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**FACULTY OF ENGINEERING AND TECHNOLOGY**

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# **BOOK OF ABSTRACTS**



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## **PAPER 2 - SOLID WASTE CHARACTERIZATION IN THE STAFF RESIDENTIAL AREA OF A UNIVERSITY FOR SUSTAINABLE MANAGEMENT PRACTICE**

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### **ABSTRACT**

The continuous expansion of academic programs across the tertiary institutions in Nigeria has led to the growing need of the services of extra academic and non-academic staff. With this increase, many staff prefer to reside in the institution's estates due to its proximity and basic social amenities provided for them. It has consequently led to a rise in the quantity of solid wastes generated amongst residents, whilst its management is becoming a key challenge faced by the local waste management authorities. This study aims to expose the inadequacies found in the management of solid wastes generated in the municipality of Unilorin Staff Quarters. This was achieved by assessing the existing status of waste generation and management via the determination of mean quantity of solid waste generated, characterization of its various compositions and estimation of recyclable potential of the wastes. An average of 10.77 kg of solid waste by weight was estimated to be generated daily with a mean 0.83 kg per site and per capita waste generation of 0.056 kg/day. Organic and polythene wastes represented the largest portion in all the sampled sites, except in three. The study revealed high recoverability potential of waste generation particularly from organic wastes and polythene. Hence, composting at household levels would be most appropriate as it would divert more than 50% of the wastes from organic source and the implementation of the 3Rs (reduce, reuse and recycle) in the case of polythene and other wastes to significantly limit the amounts of waste generated. A comprehensive community involvement and willingness to change individual orientation to an organized system are some of the required actions for reduction from sources. The adoption of these sustainable strategies after having understood the characteristics of solid wastes typical of a developing municipality would provide an incentive for similar studies in other Staff residential areas of Nigerian institutions.

**KEYWORDS:** Staff Quarters, solid waste, waste generation, recyclable potentials

## **PAPER 3 - CONTEMPORARY ISSUES OF POSTHARVEST ACTIVITIES VIS-A'-VIS IMPLICATION ON FOOD SECURITY IN NIGERIA**

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### **ABSTRACT**

Nigeria is highly food insecure, as the losses are replicated in fruits, vegetables, nuts, grains and fish, among others. The Global Food Security Index compiled by the Economist Intelligence Unit ranked Nigeria a lowly 94 out of 113 countries in 2019 with an overall score of 48.4 per cent, a mere 0.7 per cent upgrade from the 2018 score of 47.7 per cent. Equally relevant to food production in Nigeria is the development of infrastructure that will promote production, circulation and storage. As iterated by the Central Bank of Nigeria (CBN) (1994) that increased food production cannot satisfy the increasing food demand unless attention is focused on reducing postharvest losses. However, it is disheartening that much of the products is lost due to improper or lack of postharvest handling methods. It is recommended, that state, local and federal government, private investors and non-governmental organisation should embrace action or robust techniques that will ultimately reduce post-harvest losses. This research have successfully provided insight into the prevailing issues that face postharvest in Nigeria as well as food insecurity. Hence, leveraging on the state-of-the-art technologies and experienced

extension services that will adequately communicate innovative and research findings to the surmised beneficiaries.

**KEYWORDS:** Storage, Techniques, Fruits, Vegetables, Postharvest

## **PAPER 5 - EFFECT OF CERAMIC WASTE TILES ON SOIL STRENGTH AND INDEX PROPERTIES OF LATERITIC SOIL**

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### **ABSTRACT**

Lateritic soil strength and index properties are crucial in selecting construction materials. Examination of the effect of ceramic waste tile (CWT) on lateritic soil was studied. Lateritic soil combined with CWT ranged from 0 to 8% by increments of 2%. Atterberg limit tests were conducted to determine the index properties, whereas compaction, California bearing ratio (CBR), and unconfined compressive strength (UCS) tests were carried out to assess this effect on the strength properties of the modified soil. Results indicate that the plasticity index (PI) and liquid limit (LL) are 18.65% and 44.47%, respectively. For the compaction test, when 6% CWT-lateritic soil, optimum moisture content (OMC) increased to a peak value of 24.7 and 19.75%, utilising British Standard Light (BSL) and British Standard Heavy (BSH) compaction effort, respectively. An increase in CWT resulted in a decrease in maximum dry density (MDD). When applying BSL and BSH compaction efforts, the MDD of the lateritic soil was 1.68 and 1.87 mg/m<sup>3</sup>, respectively. With the addition of 6% CWT, the MDD values dropped to 1.32 and 1.67 mg/m<sup>3</sup>, respectively. Based on the findings, lateritic soil can be strengthened to be used as a sub-base material by adding 6% of CWT.

**KEYWORDS:** Ceramic tile, Clay, Lateritic soil, Strength, Waste

## **PAPER 6 - OPTIMIZATION OF THE EXTRACTION OF KERNEL OIL FROM TWO SPECIES OF MANGO (*MANGIFERA INDICA*) AND ITS CHARACTERIZATION FOR POTENTIAL AS BIODIESEL**

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### **ABSTRACT**

The paper presents the optimization of the extraction of kernel oil from two species of mango (*Mangifera indica*) and their physico-chemical analysis, towards serving as potential biodiesel in the clamour for renewable energy sources. The mix-ratio, operating temperature and heating time were optimized using One Factor at A Time (OFAT) with n-hexane as solvent by Soxhlet extraction. The ratio of kernel : n-hexane of 1:3 had the highest percentage oil yield (6.67±0.009 – 9.60±0.012%) compared to the 1:1 and 1:2 ratios, for the two mango species (Cherry and Peach) at 6 hrs and 60 °C. At the optimized mix-ratio, increasing the heating time from 4 to 8 hrs generally resulted to steady increase in the % (w/w) oil yield from 4.00±0.002 – 13.01±0.006% for the Cherry cultivar and 3.93±0.004 – 12.60±0.009% in Peach. Heating temperature significantly elevated the oil extraction process at p < 0.05 (One way ANOVA); with the optimum taken as 70°C. The kernel of Cherry mango had higher % oil yield; though not significantly higher than the counterpart. The studied kernel oil has pale colour, pH 5.9 – 6.1, melting point 31.5±0.5 (Cherry) and 31.7±0.3 (Peach), flash point 263.0 °C, refractive index 1.440 - 1.445, specific gravity at 20°C of 0.900 – 0.908, solidification temperature 24 °C, pleasant odour, acid value 6.90 mgKOH/g, viscosity at 40°C was 39.25 MPa, saponification value 205.0 – 207.5 mg KOH/g, iodine value 40.1 gl/100g oil and ester value of 198.0 – 202.2 mg KOH/g. Generally, Cherry mango had higher oil yield than Peach.

The result showed that mango tree plantation aside meeting the nutritional and medicinal needs can serve as a potential source of biodiesel for ameliorating global warming.

**KEYWORDS:** Renewable energy, One Factor at A Time, mango cultivar, mango kernel oil , global warming

## **PAPER 7 - DEVELOPMENT AND DEPLOYMENT OF A NEURAL NETWORK-BASED REMOTE TRACKING SYSTEM FOR POULTRY BIRDS**

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### **ABSTRACT**

Poultry farmers are experts charged with catering for the well-being of the poultry livestock to improve yields. This operation requires physical presence most times and can be labourious and highly cost intensive. Furthermore, the inability of farmers to detect predators early in the flock causes a high mortality rate. This study tracks poultry birds' conditions using a neural network to reduce mortality and other causes of losses in the poultry system. The proposed methodology uses the yoloV5 model to detect poultry birds and predators in poultry housing and track the movement of birds using the DeepSort tracking algorithm. The proposition also incorporates using Raspberry Pi and Pi cameras to obtain and process information on poultry 'birds' movement on the farm. The live video stream of the poultry housing is deployed on the local host, providing a means to monitor the poultry bird in the poultry housing from a remote location. The implementation shows promising results in the ability of the model to detect poultry birds, and predators as well as monitor the welfare of the entire livestock in the system.

**KEYWORDS:** Artificial Intelligence; Poultry Farming; tracking; Deep-Sort; Neural Network; Biosecurity

## **PAPER 8 - DEFINING INTERACTION GROUPS AMONG INVERTER-BASED GENERATORS FOR SYSTEM STRENGTH ASSESSMENT IN POWER GRIDS**

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### **ABSTRACT**

As inverter-based generation (IBG) proliferates in power grids, there are concerns about grid strength, particularly due to interactions among closely clustered IBGs. This study proposes a novel approach to identifying potential interactions between IBGs in power grids. The concept of "Relative Electrical Distance" (RED), derived from the network admittance matrix, is utilised to assess the likelihood of interaction between different points of interconnection (PoIs). The methodology involves iteratively converting each PoI into a synchronous generator and calculating the RED between this generator and all other PoIs. The resulting interaction matrix reveals potential interacting groups based on their RED values (0 signifies high interaction, while 1 indicates no interaction). The effectiveness of the proposed approach is demonstrated on two modified test systems: the IEEE 39-bus and the IEEE 57-bus system. The results show that the RED-based method successfully identifies interacting IBG groups within the network. This approach offers significant benefits for power grid operators and planners by simplifying the classification of interacting groups, identifying potential areas of concern, and

eliminating the need for repetitive power flow studies. Further research will explore the application of the new approach in real-world scenarios, including simulations of actual control interaction scenarios.

**KEYWORDS:** Inverter-based generation, Short-circuit ratio, Synchronous condenser, System strength.

## **PAPER 9 - EFFECT OF MULTIPLE OPERATIONAL FACTORS ON PUSH FORCE IN A PUSH BEHIND LAWNMOWER**

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### **ABSTRACT**

Push force is an indicator for making various design and optimization decisions when developing lawn mowers. This study aims to develop a model that can be used to estimate push force during mowing operations. Prediction models were developed through regression analysis using key factors affecting push force. The push speed, cutter height, and grass height were selected as explanatory variables. Push force readings were obtained using a horizontally positioned weighing balance, while push speeds were obtained from the distances covered and time taken. A total of four push force prediction regression models were proposed using 50 experimental data. The adjusted coefficient of determination ( $R^2$ ) of the proposed regression model showed a range of 0.252 to 0.660 and a mean absolute percentage error of 4.9 to 8.12. Models C (which accounts for the push speed and the cutter height) and D (which accounts for the push speed, cutter height and grass height) satisfy all the basic assumptions of the regression analysis. Model D has the least MAPE and the highest  $R^2$  values, making it suitable for push force prediction.

**KEYWORDS:** Big wheels, Cutter height, Grass height, Lawnmower, Push force, Push speed, Regression model.

## **PAPER 10 - HARMONIC DISTORTION IN PV SYSTEMS: A COMPARATIVE STUDY OF PID AND ANN CONTROLLERS**

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### **ABSTRACT**

This paper presents a comparative analysis of Total Harmonic Distortion (THD) in grid-connected Photovoltaic (PV) systems controlled by Proportional Integral Derivative (PID) and Artificial Neural Network (ANN) strategies. THD is a critical factor affecting power quality, and managing it is crucial. While PID controllers are traditionally used for their simplicity and effectiveness, their performance can be limited under varying conditions. ANNs, on the other hand, offer adaptability and robustness, making them a promising alternative. Through rigorous simulations and real-world testing, this paper evaluates the performance of both control strategies under different operating conditions. The findings provide valuable insights into the choice of control strategy for grid-connected PV systems, contributing to the broader goal of enhancing the reliability and efficiency of renewable energy systems.

**KEYWORDS:** Harmonic Distortion, ANN, PID, THD, PV, MATLAB.

**PAPER 13- DEVELOPMENT OF AN AUTOMATIC PILL DISPENSING AND  
HEALTH VITALS MEASURING SYSTEM FOR HYPERTENSIVE PATIENTS**

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**ABSTRACT**

Medication non-adherence is a significant issue for patients who require regular medication, especially those with complex schedules or multiple daily doses. This problem is particularly severe in hospitals where doctors are scarce, and monitoring hypertensive patients can be challenging. To address this problem, a proposed system has been developed that integrates automatic pill dispensers and health monitoring systems to help patients manage their condition effectively and reduce the need for constant doctor checkups. The system uses an ESP32 microcontroller and MYSQL database for data storage. DC and servo motors are utilized for dispense medication mechanism, and the real-time clock ensures that it only dispensing when required. The health monitoring system can measure temperature and blood pressure and has shown promising results when compared to other devices. The system has been tested with ten different people, and the overall reading error is within the acceptable range, with blood pressure reading error of < 10mmHg and temperature of <2.0°C indicating that it is an effective tool for managing medication adherence and monitoring health vitals. The system was able to transmit all the measured data, and the web can display the recorded data correctly.

**KEYWORDS:** ESP32 microcontroller, DC motor, Health vitals, HTML, MCU, MYSQL, PHP

**PAPER 15 - POTENTIAL OF CALCIUM CARBIDE RESIDUE MODIFIED  
SANDCRETE BLOCKS IN ENHANCING THERMAL AND ENERGY EFFICIENCY  
FOR SUSTAINABLE BUILDING DESIGN**

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**ABSTRACT**

Sustainability has increasingly become a prominent topic in the field of construction, and as such it is necessary to explore means of reducing the overdependence on the use of cement in construction works. This study investigated the effects of calcium carbide residue (CCR) as partial substitute for cement in sandcrete block. Due to the high pH value of calcium carbide residue, its disposal in landfill increases the alkalinity of the environment. From raw material extraction through final product disposal, the construction industry is integrally involved in every stage of the lifecycle of greenhouse gas emissions. In this study, cement was partially substituted using CCR at 0% and 12% by weight replacement. The sandcrete blocks were of 450 mm × 225 mm × 225 mm dimensions made from a Cement-CRR mix ratio of 1:6 and water-cement ratio of 0.6. Preliminary tests such as consistency, setting times, soundness and specific gravity test were carried out on cement and cement + 12% CCR. The thermal properties which include thermal conductivity (k), heat transfer coefficient (U), specific heat capacity (C<sub>p</sub>) and diffusivity (α) of the sandcrete blocks were determined. The thermal tests were carried out after the 28<sup>th</sup> day of curing. The result showed that CCR increased the water demand by the sandcrete blocks, hence reducing its workability. The sandcrete block samples made with 12% CCR replacement showed improved compressive strength. The k for 0% and 12% replacement was 0.5497 W/mK and 0.3978 W/mK, respectively, while the U was 54.974 W/m<sup>2</sup>K and 39.784W/m<sup>2</sup>K respectively for the 0% and 12% replacement. On the other hand, the C<sub>p</sub> for 0% and 12% was 0.0003364 J/kg°C and 0.0001598 J/kg°C, respectively, while the diffusivity for was 636.54m<sup>2</sup>/s and 1113.94m<sup>2</sup>/s for 0% and 12% replacement, respectively. As such, we can infer that 12% CCR replacement of cement gives a more energy efficient and sustainable sandcrete blocks.

**KEYWORDS:** Calcium Carbide Residue (CCR), sandcrete block, Fine aggregates, Thermal properties, Energy.

**PAPER 19 – DURABILITY OF BIO-CEMENTED SOIL AGAINST WIND EROSION:  
A CASE STUDY OF SEMI-ARID SOIL TREATED WITH BACILLUS  
MEGATERIUM-CEMENTATION REAGENT MIX**

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**ABSTRACT**

Semi-arid zone soils are vulnerable to wind erosion which causes sand movement, destruction of agroforestry and dust storms. To mitigate these effects, the impacts of ageing and rain scour on bio-cemented semi-arid zone soil of North-eastern Nigeria were investigated. The soil was treated with varying non-pathogenic urease positive *Bacillus megaterium* (*B. megaterium*) suspension densities (i.e.,  $1.5 \times 10^8$ ,  $6.0 \times 10^8$ ,  $1.2 \times 10^9$ ,  $1.8 \times 10^9$ , and  $2.4 \times 10^9$  cells/ml) and cementation reagent concentrations (i.e., 0.25, 0.5, 0.75, and 1 M) in 3 treatment cycles using 50% (*B. megaterium*) : 50% (Cementation reagent) mix ratio. With  $1.8 \times 10^9$  cells/ml *B. megaterium* suspension density and 1 M cementation reagent treatment, the bulk density of the natural soil increased from  $1964 \text{ kgm}^{-3}$  to  $2187 \text{ kgm}^{-3}$ ; the sediment flux values of the natural soil reduced from 3.4, 3.7 and  $4.2 \text{ kgm}^{-2}\text{s}^{-1}$  to 0.09, 0.19 and  $0.23 \text{ kgm}^{-2}\text{s}^{-1}$  at wind speeds of 8, 11 and  $14 \text{ ms}^{-1}$ , respectively; and for the rain scour effects, the sediment flux value of samples cured for 7 days increased from 0.45, 0.83 and  $1.17 \text{ kgm}^{-2}\text{s}^{-1}$  to 0.54, 0.97 and  $1.35 \text{ kgm}^{-2}\text{s}^{-1}$  after 3 days at wind speeds of 8, 11 and  $14 \text{ ms}^{-1}$ , respectively. Based on the ageing and rain scour impacts, the bio-cemented soil has good potential in mitigating wind erosion.

**KEYWORDS:** Ageing, bio-cementation, mitigation, rain scour, sediment flux, wind erosion.

**PAPER 21 - REVIEWING THE SAFETY, BENEFITS, AND IMPLEMENTATION OF  
CNG AND CBG ADOPTION AS ENERGY AND TRANSPORT FUELS IN NIGERIA**

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**ABSTRACT**

The removal of fuel subsidies in Nigeria highlights inefficiencies in the country's energy mix, resulting in a significant increase in energy and transportation costs. This has led to higher prices for goods and services across the board, worsening the country's economic situation. Consequently, the adoption of alternative fuel sources such as Compressed Natural Gas (CNG) and Compressed Biomethane Gas (CBG) becomes imperative. This review article explores the safety considerations, economic benefits, and energy security implications associated with replacing traditional fossil fuels like petrol and diesel with CNG and CBG in both the energy and transportation sectors. It offers a comprehensive analysis of the advantages, potential challenges, and the current state of adoption of CNG/CBG in Nigeria and other parts of the world, underscoring the urgency and importance of embracing these alternative fuel options. Drawing from a diverse range of academic and scientific sources, this review provides a thorough and robust examination of this critical subject and its implementation.

**KEYWORDS:** Compressed Natural Gas (CNG), Compressed Biomethane Gas (CBG), Energy Security, Energy Sustainability, Clean Environment, Nigeria



**PAPER 22 - OPTIMIZATION OF OIL EXPRESSION FROM TRUNK FISH  
(MORMYRUS RUME) BY RESPONSE SURFACE METHODOLOGY USING  
EXTRUDER**

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**ABSTRACT**

Oily fish have always been associated with numerous health benefits like improvement in mental ability and lowering the risk of heart diseases. The health benefits of fish oil are linked to its fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) that are of immense benefits to the cardiovascular system. Despite the benefit of fish oil, its expression has been challenging. Fish oil expression is usually achieved using an extruder. The desire for less harmful oil from freshwater fish species is of importance to this study. In the current investigation, Response Surface Methodology (RSM) was used to optimize oil expression from Trunk fish. Screw diameter was varied from 32.5 to 42.5 mm, Screw Speed from 25 to 85 rpm, applied pressure from 5 to 45 N/mm<sup>2</sup>, and pitch height from 10 to 30 mm to study their effects on fish oil yield with the aid of a two-level, four-factor central composite design (CCD). The second-order model developed accurately predicts the optimum oil yield. Optimum oil yield was obtained from the empirical model as 27.8% at a screw diameter of 42.5mm, screw speed of 55rpm, applied pressure of 40N/mm<sup>2</sup> and pitch height of 20mm. It was observed that the optimum oil yield of 27.8% is higher than the maximum oil yield of 27.1% obtained when experiment was conducted. Screw diameter, screw speed, applied pressure and pitch height substantially influence the optimum oil yield.

**KEYWORDS:** Extruder, Fish oil, Mormyrus rume, Optimization, Shaft.

**PAPER 23 - DEVELOPMENT OF A SOLAR-BASED SYSTEM FOR  
AGRICULTURAL PRODUCTS DRYING IN SOKOTO STATE, NIGERIA**

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**ABSTRACT**

Agricultural product drying systems play a vital role in preserving the quality and extending the shelf life of harvested crops. This study investigates the fundamentals underlying operation, functionality, and design of a solar-based drying system. The solar-based drying system emphasizes the interplay of temperature, humidity, airflow dynamics, and drying kinetics to achieve optimal drying conditions for farm produce. Proper airflow within the drying chamber was considered to ensure uniform drying. The study highlights the engineering principles in designing an efficient drying system tailored to local crop characteristics and ambient conditions. From this work, the adoption of solar drying technologies reduces reliance on traditional methods, which often contribute to deforestation and environmental degradation. This work presents a sustainable method for preserving agricultural produce, and helps in improving food security, thereby reducing post-harvest losses. Additionally, it explores emerging trends such as renewable energy sources, automation technologies, and sensor-based monitoring systems which enhance efficiency and sustainability. The research provides valuable insights for advancing post-harvest processing, food preservation techniques, and food hygiene in line with the Sustainable

Development Goals (SDGs): 2, 7, 9, 12 and 13 for Sokoto State's agriculture industry, which could be replicated across the nation and the continent.

**KEYWORDS:** Agricultural Produce, Drying Technology, Food Quality, Smart System, Solar Radiation

## **PAPER 24 - DEVELOPMENT OF AN INTELLIGENT EVAPORATIVE COOLING SYSTEM FOR POST-HARVEST STORAGE OF TOMATO**

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### **ABSTRACT**

This research developed an intelligent evaporative cooling system for post-harvest tomato preservation that adapts to its suitable temperature, humidity, and CO<sub>2</sub> states to store, preserve quality, and increase the shelf life of the fruits. This was accomplished through the use of transfer learning for fruit classification, the Internet of Things (IoT) for remote monitoring and shelf life tracking, and the integration of the evaporative cooling system with a CO<sub>2</sub> sensor, a temperature sensor, a humidity sensor, an Arduino Uno, and a Raspberry Pi 4b. The system can classify tomato fruit status as ripe or overripe with a prediction accuracy of 87.5% and a receiver operating characteristic (ROC) value of 88.89%. The developed evaporative cooling system extended the shelf life of ripe tomatoes from 5 to 14-17 days at 20°C and 90% relative humidity and overripe tomatoes from 3 to 9-11 days at 18°C and 95% relative humidity. These results emphasize the crucial function of evaporative cooling in fruit and vegetable storage, as it extends the shelf life of tomatoes by 180–200%, hence minimizing post-harvest loss as it also increases the farmers' income, thereby contributing positively to the economy.

**KEYWORDS:** Intelligent, Evaporative, Cooling system, Tomato, post-harvest, Transfer Learning

## **PAPER 25 - A REVIEW ON THE METHODS OF CRUDE OIL SPILL POLLUTION CONTROL**

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### **ABSTRACT**

Crude oil is a naturally occurring accumulation of petroleum products due to geological formations over a long time under the Earth's surface and is primarily composed of organic materials and hydrocarbons. Globally, crude oil has been the main driving force in the energy sector. On the other hand, this natural resource has plagued both the terrestrial and the aquatic habitats due to its indiscriminate disposal which is commonly referred to as oil spill. Impacts of crude oil spills range from interruption of the food chain due to contamination of agricultural lands and water bodies to human population which suffers several debilitating diseases. Methods of combating this crude oil spill involve physical, chemical, and biological techniques. Among these methods of remediation, the biological method has been proven to be the best approach especially the use of microorganisms such as fungi and bacteria. This is because it is more eco-friendly and also more efficient.

**KEYWORDS:** Crude oil spill, Contamination, Eco-friendly, Microorganisms, Remediation

## **PAPER 27 - DESIGN MODIFICATION AND PERFORMANCE EVALUATION OF SOLAR PV SYSTEM AT AUTOCAD LABORATORY**

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### **ABSTRACT**

The AutoCAD Laboratory at Faculty of Engineering at Kano University of Science and Technology, Wudil (KUST Wudil) faced power supply issues due to an inadequate photovoltaic (PV) system. This paper presents a comprehensive overhaul, dimensioning, and implementation of an amended PV system in the Laboratory. A load analysis was carried out, revealing a daily requirement of 275.97 Wh, significantly surpassing the average power output achievable with the current PV system. Consequently, the PV system components were meticulously tailored to power the load adequately, with a surplus. The Ampere Hour Load Method guided the sizing, resulting in the inclusion of eight batteries (100 Ah, 12 V), ten PV panels (100 W, 12 V), one 80 A charge controller, and one 1.5 kW inverter, which collectively meet the load demand. Evaluation of both systems' performance from January to December 2022 revealed that the old system's struggle to generate sufficient power, with monthly averages ranging from 1750 to 2200 Watts, falling short of load requirements varying from 3800 to 4050 Watts. Conversely, the modified PV system consistently outperformed expectations, generating monthly averages ranging from 3850 to 4220 Watts, surpassing the load requirements and ensuring uninterrupted equipment operation. This success emphasizes the significance of appropriately sizing and designing renewable energy systems.

**KEYWORDS:** Photovoltaic (PV) system, load analysis, renewable energy, sizing of battery, inverter, charge controller.

## **PAPER 29 - EXPERIMENTAL STUDY ON THE COMPRESSIVE STRENGTH OF CEMENT MORTAR WITH TERNARY BLENDS OF METAKAOLIN AND IRON ORE TAILINGS**

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### **ABSTRACT**

The addition of alternative materials as a replacement for cement has been researchers' main focus for sustainable development, to reduce the quantity of cement usage as construction materials thereby reducing the carbon dioxide (CO<sub>2</sub>) emission into the atmosphere during its production and also for waste management. Metakaolin (MK) and Iron Ore Tailing (IOT) have been considered as a good alternative material in cement individually or in combination with other materials for better mortar or concrete performance. This study is carried out to investigate the behaviour of ternary blends of MK and IOT as partial replacement of cement in mortar. The compressive strength was carried out by following the standard specification on the mortar cube size of 70.6 mm<sup>3</sup> prepared by partially replacing cement by weight with MK and IOT each in the ratio of 0, 5, 10, 15, and 20%. The two materials were blended by varying MK from 0 to 20% while keeping IOT constant at each percentage replacement of MK. The prepared samples were cured in the water tank for 7 and 28 days. The x-ray fluorescence conducted shows that MK and IOT are both pozzolanas since the sum of their oxide composition of SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, and Fe<sub>2</sub>O<sub>3</sub> in MK and IOT gives 91.14% and 95.58% respectively which is higher than the minimum value of 70% specified by ASTM C618. Optimum compressive strength was at mix sample M10T10, that is, 10% of metakaolin and 10% of Iron Ore Tailings, with values at 26 N/mm<sup>2</sup> and 34 N/mm<sup>2</sup> for 7 and 28 curing days respectively. Generally, 20% of the blends can be recommended for cement replacement in cement mortar.

**KEYWORDS:** Metakaolin, Iron Ore Tailings, Ternary Blends, Cement Mortar, Compressive Strength

**PAPER 31 - CONCENTRATION LEVELS AND HEALTH RISKS ASSESSMENT  
METALS IN BEAUTY SALONS**

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**ABSTRACT**

Heavy metals are one of the main components of indoor air pollution which has detrimental effects on human health. This study investigated the concentration levels and health risks of heavy metals in the ambient air of beauty salons. Fourteen (14) beauty salons were sampled and deposited air samples were taken from the breathing zone of workers and customers at 1.5 m above the ground level with Sorbent-impregnated polyurethane foam (SIP-PUF) disk for 30 days. Concentrations of Pb, As, Cd, Zn, Cu, Mn, Fe, Cr, Co, and Ni were analyzed with the Atomic Absorption Spectrophotometer (AAS). The mean concentrations of the selected metals ranged between 0.0968-0.5867 mg/kg, which exceeded indoor air guidelines, and workplace limit levels set by the United States Environmental Protection Agency (USEPA). The average hazard index for all the heavy metals was obtained to be lower than the statutory limit. The cancer risk estimated for Pb, As, Cr, Cd, and Ni for a child and adult ranged between  $1.22 - 2.91 \times 10^{-4}$  and  $1.47 - 7.55 \times 10^{-7}$ , respectively. These values were above the limits set by the USEPA and World Health Organization (WHO). Findings from this study have a potential influence on workplace air pollution regulations and would provide insights for policies regarding air pollution prevention in indoor spaces and product safety standards.

**KEYWORDS:** Ambient air, beauty salon, heavy metals, cancer and Hazard index

**PAPER 32- A REVIEW OF WATER RESOURCES EVALUATION USING GIS AND  
REMOTE SENSING TECHNIQUES**

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**ABSTRACT**

Water resource management is crucial for sustainable development and environmental conservation. Geographic Information Systems (GIS) and Remote Sensing (RS) technologies have revolutionized the assessment and management of water resources by providing valuable tools for data analysis, visualization, and decision-making. This paper reviews the application of GIS and RS techniques in evaluating water resources, focusing on their contributions to hydrological modeling, water quality assessment, and monitoring of water availability. The paper also discusses challenges and future directions in the field, highlighting the importance of integrating these technologies with traditional methods for comprehensive water resource management.

**KEYWORDS:** Water resources, GIS, Remote Sensing, Hydrological modelling, water quality assessment.

**PAPER 34 - ADAPTIVE AND PERSONALISED VARK E-LEARNING SYSTEM  
DESIGN BASED ON OPEN-SOURCE APPLICATIONS**

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**ABSTRACT**

For students who struggle with more conventional forms of instruction, there are a variety of freely accessible resources that can be used to create comprehensive, intelligent learning environments. This study investigates the adaptability of e-learning platforms and builds a flexible learning system to aid in the evaluation of users' learning preferences through the use of VARK questions, which stand for Visual, Auditory, Read/Write, and Kinesthetic. In order to facilitate the development of modules to assist in the learning process of adaptable and individualised e-learning systems, the system has extracted materials from an online free source while keeping in mind the usability viewpoint and a broad variety of criteria. The data extraction procedure was improved and optimized with ontology. The development of various models has encouraged the incorporation of adaptability and personalisation features. One such model is the learner's model, which incorporates the student's needs, details, and study domains into the system. This model is based on learning style theories, which are used to identify users and enhance their online learning experience. By efficiently delivering personalised learning materials to users from the vast array of open-source apps on the web or through search engines, the system provided a groundbreaking addition to adaptive e-learning systems. The system has improved with the use of evaluation and feedback provided at the beginning of each learning session, providing a more tailored experience for each learner's style.

**KEYWORDS:** Adaptive Learning System, Personalized Learning, Learning Style, E-Learning, Open-Source

**PAPER 35 - MODELING OF CRITERIA AIR POLLUTANT EMISSIONS IN AND  
AROUND CASSAVA GRANULES PROCESSING IN OYO STATE, NIGERIA**

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**ABSTRACT**

The processing of cassava leads to an elevation in atmospheric air pollutants, consequently affecting the surrounding communities. This study modelled the dispersion of NO<sub>x</sub>, CO, SO<sub>2</sub>, VOCs, and PM<sub>10</sub> from cassava processing in Oyo town, Nigeria using American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). Emissions from 10-point sources were considered with 5 different scenarios. One year of hourly meteorological observations was used for the investigation of dispersion. The daily NO<sub>x</sub> Federal Ministry of Environment - Nigeria (FMEnv) limits were exceeded in all sampling locations and each of the scenarios respectively. Particulates were detected in all the sampling locations. The cumulative gaseous pollutants resulting from simultaneous operations of all the identified air emissions from the worst-case scenario are 19.9–301.3% of their respective 24-hour limits. However, the 24-h SO<sub>2</sub> and VOCs are breaching the limits at scenarios 1, 3, and 5 respectively with value ranges from 18.88-37.8% for SO<sub>2</sub> and 9.97-19.95% for VOCs respectively. This emission inventory information is expected to guide researchers and policymakers to know the fate and effects of aerosol emission in the area for adequate air quality management.

**KEYWORDS:** Air quality, Cassava processing, Modeling criteria, ParticulaPollutant monitoring

**PAPER 36 - PARAMETRIC INVESTIGATION INTO ELECTROMECHANICAL  
COUPLING FACTOR FOR NANOSTRUCTURED PVDF-ZNO-TIO<sub>2</sub>  
PIEZOELECTRIC HYBRIDS MATERIALS**

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**ABSTRACT**

This study aims to enhance energy conversion efficiency in flexible materials through investigating the electromechanical properties of PVDF-ZnO-TiO<sub>2</sub> piezoelectric hybrids. Methodologically, ZnO nanoparticles and TiO<sub>2</sub> were integrated into the PVDF solution to fabricate piezoelectric ZnO-TiO<sub>2</sub> nanorods within the matrix, followed by parametric analysis on samples S1-S10. Findings highlight Sample S5 as an exceptional performer, boasting the highest recorded values for both electromechanical coupling factor (k) at 1.54E-06 and coefficient for energy transmission ( $\lambda_{max}$ ) at 2.37E-12 compared to S1-S10, indicating superior energy conversion efficiency. Acknowledged limitations include a focus on specific hybrid compositions and the necessity for further research on scalability and long-term stability. The study's originality lies in offering novel insights into the electromechanical properties of nanostructured PVDF-ZnO-TiO<sub>2</sub> piezoelectric hybrids, underscoring their potential for transducer design and energy harvesting technologies. The practical implications include advancements in flexible piezoelectric technologies, with potential applications in energy-efficient transducer design and sustainable energy harvesting.

**KEYWORDS:** Coefficient for Energy Transmission  $\lambda_{max}$ , Electrospinning, Nanofabrication, Piezoelectric Electromechanical Coupling Factor (k), Piezoelectric materials, Renewable energy harvesting, Transducer design

**PAPER 37 - CASTING SIMULATIONS FOR ALSi<sub>7</sub>Mg ALLOY WHEEL FOR  
PROCESS PERFORMANCE AND OPTIMIZATION**

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**ABSTRACT**

The molten fluid flow of materials, process parameters, solidification, shrinkage formation and residual stress is essential for the quality performance of a metal cast product. While various FEM and VEM methods have been analyzed in automotive wheel rims, casting simulation has not been explored using the finite volume method. This study investigates the transformation solidification and mould filling processes of aluminium silicon magnesium (AlSi<sub>7</sub>Mg) alloy wheels for process performance and optimization. MAGMASOFT software examined the phase change during the cast AlSi<sub>7</sub>Mg alloy wheel rim simulation in low pressure sand casting (LPSC). During the phase transition in the solidification process of the alloy wheel, a large amount of hidden heat was released. The location of the transition front between the molten and solid state is a strong function of the casting flow and the cooling rate in the mould.

**KEYWORDS:** Simulation, Gate design, Feeder design, Low pressure sand casting

**PAPER 38 - IMPACT EVAPOTRANSPIRATION VARIABILITY ON IRRIGATION  
WATER REQUIREMENT OF HADEJIA VALLEY IRRIGATION PROJECT,  
NIGERIA**

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**ABSTRACT**

There is established evidence on impact of climate change on irrigation. This study therefore examines how changes in evapotranspiration affect the irrigation needs of the Hadejia Valley Irrigation Project. Using meteorological data spanning 39 years (1976-2015), a CROPWAT programme was employed to calculate the reference evapotranspiration and irrigation requirements of the study area. Mann-Kendal and Sen's slope estimates were applied to investigate the trend of the series. Results indicated that the reference evapotranspiration ranged from 4.3 mm/day to 6.70 mm/day, with an average of 5.41 mm/day. Variability in evapotranspiration was observed across the months, with an annual increasing trend of 0.0027 mm/year. The irrigation requirements ranged from 2.2 mm/month to 337 mm/month. Time series analysis showed variability in the monthly series, with an annual increasing trend of 0.140 mm/year, resulting in an annual increase of 7420m<sup>3</sup> of irrigation requirement. The study concludes that the variability of irrigation water requirement poses a challenge for the valley and recommends that irrigation managers and policymakers consider this variability while planning for irrigation.

**KEYWORDS:** CROPWAT, Evapotranspiration, Irrigation, Penman-Monteith, Water

**PAPER 39 - PARAMETRIC STUDY OF A SUITABLE VOLUME FRACTION OF  
AGGREGATE FOR THE COMPRESSIVE STRENGTH OF CONCRETE IN  
MESOSCALE MODEL**

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**ABSTRACT**

Concrete is a composite material with a heterogeneous internal structure. It is represented in multi-phase composite material at the macro, meso, micro, and nano levels. The meso level appears to be the most practicable approach for evaluating the composite behaviour of concrete. The mesostructure of concrete is mainly consist of mortar, coarse aggregate, and interfacial transition zones. This structure can be represented in 2D or 3D. Most previous works adopted the trial and error method to determine a suitable volume fraction of aggregates (between 30-50%) to predict the compressive strength of concrete. This paper proposes a suitable volume fraction of aggregates in the mesoscale modelling of normal-strength concrete. The Monte Carlo random sampling principle was used to generate the mesostructure using a Python random aggregate generator (RAG). The volume fraction was varied and the mesostructure was meshed using a tetrahedral element in ABAQUS. The mechanical behaviour was modelled using concrete damage plasticity, present in ABAQUS, under uniaxial compression. The results showed that 30%, 35%, and 40% volume fractions of aggregate gave compressive strengths of 27.8 MPa, 30.8 MPa, and 34.5 MPa, respectively. A 35% volume fraction of aggregate is proposed in predicting the compressive strength of concrete in mesoscale model and should be used in studying crack initiation and propagation of normal-strength concrete.

**KEYWORDS:** Mesoscale , Volume-Fraction, Mesh, FEA.

**PAPER 40 - SYNTHESIS AND EFFICIENCY EVALUATION OF SODIUM  
ALGINATE-CHITOSAN HYDROGEL POLYELECTROLYTE COMPLEX FILTER  
FOR TREATMENT OF OIL SPILLAGE**

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**ABSTRACT**

Crude oil spills pose considerable environmental concerns thereby demanding the development of effective, sustainable, and eco-friendly remediation solutions. This study aims to synthesize and evaluate the efficiency of a biodegradable polymer filter using sodium alginate and chitosan for the treatment of oil spillage. The sodium alginate-chitosan hydrogel polyelectrolyte complex (SACHPC) filter was synthesised based on dipping method using a layer-by-layer self-assembly technique integrated with cotton wool as the filter medium. The efficiency of the filter was evaluated based on the flow rate of recovered oil and the reusability of the filter. Simulated oil spillage of 0.5 M was subjected to filtration using the SACHPC filter. The flow rate was determined based on the time taken for 1 L of oil to pass through the filter. The SACHPC filter exhibited underwater superoleophobic behaviour with exceptional filtration efficiency (> 98.3%) across various scenarios (pH 3, 7 and 11). The flow rate of the filter was  $25 \times 10^5$  m/s, while the re-used filter exhibited an increased flow rate of  $2 \times 10^6$  m/s. Moreover, the filter achieved an impressive crude oil recovery rate of 85%. X-ray diffraction analysis confirmed crude oil adsorption under the presence of an amorphous phase while scanning electron microscopy analysis revealed the structural morphology of the SACHPC filter. Overall, the SACHPC filter maintained high filtration efficiency without compromising biodegradability, offering a sustainable strategy for oily wastewater purification and oil spill clean-up.

**KEYWORDS:** Oil spillage, Polyelectrolyte, Filter, Chitosan, Hydrogel, Sodium Alginate.

**PAPER 41 - DEVELOPMENT OF A SELF-POWERED GENERATOR**

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**ABSTRACT**

Self-powered generator is a new source of power that is completely safe and efficient, the durability and design is top notch. This generator, unlike every other generator doesn't have an engine which consumes fuel/gas. Instead of an engine, it has a DC motor which is powered by a 12 volts 75 Ah rechargeable battery that recharges self while operating. Other materials used are, speed-controller, speed up gear, AC to DC charger, Ac alternator, couplings, Shafts and Gear. The alternator armature shaft was coupled directly with DC motor powered by the rechargeable battery. The DC motor rotates the armature of the alternator in the field coil at high speed when activated from the starting switch which results in alternating current output voltages of 220V. This generator generates 1KVA which can be used to power basic home appliances, office or shop. The system is designed such that an in-built battery charger recharges the battery at the same rate as the DC discharges the battery when drawing battery current. The system could be designed to any limit contingent upon the capacity of the planned load. Minimum maintenance is required. Several tests were carried out using different loads at a particular time interval, results revealed an overall efficiency of 96.30% on a load of 500W and 89.10% on a load of 700watts respectively. The results demonstrated that the generator can operate at the efficiency of 97 to 100% if permanent magnet alternator is used.

**KEYWORDS:** Alternator, Dc motor, Gear, Shaft, Charger, capacitor.



**PAPER 42 - OPTIMIZATION ANALYSIS OF DUAL-MODE RENEWABLE  
HYBRID POWER SYSTEMS: A REVIEW**

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**ABSTRACT**

The escalating threat of global warming necessitates a significant shift towards clean energy production. Renewable energy sources have emerged as a promising solution to meet the growing demand for sustainable electricity generation. However, the intermittent nature of renewable resources calls for the development of hybrid systems to ensure a consistent and reliable power supply. This review investigates the current state-of-the-art optimization analysis of dual-mode renewable hybrid power systems. Dual mode refers to grid-connected and autonomous operational modes, enabling the system to adapt to varying demands and grid availability. The paper delves into the critical challenges associated with optimizing the power output from these systems, including appropriate optimization techniques. A meticulous review of recent advancements in architecture sizing, energy management strategies, and economic evaluations of dual-mode hybrid systems is presented. The paper also explores a comprehensive classification of optimization objectives and methods employed to enhance the performance of these systems. By critically evaluating the existing body of research, this review aims to provide a roadmap for advancing the optimization of dual-mode renewable hybrid power systems. This paves the way for the development of more efficient, reliable, and cost-effective renewable energy solutions for a sustainable future.

**KEYWORDS:** Hybrid energy sources, optimization techniques, minimization, modeling, grid integration

**PAPER 43 - DESIGN OF AN IMPROVED MICROSTRIP ANTENNA OPERATING  
AT A FREQUENCY BAND OF 28 GHZ**

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**ABSTRACT**

The design of an improved microstrip antenna operating in the 28 GHz frequency spectrum is the main goal of this work. The design used a Roger RT 5880 LZ substrate with a thickness and permittivity of 0.762mm and 1.96, respectively. The antenna was simulated in CST Microwave Studio. As the antenna feed, a quarter-wave transformer was used to provide an impedance match of 50 ohms. To improve the antenna's performance, a U-shaped element was added to the ground plane. The antenna resonated at 28 GHz frequency, according to simulation data, with a return loss of -21.4 dB, VSWR of 1.18, bandwidth of 2.026 GHz, and gain of 8.19 dB. The proposed antenna exhibits a performance improvement in terms of gain and bandwidth due to the addition of U-shaped element when benchmarked with existing designs in the literature work.

**KEYWORDS:** 5G communication, Microstrip, Antenna, quarter-wave transformer, CST microwave studio

**PAPER 44- INVESTIGATING THE EFFECTS OF COCONUT SHELLS ON THE  
HARDNESS, DENSITY AND WEAR RESISTANCE OF ALUMINIUM**

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**ABSTRACT**

Aluminium matrix composites have grown to become a staple in materials engineering. This is due to its combination of properties including improved mechanical properties, wear and corrosion resistance and reduced weight. This research was conducted to investigate the effect of coconut shells on the hardness, density and wear resistance of aluminium. The selected fabrication route was stir casting. The composites were reinforced with coconut shells at 2 wt.% to 10 wt. % in increments of 2 wt.% bringing the reinforced aluminium samples to a total of 6. The microstructure of the investigated samples was characterised by a fairly uniform dispersal of the reinforcements with minimal segregation and agglomeration of the particles. The hardness of the samples was shown to improve up to 43.26%. The density of the samples was shown to decrease with increasing wt.% of the reinforcements which indicates the production of lightweight materials. The wear resistance was investigated and the results showed that the wear rate decreased with increasing weight fraction of the reinforcements owing to the presence of the hard brittle particles that work to improve the wear resistance. The results of this study will contribute to the ever-growing body of knowledge in aluminium matrix composite research.

**KEYWORDS:** aluminium matrix composites, reinforcements, coconut shells, hardness, wear resistance

**PAPER 45 - HARNESSING ARTIFICIAL INTELLIGENCE TOOLS FOR  
RENEWABLE BIOENERGY OPTIMIZATION: PROSPECTS AND CHALLENGES**

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**ABSTRACT**

Transitioning to a low-carbon economy, focusing on renewable bioenergy, is crucial for meeting increasing energy demands sustainably. Bioenergy is a more reliable form of renewable energy than solar and wind energy, as it can achieve carbon neutrality and significantly impact employment. Artificial intelligence (AI) techniques are necessary to optimize energy efficiency, sustainability, and resource utilization in renewable bioenergy systems. This paper analyzes the possibilities and challenges of using AI to enhance the effectiveness of renewable bioenergy production processes. It highlights the growing importance of renewable bioenergy in addressing climate change mitigation and energy security objectives, focusing on the limitations of traditional optimization techniques. The study investigates the influence of AI technologies, including machine learning, neural networks, and optimization algorithms, on improving biomass feedstock selection, optimizing processes, and integrating systems. The potential benefits of AI include improved resource allocation, increased energy generation, and reduced costs. However, challenges such as lack of readily available data, complex model complexity, computational requirements, and ethical considerations pose significant obstacles to widespread application. The paper proposes potential areas for future investigation in driving forward innovation in renewable bioenergy. It also offers recommendations to policymakers, researchers, and industry stakeholders.

**KEYWORDS:** Renewable Bioenergy, Optimization, low-carbon economy, Artificial Intelligence, feedstock selection, sustainability

**PAPER 47 - DEVELOPMENT OF A GSM MODULE CONTROLLED SECURITY  
DEVICE IN A FOREST ENVIRONMENT**

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**ABSTRACT**

There has been incessant increase in the rate of banditry, kidnapping and terrorism in the North-Western part of the country especially in forest prone environment. In recent times forest environments have become hideout for these bad elements. Tree planting and afforestation programme being one of the measures to combat climate change; it is important that the forest environments need to be protected. Warning system is one of the ways of alarming a community in the event of any unpleasant intrusion by criminals. In this project a GSM module-controlled security alarm was developed. The system consists of various components such as contactor, alarm, timer, power supply unit, SIM card, and a GSM Module. The GSM module-controlled alarm system applies telephone network to relay electrical impulse to the alarm when a call is put forward to it. The GSM module allows the passage of electrical impulse to the alarm system for the period at which it is set. The security device was tested and found to be effective in sounding alarm to Afaka campus community in the event of criminal intrusion.

**KEYWORDS:** GSM-module, security alarm, forest environment, banditry

**PAPER 48- COMPARATIVE ANALYSIS OF SUN, SOLAR, AND OVEN DRYING  
TECHNIQUES ON SELECTED ATTRIBUTES OF HONEY-TREATED BANANA  
FRUIT SLICES**

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**ABSTRACT**

This study investigated the effects of three drying methods (sun, solar, and oven drying) on the proximate and vitamin qualities of dried honey-treated ripe banana slices. Samples of 5mm-sized, firmly-ripe banana slices were soaked in 0.25% v/v honey solution for 4 minutes, drained, and divided into three groups. The samples were subjected to sun drying, solar drying, and oven drying (at 65°C) until constant moisture content was reached. The results showed that the banana sample dried in the oven has the highest values of 5.00%, 2.14%, and 5.60% for fat, protein, and ash respectively. However, both sun and solar drying methods recorded slightly lower moisture content (5.20%) than oven drying (5.40%). Also, higher vitamin C (81.70 mg/100g) and  $\beta$ -carotene (1361.16 ug/100g) contents were observed in the oven-dried banana sample. The results suggest that honey treatment, coupled with oven drying, is an effective combination for preserving the quality of banana slices. Oven drying demonstrated superiority in terms of vitamin C,  $\beta$ -carotene, and some proximate retention. The findings emphasize the potential of honey as a natural preservative and oven drying as an efficient method for producing high-quality dried banana slices. This research provides valuable insights for the food industry, offering an alternative approach for reducing postharvest losses of ripe bananas and enhancing the quality of dried banana slices through honey pre-treatment and oven drying.

**KEYWORDS:** Banana, Drying methods, Honey-treated, Proximate qualities, Vitamin C,  $\beta$ -carotene.

**PAPER 49 - INVESTIGATING THE INFLUENCE OF LEAN CONSTRUCTION  
TECHNIQUES ON THE COST PERFORMANCE OF CONSTRUCTION PROJECTS  
IN SELECTED STATES OF NIGERIA**

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**ABSTRACT**

In recent discussions about the optimisation of construction processes, the concept of lean construction has emerged as a promising avenue for confronting the industry's numerous challenges and elevating project performance to new heights. Lean construction is based on the principle of maximising value while minimising waste, which resonates strongly with the modern ethos of sustainability and resource optimisation. Hence, the purpose of this study is to investigate the influence of lean construction techniques on the cost performance of construction projects in Nigeria. The study adopted a quantitative method to collect data from 294 participants. The study used a descriptive-analytical method, using the Mean Item Score (MIS) to analyse the collected data. The findings revealed that all the lean construction techniques have an influence on the cost performance of construction projects, with 5S (Sort, Straighten, Shine, Standardise, and Sustain) ranking topmost. The findings of this study help in the provision of empirical evidence of the effectiveness of lean construction techniques in the Nigerian construction industry context in terms of cost performance of construction projects and filling a significant gap in the existing body of knowledge in construction business management.

**KEYWORDS:** Construction, Cost, Lean, Performance, Project, Techniques

**PAPER 50 – ENHANCING EDUCATIONAL EFFICIENCY TOWARDS  
SUSTAINABLE EDUCATION USING AI AND ROBOTICS SOLUTIONS FOR  
ADMINISTRATIVE OPTIMIZATION: A REVIEW**

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**ABSTRACT**

This review paper explores integrating artificial intelligence (AI) and robotics technologies to enhance educational efficiency and contribute to sustainable education. The traditional manual recording and collation of graded examination scripts in educational institutions are time-consuming and prone to errors, diverting educators' resources from more impactful teaching and learning activities. This review aims to streamline administrative processes by leveraging AI and robotics, liberating educators' time for strategic planning and complex challenges. While delving into existing automated solutions for educational data management, robotics and automation in education, and image processing techniques for grade recording, it also discusses data extraction methods for student information retrieval, highlighting their strengths and shortcomings. Aligned with United Nations Sustainable Development Goal 4 (Quality Education), this paper underscores the potential for technology to revolutionize traditional processes in education. Moreover, it creates implications for other SDGs, particularly SDG 9 (sustainable industrialization and foster innovation) and SDG 17 (Partnerships for the Goals), emphasizing the transformative impact of AI and robotics in educational administration.

**KEYWORDS:** Students grades recording, Artificial intelligence, Machine learning, Image processing, Computer vision, Robot awareness, Robot manipulator, Sustainable development goals

**PAPER 51 - CULTIVATED PUMPKIN (*CUCURBITA PEPO*) BASED ON CLIMATIC AND HYDRO-PHYSICAL PARAMETER MEASUREMENT USING AUTOMATED DRIP IRRIGATION SYSTEM**

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**ABSTRACT**

This developed an automated drip irrigation system, which provides a cost-effective solution to the traditional irrigation method. The project was aimed at designing a low-cost automatic irrigation system that allows for more efficient way to nurture plants in the farm by implementing low voltage sensor technology in order to minimize wastage of water. This was achieved by putting together a sensing and control unit that comprise of moisture sensors, turbidity sensors and atmospheric pressure sensor. The information is being sent to the microcontroller from the sensors which processes the data collected and then opens or closes the valve based on the information received by the microcontroller. The data that is read by the sensors is being sent to the user through a GSM module, displayed on the LCD and is also stored on an SD card every twenty-five minutes. However, it was discovered that when this automatic irrigation system is applied on the real-life application, it will provide high efficiency in nurturing plant on the field or in a greenhouse system and this will result into maximum yield. Variations were observed due to climatic conditions. However, the designed system worked optimally and is fully recommended for small-scale and large-scale farming.

**KEYWORDS:** Drip irrigation, pumpkin, climatic and hydro-physical parameters, automated system and control

**PAPER 52 -THE ROLE OF TRANSPORTATION IN AGRICULTURAL DEVELOPMENT IN NIGERIA**

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**ABSTRACT**

Transportation is vital for improving agricultural productivity, enhancing quality of life, creating markets for agricultural products and promoting economic interactions. This study investigated the impact of road transportation infrastructure on agricultural development in Nigeria. It employed a survey design within accessible and inaccessible communities, collecting data on income, farm sizes, transportation modes and access to markets. Results revealed that farmers in accessible communities with better transportation networks enjoyed higher incomes, larger farm sizes and better access to markets. Conversely, those in inaccessible communities faced challenges like head portage, reduced income and limited market access. These findings highlight the crucial role of transportation infrastructure in enhancing agricultural development, supporting investment in rural roads for improved economic growth and poverty reduction. The research also addresses the controversial findings in existing literature regarding the relationship between road transport infrastructure and agricultural sector development, focusing on Nigeria's rural road network.

**KEYWORDS:** Transportation, rural road network, rural transportation, road transport infrastructure

## **PAPER 53 - INTEGRATION OF AI ALGORITHM INTO EDGE DEVICES FOR PREDICTIVE MAINTENANCE OF INFRASTRUCTURE IN SMART CITIES**

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### **ABSTRACT**

As AI continues to evolve, there are new/emerging areas of research for leveraging AI in smart cities and infrastructure to enhance United Nations Sustainable Development Goals to meet the needs of humanity and the society. One of the key research areas is edge computing and AI, it represents the ongoing evolution of AI in smart cities and infrastructure, focused on addressing complex challenges and maximizing the benefits of AI technology for infrastructure maintenance and sustainable development. This paper presents overview of integration of AI algorithms directly into edge devices to ensure efficient and effective deployment. The integration of AI algorithms into edge devices are discussed, which involves several steps and considerations ranging from understanding what edge computing is, choice of suitable edge devices, selection of AI models, AI model optimisation, model deployment, development of data processing and inference, integration of edge devices with appropriate connectivity solutions, implementation of robust security measures to protect AI models, data, and communications on edge devices, and finally to the setting up of monitoring and management systems to monitor the performance of AI models on edge devices. AI on edge devices enables real-time monitoring of infrastructure health, detecting anomalies promptly to prevent potential failures.

**KEYWORDS:** AI, edge devices, predictive maintenance, smart cities, infrastructure, algorithm

## **PAPER 54 - SPECTROSCOPIC PROPERTIES AND PERFORMANCE EVALUATION OF A NOVEL BIO-BASED BRAKE FLUID PRODUCED FROM ROSELLE OIL WITH COPPER OXIDE NANO ADDITIVE**

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### **ABSTRACT**

A bio-based brake fluid was produced from Roselle oil with Nano copper oxide as an additive. The spectroscopic, and Physicochemical properties of the blended brake fluid were evaluated and its performance was simulated using computational fluid dynamic (CFD) on the ANSYS workbench. From the kinematic viscosity analysis, it was observed that there was a linear increase in the viscosity with an increase in the nanoparticle with a 43.3% increase in viscosity due to the inclusion of 0.3 wt.% of CuO nanoparticle. The increment is attributed to physical barriers created by the nanoparticle that generate more internal friction to the flow of oil molecules. The performance evaluation of the bio-based brake fluid under various operating conditions, including temperature, pressure, and velocity flowrate, demonstrated its ability to maintain consistent and reliable performance across a range of challenging scenarios. This finding indicates the versatility and suitability of the developed brake fluid for automotive applications. The comparison of the bio-based brake fluid with conventional brake fluid offers a clear understanding of its advantages and competitiveness, which shows that the produced bio-based brake fluid is a viable alternative in automotive applications. The production of bio-based brakefluid offers novelty in this research area and this achievement represents a significant step towards developing eco-friendly and sustainable alternatives to conventional petroleum-based brake fluids.

**KEYWORDS:** Bio-Based Brake Fluid; Simulation; Physico-chemical properties; Roselle Oil; Copper Oxide; Nanoparticle

**PAPER 55 - EXPERIMENTAL STUDY ON THE EFFECTS OF PARTIAL  
REPLACEMENT OF CEMENT WITH EGGSHELL POWDER ON CONCRETE  
PROPERTIES**

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**ABSTRACT**

Concrete, an essential construction material, accounts for a significant portion of global carbon emissions due to the high energy consumption and greenhouse gas emissions associated with cement production. This study investigated the potential of waste Eggshell Powder (ESP) as a sustainable alternative to partially replace cement in concrete production. The chemical characterization through X-ray Diffraction (XRD) and X-ray Fluorescence (XRF) of the waste ESP was analysed. Four different concrete mixes were cast with the inclusions of ESP at 0%, 5%, 10%, and 15% replacement of cement. The workability of the fresh concrete mixes, compressive strength, split tensile strength, and flexural strength of the hardened concrete mix samples at 28 days of curing were evaluated following the relevant standards. The XRF results showed the presence of CaO in waste ESP, which indicates its suitability as a supplementary cementitious material. The obtained results showed an increment in workability, compressive strength, flexural strength, and split tensile strength properties of the concrete as the content of the waste ESP increased up to 10%. Beyond that, a significant reduction in these properties was observed. The maximum compressive strength of 30.2 N/mm<sup>2</sup> was obtained at 10% inclusion of waste ESP in the concrete mix.

**KEYWORDS:** Eggshell powder (ESP), Ordinary Portland Cement (OPC), X-ray Diffraction (XRD), Split-Tensile strength, Compressive Strength, Flexural strength, Workability.

**PAPER 56 - PROCESS OPTIMIZATION OF TREATMENT METHODS AND  
EXTRUSION TEMPERATURE FOR NUTRITIONAL COMPOSITION OF RICE  
PASTA ENRICHED WITH CIRINA BUTYROSPERMI**

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**ABSTRACT**

Food security remains a critical global challenge, necessitating the exploration of sustainable and nutrient-rich food alternatives such as edible insects and non-thermal technologies. This study investigated the effect of different treatment methods (boiling, ultrasound treatment, and a combination of partial boiling and ultrasound treatment) and extrusion temperature (70, 80 and 90°C) on the nutritional composition (crude protein, in-vitro protein digestibility, calcium, zinc and iron contents) of rice pasta enriched with *Cirina butyrospermi*. The effect of treatment methods and extrusion temperature on crude protein ranged from 15.85 to 18.27%, in-vitro protein digestibility (80.42-88.55%), calcium (48.53-56.25 mg/100g), zinc (2.42-3.56 mg/100g) and iron (3.34-5.13 mg/100g), respectively. Pasta subjected to combined partial ultrasound and partial boiling treatments at high extrusion temperatures exhibited the highest crude protein, calcium, zinc, and iron content. In contrast, lower extrusion temperatures enhanced the in-vitro protein digestibility of the pasta, irrespective of the treatment method. The optimum conditions for desirable rice pasta enriched with *Cirina butyrospermi* were achieved at an extrusion temperature of 80°C, combined with a partial ultrasound and partial boiling treatment method. Conclusively, exploring edible insects like *Cirina butyrospermi* and efficient processing methods could aid in developing an improved nutrient-rich rice pasta.

**KEYWORDS:** *Cirina butyrospermi*, Ultrasound, Nutritional composition, Gluten-free, Extrusion, Rice Pasta

**PAPER 57 - OPTIMAL ALLOCATION OF STATCOM ON POWER  
TRANSMISSION NETWORK USING DRAGONFLY ALGORITHM**

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**ABSTRACT**

Power transmission networks operate closer to their voltage stability limits, due to daily escalating demand of electrical energy. Such issue leads to voltage instability, which may pilot to system collapse. Emerging Flexible Alternating Current Transmission Systems (FACTS) devices are engaged to attain appropriate utilization of the existing transmission networks. This work proposed a novel Artificial Intelligence (AI) approach explicitly Dragonfly Algorithm (DA,) in determining the optimal allocation of Static Compensator (STATCOM) for voltage stability enhancement in the network. The simulation was conducted using Newton Raphson Load Flow (NRLF) method on IEEE 30-bus test system. The DA results were compared to those of the Genetic Algorithm (GA). With GA approach, two STATCOMs were optimally located at buses 19 and 20. The Voltage Profile Enhancement Index (VPEI) achieved was 1.0334, with optimal size of 36.74MVA each, after 8 iterations. In the case of DA, the devices were located at buses 19 and 24 with optimal size of 36.80MVar each after 5 iteration, with a VPEI of 1.0505. The results have generally signified the efficacy of DA over GA algorithm.

**KEYWORDS:** DA algorithm, NRLF, Power quality, Static compensator, VPEI.

**PAPER 59 - DEVELOPMENT OF EXPERIMENTAL DATA CENTRE FOR  
IMPROVEMENT OF PEDAGOGY IN UNIVERSITY OF ILORIN, NIGERIA**

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**ABSTRACT**

In a bid to enhance teaching and assessment in the Department of Computer Engineering at the University of Ilorin, Nigeria, an Experimental Data Centre (EDC) was created. This platform aims to improve lecturer-student interaction by offering various services such as access to course materials, audio-visual classes, group projects, real-time assessments, and research support. The EDC development encompasses data center architecture design, system implementation, service deployment, and performance evaluation. It connects to the university's internet with a 2.4 Gbps bandwidth and has a 5KVA online inverter backup. Currently, it hosts two servers with a total storage of 40TB, running both Windows and Linux OS. Services include Moodle LMS, BigBlueButton for virtual classrooms, Rocket Chat for messaging, live streaming, Document Management System, and an e-book repository. Testing and debugging are ongoing, managed by departmental staff with stringent data security measures. Future plans involves expanding the EDC to other faculties within the university in phased upgrades.

**KEYWORDS:** Courseware, Data Centre, Learning Management System, Pedagogy, virtualization



**PAPER 60 - DEVELOPMENT OF MICROCONTROLLER-BASED SMART DEVICE  
FOR SUBSTANCE DETECTION IN UNIVERSITY ENVIRONMENT**

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**ABSTRACT**

The rising concerns over substance abuse particularly involving Indian hemp (marijuana) and alcohol among university students in Nigeria poses significant health and social concerns, and necessitate innovative solutions for detection, effective monitoring and intervention strategies. Substance abuse among university students has become a pressing issue, negatively impacting academic performance, contributing to increased cultism, and compromising overall student well-being. The lack of effective monitoring mechanisms within universities has allowed these behaviours to persist, with students often evading detection due to limited oversight and enforcement by university authorities. This research proposed the development microcontroller- based smart device designed specifically for detecting smoking and drinking activities on university campuses. Upon detecting suspicious activities associated with smoking or drinking activities, the device will immediately notify university law enforcement in the university and provide them with precise GPS coordinates of the location where the activity was detected. The device utilizes an MQ3 sensor for alcohol and smoke detection, a GPS sensor for location tracking, and a GSM module for real-time alerting and monitoring. This integrated system enables proactive intervention and swift response to substance-related incidents on campus.

**KEYWORDS:** Substance Detection, Microcontroller, Smart device, Monitoring

**PAPER 61– UNIVERSAL ROW-CROP TRACTOR WITH A VARIABLE BASE**

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**ABSTRACT**

This article discusses the development of a universal row-crop tractor with a variable base. The general information about a tractor with a variable base, the scope of application, information about previously created tractors with a variable base are discussed. Based on the analysis of existing designs of tractors with a variable base, a new design was developed and its 3D model presented. The design of the mechanism, the calculation of the strength of the details of the mechanism of the structure and the principle of operation of the mechanism of changing the base of the tractor are presented.

**KEYWORDS:** Row-Crop Tractor, 3D model, Strength calculation, Variable base, hydraulic cylinder, Universal

**PAPER 62 – SOCIO-ECONOMIC IMPACT ASSESSMENT OF IDOFIAN DAM,  
IFELODUN LOCAL GOVERNMENT AREA, KWARA STATE, NIGERIA.**

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**ABSTRACT**

A dam is a barrier/structure that impounds water and retains it for later use. This study was conducted to assess the socio-economic impact of Idofian dam on its catchment local communities; ten communities were selected for this assessment. Research methods include key informant interviews and a structured questionnaire survey. Key informant interviews were held with community heads while 300 questionnaires were randomly administered among respondents within the communities. The impact was analyzed based on descriptive statistics using SPSS software. The results showed that 85.3% respondents admitted awareness of environmental hazards with 0.7 % of it admitted occurrence of societal conflict, 23.6% occurrence of drought, 0.8% occurrence of flood, 4.5% for herdsmen invasion, 4.5% for sickness, while 65.4% were undecided. On the other hand, only 10% admitted getting any benefit from the dam while 90% claimed not to derive any benefit from the dam. Monthly income of majority (54.7%) of respondents falls between ₦31,000-50,000. The study shows that 75% of the respondents are farmers, while other occupations as traders, civil servants, private sector and the unemployed were 11.3%, 9.9%, 2.2% and 2.2%, respectively. The study also showed that the dam could be a more useful resource for catchment communities.

**KEYWORDS:** water resource, dam, catchment communities, socio-economic impact

**PAPER 63 - EFFECTS OF RICE HUSK ASH ADDITION ON THE REFRACTORY  
PROPERTIES OF OWO CLAY**

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**ABSTRACT**

This research investigates the effect of rice husk ash (RHA) addition on the refractory properties of Owo clay. The clay is blended with RHA in increments of 5% for each experimental run. The blended material undergoes exposure to temperatures ranging from normal crucible liner conditions to 1200° C, followed by characterization for shrinkage, porosity, density, water absorption, and modulus of rupture. Results indicate that total shrinkage increases with RHA content throughout the experimental phase but stability was observed at 10% RHA. Porosity decreases with increasing RHA content, with the 10% RHA blend showing the most consistent decrease. RHA enhances compressive strength, reaching a peak of 24 N/mm<sup>2</sup> for 5% RHA at 1200°C, and a minimum of 10 N/mm<sup>2</sup> for 5% RHA at 900°C. Bulk density increases with decreasing porosity as temperature rises. Overall, the 90%-10% Owo clay-RHA Clay blend demonstrates the most suitable properties for industrial applications.

Strength

**KEYWORDS:** Chemical composition, Owo clay, Physical properties, Refractoriness, Rice Husk Ash (RHA).

**PAPER 64 – LEVERAGING MACHINE LEARNING TO IDENTIFY SUCCESS  
FACTORS IN COMPUTING FINAL YEAR PROJECTS**

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**ABSTRACT**

Two of the Sustainable Development Goals (SDGs), Quality Education and Reduced Inequalities, can be pursued concurrently by adapting to individual learners' differences, facilitated by predictive machine learning models, to complement the inclusive access to education. This paper aims to identify factors contributing to the successful final year and software development-based projects in the computing discipline using machine learning techniques. Identifying these factors will play a crucial role in providing tailored support to future students. Scores from relevant courses, Cumulative Grade Point Average, the project aggregate score, and a questionnaire on the potential application of related subjects were collected from computer science students of Al-Qalam University Katsina, Nigeria. The study utilized multiclass supervised learning. The dataset was small and unbalanced, thus data augmentation and balancing techniques were applied to evaluate their effects. Data discretization was applied to continuous features. The experiment followed a 2 X 2 X 3 design. A Random Forest model was trained and evaluated based on accuracy and F1 metrics. The results showed that augmentation had slightly reduced overfitting. Similarly, data balancing was found to have better F1 across all cases. These findings highlight the importance of consciously sourcing and storing local datasets for future analysis.

**KEYWORDS:** predictive machine learning, undergraduate capstone project, Sustainable Development Goals.

**PAPER 65 – A STUDY OF KINETICS AND ENERGY USAGE IN KETTLE  
BOILING OF WATER**

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**ABSTRACT**

This study was geared towards examining the kinetics and energy consumption during the use of different types of household kettles to boil water for domestic use. The effect of the power rating and the water volume as it affects different aspects of the process was also keenly examined. The metal kettles were of ratings 1500W and 2500W with sizes of 2.2L and 1.7L respectively while the plastic kettles were both of 1850W with the new and old being 2.2L and 1.7L respectively. These were the commercially available grades. It was also observed from the kinetic studies that for kettles of higher power ratings, the rate of boiling will always be faster than for lower power ratings. For plastic kettles of the same rating, the kinetics are similar for both the old and the new kettles. From the consideration of the energy usage, it was observed that for most of the kettles, there was energy loss during the process. The energy wastage was between 10-50% for most non-efficient kettle experiments. It was noted that the use of plastic kettles instead of metallic did not in any way improve the energy conservation of the boiling process.

**KEYWORDS:** Kettle, Boiling, Energy, Kinetics, Heating, Water

**PAPER 66 - PRODUCTION AND CHARACTERIZATION OF CASSAVA  
PERIDERM EPOXY COMPOSITES**

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**ABSTRACT**

This study focuses on the investigation of the physical and mechanical properties of cassava periderm epoxy composites. The locally sourced cassava periderm was sun-dried, pulverized, and sieved to obtain a size of <100 µm. Various proportions of cassava periderm powder ranging from 0 to 20 wt % were mixed thoroughly with epoxy resin and cast into composites using fabricated silicone moulds. Cassava periderm particulate reinforcements were produced. The developed composites were tested for their hardness, density, and water absorption, tensile and flexural strength. The produced cassava periderm reinforced composite has a lower density and can be used to produce lightweight materials. Such materials include silica which finds its use in glass, ceramics and semiconductors production. These materials are also used in the automobile industries to produce parts like car dashboards among others. The addition of reinforcement lowers the tensile properties and improves the bending modulus of the composites.

**KEYWORDS:** Composite materials, Epoxy composite, Cassava periderm, Natural fibres, Agricultural waste, Reinforcement fibres, Mechanical properties.

**PAPER 67-DESIGN AND FABRICATION OF AN ADAPTABLE MIXER FOR  
POLYMER MATRIX COMPOSITE PRODUCTION**

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**ABSTRACT**

Production of polymer matrix composites requires a homogeneous mixture of at least two substances, usually matrix and reinforcement(s). Mixing of the substances manually results in an inhomogeneous mixture marred with inconsistencies of mixing parameters which affects the properties of the composites. In a bid to proffer a solution, this work focuses on the design, fabrication, and evaluation of an adaptable mixer. SolidWorks was used for the design of the mixer and the machine was locally fabricated using mild steel. The machine was evaluated using varied mixing speeds compared with manual mixing of an epoxy composite. The composites were assessed with flexural samples using ASTM D790 and visual observation. It was observed that the speed of mixing has a great impact on the flexural strength and quantity of bubbles. The mixer produces a homogeneous mixture at a sufficiently short time at low speeds. The machine will be useful for batch production of composites between 200 and 2000 cm<sup>3</sup> in laboratories and small-scale industries.

**KEYWORDS:** Polymer matrix, Composite, Reinforcement, Adaptable Mixer.

## **PAPER 69 - THE EFFECTS OF POOR WASTE MANAGEMENT: AN OVERVIEW OF THE ENVIRONMENTAL CHALLENGES IN NIGERIA**

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### **ABSTRACT**

Solid waste management is a major environmental challenge in most Nigerian cities. Waste generation rate in Nigeria is estimated at 0.65-0.95 kg/capita/day which gives an average of 42 million tonnes of wastes generated annually. This is more than half of 62 million tonnes of waste generated in sub-Sahara Africa annually and where and how to channel these wastes becomes a huge problem for the nation. This study examines the problems and prospects of solid waste management in some selected Nigerian cities using the mixed method of data collection. The findings revealed that waste management in Nigerian cities is largely monopolized by the agencies of state governments (sub-national governments) which have limited capacity to tackle the problems of solid waste management in their cities. In addition, 52 % of wastes generated are organic wastes which create additional disposal problems. Although the problems of solid waste management in Nigeria range from poor collection and disposal methods; lack or poor waste management database; insufficient financial resources; non-compliance to laws and lack of awareness on dangers of poor sanitary habits, this paper argues that a robust waste data base, strict policies and regulation are important for effective solid waste management in Nigeria

**KEYWORDS:** Solid waste, environmental challenge, mixed method, poor collection and disposal methods

## **PAPER 70-SYNTHESIS AND CHARACTERIZATION OF 2D GRAPHENE THIN FILMS FROM GRAPHITE FOR OPTOELECTRONIC GADGETS**

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### **ABSTRACT**

In this investigation, the synthesis of graphene from Nigerian natural graphite and the determination of the electrical conductivity of the thin films for optoelectronic gadgets were conducted. The samples were characterized by X-ray diffraction (XRD), X-ray fluorescence (XRF), field emission scanning electron microscopy and energy dispersive X-ray (FESEM and EDX) to show their structural and compositional features. XRF study showed the mineral compositions as MgO (4.35%), SiO<sub>2</sub> (25.14%), SrO (9.73%), CdO (1.99%) and C (15%). XRD pattern indicated perfectly crystallized graphene flakes. Surface morphology by SEM analysis revealed closely packed, layered and spongy structures. EDX studies indicated the elemental composition as Carbon (86.34%), Molybdenum (10.37%), Potassium (2.38%) and Titanium (0.91%). The reduced graphene oxide (RGO)-TiO<sub>2</sub> composite thin films displayed glistering surfaces due to the less density of electronic trap states and improved absorption in UV-visible region making them suitable for optoelectronic devices. The resistivity of 1.9592, 12.9366, 2.5419 and 25.1256 s/m were recorded for GO, RGO, GO-TiO<sub>2</sub> and RGO-TiO<sub>2</sub> thin films. The study has revealed that graphite and its products (GO/RGO) are of high quality. They can be produced for academic and industrial research at a lower cost compared to the imported types without detailed characterization systems into the Nigerian market.

**KEYWORDS:** Graphene oxide, graphene flakes, graphene-TiO<sub>2</sub>, graphite, electrical conductivity, FESEM, EDX, XRF

**PAPER 71 - DESIGN OF HIGH PERFORMANCE GRAPHENE LEAD FREE  
PEROVSKITE SOLAR CELLS BY NUMERICAL MODELING BASED ON  
COUPLED DIFFERENTIAL EQUATIONS**

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**ABSTRACT**

In this study, graphene oxide (GO) was prepared by modified Hummer's method and the optical properties were explored using UV-visible spectroscopy to determine absorption coefficients at different wavelengths based on Beer-Lambert's law in the design of lead-free methyl ammonium germanium halide solar cell using GO as carrier transporters. Numerical modelling of the device in solar capacitance stimulating (SCAPS 1D) program based on second order differential equation was done. A 0.6227 V, 38.58 mAcm<sup>-2</sup>, 83.07 %, 19.95 % were recorded as the open-circuit voltage, current density, fill factor and power conversion efficiency for FTO/GO/Perovskite/Cu<sub>2</sub>O/Au and 0.6659 V, 10.77 mAcm<sup>-2</sup>, 79.19 %, 22.91 % for the FTO/GO/TiO<sub>2</sub>/Perovskite/Spiro-OMETAD/Au based design for the first time. The investigation showed that the presence of graphene improved the optical transparency and enhanced carrier generation and interaction between other layers which optimizes the electrical conductivity and efficiency of the solar cells when compared to previous studies in literature. The results emphasized a viable approach to in the design of efficient and stable solar cells at a reduced cost and optical losses.

**KEYWORDS:** Graphite, Energy Band Gap, Optical Property, Graphene, Perovskite, Solar Cells, SCAPS

**PAPER 72 - ENERGY-EFFICIENT TECHNIQUES IN MASSIVE MIMO: A REVIEW**

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**ABSTRACT**

Massive multiple-input multiple-output (MIMO) technology promises significant capacity and spectral efficiency gains for fifth generation (5G) and beyond 5G (B5G) networks. However, the deployment of large-scale antenna arrays poses challenges in terms of energy consumption and operational costs. This paper provides a comprehensive review and analysis of various energy efficiency techniques proposed for massive MIMO systems. We classify these techniques into four categories: hardware-based, signal processing-based, resource allocation-based, and network-level techniques. For each technique, we discuss the principles of operation, advantages, limitations, and existing research findings. We also present a comparative analysis highlighting the trade-offs between energy efficiency, performance, complexity, and cost. Furthermore, we identify open challenges and potential future research directions in the field of energy-efficient massive MIMO. The insights provided in this paper can assist researchers, engineers, and practitioners in designing and deploying energy-efficient massive MIMO systems for next-generation wireless networks.

**KEYWORDS:** Massive MIMO, energy efficiency, hardware optimization, signal processing, resource allocation, network-level techniques.

**PAPER 73-DEVELOPMENT OF A SMART BALLOT BOX SYSTEM FOR  
ENHANCED ELECTION SECURITY IN NIGERIA**

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**ABSTRACT**

Electing competent leaders through a trusted and transparent electoral process is essential for the critical development of any nation. However, politicians most especially in Nigeria employed various tactics such as vote buying, bribing electoral officials, manipulating votes, and ballot box snatching to undermine the integrity of elections. All these tactics most especially ballot box snatching undermine democracy, denying citizens their voting rights and eroding trust in the electoral system. This hinders national growth, perpetuates instability, reduces political accountability, and stifles the voice of the people. This research proposes the development of a smart ballot box system equipped with a location tracking feature, designed to restrict access to authorized electoral officers. Only authorized personnel can open the ballot box using fingerprint recognition after the voting process is completed. The system sends a notification to the electoral authority for appropriate action once the ballot box is accessed. In the event of ballot box snatching, the integrated device within the ballot system will transmit its location for tracking purposes, enabling the relevant authorities to take immediate action. The system comprises a microcontroller, a fingerprint sensor for authentication, a GPS sensor for real-time location tracking, and a GSM module for instant alerting and monitoring.

**KEYWORDS:** Ballot Box, Fingerprint, GPS, Tracking, Electoral Process

**PAPER 74 – SIZING DISTRIBUTED ENERGY RESOURCES FOR ROBIYAN  
VILLAGE IN OGUN STATE, NIGERIA**

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**ABSTRACT**

The current grid infrastructure of today continues to struggle to meet growing energy demand, climate and environmental concerns, as well as the growing need for resiliency against natural disasters and cyber-attacks. Distributed Energy Resources (DER) provide a viable and sustainable energy source for transforming the present grid network into a smart future-ready grid. The deployment of a DER in a microgrid requires careful consideration of several factors. This study aims to size a DER system comprising of the grid, solar PV, battery energy storage system (BESS) as well and diesel generating set into a micro-grid. The study objectives include the modelling of an optimally sized DER into the smart grid to efficiently meet user energy demand and the analysis of the impact of the smart grid on the coverage area. Using the Homer Pro, optimal DER sizes are determined by considering key metrics such as energy cost, reliability, and environmental impact. The final system size comprises 1MVA of DG, 1.7MWp of solar and 6MWh of BESS, for the ideal grid, solar PV, battery and diesel generator scenario. The emission level was reduced by more than 45% when the renewable energy-based DER and storage were introduced.

**KEYWORDS:** DER, Smart Grid, Microgrid, Solar PV, BESS,

## **PAPER 75- ENHANCING COST-EFFICIENCY IN MICRO-GRID SYSTEMS: A HYBRID OPTIMIZATION APPROACH FOR UNIT COMMITMENT PLANNING**

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### **ABSTRACT**

In the face of escalating power supply expenses, efficient unit commitment planning within micro-grid systems becomes imperative. This study delves into optimizing a diverse blend of micro-pumped hydro storage, solar PV, diesel generators, and public power supply to determine the University of Jos's most cost-effective hourly load demand over the next 24 hours. Employing a robust optimization methodology, the research dynamically manages each power source's activation, departing from fixed operational hours. Through a comparative examination involving Particle Swarm Optimization (PSO), which yielded a total generation cost of ₦127,216.00, Genetic Algorithm Particle Swarm Optimization (PSO-GA), which achieved a total generation cost of ₦104,120.00, and Hybrid Particle Swarm Optimization with a local search algorithm (Hybrid-PSO), resulting in a total generation cost of ₦54,264.00, the study underscores Hybrid-PSO's superiority in power generation cost by 57% compared to PSO and 48% compared to PSO-GA. Thus, favoring it as the optimal technique. This envisaged unit commitment strategy ensures a dependable and sustainable power supply, effectively tackling the rising expenses. Adoption of this approach augments micro-grid systems' cost-efficiency while fulfilling load demand prerequisites, offering pivotal insights for optimal optimization methods' selection in micro-grid systems to enhance operational efficiency and economic viability amid mounting power supply costs.

**KEYWORDS:** Efficiency, Escalating, Hybrid, Load Demand, Optimization, unit Commitment

## **PAPER 77- UTILIZING MACHINE LEARNING ALGORITHMS FOR FOOD SAFETY MANAGEMENT: APPLICATIONS IN MONITORING AND ENSURING THE SAFETY OF FOOD LIPIDS**

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### **ABSTRACT**

This research examines how food safety management and machine learning are used to monitor and ensure palm oil safety. Triacylglycerides (TAGs) make up more than 95% of dietary lipid (palm oil), which is high in saturated fat, particularly palmitic acid. Conventionally, monitoring lipid content and safety are frequently characterized by a high level of manual work, a high cost of test sample/ equipment maintenance, and a lengthy time required even with the use of sophisticated machines like uHPLC, and GCMS. Considering Free fatty acids test on palm oil A, B, C, D, E, F, G, and H samples with values of 11.5 mgKOH/g, 10 mgKOH/g, 12 mgKOH/g, 7 mgKOH/g, 11 mgKOH/g, 8 mgKOH/g, 11 mgKOH/g and 14 mgKOH/g respectively. Comparing the imaging processing (black box models) of the samples in system training, a more unique approach will be needed. Machine learning can swiftly and cheaply assess lipid data for safety risks. Machine learning swiftly evaluates lipid data and discovers safety concerns, a viable solution. This paper examines current literature, impartial machine learning merits and cons, and food lipid research.

**KEYWORDS:** Analysis, Food, Intelligence, Lipid, Monitoring.



**PAPER 78- QUALITY MANAGEMENT AS A TOOL TO MINIMIZE  
CONSTRUCTION WASTE TOWARDS A SUSTAINABLE BUILT ENVIRONMENT:  
THE CONSULTANTS' PERSPECTIVE**

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**ABSTRACT**

Construction industry generates significant amount of solid waste which could be attributed to poor quality management of resources in construction projects. This research paper examines the management of construction waste in Nigeria's Federal Capital Territory, focusing on consultants' perspectives. Using a 1 to 5 Likert scale, responses were qualitatively analyzed using SPSS software. The Relative Importance Index (RII) was calculated using Excel to determine the rank of factors. Initial research identified seventeen potential waste causative factors, however, RII analysis identified top 10 most significant waste causative factors with "Poor Materials Handling and Storage" being the most influential factor with a mean of 4.57. Pearson product correlation analysis showed a low correlation between "Inexperience designer" and "complicated design", which was statistically significant in the technical factor section. There were no correlating factors in the Management Factor Section, Workers Factor Section, and External Factor Section, indicating their independence. Consultants, according to the Chi-square test, acknowledged the crucial role of quality management in waste reduction within construction projects, emphasizing the importance of early identification and proper handling to reduce and mitigate waste. The findings highlight the need for quality waste management practices in F.C.T, Nigeria, in order to promote sustainability in construction activities.

**KEYWORDS:** Construction Waste, Quality Management, Waste Causative Factors, Waste Management

**PAPER 79 -THE POTENTIAL OF JATROPHA CURCAS EXTRACT (JATROPHA  
CURCAS OIL) IN MODIFICATION OF BITUMEN**

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**ABSTRACT**

This research objective is to determine the feasibility of Jatropa Curcas Extract as a novel bio modifier by evaluating the interactions between Jatropa Curcas Oil (JCO) and bitumen, incorporating JCO into bitumen, and comparing the index, chemical, and performance properties of the modified samples with 60/70 Penetration Grade (PG) neat bitumen. JCO was chosen because it is a cheap, non-edible, renewable, environmentally friendly crop with high unsaturated fatty acids which makes it suitable as a biolubricant with good binding properties. Besides, this is also a way to reduce the environmental impacts of bitumen, improve sustainability by promoting the use of renewable resources, save cost, and enhance the rheological properties of bitumen. JCO was extracted from the Jatropa seeds by mechanical means and used to modify neat 60/70 PG bitumen. The unmodified and modified bitumen samples were tested for their index (penetration, softening, flash, and fire point tests), chemical (Fourier transform infrared spectroscopy) and rheological (dynamic shear rheometer-frequency sweep test) properties. The results achieved for a base and modified bitumen were analyzed and compared. These results showed that the use of JCO as a bio modifier in bitumen shows benefits in health, environmental, economic, and rheological perspectives.

**KEYWORDS:** Jatropa curcas oil, bio-modifier, penetration grade, bitumen, unmodified bitumen, penetration

**PAPER 80 - DEPLOYING 3-STAGE SWITCH MODE TECHNIQUE AT BASE STATIONS TO OPTIMIZE ENERGY CONSUMPTION IN WIRELESS COMMUNICATION NETWORKS**

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**ABSTRACT**

This work focused on the deployment of a 3-stage mode technique at base station to optimize energy consumption in wireless communication network. The projected rise in wireless communication traffic has necessitated the advancement of Energy Efficient (EE) techniques for the design of wireless communication systems, thereby providing high operating costs of conventional wireless cellular networks and scarcity of energy resources in low-power applications. Considering the current energy concerns, the base station is the hub of bulk energy consumption with the interest to improve energy efficiency at the base stations level for future generation networks. This work examined different ways of deploying energy efficient techniques at the base stations in order to make the base station more energy efficient and to examine the paradigm shifts by using switch mode approaches to enhance energy efficiency at the base station level. The research adopted three switch modes techniques. Three switching stages were considered namely, Sleep mode, Safe mode, and ON modes. With the three switch mode technique, the energy efficiency was improved from significantly when compared with the two switch modes technique.

**KEYWORDS:** Energy efficiency; switch modes; Base station; sleep mode, safe mode, Network.

**PAPER 81 – INVESTIGATION OF EFFECTIVE EARTH RADIUS FACTOR (k-FACTOR) AND ITS APPLICATION TO RADIO COMMUNICATIONS OVER NORTH WESTERN NIGERIA**

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**ABSTRACT**

This study investigated the long-term variations in  $k$ -factor over North West, Nigeria. Data (1980-2020) of temperature, pressure and humidity at the surface, 100 m and 250 m above ground level from the European Centre for Medium-Range Weather Forecasts (ECMRWF) ERA-5 were deployed. Computations were made using the latest ITU-R, Rec. P.453, 2019. The Study reveals that  $k$ -factor exhibits seasonal and location dependence. The obtained  $k$ - factor for the study areas are higher than the ITU-R standard value of,  $\frac{4}{3}$  (1.33). The range of the mean values for twelve months across the seven locations of the study is 1.597- 5.362 where the first and second highest values are 5.362 and 5.243 in September and October in Gusau respectively. The lowest value is 1.597 in February obtained in Sokoto. The overall mean values for the dry season in Katsina, Kaduna, Dutse, Sokoto, Gusau, Birnin Kebbi and Kano are 1.805, 1.851, 1.978, 1.776, 1.532, 1.901 and 2.014 and for the wet season we have 3.273, 3.738, 3.212, 2.590, 3.849, 2.469 and 3.598 respectively. The findings from all locations indicate that radio signal propagation would be affected by super-refractive conditions, thus the need to compensate for this to enhance quality of service.

**KEYWORDS:** Effective earth radius factor ( $k$ -factor), radio signal propagation, super refraction, North West Nigeria

**PAPER 82 - EVALUATING THE ENGINEERING SOLUTION TO CHOLERA  
PREVALENCE IN OFFA LOCAL GOVERNMENT AREA OF KWARA STATE**

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**ABSTRACT**

Cholera is a global threat to public health associated with high mortality and morbidity. The disease has become a source of great concern in Offa Local Government Area (LGA) of Kwara State due to its prevalence therein. Hence, this study assessed the risk of a cholera outbreak in Offa by identifying its causative factors, examining its most vulnerable areas, evaluating the community awareness level, and assessing the nature of health risks related to cholera. 110 questionnaires were administered with a total of 100 (90.9%) returned. A simple random sampling technique was used and thereafter analyzed using Microsoft Excel and descriptive statistics such as charts, histograms, and frequency tables. This study identified inadequate access to clean water and sanitation, low levels of community awareness, poor hygienic practices, poor public health systems, and inadequate waste management in the community as the major causative factors to the cholera epidemic. It also shows that only 32% of respondents were aware of the epidemic whilst a majority (68%) of respondents were unaware. Four hazards (dumpsites, open toilets, stagnant waters, and shallow wells) were found to be dominant in the vulnerable areas. It was recommended that raising awareness through community sensitization, and education, as well as providing access to adequate public health services, especially to high-risk areas was the panacea.

**KEYWORDS:** Public health, cholera epidemic, awareness, clean water, sanitation

**PAPER 83: PERFORMANCE EVALUATION OF ECO-FRIENDLY AGRO-ANIMAL  
RESIDUES COMPOSITE BRAKE PAD: A REVIEW**

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**ABSTRACT**

The importance of braking in automobiles cannot be overemphasized as it is the crucial part that regulates/controls motion during operation. However, the brake pad is majorly made of asbestos composite and has been severally reported to cause health hazards to manufacturers, users and maintenance personnel in the industry. This has made researchers carry out an intensive investigation on substitutes for asbestos in brake pad production and Nigeria's locally sourced agro-animal residue composites have displayed a huge potential for brake pad application. This review paper presents the properties of brake friction material made from agro-animal residue composite. It is found that the properties of agro-animal residue brake friction material are closely related to that of asbestos brake pads and therefore can replace the cancerous asbestos product available in the market and provide a safe environment in the automobile industry.

**KEYWORDS:** Agro-animal residues, Automobile, Compositions, Brake Pads, Braking system, Properties

## **PAPER 84 - INVESTIGATING THE MECHANICAL BEHAVIOR OF GEOPOLYMER CONCRETE AFTER EXPOSURE TO ELEVATED TEMPERATURES**

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### **ABSTRACT**

Geopolymer or alkali-activated binders are being recognized as an eco-friendly and sustainable substitute for ordinary Portland cement (OPC). Geopolymers offer environmental advantages and possess notable mechanical properties, such as exceptional high-temperature endurance. While numerous studies have examined the thermal properties of geopolymer concrete, there is limited research on the behavior of fly ash and sugarcane bagasse ash-based geopolymer concrete at high temperatures. Therefore, the current work examines the mechanical characteristics of geopolymer concrete (GPC) made up of fly ash and sugarcane bagasse ash after exposure to high temperatures. The mechanical properties of the GPC and OPC concrete specimens were evaluated after they were heated to elevated temperatures of 200 °C, 400 °C, 600 °C, and 800 °C. This study results revealed that heated GPC specimens have an 18% loss in compressive strength compared to unheated GPC specimens when exposed to 200 °C. However, when heating GPC specimens to 400 °C, 600 °C, and 800 °C, their compressive strength ( $C_{str}$ ) decreases by approximately 27%, 66%, and 74%, respectively.

**KEYWORDS:** Geopolymer concrete, Sugarcane bagasse ash, Elevated temperature, Mechanical properties

## **PAPER 87 - FLEXURAL PERFORMANCE OF RICE HUSK ASH-CEMENT CONCRETE REINFORCED WITH OIL PALM (*Elaeis guineensis*) BROOM FIBRE**

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### **ABSTRACT**

Concrete is the most widely used building material worldwide. It is usually made of cement, water, and aggregates. However, because cement prices have been rising steadily, rice husk ash (RHA), an agricultural waste gotten from rice husk, has been utilized in place of certain cements. Although it is known to be weak under tension, concrete is strong in compression. Over the years, concrete has been reinforced using a variety of techniques and materials to address this weakness. Therefore, in this study, oil palm broom fiber (OPBF) was added at volume fractions of 0.5%-5% by weight of RHA-cement at 0.5 interval and compared with the control sample. M25-grade concrete was used with RHA as a 10% partial replacement of cement. The effect of fibre inclusion on the workability and flexural strengths of concrete were determined. Based on the results, the addition of OPBF led to decrease in workability. On the other hand, a significant improvement was observed in the flexural strengths of concrete with the addition of OPBF, achieving a higher flexural strength than the control sample. The highest flexural strength was achieved with the addition of 3% of OPBF; a further addition of fibers beyond 3% decreased the strength.

**KEYWORDS:** Oil Palm Broom Fiber, Rice Husk Ash, Cement, Concrete, Flexural Strength and Eco-friendly.

**PAPER 88 - A REVIEW ON EXTENDING NETWORK LIFETIME OF WIRELESS RECHARGEABLE SENSOR NETWORKS: CURRENT TRENDS AND FUTURE PERSPECTIVES**

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**ABSTRACT**

Advancement in Wireless Energy Transfer (WET) has led to a significant development in Wireless Rechargeable Sensor Networks (WRSN), whose sensors are replenished via WET using a Wireless Charging Vehicle (WCV). One of the challenges in WRSN is how to ensure nodes remain alive using minimal energy by the WCV. Some schemes extend the lifetime of WRSN by using a mobile WCV that collects data from the network and replenishes the nodes based on the assumption the nodes are capable of simultaneous target monitoring and energy reception. Others only allow replenishing the energy of the nodes when they are not in the state of sensing and transmission. This paper reviewed about 40 recent research papers from high impact factor journals and reputable conferences to determine the extent of development in extending the lifetime of WRSN. The analysis of the review shows that 25% of them allowed simultaneous energy replenishment with data gathering, consisting of 10% that employed a mobile sink. 7.5% prevents upsetting the low-cost requirement of the nodes by executing the two tasks at different time instances. 10% proposed partial recharging of nodes by the WCV as the best way to reduce the energy consumption of mobile data.

**KEYWORDS:** Algorithms, Clustering, Energy Recharging, Mobile charger, review, and sensor nodes

**PAPER 89 - DETERMINATION OF HEALTH AND SAFETY COST IN BUILDING CONSTRUCTION FOR SUSTAINABLE PROJECTS DELIVERY**

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**ABSTRACT**

The poor health and safety (H&S) record in the construction industry suggests that the sector is far from being sustainable. This situation manifests as the poor handling of occupational health and safety management, and is due to contractor not allocating sufficient financial resources to the management of H&S compliance. The study determined the H&S cost in building construction projects. The study's population were building construction projects that had been completed within the last three years in Abuja. The study employed project bills of quantities (BOQ) as the source of data, and percentiles as the method of data analysis. Study's results revealed that scaffold, plant and equipment were the H&S cost items that were most often provided for in the BOQ. It was concluded that on the average, 1.02% of the total project cost value would be required for providing workplace safety through Collective Protective Measure (CPM). The highest amount that could be spent on CPM /M<sup>2</sup> of construction area in Nigeria was (₦27,155.20). The research has recommended that a separate section be created for H&S in the BOQ to aid in the detailed estimation of H&S cost items. Apart from encouraging uniformity in the pricing of H&S items in the BOQ, it will help main contractors during the bidding phase, because the cost of H&S, especially CPM can be estimated in detail.

**KEYWORDS:** Building, Construction, Health and Safety, Safety Cost, Sustainable, Projects

## **PAPER 91 - ACHIEVING QUALITY EDUCATION THROUGH AI: PREDICTING ENGINEERING STUDENT RETENTION AT THE UNIVERSITY OF ILORIN**

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### **ABSTRACT**

Nigerian universities collect a wealth of student data on entrance exams, grades, and demographics. This data presents a valuable opportunity to improve educational outcomes, particularly by predicting and preventing student dropout. However, technical limitations often impede its effective utilisation. This study introduces an approach using KNIME's no-code Automated Machine Learning to analyze entrance exam scores such as UTME, Post UTME, and O' Level data for predicting first-year engineering student dropout risk. Two experiments were conducted two experiments and with a 5-fold cross-validation technique, AUC >0.75% was achieved in all models in both experiments. These results suggest that AI-powered dropout prediction can empower educators to identify at-risk students early and implement targeted interventions, such as academic advising or support groups, to improve student's performance. Furthermore, this study underscores the use of no-code platforms for developing AI solutions, as its adoption among educators and administrators would foster educational innovations that could contribute towards achieving Sustainable Development Goal 4 (i.e Quality Education).

**KEYWORDS:** Dropout Prediction, Student Retention, AutoML, Predictive Analytics, Education Advancement

## **PAPER 93 - DEVELOPMENT AND CHARACTERIZATION OF SUGARCANE BAGASSE-PLANTAIN PEEL - POLYESTER COMPOSITES**

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### **ABSTRACT**

The research study encompasses the production of composites using polyester resin, plantain peel wastes, and sugarcane bagasse fibre. It is aimed at reducing the effects of these agricultural wastes on the environment. This is done by developing materials that can have a wide range of applications. In this research study, two kinds of agricultural wastes (sugarcane bagasse fibre and plantain peel powder) of varying percentages were used to reinforce polyester. The materials used for the production of the composite were constrained to – polyester (75% - 100%), sugarcane bagasse fibre (0% - 7.23%), and plantain peel powder (0% - 25%). Afterward, the developed composites were subjected to physical, mechanical, and morphological characterization. Test results investigated are shown in the work.

**KEYWORDS:** Composite materials, Polyester composite, Sugarcane bagasse, Plantain peel, Agricultural waste, Reinforcement fibres, Mechanical properties.

**PAPER 94 - SYNTHESIS AND ELECTRODEPOSITION OF ZINC-CALCIUM  
NANOPARTICLES FOR IMPROVED SURFACE PERFORMANCE**

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**ABSTRACT**

This study investigates the impact of electrodeposition parameters on the creation of novel nanocomposite coatings comprising zinc with calcium oxide nanoparticles (CaO<sub>np</sub>) derived from oyster shells. The key electrodeposition parameters were studied including the concentration of CaO<sub>np</sub> in grams per liter, current density, deposition temperature, and deposition time. The experimental findings showed: optimal conditions for electrodeposition occurred at 10g/l of CaO<sub>np</sub>, a deposition temperature of 80°C, a current density of 1.5A/cm<sup>2</sup>, and a deposition time of 15 minutes. The research demonstrates that discarded oyster shells can effectively be utilized for the electrodeposition process on mild steel to improve both corrosion resistance and hardness values.

**KEYWORDS:** Synthesis, Electrodeposition, Nanoparticles, Coating, Calcium oxide.

**PAPER 95 - ANALYSIS AND SIMULATION OF A GRID-TIED INVERTER USING  
SIMULINK**

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**ABSTRACT**

The grid-tied inverter is one way to interface renewable power sources such as solar PV, batteries, fuel cells, and wind power to the utility grid and ensure efficient conversion, control, and exchange of electric power from these sources to the utility grid and vice-versa. The grid-tied inverter also alleviates the challenges of satisfying grid code standards which power system operators demand for renewable energy integration to the grid. In this paper, the model of the grid-tied inverter and associated controllers is developed, analysed, and simulated for active power flow control. A reference current of -114 A is demonstrated to provide an active power flow of 100 kW to a three-phase power grid via current control using two PI controllers in the synchronous reference frame. The three-phase inverter is powered from a DC voltage of 800 V. Simulation results of active power, inverter, and grid voltages and currents prove the effectiveness of the phase-locked loop and current control method applied for stable and reliable power supply from the DC source to the grid.

**KEYWORDS:** grid-tied inverter, synchronous reference frame, phase-locked loop, active power, grid.

## **PAPER 96 - CONCRETE COMPRESSIVE STRENGTH ASSESSMENT USING ARTIFICIAL NEURAL NETWORK**

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### **ABSTRACT**

Artificial intelligence (AI) has the potential to transform the way civil engineers design, build, and manage infrastructure. Despite the potential benefits of integrating artificial intelligence into Civil Engineering, there is a lack of study on the effective implementation and optimization of AI systems in the industry, as well as concerns about job displacement and ethical considerations. In this study, concrete compressive strength predictive model was used for Artificial Neural Network (ANN), with data from construction sites. A Python library called TensorFlow was used for Neural networks in deep learning for the prediction. A comparative analysis was conducted by determining the average compressive strength of six (6) 100x100mm concrete cubes through laboratory testing. The graphs obtained followed a straight line pattern. In the model's training data, the average value of cement was about 281kg. When compared to the value of cement for sample 3 (181.4 Kg). The mean absolute error for the test data is approximately 6 and 7 meaning, if we have a prediction X, the correct value would be  $X \pm 6$  MPa and  $X \pm 7$  MPa respectively. This shows the model's evaluation is very good with a limited error value.

**KEYWORDS:** Artificial Intelligence, Artificial Neural Network, Compressive strength, Tensor Flow, Python Library

## **PAPER 97 - PHYSICOCHEMICAL PROPERTIES OF FUEL GAS PRODUCED FROM GROUNDNUT SHELL WASTES USING DOWNDRAFT GASIFIER**

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### **ABSTRACT**

The use of groundnut shell wastes for fuel gas production have not been adequately addressed. This is important for more energy recovery from wastes. In this study, fuel gas is produced and analyzed from groundnut shell wastes, a common biomass. Fuel gas was produced through a downdraft gasification process. Two steel alloy barrels and galvanized iron pipes of various lengths and diameters were used in the manufacture. More details were provided on the waste's gasification process, and test performance of the gasifier. Operating parameters of the process include duration of experiment, flowrate and pressure of air supply, feed rate, producer gas, char generation, and char flowrate. Further gas cleaning and treatment were recommended.

**KEYWORDS:** Fuel gas, groundnut shells, downdraft gasification, production parameters.



**PAPER 98 - ADVANCEMENTS IN AUTOMATED COOLING AND EXHAUST  
SYSTEMS: TOWARDS SUSTAINABLE THERMAL MANAGEMENT**

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**ABSTRACT**

As industries strive for sustainability, major advancements in cooling/exhaust systems become more vital and play a pivotal role in achieving near-maximum efficiency with regard to thermal management. To this effect, this paper seeks to provide a comprehensive overview of one key strategy for improving temperature control systems in industrial settings. With a strategic focus on modifying existing ventilation technology, attention is directed towards a breakthrough automation system that hybridizes the crucial components of both cooling and exhaust systems. This discussion shall be centered around the design, construction, and testing/analysis of a novel automated cooling exhaust system with multiple modes of control. Additional features include temperature regulation, real time speed monitoring for cooling fans, and toxic fumes detection system. The experiments performed in this article expound on the functionality of this prototype, its sensitivity to different sources of toxic fumes, as well as the stark contrast between present day commercially available systems and the model put forward by this report. As this paper navigates through these complex discussions, a greener future is envisioned, where advancements in automated cooling/exhaust systems propel humanity towards adopting more sustainable and more eco-friendly industrial practices.

**KEYWORDS:** Sustainability, Cooling/Exhaust, Microcontroller, Speed Control, Fumes Detector, Automated Temperature Regulation

**PAPER 99 - ASSESSING AGRICULTURAL CROP WASTE AS SUSTAINABLE  
CEMENTITIOUS BINDERS IN CONSTRUCTION: A CRITICAL REVIEW**

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**ABSTRACT**

With a view to addressing environmental challenges associated with various agricultural crop waste disposal techniques and the greenhouse gas effect linked to the cement production process, various research works have been conducted on the possibility of converting these agro-waste products into cementitious binders for use as construction material. This study seeks to examine the various studies conducted on the physical and chemical characteristics of rice husk ash (RHA) and corncob ash (CCA) and their viability for partial substitution for cement in the production of mortar and concrete. The review scope encompassed the chemical analysis, microstructural analysis of the RHA and CCA in concrete, and the effects of partially replacing cement with these ash materials on the properties of fresh and hardened concrete. The chemical analysis test results indicated that the ash derived from agricultural waste primarily comprised aluminosiliceous material, thereby satisfying the criteria for pozzolanic materials. The consistent addition of RHA and CCA resulted in a reduction in workability. However, the mechanical properties outcomes demonstrate promising potential, as the integration of RHA and CCA resulted in concrete with enhanced strength compared to plain concrete, with optimal outcomes achieved at a 10% replacement level. In conclusion, the review revealed that agricultural crop residues meet the properties of pozzolanic materials and hold significant potential to substitute cement by up to 10% without compromising the performance of concrete.

**KEYWORDS:** Rice Husk Ash, Corncob Ash, Cementitious binders, Pozzolans, Concrete

**PAPER 101 - MERCERIZATION OF COCONUT COIR: CONCENTRATION-DEPENDENT EFFECTS OF SYNTHETIC AND NATURAL TREATMENTS AT UNIFORM DURATION**

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**ABSTRACT**

Despite the widespread use of mercerization in treating cellulosic materials, there is a lack of understanding about the effects of different alkaline sources and concentrations. This study investigated the structural, compositional, and morphological changes induced by mercerization on coconut coir samples using FTIR and SEM analyses. FTIR analysis revealed a 92.3% increase in the O-H stretching vibration peak intensity at 3690.1 cm<sup>-1</sup> in Sample I, indicating significant changes in the hydrogen-bonding environment and crystalline structure, potentially converting cellulose I to cellulose II. SEM analysis showed an increase in carbon content, ranging from 89.46 atomic concentration (Sample G, 20% synthetic alkaline) to 94.16 atomic concentration (Sample F, 10% synthetic alkaline). A reduction in nitrogen content, indicating fewer proteinaceous compounds/organic impurities, was observed, with the lowest level of 4.73 atomic concentration in Sample E (5% synthetic alkaline). Sample C (20% natural alkaline) exhibited the highest purity, with 93.70 atomic concentrations of carbon and 4.98 atomic concentrations of nitrogen. Mercerization effectively reduced inorganic impurities, with Sample C showing the lowest levels of calcium (0.32 atomic concentration) and aluminum (0.31 atomic concentration), particularly with natural alkaline treatments. The findings provide quantitative insights for optimizing treatment conditions and tailoring cellulosic material properties. Notably, a 20% natural alkaline concentration resulted in the highest purity and most effective impurity removal, making it a promising treatment condition for further exploration.

**KEYWORDS:** Synthetic alkali, Natural alkali, SEM, FT-IR, Hydrogen Bonding, Functional group.

**PAPER 102 - INFLUENCE OF MULTI-CROSS SECTIONAL TUBE CONFIGURATIONS ON THERMO-HYDRAULIC PERFORMANCE OF SHELL AND TUBE HEAT EXCHANGERS**

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**ABSTRACT**

In effective energy management, Shell-and-Tube-Heat-Exchangers (STHEs) combined with Straight-Tube-Geometries (STG) are linked to low heat duty and high pressure drop, which raise the energy demand of a plant in process industries. These have not been sufficiently addressed by recently produced STHEs with modified tube designs. Multi-cross-Sectional-Tube-Geometrical (MSTG) configurations have potentials at improving fluid pressure along flow lines, but their applications in STHEs are sparsely reported. Therefore, this study was designed to investigate the influence of MSTG configurations on the STHEs' performances. STHE with Convergent-Divergent-Tube-Geometry (CDTG) and Divergent-Convergent-Tube-Geometry (DCTG) configurations of Penetration Angles (PA), 45 and 90° were evaluated numerically using the finite volume method for Flow Rate (FR) ranging from 0.6 - 2.6 kg/s. Global-Thermo-Hydraulic-Performance (GTHP) indices; Weighted-Shell-Gain-Performance-Factor (WSGPF), Weighted-Performance-Evaluation-Index (WPEI), and Weighted-Thermal-Performance-Factor (WTPF) were assessed. The GTHP values obtained for STHE-MSTG (i.e. CDTG & DCTG) were 60 - 93% higher than those obtained in STHE-STG for all FR and at 45 and 90° PAs, with the maximum at 45° PA and the lowest at 90° PA. Tube-side pressure drops in STHE-MSTG configurations reduced by 72– 73% in comparison with that obtained in STHE-STG. Incorporating MSTG into the design of shell and tube heat exchanger led to improved performance.

**KEYWORDS:** Shell-and-tube heat exchanger, Tube-Geometry, Penetration angles, Performance indices

**PAPER 103 - PARAMETRIC STUDY ON NATURAL VENTILATION: A CASE  
STUDY OF ENGINEERING CENTRAL WORKSHOP, FEDERAL UNIVERSITY OF  
TECHNOLOGY MINNA**

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**ABSTRACT**

This study provides a literature review on natural ventilation principles, factors affecting airflow, thermal comfort, and the use of Computational Fluid Dynamics (CFD) in building design. The researchers created a detailed 3D model of a workshop and conducted simulations using the DesignBuilder-EnergyPlus software suite. The simulations focused on thermal comfort and were performed on a baseline model with a window-to-wall ratio (WWR) of 30%. The results showed that occupants experienced thermal discomfort for 30.74% of the year, with the remaining 69.26% being comfortable, ranging from "hot" to "slightly warm" sensations. The study then explored the impact of different interventions. Implementing lighting control improved thermal comfort, resulting in a 1.37% increase in the number of hours occupants experienced comfort. The introduction of mechanical ventilation without cooling had a minimal impact on thermal comfort (1.17% improvement). However, when mechanical ventilation and scheduled cooling were combined, there was a significant improvement. The predicted thermal sensation ranged from "slightly warm" to "slightly cool," with most occupants experiencing "neutral" conditions. This strategy increased comfort hours by 14.62% compared to the baseline. While lighting control and mechanical ventilation with fans offered minimal benefits, the combination of mechanical ventilation and scheduled cooling significantly enhanced occupant comfort.

**KEYWORDS:** natural ventilation, Computational Fluid Dynamics (CFD), thermal comfort, sensational vote, simulation

**PAPER 105 - BENEFICIATION OF NIGERIAN LITHIUM ORE BY FROTH  
FLOTATION TECHNIQUE USING FORMULATIONS FROM LOCAL REAGENTS:  
A REVIEW**

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**ABSTRACT**

The use of lithium compounds in lithium-ion battery technology, portable electronic devices, and power storage systems has resulted in a significant growth in demand for lithium minerals in recent years. Froth flotation is the most widely used beneficiation method for lithium minerals. Froth floatation reagents namely; collectors, frothers, and depressants play key roles in lithium mineral flotation. However, the exorbitant costs and non-availability of conventional reagents used in the beneficiation of lithium ores make the production of lithium concentrates locally difficult. This review provided detailed, comprehensive, and valuable reference sources on the beneficiation of lithium ore by froth flotation technique using formulations from different conventional reagents. Various analyses including the mineralogical characterization of the lithium ore and the chemical characterization of the reagents were also reviewed. These analyses are going to provide information about the ore and the chemical composition of the conventional and the local reagents respectively. The chemical analyses of the reagents will also help to understand whether these reagents can be utilized in lieu of each other. This paper also discusses briefly the use of the Design of experiments (DOE) to choose optimal conditions that could apply to all the reagents considered.

**KEYWORDS:** beneficiation, design of experiments, froth floatation, lithium, reagents.

**PAPER 107 - ENHANCING AUTOMOBILE SECURITY IN THE SMART ECONOMY: IMPLEMENTING BLOCKCHAIN AND AI-BASED SOLUTIONS**

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**ABSTRACT**

The automotive industry is amidst a transformative phase, embracing the smart economy while facing escalating security challenges. This paper explores the convergence of Blockchain and Artificial Intelligence (AI) as a paradigm-shifting approach to fortify automobile security. Blockchain, characterized by decentralization, immutability, and cryptographic security, provides a secure and transparent ledger system. Paired with AI's analytical capabilities and machine learning algorithms, this integration establishes a robust security infrastructure for automotive systems. The synergies between Blockchain and AI enable real-time threat detection, secure data sharing, and predictive maintenance within vehicular systems. Blockchain's immutable ledger ensures data integrity, while AI's proactive threat identification mitigates risks, elevating automotive security to unprecedented levels. Case studies illustrate successful implementations of Blockchain and AI in enhancing automotive security, showcasing their efficacy in threat detection, predictive maintenance, and supply chain traceability. However, challenges such as scalability and regulatory compliance demand attention. Addressing these challenges through hybrid solutions and privacy-preserving AI models is crucial for widespread adoption. This paper advocates for stakeholders in the automotive sector to embrace these technologies, urging collaborative efforts to integrate Blockchain and AI-based solutions. The proactive adoption of these technologies is pivotal in establishing a resilient security framework, ensuring safer and more trustworthy automotive ecosystems in the evolving smart economy.

**KEYWORDS:** AI, Automotive Security, Blockchain, Integration, Technology.

**PAPER 108 - LOSSES OPTIMIZATION OF INDUCTION MOTOR DESIGN USING ARTIFICIAL INTELLIGENCE TECHNIQUES**

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**ABSTRACT**

This work optimizes the losses of a 10hp, 4 Pole, 3- phase, 50Hz squirrel cage inductor motor design using three Artificial Intelligence (AI) techniques while subjecting them to the same optimization conditions in terms of design variables and constraints to determine the best. Losses optimization selects the optimal values of the design variables which give the least losses while satisfying some constraints. The AI techniques used were the Bat Algorithm (BA), Cuckoo Search Algorithm (CSA) and Firefly optimization (FFO). The design optimization which was implemented using MATLAB software had seven design variables and five constraints. The techniques were successfully used in the optimization and the results obtained showed that the best optimized losses of 741.22W was achieved with the BA, while CSA and FFO gave 748.01W and 765.33W respectively. This outcome can serve as a guide for induction motor designers and manufacturers that use AI techniques and whose goal is to roll out efficient products.

**KEYWORDS:** induction motor, optimization, artificial intelligence, objective function.

**PAPER 109 - A STUDY ON THE AWARENESS OF WIRE ARC ADDITIVE  
MANUFACTURING FOR ADVANCED MANUFACTURING TECHNOLOGIES IN  
NIGERIA**

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**ABSTRACT**

Additive Manufacturing (AM) technologies commonly refer to as ‘3D Printing’ have shown significant impact in manufacturing industries over the past decade. AM is now one of the fast growing areas of research in manufacturing and engineering world due to its ability to create three-dimensional complex and near-net shape parts in a layer-by-layer deposition process which is a key powerful force for breakthrough. Wire arc additive manufacturing (WAAM) is an AM technique that can be considered as a modification of the classical gas metal arc welding (GMAW) process due to its high deposition rate, high material utilization, and short production lead time. This paper examines the awareness of WAAM for advanced manufacturing technology among respondents in Nigeria.

**KEYWORDS:** Wire Arc Additive Manufacturing; 3D Printing; Surface Enhancement; Defects; Post Processing.

**PAPER 110 - CHALLENGES RESPONSIBLE FOR THE DECLINE OF THE  
MANUFACTURING SECTOR IN NIGERIA**

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**ABSTRACT**

The paper examined the challenges responsible for the decline of the manufacturing sector in Nigeria and the solution to these problems. The manufacturing sector is the hub of a vibrant national economy, the sector can harness the various available raw materials, process and transform them into marketable finished or partly finished goods through the use of human capital and other agents of production. The finished goods and services thus generated contribute meaningfully to the national gross domestic product GDP and generate income and employment opportunities for the citizenry of that nation. Secondary sources of information in this research are a communique from the annual general meeting of the Manufacturing Association of Nigeria, an Article and publication from the Central Bank of Nigeria, and reports from the National Bureau of Statistics in collecting the data. However, the Nigerian manufacturing sector is faced with many challenges, ranging from an unfriendly business environment, poor regulatory environment, poor infrastructures, multiple taxation, rising cost of capital interest rate, and a dearth of local skill and technology. The findings indicate that these challenges can be overcome by massive investment in the power and energy sector, the need to invest in human development of indigenous technology and local sourcing of raw materials, provision of land for manufacturing companies, and setting aside a tax-free period for these companies. The implementation of this solution will have a favorable impact on the manufacturing sector which will stimulate national economic growth.

**KEYWORDS:** Manufacturing sector, National economy, Challenges, production, resources

**PAPER 112 - CONCENTRATION LEVELS AND HEALTH IMPLICATIONS OF  
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN MAINSTREAM  
SMOKES FROM CIGARETTE AND MARIJUANA**

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**ABSTRACT**

This study examined the concentration levels and health implications of particulate-bound PAHs in the mainstream smoke of selected cigarette and marijuana samples. The ring profile revealed that 3 ring congeners constituted the major constituents of the marijuana samples with a 73% percentage contribution. The carcinogenic and non-carcinogenic distribution showed that about 95% of the analysed marijuana samples (with a mean value of 11.324 µg) were found to be non-carcinogenic while only 5% of the samples were carcinogens and the analysed cigarette samples showed that about 89% (with a mean value of 10.29 µg) were found to be non-carcinogenic while only 11% of the samples were carcinogens. Health risk assessment associated with PAH revealed that for the marijuana samples, the WHO ILCR value was 75 folds higher than the acceptable level of 10<sup>-5</sup>. The USEPA ILCR value was 5 folds higher than the acceptable level of 10<sup>-6</sup>. The approximated mean value of 8 indicated that the HQ value exceeded the acceptable level by 8 folds. The WHO ILCR value was 40 folds higher than the acceptable level of 10<sup>-5</sup> while that of USEPA was 2.78 folds higher than the acceptable level of 10<sup>-6</sup>.

**KEYWORDS:** Incremental lifetime cancer risk, carcinogenic PAHs, Hazard quotients, Mainstream smoke, Marijuana

**PAPER 113 - EXIGENCY FOR SURFACE MODIFIED COIR AND ITS  
APPLICATIONS -A REVIEW**

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**ABSTRACT**

Natural insulating materials like rock wool and coir offer numerous benefits and uses, but their hydrophilic nature is a serious problem. Recent studies have revealed that a minor increase of 13.9% in moisture content can result in a 312% gain in thermal conductivity values of biomass materials such as rock wool. This review paper delves into the work of researchers in the biocomposite field as they explore the root causes of hydrophilicity in coir and other biomass materials, propose methods to reduce hydrophilicity, and suggest strategies to enhance the hydrophobicity of coir and other biomass materials for industrial application purposes.

**KEYWORDS:** Coir, Hydrophilicity, Hydrophobicity, Water contact angle

**PAPER 114 - A REVIEW OF THE ROLE OF ARTIFICIAL INTELLIGENCE IN  
INFRASTRUCTURAL DEVELOPMENT OF SMART CITIES IN NIGERIA**

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***ABSTRACT***

Nigeria's rapid urbanization strains its aging infrastructure. This paper explores how Artificial Intelligence (AI) can revolutionize civil engineering, specifically addressing Nigeria's urban challenges and sustainability goals. AI offers unprecedented opportunities to improve efficiency, resilience, and sustainability in infrastructure projects. We examine AI's potential for structural health monitoring and risk assessment to prioritize maintenance and ensure infrastructure longevity. Furthermore, AI's potential was examined for smart infrastructure systems for optimized transportation, energy management, and sustainable practices. By implementing these AI-powered solutions and fostering collaboration among stakeholders, Nigeria can build more resilient, efficient, and sustainable cities for the future.

***KEYWORDS:*** Artificial Intelligence, Smart Cities, Civil Engineering, Infrastructure, Nigeria

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