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SPACE 2025 PSG Institute of Technology and Applied Research

SPACE 2025

PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH
NEELAMBUR, COIMBATORE

International Conference on Sustainable Practices and Advancements in Civil Engineering

02 - 03 April 2025

CONFERENCE PROCEEDINGS

Editors

Dr.R.Balaji, AP/Civil
Dr.J.Karthick, AP(Sr.Gr)/Civil
Dr.M.Arun, Professor/Civil
Dr.M.I.Abdul Aleem, Professor & Head/Civil

PROCEEDINGS OF THE
INTERNATIONAL CONFERENCE

SUSTAINABLE PRACTICES AND ADVANCEMENTS IN CIVIL ENGINEERING

SPACE-25

02nd - 03rd April 2025

Organized by

DEPARTMENT OF CIVIL ENGINEERING

PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH

COIMBATORE

TRUSTEE'S MESSAGE

Shri. L. Gopalakrishanan
Managing Trustee

I am immensely pleased that the Department of Civil Engineering of PSG Institute of Technology and Applied Research is organizing an International Conference on **"Sustainable Practices and Advancements in Civil Engineering"** on 02nd and 03rd April 2025.

The theme of the conference allows students, researchers, faculty and practitioners of civil engineering to investigate into the latest developments pertaining to the study of recycling and use of energy efficient methods in civil engineering.

I wish the Principal and his team a great success in the conduct of the conference.

PRINCIPAL'S MESSAGE

Dr N Saravanakumar
Principal

I would like to commend the Department of Civil Engineering for taking the initiative to organize the **International Conference on "Sustainable Practices and Advancements in Civil Engineering"** on 2nd and 3rd April 2025.

In today's rapidly evolving industrial landscape, sustainability has become a cornerstone of civil engineering. The emphasis on **sustainable practices** highlights the importance of preserving the environment - our life force. Sustainable construction methods, including the use of eco-friendly materials and resource-efficient technologies, are crucial for conserving non-renewable resources. This conference serves as a vital platform for experts and emerging professionals to exchange ideas, explore innovative solutions, and reimagine infrastructure to withstand the accelerating impacts of environmental change.

I am confident that this conference will play a significant role in fostering discussions on reducing environmental impact, mitigating biodiversity loss, and curbing greenhouse gas emissions.

I extend my best wishes to the entire Civil Engineering Department of PSGiTech for the grand success of this event.

SECRETARY'S MESSAGE

Dr P V Mohanram
Secretary

The International Conference on **"Sustainable Practices and Advancements in Civil Engineering"**, scheduled for 2nd and 3rd April 2025, is being organized by the Civil Engineering Department to explore the challenges and opportunities in the field. This event will address not only environmental concerns but also the impact of economic volatility on civil engineering.

I am confident that this conference will serve as a valuable platform for knowledge exchange, collaboration, and innovation. By bringing together experts, it will facilitate discussions on maximizing the potential of renewable energy, tackling the energy crisis, and developing practical solutions for environmental protection.

I extend my best wishes to the organizers for the successful execution of this conference.

HoD'S MESSAGE

Dr. M. I. Abdul Aleem
Professor & Head

It gives me immense pleasure that our Civil Engineering Department is conducting an International Conference on **"Sustainable Practices and Advancements in Civil Engineering"** on **02nd and 03rd April 2025.**

This conference provides a platform for the exchange of ideas and information between research communities and construction Engineers. The purpose of this conference is to bring out the innovative practices in Civil Engineering construction using modern materials and methods. The conference will also facilitate the sharing up of innovative ideas and energy efficient practices. I am confident that this conference will be an eye opener and a productive one for all participants. I wish everyone a great success.

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PERFORMANCE EVALUATION OF TAILING IN MAGNESITE MINING FOR PAVEMENT CONSTRUCTION

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Abstract

This study delves into the potential for reusing tailings in magnesite mining operations. The research aims to investigate the feasibility and benefits of repurposing tailings within the context of magnesite extraction processes. By exploring the reuse potential of tailings and converting it into sustainable mining practices and resource optimization in the magnesite industry. This work contributes to the broader discourse on enhancing environmental sustainability and efficiency in mining operations through tailings management strategies. Mine waste composition varies by site, influenced by local conditions, emphasizing the lack of standardized practices in utilizing mineral resources in India. Mining activities lead to extensive land degradation, transforming natural ecosystems into waste-dump areas. The gradual spread of topsoil from mine dumps contaminates nearby agricultural lands due to both natural processes and human activities. The physical and chemical properties of tailings were analyzed through various standard tests, including particle size distribution, moisture content, compaction characteristics, and California Bearing Ratio (CBR). The results indicate that the tailings possess a high silica (SiO2) and magnesium oxide (MgO) content, making them suitable for engineering applications. The study concludes that magnesite tailings can be effectively utilized in road construction and other infrastructure projects, thereby reducing environmental hazards and promoting sustainable mining waste management.

Keywords: *Magnesite Tailing waste, California Bearing Ratio, soil properties*

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FABRICATION OF SOIL BLOCK STABILIZED BY CERAMIC DUST WASTE AND GEOPOLYMER

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Abstract

This project is focused on the development of sustainable building blocks by combining natural soil, ceramic waste dust, and a geopolymer binder. Ceramic dust, a by-product of the ceramics industry, is used as a stabilizing agent, while geopolymers serve as an alternative to traditional cement, offering a more environmentally friendly solution. The primary goal is to create strong, durable, and eco-friendly building materials that have a lower environmental impact compared to conventional construction materials. The fabrication process involves blending the soil with the ceramic dust waste and a geopolymer solution. The soil in Salem district, Tamil Nadu is predominantly red and brown non-calcareous, with some red and brown calcareous, black, and alluvial soil. The most common soil types are Red and brown non-calcareous soil, covering 62.6% of the north-western zone of the district whereas the Red and brown calcareous soil covers 30.5% of the north-western zone. Black soil covers 5.6% of the district and Alluvial soil covers 1.3% of the district. Provided with the low clay content in this non-calcareous soil, using unstabilized soil materials (without an added binder) was not feasible. Consequently, in this study, the soil has been stabilized using ceramic dust waste and geopolymer. The mixture is then compacted into molds and cured at ambient temperatures, eliminating the need for high-energy curing methods. By incorporating industrial waste products like ceramic dust, this approach reduces landfill waste and helps to lower the carbon footprint of the construction industry. The resulting blocks are not only cost-effective but also contribute to sustainable building practices, making them a promising option for greener construction in civil engineering.

Keywords: *Ceramic dust waste, Geopolymer binder, Bottom ash, Metakaolin*

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ASSESSMENT OF MICROPLASTICS IMPACTS ON EARTHWORM PHYSIOLOGY AND SOIL HEALTH

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Abstract

Microplastics are an emerging contaminant that causes concern in soil worldwide due to its widespread distribution and potential dangers to the ecosystem. This study aims to shed light on the scale and sources of soil contamination in dump yard soils, ultimately contributing to better waste management practices and soil restoration strategies. Key parameters such as soil pH, moisture content, and burrowing depth were assessed, along with physiological responses of earthworms, including changes in body weight and burrowing behaviour. The results demonstrated that microplastic presence significantly altered soil properties and adversely affected earthworm health. Notably, a reduction in burrowing depth and earthworm weight was observed in microplastic-contaminated soils, indicating physical and possibly toxicological stress. Soil pH and moisture content also exhibited variations, potentially disrupting microbial activity and nutrient cycling. These findings emphasize the broader ecological risks posed by microplastic contamination in terrestrial systems and highlight the vulnerability of essential soil organisms like earthworms. The study underscores the pressing need for effective waste segregation, recycling, and the development of sustainable waste management strategies. Regulatory interventions and public awareness campaigns are essential to minimize microplastic pollution at its source and ensure long-term soil and ecosystem health.

Keywords: *Microplastics, soil health, earthworms, soil contamination, plastic pollution*

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NUMERICAL STUDY ON SOIL STRUCTURE INTERACTION OF FOOTING RESTING ON STABILIZED CLAY SOIL USING PLAXIS SOFTWARE

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Abstract

Soil-structure interaction (SSI) is a crucial aspect of geotechnical engineering that influences the stability and performance of foundations. In this study, a numerical investigation is conducted to analyze the behavior of footings resting on stabilized clay soil using PLAXIS, a finite element software specialized in geotechnical modeling. Clayey soils often exhibit poor engineering properties, such as low bearing capacity and high compressibility, which can compromise the stability of structures. To improve these properties, soil stabilization techniques using additives like Natural polymer such as Sodium alginate and Natural Fibers such as jute fibers considered. The research focuses on evaluating the influence of soil stabilization on the load-bearing capacity, settlement characteristics, and overall performance of shallow foundations. A series of numerical simulations are performed using PLAXIS 2D/3D, considering various stabilization methods and their corresponding effects on soil strength parameters. The analysis incorporates different footing sizes, loading conditions, and soil improvement techniques to assess their impact on stress distribution and deformation behavior. This study demonstrates the applicability of PLAXIS in simulating SSI problems and offers valuable recommendations for engineers and researchers working on foundation design over weak soils. Future research directions include experimental validation of numerical results and the exploration of advanced stabilization techniques to further enhance foundation performance.

Keywords: *Soil-Structure Interaction, Stabilized Clay, Footing, PLAXIS, Numerical Analysis, Foundation Engineering*

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SUSTAINABLE CONCRETE WITH SISAL FIBER, REDMUD AND METAKAOLIN: A CEMENT FREE APPROACH

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Abstract

This study explores the potential of incorporating sisal fiber, red mud, and metakaolin into concrete as a sustainable alternative to conventional cement-based construction materials. Cement production is a major contributor to carbon emissions and environmental degradation, necessitating the development of eco-friendly alternatives. Sisal fiber, a natural and renewable resource, improves the mechanical properties of concrete by enhancing tensile strength, crack resistance, and durability. Additionally, its lightweight nature contributes to reduced structural weight, making it a promising reinforcement material. Red mud, a byproduct of the aluminum industry, presents a significant environmental challenge due to its disposal issues. Utilizing red mud as a partial cement replacement not only mitigates waste management concerns but also enhances the pozzolanic reaction, leading to improved strength and durability characteristics in concrete. Similarly, metakaolin, a highly reactive pozzolanic material derived from calcined kaolin clay, improves the overall performance of concrete by refining its microstructure, reducing permeability, and increasing resistance to chemical attacks. The findings of this research contribute to the advancement of sustainable construction practices by offering an environmentally friendly and cost-effective alternative to conventional cementitious materials. The integration of sisal fiber, red mud, and metakaolin in concrete has the potential to reduce dependency on cement, lower carbon emissions, and promote circular economy principles in the construction industry. This study paves the way for further innovations in green building materials, aligning with global efforts toward sustainable infrastructure development.

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AN EXPERIMENTAL STUDY ON STABILIZATION OF HIGH SWELLING CLAY SOIL USING CALCIUM OXIDE

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Abstract

Expansive clay soils present significant geotechnical challenges due to their high swelling and shrinkage characteristics, leading to structural failures in foundations, roads, and embankments. To mitigate these issues, soil stabilization techniques are essential for improving the engineering properties of such problematic soils. This study focuses on the stabilization of high-swelling clay soils using calcium oxide (CaO) and evaluates its effectiveness through unconfined compressive strength (UCS) testing. Calcium oxide, commonly used as a soil stabilizer, reacts with the clay minerals through hydration and pozzolanic reactions, reducing plasticity, enhancing load-bearing capacity, and improving long-term stability. Laboratory experiments were conducted with varying percentages of calcium oxide and different curing periods to assess the strength development of the treated soil. UCS tests were performed to measure the improvement in compressive strength over time. The experimental results indicate that the addition of calcium oxide significantly reduces the soil's swelling potential while increasing its strength and durability. The findings highlight that an optimal dosage of CaO, coupled with adequate curing time, results in a substantial enhancement of the soil's mechanical properties, making it suitable for construction applications. This study emphasizes calcium oxide stabilization as a cost-effective and sustainable solution for addressing the challenges associated with expansive clay soils. The research findings provide valuable insights into the role of CaO in improving soil performance, contributing to the development of more resilient and long-lasting infrastructure in areas affected by swelling clay soils.

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A LITERATURE SURVEY ON ENVIRONMENTAL AND ECOLOGICAL IMPACT OF GEOPOLYMER CONCRETE WITH MINERAL AND AGROWASTE AS PARTIAL REPLACEMENT OF FLY ASH

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Abstract

Cement production emits roughly 1.56 billion metric tonnes of CO2 per year, contributing 8% of global emissions. This contributes to almost half of the calcination process, and together with thermal combustion, clinker generation could be responsible for 90% of the sector's emissions. To decrease the amount of emission from the cement production process, here alternatively the conventional concrete is replaced with the geopolymer concrete. Geopolymer concrete (GPC) is an eco-friendly alternative, utilizing industrial and agricultural waste as binders. Geopolymer (GP) is the third-generation binder after lime and ordinary Portland cement for concrete production. As per several literatures, GPC outperforms the conventional concrete showing better far results in the strength and durability properties. From the stipulated literatures, the fly ash is replaced with the mineral based and agro based wastes in the geopolymer concrete production and also several tests (chloride ion penetration, compressive strength test, etc) were performed to assess the strength and durability properties of the concrete. On the whole geopolymer concrete showed better results and is more reliable than the conventional concrete. Here is to the conclusion, this literature carries the analyzation of the embodied energy and the carbon footprint that serves as a major threat for the environmental system. This study contributes to the sustainable development of the cement production process.

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PERFORMANCE EVALUATION OF SPAR EQUIPPED WITH SOLITARY AND DOUBLE HEAVE PLATE FOR USE IN EAST COAST OF INDIA

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Abstract

Numerical techniques which are effective and affordable can be used to model and solve complex situations in ocean engineering problems. Either the time domain or the frequency domain can be used to solve the fluid structure interaction problems involving regular and random waves. The ANSYS AQWA program which is built on three-dimensional panel method which falls under the category of Boundary Element Method is designed to analyze the interaction between surface waves and offshore structures using diffraction radiation phenomenon. Heave plates have been extensively employed on Spar as dampening mechanisms to minimize its motion responses. These plates are effective in offering viscous damping and considerable added mass in heave mode. The hydrodynamic analysis of Spar equipped with twin heave plate under regular and random waves was conducted using ANSYS AQWA. The role of relative spacing on Spar's motion response was assessed and subsequently presented in the analysis. The simulated results revealed that the Spar featuring a pair of heave plates with a relative spacing ranging from 30 to 40% greater than that of Spar integrated with a solitary heave plate possessing a diameter ratio of 1.3 was highly effective in reducing responses under operating and survival wave environment in India's East coast.

Keywords: *Double heave plate; Heave added mass; Viscous damping; Motion responses, Performance evaluation.*

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EXPERIMENTAL STUDY ON THE INFLUENCE OF GROUNDNUT SHELL ASH AND NANO ALUMINA IN CONCRETE

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Abstract

This paper discussed sustainable and environmentally friendly substitutes for cement, providing a cost-saving option while encouraging a circular economy. Because of the environmental footprint and increasing demand for cement, waste by-products such as paper waste, red mud, rice husk, and plastic waste were examined as alternatives in concrete making. Groundnut shell ash (GSA) was discovered to be a source of potential replacement for cement by virtue of being composed of calcium oxide (CaO), silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), and iron oxide (Fe_2O_3). In investigations, a powdered form of Groundnut ash passed through a 75µm IS sieve was employed as a partial alternative for cement in the production of concrete.An assessment of strength of concrete under 5% cement replacement with GSA was the purpose of the study. Concrete samples, based on the mix proportion ratio of 1:1:2 (cement, sand, and aggregate) and having a water-cement ratio of 0.40, were made. Additional tests were performed with varying nano alumina percentages to evaluate the synergistic effect of GSA and nano alumina on compressive strength, flexural strength, and split tensile strength at 7, 14, and 28 days. From the results, it was observed that a combination of 5% GSA and 1% nano alumina gave the highest strength values in comparison to other GSA and nano alumina combinations, and this established that nano alumina had a marked improvement effect on the performance of GSA-based concrete.

Keywords: *Concrete, groundnut shell ash (GSA), nano alumina, cement replacement, strength properties, compressive strength, flexural strength*

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STUDY OF FLEXURAL BEHAVIOUR OF RC BEAM USING DOLOMITE AND BAGGASE ASH AS A BINDER

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Abstract

The flexural behavior of Reinforced Cement Concrete (RCC) beams is a critical area of study in structural engineering, particularly with regard to enhancing material properties while promoting sustainable construction practices. The increasing demand for alternative and eco-friendly construction materials has led to exploring industrial by-products such as Dolomite and Bagasse Ash as partial replacements for traditional binders in cement. This study focuses on analyzing the flexural performance of RCC beams incorporating Dolomite and Bagasse Ash as binder materials. The problem addressed in this research is the environmental impact and resource depletion associated with the use of conventional cement in RCC beams. Cement production is a major contributor to greenhouse gas emissions, prompting the need for viable alternatives. The primary aim of the present work is to evaluate how Dolomite and Bagasse Ash, when used as binder replacements, affect the flexural strength, ductility, and overall performance of RCC beams. Materials used in this study include Ordinary Portland Cement (OPC), Dolomite, and Bagasse Ash, with Dolomite and Bagasse Ash acting as partial replacements for cement in varying proportions (e.g., 5%, 10%, and 15%). The methodology involved mixing these materials in different ratios, casting RCC beams, and subjecting them to a four-point bending test to determine flexural strength, modulus of rupture, and failure characteristics. The results showed a noticeable improvement in the flexural strength and ductility of the RCC beams with the incorporation of Dolomite and Bagasse Ash, especially at lower replacement levels. Beams with 5% Dolomite and 10% Bagasse Ash exhibited the best performance in terms of flexural strength and cracking behavior compared to the control sample. The results also suggest that the inclusion of Dolomite and Bagasse Ash provides a sustainable alternative without compromising structural integrity. This study demonstrates the potential of utilizing Dolomite and Bagasse Ash as sustainable binders in RCC beams, offering an environmentally friendly alternative without sacrificing structural performance.

Keywords: *Reinforced Cement Concrete (RCC), Flexural Strength, Dolomite, Bagasse Ash, Binder Replacement, Sustainable Construction, Eco-friendly Materials, Cement Alternatives*

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EXPERIMENTAL STUDY ON CONCRETE INCORPORATING EGGSHELL POWDER AND JUTE FIBER FOR ENHANCED STRENGTH

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Abstract

The construction industry's key materials are mortar and concrete. Cement is a key component in the production of mortar and concrete. Natural limestone is used to make cement. When limestone is burned to make cement, carbon dioxide gas is liberated as a by-product, which is considered as a greenhouse gas with adverse environmental effects. Waste materials can be used in the manufacture of mortar and concrete to minimize negative consequences and natural resource utilization. In investigations, a powdered form of eggshell passed through a 90µm IS sieve and jute fiber were employed as a partial alternative for cement in the production of cement mortar. The cement mortar is formed with a 1:3 mix ratio. ESP is added in percentages of 0%, 3%, 4% and 5%, by cement weight. Eggshells are abundant in calcium oxide and have a chemical composition similar to natural limestone. The ideal fiber length is 5-10mm. According to the findings, increasing the percentage of eggshell powder (ESP) in the mortar mix along with jute fiber (JF) increases the split-tensile, compressive and flexural strength of the cement mortar specimen. JF is added in percentages of 0%, 0.5%, 0.8% and 1.0%, by cement weight Mechanical properties such as split-tensile, compressive and flexural strength with percent Jute fiber were compared to a nominal cement mortar cube. The effects of ESP and jute fiber on split-tensile, flexural and compressive strength, weight, water absorption, bulk density has been evaluated.

Keywords: *Eggshell powder (ESP), Split-Tensile strength, Jute fiber (JF), Compressive Strength, Flexural strength.*

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EXPERIMENTAL INVESTIGATION ON PAVER BLOCKS-UTILIZING DRIED POULTRY LITTER ASH - A SUSTAINABLE WASTE MANAGEMENT APPROACH

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Abstract

The environmental challenges posed by traditional cement production, a process that demands substantial resources and energy, have prompted the search for sustainable alternatives. Simultaneously, the poultry industry generates large volumes of poultry litter, a by-product often disposed of through landfilling or incineration, leading to environmental pollution. This research explores the potential of using dried poultry litter ash (PLA) as a partial replacement for cement in the production of paver blocks, offering a solution to both sustainable practice and the environmental impact of the construction industry. The study examines the effects of varying percentages of poultry litter ash (0%, 5%, 10%, and 15%) on the compressive strength, water absorption, and overall performance of the paver blocks. The results reveal that a 5% replacement of poultry litter ash significantly enhances the compressive strength, indicating that PLA can improve the mechanical properties of paver blocks. However, higher substitution levels result in a decline in compressive strength, suggesting an optimal substitution level for maximum performance. By utilizing poultry litter ash, this research offers a benefit of sustainable infrastructure. Incorporating dried poultry litter ash into paver blocks fosters a circular economy by recycling waste into usable materials, reducing environmental pollution. It enhances sustainability by reducing the need for cement, thus conserving natural resources and lowering carbon emissions. The findings demonstrate the potential of poultry litter ash as a viable alternative to traditional cement, contributing to the creation of resource-efficient, low-environmental-impact construction materials and promoting green building practices.

Key words: *Poultry Litter Ash, Sustainable construction practice, Circular economy, Waste utilization, Environmental impact reduction*

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UTILIZING RISE HUSK ASH NANOPARTICLES FOR IMPROVED CONCRETE PERFORMANCE: AN EXPERIMENTAL STUDY

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Abstract

Rice husk ash (RHA), an agricultural by product rich in silica, is a promising material for producing nanoparticles that serve as supplementary cementitious materials (SCMs). Incorporating RHA nanoparticles into concrete provides numerous advantages. Mechanically, the nano-sized silica particles enhance compressive strength by filling micro-pores in the concrete matrix, improving packing density and bonding. Additionally, they boost flexural strength by promoting pozzolanic reactions that form more calcium silicate hydrate (C-S-H) gel, further strengthening the material. In terms of durability, RHA nanoparticles refine the concrete's pore structure, reducing permeability and enhancing resistance to water and chloride ion penetration. They also mitigate chemical attacks, such as sulphate and alkali-aggregate reactions, while improving resistance to freeze-thaw cycles due to their ability to density the microstructure. From a sustainability perspective, RHA nanoparticles contribute to waste utilization by converting rice husk, an agricultural residue, into a valuable resource, reducing environmental waste. Their use also allows for partial replacement of cement, thereby lowering carbon emissions associated with cement production. Furthermore, the production of RHA nanoparticles can be achieved using controlled combustion techniques that harness the energy within rice husk. Overall, the integration of RHA nanoparticles into concrete enhances mechanical and durability properties while promoting sustainable construction practices. The proportions of replacement chosen are at 10% for using in rice husk ash interval starting from 5%, 10% and the casted concrete were tested under compression at different ages and results obtained are compared with normal concrete of same grade and it is concluded that the results are comparable.

Keywords: *Compressive strength, Density, Rice hush ash, Volume, Workability*

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EVALUATION OF MECHANICAL PROPERTIES OF STEEL FIBER REINFORCED CONCRETE

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Abstract

Steel Fibre Reinforced Concrete (SFRC) is increasingly utilized in the structural elements of buildings, such as industrial floors, slabs, walls, and foundations. The application of load to a fibre-reinforced composite consisting of a low-modulus matrix reinforced with high-strength, high-modulus fibres result in the plastic flow of the matrix under stress, transferring the load to the fibre. This interaction produces a high-strength, high-modulus material that determines the stiffness and stress characteristics of the composite. This study investigates the mechanical properties of SFRC to enhance its structural performance in construction. The research focuses on analyzing the compressive and split tensile strengths of SFRC specimens with varying fibre volume fractions (0.5%, 1.0%, 1.5%, and 2%) and aspect ratios (60 and 120). Experimental results demonstrate significant improvements in both tensile and compressive strength compared to conventional concrete. The optimal performance was observed with 2% fibre volume and an aspect ratio of 120, which achieved a maximum split tensile strength of 5.645 N/mm² and an ultimate load capacity of 690 kN. The study highlights SFRC's potential applications in earthquake-resistant structures and hydraulic systems, offering improved durability, toughness, and ductility. These properties make SFRC particularly suitable for structural elements subjected to high stress, such as in seismic zones or exposed to harsh environmental conditions. Future research will focus on exploring broader applications and optimizing mix designs for specific structural requirements.

Keywords: *Steel Fiber Reinforced Concrete, compressive strength, split tensile strength, fibre volume fraction, aspect ratio, structural performance.*

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EXPERIMENTAL STUDY ON GEOPOLYMER BRICK USING C&D WASTE AND SPENT COFFEE GROUNDS

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Abstract

Geopolymer bricks have emerged as a sustainable alternative to conventional clay bricks, utilizing industrial and agricultural waste materials while reducing environmental impact. This study investigates the development of geopolymer bricks incorporating Construction and Demolition (C&D) waste, spent coffee grounds (SCGs), and fly ash, focusing on strength and durability optimization by varying the alkaline molarity (6M, 7M, and 8M). The influence of different alkaline concentrations on the mechanical and durability properties of the bricks is analyzed to determine the optimal formulation. A comprehensive characterization of the raw materials is conducted using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDAX), and X-ray Diffraction (XRD) to assess microstructure, elemental composition, and mineral phases. Additionally, chemical composition tests evaluate the suitability of waste materials for geopolymerization. SCGs, rich in silica (SiO_2), potassium (K), calcium (Ca), and magnesium (Mg), enhance the geopolymer matrix, with silica aiding geopolymerization, potassium contributing to alkali activation, and calcium and magnesium improving mechanical properties and durability. Experimental results show that the alkaline molarity significantly affects compressive strength and durability. Among the tested concentrations, the 8M solution exhibits the highest compressive strength (14.8 M Pa) and improved durability, making it the most suitable for practical applications. SEM analysis reveals a denser, more compact microstructure at higher molarity levels, while XRD and EDAX confirm the formation of strong geopolymeric bonds, leading to enhanced mechanical performance. This study demonstrates the feasibility of utilizing SCGs, C&D waste, and fly ash in geopolymer brick production, promoting waste valorization and circular economy practices.

Keywords: *Geopolymer bricks, Spent coffee grounds, Flyash brick, Construction and Demolition waste, Coffee waste, Geopolimerization*

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EXPERIMENTAL INVESTIGATION ON UTILIZING CASTING SAND WITH METAKAOLIN FOR GEOPOLYMER MORTAR

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Abstract

The construction industry significantly contributes to global CO_2 emissions due to the extensive use of Ordinary Portland Cement (OPC) and natural river sand. Cement production releases a considerable amount of carbon dioxide during clinker formation, while excessive sand mining disrupts ecosystems, leading to environmental degradation. To address these concerns, this study explores the development of a sustainable geopolymer mortar by replacing OPC with metakaolin as the primary aluminosilicate precursor and partially substituting fine aggregate with casting sand, an industrial byproduct from metal casting processes. The objective of this research is to optimize the mix proportions and alkali activator molarity to achieve an eco-friendly and high-performance mortar. Geopolymer specimens were prepared using various ratios of metakaolin and casting sand, with sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) as activators. The specimens underwent different curing regimes, including ambient and heat curing. Performance evaluation was conducted through compressive strength, water absorption, and durability tests. Additionally, XRD and SEM analyses were performed to assess the microstructural characteristics of the geopolymer matrix. The results demonstrate that replacing OPC with metakaolin and partially replacing fine aggregates with casting sand produces a geopolymer mortar with promising mechanical properties and enhanced durability. The study emphasizes the environmental benefits of utilizing industrial waste materials, reducing CO_2 emissions, waste management and promoting sustainable construction practices. This research lays the foundation for further optimization and large-scale application of geopolymer mortar as a viable alternative to conventional cement-based materials.

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STUDT ON BEHAVIOUR OF RC COLUMN UNDER AXIAL COMPRESSION USING NANO SILICA AND BAGASSE ASH AS A PARTIAL REPLACEMENT TO CEMENT

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Abstract

The use of traditional cement in concrete has raised concerns due to its high environmental impact, particularly in terms of CO2 emissions. The performance of reinforced concrete (RC) columns under axial compression is critical in structural engineering, particularly in enhancing the material strength and durability. With the increasing demand for sustainable construction materials, there is a growing interest in utilizing industrial by-products and nano-materials as partial replacements to enhance the performance of concrete. The study investigates the behavior of RC columns under axial compression by incorporating Nano Silica (NS) and Bagasse Ash (BA) as partial replacements for cement. This research focuses on evaluating the axial compression behavior of RC columns with a mix of Nano Silica and Bagasse Ash as partial replacements for cement. It examines the impact of these materials on the load-bearing capacity, deformation characteristics, and failure modes of the columns. The materials used in this study include Ordinary Portland Cement (OPC), Nano Silica (NS), Bagasse Ash (BA), fine and coarse aggregates, and water. The NS and BA were used as partial replacements for cement, with varying proportions (1%, 1.5%, 2% and 2.5% for Nano Silica and 5%, 10%, 15% and 20% for Bagasse Ash) to evaluate their effect on the properties of concrete. The mix proportions were designed according to standard mix design procedures, with adjustments for the partial replacement of cement with NS and BA. The columns were tested under axial compression to determine their load-carrying capacity, strain, and deformation characteristics. The failure modes of the columns were observed and documented. The experimental results showed that the inclusion of Nano Silica and Bagasse Ash as partial replacements for cement enhanced the axial compression strength of the RC columns. Columns with 1.5% NS and 10% BA exhibited the highest increase in load-carrying capacity compared to the control specimens. The study is limited by the scale of the experimental testing, which focused on small-scale RC column specimens. The long-term durability effects of Nano Silica and Bagasse Ash in RC columns, as well as their behavior under cyclic loading or environmental exposure conditions, were not investigated

Keywords: *Reinforced Concrete Columns, Axial Compression, Nano Silica, Bagasse Ash, Partial Replacement, Concrete Strength.*

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EXPERIMENTAL INVESTIGATION ON DEVELOPMENT OF PAVER BLOCK USING PLASTIC WASTE

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Abstract

Plastic waste, particularly polyethylene terephthalate (PET), high-density polyethylene (HDPE), and low-density polyethylene (LDPE), poses a significant environmental threat due to its non-biodegradable nature. With global plastic waste generation exceeding 400 million tons annually, improper disposal leads to severe land and marine pollution. A promising approach to addressing this issue is the utilization of plastic waste as a partial replacement for fine aggregates in construction materials, such as concrete and paver blocks. Studies have demonstrated that incorporating plastic waste can enhance properties like reduce water absorption and improve durability. However, challenges such as weaker bonding strength between plastic particles and cementitious materials, as well as issues related to thermal expansion, must be addressed through optimized mix designs and processing techniques. Experimental investigations have explored replacing fine aggregates with plastic waste at varying percentages, typically ranging from 5% to 25%. Research indicates that an optimal replacement level exists, often around 10-15%, beyond which compressive strength may decline due to poor interfacial bonding. Despite this limitation, plastic-modified paver blocks offer several advantages, including reduced density, making them suitable for lightweight construction. These properties make plastic waste a viable and sustainable alternative for construction applications, contributing to both environmental conservation and resource efficiency. However, further research is needed to refine mix proportions, address long-term performance concerns, and ensure scalability for industrial production. By repurposing plastic waste in this manner, we can mitigate its environmental impact while creating innovative, eco-friendly construction materials.

Keywords: *Plastic Waste-Polyethylene Terephthalate (PET) - High-Density Polyethylene (HDPE) - Low-Density Polyethylene (LDPE) - Paver Blocks – PVC Waste – Eco-friendly product.*

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EXPERIMENTAL BEHAVIOUR OF HIGH STRENGTH CONCRETE USING STEEL FIBRES FOR STRUCTURAL APPLICATIONS

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Abstract

Steel fibers to plain concrete is intended both to improve the materials ant ductility and that of structure in which Concrete is the most widely used structural material in the world with an annual production of over seven billion tons. The reason for concrete to suffer cracking may be attributed to structural, environmental or economic factors, but most of the cracks are formed due to the inherent weakness of the material to resist tensile forces. It has also been proved by extensive research and field trials carried out over the past three decades, that steel fibres to conventional plain concrete members at the time of mixing/production imparts improvements to several properties of concrete, particularly those related to strength, performance and durability. The maximum potentiality of high strength concrete cannot be realized fully in structures due to the brittleness of materials. The three major components contributing to the cost of a structural member are concrete, steel reinforcement and formwork. This paper aims at comparing these major components when concrete of higher grade is used in the design and to establish that High strength concrete. This paper presents the experimental investigations carried out to study the effect of steel fibers for high strength concrete using mix design of M60 concrete.

Keywords: *high performance concrete; compressive strength; split tensile strength; shear strength; flexural strength; modulus of elasticity.*

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EFFECT OF SILICA-FUME ON THE SELF-HEALING CHARACTERISTICS OF CEMENT CONCRETE IN MARINE ENVIRONMENT

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Abstract

Micro-cracks in concrete structures, particularly in marine environments, can lead to premature degradation and compromise the durability of coastal infrastructure. Self-healing concrete has shown promising results in repairing cracks up to 3 mm wide. In this study, silica fume as self-healing agent infused into M40 grade concrete, to study the self-healing observations. This study investigates the efficacy of mineral-based concrete, infused with copper slag and silica fume, in healing micro-cracks under marine conditions. The results show that the mineral-based concrete samples infused with 30% copper slag as mineral additive and 10% silica fume as self-healing agent exhibit enhanced micro-crack healing capabilities under simulated marine conditions. This innovative approach offers a promising solution for developing sustainable, self-healing concrete materials that can mitigate micro-crack damage in marine infrastructure. The findings of this study will have significant implications for the construction industry, enabling the creation of more resilient, environmentally friendly, and cost-effective coastal structures.

Keywords: *Silica Fume, Self-healing agents, Strength characteristics, Marine concrete, Porosity.*

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UTILIZATION OF RECYCLED PLASTIC WASTE AS A PARTIAL SUBSTITUTE FOR FINE AGGREGATE IN ENVIRONMENTALLY SUSTAINABLE CONCRETE

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Abstract

Plastic waste is one of the most common environmental problems in this era. It is difficult to decompose takes 50-100 years. In this study, plastic waste is used as a substitute of fine aggregate. The variations of plastic wastes are added to concrete as 0%,10%,20% and 30%. The compressive strength decreases with the increase in the percentage of plastic waste added. Maximum compressive strength is at the variations of as 0%,10%,20%and 30% with 19.21N/mm^2,22.54 N/mm^2, 20.22 N/mm^2 and21.08 N/mm^2 respectively. Two groups are considered whereas group 1 is 0% and group 2 is10%. Each group has 16 samples. Total sample of N = 32. SPSS carried out has a significance of 0.001 (P<0.05). The 10% group has the highest mean compressive strength. The 0% group has the lowest mean compressive strength. The error bars represent 95% confidence intervals (CI) and ±2 standard deviations (SD). There is a slight decrease in compressive strength beyond 10%, as seen in the 20% and 30% groups.

Keywords: *Plastic waste, Compressive strength, SPSS, Sustainable concrete*

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OPTIMIZING RECYCLED AGGREGATE PROPERTIES THROUGH THERMAL TREATMENT: EXPERIMENTAL AND LIFE CYCLE ANALYSIS

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Abstract

The higher demand for sustainable materials in the construction has strengthened the research towards utilization of recycled aggregates in the concrete. Nevertheless, the substandard characteristics of recycled aggregates due to the adhered mortar lowers its substitution. In this study, the recycled coarse aggregate (RCA) was treated thermally and used as substitute to natural coarse aggregate (NCA). The RCA was treated at 300 ^{o}C, 600 ^{o}C and 900 ^{o}C for 30 minutes, cooled at room temperature and used as thermally treated RCA (TRCA). The aggregates were investigated for its physical properties (adhered mortar, water absorption, density and specific gravity), microstructure and oxide composition. The concrete mixtures NAC, RAC and TRAC with NCA, RCA and TRCA were investigated for its workability, strength (compression, tension and flexure) and elastic modulus at 7, 14 and 28 days. The optimized treatment of RCA at 300 ^{o}C show 75% reduction in the percentage of mortar, resulting in 41.01% lower water absorption and 24.73% higher density. The workability of RAC was lowered by 30%, while the workability of TRAC was enhanced by 18%. The compressive strength, tensile strength, flexural strength and elastic modulus of the TRCA was 16.67%, 12.43%, 20.95% and 6.84% higher than RAC. The results infer that thermal treatment to RCA removes the adhered mortar on the RCA and thus improving its physical properties and hardened properties of the RAC. Life cycle assessment was performed through openLCA and observed RAC show lesser embodied energy and carbon footprint than other mixes.

Keywords: *Recycled aggregate, Thermal treatment, Physical properties, Mechanical properties, Life cycle analysis*

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UTILIZATION OF PROSOPIS JULIFLORA ASH AS SUSTAINABLE CEMENTITIOUS MATERIAL: INFLUENCE ON CONCRETE PROPERTIES AND ENVIRONMENT

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Abstract

Construction industries contribute to environmental distortion by using cement that emits CO_2 leading to ecological imbalance. Conversely, certain invasive species such as Prosopis juliflora negatively affect the environment. This paper investigates the influence of Prosopis juliflora ash (PJFA) on the mechanical properties of concrete. The cement was substituted with PJFA up to 40% at intervals of 5% in the concrete to assess its fresh properties and hardened properties such as compressive strength, tensile strength, flexure strength and elastic modulus. Microstructural investigations were performed on PJFA through XRD, SEM, FTIR and DTA and TGA analysis to investigate for its suitable replacement to the cement. The optimal substitution of PJFA as found to be 20%, beyond which it affects the concrete properties. The workability of PJFA concrete was lowered by 33.63% with increase in the substitution up to 40%. The strengths (compression, tension, flexural and elastic modulus) of the concrete with optimized PJFA was 6.73%, 5.70%, 7.07% and 7.11% than the control mix. The results infer that the finer particle size of PJFA densifies the microstructure and improves the concrete strength, while substitution beyond optimal level results in hinderance of hydration reaction. Microstructural investigations through SEM, element analysis through EDAX and overlay mapping of elements were also performed to validate the obtained results. Life cycle assessment through openLCA was also performed to support the discussion on reduction in the environmental impact.

Keywords: *Prosopis Juliflora Ash, Workability, Strength, Life cycle assessment, Microstructure*

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FLEXURAL BEHAVIOUR OF STEEL FIBRE REINFORCED CONCRETE BEAMS WITH NANO SILICA

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Abstract

In construction industry the innovation and advancement technology have major scope in new inventions. Nano materials play their role in the improvement of the construction sector by enhancing the material properties. Nano particles which are having high surface area compared to its volume. Nano materials are more reactive and improve the concrete mechanical properties. In order to study the performance of the nano silica concrete, the various mix ratios were used. The objective of research is to find the optimum dosage of nano silica in concrete. Various dosages of nano silica of 0%, 1.5%, 2%, 2.5%, 4%, 6%, 8% were added. A constant water to cementitious materials ratio of 0.45 was kept for all mixtures. The results indicate that the incorporation of nano silica increased the compressive strength of the concrete when compared to control concrete. Compressive strength, Modulus of Elasticity and flexural strength of the nano silica-based concrete were also examined. Optimum dosage of Nano Silica is found as 2% addition. Steel fibre of 0%, 0.5%, 1.0%, 1.5%, 2% and 2.5% were added to concrete and tested. Optimum dosage of steel fibre was found as 2%. Further the study was extended to create sustainable concrete beams with addition of nano silica and steel fibre. Nano silica concrete beams with steel fibre were cast. Two point loading was adopted to find flexural behaviour of steel fibre reinforced concrete beams with nano silica. With the analytical results obtained from ANSYS compared with the experimental results of steel fibre reinforced concrete beams with nano silica. The performance of the steel fibre reinforced concrete beams with nano silica shows better performance compared to the conventional concrete beam.

Keywords: *Nano silica, Compressive strength, Steel fibre, Ultimate load capacity.*

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EXPERIMENTAL INVESTIGATION ON THE STRUCTURAL BEHAVIOR OF STEEL FIBER REINFORCED CONCRETE ELEMENTS UNDER AXIAL LOADING

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Abstract

Extensively used material in construction industry is concrete this is because of good workability and ability to be moulded to any shape. Ordinary cement concrete possesses very low tensile strength, limited ductility and less resistance to cracking. The concrete shows the brittle behaviour and fails to handle tensile loading hence leads to internal micro cracks which are mainly responsible for brittle failure of concrete. For this problem the addition of randomly disbursed Fibers steel will reduce cracks and improves its strength, durability, toughness, ductility and post-cracking load resistance. They are typically made from high-strength materials that provide durability, resistance to wear, and sufficient sharpness to efficiently open fibers. As these fibers are made of carbon steel with a unique shape, they possess ductility which can be compensated with the concrete brittleness producing durable concrete with minimum cracks and efficient crack control. Many types of steel Fibers are used for concrete reinforcement. Round Fibers are the most common type and their diameter ranges from 0.25 to 0.75 mm. Rectangular steel Fibers are usually 0.25 mm thick, although 0.3 to 0.5 mm wires have been used in India. This study involves experimental testing of steel fiber-reinforced concrete (SFRC) columns with varying fiber volume fractions (0.5%, 1%, 1.5%, and 2%) and reinforcement volume percentages (0.8%, 1%, and 2%). The specimens were subjected to axial compression tests to analyze their load-carrying capacity, deformation characteristics, and failure mechanisms. The results indicate that the inclusion of steel fibers enhances the compressive strength, energy absorption, and post-cracking load resistance of concrete. The optimal combination of fiber and reinforcement volume was identified based on the experimental findings. The study highlights the potential applications of SFRC in bridge piers, earthquake-resistant structures, and other high-performance structural elements.

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THE ROLE OF HEMPCRETE IN SUSTAINABLE CONSTRUCTION

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Abstract

The construction industry is increasingly seeking sustainable alternatives to conventional building materials to mitigate environmental impacts. This study investigates the mechanical properties of hempcrete-based materials, including concrete cubes, bricks, and paver blocks, to evaluate their potential as eco-friendly construction solutions. The research focuses on three key performance metrics: compressive strength, water absorption, and split tensile strength. Samples were prepared using a mixture of hemp hurd, lime, and water, and subjected to standardized testing procedures to assess their structural integrity and durability. The findings suggest that hempcrete-based materials offer a viable alternative to traditional construction materials, contributing to reduced carbon emissions and enhanced sustainability. This study underscores the importance of further research into optimizing hempcrete formulations and exploring its integration into mainstream construction practices. By addressing both environmental and structural considerations, this research aims to advance the adoption of hempcrete in sustainable building projects.

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CORROSION RESISTANCE OF MILD STEEL PLATE USING POLYMERIC COATING

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Abstract

Mild steel (MS) plates are widely used in various industries due to their mechanical strength and cost-effectiveness, but their susceptibility to corrosion 0limits their longevity and performance. Conventional coatings, such as epoxy-based paints, provide limited protection and often fail in aggressive environments. This study aims to explore the influence of paracetamol-based polymer coatings on the corrosion resistance of MS plates. The primary objective is to assess how different polymer coatings affect the corrosion behaviour of MS plates. Fourier Transform Infrared Spectroscopy (FTIR) is employed to investigate the chemical structure and functional groups of the polymers, ensuring that the desired properties, such as hydrophobicity and chemical stability are present. Differential Scanning Calorimetry (DSC) is used to assess the thermal behaviour and stability of the polymeric materials. These techniques provide valuable insights into the polymer's stability, adhesion to the MS surface, and its ability to act as a protective barrier against corrosion. Paracetamol-based polymers were coated in the MS plate and allowed for curing. The effectiveness of the coatings is assessed through visual observations of the coated MS plates over time, monitoring physical changes such as discoloration, blistering, or pitting. Additionally, corrosion rate measurements are conducted using electrochemical methods like Nyquist plot, Tafel plot and linearity to quantitatively evaluate the level of protection offered by the polymeric coatings compared with other polymeric coating plates. The corrosion resistance of the different polymer materials is determined and compared. After comparing, the polymer that shows the minimum corrosion rate can be adapted for different applications even in harsh or moist environments.

Keywords: *corrosion, paracetamol-based polymer, MS plates, FTIR&DSC, Electrochemical methods.*

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A STUDY AND CHARACTERISTICS OF SILVER OXIDE NANOPARTICLES FROM GREEN SYNTHESIS METHOD

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Abstract

In modern times, some of the nanoparticle synthesis processes have switched from conventional synthetic methods to green synthetic methods. The present study involves green synthesis of silver oxide nanoparticles using citron leaf extract. The experimentation involves the reaction between aqueous silver nitrate and leaf extract under reflux condition. The operating conditions include a constant stirring rate of 300 rpm, at a temperature of 90 ºC for a duration of 1 hour. The colour change in the silver nitrate solution confirms the formation of silver oxide nanoparticles. In green synthesis, the citron plant extracts act as a capping agent as well as a reducing agent. The synthesis of silver oxide nanoparticles using citron plant leaf extract has been characterized using XRD, FESEM, and EDX, revealing nanoparticles that are nano sized, angular in shape and in cluster form. EDX confirms the presence of capping agent in the synthesised nanoparticles. These nanoparticles exhibit unique biological property, including anti-microbial offering significant potential for medical applications. Further investigation is essential to explore the biological activities of the synthesized nanoparticles and contribute to various medical advancements.

Keywords: *Silver oxide, Nanoparticles, Green-synthesis, Citron leaf extract, Anti-microbial properties.*

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METHOD OF DEVELOPING AMBIENT CURED, EARLY STRENGTH ALKALI ACTIVATED CONCRETE FROM INDUSTRIAL WASTE

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Abstract

The construction industry faces the challenges of minimizing environmental footprint while attaining high-strength concrete materials for speedy and sustainable construction. This invention facilitates energy efficient and sustainable construction technique for designing ambient-cured AAC. The mix integrates 30wt% GGBS, obtained from industrial waste, 20wt% waste foundry sand, and 50wt% coarse aggregate. The alkaline activator solution is obtained by sodium silicate and 10M sodium hydroxide in a 2.5:1 ratio, offering efficient geopolymerization at ambient condition. The preparation process engages dry mixing of aggregates and GGBS with subsequent addition of the alkaline activator while blending to achieve uniformity. Followed by, the mixture is compacted in molds to lowers air voids and cured under ambient conditions, neglecting the requirement of energy-intensive thermal curing. The developed AAC explores exceptional characteristics, with an early age (7 days) compressive strength of 75 MPa, a acquired a high-density of 2412 kg/m³, and possessed a low water absorption of 0.28%, demonstrates of its structural integrity. This novel material extends the adaption of industrial by-products, lowering dependency on natural resources and mitigating waste disposal issues, while ambient curing remarkably reduces energy consumption. The invention is specifically benefit for expeditious construction industry, ensuring sustainable, cost effective, and long-term structural performance in diverse construction applications

Keywords: *Alkali-Activated Concrete (AAC), Geopolymer Concrete, Industrial Waste Utilization, Ambient Curing.*

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ANALYSIS OF SEASONAL VARIATIONS IN AEROSOL OPTICAL DEPTH (AOD) OVER TAMIL NADU (2014–2023)

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Abstract

The atmospheric aerosol concentration that influences climate and air quality is Aerosol Optical Depth (AOD). This study analysis the seasonal variation of AOD over Tamil Nadu between 2014 and 2023. In order to analyse the trends in aerosol dispersion, the analysis studies at the differences between urban and rural districts. The Pre-Monsoon (March–May) and Northeast Monsoon (October–December) seasons had the highest AOD levels, according to the results, because of dust movement, biomass burning, and industrial emissions. On the other hand, wet deposition from monsoonal rainfall is the main reason why the Southwest Monsoon (June–September) season has the lowest AOD levels. The winter season fog and atmospheric stability have an impact on the moderate AOD levels during the Post-Monsoon (January–February) season. The influence of weather on aerosol dispersion is shown by these seasonal variations. The results indicate the necessity of continuous AOD monitoring for air quality control and reduce environmental effects in Tamil Nadu.

Keywords: *Aerosol, seasonal variation, air quality.*

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FABRICATION OF POLYMER MEMBRANE FROM THERMALLY TREATED LEFT OVER OF WASTE PRINTED CIRCUIT BOARDS AND ITS APPLICATION IN DYE ADSORPTION

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Abstract

Membrane-based technologies have gained significant attention for the removal of dyes from wastewater due to their high efficiency, low energy consumption, and environmental sustainability. This study explores the use of various membranes for the removal of synthetic dyes, focusing on the mechanisms of adsorption. The research investigates the fabrication of polyvinyl alcohol membrane incorporated with the residual WPCB treated in muffle furnace. The membrane is optimised by varying the operational parameters such as dosage of carbon forms and pH varied from 3 to 12 on dye removal efficiency. Results demonstrate that membrane adsorption, particularly when combined with advanced modifications by reinforcing carbon material, presents a promising solution for effective dye removal up to 90% from dye effluents. Furthermore, the study highlights and ensures the sustainable and scalable application in real-world scenarios.

Keywords: *Dye removal, Environmental sustainability, Dye effluent, Membrane adsorption*

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TREATMENT OF CAR WASH WATER USING ELECTRO COAGULATION, CHEMICAL AND BIOLOGICAL PROCESS - A COMPARATIVE STUDY

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Abstract

Waste water generated from car wash service station contributes to majority of environmental contamination because of the chemical characteristics present in the car wash water. This research work compares the effectiveness of treating car wash water collected from car wash station located in Coimbatore using naturally available water hyacinth, chemical(alum) and electrocoagulation (Cu - Cu, Cu - Al, Al - Al) method. Different parameters like pH, turbidity, Chemical oxygen demand, oil and grease, total organic carbon were characterized for the collected car wash water. Oil and grease, Chemical oxygen demand contributes to majority of pollution. Experimental results show that electro coagulation method has better removal efficiency of oil and grease, Chemical oxygen demand and turbidity. Maximum Chemical oxygen demand removal efficiency of 61% and oil and grease removal efficiency of 70% has been attained by electro coagulation method. Water hyacinth has also shown a good result with Chemical oxygen demand removal efficiency of 50% and oil and grease removal efficiency of 54.5%. Electrocoagulation method with Al-Al electrode combination has been found to give better results for the treatment of car wash water.

Keywords: *Electro Coagulation; Chemical Process; Biological Process; Water hyacinth*

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EFFECT OF ELEVATED TEMPERATURE AND NATURAL FIBERS ON THE INTERFACIAL BOND BEHAVIOR OF ULTRA-HIGH TOUGHNESS CEMENTITIOUS COMPOSITES

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Abstract

In this study, an attempt is made to understand the interfacial bond behaviour of conventional concrete and ultra-high toughness cementitious composites (UHTCC) through slant shear compression testing. The main objective of the proposed work is to understand the residual mass strength reduction and failure mechanisms on the interfacial bond characteristics of UHTCC at elevated temperatures. Moreover, the novelty of the work lies on the use of natural plant-based hemp fiber instead of artificial fibers in UHTCC. The conventional concrete cylinders of grade M30 was cut at an interfacial angle 40^0 and was re-cast with natural fiber UHTCC mix for conducting the slant shear test. After sufficient curing, the specimens were subjected to temperature range of 300^0C and 450^0C to understand their behavior after thermal exposure. From the load values, the normal stress and the shear stress developed at the interface between UHTCC and conventional concrete was estimated. Results reveal that the normal stress and shear stresses reduce significantly due to the thermal exposure. In specific, both the normal and shear stress values reduced by 31.4% for the 300^0C and 450^0C exposed slant shear specimens respectively.

Keywords: *UHTCC Matrix, Hemp fiber, Slant shear test, Thermal exposure*

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INFLUENCE OF INDUSTRIAL AND AGRO BY PRODUCTS ON STRENGTH AND ELEMENTAL PROPERTIES OF GEO POLYMER MORTAR

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Abstract

The construction industry significantly contributes to global CO_2 emissions, with Ordinary Portland Cement (OPC) accounting for approximately 8% of total emissions. As a sustainable alternative, geopolymer mortar has emerged, utilizing industrial and agro by-products to reduce environmental impact while enhancing mechanical properties. This study investigates the influence of Ground Granulated Blast Furnace Slag (GGBS), Micronized Biomass Silica (MBS), and Sewage Sludge Ash (SSA) on the strength properties of geopolymer mortar. A ternary blended geopolymer system was developed by partially replacing GGBS with MBS and SSA in varying proportions (0–30%) under ambient curing. Alkaline activation was achieved using sodium silicate to sodium hydroxide (SS/SH = 2). The compressive strength results revealed that a mix proportion of 60% GGBS, 20% MBS, and 20% SSA exhibited compressive strength comparable to the control mix (100% GGBS) after 28 days. Elemental property of optimum mortar mixes was found using X-Ray Diffraction (XRD) analysis and the results confirmed that the formation of Yugawaralite, Anorthite, and Quartz, which contributed to strength development. The findings highlight the potential of GGBS-MBS-SSA-based geopolymer mortar for high-strength structural applications, promoting sustainable and high-performance cementitious materials in the construction industry.

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DEVELOPMENT OF TRADITIONAL BRICK USING SAPONINS AS A NATURAL FOAMING AGENT

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Abstract

This study presents a novel approach to traditional brick manufacturing by incorporating soapnut berry water, a natural surfactant-rich solution, as a substitute for conventional water. Soapnut berries, derived from the Sapindus mukorossi tree, possess saponins known for their foaming and cleansing properties. The research investigates the effects of varying concentrations of soapnut berry water on bricks' mechanical properties, durability, and environmental impact. Experimental trials explore different mix proportions and hardening and solidifying techniques to optimize the performance of soapnut berry water-based bricks. The study evaluates the compressive strength, water absorption and weathering resistance of the produced bricks compared to conventional ones. Economic feasibility and environmental sustainability are also analysed to assess the practicality of integrating soapnut berry water into brick manufacturing processes. The findings of this research offer a promising eco-friendly alternative to traditional brick production, contributing to the production of lighter bricks with sustainable practices in the construction industry. The soapnut solution is also used to reduce the usage of water, which will make extra bricks in the foaming solution.

Keywords: *Conventional, Traditional brick, Soap-nut berries, Sustainability, Sapindus mukorossi, Eco-friendly.*

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DEVELOPMENT OF BIOCHAR BASED FIBER REINFORCED SELF COMPACTING CONCRETE

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Abstract

Concrete being widely used material in construction industry and it requires compaction for reducing air voids and compaction can be difficult in confined and congested places. Self-Compacting Concrete (SCC) which compacts under its own weight reduces air void addresses this issue. Since construction industry is moving towards sustainability by seeking alternatives to replace materials which has high carbon emission, replacement of cement with biochar is a viable option. This study develops eco-friendly Self Compacting Concrete (SCC) by integrating biochar, which provides carbon sequestration and improves workability while maintaining its other properties like filling, flowing, passing ability and increases the sustainability of the mix. In total, eight trail mixes were prepared by varying biochar dosages as a replacement for cement with an increment of 2.5% for each mix. Additionally, the inclusion of sisal fibers enhances the ductility property and tensile strength of concrete. Also, it enhances the bonding between concrete leading to structural integrity, and controls the cracking improving overall durability.

Keywords: *Self-Compacting Concrete; Biochar; Sisal Fiber; Sustainability*

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EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF BACTERIA INFUSED GEOPOLYMER CONCRETE

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Abstract

This study investigates the development and mechanical properties of bacteria-infused self-healing ceramic-based geopolymer concrete. Geopolymer concrete, a sustainable alternative to traditional cement- based concrete, was infused with bacteria (Bacillus Megaterium) to enhance its self-healing capabilities. Geopolymer is a new development in the world of concrete in which cement is totally replaced by pozzolanic materials like fly ash and activated by highly alkaline solutions to act as a binder in the concrete mix. In this project we have totally replaced cement with ceramic powder. Therefore, efforts are made in this study to develop geopolymer concrete by employing ceramic powder as binder material and sodium hydroxide (NaOH) and sodium silicates (Na_2SiO_3) as alkaline activators. The activator solution (AAS) to binder solids (BS) ratio ranging from 0.4 to 1.0. Investigations are carried out to determine the fresh properties and mechanical properties such as compressive strength, splitting tensile strength, flexural strength and water absorption also carried out. Present investigation has been under taken to study the strength parameters of GPC on adding 10%, 20%, 30% of bacteria (Bacillus Megaterium) along with water in GPC. The results show that the bacteria-infused geopolymer concrete exhibits improved mechanical and self-healing properties, reduced water absorption, and enhanced self-healing capabilities compared to the control concrete. This innovative material has potential applications in infrastructure development, offering a sustainable solution for concrete structures.

Keywords: *BS-Binder Solution, AAS-Alkaline Activator Solution, GPC-Geopolymer Concrete, NaOH- Sodium Hydroxide, Na_2SiO_3-Sodium Silicate*

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PRE AND POST FIRE ANALYSIS OF COMPOSITE CONCRETE

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Abstract

The pre- and post-fire behaviour of concrete structures is crucial for ensuring safety and durability in fire-prone environments. This study investigates the fire resistance and recovery characteristics of concrete reinforced with composite cement, ceramic fibre, silicon carbide, steatite powder, vermiculite, and Bacillus bacteria. The inclusion of these additives aims to enhance the material's structural integrity, thermal stability, and self-healing capabilities. Composite cement improves the overall strength and durability, while ceramic fibre and silicon carbide provide superior thermal resistance, reducing heat conduction and minimizing thermal stress. Steatite powder contributes to thermal insulation, preventing excessive cracking under high temperatures. Vermiculite, a lightweight fire-resistant mineral, reduces spalling and helps retain moisture within the concrete matrix during exposure to heat. Bacillus bacteria introduce a self-healing mechanism by producing calcium carbonate, which seals micro-cracks and restores structural integrity post-fire. Pre-fire analysis highlights improvements in compressive strength, thermal conductivity, and resistance to spalling, while post-fire analysis shows higher residual strength, reduced crack propagation, and effective self-healing. This comprehensive approach to enhancing concrete performance can significantly improve the longevity and safety of structures in fire-exposed environments by varying the temperature from 27, 100, 200, 300, 400, 500, 600°C, making it a promising solution for modern construction challenges.

Keywords: *Bacterial Concrete, Self-healing, Mechanical, Chemical and mineral admixtures, Properties, Durability.*

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ENHANCING FLOWABILITY, STRENGTH, AND DURABILITY OF HIGH-PERFORMANCE SELF-COMPACTING AND SELF-CURING CONCRETE WITH LIGHTWEIGHT AGGREGATES

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Abstract

This study provides a comprehensive evaluation of the properties and performance of M60-grade self-compacting and self-curing concrete mix designs. It involves a detailed analysis of various concrete compositions, each with specific aggregate combinations and proportions. The primary focus is on assessing flowability, mechanical strength, durability, and microstructural characteristics. The research highlights the effectiveness of incorporating fine aggregate alternatives (FAA) alongside natural coarse aggregates (NCA) to enhance concrete properties. Among the analyzed mixes, M15 exhibited superior performance in terms of fresh concrete properties, mechanical strength, and durability. The findings emphasize the crucial role of aggregate selection and substitution in optimizing the overall strength, durability, and structural integrity of M60-grade concrete. These insights contribute to the advancement of optimized mix designs, supporting improved mechanical performance, microstructural stability, and long-term sustainability in the construction industry. Self-compacting concrete (SCC) is a specialized form of concrete designed to flow and consolidate under its own weight, eliminating the need for mechanical vibration. Developed to enhance construction efficiency and structural quality, SCC offers high fluidity, ensuring uniformity and homogeneity while effortlessly filling complex formwork and congested reinforcement areas. Key attributes of SCC include excellent flowability, resistance to segregation, and a superior surface finish, making it ideal for intricate and heavily reinforced structures. The mix design of SCC requires precise proportioning of cementitious materials, fine and coarse aggregates, chemical admixtures, and viscosity-modifying agents to achieve optimal rheological properties. Additionally, supplementary cementitious materials such as fly ash, silica fume, and ground granulated blast furnace slag are commonly incorporated to enhance workability, strength, and durability. Research on SCC continues to focus on optimizing mix compositions, evaluating mechanical and durability properties, and exploring sustainable alternatives such as recycled aggregates and industrial by-products. The adoption of SCC in the construction industry significantly reduces labour costs, accelerates construction timelines, and improves long-term structural performance. Ongoing advancements in SCC formulations, including self-curing and high-performance variations, further expand its applications in modern infrastructure development.

Keywords: *Self-compacting and self-curing concrete; Light Weight Expanded; Clay aggregate and fly ash aggregate.*

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MECHANICAL PROPERTIES OF FIBRE REINFORCED CONCRETE

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Abstract

Concrete is one of the most commonly used construction materials. It is a composite material compose of cement, fine aggregate, coarse aggregate and water with or without admixture. Concrete is known for its high compressive strength; however, it has low tensile strength. Thus, reinforcing concrete with reinforcing bars becomes in necessity for construction of large structures. In recent times, reinforcing concrete with fibres has been gaining much attention has it leads to improve tensile strength. Commonly used fibres include carbon fibres, micro steel, polypropylene, etc. Natural fibres are not only environment friendly but easily available if locally available fibres are properly chosen. Plants such as coconut and banana are available locally in Tamil Nadu. Coconut and banana fibres can be utilized effectively as a reinforcing material in concrete. Many at times being an agricultural waste, they are plentily and cheaply available. This experimental work aims to find the optimum fibre reinforcement percentage by conducting experiments at four different reinforcement percentages. From the study it was found out that both the fibres give maximum tensile strength at 1.5 percentage reinforcement

Keywords: *Fibre reinforced concrete, banana fibre, coconut fibre, tensile strength*

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INFLUENCE OF MAGNETIZED WATER ON THE BEHAVIOUR OF ONE PART GEOPOLYMER CONCRETE

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Abstract

This study investigates the use of magnetized water in one-part geopolymer concrete to enhance its properties compared to traditional concrete. Conventional concrete relies on ordinary water, which does not actively improve the material's characteristics. Additionally, the widespread use of cement-based concrete significantly contributes to CO_2 emissions, posing environmental challenges. According to Indian standards, only normal water should be used for mixing and curing concrete. However, in some regions, water quality may not meet the required chemical parameters. In such cases, water is magnetized to bring its chemical composition within the acceptable range, making it suitable for use in concrete mixing and curing, and reducing internal corrosion risks. Geopolymer concrete, a lower-carbon alternative to traditional concrete, has shown promise, but its performance can be further enhanced using innovative approaches. This research aims to assess the impact of various magnetic field intensities (0.5T, 0.9T, 1.0T, 1.5T, and 1.8T) and exposure durations (1, 3, 7, 14, 21, and 28 days) on geopolymer concrete. It is hypothesized that magnetized water will improve the strength, workability, and durability of one-part geopolymer concrete, making it a more efficient and eco-friendly material than conventional concrete. The study will also analyze the optical properties and morphological features of the magnetized water incorporated into the geopolymer concrete, offering insights into the material's structural advantages. By integrating magnetized water, this research supports sustainable construction practices by reducing cement dependency, minimizing carbon emissions, and promoting environmentally friendly alternatives. The goal is to advance high-performance and sustainable construction materials, ultimately contributing to a greener, more resilient built environment.

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SYNTHESIS OF NANO SILICA FROM INDUSTRIAL BY PRODUCT AND ITS EFFECTIVE USAGE IN METAKAOLIN AND GGBS BLENDED GEOPOLYMER MORTAR

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Abstract

The increasing environmental impact of cement production has accelerated the search for sustainable alternatives. Geopolymer concrete (GPC) is a promising eco-friendly material that utilizes industrial by-products such as ground granulated blast furnace slag (GGBS), metakaolin (MK), and sugarcane bagasse ash (SCBA) as alternative binders. This study investigates the mechanical and durability properties of geopolymer concrete prepared with varying proportions of MK and GGBS, activated by sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) solutions. The study evaluates compressive strength and durability under different curing conditions, including ambient and elevated temperature curing. Microstructural analysis using Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD) is conducted to assess the morphological characteristics of geopolymer concrete. The scope of this research involves the examination of the effect of the blends on the strength development and corrosion behaviour of concrete. The results demonstrate that replacing traditional cement with MK-GGBS binders enhances both mechanical performance and durability. Additionally, the findings suggest that SCBA can be incorporated as a supplementary material, reducing energy consumption and carbon footprint. This study contributes to the development of sustainable and high-performance geopolymer concrete suitable for modern construction applications. This study investigates the mechanical properties of the geopolymer mortar at different ages and to validate the strength value by means of microstructure studies

Keywords: *sugarcane bagasse ash, Metakaolin, Ground granulated blast furnace Slag*

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UTILIZATION OF PALM OIL CLINKER, POC SAND, AND PALM OIL FUEL ASH IN GEOPOLYMER MORTAR: A SUSTAINABLE APPROACH TO REDUCING BINDER AND SAND USAGE IN CONSTRUCTION

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Abstract

The increasing environmental concerns associated with excessive sand mining and cement production in the construction industry necessitate the development of sustainable alternatives. This study investigates the potential use of palm oil clinker (POC), POC sand, and palm oil fuel ash (POFA) as eco-friendly replacements for conventional binders and sand in geopolymer mortar. These by-products from the palm oil industry, which are often considered waste, possess promising properties that can enhance the sustainability of construction materials while reducing industrial waste disposal issues. The research focuses on optimizing the geopolymerization process to develop a mortar mix with improved mechanical properties and environmental benefits. The study examines the influence of incorporating POC, POC sand, and POFA on the strength and durability of geopolymer mortar. To assess its performance, a series of experimental tests are conducted, including compressive strength and modulus of elasticity (MOE) measurements. Samples are tested at different curing ages—1, 7, 14, and 21 days—to evaluate the early and long-term mechanical behaviour of the material. By analyzing the test results, this study aims to determine the feasibility of using these palm oil industry by-products as a sustainable alternative in construction applications. The findings will provide valuable insights into the mechanical performance, durability, and potential advantages of geopolymer mortar incorporating POC, POC sand, and POFA. Ultimately, this research contributes to reducing the environmental footprint of the construction sector by promoting the use of industrial by-products while maintaining structural integrity and performance standards.

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ENHANCED CORROSION PROTECTION OF MILD STEEL IN SIMULATED CONCRETE ENVIRONMENTS USING POLYMER-MODIFIED NANOCOMPOSITE COATINGS

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Abstract

This study evaluates the corrosion inhibition efficiency of polymer-modified nanocomposite coatings on mild steel in a simulated concrete pore solution using Tafel polarization, open circuit potential (OCP) measurements, and weight loss analysis. Four coatings—ZnO-Ni/PVDF, Ni-NiO/PVDF, ZnO-Zn/PVDF, and ZnO-NiO/PVDF—were analyzed to determine their ability to mitigate corrosion. The Tafel polarization curves reveal that Ni-NiO/PVDF exhibits a more positive corrosion potential while ZnO-Zn/PVDF shows a lower corrosion current density with both coatings demonstrating similar overall inhibition efficiencies. ZnO-Ni/PVDF provides the highest corrosion protection, followed by Ni-NiO/PVDF and ZnO-Zn/PVDF, with slightly reduced inhibition observed for ZnO-NiO/PVDF. Bare mild steel shows the least resistance to corrosion, aligning with the OCP trends. Weight loss analysis further supports these findings, showing inhibition efficiencies of 80%, 73%, 71%, and 67% for ZnO-Ni/PVDF, Ni-NiO/PVDF, ZnO-Zn/PVDF, and ZnO-NiO/PVDF coatings, respectively, compared to bare mild steel. The superior performance of ZnO-Ni/PVDF is attributed to its synergistic composition, forming a dense protective barrier against corrosive agents. These results highlight the potential of tailored polymer-modified nanocomposite coatings for enhancing the durability of steel reinforcements in concrete environments. This study underscores the importance of advanced coatings in mitigating steel corrosion for civil engineering applications.

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SYNTHESIS OF COPPER OXIDE NANOPARTICLES FROM WASTE PRINTED CIRCUIT BOARDS AND ITS UTILIZATION FOR DYE ADSORPTION

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Abstract

E-waste also known as electronic waste refers to the discarded electrical and electronic devices and their components due to their malfunction, obsolescence, or replacement. PCBs; a major component of e-waste, consists of 30% of non - metallic parts and 70% of metallic parts in which copper is approximately 30% of the composition. WPCBs cause many problems as these are toxic, requires many landfills and burning of these also leads to release of toxic fumes and dioxins into the atmosphere. Due to the complexities of disposing WPCBs, Recycling is the better option when compared to the previous and there have been many researches regarding separation and extraction of metals form the WPCBs. There have been many researches and initiatives regarding recycling of E-wastes such as setting up of micro factories for recycling, bacterial extraction of metals from WPCBs and many others. In this proposed work; we are focusing on extraction of Copper from WPCBs in the form of copper oxide Nano particles via the process of Hydrometallurgy and characterisation of the synthesised copper nanoparticles are done via XRD, FSEM and EDX analysis. The synthesised copper oxide nanoparticles are assessed for its dye adsorption capacity against Industrial dyes.

Keywords: *E- Waste, WPCB, Copper oxide Nanoparticles, Hydrometallurgy, Dye adsorption.*

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CORROSION MODELING IN RC BEAMS

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Abstract

Corrosion of reinforcement in reinforced concrete (RC) beams is one of the most significant factors affecting their durability and structural performance. Over time, the deterioration caused by corrosion leads to reduced load-bearing capacity, cracking and eventual failure of RC structures. This paper reviews various modeling approaches used to predict and assess the impact of corrosion on RC beams, including analytical methods, finite element modeling (FEM), numerical simulations and data-driven techniques. It also explores recent advancements in probabilistic models and phase-field approaches, which help capture the uncertainties and complex behaviours associated with corrosion-induced damage. By comparing the strengths and limitations of these methodologies, this study provides valuable insights into the current state of corrosion modeling and identifies potential areas for future research. The findings aim to support the development of more effective maintenance strategies and prolong the service life of RC structures.

Keywords: *Reinforced concrete beams, Corrosion of reinforcement, Durability of RC Structure, Finite element modelling (FEM), Probabilistic models*

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EXPERIMENTAL INVESTIGATION ON OPTIMIZING THERMAL INSULATION OF BUILDING BRICKS USING SUGARCANE BAGASSE ASH

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Abstract

The construction industry is increasingly focusing on sustainable and energy-efficient building materials to reduce environmental impact and energy consumption. This study investigates the optimization of thermal insulation in building bricks using industrial waste materials, including fly ash, sugarcane bagasse ash, and quarry dust. The base composition of the bricks consists of fly ash (60%), lime (15%), gypsum (5%), quarry dust (20%), and water, with varying percentages of sugarcane bagasse ash (0%, 5%, 10%, 15%, and 20%) added to the mix. The experimental investigation evaluates the thermal, mechanical, and structural properties of the bricks. Results indicate that the inclusion of sugarcane bagasse ash significantly reduces thermal conductivity, enhancing the insulation properties of bricks. The density of the bricks decreased with increasing SBA content, resulting in lighter and more manageable building materials. However, the porous nature of the bricks also led to higher water absorption, which may require limited requirements for better results. Microstructural analysis using scanning electron microscopy (SEM) revealed a uniform distribution of SBA particles and the formation of pores, further explaining the improved thermal insulation properties.

Keywords: *Sugarcane Bagasse Ash (SCBA), Thermal Insulation, Sustainable Construction, Energy-Efficient, Optimization*

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RAPIDASH BASED GEOPOLYMER CONCRETE

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Abstract

This project report presents the development of RapidAsh based geopolymer concrete as a sustainable alternative to conventional Portland cement concrete. The main objectives were to effectively utilize low calcium fly ash and enhance the concrete's workability, compressive strength, and durability using a RapidAsh admixture while reducing environmental impact. The methodology involved a detailed literature review, material characterization, and formulation of an optimized mix design by varying RapidAsh dosages (4 kg/m³ vs. 8 kg/m³) and the alkaline activator-to binder ratio (0.30 vs. 0.45). Concrete specimens were cast and cured under ambient conditions, followed by compressive strength testing at 7 and 14 days. Key findings indicate that a higher RapidAsh dosage of 8 kg/m³ combined with an activator ratio of 0.45 produces a denser, stronger matrix. The inclusion of supplementary materials like GGBS further enhanced strength and durability, confirming the potential of geopolymer concrete for resilient, low-carbon infrastructure.

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A STUDY ON STRENGTH CHARACTERISTICS OF ARTIFICIAL AGGREGATE

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Abstract

The growing demand for construction materials has led to the depletion of natural aggregates, necessitating the development of sustainable alternatives. This study explores the potential of artificial aggregate produced from industrial by-products and agricultural waste, such as Ground Granulated Blast Furnace Slag (GGBS) and Rice Husk Ash (RHA). These materials were mixed in varying proportions and subjected to different tests to evaluate their physical, mechanical, and morphological characteristics. Key assessments included particle size distribution, specific gravity, water absorption, impact resistance, and crushing strength. Additionally, a Scanning Electron Microscope (SEM) was used to examine the structural integrity of the artificial aggregates. These artificial aggregates were incorporated into conventional concrete in varying proportions, and multiple tests were conducted to analyze their performance. The evaluation included compression tests at different curing periods (7,14, and 28 days), along with SEM analysis to assess the bonding between artificial aggregates and cement. The findings suggest that these aggregates can be effectively utilized in the reduction and conservation of natural resources.

Keywords: *Artificial aggregates, GGBS, RHA, SEM, Bonding between cement and aggregates, characteristics test.*

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OPTIMIZATION OF WASTE GLASS POWDER AS FINE AGGREGATE FOR M20 GRADE OF GEOPOLYMER CONCRETE

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Abstract

Geopolymer concrete is a type of concrete that is made by reacting aluminate and silicate materials such as fly ash or slag from iron and metal production. Geopolymer concrete is a type of concrete that uses industrial by-products as binders, reducing the need for cement and minimizing waste. It can be a suitable substitute for Ordinary Portland Cement (OPC) concrete. The use of abundantly available wastes such as glass powder shall be used in construction industry in the form of geopolymer concrete using glass waste as fine aggregate turns out to be the search of a very promising building material for a sustainable future. The majority of research on geopolymer concrete has focused on utilizing fly ash as the primary source material. However, this study explores the use of Glass waste as an additional source material, given its abundance and potential as a valuable resource for fine aggregate. Fine aggregate will be replaced by waste glass powder as 0%, 10%, 20% and 30% by weight for M20mix and the alkaline activator solution used is a mixture of 8 molar sodium hydroxide and sodium silicate in the ratio of 1:2.5. Glass waste is a significant waste material which has characteristics similar to ordinary river sand and hence its incorporation into geopolymer concrete can provide several benefits including reduced waste disposal costs, conservation of natural resources and potential improvement in mechanical properties and durability characteristics. The strength parameters of various combinations of Geopolymer concrete is studied and an optimum mix is obtained.

Keywords: *Geopolymer concrete, Glass waste powder, Fly ash, Alkaline activator solution, Mechanical properties and durability characteristics.*

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STUDIES ON ENHANCING THE USE OF TEXTILE SLUDGE AS SUSTAINABLE CONSTRUCTION MATERIALS

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Abstract

The textile industry is the second-largest provider of employment in India, following agriculture. It plays a crucial role in the Indian economy, contributing significantly to the rural economy, industrial production, and exports. However, this sector also generates a substantial amount of effluent, which contains high levels of contaminants such as color, BOD, COD, pH, Total Suspended Solids (TSS), and Total Dissolved Solids (TDS). To manage this, Effluent Treatment Plants (ETPs) and Common Effluent Treatment Plants (CETPs) are employed to treat the wastewater. During the treatment process, a large quantity of toxic sludge is produced, which can pose serious environmental hazards if disposed of improperly. The management of this sludge has become a global challenge, requiring effective reuse and safe disposal methods. Recent studies have explored the potential for utilizing textile ETP sludge in the production of non-structural building materials, such as cement concrete flooring tiles, hollow blocks, solid blocks, burnt clay bricks, and pavement blocks. In civil engineering projects, building materials like bricks, sand, coarse aggregates, and cement typically account for 60-70% of the total project cost. With this in mind, the focus has shifted towards using textile sludge to produce building materials with enhanced mechanical properties. The aim is to optimize process parameters, such as the percentage of waste material used and furnace temperature, to achieve physical and mechanical properties that exceed those of conventional materials. This research seeks to explore the potential of textile ETP sludge in the production of non-structural building materials, including flooring tiles, pavement blocks, and bricks. The outcomes of this study will present a cost-effective and environmentally sustainable approach for creating building materials, such as paver blocks, flooring tiles, and bricks, using textile ETP sludge.

Keywords: *Physical and Mechanical Properties, Textile Sludge & Waste to Wealth.*

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ENTRAPMENT AND UTILIZATION OF AMMONIA GAS IN THE POULTRY FARMS

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Abstract

Poultry houses emit large amount ammonia (NH_3), which is a serious health and environmental hazard that can lead to respiratory problems in farmers, decreased chicken output, and air pollution. In order to effectively capture and reduce ammonia emissions in poultry habitats, this study investigates the use of nanotechnology, more especially nanostructured aluminosilicates and zeolite clinoptilolite. Different doses of zeolite clinoptilolite (0.5 kg, 1.0 kg, 1.5 kg, 2.0 kg, and 2.5 kg) were used in a controlled experimental investigation, and ammonia concentrations were tracked for 48 hours. The findings showed that the ideal dosage of zeolite clinoptilolite was 1.0 kg, which reduced ammonia levels by about 50% in comparison to baseline readings. The fact that higher doses only slightly increased adsorption efficiency confirms that using too much zeolite does not increase it proportionately. This large reduction in ammonia contributes to enhanced chicken welfare, cleaner air for farmers, and less environmental damage. By adopting a composting method to turn ammonia-laden zeolite into an ammonia-nitrogen-enriched fertilizer, this work offers a sustainable solution that goes beyond ammonia mitigation. In early tests, the composted product showed increased nitrogen availability, which improved soil fertility and raised crop output. By turning waste into a useful resource, this innovative method not only lowers ammonia emissions but also encourages circular farming practices. The findings underscore the relevance of nanotechnology in producing cost-effective and environmentally acceptable ammonia control systems.

Keywords: *Ammonia Entrapment, Zeoliteclinoptilolite, Nanotechnology-based adsorption, Nitrogen-enriched fertilizer, sustainable Agriculture*

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DEVELOPMENT OF SUSTAINABLE PAVER BLOCKS BY USING BANANA PEDUNCLE ASH AND ARECA PLATE WASTE ASH: INSIGHTS INTO CARBON SEQUESTRATION

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Abstract

The development of sustainable building materials is crucial for minimizing environmental impact and promoting resource efficiency. This study investigates the use of Banana Peduncle Ash (BPA)at (4%, 8%,12%) and Areca Plate Waste Ash (APWA) at (5%, 10%, 15%) as partial cement replacements in paver block production, aiming to reduce cement consumption and associated CO_2 emissions. The integration of these agricultural waste by-products not only enhances mechanical performance but also contributes to carbon sequestration through carbonation reactions. Comprehensive experimental analyses, including compressive strength, water absorption, demonstrate that BPA and APWA improve the structural integrity and durability of paver blocks. Furthermore, the study underscores the significance of waste valorization and circular economy principles, offering a sustainable solution for urban infrastructure. By utilizing locally available waste materials, this approach reduces construction waste, decreases reliance on non-renewable resources, and aligns with global efforts to develop low-carbon materials.

Keywords: *Banana Peduncle Ash (BPA), Areca Plate Waste Ash (APWA), Carbon sequestration, Waste valorization, Circular economy.*

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DEVELOPMENT OF TIO_2 CONCRETE WITH APPLICATION OF SENSOR FOR ENVIRONMENTAL MONITORING

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Abstract

The integration of Titanium Dioxide (TiO_2) in M40-grade concrete presents a promising approach for developing self-cleaning, pollution-reducing, and smart monitoring infrastructure. This study focuses on formulating and evaluating TiO_2 modified M40 concrete, incorporating embedded sensors for real-time environmental monitoring and structural health assessment. This study explores the integration of TiO2 nanoparticles into concrete formulations, aiming to develop a composite material with enhanced self-cleaning and pollution-reducing properties. In addition to its environmental benefits, the concrete is embedded with sensors for real-time environmental monitoring. The challenges are to create material that can remove pollutants, cut down greenhouse gases, and clean themselves for a healthier environment. The concrete cube is formed with a mix ratio. TiO_2 is added in percentages of 1%, 2%, and 3%, by cement weight. A comprehensive experimental analysis was conducted, including mechanical strength tests (compressive, flexural, and tensile), photocatalytic efficiency evaluation, and sensor-based air quality monitoring. This research highlights the potential of TiO_2 concrete as a dual-functional material that addresses environmental pollution while contributing to sustainable construction practices. The integration of embedded sensors offers an innovative approach to monitoring and enhancing the effectiveness of environmentally responsive materials in real-time.

Keywords: *gas detecting sensor, self-cleaning concrete, Titanium dioxide, (compressive strength, flexural)*

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TO INVESTIGATE THE EFFECTIVENESS OF NATURAL FIBERS AS A FILTRATION MEDIA FOR GREY WATER TREATMENT

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Abstract

The growing concern over water pollution and the limited availability of fresh water has prompted the need for sustainable and cost-effective wastewater treatment solutions. This study investigates the effectiveness of natural fibers. It will reduce the strength of the grey water using natural fibres and also, it removes the organic pollutants from domestic waste water. As the demand for more eco-friendly and cost-effective solutions increases, natural fibers are gaining attention as viable alternatives in wastewater treatment. The materials used as a filter bed in this study are ramie fiber, palf fiber, activated carbon and M sand. The removal efficiency of these materials has been studied by setting the filter bed for different contact period. Influent greywater sample and effluent greywater sample collected and analysed for pH, Total dissolved solids, Total suspended solids, Total hardness. The study highlights the potential of natural fibers as an eco-friendly and cost-effective alternative to synthetic filtration materials, contributing to sustainable wastewater management in domestic settings. Furthermore, the feasibility of using these fibers for large-scale applications and their environmental benefits are discussed, emphasizing their role in enhancing water quality and supporting circular economy practices.

Keywords: *Grey water, Ramie Fiber, Palf Fiber, Manufacturing sand, Sugarcane bagasse, Waste water treatment.*

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ENHANCING CONCRETE PERFORMANCE WITH NANO TITANIUM DIOXIDE

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Abstract

The wide application of Nanotechnology in science and engineering are advantageous because of its small surface area and long-lasting strength. Nanotechnology has emerged as a transformative force in all the fields, particularly in the construction industry, where nano materials are increasingly utilized. A large number of studies revealed the properties of Nano Titanium dioxide (TiO_2) in different forms of concrete. This paper portraits an experimental investigation on nano concrete containing Nano TiO_2 (NT). The importance of this research is to find about the feasible properties with nano TiO_2.in concrete. The substitution of Nano TiO_2 for cement was between 0.5 to 3% in M20 grade concrete. The concrete's durable and mechanical properties were studied with cubes, cylinders and beams of size 150mmx150mmx150mm, 150mm x 300mm and 150mmx150mmx700mm respectively to obtain the optimum percentage of nano TiO_2. The findings of the experiment revealed that concrete with 1% of Nano TiO_2 showed good performances with an increase in strength The reduction in water absorption and sorptivity showed good durability results because of the nano structure of TiO_2 in concrete. The distribution of nano titanium dioxide with closed pore structure, the intensity of material and the additional C-S-H gel formation was analyzed by SEM micrograph and XRD analysis.

Keywords: *Nano Titanium dioxide, Mechanical properties, durable properties, Self-cleaning property, Photo catalytic effect.*

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EFFECTIVE UTILIZATION OF HYACINTH ASH AS SUSTAINABLE REPLACEMENT OF CEMENT IN MORTAR

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Abstract

The increasing demand for construction materials, coupled with the environmental impact of cement production, has prompted research into sustainable alternatives. This study explores the effective utilization of hyacinth ash (HA) as a partial replacement for cement in mortar, aiming to reduce the environmental footprint of traditional construction materials. Hyacinth ash, a byproduct of the invasive aquatic plant Eichhornia crassipes, is abundant and often discarded as waste, posing environmental concerns. This research investigates the potential of HA as a supplementary material in cement-based mortar, evaluating its impact on key properties such as compressive strength, workability, setting time, and durability. The experimental study involved replacing cement with varying percentages (5%, 10%, 15%, of hyacinth ash by weight in mortar mixes. The performance of the modified mortars was compared to that of conventional cement-based mortar. Results indicate that up to 15% replacement of cement with hyacinth ash provides a significant enhancement in workability, while maintaining acceptable compressive strength, particularly in the early curing stages. Beyond 15%, there was a noticeable decline in compressive strength, suggesting a limit to HA's effectiveness as a cement replacement. Additionally, durability tests demonstrated improved resistance to sulfate attack and chloride penetration, which are critical factors for long-term structural integrity. This study concludes that hyacinth ash is a viable and eco-friendly alternative to cement, especially when used in controlled proportions, offering a sustainable solution to the challenges posed by cement production and waste management. The findings suggest the potential for integrating hyacinth ash into the construction industry, contributing to sustainable development and the reduction of environmental pollution.

KEYWORDS: *Hyacinth Ash, M-sand, Cement Replacement, Water, Sustainability, Compressive Strength, Durability, Waste Utilization, Environmental Impact.*

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AN EXPERIMENTAL ANALYSIS OF THE MECHANICAL PROPERTIES OF COCONUT COIR FIBER TO ENHANCE CONCRETE STRENGTH

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Abstract

Sustainable and environmentally friendly alternatives to conventional building materials are an ongoing focus of innovation in the construction industry. Developing nations encounter considerable obstacles in managing solid waste, particularly in the handling of construction materials. The study explores the potential of using coconut fibre as an alternative to traditional binding materials in M20 grade concrete. Scanning Electron Microscopy, energy X-ray dispersive, and Fourier Transform Infrared Spectroscopy analysis were done to characterise the novel coconut fibre. By integrating coconut fibre into the concrete formulation to improve the strength of the concrete. To evaluate the effectiveness of coconut fibre, various proportions (0.5%, 0.75%, 1%, 1.5%) were examined. The dimension of the coconut fibre added to the concrete was (25mm,50mm,75mm,80mm) respectively. Addition of NaOH solution (sodium hydroxide) to reduce the water absorption in the coconut fibre. In the experimental study, the optimum strength was attained with a length of 75 mm, and the proportions were 0.75% in the concrete.

Keywords: *Coconut coir, Compressive strength, binding materials, mechanical properties*

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AI BASED TRAFFIC MONITORING SYSTEM

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Abstract

Artificial Intelligence is rapidly changing the world around us, and one of the most effective solutions as it provides parking management and Traffic control system. With the help of AI, one can accurately predict the flow of people, vehicles, and objects at different locations of interconnected transportation networks. Advanced technology such as AI will help improve road safety and reduce the number of accidents by optimizing the flow of vehicles and citizens, as well as redirecting routes that are under construction. Moreover, ride-sharing services can leverage this smart technology to get better insights into passengers. Traffic Management systems were traditionally monitored and controlled manually by officers and government officials, but with the up rise of AI & Machine Learning, these systems are getting automated. AI is used to analyze real-time traffic data from various Cameras and IoT devices, which include vehicles such as cars, buses, and even trains. To monitoring the traffic, the video processing technique is used. It will detect the object such as cars, bike etc... and according to the vehicles count the traffic signal time will be adjusted. Traffic lights were invented to ensure smooth traffic flow and avoid accidents, overcrowding, and other disruptions in public places. It monitors the traffic and controls the timing of traffic lights on the transportation network. Nowadays, AI is used by many nations to make traffic lights smarter and more efficient for safeguarding passengers and on-road drivers. It uses Computer Vision to detect the density of vehicles on road and passengers near the footpath and gives drivers indications based on the collected data. And we selected the more congested traffic area in Salem city such as kondalampatty, Seelanaickenapatty, alagapuram, junction main road.

Keywords: *Video processing, Yolo algorithm, traffic signal, vehicle count, Artificial intelligence*

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AUTOMATION IN CONSTRUCTION: A COMPLETE AUTOMATIC PAINT SPRAY SYSTEM FOR RESIDENTIAL BUILDINGS

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Abstract

Small and medium-sized businesses (SMBs) often face challenges with manual painting processes, including inconsistent quality, inefficiency, material waste, and worker health risks. This paper presents a portable, cost-effective automated paint spray system designed to address these limitations. Manual painting frequently leads to uneven finishes on 20–30% of surfaces, 15–25% higher annual labour costs, 30–50% project delays compared to automation, and 25-30% material waste. This automated system aims to improve safety, reduce labour dependence, and enhance efficiency. An Arduino UNO microcontroller provides precise spray control, while ultrasonic sensors minimize overspray and material waste. Motorized movement along a mild steel frame ensures consistent coverage, addressing uneven finishes. Limit switches provide safety and boundary control, and Bluetooth connectivity enables wireless control and monitoring. Its portability allows deployment across diverse industrial settings, like material handling and automotive bodywork. A cost analysis comparing manual and automated painting will evaluate potential savings. Real-world testing and deployment will occur in the Salem District. This system offers SMBs a practical solution for improved painting quality, efficiency, and cost-effectiveness.

Keywords: *Arduino UNO, Automated painting system, Material waste reduction, Portable paint system, SMB painting efficiency, Ultrasonic sensors.*

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EXPERIMENTAL STUDY ON AN AUTOMATED SENSOR AND IOT INTEGRATED COMPOSTING PIT IN SONA COLLEGE BOY'S HOSTEL

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Abstract

Effective organic waste management is crucial for sustainability, and composting presents a viable solution by converting biodegradable waste into nutrient-rich compost. This study investigates the development of an Automated Sensor and IoT Integrated Composting Pit designed for efficient and controlled decomposition of organic waste at Sona College Boys' Hostel. The system incorporates temperature, moisture, and gas sensors to monitor composting conditions in real time, optimizing microbial activity and decomposition rates. Data from sensors are transmitted via an IoT platform for continuous analysis, enabling automated adjustments to aeration and moisture levels for enhanced compost quality. A comprehensive characterization of organic waste is conducted, assessing carbon-to-nitrogen ratio (C/N), moisture content, and microbial activity to determine the optimal composting conditions. The study also evaluates the impact of sensor-based automation on decomposition efficiency, nutrient retention, and Odor control. The experimental setup consists of varying moisture and aeration conditions, comparing traditional composting methods with automated control systems. Results demonstrate that real-time monitoring and automated adjustments significantly enhance the composting process, reducing decomposition time and improving compost quality. The IoT-integrated system maintains ideal composting conditions, ensuring higher nutrient retention and minimizing greenhouse gas emissions. The findings highlight the feasibility of integrating smart technologies into waste management, promoting sustainable and efficient organic waste recycling practices. This study contributes to advancing automated composting solutions that support circular economy principles and sustainable waste valorisation in institutional settings.

Keywords: *Automated composting, IoT-integrated composting, Smart waste management, Organic waste recycling, Sensor-based composting, Real-time monitoring*

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MANPOWER MANAGEMENT IN THE CONSTRUCTION INDUSTRY

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Abstract

This journal examines the vital role of manpower management in construction projects, based on insights gathered from a questionnaire survey among construction professionals, including project managers, site engineers and labourers. The study sought to assess current practices, pinpoint challenges and evaluate the effectiveness of labour management strategies. It focused on key areas such as workforce planning, recruitment, training, scheduling, performance monitoring and safety compliance. The findings highlighted significant issues, including labour shortages, low productivity and inadequate safety measures, which often result in project delays and budget overruns. Respondents emphasized the need for better planning, skill enhancement and technology integration to overcome these challenges. Furthermore, worker-oriented strategies, such as incentive programs and improved communication, were found to boost morale and productivity. Drawing from the survey results, the journal presents practical recommendations to improve manpower management in construction projects, ensuring on-time completion, cost-effectiveness and higher safety standards. The insights from this research offer valuable guidance to stakeholders in the construction industry.

Keywords: *Construction projects; risk factors; workforce; manpower management; literature survey.*

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EXPLORING THE IMPLEMENTATION OF VALUE ENGINEERING IN BUILDING CONSTRUCTION

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Abstract

This paper explores the methodologies of value analysis and value engineering, emphasizing their significance in enhancing decision making processes across various sectors. It discusses how these techniques can be applied to improve products, services, and administrative processes, thereby contributing to cost reduction while maintaining or enhancing functionality. The paper highlights the dual dimensions of value analysis and value engineering, which encompass both technical skills necessary for generating innovative ideas and interpersonal skills essential for navigating organizational challenges and facilitating the implementation of these ideas. Additionally, the paper addresses the role of information technology as a transformative force in the construction industry, suggesting that it can bridge the gaps in knowledge management and value engineering practices. The authors argue that effective application of value engineering during the design phase can lead to significant cost savings, potentially reducing project costs by up to 15%. The integration of methodologies such as lean and six sigma with value analysis and engineering is also discussed as a means to combat inefficiencies and high costs in manufacturing, ultimately aiming to retain jobs within domestic industries. The findings underscore the importance of adopting a comprehensive approach thar combines technical and interpersonal strategies to foster innovation and efficiency in various organizational contexts. By leveraging these methodologies, organizations can not only enhance their competitive edge but also contribute to sustainable development in the construction sector and beyond. This paper serves as a valuable resource for practitioners and researchers interested in the practical applications of value engineering and analysis in improving operational effectiveness and resource utilization.

Keywords: *Value Engineering, Building Construction, Construction Management, Cost Optimization, Quality Improvement, Lean Construction, Sustainability*

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ECO-FRIENDLY BUILDING COMPOSITES: INTEGRATING WASTE POLYPROPYLENE AND FOUNDRY SAND INTO SUSTAINABLE CONSTRUCTION MATERIALS

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Abstract

Foundry industries produce vast amounts of sand waste, while polypropylene (PP) waste contributes to plastic pollution. The fusion of these materials offers a promising solution for sustainable composite development, reducing environmental impact and enhancing material properties. The fusion of polypropylene (PP) with waste foundry sand (WFS) offers a sustainable approach to developing high-performance polymer composites. This study investigates the interaction mechanisms between molten PP and WFS, emphasizing the role of silica (SiO_2) in enhancing adhesion and crystallization. The incorporation of WFS into the PP matrix influences its thermal and mechanical properties, leading to improved tensile strength, compressive strength, and structural integrity. Experimental results reveal that compressive strength increases from 15 MPa at 10% polypropylene to a peak of 62 MPa at 40% polypropylene, followed by a slight reduction to 49 MPa at 50% polypropylene. Similarly, flexural strength improves from 4 MPa at 10% polypropylene to 8.5 MPa at 40%, with a minor drop to 7.9 MPa at 50%. Water absorption tests indicate a significant reduction from 1.7% at 10% polypropylene to 0% at 50%, enhancing moisture resistance and making these composites suitable for high-humidity environments. The resulting composites demonstrate potential for various applications, including polymer mortars, engineered cementitious composites, and eco-friendly paver blocks. However, comprehensive studies focusing on the long-term durability and adhesion enhancement techniques for PP-WFS composites remain limited. Addressing these gaps will pave the way for optimized formulations and large-scale implementation in sustainable construction and industrial applications.

Keywords: *Polypropylene composites, Waste foundry sand, Sustainable materials, Mechanical properties, Polymer fusion, Construction applications*

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PERFORMANCE EVALUATION OF GEOPOLYMER CONCRETE WITH VARYING SODIUM HYDROXIDE MOLARITIES AND SILICATE RATIOS

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Abstract

In the current scenario, the demand for construction materials in the construction industry is increasing due to the depletion of natural resources. The cost of these materials is rising abnormally. Despite these cost increases, Ordinary Portland Cement (OPC) remains the primary ingredient in concrete, second only to water. The production of OPC generates significant CO2 emissions, contributing to global warming. Cement production poses a major threat to humanity. Despite this, cement production is not adequately controlled. Therefore, alternative materials that reduce cement usage have a positive impact on concrete preparation. This research explores Geopolymer Concrete (GPC) as an alternative solution to reduce cement use. Fly ash (FA), a by-product of coal combustion, is used as a precursor. GPC blended with FA helps minimize the carbon footprint of production. Sodium Hydroxide (NaOH) and Sodium Silicate (Na2SiO3) are used as alkali activators to activate precursor effectively. The main focus of this study is to investigate the effects of different NaOH concentrations and sodium silicate-to-sodium hydroxide ratios on the properties of class F fly ash-based geopolymer products. NaOH molarities (M) of 8 M, 10 M, and 12 M were examined, and sodium silicate-to-sodium hydroxide ratios of 2.5, 2, 1.5, 1, and 0.5 were tested. GPC has been reported to achieve excellent strength and durability when cured at higher temperatures (900C), as ambient temperatures are often too low to activate the aluminosilicate compounds of the source materials and alkaline liquids. Experimental studies show that increasing the molarity decreases the binding and strength properties.

Keywords: *Geopolymer Concrete, Sodium Silicate, Sodium Hydroxide, Molarity etc.*

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EXPERIMENTAL INVESTIGATION ON FLEXURAL BEHAVIOR OF REINFORCED CONCRETE BEAMS STRENGTHENED WITH BASALT FIBER

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Abstract

Retrofitting of reinforced concrete (RC) structural members is essential to restore the strength of deteriorated elements and prevent further distress. This study investigates the flexural behaviour of RC beams retrofitted with basalt fibers. The research includes an investigation of various retrofitting methods, with a focus on fiber-reinforced polymer (FRP) composites. The experimental program involves tests on cement, coarse aggregate, and fine aggregate to determine their properties. Tests include specific gravity, water absorption, and fineness modulus. Beams are cast, cured, and then retrofitted with basalt fiber sheets using epoxy resins. Flexural strength tests are conducted on conventional beams and beams with single and double wrapping of basalt fibers. Results indicate that retrofitting with basalt fibers enhances the flexural behaviour of RC beams. Initial flexural cracks appear at a higher load in retrofitted beams. The maximum flexural strength is achieved with double wrapping of basalt fiber. The use of basalt fiber wrapping improves the load-carrying capacity and delays crack formation compared to conventional beams.

Keywords: *Basalt fibers, Fiber-reinforced polymer (FRP), Epoxy resins, Crack formation*