray images. The models were assessed based on key performance metrics, including precision, recall, F1-score, quality index, Cohen's Kappa, and mean absolute error (MAE). EfficientNet B0 achieved the highest overall accuracy (96.62%), average quality index (0.9663), and Cohen's Kappa (0.9323), indicating strong overall performance. MobileNetV2 demonstrated the best average quality index (0.9693) and Cohen's Kappa (0.9385), reflecting superior precision (98.46%) and recall (98.41%) for pneumonia detection. Inception V3, while competitive with an accuracy of 95.85%, showed slightly lower recall, reflecting a trade-off between model complexity and sensitivity. These findings highlight the importance of model selection based on specific clinical requirements, balancing accuracy, computational efficiency, and interpretability for real-world medical imaging applications.

Keywords: Deep Learning, Machine Learning, Medical Imaging

Improving the Blow Molding Design, Increasing the Gas Discharge Rate in Unit Time, Minimizing Errors in the Product Geometric Form, Increasing Production Efficiency and Sustainability

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Abstract

In today's manufacturing industry, the ability of companies to maintain their competitive position both in domestic and global markets largely depends on R&D efforts aimed at reducing costs and increasing efficiency. In this context, shortening process durations, increasing the number of products manufactured per unit time, and improving final product quality are of critical importance. In high-volume, mass-production sectors such as PET bottle manufacturing, even the smallest improvement in the production process can have a multiplier effect on both quality and cost.

This paper addresses the impact of structural improvements in the design of molds used in the PET blow molding process on production performance. The focus of the study is to improve the evacuation of residual air within the mold by increasing the number of gas vent holes and optimizing their angles and diameters, particularly in the production of 500 cc PET bottles. Reducing the air evacuation time inside the mold enables an earlier and more uniform start to the blowing process, which ensures the PET bottle spreads more homogeneously over the inner mold surface.

These design improvements aim not only to prevent deformations in the product geometry but also to shorten production times, thereby increasing the number of units produced per cycle. The next-generation blow molds developed within the scope of this study are expected to offer more effective air evacuation compared to conventional molds, standardize final product quality, minimize technical issues, and enhance production line efficiency.

What sets this design apart from similar applications in the industry is the increase in the number of gas vent holes combined with a redesign of their placement angles and diameters based on engineering calculations. As a result, this approach enables the production of more uniformly shaped products while also saving energy and time. Ultimately, this project presents an innovative approach to PET blow molding technology and offers a unique engineering solution that directly contributes to both product quality and production efficiency.

Keywords: Blow Molding, Bottle Geometry Optimization, Pet Preform, Sustainability

Nuclear Disarmament: Global Status and Potential Contribution of Molten Salt Reactors

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Abstract

The scientific and technological foundations of nuclear energy were introduced to the world of science in 1934 as a result of the pioneering work of physicist Enrico Fermi, who experimentally demonstrated the interaction of uranium atoms with neutrons. With the realization of the potential of this new technology, many countries have accelerated their efforts to develop both civilian nuclear power plants and military nuclear weapons.

Realizing that the use of a nuclear weapon could have devastating effects and that the proliferation of nuclear weapons posed a serious threat to global security in the 1960s, work on a nuclear disarmament system, including various restrictive regulations and control mechanisms, was initiated.

The 1968 Non-Proliferation Treaty (NPT) is a milestone on the road to disarmament. While disarmament treaties have been signed and ratified by a large number of states around the world, some European countries, in particular, have not become parties to the treaties or have refused to ratify them. Recent studies support that Molten Salt Reactors, one of the 4th generation nuclear reactors, can use the Plutonium isotope, the main fissile material for nuclear weapons, as fuel.The flexibility to use fissile fuel in continuous operation in Molten Salt Reactors, minimal fuel preparation, inherent safety features, combined with the advantages of fissile fuel use in continuous operation in Molten Salt Reactors, support the suitability of using Weapons grade Plutonium for incineration in Molten Salt Reactors.

In this context, Molten Salt Reactors help to reduce the Plutonium stockpile by using spent fuel from conventional reactors as fuel. In addition, the use of thorium material, which is not used in the production of nuclear weapons, as fresh fuel in Molten Salt reactors contributes to nuclear disarmament.

Keywords: Molten Salt Reactor, Nuclear Weapon, Nuclear Disarmament, Global Security.

Mold with Special Cooling and Ventilation System for Preform Design with Reduced Weight Improving Design and Sustainability

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Abstract

In the plastic packaging sector, the concept of sustainable production is gaining importance due to increasing environmental regulations and raw material supply challenges. Particularly, rising procurement and transportation costs of PET raw material in international markets have made energy efficiency and resource conservation in production a priority. In this context, this study presents the design of an innovative blow mold equipped with special ventilation and cooling systems, compatible with lightweight preforms.

A new 500 cc PET bottle model was developed by reducing the current preform weight from 10 grams to 9 grams. Extensive improvements were made in the mold design to ensure that the lightweight preform could achieve the desired bottle shape under lower pressure. Specifically, the mold's internal ventilation system was optimized to reduce required air pressure during the blowing process and accelerate the cycle. The number and placement of gas vent holes were revised based on analysis results. Additionally, dedicated cooling channels were developed to enhance internal cooling performance and improve temperature control during production.

Structural analyses, temperature distribution assessments, and flow simulations were conducted, resulting in a mold design optimized both thermally and mechanically. The developed mold model was tested on the production line, where it was observed that the target bottle shape was achieved successfully at low pressure, along with a notable reduction in cycle time. Moreover, a significant decrease in energy consumption was recorded.

The innovative aspects of this study include the development of a new lightweight-compatible bottle model, the integration of tailored ventilation and cooling systems, and improvements in energy efficiency. The technical gains achieved contribute not only to product quality and production efficiency but also to broader environmental sustainability goals. Furthermore, the engineering solutions introduced provide a solid foundation for future R&D and mold design projects.

Keywords: Blow Molding, Grammage Optimization, Pet Preform, Plastic İnjection Mold, Sustainability

Key Fabrication Techniques for Polymer Materials: Sol-Gel, Hot Press Injection, and 3D Printing

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Abstract

The three basic methods commonly used in the production of polymer materials are the sol-gel process, hot press injection, and 3D printing. The sol-gel method allows the production of homogeneous and nanostructured composite materials through chemical reactions at low temperatures. This method is especially preferred in applications where content purity is important and material properties must be precisely controlled. The hot press injection method allows polymers to be shaped by injecting them into molds under certain temperatures and pressures. It is suitable for industrial applications requiring high mechanical strength and mass production. Production with 3D printing is based on the layer-by-layer production principle and allows structures with complex geometries to be produced in a personalized, fast, and waste-free manner. Although these methods vary in terms of production speed, shape flexibility, material compatibility, and cost, each offers effective and innovative solutions in certain application areas.

Keywords: Polymer Materials, Sol-Gel Process, Hot Press Injection, 3D Printing

Machine Learning Support for Computational Fluid Dynamics

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Abstract

As of today, it is predicted that the use of Artificial Intelligence (AI) improvement processes and generating faster foresight power in the Computational fluid dynamics (CFD) will create a great acceleration and reduction in workload. However, the first question is how reliable predictions can be created using AI? How can these predictions be proven? How much does it canalize the calculations in the right direction?

As of 2025, although AI provides an almost unlimited information repository, interpretation, and inference capabilities remain at a very low level. Especially when the same questions are asked with different words on interpretation, the contradictory answers they give are proof of this situation. When viewed from this perspective, AI still has a long way to go before it can make comments at the level of an engineer or academician. For example, when investigating the effects of small changes on the external structure of a vehicle's aerodynamics, AI makes similar comments. It should not be forgotten that Aerodynamics is a field where very small changes can lead to unexpected, very large, and different results. However, numerical solutions produce acceptable and satisfactory results within the correct boundary conditions and mesh structure. When CFD produces a solution on its own, it starts almost from scratch each time, using its previous knowledge very limitedly. This situation leads to excessive computational load. There are studies that AI support is used in CFD in the literature indicating that the computational load is reduced by a lot. There are also successful model algorithms that intertwine artificial neural networks and turbulence models. Therefore, it is a must to continue research on the use of AI in CFD. However, the accuracy of the results should be supported, interpreted, and discussed with literature and other fluid dynamics numerical analysis methods as well as experimental methods.

Keywords: Machine Learning, Computational Fluid Dynamics, Artificial Neural Networks, Aerodynamic

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