



# BOOK OF ABSTRACTS

**NIGERIAN SOCIETY OF CHEMICAL ENGINEERS (NSChE)**

[A DIVISION OF NIGERIAN SOCIETY OF ENGINEERS (NSE)]

**EDO/DELTA 2023**



## INTERNATIONAL CONFERENCE & ANNUAL GENERAL MEETING/EXHIBITION



**THEME:**

**OPTIMIZATION OF NIGERIA'S OIL AND  
GAS ASSETS FOR SUSTAINABLE  
ENERGY TRANSITION**

**DATE:** Thurs. 2nd - Sat. 4th Nov., 2023

**VENUE:** P.T.I. Conference Center/Wellington  
Hotel, Effurun, Delta State.



## NSChE Vision

The vision of NSChE is to be the center of excellence for Chemical Engineering profession in Africa and the prime mover for industrialization in Nigeria.

## NSChE Mission

“To organize the Nigerian Society of Chemical Engineers into a virile professional body capable of promoting the relevance and versatility of the profession, achieving better training and updating of Chemical Engineers through its activities.

Fostering of relationship with the academia, research institutes, industries, other professional bodies and government will be the basis for stimulating accelerated industrialization of the country and improving the quality of life of the Nigerian people”

## NSChE Core Values

The NSChE core values are

1. Professional Excellence in all work
2. Commitment, dedication and loyalty to the cause of Chemical Engineers.
3. Sustenance of professional ethics and standards
4. Integrity and accountability in all we do.
5. Care of members welfare.
6. Respect for the rule of law





## NATIONAL ANTHEM

Arise, O Compatriots,  
Nigeria's call obey  
To serve our fatherland  
With love and strength and faith  
The labour of our heroes past  
Shall never be in vain  
To serve with heart and might  
One nation bound in freedom  
Peace and unity.

O God of creation  
Direct our noble course  
Guide our leaders right  
Help our youth the truth to know  
In love and honesty to grow  
And living just and true  
Great lofty height attain  
To build a nation where peace  
And justice shall reign

## NATIONAL PLEDGE

I pledge to Nigeria my country  
To be faithful, loyal and honest,  
To serve Nigeria with all my  
strength  
To defend her unity  
And uphold and honour and glory  
So help me God.



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## TP01: Preparation of Zeolite for Plastic Waste Conversion to Fuel: Characterization, Beneficiation and Acid Leaching of Okada Clay

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### ABSTRACT

The use of clay from the South-South region of Nigeria as a catalyst for the pyrolytic conversion of waste plastics to liquid fuel has not been adequately covered. Therefore, this work aims to report on zeolite synthesis from mined clay located at Okada site in Edo State, Nigeria. The procedures involved the beneficiation of the raw clay and calcination at 900 °C, to transform the clay to a more reactive metakaolin. This reactive metakaolin was treated with hydrochloric acid to obtain a ratio of silica-alumina necessary for the zeolite synthesis. Identification of the crystalline phases by X-ray Diffraction (XRD), chemical/elemental compositions by X-ray Fluorescence (XRF)/Energy Dispersive Spectroscopic analyses (EDS), surface morphology by Scanning Electron Microscopy (SEM) and molecular vibration of units by Fourier Transform Infrared Spectrophotometry (FT-IR) were done. Results show that the sample contains 71.742% silica, 13.909% alumina, and 1.0821% of iron impurities. Considering the 5.9:1 ratio silica to alumina, and the negligible amount of iron impurities, the Okada clay sample shows potential for zeolite synthesis.

**Keywords:** Clay pre-treatment; Characterization; Zeolite, Plastic wastes, Fuel.



## TP02: Effect of Catalyst Loading and Reaction Temperature on the Production of Isopentanol Via Hydrothermal Conversion of *Gmelina Arborea* Leaves

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### ABSTRACT

A high energy density isopentanol was produced from *Gmelina arborea* leaves through hydrothermal conversion of the dried leaves using barium chloride catalyst. The isopentanol was produced at two different catalysts loading of 0.25 and 0.50 g and at varying reaction temperatures of 60, 70, 80, and 90 °C. The products were analyzed with Gas Chromatography and Mass Spectrometry (GC-MS). At 0.25 g catalyst loading, isopentanol yield of 293.20, 286.80, 174.00, and 422.40 mg/g were obtained at 60, 70, 80, and 90 °C, respectively. Similarly, at 0.50 g catalyst loading the yield of isopentanol obtained at the corresponding temperatures of 60, 70, 80, and 90 °C were 284.00, 399.40, 343.40, and 350.80 mg/g, respectively. Within the operating conditions, the minimum yield of 174.00 mg/g was achieved with 0.25 g catalyst loading and at 80 °C reaction temperature, while the maximum yield of 399.40 mg/g was obtained using 0.50 g of the catalyst loading and at 70 °C. The main raw material (*Gmelina arborea* leaves) is cheap and radially available, water is equally cheap and available. The materials are safe and harmless to human and ecosystem. The process is therefore feasible and sustainable.

**Keywords:** *Gmelina arborea* leaves, isopentanol, hydrothermal conversion, barium chloride



## TP03: Synthesis, Characterization and Evaluation of the Corrosion Behaviour of Carbon Steel C1020 in *Jatropha* Oil Biodiesel

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### ABSTRACT

In this work, jatropha oil biodiesel (JOB) was synthesized and characterized using gas chromatography-mass spectroscopy (GC-MS), Fourier transform infrared (FTIR) spectroscopy and ultra violet-visible (UV-Vis) spectrophotometry. Its corrosion impact on C1020 carbon steel was investigated at room temperature (25 °C) using extensive weight loss measurements complemented with UV-Vis, FTIR and optical surface camera imaging. The C<sub>18</sub> fatty acids were the most dominant components of JOB. Weight loss measurements revealed that the steel corrosion rate in the biodiesel increased with the immersion time and exhibited a corrosion rate of 0.0036 mpy after 56 days. UV-Vis analysis further confirmed the C<sub>18</sub> fatty acid groups as the major acid responsible for the corrosion attack. The acid induce the corrosion by physically adsorbing on the steel surface using their C–O and C=O functional groups based on FTIR and UV-Vis results. Optical surface imaging affirmed the occurrence of localized pitting corrosion after prolonged exposure. The results of the investigations revealed that over time, diesel engine components made of steel would suffer corrosion-related surface degradation when biodiesel is incorporated in the fuel system resulting in diminished structural integrity and contamination. Thus, organic, non-reactive inhibitors could be investigated in mitigating corrosion tendencies associated with biodiesel.

**Keywords:** Biodiesel production, Chromatographic analysis, Weight loss, Spectroscopic investigations, Optical microscopic study.



## TP04: Thermal Radiation Release from Refinery Flare System Simulation and Safety Consequences

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### ABSTRACT

Gas flaring is one of the world's most difficult energy and environmental issues today. Environmental consequences of gas flaring have serious consequences for personnel and equipment, frequently resulting in equipment damage and serious health problems. In this study, thermal radiation simulation and safety consequences due to flare system released were studied using Flaresim software (5.0) were adopted. The results demonstrated that the lower level of thermal radiation intensity, 1.577 kW/m<sup>2</sup>, covered a distance of 231.0m to 423.6m, while the higher level, 6.309 kW/m<sup>2</sup>, covered a distance of 40 m to 134.7 m and was high at the base of the flare stack. Additionally, the thermal radiation intensity was above the KRPC sterile area of 200 m. On the recommendation; all pressure safety valves (PSVs) in the units should be serviced and recalibrated. Operational and emergency flare igniters should be move away to a secure area.

**Keywords:** Flare System; Thermal radiation; sterile area, Flare tip, Personnel



## TP05: Kinetics and Modelling of Degradation Process of Organic Pollutants in Ajali River Stretch, Enugu, Nigeria

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### ABSTRACT

This work investigated the kinetics and modeling of the biodegradation process of organic pollutants in the Ajali River stretch for showery and dry seasons. Dissolved oxygen (DO) was determined using the Winkler-Azide method, while biochemical oxygen demand (BOD) was determined after five days of incubation. Kinetic data was fitted to first and second order models and the best model was assessed with high correlation coefficients, the closeness of predicted ultimate first stage BOD with the experimental one and least error. Experimental first-stage BOD was estimated at a twenty-two days incubation period. It was observed that the kinetic data fitted well to the first-order model for both seasons with correlation coefficients of 0.9934 and 0.9947 and the least error of 0.646 and 0.71 for both dry and showery seasons respectively. The rate of biodegradation was obtained as  $0.149 \text{ day}^{-1}$  and  $0.1521 \text{ day}^{-1}$  for dry and showery seasons respectively. The exponential model was seen as the best model for the two seasons with correlation coefficients of 1.0 and least residuals. The model revealed the nonlinear relationship of those contributing factors with the drop in dissolved oxygen.

**Keywords:** Biodegradation, Dissolved Oxygen, First stage BOD, Software R, Winkler-Azide



## TP06: Valorization of Waste *Gmelina arborea* Leaves for Nonadecane Synthesis

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### ABSTRACT

In a bid to convert waste to wealth, the valorization of *Gmelina arborea* leaves into useful biochemical active molecule, (nonadecane) was investigated. Littered leaves of *Gmelina arborea* were hydrothermally converted into nonadecane and other biochemicals. The yields of nonadecane obtained using 0.25 g BaCl<sub>2</sub> catalyst and at varying reaction temperatures of 60, 70, 80, and 90 °C were 4.46, 8.06, 1.59, and 6.18%, respectively. Similarly, using 0.5 g catalyst loading, the yields of the nonadecane were 9.41, 7.16, 8.34, and 7.15%, respectively. The variation of the yield of nonadecane, from the hydrothermal conversion of *Gmelina arborea* leaves, with reaction temperature, exhibited a sinusoidal wave. *Gmelina arborea* leaves, therefore, can serve as a source of bio-chemical (nonadecane), and its application in cosmetic, fragrance, and fuel industries would provide a green waste management method for disposing of waste leaves. This method would provide a more reliable and sustainable nonadecane production process.

**Keywords:** Valorization, *Gmelina arborea* Leaves, Nonadecane, Synthesis, Waste.



## TP07: Physicochemical and Dielectric Strength Characterization of Some Selected Plants and Vegetables Oils as Environmentally Friendly Transformer Oil

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### ABSTRACT

Mineral oil has been the sole insulation fluid used in electrical transformer due to its availability and high dielectric strength. However, the environmental and health issues associated with mineral oil had posed threats to humanity. The search for alternative and environmentally friendly oil of plant and vegetable source-based transformer oil is a subject of interest. In this work, oils were produced from soyabean, moringa oleifera, jatropha curcas and parkia biglobosa using n-hexane via soxhlet extraction process. These oils were characterized for some physicochemical properties and breakdown voltage based on ASTM standard. The pH values ranged (6.1 and 6.6), flash points were in the range (253 °C and 331 °C), and densities ranged (0.78 to 0.91 g/ml). Saponification values revealed that only moringa oleifera and jatropha oils fell within the standard range (150 to 244 mg KOH/g), while others were below the ranged values. The iodine values of (71.06 and 123.09 mg KOH/g) are within the ASTM standard. The breakdown voltage ranged between (20 and 48 kV) for all the oils produced met the ASTM standard range of 11 to 40 kV for transformer oil, thus; the oils have high potentials for use as an alternative to mineral oils for transformer and breakers cooling system.

**Keywords:** Breakdown voltage, Environmental, Extraction, Insulation oil, Threats



## TP08: Adsorption Behaviour of Methylene Blue by Palm Oil Mill Sludge Adsorbent Functionalized with Deep Eutectic Solvents

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### ABSTRACT

This study evaluated the adsorptive properties of deep eutectic solvents (DESs) functionalized palm oil mill sludge (POMS) adsorbents for methylene blue. The adsorbents were functionalized in the ratio of 1:2 at 80 °C to form P1:D2@80°C, at 25 °C to form P1:D2@25°C and without DESs to form dry sludge (DS). The adsorbent samples were characterized for surface functional groups, textural properties and surface morphology. P1:D2@80°C, P1:D2@25°C and DS had specific surface area of 534, 236 and 184 m<sup>2</sup>/g, respectively. Batch adsorption studies of methylene blue by P1:D2@80°C, P1:D2@25°C and DS at varying initial concentration, adsorbent dosage, pH, contact time and temperature was performed. P1:D2@80°C, P1:D2@25°C and DS showed adsorption capacity of 72.07, 56.18 and 48.33 mg/g, respectively, in which the possible adsorption mechanisms were pore filling and ionic interaction. The adsorption data were well fitted by Sips isotherm model, suggesting that the adsorption by P1:D2@80°C, P1:D2@25°C and DS was a physical process onto their heterogeneous surface. Therefore, P1:D2@80°C, P1:D2@25°C and DS are potential alternative adsorbents for dye removal from wastewater.

**Keywords:** Adsorption, wastewater, deep eutectic solvents, palm oil mill sludge, methylene blue





## TP09: Methylene Blue Adsorption onto Deep Eutectic Solvents Modified Palm Oil Mill Sludge: Kinetics and Thermodynamics Studies

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### ABSTRACT

The adsorptive properties of palm oil mill sludge functionalized by deep eutectic solvents adsorbents (*P1:D2@80°C*, *P1:D2@25°C* and *DS*) for methylene blue removal was investigated. The adsorbent samples were characterized for textural properties by Brunauer-Emmett-Teller (BET) and BJH methods and surface chemistry by Fourier transform infrared spectroscopy. *P1:D2@80°C*, *P1:D2@25°C* and *DS* exhibited specific surface properties of 534 m<sup>2</sup>/g, 236 m<sup>2</sup>/g and 184 m<sup>2</sup>/g, respectively. *P1:D2@80°C* displayed highest values of rate constant. Pseudo-second-order kinetics model gave best fit to adsorption data ( $R^2 = 0.993$  and  $SSE = 0.43$ ), thereby suggesting electron transfer or sharing between the adsorbent and methylene blue. The adsorption is also spontaneous, feasible and exothermic in nature with decreased disorderliness in the solid-bulk solution interface.

**Keywords:** Adsorption, palm oil mill sludge, functionalize, methylene blue, deep eutectic solvents



## TP10: The influence of Diffused Liquid on Physical and Mechanical Properties of Tallow Seed Pod (*Detarium Senegalense*)

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### ABSTRACT

The study investigated the moisture-dependent physico-mechanical properties of tallow (*Detarium senegalense*) seeds. A randomized complete block design comprising of eight treatments with three replications were used. The initial moisture contents of the tallow seeds were determined before and after oven drying. Moisture conditioning was done in four moisture levels (19.65, 20.72, 21.90, and 22.81% dry basis). The findings showed that the length, width, and thickness of the seeds ranged between 3.1 to 4.6, 2.7 to 4.2, and 1.2 to 2.3 mm, respectively, while the mean of geometric diameter and equivalent surface area ranged between 2.92 to 6.6 mm and 26.79 to 119.36 cm<sup>2</sup>, respectively. The mechanical properties investigated were force, stress, strain, energy, deformation and Young's modulus and were found to be in the range of 99.000 – 1152.500 N, 1.641 – 12.832 N/mm<sup>2</sup>, 3.980 – 13.369 mm/mm, 0.680 – 3.083 Nm and 1.393 – 4.734 mm N/mm<sup>2</sup> in the major orientation and 19.655.670 – 2465.300 N, 1.876 – 14.853 N/mm<sup>2</sup>, 8.808 – 28.556 mm/mm, 0.176 – 10.20.721.90 Nm and 1.515 – 5.786 mm. 0.22.818 – 0.794 N/mm<sup>2</sup> in the minor orientation respectively. The coefficient of friction was also affected by moisture content. It increased on galvanized steel (1.28 – 1.42) and plywood (1.90 – 2.40) but decreased on plastic (1.57 – 1.00) as moisture increased. The effect of moisture content on both the physical and mechanical properties was found to be significant ( $p \leq 0.05$ ) at (19.65, 20.72, 21.90, and 22.81% d.b) moisture contents except for stress at yield, strain at break, energy at break and yield, deformation at peak and Young modulus. The results obtained in this study will provide useful information for the mechanization of various unit operations involved in post-harvest processing and also in the development and evaluation of optimization parameters for efficient and effective processing equipment.

**Keywords:** Moisture, Effect, Physical, Mechanical, Tallow, pod



## TP11: Design of Hybrid Grid - Tied Solar Power Plant for Constant Energy Supply in Nigeria

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### ABSTRACT

Constant energy supply has been a major challenge to the Nigerian Government and other stake holders in the Nigerian energy sector. Epileptic energy supply has hindered industrial, technological and economic advancement of Nigeria. This problem could be solved if the Nigerian energy deficit could be made up for by producing an extra 30,000 Megawatts of electric power. A study reveals that 7,500,000 hybrid grid-tied solar power plants of 4,000 Watts capacity evenly distributed in Nigeria can provide the additional 30,000 Megawatts required. This hybrid and grid-tied energy will enhance the constant energy supply. Also, being sourced from renewable energy source (the sun) would enhance the realization of the Nigerian quest for zero carbon emissions by the year 2060. A net cash flow of N 54,058,598, 090-0,000.00, a Rate of Return on Investment of 72.30 % and a Pay-back Period of 1 year, four and a half months, shows that hybrid grid-tied solar power plants, if well managed, could be economically viable in Nigeria. Nigerians and the Nigerian Government are therefore encouraged to invest in the hybrid grid-tied solar power plant project as it could advance the Nigerian economy and lift hundreds of millions of Nigerians out of poverty.

**Keywords:** Renewable Energy; Photovoltaic; Rate of Return on Investment; Net Cash Flow; Pay-back Period.



## TP12: Determination of Warake Gypsum's Viability as an Alternative to Spain Gypsum for Cement Production

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### ABSTRACT

The inherent properties of gypsum samples from Warake and Spain were investigated and compared using X-ray fluorescence (XRF), X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), and Brunauer-Emmett-Teller (BET) techniques. The gypsum samples undergo dry beneficiation involving crushing and sieving to a 2 mm size, after which 500 g of each sample was heated at 45°C for 24 hours. Following another heating at 120°C for 30 minutes, 10 g of each gypsum sample was ground, sieved to 45 µm and analyzed. The XRF study showed Warake and Spain's gypsum had enhanced active components of 72.26% and 73.55%, respectively, while their SO<sub>3</sub> purity was 86.97% and 89.99%, respectively. Spain sample was found to have crystalline phases of gypsum, calcite, quartz, osumilite, albite, and portlandite, while the Warake sample contained an additional dolomite phase. FTIR analysis demonstrated a variety of functional groups across both samples (–COOH, –OR, CO–NH<sub>2</sub>, –C≡N, –OH, –NH<sub>2</sub>, C=O, C–I, Br, F, C=C, and –C≡C–), which interacts ionically with clinker minerals. BET analysis of the Warake gypsum showed better surface area, pore size, and pore volume results (289.924 m<sup>2</sup>/g, 2.144 nm, 0.180 cm<sup>3</sup>/g) compared to Spain gypsum (257.272 m<sup>2</sup>/g, 2.123 nm, 0.143 cm<sup>3</sup>/g). This substantiates the viability of Warake-sourced gypsum variants for cement production in Nigeria.

**Keywords:** *Gypsum, dry-beneficiation, characterization, purity composition, phases*



## TP13: Optimization of Thermophilic Anaerobic Wastewater Treatment for the Production of Sustainable Energy in Nigeria

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### ABSTRACT

Energy Production from biogas could enhance realization of Nigeria's quest for zero carbon emissions by the year 2060, as biogas has less carbon. A biogas turbine power plant with thermophilic anaerobic wastewater treatment plant yielded 6,785.5953 kJ/s of heat energy. This heat helped turn a shaft at the speed of  $23.565 \text{ ms}^{-1}$  in a magnetic field to produce electricity. In accordance with the second thermodynamics law, that all the heat cannot be converted to work 6,781.152826 kilowatts of work was produced from that heat. Study reveals that 4,424 grid-tied biogas turbine power plants of 6,781.152826 kilowatts capacity can generate the required 30,000 Megawatts of energy. The number of plants could be reduced by scaling - up the design but small plants are easier to maintain. Economic analysis gave a net annual profit of N 600,405,586.40, a rate of return of 32.6 1 % and a pay-back period of 3 years, 3 weeks. This shows that a biogas turbine power plant with a thermophilic anaerobic wastewater treatment plant if well managed could be economically viable in Nigeria. The Nigerian Government and the private investors are therefore encouraged to set-up the plant as much profit could be made from the investment.

**Keywords:** Biogas, Liquid wastes (wastewater); Electricity; Pay-back period; Rate of Return on Investment.



## TP14: Modelling and Simulation of Wastewater Treatment Plant

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### ABSTRACT

Maintaining environmental sustainability and public health requires effective management of wastewater treatment plants. Computer-based modelling and simulation tools have become crucial in designing, optimizing, and operating these plants. This study presents a comprehensive approach to wastewater treatment plant modelling and simulation using commercially available software for prediction and optimization of plant performance. Sensitivity analysis was performed to examine the impact of different operational and design parameters on plant performance. Furthermore, optimization techniques were employed to identify cost-effective operational strategies and potential areas for improvement. The influent concentration values of alkalinity, COD, BOD, volatile suspended solid and total suspended solid were reduced to 3.92, 78.74, 10.95, 8.08, 10 mg/l respectively at the effluent. The findings from this research provided valuable insights into the wastewater treatment plant's performance and offer recommendations to enhance its efficiency and environmental sustainability.

**Keywords:** Wastewater, modelling, simulation, BioWin, effluent quality.



## TP15: Modelling and Simulation of A Cyclic Steam Stimulation System

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### ABSTRACT

Cyclic steam stimulation (CSS) is a common thermal recovery technology used to remove heavy oil and bitumen from oil reservoirs. The aim of this research was to simulate and model an enhanced oil recovery method, particularly thermal method of enhanced oil recovery using cyclic steam stimulation, and evaluate its effectiveness in enhancing oil recovery. To improve recovery efficiency, the study emphasized the importance of precise reservoir characterization, optimal steam injection procedures, and reservoir management techniques. The findings help to progress CSS technology by allowing operators to make more informed decisions and increase the economic viability of heavy oil and bitumen production. This research focused on the simulation and modeling of cyclic steam stimulation with Computer modelling group (CMG) software, a strong reservoir engineering tool widely used in the oil and gas sector. The base case has a cumulative oil value of 9,000 m<sup>3</sup> and an oil recovery factor of 5.1 SCTR or 42.5%, while the cyclic steam has a cumulative oil value of 20,500 m<sup>3</sup> and an oil recovery factor of 11.8 SCTR or 98.3%. CMG for thermal enhanced oil recovery, like cyclic steam simulation, saves cost and time, providing pre-process replicas, helping oil companies plan optimal recovery methods.

**Keywords:** Cyclic steam, simulation, CMG, thermal recovery, reservoir.



## TP16: Designing and Modeling of Offshore Floating Facilities Using Moses Software

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### ABSTRACT

The "MOSES Software for Designing and Modeling Offshore Floating Structures" serves as a comprehensive toolset to address the intricate challenges of offshore engineering. This report outlines the software's pivotal role in accurately simulating, analyzing, and optimizing the behavior of diverse floating structures, such as offshore platforms, vessels, and wind energy converters. Through case studies, the report showcases MOSES' ability in real-world applications, demonstrating its effectiveness in ensuring safety, reliability, and efficiency. The report delves into the intricacies of MOSES load modeling with a barge, highlighting how the software facilitates the simulation and analysis of a wide array of loads, including dead loads, live loads, and environmental forces. This load model assessment provides valuable insights into the structural integrity, stability, and dynamic responses of the barge, aiding engineers in making informed design decisions and operational optimizations. Furthermore, the report addresses the critical aspect of intact and damaged stability within the realm of offshore floating structures. It emphasizes MOSES' capacity to evaluate the stability of these structures under normal conditions as well as during potential instances of damage. This functionality is paramount for safeguarding personnel, cargo, and the structure itself against unforeseen events.

**Keywords:** MOSES software; Offshore structures; Modeling; Stability.





## TP17: Optimization of Nigeria's Oil and Gas Assets for Sustainable Energy Transition: Recovery and Reuse of Flared Gas As An Approach Towards Waste Management, Safety And Environment

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### ABSTRACT

Flare gas recovery has emerged as a crucial aspect of sustainable energy practices and waste management in the oil and gas industry. This abstract explores two significant methods for flare gas recovery: electricity generation and Gas to Liquid (GTL) chamber technologies. The first method involves harnessing flare gas, which is traditionally burned off into the atmosphere, to generate electricity. By employing an innovative technology (turbines) this approach not only curbs greenhouse gas emissions but also generates valuable electricity, contributing to a more sustainable energy future. The second method, GTL chamber technology, focuses on converting flare gas into high-quality liquid fuels or chemicals. Through advanced catalytic processes, flare gas is transformed into valuable liquid products, mitigating environmental pollution and generating economic value. Both approaches signify a paradigm shift in waste management within the oil and gas sector. By utilizing flare gas for electricity generation and converting it into valuable liquids, industries not only reduce their carbon footprint but also create new revenue streams, thus aligning economic growth with environmental responsibility.

**Keywords:** Flare gas, Gas to liquid, electricity, innovative technology, greenhouse gas.



## TP18: Application of Artificial Neural Network and Sensitivity Analysis to Enhance Bioethanol Yield in a Butadiene Plant

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### ABSTRACT

The paper discusses bioethanol's uses as a consumer product and its potential in butadiene production for vehicle tire manufacturing. The primary aim of this research is to improve bioethanol production by using sensitivity analysis in the extractive distillation process of a butadiene plant. The study specifically focuses on optimizing essential variables in this process, such as the molar reflux ratio of the azeotropic column and the number of stages in both the azeotropic and extractive distillation columns using Aspen Plus V11. Given the complexity of bioethanol production through extractive distillation, precise modelling is crucial for increasing efficiency and yield. To address this challenge, the study introduces Artificial Neural Networks as a modelling approach. The optimized values for variables 1, 2, and 3 within their respective ranges were determined to be 4.62709, 17, and 20, respectively, using a simulated butadiene plant. The results obtained from training the ANN model showed a R value of 0.99998 and a Mean Square Error of 2.25 E-09, which is close to zero. This indicates that the model accurately represents the process. The effectiveness of the ANN approach in precisely predicting key process variables and optimizing extractive distillation for bioethanol production was demonstrated.

**Keywords:** Bioethanol, butadiene plant, sensitivity analysis, ANN, ethanol recovery.



## TP19: Carbon Capture, Utilization, and Storage (CCUS): A Key Strategy for Nigeria's Energy Transition

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### ABSTRACT

This study focuses on the potential application of Carbon Capture, Utilization, and Storage (CCUS) in Nigeria's oil and gas sector for an effective energy transition. The global shift towards clean energy sources and decarbonization strategies to mitigate carbon emissions and address environmental concerns has led to increased interest in CCUS technologies. This study looks into the potential and barriers of adopting CCUS in Nigeria's energy landscape, starting with an overview of its fossil fuel-heavy energy mix and the resulting economic and environmental consequences. It stresses the urgency of transitioning to cleaner energy sources. The study explores CCUS prospects in the country's oil and gas sector, covering carbon capture, transportation, storage, and utilization, drawing insights from successful global projects to highlight feasibility and benefits. The study recognizes the intricate effects of CCUS and emphasizes meticulous planning, effective policies, and community engagement for positive outcomes and lessening drawbacks. It stresses aligning CCUS with Nigeria's energy transition goals. In conclusion, the research underscores CCUS as vital for cutting carbon emissions and attaining sustainable energy in Nigeria's oil and gas. It highlights the necessity of legal, financial, and infrastructural support, alongside community engagement, for successful implementation.

**Keywords:** Carbon, Capture, Energy, Sustainable, Industry



## TP20: Influence of Drying on Proximate Composition of Kirikou Okra Variety

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### ABSTRACT

Okra is one of the widely consumed vegetable crops and contains a high percentage of moisture. Due to the increase in demand, high moisture, and limited shelf life of okra, there is a need to explore a drying method of preservation in order to maintain and enhance its quality. Fresh kirikou variety of okra was sliced into 5 mm thickness and at temperature ranges of 40, 50, and 60°C were dried to constant weight. The moisture content of the dried okra ranged from 10.02±0.01 to 10.93±0.01 while the fresh okra showed an average of 80.26±0.01 percentage moisture. Characterization of the fresh and dried okra for its proximate composition was carried out and statistical analysis by ANOVA using SPSS version 20.0 gave p-values to be less than 0.05 showing, a significant influence of the temperature range on its characterization. Samples dried at a temperature of 40°C showed good nutritional value results since they contained the necessary composition of okra.

**Keywords:** Kirikou okra, moisture content, nutritional value, proximate composition and temperature



## TP21: Optimization of catalytically induced Bio-gasification of organic waste using a cylindrical batch digester

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### ABSTRACT

This study was carried out to investigate the production capacity of biogas from mesophilic anaerobic digestion of cow dung (CD) with activated carbon as a catalyst. Laboratory scale digesters were constructed and set-up to digest cow dung. The experiment was a batch process and gas volume from the setup was collected every 5 days for 35 days. Total biogas volume obtained at the elapse of 35 days was 551 mL. Retention time of 15 days gave the maximum biogas volume of 170 mL, at pH 7 and catalyst dose of 3 g. The main effect plots demonstrated that each independent variable contributed significantly in biogas volume generation. The volume of biogas generated from the optimum predicted analysis was 188 mL at process conditions of pH 7.2, catalyst dose of 3.5 g and time of 15.5 days. The verification experiments agreed with the predicted values with standard error value of 1.06%. Overlay contour plot established optimum areas where the predicted response variable is in an acceptable range ( $\geq 80\%$ ) with respect to optimum conditions. *Face-centred central composite design* (FCCD) approach was suitable for optimizing the process giving higher biogas volume when compared to the main effect plots.

**Keywords:** Biogas; anaerobic digestion; cow-dung; catalyst; response surface methodology.



## TP22: Characterization of Palm Oil Mill Sludge, Palm Oil Mill Effluent and Rice Husk for Biogas Production

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### ABSTRACT

In this study, rice husk (RH), palm oil mill sludge (POMS), and palm oil mill effluent (POME) were characterized for biogas production and then co-digested using cow dung at mesophilic temperatures. RH and POMS were sun-dried, ground, and sieved as mechanical pretreatment methods for digestible particles. The characterization of the POME showed an acidic pH, with BOD, COD, TSS, and TDS values of 57.0mg/l, 84.0mg/l, 19.7mg/l, and 8200mg/l, respectively. RH had a pH of 5.30, C/N, TS, VS, MC, and ash content of 28.64, 90.56%, 72.78%, 9.45%, and 17.78%, respectively. The Lignin, Cellulose, and hemicellulose contents are 16.47%, 55.53%, and 27.54%. POMS also had a pH of 5.95 with C/N, MC, and ash content of 64.1, 5.07%, and 4.73% and Lignin, Cellulose, and hemicellulose contents of 44.88%, 24.67% and 30.46% respectively. Preliminary co-digestion of the samples at room temperature (27.8°C) revealed cumulative biogas production potentials, i.e., 280 ml and 170 ml from POME+RH and POME+POMS respectively, proving the potency of POME, RH, and CD as potential candidates for biogas production.

**Keywords:** Lignocellulosic materials, POME, Rice husk, Palm oil mill sludge, co-digestion



## TP23: Tensile Property Evaluation of Some Natural Fibre Reinforced Polypropylene Composites for Load Bearing Applications

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### ABSTRACT

Fibre reinforced polymer composites were fabricated in order to improve the desired mechanical properties of the virgin polymer. The evaluated properties included young's modulus (MPa), Tensile strength (MPa) for the various process parameters affecting them i.e temperature (°C), force (KN), Time (minutes). The simulated results were determined from the response surface methodology (RSM) plots for each fibre reinforced polymer composite. For rayon fiber composite the maximum tensile strength was 28.94 MPa at a time of 8 mins, force of 3 KN and temperature of 210 °C, the maximum young's modulus is 652.6 MPa at a temperature of 190 °C, time of 10 mins, force of 4 KN. For linen fiber composite the maximum tensile strength was 22.15 MPa at a temperature of 180 °C for a force of 5 KN and time of 15 mins. The maximum young's modulus was a 998 MPa at 180 °C temperature and time of 15 mins and force of 5 KN. The hemp fiber composite had a maximum young's modulus of 4010 MPa at a temperature of 180 °C, time of 15 mins and force of 5 KN while the maximum tensile strength is 30.51 MPa at temperature of 210 °C, time of 8 mins and force of 3 KN. The Jute fiber composite had maximum tensile strength at 14.37 MPa at a temperature of 180 °C and time of 15 mins and a force of 5 KN. The maximum young's modulus was 1449 MPa at a temperature of 180 °C, time of 15 mins and force of 5 KN. The viscose fiber composite had a maximum tensile strength of 24.5



MPa at a temperature of 210 °C, at a force of 3 KN while the maximum young's modulus was 3319 MPa at a temperature of 210 °C, at a time 8mins and at a force of 3 KN. The lyocell fiber composite had a maximum tensile strength of 22.85 Mpa at a temperature of 180 °C, a time 15 mins and a force of 5 KN while the maximum young's modulus was 2844 MPa at a temperature of 180 °C and a time of 15 mins for a force of 5KN. The scenario showed Hemp fiber composite had the highest tensile strength and highest young's modulus.

**Keywords:** Fiber composite, Hydrophilic fiber, Hydrophobic matrix, Interlocking fiber matrix, Lignocellulose Fiber





## TP24: Evaluating the Impact Strength of Natural Reinforced Polymer Composites for Household Applications

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### ABSTRACT

Composites are hybrid materials made of a polymer resin reinforced by fibres, combining the high mechanical and physical properties of the fibres and the appearance, bonding and physical properties of the polymers. This work studies the impact strength for given range of temperature (210 – 180 °C) force (5 – 8 KN and time (8-15 mins) for six natural fibres reinforced with polypropylene matrix base. The best fibres include viscose, Rayon, Lyocell, Linen, Jute and Hemp. The results show for Rayon a maximum impact strength of 32.3144 KJ/m<sup>2</sup> at a force of 3 KN, time of 10 mins and a temperature of 200°C Viscose, a maximum impact strength of 30.7716 KJ/m<sup>2</sup> at a temperature of 180 °C, time of 15 mins and force of 5 KN. Lyocell had a maximum impact strength of 29.3869 KN/m<sup>2</sup> for an elapsed time of 10 mins, impact force of 3 KN and a temperature of 200°C linen had a maximum strength of 35.8735 KJ/m<sup>2</sup> at an elapsed time of 10 mins, impact force of 3 KN at a temperature of 200 °C, Jute had a maximum strength of 13.2075 KJ/m<sup>2</sup> at an elapsed time of 8 mins, impact force of 3 KN and a temperature of 210 °C. Hemp had a strength of 12.7050 KJ/m<sup>2</sup> at an elapsed time of 10 mins, impact force of 3 KN and a temperature of 200°C.

**Keywords:** Charpy impact test, Hydrophilic fibre, Hydrophobic polymer, Fiber–matrix commingling, Lignocellulosic fiber.



## TP25: Domesticating Carbon Capture for Effective Energy Transition

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### ABSTRACT

Carbon capture has emerged as an important solution to mitigate greenhouse gas emissions while ensuring continued use of fossil fuels in the transition to a low-carbon economy. However, the technology is not yet widely adopted due to high costs and technical challenges. In order to make carbon capture more effective, it is important to focus on domesticating the technology. This involves developing and implementing carbon capture projects domestically, rather than relying on overseas projects. Domesticating carbon capture will create local jobs and expertise, reduce the cost of the technology, and increase public acceptance. It will also enable countries to meet their emissions reduction targets and contribute to global efforts to limit climate change. In this article, the sequence and stages to domesticate Carbon Capture for effective energy transition is highlighted. Governments should provide policy support and incentives to encourage the deployment of carbon capture technology, while industry should continue to innovate and collaborate to drive down costs and improve efficiency. By domesticating carbon capture, we can accelerate the transition to a low-carbon economy and ensure a sustainable future for generations to come.

**Keywords:** Carbon capture, Greenhouse gas, Fossil fuel, Emission reduction, Climate change



## TP26: Challenges and Possible Solution's on Deployment of Digital Technologies for Process Control and Asset Management in Nigerian Oil and Gas Operations.

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### ABSTRACT

Digital technologies have been used in the oil and gas industry for decades, but recent advancements in technology have made it possible to deploy these technologies for process control and asset management in a more effective way in Nigeria. The Nigerian oil and gas industry has been slow to adopt these technologies, but there has been a recent push to deploy them to improve operational efficiency, reduce costs, and increase safety. This article discussed the challenges and possible solutions of deployment of digital technologies in Nigerian oil and gas operations, with a focus on process control and asset management.

**Keywords:** Digital Technologies, Decades, Industry, Process control, Asset management



## TP27: Analysis of Okuribada Clay for Zeolite Production

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### ABSTRACT

This study analyzed the characterization of clay from Okuribada in Okurekpo community, Ethiope East Local Government, Delta State, Nigeria. The characterization was based on their physicochemical characterization, mineralogy, and elemental analysis using Scanning Electron Microscopy (SEM), Fourier Transform Infra-Red Spectroscopy (FTIR), X-Ray Diffraction (XRD), and Energy Dispersive X-ray fluorescence (EDXRF). The pH was 6. the bulk density was 1.1g/cm<sup>3</sup>, the cation exchange capacity was 51 meq/100g, the electrical conductivity was 90  $\mu$ ms/cm, the salinity was 0.03 ppt, total organic matter was 4.65 %, pore volume was 0.2 cm<sup>3</sup>/g, porosity was 23 %, pore size was 5.423 nm, and surface area was 1048.370 m<sup>2</sup>/g. The morphology of the clay at 9000X was determined with SEM which showed that the clay from Okuribada has a typical structure of conventional quartz. The resulting silica to alumina (Si/Al) ratio was 3.89. The general data revealed that the primary constituents of the clay were high quartz content and a high SiO<sub>2</sub> of 62.67 %. The XRF result showed that SiO<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> concentration was dominant in the clay. However, there was the presence of some impurities (contaminations) such as TiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, k<sub>2</sub>O, and MgO concentration but these are very insignificant. Therefore

**Keywords:** Clay, Mineralogy, Bulk density, Morphology, Okuribada



## TP28: Optimization of Liquid Storage Tank

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### ABSTRACT

Liquid storage tanks play a crucial role in various industries for storing liquids ranging from water and chemicals to petroleum products. The efficiency of these tanks impacts safety, environmental impact, and operational costs. The study focused on optimizing the design and operation of liquid storage tanks to enhance their overall performance. The primary objective of this research is to develop a comprehensive optimization framework that considers multiple factors such as tank geometry, material selection, insulation methods, and operational strategies. The optimization process seeks to minimize energy consumption, reduce emissions, enhance safety, and optimize storage capacity while adhering to relevant regulatory standards. The study integrates advanced computational tools and simulation techniques to model fluid dynamics, heat transfer, and structural behavior within the storage tank. By utilizing these simulations, the optimization framework aims to identify optimal designs and operational parameters that strike a balance between thermal efficiency, structural integrity, and economic feasibility.

**Keywords:** Liquid storage tanks, Optimization, Design, Operation, Energy efficiency



## TP29: Sustainable Energy Transition in Nigeria and Waste Management in Cassava Processing Industry: The Nexus

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### ABSTRACT

Bioenergy from cassava is a promising alternative energy-source. However, Nigeria, the major producer of cassava in the world, is yet to exploit this energy source in her quest for sustainable energy development. The main purpose of this study was to assess the suitability of cassava wastes for sustainable development of bioenergy. This review has established that wastes generation during cassava processing is inevitable irrespective of the cassava-based products. In the course of characterizing the wastes which emerged during processing is massive. It was established that their physical, chemical and biological properties are within the range as paired: Carbon/Nitrogen (17.64 – 30.0), Total Solid (4.5 - 38.2 mg), Volatile Solid (3.4 - 33.0 mg), pH (3.6-6.2), Total Chemical Oxygen Demand (8.0 - 66.2), Soluble Chemical Oxygen Demand (14.2-34.5), Total carbohydrate (9.6 - 37.5 mg), Cellulose(36.0 – 43.2 mg) Hemicellulose (44.0 – 64.4 mg), Lignin.(24.0-46.2 mg), Cyanide(45 to 154 mg). It was confirmed that the cassava wastes though toxic contains valuable component for sustainable energy development. This was proven as its energy content is about 11% of the crop energy. This can be harnessed and add to our energy mix.

**Keywords:** Sustainable Energy, Cassava Wastes, Bioenergy



## TP30: Application of 2<sup>k</sup> Full Factorial Design for the Production of Pyro-Oil from the Pyrolysis of Waste Plastics (Pure Water Sachets)

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### ABSTRACT

Plastic wastes continue to be a concern to the environment despite their numerous uses. Plastic wastes are one of the main sources of environmental contamination, and the fact that they are nonbiodegradable adds to the dangers they pose to the environment. Annual production of fossil fuel-based plastics is set to top 1.2 billion tonnes by 2060 and waste plastics to exceed 1 billion tonnes. The production of pyro oil using 2<sup>k</sup> full factorial Design in Design Expert V12 software was utilized in this research work. The factors considered were: Time of pyrolysis (hrs), Quantity of catalyst (g) and Particle Size (categorical). Analysis of variance (ANOVA) indicates that the combine effects of Time(A) and Quantity of Catalyst (B), Time (A) and Particle Size (C), Quantity of Catalyst (B) and Particle Size (C), were all significant with p-values of 0.0309, 0.0026 and 0.0113 respectively. The singular effect of Time (A) was also significant with p-value of 0.0051. The **Model F-value** of 140.15 and **P-value** of 0.0071 implies the model is significant. The high value recorded for the coefficient of determinant ( $R^2$ ) for the model of 0.9977 and Adjusted  $R^2$  of 0.9900 depicts that the model equation has a very good fit to the experimental data. The physicochemical properties of the pyro oil include: density of 792.6 kg/m<sup>3</sup>, flash point of 62 °C, pour point of -13 °C, cetane number of 59.23 and calorific value of 39.16 MJ/kg.

**Keywords:** Plastics, Waste Plastic, Pyrolysis, Pyro-oil, Polyethylene, Fuel.



## TP31: Evaluation of the Potential of the Activated Sludge Biomass from Nigeria as a Feedstock for Biofuel Production

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### ABSTRACT

The depleting fossil fuel reserve, and greenhouse gases effects on climate change have led to the investigation of alternative energy sources such as biofuel including biodiesel and renewable diesel. Unfortunately, the cost of the feedstock consumes over 70% of the total production cost. The current work investigated the potential of utilizing a waste product (activated sludge) of wastewater treatment as an alternative feedstock for biodiesel production. The lipid was extracted by solvent extraction, and the biomass was pretreated with subcritical water to enhance the lipid yield. The result showed that lipid yield from the activated sludge was 4.73-8.58%. After the subcritical water pre-treatment under varying conditions of the parameters (residence time, temperature and biomass loading), the lipid yield increased by 158.04 - 400%. Upon GC-MS analysis of the fatty acid methyl esters (FAME) from the transesterification of the lipid extract using calcined egg shell as catalyst, the following lipids were obtained: triglyceride, fatty acids sphingolipid, phospholipid, glycerolipid, glycerophospholipid, steroid and cholesterol. The predominant lipid was triglyceride, and high percentage of the unsaturated fatty acids including arachidonic acid (23.54%), eicosadienoic acid (8.37%) and oleic acid (6.23%), suggesting that the lipid extract is a potential feedstock for biodiesel production.

**Keywords:** Lipids; Biodiesel; Subcritical Water; Wastewater; Activated sludge





## TP32: Integrated Renewable Energy System Model for Power Supply in A Nigerian Rural Community

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### ABSTRACT

Energy systems powered by renewable energy sources can be assembled to form an integrated renewable energy system (IRES), capable of meeting electricity consumption of locations in an efficient and sustainable form. In this paper an IRES model was developed for the energy demand for Etung Local Government Area (L.G.A) of Cross River State, Nigeria using a combination of hydro and different forms of biomass resources from Agbokim community also situated in Cross River State. On the basis of data collated from several literatures, the total energy demand of Etung L.G.A was estimated to be 8,019,600KWh/yr. The estimated available energy derivable from the resources at Agbokim were: micro-hydro (MHP) 175200wh/yr, fuel wood 4576205KWh/yr, forest residue 2745723KWh/yr, biogas 941481kWh/yr and crop residue energy 550750Kwh/yr. The IRES model was solved using excel solver and the results verified with LINDO software. The results indicated that the optimal energy needs of Etung requirements is 1,401,600 kWh/yr (17.48%) from MHP, 3,600,964 kWh/yr (45.65%) from fuel wood, 2,196,578 kWh/yr (27.39%) from forest residue, 748,307.2kWh/yr (9.33%) from biogas and 440,600kWh/yr (5.5%) from agriculture crop residue. Ms Excel solver and Lindo estimated the total cost of energizing Etung as ₦61,606,500.00/yr

**Keywords:** Renewable energy, Optimization, Excel solver, Lindo software













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