NIGERIAN SOCIETY OF CHEMICAL ENGINEERS (NSChE)

(A Division of NSE)

52nd

Annual International Conference & Annual General Meeting

Harmony 2022

Ilorin, Kwara State, Nigeria

THEME ▶ **Rejuvenation of the Nigerian Industrial Sector: The Chemical Engineering Perspectives**

BOOK OF ABSTRACTS

De Peace Hotel, Ilorin, Kwara State

Thursday 10 – Saturday 12 November, 2022

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(Including Conference Programme)

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SCHEDULE OF EVENTS		
PERIOD	**EVENT**	**VENUE**
Wednesday November 9 2022		
08:00 - 23:59	Arrival of invited Guests	De Peace Hotel & Suites + other designated hotels (as applicable)
Thursday November 10 2022		
08:00 - 18:00	Arrival/All Day Registration	Registration Desk at the De Peace Hotel & Suites
11:30 - 15:30	Golf Tournament	Ilorin Golf Club, Kwara
16:00 - 17:00	Press Conference by the National President	Main Conference Hall
17:00 – 18:00	Rapporteurs Meeting	Main Conference Hall
18:00 - 19:30	Networking	De Peace Hotel & Suites Arena
19:30 - 21:00	Cocktail/Fellows Happy Hours	De Peace Hotel & Suites Arena
Friday 11 November 2022		
07:30 - 08:00	Arrival & Registration/Accreditation	Main Conference Hall
08:00 – 09:00	Breakout Technical Sessions I	Rooms 1 - 4/Online
09:10 – 10:10	Plenary Session 1	Main Conference Hall
10:10 – 10:40	Tea/Coffee Break/Networking	Tea/Coffee Corner/Online
10:50 – 13:00	Opening Ceremony	Main Conference Hall
13:00 - 14:30	Lunch/Friday Prayers	Designated Dining Area
14:30 - 18:00	Spouse's Program	
14:30 – 16:00	Plenary Session II (3 speakers)	Main Conference Hall
16:10 - 17:40	Breakout Sessions II	Physical Rooms/Online
Saturday 12 November 2022		
07:30 - 08:00	Arrival & Registration/Accreditation	Main Conference Hall
08:00 – 09:00	Breakout Sessions III	Physical Rooms/Online
09:10 - 10:10	Plenary Session III	Main Conference Hall/Online
10:20 - 10:50	Tea/Coffee Break/Networking	Tea/Coffee Corner/Online
11:00 – 12:00	Breakout Sessions IV	Physical Rooms/Online
12:10 - 13:10	(i) Sectorial Group Meetings	Main Conference Hall
	(ii) Students Session	Hall Room
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14:30 – 15:00	Preparation for AGM	Main Conference Hall
15:00 - 18:00	AGM	Main Conference Hall/Online
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ABSTRACTS

TS01 - Synthesis and Application of Clinoptilolite for the Purification of Biogas from Cow Dung

[*]Emmanuel O. EHINMITOLA, Olayinka SANDA, Elijah A. TAIWO, Ridwan A. OSENI, Azeez O. RAIFU, Oladele S. MATUWO and Samuel O. ADEBAYO

Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

fehinmi@oauife.edu.ng

[*]Corresponding author

ABSTRACT

This study batch-synthesized clinoptilolite using silica derived from rice husk and bamboo leaves, with a view to using it as purification media for biogas produced from cattle droppings. Silica gels synthetized from rice husk and bamboo leaves were impregnated with NaOH and $Al(OH)_3$ without seeding, to constitute the clinoptilolite samples. Analysis of the unseeded products by x-ray fluorescence (XRF) indicated high Si to Al ratio of > 4 while x-ray diffraction (XRD) patterns indicated the presence of minerals of the same family as clinoptilolite. The porosity values of the products from rice husk and bamboo leaves were found to be 0.773 and 0.800 respectively. The synthesized clinoptilolite samples were used as absorbers attached to biodigesters generating biogas from cattle droppings and it was found that the CO_2 contents reduced in all the test cases. It can be concluded from the study that clinoptilolite produced from silico-alumina rich wastes have potentials of use as biogas purifiers.

TS02 - Air Emissions from Stepwise Co-Pyrolysis of Plastic Mixtures

Atilade A. OLADUNNI[1*], Oludare J. ODEJOBI[2], Jacob A. SONIBARE[2]

[1]*Department of Chemical Sciences, Ajayi Crowther University, Oyo, Nigeria*
[2]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*

[1*]aa.oladunni@acu.edu.ng, [2]dareodejobi@oauife.edu.ng, [3]asonibar@yahoo.com

[*]Corresponding author

ABSTRACT

Stepwise air emissions of Hydrocarbon, carbon II oxide (CO), carbon IV oxide (CO_2), nitrogen II oxide (NO), nitrogen IV oxide (NO_2), oxides of nitrogen (NOx), Sulphur IV oxide (SO_2), and hydrogen sulphide (H_2S) from co-pyrolysis of Low-density polyethylene (LDPE), Polystyrene (PS) and Polyethylene terephthalate (PET) were studied between 50 °C - 450 °C using E8500 plus combustion analyzer. The maximum air emissions measured were compared with available Ambient Air Quality Guidelines from World Health Organization and National Environmental Standards and Regulations Enforcement Agency. The result showed that HC, CO, and NO were detected while CO_2, NO_2, SO_2, and H_2S were not. Co-pyrolysis of plastic mixture comprising 50% LDPE, 0%PS and 50% PET gave the highest HC emission of 16,567 mg/m^3 at 400-450 °C, while co-pyrolysis of 100% LDPE, 0% PS and 0% PET gave the highest CO emission of 16239.85 mg/m^3 and NO emission of 138.44 mg/m^3 at 50-100, and 250-300 °C respectively. The maximum measured emission of CO far exceeded the maximum allowable standards which implied toxic ambient air within the vicinity of operation.

TS03 - Characterization of Char Derived from Pyrolysis of Low-Density Polyethylene Waste

Adebola F. ADE-AJAYI[1,a*], Aishat A. OSIGBESAN[2,a], Ephraim A. AUDU[3,a], Zaharaddeen Z. GANO[4,a], Jeffery T. BARMINAS[5,a]

[a] *Petrochemicals and Allied Department, National Research Institute of Chemical Technology, Zaria*
[1]phemmistic@gmail.com, [2]aishatosigbesan2011@gmail.com,
3ephraim.audu@yahoo.com, [4]zaharaddeenn@gmail.com, 5bjtsware@gmail.com
*Corresponding author

ABSTRACT
Char (solid residue) from pyrolysis of Low-Density Polyethylene (LDPE) was collected and analysed to investigate its proximate properties, ultimate properties, High Heating Value (HHV), morphology, compositions, and functional groups using bomb calorimetry, Scanning Electron Microscopy – Energy Dispersive X-ray (SEM – EDX) and Fourier Transform Infrared (FTIR) spectroscopy. From the proximate analysis, the pyrolysis char had fixed carbon (80.56%), moisture (1.40%), volatile matter (5.52%) and ash (12.52%). The ultimate analysis showed that the percentages of C, H, N, O and S are 70%, 3.45%, 1.29%, 24.21% and 0.1%, respectively. The calorimetric analysis of the sample showed that the char has a High Heating Value (HHV) of 40.80 MJ/Kg. The elemental composition of the char as obtained from the SEM-EDX analysis showed the presence of Si (39.57%wt), Br (17.79%wt), Fe (8.23%wt) Cu (5.79%wt) with an average particle size of 47 µm. The FTIR spectra showed the presence of hydrocarbons in the char. These results would serve as a basis for further works on pyrolysis char applications.

TS04 - QUANTIFICATION OF 5-HYDROXYMETHYLFURFURAL AND LACTIC ACID FROM HYDROTHERMAL CARBONIZATION OF SUGAR CANE BAGASSE AND CORN COB

Opeoluwa O. FASANYA[1]*, Dan Mallam A. ADAMU[2], Abdulazeez R. ISA[3], Chidimma D. NWAKUBA[2], Elizabeth WINFUL[1], Olanikpekun IDOWU[2], Elijah A. ADEGBE[2], Saheed A. IBRAHEEM[2], Ephraim A. AUDU[2], Yusuf O. USMAN[2], Mas'ud J. MUSA[2], Uzo B. AGUNWA[4], Jeffrey T. BARMINAS[4]

[1]*Industrial and Environmental Pollution Department, National Research Institute for Chemical Technology, Zaria, Nigeria*
[2]*Scientific and Industrial Research Department, National Research Institute for Chemical Technology, Zaria, Nigeria*
[3]*Pilot Plant and Fabrication Department, National Research Institute for Chemical Technology, Zaria, Nigeria*
[4]*Directorate, National Research Institute for Chemical Technology, Zaria, Nigeria*

[1*]*ope.fasanya@narict.gov.ng*

*Corresponding author

ABSTRACT
The production of platform chemicals from biomass has gained wide acceptance in the scientific and industrial community. These chemicals are seen as a viable alternative to petrochemicals due to reduced pollution and cost competitiveness. Some of these include lactic acid (LA) and 5-hydroxymethylfurfural (5-HMF). The aqueous phase that is left behind during hydrothermal carbonization (HTC) of biomass is a potpourri of chemicals at different concentrations which depend on the starting material. In this paper, the presence of lactic acid and 5-HMF in the HTC liquor was determined and quantified. Hydrothermal carbonization was conducted on two different types of biomasses: corn cob and sugar cane bagasse at 200 °C. The effect of varying time on the LA and 5-HMF concentration in the liquor was determined. Sugar cane bagasse gave higher concentration of 1.64 g/L and 0.026 mg/mL for LA and 5-HMF respectively. The amount of 5-HMF and LA reduced with increase in processing time.

TS05 - Investigations on the Suitability of the Langmuir Isotherms in the Adsorption of Nitrophenol, Naphthalene and Methylene Blue from Aqueous Media onto Activated Bentonite Clay

Ayobami O. AJANI[1], Wasiat O. BELLO[1,2], Tinuade J. AFOLABI[1,2], Funmilayo N. OSUOLALE[1,2], Olufunmilayo A. AWORANTI[1,2], Mujidat O. AREMU[1,2], Victoria A. ADEYI[1,2], Adeola R. AMOLE[1,2], and Abass O. ALADE[1,2,3*]

[1] *Department of Chemical Engineering, Faculty of Engineering, Ladoke Akintola University of Technology, (LAUTECH), Ogbomoso, Nigeria*
[2] *Bioenvironmental, Water and Engineering Research Group (BWERG, LAUTECH), Ogbomoso, Nigeria*
[3] *Science and Engineering Research Group (SAERG, LAUTECH), Ogbomoso, Nigeria*
aoajani@lautech.edu.ng, waasiahbintbello@gmail.com, tjafolabi@lautech.edu.ng, waasiahbintbello@gmail.com
*Corresopnding: aoalade@lautech.edu.ng

ABSTRACT

The presence of industrial effluents containing various pollutants (such as naphthalene, nitrophenol, and methylene blue (NNM)) in wastewater is a prime concern in the environment due to their toxic, carcinogenic and mutagenic effects on man. This research was aimed at investigating the best Langmuir isotherm that fits the adsorption process of NNM from an aqueous solution using modified bentonite clay. A composite of ratio 40:30:30 of acid, base and salt-modified bentonite clay was used for the adsorption process. Six Langmuir isotherms were investigated to know which best fit the adsorption process. The correlation coefficient (R^2) of the linearized form of Langmuir isotherm models gave 0.965, 0.947 and 0.924 for Naphthalene, Nitrophenol and Methylene blue respectively. Langmuir 2 was most suitable for the adsorption of Naphthalene and Methylene blue while Langmuir 6 fit better the adsorption of Nitrophenol from the multicomponent solution. This means the adsorption of NNM took place at a specific homogeneous site within the adsorbent.

TS06 - Simulation of Pyrolysis Reactor to Produce Bio-Fuel from Selected Biomass

Ebenezer O. DADA[1, 2], Oluchukwu C. OYEKA[1], Ifeoluwa O. GBOLAHAN[1], Temitope S. OLAWALE[1], Victor O. OLALEYE[1], Akinola D. OGUNSOLA,[3] Kamoru O. OLADOSU[4,5] and Abass O. ALADE, [1,2,5*]

[1]*Chemical Engineering Department, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.*

[2]*Bioenvironmental, Water and Engineering Research Group (BWERG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*

[3]*Department of Mechanical Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*

[41]*Department of Mechanical Engineering, Kwara State University, Malete, P.M.B 1530 Ilorin, Nigeria*

[5]*Science and Engineering Research Group, (SEARG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*

,

[*]Corresponding author: [3]aoalade@lautech.edu.ng

ABSTRACT

Numerical simulations simulation of the rice straw and sugarcane bagasse was based on the data from the previous literature on biomass pyrolysis simulation, to determine the efficiency of the pyrolysis reactor, the effect of the feedstock and the operating conditions of the process. The simulation was carried out using Aspen plus. The product yield of fast pyrolysis of lignocellulosic biomass was calculated from developed pyrolysis reactions. The total mass flows rate of the liquid stream, gas stream and char stream compositions at 500 °C were 34.6737, 22.2392 and 15.3268 kg/h, respectively, while the heating rates for the samples were 10 and 60 °C/min. The yield of biochar at different pyrolysis temperatures of rice straw in the simulation is more than that of the sugarcane bagasse because of the size of particles and moisture content. The result of this model showed that it was suitable for predicting fast pyrolysis reactions for lignocellulosic biomass feedstock at high temperatures (500-600 °C).

TS07 - Bio-Electrochemical Treatment of Pharmaceutical Wastewater and Sustainable Bioelectricity Generation Using Microbial Fuel Cell

Odunayo D. AKINWUMI*, Samuel E. AGARRY[1], Mujidat O. AREMU[1], Abass O. ALADE[1], Abiola O. AWORANTI[1]

[1] *Department of Chemical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Oyo State. Nigeria*

1*aoakinwumi@lautech.edu.ng, 1seagarry@lautech.edu.ng, 1moaremu@lautech.edu.ng, 1aoalade@lautech.edu.ng, 1aoaworanti@lautech.edu.ng

*Corresponding Author

ABSTRACT

This study was conducted to evaluate the performance of bio-electrochemical treatment of pharmaceutical wastewater and the simultaneous production of bioelectricity using dual-chamber microbial fuel cells (MFCs). The anodic chamber was loaded with pharmaceutical wastewater (PWW), while the cathodic chamber contained a prepared buffer solution. The system was operated at varying pH (4.5, 5.5, 6.5 and 7.5), temperature (25, 35, 45 and 60 °C), and fruit waste additives (10, 20, 30, 40 and 50 g). The initial Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) for the PWW were 1346.17 and 1025.01 mg/L, respectively. Maximum power generations of 775 mV, 652 mV, and 1012 mV were achieved at a pH of 7.5; temperature of 35 °C; and mixed fruit wastes additive. The highest BOD and COD removals of 96.25 and 97.99% were attained at 100 Ω resistance of MFC. The results from this study further intensify the industrial wastewater treatment and bioelectricity generation potentials of the MFC technology.

TS08 - An Approach to Scale Up of Neem Seed Oil Solvent Extraction Pilot Plant

John G. USMAN[1*], Paul C. OKONKWO[2], Bello MUKHTAR[3], Abdul BABA[4]

[1]*Department of Chemical Engineering, Kaduna Polytechnic, Nigeria.*
[2,3,4]*Department of Chemical Engineering, Ahmadu Bello University, Zaria, Nigeria.*

[1*]johngoji@yahoo.com, [2]chemstprom@yahoo.com,[3]belloonline@yahoo.com, [4]olubababdul@gmail.com

*Corresponding author Tel.: +2348068902311

e-mail: johngoji@yahoo.com

ABSTRACT
The current mechanical expression of oil from neem seed cannot satisfy the ever-increasing demand of the neem oil. The futuristic solution to the shortage of neem oil is the successful scale up of the solvent extraction pilot plant to larger commercial plant to boost the production capacity. The scale up approach is based on the pilot plant study and the use of existing model equations. The similarities values for the scale up are 21.69 W/m^2, 0.125, 0.029, 0.21 and 7.5831 × 10^{11} as power per volume, shape factor, Froude number, impeller speed and Reyleigh number respectively. Scaling up the agitation pilot plant, using ethanol at an extraction temperature of 50 °C and separation of the miscella at 50 °C under reduced pressure of 207.02 mmHg will reduce the recovery time and retain the oil quality. ASPEN PLUS V10 is recommended for simulation and the fractional compositions of neem seed kernel are 0.45% neem oil and 0.55% neem seed cake, while for ethanol are 96% pure ethanol and 4% water. The concept of overall heat transfer coefficient will be used for design and sizing of the condenser heat exchanger.

TS09 - Modeling of Gaseous Pollutant Emissions from Savanna Vegetation Fires

Khadijat A. ABDULRAHEEM[1,2*], Jamiu A. ADENIRAN[3]. and Adeniyi S. AREMU[1]

[1] *Department of Civil Engineering, University of Ilorin, Ilorin, Nigeria.*
[2] *Department of Water Resources and Environmental Engineering, Ahmadu Bello University, Zaria, Nigeria.*
[3] *Environmental Engineering Research Laboratory, Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria.*

[1*]khadijatabdulkareem2102@yahoo.com, 2adeniran.ja@unilorin.edu.ng, 3aremu.as@unilorin.edu.ng.

*Corresponding author

ABSTRACT
The concentration and transport dynamics of emissions during savanna vegetation fires are not well-understood. This study aims at modeling the ground level concentrations (GLC) of gaseous pollutants on the receptor environment using the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). Three (3) scenarios were investigated based on the vegetation density of the savanna grasses. The model revealed that the 24-hour averaging period for CO, NO_2, SO_2 and volatile organic compounds (VOC) ranges from 50 – 5,046 µg/m^3; 0.049 – 4.97 µg/m^3; 0.6 - 55.9 µg/m^3 and 63 – 6,253 µg/m^3 for Scenario 1; 288 – 28,825 µg/m^3; 0.08 – 8.31 µg/m^3; 2 – 203 µg/m^3 and 65 – 6,498 µg/m^3 for Scenario 2; 394 and 39,435 µg/m^3; 0.2 and 22.3 µg/m^3; 4 – 419 µg/m^3; and 118 - 11,782 µg/m^3 for Scenario 3, respectively. The study revealed that the World Health Organization (WHO) guideline of 4 mg/m^3 for the 24-hour concentration of CO was breached under Scenarios 2 and 3 by 150%. The findings of this study will help in the accurate estimation of emissions from the Savanna fires and in the development of appropriate mitigation strategies for emission control.

TS10 - Three-box sequential modelling of the emission, decay and transportation of Volatile Organic Compounds in beauty shops

Sarat Ayodele ATANDA [1*], Jamiu Adetayo ADENIRAN[1], Tunmise Latifat ADEWOYE[1]

[1]*Department of Chemical Engineering, University of Ilorin, Nigeria*

[1*] sarat.morenikeji@gmail.com, [2] adeniran.ja@unilorin.edu.ng, [3] adewoye.tl@unilorin.edu.ng

[*] Corresponding author

ABSTRACT

The concentration of Volatile Organic Compounds (VOCs) in indoor environments such as beauty shops where numerous essential oil and scented products are used depends on their emission rate, decay and transportation. Consequently, a better understanding of the dynamic behaviour of this pollutant in the indoor environment improves estimates of human exposure to indoor air pollutants. Single -zone-based models are easy to simulate but are inadequate for predicting exposure in indoor spaces where the source of the pollutant is near. In this study, a three sequential box model which accounts for the mass transfer process in the air, emission from indoor sources, decay and transportation was developed with the assumption of perfect mixing. The dsolve package in MATLAB R2019a software was used to solve model equations. Finally, t he results of the study revealed that as the VOCs concentration in the box that contains the emission source decreases the concentration in other boxes increases and has a correlation coefficient of 0.9401 with the measured value. Hence, a suitable control strategy can be developed to reduce VOCs concentration in indoor environments.

TS11 - Reduction of COD from Tannery Wastewater using CNTs Modified *Albizia Lebbeck* Pods

Tunmise Latifat ADEWOYE [1,4*], Salimah OMARI [1], Sarat Ayodele ATANDA [1], Oladipupo Olaosebikan OGUNLEYE[2], Taofeek Olalekan SALAWUDEEN[2], Ambali Saka ABDULKAREEM[3,4], Sherif Ishola MUSTAPHA[1]

[1] *Department of Chemical Engineering, University of Ilorin, PMB 1515 Ilorin, Kwara Nigeria*
[2] *Department of Chemical Engineering, Ladoke Akintola University, PMB 4000 Ogbomoso, Oyo State*
[3]*Department of Chemical Engineering, Federal University of Technology, PMB 65 Minna, Niger State, Nigeria*
[4] *Nanotechnology Research Group, Africa Centre of Excellence for Mycotoxin &Food Safety, Federal University of Technology, PMB 65 Minna, Niger State, Nigeria*

[1,4]adewoye.tl@unilorin.edu.ng,[1]salimaaomari@gmail.com, [1*]sarat.morenikeji@gmail.com, [2] ooogunleye@lautech.edu.ng, [2]tosalawudeen@lautech.edu.ng, [3,4]kasaka2003@futminna.edu.ng, [1]mustapha.si@unilorin.edu.ng

[*] Corresponding author

ABSTRACT

Tannery effluent, which contains a large quantity of organic and inorganic contaminants has a detrimental effect on health and the environment when discharged directly into the water bodies. The a dsorption potential of unmodified and modified carbonized Albizia Lebbeck pods for the reduction of chemical oxygen demand (COD) in tannery wastewater was investigated in this study. Albizia Lebbeck pods were carbonized and modified with purified carbon nanotubes (CNTs) to produce carbonized Albizia Lebbeck (ALC) and modified Albizia lebbeck (MALC) adsorbents. The developed adsorbents were characterized by Brunauer –Emmett-Teller (BET), high-resolution scanning electron microscopy (HRSEM), energy dispersive X-ray spectrometry (EDS) and X-ray diffraction (XRD). The batch adsorption process was conducted to investigate the effect of, pH, contact time, adsorbent dosage and temperature on the uptake of COD from tannery wastewater onto the adsorbents. The BET surface area of the ALC and MALC were 638 and 616 ??^{2}/g, respectively. HRSEM revealed that the adsorbents have good morphology while the XRD showed that the adsorbents are highly crystalline. The maximum adsorption efficiency of MALC and ALC are 95 and 93%, respectively. It can be deduced that modification of carbonized Albizia Lebbeck (ALC) with CNT slightly improved the adsorption potential of the ALC adsorbent.

TS12 - Optimisation of Removal Efficiency of Palm Kernel Shell Ash in the Treatment of Multicomponent Dyes in Simulated Wastewater

Abass O. ALADE[1,2,5]*, Aduragbemi, G. OYELADE[1,2], Dauda O. ARAROMI[1], Taofik O. SALAWUDEEN,[1], Rebecca A. OLAOYE[3], Temitope E. ODETOYE[4], Monsur O. DAUDA[1,2] and Tinuade J. AFOLABI[1,2]

[1]*Department of Chemical Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[2]*Bioenvironmental, Water and Engineering Research Group, (BWERG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[31]*Department of Civil Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[41]*Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria*
[3]*Science and Engineering Research Group, (SEARG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*

*Corresponding author: aoalade@lautech.edu.ng

ABSTRACT

Synthetic dyes are mostly employed in the textile industries creating a risk to the environment for both plants and animals. The removal efficiency of ashed Palm Kernel Shell (APKS) adsorbent for the removal of Malachite green (MG), Methyl Orange (MO), and Crystal Violet (CV) from simulated wastewater was examined in this study. The palm kernel shell (PKS) was washed, sun-dried, and milled to a consistent size. The milled PKS was ashed in a muffled furnace at 700 °C for 4 h. The feasible mixtures of the selected dyes were developed based on the Design Expert (12.0) software, Optimal Design feature. The solution (100 mL) of the mixed pollutants was mixed with 1 g of the APKS in a 250 mL flask and agitated at 150 rpm for 1 h. The unabsorbed concentration was quantified with a UV-visible spectrometer at the wavelength of 624 nm, 464 nm, and 579 nm and the maximum removal efficiency was 99.52 %, 74.64 %, and 98.46 % for MG, MO, and CV respectively. The R^2 of the model generated were 0.8046, 0.9850, and 0.9482 for MG, MO, and CV respectively. The APKS developed demonstrated satisfactory removal efficiency for the treatment of dye mixture in wastewater.

TS13 - Process Development for the Production of Lower Olefins from Levulinic Acid Using 2 Sec-Butyl Phenol Recovery Strategy

Aramide A. ADESINA[1,2,3*], David LOKHAT[1] and Kamilu F. OYEDEKO[2]

[1]*Discipline of Chemical Engineering, University of KwaZulu-Natal, Durban 4001, South Africa*
[2]*Department of Chemical Engineering, Lagos State University, Lagos, Nigeria*
[3]*ORCID 0000-0002-8689-3879*

[1*]aramide.adesina@lasu.edu.ng, [2]*lokhat@ukzn.ac.za*, [3]kamilu.oyedeko@lasu.edu.ng

*Corresponding author

ABSTRACT

This work presents a technical evaluation of a potential second-generation biorefinery process aimed at the production of ethylene and propylene as lower olefins from lignocellulosic biomass using an alternative levulinic acid recovery strategy. The process development was carried out through the coupling of various catalytic processes involving hydrolysis, hydrogenation, decarboxylation, and cracking. Additional alternative configurations were developed as an improvement to the base case process using the combustion of all generated hydrocarbons and solid by-products. The proposed bio-olefin production route was evaluated using the target product yield and energy efficiencies. The results revealed that 40 ktonne/yr of lower olefins can be produced from the process at a plant processing capacity of 701 ktonne of sugarcane bagasse per year with a base case energy efficiency of 41%. Therefore, the developed process is a viable option for the production of ethylene and propylene from lignocellulosic biomass.

TS14 - Thermodynamics Studies of Adsorption of Selected Antibiotics Mixture from Aqueous Solution using *Delonix regia* Pod

Ilesanmi A. OJO[1,2,3], Ayobami O. AJANI[1,2], Wasiat O. BELLO[1,2], Tinuade J. AFOLABI[1,2], Abdulrazaq, ABDULLAHI[1,2], Akeem O. OLAYIWOLA[4,] Ameen N AKINSOLA[3], and Abass O. ALADE[1,2,5*]

[a] *Department of Chemical Engineering, Faculty of Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[b] *Bioenvironmental, Water and Engineering Research Group (BWERG), Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[c] *Science Laboratory Unit, Al-Hikmah University, Ilorin, Nigeria*
[d] *Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[e] *Science and Engineering Research Group (SAERG), Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

*Corresponding Author: aoalade@lautech.edu.ng

ABSTRACT
The thermodynamic properties of batch adsorption of antibiotics mixture in aqueous solution onto Delonix regia Pod (DRP) activated, under the effect of temperature, was investigated in this study. The raw DRPs were processed, activated with KOH, carbonised at 500 °C for 40 mins and then used for the treatment of wastewater containing a multi -component mixture of amoxicillin, tetracycline and ampicillin, in a batch mode at varying temperatures (40 -60 °C). Thermodynamic parameters, such as Gibb's Free Energy (? G^0), Enthalpy Change (? H^0), Entropy Change (? S^0), Isosteric Heat of Adsorption (? H_X), Activation Energy (??), Sticking Probability (S), Surface Coverage (??) and Hopping Number (n) were calculated, which are indicators of the possible nature of adsorption. The most suitable adsorption temperature was 40 ºC with maximum adsorption capacities of 5.1, 5.3 and 4.5 mg/g and the corresponding removal efficiency of 85.91, 91.24 and 78.67 %, were obtained for amoxicillin, tetracycline and ampicillin respective ly. The ÄH, ÄS, ???and S* values were - 314.30, -72.74 and -364.12 kJ/mol; 7.8459, 16.2522 and 2.7079 kJ/mol; 69.0885, 6.7706 and 150.824 gmol^{1}; and 0.6909, 0.8606 and 0.4842 for amoxicillin, tetracycline and ampicillin respectively. These values confirm that the adsorption process is favourable and exothermic.*

TS15 - RESPONSE MODELLING AND OPTIMISATION OF PRODUCED PARTICLEBOARDS FROM SAWDUST SOFTWOOD USING R7AD2 ADHESIVE

Lucas A. J. HAMIDU[1*], Umar O. AROKE[2]

[1] Nigerian Building and Road Research Institute 10, NBRRI Way/ I.T. Igbani Street, off Awolowo Way, Jabi, Abuja, Nigeria
[2] Department of Chemical Engineering, Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi, Nigeria
[1*]lucadohamidu@yahoo.com, [2]zaaaroke@yahoo.com,
***Corresponding author**

ABSTRACT
This work presents the model ling and optimization of produced particleboards from sawdust softwood using R7AD2 adhesive, focusing on conversion of wastes into wealth for a sustainable environment. Mixture design of experiment (DOE) using Design Expert Software, Version 6.0.8 were emp loyed in the process formulation for the production of particleboards due to compatibility. The produced particleboards were characterized for the responses water absorptions (WA) at 2 and 24 hours and density and optimized. The analysis of variance (ANOVA) and sequential model sum of squares (SMSS) were used to validate the responses. Based on the results of the optimized responses, the sawdust softwood particleboard formulation 8 (SDP8) which has ratio of 0.32 softwood sawdust (SD) to 0.68 R7AD2 adhesive with the characteristic values of 17.23%WA at 2 hours, 90.48%WA at 24 hours and 647.28 kg/m ^{3}density was found best fit among others, placing the produced

TS16 - Equilibrium Study of Methylene Blue Adsorption by *Vitex Doniana* Activated Carbon

, Kevin S. OTOIKHIAN[1], Oluwadayo A. FRANCIS[2*], Emeka C. NWORIE[3]

[1,2]*Department of Chemical Engineering, Edo State University, Uzairue, Nigeria*
[3]*Department of Chemical Engineering Technology, Auchi Polytechnic, Auchi, Nigeria*

[1]otoikhian.kevin@edouniversity.edu.ng, [2*]Francis.asokogene@edouniversity.edu.ng,
[3]nocyka2016@gmail.com

[*]Corresponding author

ABSTRACT

Vitex doniana activated carbon modified with zinc chloride ($VDZnCl_2$) was synthesized for the removal of methylene blue. $VDZnCl_2$ was characterized for textural properties, surface morphology and surface chemistry._The textural properties revealed increased surface area from 14.02 to 933.25 m^2/g, the surface morphology showed pores with widened cavities, and the surface chemistry showed the inclusion of O—H group and a characteristics C=C group commonly found in carbonaceous materials. Adsorption study showed increased removal of methylene blue as concentration increased from 1 to 800 mg/L until equilibrium was attained. Sips isotherm model had the best fittings with the equilibrium data (R^2 = 0.938 and SSE = 7016.14), thereby suggesting physical adsorption onto the heterogeneous surface of $VDZnCl_2$. However, the maximum adsorption capacity was 238 mg/g. The performance put up by $VDZnCl_2$ suggested that it is a possible and suitable alternative adsorbent for textile and dyeing industries wastewater.

TS17 - Fuzzy Logic Controller Design for Temperature Control of Servo Systems using Simulink

Ajiboye OSUNLEKE[1*], Ayorinde BAMIMORE[1], Sunrise EZEKIKWU[2], Ismail OYEHAN[1], Nafees O. SANNI[1],

[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Andela, USA*

[*]Corresponding author: aosunlek@oauife.edu.ng

ABSTRACT

In this paper, the versatility in the applications of a fuzzy logic controller (FLC) in control systems was utilized in the temperature control of a servo system using Simulink. Servo system is one of the automatic control systems employed in manipulating the rotation angle (or displacement) of the controlled object so that it can automatically, continuously, and accurately respond to the input command in a feedback control loop. A servo control loop is one which responds to a change in setpoint which changes as a function of time, and in which the controlled variable must track the setpoint. The aim of this work is to employ fuzzy logic modelling approach to design controllers for temperature control of heat chamber, CSTR and Distillation columns. Model of a fuzzy logic controller was designed using the Fuzzy Logic Toolbox in MATLAB and the models of the systems required test the performance of the controller designed were built using Simulink. The performance of the fuzzy controller was evaluated based on the rise time, overshoot, and steady state error. Simulations were carried out for each system with step changes of +1, -1, +5 and -5 applied to the setpoint. The results obtained indicated that the controllers designed using Fuzzy Logic were robust and can be utilized successively for temperature control of systems.

TS18 - Thermodynamic Activity Coefficient Modelling of Liquid-Liquid Equilibrium Data for Tropical Almond Oil Biodiesel System

Kenneth K. ADAMA*[1], Rilva S. SANTIAGO-AGUIAR[2], Regiane S. PINHEIRO[2], Robson A. C. da SILVA[2], Emmanuel O. ALUYOR[1, 3], Thomas O.K. AUDU[3]

[1] *Department of Chemical Engineering, Edo State University Uzairue, P.M.B 04, Auchi, Edo State, Nigeria*
[2] *Chemical Engineering Department, Federal University of Ceara, Pici Campus, B1. 709, CEP 60455 – 760, Fortaleza, CE Brazil*
[3] *Department of Chemical Engineering, University of Benin, P.M.G 1154, Ugbowo, Benin City, Edo State, Nigeria*

*Corresponding author: adama.kenneth@edouniversity.edu.ng

ABSTRACT
In this study, the liquid-liquid equilibrium (LLE) data of system containing tropical almond oil biodiesel/methanol/glycerol was used to evaluate the performance of four thermodynamic activity coefficient models of Non-Random Two-Liquid (NRTL), Universal Quasichemical Activity Coefficient (UNIQUAC), Universal quasichemical Functional group Activity Coefficient (UNIFAC) and Analytical Solutions of Group (ASOG). The evaluated system formed the significant components at the conclusion of the methanolysis reaction of tropical almond oil and its subsequent purification. Using average global deviations, the accuracy of the models was evaluated. The experimental data were correlated satisfactorily. The order of prediction accuracy was established as: 3.72 UNIQUAC> 3.84 NRTL> 5.26 UNIFAC> 5.37 ASOG. In this regard, the activity coefficient models could be used for process simulation of biodiesel production, purification, separation and equipment design.

TS19 - Fuzzy Logic Controller Design: A General Appraisal

Ajiboye OSUNLEKE[1*], Ayorinde BAMIMORE[1], Ayodeji AJANI[1], Nafees SANNI[1], Ibrahim Abimbola BADMUS[2]

[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Process and Operations, Dangote Petroleum Refinery and Petrochemicals, FZE Lagos, Nigeria*
[1*]aosunlek@oauife.edu.ng, [1]abamimore@oauife.edu.ng, 2u1269949@utah.edu,
[1]nafeesolaitan@gmail.com, [2]ibrahimabimbolabadmus@yahoo.com
[*]Corresponding author

ABSTRACT
This research work aims at presenting the general appraisal of fuzzy logic control (FLC) in its application in controller design. The method used involves the formulation of a general design algorithm for constructing a fuzzy logic controller for a single-input single-output system as well for a multivariable system. The Fuzzy Logic Toolbox feature in MATLAB and Simulink is utilized for system design and simulation. Nonlinear water tank model, continuous stirred tank reactor; and a steam-heated stirred tank are considered as case studies for this appraisal. The performance criteria taken into consideration are overshoot, rise time, settling time and steady state error. The results obtained largely show that fuzzy logic control gave results over its conventional counterpart, giving absolutely no overshoots, little or no oscillations, better rise and settling times in most cases with minimal differences in the few cases where it was not. It can be concluded that FLC handles nonlinear systems well and when compared with conventional control, can provide better transient response performance.

TS20 - A New Implicit Model for Predicting Economic Pipe Diameter in a Fully Developed Turbulent Single-phase Pipe Flow

Joseph U. OKON[1], Emmanuela O. AINERUA[1], Innocent O. OBOH[*1] and Anselm I. IGBAFE[2]

[1]*Department of Chemical and Petroleum Engineering, University of Uyo, Uyo, Nigeria*
[2]*Department of Chemical and Petroleum Engineering, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria*
\
[1]*utibe.okonyahoo.com*, [1]eemmanuelaainerua@uniuyo.edu.ng,[1*]*innocentoboh@uniuyo.edu.ng*, [2]*igbafeai@abuad.edu.ng*,

[*]Corresponding author

ABSTRACT
The cost of a piping system accounts for about 20% of the plant's total cost and could run higher than that for pipeline transporting crude or petroleum products through a thousand kilometres of distance hence the need to accurately select the optimal size during the design stage of such a project. This paper presents an implicit correlation for optimization of economic pipe diameter based on the simple economic balance approach first used by Genereaux. A new model was developed and is implicit in D (Economic pipe diameter) which has been found to give superior estimates over existing correlations. The computations of the economic diameter of brass, stainless steel and aluminium pipes were carried out using the developed implicit model. A plot of effect of pipe roughness on economic diameter was obtained with a coefficient of determination of R^2 = 0.909. Results from the study showed that heavier fluids would require larger diameter.

TS21 – MODELLING OF LIQUEFIED NATURAL GAS AND PROPANE PRODUCTION USING NONLINEAR AUTOREGRESSIVE WITH EXOGENOUS INPUT NEURAL NETWORK

Azubuike Shedrack ASHINZE[1*], Adekunle Tirimisiyu ADENIYI[2], Abdulwahab GIWA[3]

[1,2,3]*Department of Chemical and Petroleum Engineering, College of Engineering, Afe Babalola University, KM. 8.5, Afe Babalola Way, Ado-Ekiti, Ekiti state, Nigeria.*

[1*]azubuikea@abuad.edu.ng, [2]adeniyia@abuad.edu.ng, [3]agiwa@abuad.edu.ng

[*]Corresponding author

ABSTRACT

Natural gas is used globally for the production of liquefied natural gas (LNG) and propane. In this paper, a Nonlinear Autoregressive with exogenous inputs (NARX) neural network model was built in MATLAB R2021a in a bid to capture the time-behaviour of the LNG and propane production process. Five input parameters and three output parameters were chosen from the daily production report of a natural gas handling facility in southern Nigeria which were tabulated/saved in Excel, and then incorporated into a written transfer function generation algorithm and used to develop a Simulink model. The simulation generated input-output time series datasets representing the dynamics of the natural gas liquefaction plant. Furthermore, the datasets were imported into the NARX Graphical User Interface (GUI) in MATLAB R2021a to create the neural network model. The NARX model developed was trained iteratively, and its performance was evaluated using mean squared error (MSE) and regression ® values as the criteria. MSE values of approximately 0.7357, 0.7819, 0.8398 and R-values of approximately 0.9981, 0.9979, 0.9977 were obtained after training, validation, and testing respectively, which depicted the efficacy of the model in capturing the dynamics of the production process as well as forecasting future values of LNG and propane.

TS22 - EVALUATION OF NATURAL GAS LIQUEFACTION PROCESS USING NONLINEAR AUTOREGRESSIVE NEURAL NETWORK AND NONLINEAR INPUT-OUTPUT NEURAL NETWORK: A COMPARATIVE STUDY

Azubuike Shedrack ASHINZE[1*], Adekunle Tirimisiyu ADENIYI[2], Abdulwahab GIWA[3]

[1,2,3]*Department of Chemical and Petroleum Engineering, College of Engineering, Afe Babalola University, KM. 8.5, Afe Babalola Way, Ado-Ekiti, Ekiti state, Nigeria.*

[1*]azubuikea@abuad.edu.ng, [2]adeniyia@abuad.edu.ng, [3]agiwa@abuad.edu.ng

[*]Corresponding author

ABSTRACT

The simulation modelling of artificial neural network models to evaluate a natural gas liquefaction process has been carried out in this work. Five input parameters gas feed volume, gas feed flow rate, gas feed temperature, gas feed pressure and volume of fuel gas utilized in the gas turbine power plant and three output parameters volume of Liquefied Natural Gas produced, volume of propane produced, and volume of gas condensates produced were chosen from the raw data obtained from a liquefaction facility in southern Nigeria. These parameters were arranged in Excel before being incorporated into an m-file transfer function algorithm and transfer function model in MATLAB R2021a to generate a time series dataset. The input and output parameters were imported into the time series application available in MATLAB R2021a and trained using the Levenberg Marquardt algorithm. The Nonlinear Autoregressive (NAR) model gave 0.758528, 0.820267 and 0.857507 while the Nonlinear Input-Output (NIO) model gave 33.16290, 35.68165 and 36.05067 as the Mean Squared Error (MSE) values for training, validation and testing, respectively. Thus, for the Autoregressive two neural network models considered, the NAR model outperformed the NIO model in the evaluation of natural gas liquefaction process perceptible in the lower MSE values returned.

TS23 - Flow and Compaction Properties of Excipients Developed from Biopolymer Waste Snail Shell and Influencing Factors

Babatunde K. ADEOYE[1*], Elizabeth F. ARANSIOLA[2], Gbenga ALEBIOWU[3], Micheal O. OSUNGUNNA[3]

[1]*Department of Food Science and Technology, Federal University of Technology, Akure, Nigeria.*

[2]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*

[3]*Department of Pharmaceutics, Faculty of Pharmacy, Obafemi Awolowo University. Ile-Ife, Nigeria*

[1*]bkadeoye@futa.edu.ng, [2]aransiolaef@gmail.com, [3]*galebiowu@gmail.com,* [3]*mowole@oauife.edu.ng*

[*]Corresponding author

ABSTRACT

This study developed functional excipients from biopolymer materials and evaluated their flow and compaction properties for preparation of tablet. Chitosan, a based excipient was extracted from snail shell and a compositional experimental design under the pharmaceutical dosage framework with corn-starch and lactose was used to study the singular and interaction effects of influencing parameters (Density; Hausner ratio; Carr's index; angle of repose; angle of internal friction; The Kawakita model; Consolidation index and Rate of consolidation) on the co-processed excipients, as well as, individual excipients. X-ray diffraction profiles showed that the chitosan produced was rich in or mostly made up of calcium silicate ($CaSiO_3$). The novel functional excipients developed had substantially better flow with Hausner's ratio ranging from 1.254 to 1.327, Carr's index from 20.272 to 24.627, angle of repose from 26.06 to 36.32° and angle of internal friction from 38.84 to 44.82°. The novel excipients also had improved compaction properties with compressibility values ranging from 0.390 to 0.537, consolidation rate from 0.559 to 0.675 and consolidation index from -1.466 to -1.268, which were advantageous in tableting. The role of pressure as the most significant parameters influencing the compaction and consolidation rate was also established. The results suggest that the better rate of flow and compaction propeties of co-process excipients can be achieved with high volume of chitosan at moderate mixing ratio.

TS24 - Adsorption of Nickel (II) Cation from Aqueous Solution using Maize Cob-Activated Carbon: Optimization and Kinetic Studies

Mayowa A. LALA[1*], Zainab O. OLOMOWEWE[1], Adekunle T. ADENIYI[1], Abdulwahab GIWA[1]

[1]*Department of Chemical and Petroleum Engineering, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria*

[1*]lalam@abuad.edu.ng, 2zainabwewe@gmail.com, [3]adeniyia@abuad.edu.ng, 4agiwa@abuad.edu.ng

[*]Corresponding author

ABSTRACT

This work has been carried out to study the adsorption of nickel (II) from a solution using an activated carbon developed from maize cob. The maize cob activated carbon (MCAC) was prepared by chemical activation. Afterwards, the MCAC was characterized and used as an adsorbent for batch adsorption of nickel (II) from aqueous solution. Three adsorption process variables, namely initial adsorbate concentration, contact time and adsorbent dosage were considered as the input parameters. The experiments carried out were designed using central composite design (CCD) of response surface methodology. The model developed from the experimental data using regression analysis was optimized with the aid of MATLAB. The analysis of variance (ANOVA) revealed that all the considered independent process variables had significant effect on the adsorption process. The optimum conditions obtained from MATLAB were found to be 9.75 mg/L for initial nickel (II) concentration, 120 min for contact time and 0.803 g for adsorbent dosage, and the application of the optimum conditions led to 100% removal of the nickel (II). Moreover, the experimental data were observed to be fitted best with pseudo-second-order kinetic model.

TS25 - Extraction of Bioemulsifier from *Candida tropicalis* Isolated from Banana (*Musa* x *paradisiaca* L.)

Abigail O. ADETOYESE[1], Elizabeth F. ARANSIOLA[1*], Hezekiah A. ADENIRAN[2]
[1] *Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria.*
[2] *Department of Food Science and Technology, Obafemi Awolowo University, Ile-Ife, Nigeria.*

[1] abylarry2@gmail.com, [1*]aransiolaef@gmail.com, [2] hexadeniran@gmail.com
*Corresponding author

ABSTRACT
Given the high expense of producing chemical-based emulsifying agents, the risk to human health, and the rising demand for natural products, biotechnologically-based compounds are gradually replacing these chemically synthesized emulsifiers. This work aimed to extract bioemulsifier from yeast strains isolated from available local fruits. Different fruit samples were collected randomly and allowed to grow on Potato Dextrose Agar (PDA) medium supplemented with 0.1 mg mL^{-1} chloramphenicol. The expected yeast isolates were then screened by using the same medium. This resulted in 18 isolates. These isolates were identified and characterized based on morphological and biochemical tests. Isolate E3 from ripe bananas showed the best result and this was used for molecular characterization. The Blast results from the molecular test revealed 98.78% similarity with Candida tropicalis MN450877.1 in the NCBI database. Based on this, the strain was identified as Candida tropicalis. The bioemulsifier was extracted from the Candida tropicalis using the autoclaving method. The yield of bioemulsifier was 0.34g/3g dry yeast and emulsion activity after 24 h was 66.67%. This study has provided information on the potential, technological properties and suitability of Candida tropicalis isolated from ripe banana as bioemulsifier.

TS26 - APPLICATION OF BOX-BEHNKEN DESIGN IN THE LEACHING KINETICS OF DOLOMITE IN HYDROCHLORIC ACID (HCL)

Isaac Adekunle JOSEPH[1*], Elijah Olawale AJALA[1], AHMED El-lmam Amina[2], Mary Adejoke AJALA[1]

[1]*Department of Chemical Engineering, University of Ilorin, Nigeria*
[2]*Department of Microbiology, University of Ilorin, Nigeria*

[1*]isaacchemeng@yahoo.com,[1]olawaleola01@yahoo.com,
[2]amkmusty@yahoo.com,[1]ajala.ma@unilorin.edu.ng

* Correspondence author

ABSTRACT
*A more simplified approach of kinetic study of the leaching of dolomite in HCl using Box-Behnken Design was investigated in this study. Atomic absorption spectroscopy analysis shows that 54.14% calcium and 39.66% magnesium are the major elemental composition of dolomite, while the remaining 6.20 % is considered to be impurities. Dolomite was leached in a solution of HCl at an acid concentration between 0.5 and 2.5 M, temperature between 30 and 80 °C and reaction time between 10 and 40 minutes. The impurities were separated by filtration. A quadratic model with a coefficient of determination (**R^2**) of 0.9465, an **adjusted R^2** of 0.9222, and a **predicted R^2** of 0.8615 best represent the leaching study. The analysis of variance revealed that acid concentration and leaching time enhanced the leaching process. At 50 °C, 10 minutes and 2 M, leaching efficiency of 97.67 % was predicted, while 96.998 % was achieved. Atomic absorption spectroscopy confirms the concentration of calcium and magnesium ions in the filtrate at optimum to be 232.545 ppm and 18.087 ppm, respectively. The developed quadratic model equation in this study was used to study the leaching kinetics of dolomite under different process conditions. The exponential curve model confirms the first order kinetics of the leaching process. Hence, Box-Behnken Design is a suitable novel approach to determine reaction kinetics.*

TS27 - Analysis of Liquid Products of Pyrolyzed Low Density Polyethylene

Aishat Ayoola OSIGBESAN[1*], Adebola Femi ADE-AJAYI[1], Ephraim Akuaden AUDU[1], Zaharaddeen Sani GANO[1], Jeffrey Tsware BARMINAS[1]

[1]*Petrochemicals and Allied Department, National Research Institute of Chemical Technology, Zaria*

aishatosigbesan2011@gmail.com, phemmistic@gmail.com, ephraim.audu@yahoo.com, zaharaddeenn@gmail.com, bjtsware@gmail.com

* Correspondence author

ABSTRACT

Waste Low Density Polyethylene (LDPE) was pyrolyzed and reformed in an integrated pyrolysis and fixed bed reactor system at 400 and 450 °C respectively. The reforming was carried out with and without mordenite – based catalyst. The oils samples obtained were collected and analysed using Fourier Transform Infrared Spectroscopy (FTIR), Gas Chromatography - Mass Spectroscopy (GC-MS) and bomb calorimetry. The calorimetric analysis of the catalysed sample showed that the oil has a High Heating Value (HHV) of 43.40 MJ/Kg. The FTIR spectra showed that peaks of aliphatic hydrocarbons in the uncatalysed oil are more prominent than in that of the catalysed oil. Conversely, the peaks of aromatic hydrocarbons appeared to be more in the catalysed oil than in the uncatalyzed oil. The GC-MS analysis confirmed high presence of aliphatic (alkane and alkene) hydrocarbons in the uncatalyzed sample, which were lower in the catalysed sample. These differences showed that reforming took place in the presence of the mordenite – based catalyst. These results would serve as a basis for further works on pyrolysis technology.

TS28 - Synthesis and Characterization of Fe Doped Mordenite as a Prospective Catalyst for Pyrolysis of Waste Plastics

Ephraim A. Audu[a*], Zaharaddeen S. Gano[a], Aishat A. Osigbesan[a], Adebola F. Ade-Ajayi[a], Jeffrey T. Barminas[a]

[a] *National Research Institute for Chemical Technology, Basawa, Zaria, Kaduna State, Nigeria*

[a]*akuadenaudu@gmail.com, [a]zaharaddeenn@gmail.com, [a]aishatosigbesan2011@gmail.com,

[a]phemmistic@gmail.com, [a]btsware@gmail.com

*Corresponding author

ABSTRACT

In this work, metal doped on mordenite (MO) was synthesized using wet impregnation method for potential use as catalyst in the pyrolysis of waste plastics. Varying concentrations of iron was considered for catalyst formulations. The obtained catalyst samples were characterized using Fourier Transform Infrared (FTIR) spectroscopy, Energy Dispersive X-ray (EDX) and pyridine FTIR. The FTIR spectra revealed the presence of basic peaks 3411, 1640, 1250, 950, 769, 586 and 450 cm^{-1} found in mordenite both in Fe doped and unmodified mordenite. EDX analysis confirmed the synthesis of Fe-MO and further gave iron concentrations of 0.99, 2.45 and 3.89 %wt corresponding to 1, 3, and 5 %wt that were prepared. Results of Pyridine FTIR on the samples revealed Bronsted acidic site at 1534 cm^{-1}. Acidity of mordenite was improved as Fe loading increased signifying that the sample could promote cracking of pyrolysis products into shorter chain hydrocarbons. This suggests that Fe doped on mordenite has improved the characteristics of the catalyst which can enhance its activity, and selectivity towards lighter hydrocarbons in pyrolysis of plastics. Overall, the results showed iron doped mordenite exhibits properties that have high potential for application as catalysts in pyrolysis of plastics wastes.

TS29 - Investigation of Adsorption Capacity of Eggshell-based Chitosan in the Treatment of Multicomponent Aromatic Organic Pollutants

Azeez G. AKINYEMI[1,2], Arinkoola O. AKEEM[1], Shukurat B. OLABIYI[1], Monsuru O. DAUDA[1,2], Monsurat O. JIMOH[1,2], Odunola D. AKINWUMI[1], Sunday O. OYEKUNLE[1], Tinuade J. AFOLABI[1,2] and Abass O. ALADE,[1,2,3*]

[1]*Department of Chemical Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[2]*Bioenvironmental, Water and Engineering Research Group, (BWERG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[3]*Science and Engineering Research Group, (SEARG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*

Corresponding Author: aoalade@lautech.edu.ng +2347037885961

ABSTRACT

Adsorption technology has been advocated for wastewater treatment to diminish the harmful effects of aromatic hydrocarbons (AHs) on the environment and human health. This work investigated the adsorption capacity of chitosan-based adsorbents developed from waste eggshells for the treatment of wastewater containing selected AHs. The eggshell was washed, sun-dried, oven-dried and milled to uniform sizes. The milled eggshell was deproteinized with 1 M NaOH at 60 °C for 2 h and then demineralized with 1.2 M HCl for 4 h to produce eggshell chitin, which was further deacetylated with 50 wt.% NaOH at 120 °C for 2 h to produce Eggshell Chitosan (ESC). The ESC (1 g) was mixed with a solution (100 ml) of selected AHs (phenol, acenaphthene, and pyrene) which were mixed at different concentration ratios (20-60 mg/L) based on the Simplex Centroid Design (SLD) of the Design-Expert (12.0.1) software, The batch adsorption process was conducted in 250 mL flasks, agitated on a rotary shaker at 150 rpm for 1 h at room temperature. The residual concentration was evaluated using a UV-VIS spectrophotometer at 274 nm, 303 nm, and 335 nm for the phenol, acenaphthene, and pyrene respectively. The data generated were statistically analyzed. The maximum adsorption capacity of phenol, acenaphthene and pyrene removal was 5.746 mg/g, 5.761 mg/g, and 5.840 mg/g, respectively. The eggshell-Chitosan adsorbent demonstrated satisfactory capacity for AHs adsorption.

TS30 - Impacts of Metal Recycling Plant Operations on Ambient Air and Noise Qualities

Bamidele S. FAKINLE[1*], Jacob A. SONIBARE[2], Funso A. AKEREDOLU[2] and Ebenezer L. ODEKANLE[3]

[1]*Department of Chemical Engineering, Landmark University, Omu-Aran, Nigeria*
[2]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Chemical and Mineral Resources Engineering, First Technical University, Ibadan, Nigeria*

[1*]fakinle.bamidele@lmu.edu.ng, [2]asonibar@yahoo.com, [2]osnufy2k3@yahoo.co.uk, [3]eodekanle@yahoo.com

[*]Corresponding author

ABSTRACT

Air quality and noise levels assessment of an Iron and Steel company located, Ile-Ife, Osun State, a typical metal recycling plant in Southwest Nigeria was carried out within and around factory premises with a view to determining the impacts of the plant operation on ambient air quality. Relevant weather parameters, air pollutants and noise levels were determined accordingly and the results compared with relevant recommended limits. Measure meteorological parameters were in harmony with the historical climate data of Ile Ife. Of all the air pollutants, only CO and NH_3 (1.0 ppm) were detected within the factory, while SO_2, NO, NO_2, H_2S and VOCs were not detected (< 1.0 ppm). However, in the surrounding, only NO was detected. 24-hour extrapolated concentrations were all within the recommended limits. The 24-hours extrapolated concentrations of PM_{10} and TSP within the factory's premises as well as in the surrounding fell within their respective limits, Noise levels within the factory and some locations outside the factory were observed to exceed sleep disturbance limits recommended by WHO, while some other location outside the factory premises were within the recommended limit. Preventive and control measures to mitigate exposure to air pollutions and noise within and outside the factory were suggested.

TS31 - Suitability of Adsorptive Cellulose derived from *Tithonia diversifolia* Xylem for the Treatment of Multicomponent Pharmaceutical Wastewater: Adsorption Capacity Optimization

Olusesan A. OLU-AROTIOWA[1], Abdulganiy O. YUSUF [1,2], Monsur O. DAUDA [1,2], Omodele A.A. ELETTA[3], Kazeem K. SALAM[1], Rasheed O. ADETORO[4], Lekan T. POPOOLA[5], Tinuade J. AFOLABI[1,2] and Abass O. ALADE[1,2,6*],

[1]*Department of Chemical Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[2]*Bioenvironmental, Water and Engineering Research Group, (BWERG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[3]*Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria*
[4]*Department of Pure and Applied Chemistry, Osun State University, Osogbo, Nigeria*
[5] *Department of Chemical and Petroleum Engineering, College of Engineering, Afe Babalola University Ado-Ekiti, ABUAD, Ado-Ekiti, Ekiti State, Nigeria*
[6] *Science and Engineering Research Group, (SEARG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[*]Corresponding author: aoalade@lautech.edu.ng +2347037885961

ABSTRACT

The presence of residual pharmaceutical products in the surface water is detrimental to the plant and animal lives, thus there is growing agitation for their removal. Raw Tithonia Diversifolia (sunflower) Xylem (TDX) was employed to develop a cellulose-based adsorbent for the treatment of wastewater containing mixtures of Tetracycline, Metronidazole and Cotrimoxazole. The raw TDX obtained was washed, dried, uniformly milled and treated with 4 wt.% NaOH at 80 °C for 2 h, before being acetylated and treated with $NaClO_2$ for 24 h. The residue was washed, dried at 50 °C and then treated with H_2O_2(30 %). The product was neutralized and dried as TDX cellulose. Simplex Lattice Design of the Design-Expert (12.0.1) software was employed to simulate possible mixing ratios of the three selected pharmaceuticals in the ranges of 25–50 mg L^{-1}. The batch adsorption experiment was carried out at room temperature, 150 rpm and 60 mins. The residual concentration of the pharmaceutical mixture was determined using 357 nm, 340 nm and 520 nm wavelengths in a UV-visible spectrophotometer, for Tetracycline, Metronidazole and Co-trimoxazole, respectively. The data generated were analysed statistically with the Design-Expert software. The maximum Adsorption Capacity (qe) obtained were 4.7715, 4.2259 and 4.8372 mg/g respectively. The linear model developed gave R^2, adjusted R^2 and standard deviation of (1.0000, 1.0000 and 0.0037), (0.0630, 0.9992 and 0.9951) and (0.1174, 0.9833 and 0.9858) for Tetracycline, Metronidazole and Co-trimoxazole respectively. The developed TDX cellulose adsorbent demonstrated satisfactory adsorption capacity for remediating wastewater containing pharmaceutical pollutants.

TS32 - AIR AND NOISE QUALITY ASSESSMENT AROUND LUBE BLENDING AND INSECTICIDE PRODUCTION PLANT

Jacob A. SONIBARE[1*], Funso A. AKEREDOLU[1], Ebenezer L. ODEKANLE[2] and Bamidele S, FAKINLE[3]

[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Chemical and Mineral Resources Engineering, First Technical University, Ibadan Nigeria.*
[3] *Department of Chemical Engineering, Landmark University, Omu-Aran, Nigeria*

[1*]asonibar@yahoo.com, [1]osnufy2k3@yahoo.co.uk, [2]eodekanle@yahoo.com, [3]fakinle.bamidele@lmu.edu.ng
[*]Corresponding author

ABSTRACT

The air quality impacts of Lube Oil Blending and Insecticide Plants of an Oil company in Lagos Nigeria was carried out by measuring relevant microclimatic and air quality parameters as well as noise levels within and around the plant premises. The results were compared with the appropriate permissible limits. The results showed that the measured microclimatic parameters of the environment were within the historical climatic condition of Lagos. Furthermore, VOCs were detected in only nine of the seventeen sampling locations, while NH_3, SO_2 NO_2, CO, and H_2S were not detected at all. The extrapolated 24-hour concentrations of VOCs exceeded both the WHO guidelines and the FMENV limits only in the Fuel Loading Rack of the company. Particulates were detected in all the sampling locations and the 24-hours extrapolated concentrations of PM_{10} were found to be about 5.0 - 11.9% of the World Bank's limit of 80 g/m^3 while the TSP levels are 1.7 – 4.0 % of the Federal Ministry of Environment's limit of 250 g/m^3 in all the sampling locations. Also, measured noise levels did not exceed the shopfloor 8-hour limit of the FMENV in all the locations, but it exceeded the sleep disturbance limit in all.

TS33 - Valourisation of Waste *Parkia* Pendula Inflorescence as Biosorbent for the Treatment of Synthetic Wastewater Containing Pesticides

Tinuade J. AFOLABI[1,2], Hekram, A. SADIQ[1,2], Adewemimo, O. POPOOLA[1], Sunday, O. OLADUNNI,[1,2], O. Monsur, O. DAUDA[1,2], Omotayo, S. AMUDA[3], Abolaji, G. FAROMBI[4], Esther O. AWOTONA[1,2], and Abass O. ALADE[1,2,5*]

[1] *Department of Chemical Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[2] *Bioenvironmental, Water and Engineering Research Group, (BWERG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[3] *Analytical/Environmental Chemistry Unit, Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[4] *Department of Science Laboratory Technology, Osun State Polytechnic, Iree, Nigeria*
[5] *Science and Engineering Research Group, (SEARG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*

Corresponding Author: aoalade@lautech.edu.ng +2347037885961

ABSTRACT

The increasing presence of pesticides in the water bodies, due to the surge in their uses in modern day agricultural activities, is deleterious to the aquatic lives and humans. This study examined the resourcefulness of the inflorescence of Parkia pendula which is shed and wasted annually without any usefulness, the possibility of being used as biosorbent for the treatment of wastewater containing pesticides attracts the interest of this study. The shed Parkia pendula inflorescence was collected, washed, sun-dried, milled to uniform particle size, and activated with H_2O_2 (20 wt. %) for 120 h to produce Parkia Pendula Inflorescence Biosorbent (PPIB), which was used in the treatment of wastewater containing predominantly used pesticides [Glyphosate (GLY), Chlorpyrifos (CPF), and Lambda-Cyhalothrin (LCT)]. The three pesticides were mixed at different ratios (20–60%) based on the mixture methodology of the Design-Expert (12.0.0) software to simulate various the pesticides composition. Batch adsorption of the mixture was conducted and the maximum q_e obtained for Lambda-Cyhalothrin, CPF, and GLY removal were 6.503, 6.407, and 2.994 mg/g respectively. The Analysis of Variance of the models generated is significant at Coefficient of Determination (R^2) 1.0000; 0.9961l and 0.9958, for LCT, CPF, and GLY, respectively. This study shows that the pendula inflorescence of the Parkia biglobosa is very resourceful in the remediation of wastewater containing pesticide component.

TS34 - ADSORPTION OF PARACETAMOL FROM PHARMACEUTICAL WASTEWATER USING GROUNDNUT (ARACHIS HYPOGAEA) SHELL ACTIVATED CARBON

Idayat A. OLOWONYO[1], Mujidat O. AREMU[1], Agbaje LATEEF[2], Kazim K. SALAM[1]

[1] *Department of Chemical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.*
[2] *Department of Pure and Applied Biology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.*

[1]olowonyoidayat@gmail.com, [2]moaremu@lautech.edu.ng, [3]Alateef@lautech.edu.ng,[4*]kksalam@lautech.edu.ng
[*]Corresponding author

ABSTRACT

Groundnut shell activated carbon (GNSAC) was investigated for the removal of paracetamol from pharmaceutical wastewater and the effect of temperature and contact time on percentage removal of paracetamol were studied in a batch experiment. The GNSAC was characterized using FTIR and proximate analysis. The optimum paracetamol removed was 90 % at optimum conditions (dosage, temperature and time) of 0.7g, 28°C and 42 min respectively. The thermodynamics of paracetamol adsorption onto GNSAC indicated that the adsorption was spontaneous and endothermic in nature.

TS35 - PRODUCTION OPTIMIZATION OF A NIGERIAN OIL WELL

Ajiboye S. OSUNLEKE[1*], Ayorinde BAMIMORE[1], Francis CHUKWUNTA[1], Nafees SANNI[1], Ibrahim A. BADMUS[2]

[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Process and Operations, Dangote Petroleum Refinery and Petrochemicals FZE, Lagos*

[*]Corresponding author: aosunlek@oauife.edu.ng

ABSTRACT

Obtaining the most out of a hydrocarbon reservoir is not commonplace as it takes a lot of informed decisions to make. Over the last decade, there has been a constant growing demand for oil and gas, and a reduced discovery of very large oil wells. Hence, a need to efficiently exploit existing ones. One possible way of improving production rate is through a wide array of techniques collectively termed Production Optimization. Production Optimization techniques employed here was used to control undesired fluid production, increase the potential for greater oil recovery and predicting field performance. Hence, enhance reservoir profitability. In this work, an optimal control to reservoir management, and in particular to reservoir production is applied. An open-source reservoir simulator (MATLAB Reservoir Simulator Toolbox, MRST) was used to simulate and run production optimization for a real reservoir model considering different well placements. Three different well placement scenarios were used with each scenario having multiple producer wells and either single or multiple injector wells. The performance criterion used for this work is water cut. For all scenarios considered, the well performance and simulation schedule over a 10-year period (total simulation time) was analysed. The profitability of each producer well in all the scenarios was found to depend on both its well placement and that of the injector wells. The volume and number of injector wells was also found to affect the volume of oil produced, and the profitability length. Scenario 1 with an injector well produced less oil but of greater profitability length in the simulated time. Scenarios 2 and 3 with three injector wells each had less profitability length but produced more oil than scenario 1 in 10 years.

TS36 - Extraction of Keratin Protein from Chicken Feathers: An Optimization Study

Favour Oluwabukunmi KAYODE[1], Benjamin ADEREMI[2], Olayomi Abiodun FALOWO[3*]

[1,2,3]*Department of Chemical Engineering, Landmark University Omu-Aran, Nigeria.*

[*]Corresponding author: falowo.olayomi@lmu.edu.ng

ABSTRACT

Box-Behnken design was used to model, optimize and examine the interplay of the process variables affecting the extraction of keratin protein. The variables used in the experimental design were Temperature (70°C - 90°C), extraction time (2-8 hrs), liquid-solid ratio (5-20 ml/g), and concentration of sodium sulfide (8-50 g/l). Biuret test was carried out on extracted keratin and Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) were used to characterize the extracted keratin. The extraction was done and biuret test confirmed that the extract was indeed protein. From the FTIR analysis, the presence of functional groups such as amino and carbonyl groups confirmed the presence of protein backbone in the extracted keratin. The micrograph from the SEM analysis compared the appearance of keratin and the feather residue after keratin extraction. The optimal process conditions established for the keratin protein extraction are a temperature of 72°C, an extraction time of 2 hrs, a liquid-solid ratio of 5 ml/g, and a sodium sulfide concentration of 20.614 g/l. These conditions generated a protein yield of 86.92 wt.%.

TS37 - Modelling, Simulation and Optimization of a Reactive Distillation Column

Chinenye S. UKPAI[1*], Mufliah G. OMOFOYEWA[2], Idowu I. OLATEJU[3], Saidat O. GIWA[4], Abdulwahab GIWA[5,*]

[1,2,3,5]*Department of Chemical and Petroleum Engineering, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria*

[4]*Chemical Engineering Department, Faculty of Engineering and Engineering Technology, Abubakar Tafawa Balewa University, Tafawa Balewa Way, Bauchi, Nigeria*

[1]ukpaichinenye@yahoo.com, [2]gomofoyewa@gmail.com, [3]iolateju@abuad.edu.ng, [4]sogiwa@atbu.edu.ng, [5,*]agiwa@abuad.edu.ng

[*]Corresponding author

ABSTRACT

Reactive distillation (RD) is a technology for process intensification that combines chemical reaction and separation (distillation) into a single device. Separation of products from unconverted reactants enables high conversion in the reactive distillation system because product removal restores equilibrium and forces the reaction to completion. This method has numerous advantages; however, the combination of chemical reaction and separation in the same piece of equipment has created some difficulties in the process, and chemical engineers are still working on finding the best optimum parameters for the process. Consequently, this research has been carried out to determine the optimum values of the parameters required for a reactive distillation system involved in the production of biodiesel. Aspen HYSYS, Design Expert v13 and MATLAB were used respectively to create the steady state model of the system, design the experiments and develop the models for the optimization to estimate the optimum values. The optimum values of the simulation process were obtained to be a reflux ratio of 10 and a reboiler duty of 500000 kJ/s. The reactive distillation system was discovered to be capable of completing both processes in a single column with improved efficiency and yield.

TS38 - PROCESS SIMULATION AND OPTIMIZATION OF PALM OIL FROM SPENT BLEACHING EARTH VIA SUPERCRITICAL EXTRACTION FOR SUSTAINABLE DEVELOPMENT

Wasiu A. OLADOSU[1*], Mohammed S. HARUNA[1], Alaba A. SALAMI[1]

[1]*National Agency for Science and Engineering Infrastructure (NASENI), Abuja*

[*]Corresponding author: 1*wasiureal@gmail.com

ABSTRACT

Vegetable oils undergo numerous refining steps to remove undesirable compounds and produce high quality, stable commercial products. Recovery of vegetable oil from spent bleaching earth is an area where ample opportunities exist for cleaner production and cost saving in the vegetable oil processing industry. Conventional oil extraction and refining processes, which involve multiple unit operations, have several disadvantages. These include complex separation steps, energy-intensive operations, the requirement for large amounts of water and hazardous chemicals and the potential of generating large quantities of wastes. Therefore, the objective of this study is to develop a process simulation and optimization for the recovery of palm oil from spent bleaching earth using supercritical fluid extraction (SFE). The methodology adopted for this study include applying experimental data to enable the development of a reliable simulation and optimization models of the supercritical fluid extraction to recover palm oil from spent bleaching earth. The result of the study shows that optimal total annual cost of US$246 million at 10 MPa and 45 oC with optimum separation pressure of 2 MPa was obtained. The simulation and optimization for obtaining palm oil from spent bleaching earth via SFE will produced comparable and better oil recovery, using a significantly intensified process that was green and sustainable.

TS39 - Production of Fuels from Guinea-Corn Straw and Waste Plasticss

Adeola Grace OLUGBENGA[1*], Rasheed BABALOLA[2]

[1]*Department of Chemical Engineering, Faculty of Engineering, University of Abuja,*
[2]*Department of Chemical/ Petrochemical Engineering, Faculty of Engineering,*

[1]grace.olugbenga@uniabuja.edu.ng, [2]rasheedbabalola@aksu.edu.ng
[*]Corresponding author

ABSTRACT
The production of fuels from guinea - corn straw and waste plastics predominantly polyethylene during pyrolysis was studied. The effects of mixing ratio of guinea-corn straw and waste plastics, pyrolysis temperature, and gas passed over the pyrolysis reaction (CO2 or N2) on the quantities of pyrolysis oil were studied. The results showed that pyrolysis of guinea-corn straw and waste plastics can increase the amount of produced oil due to the petroleum-based content in the waste plastics. When a ratio of 1:4 for guinea-corn straw to waste plastics was used, the product fuel oil was as high as 52.1%, which was 4.5% more than the calculated value. At an increased temperature of decomposition, the product improved having its maximum at 485◦C. The addition of 25% by weight of HZSM-5 catalyst reduced the proportion of oxygenates and promoted the generation of aromatic hydrocarbons. This study identified the theoretical basis for the comprehensive utilization of plastic and biomass energy because the pyrolysis of plastics has yielded pyrolysis oil and gas with improved hydrogen content and calorific value having lowered the oxygen content to an improved product property.

TS40 - ANN Prediction of Selected Oleophilic Bacterial Growth in Crude Oil Bioremediation

Ajiboye S. OSUNLEKE[1*], Nafees O. SANNI[1], Mumeenah O. Mustapha[2], Elizabeth F. ARANSIOLA[1]
[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Microbiology, Kwara State University, Malete, Nigeria*
[*]Corresponding author: aosunlek@oauife.edu.ng

ABSTRACT
Crude oil spillage during exploration of oil causes a menace to the marine ecosystem and threatens the aquatic lives so it must be cleaned to restore the marine environment to its natural state. Bioremediation is the most environmentally friendly restorative approach to employ in mitigating these spills. A good number of effective oleophilic micro-organisms have been isolated by researchers for bioremediation. This work investigates the interactive effect of various parameters on bacterial growth rate and how these physicochemical parameters (temperature, pH, number of days, inoculum size and crude oil percentage) can be varied to predict bacteria growth rates. Hydrocarbon-degrading bacteria were isolated from an auto-mechanic workshop and growth rate tests were carried out to screen for the two most effective bacteria isolates. Parameters were then varied for the best performing isolates and growth rates were measured periodically for twenty-five (25) days. An artificial neural network (ANN) was employed in training the data and the network parameters were tuned to predict the response from the input factors. The correlation parameter (R2) obtained was greater than 0.91 which demonstrated that the training was successful, and the network could predict closely related values to that of the experimentally obtained values.

TS41 - Adsorption Studies on Waste Plantain Peel Ash as Adsorbent for Sorption of Pharmaceutical Wastewater

Dauda O. ARAROMI[1], Sofiat O. GANIYU[1,2], Ademola T. ADENIJI [1,2,3], Damilola O. ADEBUKOLA [1,2], Ayobami O. AJANI [1,2], Oluseye O. AGBEDE[1], Kehinde A. BABATUNDE[1], Solomon O. ALAGBE[1], Samuel E. AGARRY[1], Taofik A, ADEDOSU[4], Ganiyu K. LATINWO[1], Abass O. ALADE[1,2,5*], and Tinuade J. AFOLABI[1,2]

[1]*Department of Chemical Engineering, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[2]*Bioenvironmental, Water and Engineering Research Group, (BWERG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[3]*Department of Chemistry, University of Porto, Porto, Portugal*
[4]*Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[5]*Science and Engineering Research Group, (SEARG), Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria*
[*]Corresponding author: aoalade@lautech.edu.ng +2347037885961

ABSTRACT
Unregulated use of pharmaceutical products has created a huge threat to all life forms in the biosphere, although they have been credited with benefits such as extending life spans, alleviating diseases, and improving quality of life. This study aims to perform optimization studies of some selected emerging pharmaceutical contaminants from wastewater using adsorbents developed from Plantain peel waste. The plantain peel used was obtained from a local market at Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria. washed thoroughly to remove dirt particles, dried, grounded, screened, and ashed in a muffled furnace at a temperature of 600 ^{o}C for 3 h. Ibuprofen, Doxycycline, and Chloroquine (IDC) mixtures were prepared and 100mL of IDC was mixed with Plantain peel Ash (PPA) and optimization study was carried out and Adsorption capacity (AC) was evaluated as the response. The maximum AC (3.35 mg/g) for Ibuprofen was obtained at Run 7 and 8, the maximum AC (3.15 mg/g) for Doxycycline was obtained at Run 14, and for Chloroquine, the maximum AC (3.51 mg/g) was obtained at Run 5. The Plantain Peel Ash adsorbent developed showed great efficacy in the removal of IDC from an aqueous solution.

TS42 - EMISSION OF AIR POLLUTANTS IN THE PAPER RECYCLING PLANTS: MEASUREMENT RESULTS FROM A NIGERIAN MAJOR PAPER RECYCLING PLANT PRODUCTION FLOORS

Funso A. AKEREDOLU[1], Bamidele S. FAKINLE[2*], Ebenezer L. ODEKANLE[3] and Jacob A. SONIBARE[1]

[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Chemical Engineering, Landmark University, Omu-Aran, Nigeria*
[3]*Department of Chemical and Mineral Resources Engineering, First Technical University, Ibadan Nigeria.*

[1]osnufy2k3@yahoo.co.uk, [2*]fakinle.bamidele@lmu.edu.ng, [3]eodekanle@yahoo.com, 1asonibar@yahoo.com

[*]Corresponding author

ABSTRACT
To assess the contribution of paper recycling plants to atmospheric pollution load, meteorological parameters, and air emissions around paper recycling plant in Ikeja, Lagos, were measured during wet and dry season and, the results were compared with the permissible limits of the Federal Ministry of Environment (FMENV) and World Health Organization. The results indicated that the measured meteorological data were in agreement with the historical data of the study area. Furthermore, 24-hour extrapolated values of both gaseous air pollutants and particulate matters were within permissible limits, although wet season concentrations of the pollutants were lower than dry season concentrations. It was concluded that although, the air quality around the plant currently poses no threat to human's health, long exposure should be avoided.

TS43 - Elemental Characterization of Pollutants Emanated from Combustion of Selected Agricultural Remnants

Temilade, T. ADEBISI[1], Adejoke O. ALAMU[2,] Sunday A. ADEBANJO[3], Olusesan A. OLU-AROTIOWA[2], Kazeem K. SALAM[2], Lukuman, A. JIMODA[2] and Abass O. ALADE,[2*]

[1] Department of Science Laboratory Technology, Oyo State College of Agriculture and Technology, Igboora, Oyo State, Nigeria.
[2]Department of Chemical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.
[3]Chemical Engineering Department, Lagos State University, Epe Campus

[*]Corresponding author: aoalade@lautech.edu.ng

ABSTRACT
Trace metals pose challenges to humanity especially when recommended limit is exceeded. This study considered agricultural remnants: Coconut Husk (CH), Groundnut Shell (GS) and Empty Palm Kernel Fruit Bunch (EPKFB) which were subjected to controlled combustion in a laboratory-scale combustion chamber. The concentration(µg/m^3) range of heavy metals (K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Kr and Rb) analyzed from TSP trapped filters were 0.47 - 464.31; 0.75 - 548.53 and 0.26 - 306.64, that from $PM_{0.8}$ filters were 0.008 – 89.93; 0.076 – 89.021 and 0.083 – 75.34 while 0.083 – 82.40; 0.04 – 77.94 and 0.061 – 59.88 were obtained from 0.4 µm size particles. In exemption of heavy metals analyzed on TSP trapped from GS emission, the concentration of K emitted from all the crop residues burnt significantly preceded others while Ga and Ge mostly have the least emission values. Although there were variations in all the experimental runs, it was discovered that CH emitted a larger elemental concentration compared to other crop wastes. Also, elemental concentrations increase with increasing particle size.

TS44 - Seasonal Variation and Health Risks of Particulates at and around Traffic Hotspots in Ibadan -a Model African Metropolis

Emmanuel T. ODEDIRAN[1*], Jamiu A. ADENIRAN[1], Rafiu O. Yusuf[1]

[1]*Environmental Engineering Research Laboratory, Department of Chemical Engineering, University of Ilorin, Nigeria*

[1*]odedirantolu@yahoo.com, [1]adeniran.ja@unilorin.edu.ng, [1]yusuf.ro@unilorin.edu.ng
[*]Corresponding author

ABSTRACT
Fewer studies have investigated incidents of pollution from vehicular traffic in African cities compared to other parts of the world. This study assessed variation in seasonal concentrations and exposure to health risks of particulates (PM_1, $PM_{2.5}$, PM_{10} & TSP) at and around twenty-five (25) major traffic Intersections (TIs) within Ibadan City, a typical urban environment in Sub-Saharan Africa. The 24h mean concentration of PM_1, $PM_{2.5}$, PM_{10} and TSP sampled at 25 TIs in Ibadan during the dry season were 1.57, 2.29, 4.19 and 4.09 times their corresponding values during the rainy season. The Pearson's correlations of total vehicle on-road with PM_1 and $PM_{2.5}$ were positive while that of PM_{10} and TSP gave negative correlations. Statutory Limit Breach (SLB) values were above the set standards of regulatory agencies at several TIs. Total Respiratory Deposition Doses (TRDD) of PM_1, $PM_{2.5}$ & PM_{10} were higher during the dry season by 35.15%, 56.89% and 78.27% than those during the rainy season. SLB and TRDD estimates showed that road users are significantly at risk of exposure to particulates from traffic-related sources.

TS45 - ISOLATION AND IDENTIFICATION OF POTENTIAL HYDROCARBON DEGRADING MICROBES FROM NON-HYDROCARBON CONTAMINATED SOURCES FOR CRUDE OIL SPILL CLEAN-UP

Elizabeth WINFUL[1], Opeoluwa O. FASANYA[1*], Jibrin ABDULKADIR[1], Balli GAUJE[1], Ugochi J. OKODUWA[1], Simon I. ADAMUN[1], Ephraim AUDU[2], Judy ADUDU[2], Hauwa A. MOHAMMED[1], Olalekan ADESINA[1], Jeffrey T. BARMINAS[3]

[1]*Industrial and Environmental Pollution Department, National Research Institute for Chemical Technology, Zaria, Nigeria*
[2]*Scientific and Industrial Research Department, National Research Institute for Chemical Technology, Zaria, Nigeria*
[3]*Directorate, National Research Institute for Chemical Technology, Zaria, Nigeria*

[1]modupewins@gmail.com, [2*]*ope.fasanya@narict.gov.ng,*
[*]Corresponding author

ABSTRACT
Pollution due to spillage of crude oil has resulted in appreciable levels of damage to many communities. Water sources as well as land are affected leading to destruction of natural fauna and flora. Hydrocarbon degrading microbes from non-crude oil contaminated environments were isolated and their potential degradation efficiency was studied. Morphological and biochemical characterization as well as molecular studies were used to identify the isolates. Preliminary qualitative studies were also carried out on the isolates to evaluate their ability to produce biosurfactants. The microbes were found to belong to Bacillaceae, Xanthomonadaceae and Saccharomycetaceae families. Highest crude oil degradation after 15 days in this study was 45 and 56% by 2 of the 12 isolates studied. This shows that microorganisms isolated from non-crude oil contaminated sites have the potential to degrade crude.

TS46 - PRELIMINARY INVESTIGATION ON DEMULSIFICATION OF NIGERIAN CRUDE OIL EMULSION USING SYNTHESIZED BIO-DEMULSIFIER

Deborah. C **NWAKUBA**[1*], Ibrahim Ali **MOHAMMED-DABO**[1*], Haruna **IBRAHIM**[1*]
National Resaerch Institute for chemical Technology (NARICT), Zaria. Nigeria
Ahmadu Bello University zaria, Nigeria
Kaduna Polytechnic, Kaduna Nigeria
chidimmanwakuba@gmail.com, iroali@mail.ru, ibrahimhauna@gmail.com
* chidimmanwakuba@gmail.com

ABSTRACT
Commercial demulsifiers being used in Nigerian National Petroleum Corporation (NNPC) are not biodegradable which has made it of paramount importance to seek bio-demulsifiers that can be produced in Nigeria from Nigerian vegetable seed oils. In this study, three demulsifiers were produced from Nigerian vegetable seed oils using 15 g of oil, heated to 60 ^{0}C, 25 g of paraffin wax, 30 g of starch and 20 g of soup which were homogeneously stirred for 1hour at 60 ^{0}C and tested alongside the commonly commercial demulsifiers being used in NNPC. They all performed very well at thermal test. Calabash demulsifier had high performance of 80% same as commercial demulsifier while Neem demulsifier had 75% and mahogany has 78%. They are, therefore, good enough to replace commercial demulsifiers at improved level.

Ts47 - DIGESTATE VALORIZATION: A VALUE ADDITION TO ANAEROBIC BIODIGESTION TECHNOLOGY

[1]Minister Obonukut, Sunday Alabi[2], Jock Alexander[2], Kingsley Egemba[2] and Benedict Edenseting[2]

[1]Department of Chemical Engineering, Topfaith University, Mkpatak, Nigeria
[2]Department of Chemical and Petroleum Engineering, University of Uyo, Nigeria

[1]Corresponding Author: minister.obonukut@topfaith.edu.ng /+2348026255655

ABSTRACT
Anaerobic digestion technology, exploited to transform diverse bio-sourced feedstocks into valuable products, is challenged by Gregory effect/Dutch disease. Digestate, the leftover product after biogas generation, is mostly discarded as its valorization is domiciled within fertilizer application. The consumption rate for fertilizer generation is reported to be one-tenth of its production rate. This review found that large-scale bio-fertilizer production is confronted with high operational and transportation costs, greenhouse gas emissions during storage, and improper nutrient content. It becomes necessary to examine the potential of digestate beyond bio-fertilizer application. It was found that the digestate liquor is suitable for microalgae cultivation due to its rich nutritional content. Due to its rich cellulose content, the digestate filtrate is a suitable culture medium for bioethanol production with the additional advantages of about 33% energy reduction with fewer inhibitory compounds. In the case of the digestate residue, strong complementary role of thermochemical process was showcased. It was found that several valuable products with superior properties were produced. These valuable products are exploited as: soil amender, adsorbent, activated carbon, particle board, and nanocellulose. However, the processes are still in their infancy and, as expected, have some drawbacks. Consequently, more studies to overcome these challenges are recommended.

TS48 - Performance of Deep Eutectic Solvents in the Extraction of Lactic Acid from Sugarcane bagasse and Corncob

John E. OGUCHE[1*], Alewo O. AMEH[1], Tajudeen K. BELLO[1] and Nehemiah S. MAINA[1]

[1]*Department of Chemical Engineering, Ahmadu Bello University, Zaria, Nigeria*
1*mailoguchejohn@yahoo.com,alewooameh@yahoo.com,tjbello27@gmail.com, *nsmaina@yahoo.com*
[*]Corresponding author:*mailoguchejohn@yahoo.com*

ABSTRACT
Recently, hydrophobic deep eutectic solvents (HDESs) are gaining attention as to conventional extracting solvents because of their low extraction efficiency, cost, and high toxicities. HDESs are green solvents and have advantages such as low toxicity, recyclability, low viscosity, ease of preparation, biodegradable and sustainable over conventional organics solvents. Three hydrophobic deep eutectic solvent (HDESs) were synthesized from decanoic acid, menthol and thymol using a molar ratio of 1:1 respectively and used to study the extraction of lactic acid produced from corncob and sugarcane bagasse respectively. Their physicochemical properties for all the synthesized HDESs were determined and the value are close to that reported in literature. Conventional solvents such as trioctylamine (TOA), butanol and benzene were also used as extractants for lactic acid in order to compare the performances with the newly prepared HDESs. The Synthesized HDESs showed higher extraction efficiencies of 90 %, 93 % and 89 % from corncob and 94 %, 97 % and 90 % from sugarcane bagasse for DES1, DES2 and DES3 respectively compared to 71-78 % for TOA, 59- 62% for butanol and 56-58 % for benzene from the same substrates. Therefore, HDESs synthesized performed better with higher extraction efficiency than conventional organic solvents used.

TS49 - Synthesis and Characterization of Zinc Chloride Modified Activated Carbon and other Derivative Adsorbents from *Vitex Doniana* Seed

Oluwadayo A. FRANCIS[1*], Emeka C. NWORIE[2], Kevin S. OTOIKHIAN[3]

[1,3]*Department of Chemical Engineering, Edo State University, Uzairue, Nigeria*
[2]*Department of Chemical Engineering Technology, Auchi Polytechnic, Auchi, Nigeria*

[1*]Francis.asokogene@edouniversity.edu.ng, [2]nocyka2016@gmail.com,
[3]otoikhian.kevin@edouniversity.edu.ng

[*]Corresponding author

ABSTRACT
This study evaluated the characteristics and adsorption performance of zinc chloride modified activated carbon (VDZnCl2), its precursor (VDC), and sodium hydroxide (VDNaOH), hydrochloric acid (VDHCl) and thermally (VDT) modified adsorbents from vitex doniana. The adsorption performance of the adsorbents for methylene blue was in this order: VDZnCl$_2$ < VDNaOH < VDC < VDT < VDHCl. The VDZnCl$_2$ was characterized by Fourier transform infrared (FTIR), Brunauer-Emmett-Teller (BET), scanning electron microscope (SEM), energy-dispersive X-ray (EDAX) and thermal gravimetric analysis (TGA). The FTIR spectrum showed the presence of O—H group and characteristics C=C group generally found in carbonaceous materials. The BET surface area remarkably increased from 14.02 m^2/g to 933.25 m^2/g and pore size from 0.92 to 18.9 Å which reflected enhanced specific surface area and porous nature of the adsorbent, and its ability to facilitate pore fillings of many molecules inside its carbon matrix during adsorption. The SEM micrograph showed varieties of pores with widened cavities Therefore, VDZnCl$_2$ is a potential adsorbent substitute for wastewater treatment.

TS50 - Solvent Extraction of Acetic Acid from Aqueous Media Using Trioctyl Phosphine Oxide (TOPO) – Based Solvent Systems

O. SANDA[1,2*], Emmanuel. O. EHINMITOLA[1], Bamidele S. FAKINLE[2] and Elijah. A. TAIWO[1]
[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Chemical, Landmark University, Omu-Aran, Kwara state, Nigeria*

[1,2*] *osanda@oauife.edu.ng,* [1] fehinmi@oauife.edu.ng , [2]fakinle.bamidele@lmu.edu.ng [1] etaiwo@oauife.edu.ng

[*]Corresponding author

ABSTRACT
Acetic acid is a very important commodity chemical with several applications in the chemical and food industry. Although acetic acid can be produced readily via fermentation processes, various factors such as low yield, the presence of secondary fermentation products and the rather complex separation requirements make the production high quality acetic acid via the fermentation route rather expensive. This study examined the reactive extraction of acetic acid from aqueous media using trioctyl phosphine oxide (TOPO) with n – hexane, toluene, methyl isobutyl ketone (MIBK) and methyl ethyl ketone (MEK) as diluents. Effect of various parameters such as phase ratios, and concentration of TOPO in the diluents on the degree of extraction of acetic acid were studied and the results obtained showed that while MEK on its own gave a higher extraction yield than MIBK, a reversal in trends was observed on adding TOPO to these solvents with the MIBK – TOPO system having a greater degree extraction, compared to the MEK – TOPO system. The extractions performed using n-hexane and toluene as diluents gave higher extraction yields with toluene. The degree of effectiveness of the diluents in the extraction of acetic acid from aqueous media is MIBK > MEK > Toluene > n – hexane.
Keywords: *Acetic acid, MIBK, MEK, Reactive Extraction, TOPO.*

TS51 - Electrochemical and Thermodynamic Evaluations of *Spondias Mombin* Leaves Extract as Green Inhibitor for Mild Steel Corrosion in Acidic Medium

Kenneth K. ADAMA*[1], Benedict I. ONYEACHU[2], Ebijuwa M. IGHO[1]

[1] *Department of Chemical Engineering, Faculty of Engineering, Edo State University Uzairue, Edo State, Nigeria*
[2] *Department of Industrial Chemistry, Faculty of Science, Edo State University Uzairue, Edo State, Nigeria*
*Corresponding author: adama.kenneth@edouniversity.edu.ng

ABSTRACT
Acid corrosion of steel-based structural equipment is a serious challenge for the chemical industry, especially, during descaling practices. Adding efficient corrosion inhibitors into the acid solution can significantly mitigate against this phenomenon. Currently, greener corrosion inhibitors, such as extracts of plant parts, have gained outstanding attention because they impact minimally when discharged into the environment. In this work, electrochemical and thermodynamic methods were employed to investigate the inhibitive efficiency of the water and ethanol extracts of spondias mombin leaves against the corrosion of typical industrial steel (C1020) in 1.0M HCl. Both extracts protect the steel surface by blocking anodic and cathodic reactions on the steel surface and lowering the capacitive behavior of the steel-acid interface. The extracts adsorb according to the models of Langmuir and Freundlich isotherms. The ethanol extract performs better (with an efficiency 96–98 %) than the water extract (efficiency 36–38 %) and exhibits more negative ΔG (-28.00 KJ/mol.) which is synonymous with more feasible and spontaneous adsorption.

TS52 - PRODUCTION OF BIODIESEL FROM ORANGE PEEL AND AVOCADO SEED OILS. EFFECT OF REACTION PARAMETERS ON PRODUCTION EFFICIENCY

Sylvester O. Anyikwa*, M. S Nwakaudu., A. Anwakaudu and C. Ngolube

Department of Chemical Engineering, School of Engineering and Engineering Technology, Federal University of Technology, Owerri Imo State.

*Corresponding author: anyikwasylvester@gmil.com

ABSTRACT

Comparative analysis of the effect of reaction parameters on the production of biodiesel from two different non-edible oils (orange peel oil and avocado seed oil) was carried out of the non-edible oils from the orange peel and avocado seed with the aid of a soxhlet extractor in N-hexane. Orange peel gave a percentage oil yield of 14.2%, while that of avocado seed was 20.5%. Transesterification reaction was carried out by a reaction between methanol and oil with sodium hydroxide (NaOH) as catalyst. The varying reaction parameters considered were temperature of 30-80°C, catalyst concentration of 0.03-0.3, methanol to oil ratio of 1:3-1:95. For avocado oil, an optimum yield of 90.23% was obtained at a temperature of 45°C, catalysts concentration of 0.3 and alcohol to oil ratio 9:1; an increase in methanol to oil ratio has greater effect on the yield than temperature. For the orange oil, to obtain an optimum yield of 91.03%, the optimum conditions are temperature of 60°C, catalyst concentration of 0.36 and alcohol to oil ratio of 6:1. It was concluded that orange oil gives a greater biodiesel yield than avocado seed oil.

TS53 - Adsorption Behaviour of Naphthalene, Anthracene and Pyrene in Aqueous Medium onto Rice Husk Ash: Removal Efficiency Optimization

Ayobami O. AJANI [a,b], Ismahil K. SOKUNBI [a,b], Damilola I. ADEBUKOLA,[a,b], Sofiat, O., GANIYU [a,b], Haleema O. ADEDOSU[C], Elizabeth F. ARANSIOLA[d], Tinuade J. AFOLABI [a,b], and Abass O. ALADE,[a,b,e]*

[a] *Department of Chemical Engineering, Faculty of Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

[b] *Bioenvironmental, Water and Engineering Research Group (BWERG), Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

[c] *Department of Science Laboratory Technology, Faculty of Pure and Applied Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

[d] *Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*

[e] *Science and Engineering Research Group (SAERG), Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

*Corresponding Author Email: aoalade@lautech.edu.ng; Phone: *+2347037885961*

ABSTRACT

Polycyclic Aromatic Hydrocarbons (PAHs) are two or more fused aromatic ring compounds that are toxic, carcinogenic and recalcitrant, thus posing risks to the environment and humans. The removal of PAHs from an aqueous solution via adsorption has undergone extensive research and this is extended to the removal of Naphthalene, Anthracene and Pyrene from an aqueous solution using Rice Husk Ash (RHA) as an adsorbent, in this work, under batch adsorption experiment. The raw RH was washed, sun-dried and ashed in a furnace at 700 °C for 4 h. Design Expert (12.1.0) software was employed to optimize the effective mixture ratio (10-80%) of the three samples' concentrations, under Simplex Lattice Design. The maximum ***removal efficiency*** *of 92.31 %, 98.12 % and 92.06 % was obtained for Naphthalene, Anthracene and Pyrene. The Special-Quartic, Special-Quartic and Quadratic model equations with P-Values and Coefficient of Determination (R^2) of 0.0009, 0.9785; < 0.0001, 0.9931; and 0.0046, 0.8416 were generated for Naphthalene, Anthracene and Pyrene, removal respectively. The feasibility of adsorption of PAHs in an aqueous medium using ash-based (rice husk) adsorbent is demonstrated based on the high removal efficiency of the batch adsorption process.*

TS54 - STUDY ON ELECTRICAL AND THERMAL CONDUCTIVITES OF OPTIMIZED RICE HUSK PARTICLEBOARD

Lucas A. J. HAMIDU[1]*, Umar O. AROKE[2], Odeh A. OSHA[3], Idris M. MUHAMMAD[2]

[1]Nigerian Building and Road Research Institute 10, NBRRI Way/ I.T. Igbani Street, off Awolowo Way, Jabi, Abuja, Nigeria
[2] Department of Chemical Engineering, Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi, Nigeria
[3] Department of Chemical Engineering, University of Calabar, P.M.B. 1115, Calabar, Nigeria
*[1]lucadohamidu@yahoo.com, [2]zaaaroke@yahoo.com, , [3]oshaodee@gmail.com, [2]idrismisau@gmail.com

*Corresponding author: *anyikwasylvester@gmil.com*

ABSTRACT
The study determined the electrical and thermal conductivities of the optimized particleboard produced from rice husk waste and R7AD2 adhesive produced from polystyrene waste. The electrical conductivity was determined using industrial insulation test resistance tester and the thermal conductivity was determined using Lee's disc method based on industrial standard. This was to ascertain the extent of the resistance of the particleboard to electrical conductivity and the thickness of the particleboard for energy conservation. The optimized RHP8 particleboard resistance ranges from 1.52×10^{10} ? to 1.21×10^{10} ? , while the corresponding power ranges from 1.64×10^{-5} to 2.07×10^{-3} Watts at 500 V and 5000 V test. The rate of heat transfer and thermal conductivity at RHP8?20 thickness were 28.41 Watts and 8.1×10^{-4} W/m. K respectively. This inferred that the optimised RHP8 particleboard produced from rice husk using R7AD2 adhesive is highly resistant to electric shock and can conserve energy for thermal comfort of the user in structural environment at 20 mm thickness size as desired.

TS55 - INVESTIGATION OF GEOCHEMICAL PROPERTIES OF LATERITES IN SELECTED AREAS IN JOS -NORTH

Yohanna A. ALIYUDA [1], Lucas A. J. HAMIDU[1]*, Friday I. APEH[1], Pyendang S. ZACHARIAH[1], Yakubu ISHENI[1], Felix ACHEMA[1]

[1]Nigerian Building and Road Research Institute, 10 NBRRI Way/I.T. Igbani Street, off Awolowo Way, Jabi, Abuja Nigeria

[1]kiddogimba@gmail.com , *[1] lucadohamidu@yahoo.com, [1]fiapeh2@yahoo.com, [1]pyendangzach@gmail.com, [1]isheniwonders@gmail.com, [1]achemafelix@gmail.com

*Corresponding author

ABSTRACT
This research investigated the geochemical properties of laterite soils in selected three (3) locations of Jos North Local Government Area, Plateau State (Zaria Road, Bauchi Road and Tudun Wada) using the global positioning system (GPS) device for the geographical coordinates locations (altitudes, latitudes and longitudes). The laterite soils were processed for the determinati on of moisture content, loss on ignition, organic carbon contents, oxides and elemental compositions. The results revealed that Zaria Road, Bauchi Road and Tudun Wada moisture contents were 0.82%, 0.33% and 0.23%, loss on ignition0.06912%, 0.0456% and 0.004436%, and organic carbon contents were 0.002138%, 0.001963% and 0.007615% respectively. The XRF results for the oxide compositions ranges are SiO_2 (63.51 – 69.47%), MnO (0.09 – 0.34%), Fe_2O_3 (5.38 – 10.77%), SO_3 (0.09 – 0.258%), CaO (0.82 – 1.67%), K2O (1.21 – 2.55%), Al_2O_3 (15.90 –17.66%), TiO_2 (1.71 – 2.55%), Cl (1.11 – 1.67%) and ZrO_2 (0.089 – 0.194) respectively. The absence of organic carbon matter and loss on ignition in the laterites revealed that the laterites are non -emitting and has high potenti als for the formulation and optimization of the interlocking compressed stabilized earth block (ICSEB) production to compliment the use of conventional Portland cement in infrastructural development.

TS56 - Utilization of COSMO-RS for Valuable Metal Extraction from Spent Lithium-ion Batteries

Hussein K. Amusa,.[ab*]; Ahmad S. Darwish[a], Tarek Lemaoui[c], Hassan A. Arafat[a,b], Inas M. Nashef[a,b]

[a] *Department of Chemical Engineering, Khalifa University of Science and Technology, Abu Dhabi, United Arab Emirates.*
[b] *Center for Membranes and Advanced Water Technology, Khalifa University, P.O. Box 127788, Abu Dhabi, United Arab Emirates.*
[c] *Laboratoire des Matériaux Polymères Multiphasiques (LMPMP), Université Ferhat ABBAS Sétif-1, 19000 Sétif, Algeria.*

[*]Corresponding author: husseinkehindeamusa@gmail.com

ABSTRACT
Lithium-ion batteries (LIBs) wide usage constitutes a disposal threat to the environment. As a result, several laws are being introduced to encourage the recycling of this waste, particularly, in lithium recovery. Deep eutectic solvent (DES) has been reported as an efficient solvent in valuable metal recovery from spent LIBs. However, efficient deep eutectic solvent design requires a smart selection of components. This study developed a COSMO-RS model to screen several components as DES starting material in lithium extraction from spent LIB. The model consists of 191 different constituents. The model is developed using the cosmo therm software in the LIB application for the first time. The model uses lithium chemical potential to measure the affinity of lithium in the screened components. Overall, all the compounds show an affinity for lithium. The components are classified into ionic and non-ionic. The ionic compounds performed better than the non-ionic compounds. This is due to the coordinating ability of the ionic compounds with lithium. Further, this study highlights other properties such as reducibility, toxicity, and viscosity as screening strategies in DES component selection for lithium extraction. This is to implement the full green chemistry principle essential for industrial application.

TS57 - SIMULATION OF SAFETY HAZARDS DUE TO THERMAL RADIATION FROM REFINERY FLARE SYSTEM

S. **MUSA**[1]**;** U. **Abubakar Zaria**[2,*] P.C. **Okonkwo**[3]

[1] *Department of Chemical Engineering, Ahmadu Bello University, Zaria*

Corresponding author: uabubakar@abu.edu.ng/Tel.: +234(0)8033690787*

ABSTRACT
Gas flaring is one of the most difficult energy and environmental issues today. Environmental consequences of gas flaring have serious impacts on personnel and equipment. This often results in equipment damage and serious health problems. In this study, simulation of the thermal radiation hazards due to flare system was carried out. Flaresim Software 5.0 was used. Results show that, the lower level of thermal radiation intensity determined to be 1.577 kW/m², could have a radius falling in the range 200 –400 m the Upper level of the radiation intensity, which was determined to be 6.309 kW/m², could be in the range 40- 130 m, presenting high risks at the base of the flare stack. This study recommends that all safety critical pressure safety valves in the unit should be serviced and recalibrated. Also, operational and emergency flare igniters should be moved to a secure area.

TS58 - Application of Quaternary Composite Adsorbents Prepared from Selected Waste Plastic for Removal of Pesticide Mixture from Wastewater

Sunday O. OLADUNNI[1,2], Dauda O. ARAROMI[1], Akeem O. ARINKOOLA[1], Funmilayo N. OSUOLALE[1], Oladipupo, O. OGUNLEYE[1], Wasiat O. BELLO[1,2], Victoria, A. ADEYI[1,2], Adeola, R. AMOLE[1,2], Tinuade J. AFOLABI[1,2], Abass O. ALADE[1,2,3*]

[1] *Department of Chemical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[2] *Bioenvironmental, Water and Engineering Research Group (BWERG), Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[3] *Science and Engineering Research Group (SAERG), Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

1soladunni2005@yahoo.com, 2doararomi@lautech.edu.ng, [3]waasiahbintbello@gmail.com, [4]tjafolabi@lautech.edu.ng 5aoarinkoola@lautech.edu.ng, 6fnosuolale@lautech.edu.ng, 7ooogunleye@lautech.edu.ng, [8]victoria_adeyi@yahoo.com, [9]amoleadeola1@gmail.com, [10]aoalade@lautech.edu.ng

[*]Corresponding author: aoalade@lautech.edu.ng

ABSTRACT

The discarded plastics of plastic chairs (WPCG), polyvinyl chloride pipes (WPVC), jerry cans (WJCG) and waste electronics casing (WECG) were collected and mixed into a composite for the treatment of an aqueous solution containing a mixture of pesticide Chlorpyrifos and Dichlorvos (DDVP) because the mixture is generated as industrial effluents. Each waste plastic sample was washed, milled to 840um size and acetylated to obtain Activated Waste Plastic Granules (AWPGs). The Mixture Methodology (MM) of Design Expert (DOE 12.0.1) was adopted to generate different mixing ratios (15 to 55%) of the four AWPGs samples leading to AWPG composite (AWPGC), which were used for the removal of the pesticide (Chlorpyrifos and DDVP) mixture from aqueous solution in a batch study. Results showed that the maximum adsorption capacity (2.6091mg/g) and removal efficiency (52.18%) were obtained in Run 2 when the mixture ratio of WPCG: WPVC: WJCG: WECG is 35:35:15:15 % (w/w). This investigation demonstrated that the WPCG: WPVC: WJCG: WECG composite developed has the potential for the removal of strong pesticide (Chlorpyrifos and DDVP) samples from polluted surface water.

TS59 - Air Quality Implication of Solid Waste Incineration in Lagos

Jacob A. SONIBARE[1], Abiodun J. ADEWALE[2*], Daniel O. OKE[3]

[1]*Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*

[1]asonibar@oauife.edu.ng, [2]adewaleabiodun@pg-student.oauife.edu.ng, [3]okedaniel097@gmail.com

[*]Corresponding author: adewaleabiodun@pg-student.oauife.edu.ng

ABSTRACT

Solid waste incineration is a major source of air pollution in the atmosphere which has adverse effects on the environment, plants, animals, and nearby communities. This study carried out air quality implications on some incinerators in Lagos State, Nigeria. The study was undertaken using an emission inventory and ISC-AERMOD view (version 8.2.0) dispersion modeling tool considering five operating conditions scenarios. Impacts of the predicted ground-level concentrations emission of air pollutants including carbon monoxide, CO; oxides of nitrogen, NO_X; sulfur dioxide, SO_2; suspended particulate matter, SPM and hydrocarbons, HC on ambient air quality were investigated using the National Ambient Air Quality Standards (NAAQS) of criteria air pollutants. The study concluded that all the investigated air quality parameters were within their respective standards except the 24-hour averaging period SO_2 and the 1-hour averaging period NO_X. However, modification of the incinerators' stack height from the proposed 6.2 m to 8 m reduces the daily averaging period SO_2 from 31.8 µg/m3 breaching the 26 µg/m^3 limit to 23.9 µg/m^3 that is within it. Similarly, modification of the electric power generator stack from the proposed 6.2 m to 20 m will reduce the anticipated 1-hour NO_X to its world bank group (WBG) limit.

Ts60 - Assessment of Removal Efficiency of Ag_2O-TiO_2-Kaolinite Clay Hybrid Nanocomposite developed for the treatment of Mn(II), Fe(III), Pb(II) And Cu(II) in Mining Wastewater

Mary A. AJALA[1,2*], Ambali S. ABDULKAREEM[2], Abdulsalami S. KOVO[2], Jimoh O. TIJANI[3], AJALA, Olawale Elijah[1]

[1]*Department of Chemical Engineering, University of Ilorin, Ilorin, Kwara State, Nigeria.*
[2]*Department of Chemical Engineering, Federal University of Technology, Minna.*
[3]*Department of Chemistry, Federal University of Technology, Minna, Niger State, Nigeria.*
[1*]ajala.ma@unilorin.edu.ng; maryjokes2002@yahoo.com, 2kasaka2003@futminna.edu.ng 3kovo@futminna.edu.ng 4jimohtijani@futminna.edu.ng [5]*ajala.oe@uniloirn.edu .ng*
[*]Corresponding author

ABSTRACT

This study considered the synthesis of Ag_2O-TiO_2-kaolinite-clay nanocomposite by the combination of green and wet impregnation method, which involves the reduction of silver nitrate and titanium tetra isopropoxide to nanoparticles with aqueous extract of Parkia biglobossa leaf. These were then immobilised on acid-activated kaolinite clay. The prepared nanomaterials' phase structure, morphology, chemical composition, and oxidation states were determined using X-ray diffraction (XRD), high resolution scanning electrode microscopy (HRSEM), and X-ray photoelectric spectroscopy (XPS). The ability of the nanocomposite prepared to adsorb four heavy metal ions (Mn (II), Fe (III), Pb (II), and Cu (II)) from mining wastewater was examined by varying the contact time. The XRD pattern of the Ag_2O-TiO_2-clay reveals the synthesis of the rutile phase of TiO_2 embedded in the kaolinite clay, while the HRSEM shows evenly distributed arrangement of hemispherical stacks of kaolinites. The states of oxidation of Ag and Ti revealed by the XPS are +1 and +4 respectively either as binary or ternary nanocomposite. The Ag_2O-TiO_2-clay nanocomposite adsorbed 99.85%, 97.85% 95.18%, and 40% of Fe (III), Mn (II), Cu(II) and Pb(II) ions at 120 min from the mining wastewater respectively. The synergetic efforts of the Ag_2O, TiO_2, and acid-activated kaolinite clay was found responsible for the adsorptive capability and post-separation possibility of the Ag_2O-TiO_2-clay nanocomposite.

TS61 - Application of Machine Learning Xgboost Model for the Prediction of Dye Adsorption onto Agro-Waste-Based Activated Carbons

Abass O. ALADE[a,b,c]*, Christopher I. ONI[a,b], Oladipupo O. OGUNLEYE[a], Samuel E. AGARRY[a], Ganiyu K. LATINWO[a], Aminah A. SULAYMAN[a], Monsur O. DAUDA[a,b], Teslim B. ASAFA[c,d], Tinuade J. AFOLABI[a,b] and Sanni, A.O. OGIRIMA[e]

[a] *Department of Chemical Engineering, Faculty of Engineering, Ladoke Akintola University of Technology, (LAUTECH), Ogbomoso, Nigeria*
[b] *Bioenvironmental, Water and Engineering Research Group (BWERG),(LAUTECH), Ogbomoso, Nigeria*
[c] *Science and Engineering Research Group (SAERG), (LAUTECH), Ogbomoso, Nigeria*
[d] *Department of Mechanical Engineering, Faculty of Engineering, Ladoke Akintola University of Technology, (LAUTECH), Ogbomoso, Nigeria*
[e] *Department of Information Systems, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*

*Corresponding: aoalade@lautech.edu.ng +2347037885961

ABSTRACT

The machine learning (ML) method is an emerging and powerful tool to elaborate complicated multivariate relationships. Xgboost model of the ML was used to model thirty-nine adsorbents manufactured from sixteen types of agro-waste and Heat-map was used to demonstrate the association of variables with the target-independent variable in a dataset (350 sets) of adsorption trials (adsorbent efficiency). The ideal model parameters were also selected to enhance the outcome, after optimization and selection of the five most associated independent variables (initial concentration, agro-waste pH, surface area, pore volume, and particle size). The scores obtained for the initial concentration, agro-waste pH, surface area, pore-volume, and particle size are 0.351, 0.248, 0.245, 0.129, and 0.025, respectively. The initial concentration and agro-waste pH have the highest influence, while surface area and agro-waste pH were closely correlated. The R, MSE and RMSE of the trained data were 0.95, 0.037636 and 0.194, while those of the Test Data were 0.71, 0.018496 and 0.136, respectively. This study indicates that the Xgboost model is suitable to predict dye adsorption onto agro-waste-based activated carbons.

TS62 - OPTIMIZATION OF AVOCADO SEED OIL EXTRACTION USING FIVE-LEVEL RESPONSE SURFACE METHODOLOGY DESIGN

Saidat O. GIWA[1*], Fatima Y. Abdullahi[2], Olukayode G. OLOYEDE[3], Saidu IBRAHIM[4], Abdulwahab GIWA[5]

[1,23,4]*Department of Chemical Engineering, Abubakar Tafawa Balewa University, Bauchi, Nigeria*
[5]*Department of Chemical and Petroleum Engineering, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria*

[*]Corresponding author: sogiwa@atbu.edu.ng

ABSTRACT

In this work, optimization of avocado seed oil extraction was carried out with the aid of Design Expert 7.0.0. The effects of particle size, extraction temperature and extraction time on the percentage yield of oil and cake were considered. Experiments were designed according to central composite method. With n-hexane as the solvent, each experimental run was carried out in a Soxhlet apparatus. Thereafter, experimental data were modelled. The analysis of variance results showed that the model developed for oil yield was statistically significant with p-value of 0.0277. The R-squared value of the model was found to be 0.6722 which was an indication that the quadratic model developed fairly represented the experimental data. The cake yield model was also significant and had an R-squared value of 0.6459. However, based on the adjusted R-squared value obtained, overall mean was observed to be a better predictor of the cake data. The numerical optimization results predicted 0.74 mm, 55°C and 5 h as the optimum conditions to achieve 13.21 % and 74.63 % oil and cake yields respectively. On validation using the same conditions, 17.54 % oil yield was obtained. The physicochemical properties of the extracted oil were also investigated.

TS63 - Design of Experiment as an Experimental Key in the Optimization of the Oil Yield from Fluidized Catalytic Cracking of Oil Shale Using ZSM-5 Catalyst

B. O. Umeh[1], P.E. Dim[2], A. G. Olugbenga[3] and M.B. Bab[4]

[1,2,3]Department of Chemical Engineering, Federal University of Technology Minna, Niger State, Nigeria.
[4]Department of Water Aquaculture and Fishery Technology WAFT, Federal University of Technology Minna, Niger State, Nigeria.

[*]Corresponding author: bobbyfrank9june@gmail.com .

ABSTRACT

Alternatively, an unconventional fuel oil is obtained by fluidized catalytic cracking of oil shale using abundant deposit of Kaolin Clay which serves as a local source for ZSM-5 Catalyst. Oil Shale is an unconventional source of energy which is abundantly present in some parts of Nigeria like Abakaliki, Bida, Adamawa, Benue, Borno and among others as reported. The material is significant to Nigeria's economic sustainability but yet to be tapped efficiently. The aim of this work is to improve the yield of fuel oil from shale oil via fluidized catalytic cracking using abundant gypsum as catalyst. In this research work, oil shale sample obtained from Lokpanta area of the Abakiliki anticlinorium in Ebonyi State, an epicenter in the Lower Benue trough. Prior to the fluidized catalytic cracking of shale oil using a fabricated fluidized bed reactor, proximate and ultimate analyses were carried out to investigate the obtained shale oil. The optimization methodology involved the use of Design of Experiment (DOE) where the Central Composite Design (CCD) was adopted. The factorial indicates that the optimum yield is at point 5. Therefore, the experimental result shows that Lokpanta has a good organic matter which makes it fit for the optimization of oil yield via a fluidized catalytic bed reactor along with other analytical assessment in subsequent research findings.

TS64 - Profit Making through Pinch Analysis of Feed Gas Circuit in Liquefaction System of Natural Gas

Babatunde O. OLALEYE[1*], Micheal S. OLAKUNLE[2], Adegboyega S. OLAWALE[3]

[1,2,3]*Department of Chemical Engineering, Ahmadu Bello University, Zaria, Kaduna, Nigeria*

[1*]olatunde9200@gmail.com, [2] molakunles@gmail.com, [3]asolawale@yahoo.com

[*]Corresponding author

ABSTRACT

In this study pinch technology was used to determine the reduction of total annual cost for feed gas circuit in cryogenic liquefaction system of natural gas. Reduction of the total annual cost was achieved by determining the optimum minimum temperature difference through a trade-off between the capital cost target and operating cost target. The total annual cost of the base case at minimum temperature difference of 5°C was was compared with the optimized case. At the end of the HEN design total annual cost of $1024920 was saved per annum through optimum temperature difference of 4.1°C.

TS65 - Valorization of *Garcinia kola* Fruit pod Extract as a Green Inhibitor for Mild Steel in Acidic Media

Innocent O. OBOH[1*], Anselm I. IGBAFE[2], Joshua A. ADAM[1]

[1]*Department of Chemical and Petroleum Engineering, University of Uyo, Uyo, Nigeria*
[2]*Department of Chemical and Petroleum Engineering, Afe Babalola University, Ado-Ekiti, Ekiti State, Nigeria*

[1*]*innocentoboh@uniuyo.edu.ng*, [2]*igbafeai@abuad.edu.ng*, [3]*adamsmithsuccess@yahoo.com*

[*]Corresponding author

ABSTRACT

Corrosion is a constant problem since it affects every sphere of the economy, specifically the manufacturing sector resulting in enormous economic loss. Extracts of Garcinia Kola fruit pods were screened for physicochemical and phytochemical properties. The corrosion behaviour and mechanism of mild steel in (1M HCl) hydrochloric acid solutions were examined in the presence of the plant extracts used as inhibitors. The results revealed that as extract concentrations increased, the inhibitors' effectiveness increased as well. Maximum inhibitory efficiency values of 94.4%, 93.4%, 83.4%, 76.9%, and 52.5% were achieved in 1M HCl environments for 500 mg/L, 400 mg/L, 300 mg/L, 200 mg/L, and 100 mg/L, respectively. From the findings, the plant extracts provided gave effective protection for mild steel.

TS66 - Adsorption of Malachite Green onto Cellulose Synthesized from Baobab Pod

Victoria A. ADEYI[1,2], Samuel E. AGARRY[1], Adeola R. AMOLE[1,2,] Wasiat O. BELLO[1,2], Tinuade J. AFOLABI[1,2], Azeez G. AKINYEMI,[1,2], Monsuru O. DAUDA[1,2], Olufunmilayo A. AWORANTI[1,2], Esther O. AWOTONA[1,2] and Abass O. ALADE[1,2,3*]

[1] *Department of Chemical Engineering, Faculty of Engineering, Ladoke Akintola University of Technology, (LAUTECH), Ogbomoso, Nigeria*

[2] *Bioenvironmental, Water and Engineering Research Group (BWERG), (LAUTECH), Ogbomoso, Nigeria*

[3] *Science and Engineering Research Group (SAERG), (LAUTECH), Ogbomoso, Nigeria*

*Corresponding: aoalade@lautech.edu.ng

ABSTRACT

Wastewater generated from textiles, cosmetics and other industries includes different types of dyes used in colouring amongst other impurities and these dyes-laden wastewaters pose health hazards to aquatic life and humans when left in water sources unattended to. Therefore, the need for effective remediation through a suitable technique such as adsorption arises. This study, therefore, looked into the adsorption of Malachite Green (MG) by cellulose generated from the baobab pod. Waste baobab pod synthesized to Baobab Pod Cellulose (BPC) was used in batch adsorption of Malachite Green (MG) from synthetic wastewater. The data obtained were used to determine the adsorption isotherms (Henry, Freundlich and Langmuir) and Kinetic (the Pseudo-Second order) properties of the process. The removal efficiencies of the BPC for MG were in the range of 84.7-91.3% within contact time of 10-225 mins, while the adsorption capacity was 0-8.47 mg/g. The coefficient of determination (R2) for Henry, Freundlich and Langmuir isotherms were 0.9601, 0.9250 and 0.9349, respectively. The adsorption process follows the pseudo-second-order kinetic model Type 1 with its values as 0.99997, 0.99994 and 0.99993 for Pearson's r, R-Square, Adj. R-Square, respectively. Based on the results gotten it can be concluded that baobab pod cellulose is a good adsorbent for adsorption processes.

TS67 - Efficient High Temperature Acid Corrosion Protection of SS 316L Stainless Steel using an Imidazole + KI Inhibitor Mixture

Aremiyau S. MOMOH[1], Kenneth K. ADAMA[1], Ikenna B. ONYEACHU[2*]

[1]*Department of Chemical Engineering, Edo State University Uzairue, Edo State, Nigeria*

[2]*Department of Chemistry, Edo State University Uzairue, Edo State, Nigeria*

[*]Corresponding author: onyeachu.benedict@edouniversity.edu.ng.

ABSTRACT

Protecting chemical reactor alloys is very important in the industry. Nowadays, the use of highly efficient and environmentally friendly chemicals is greatly encouraged. This work investigates the efficiency of a corrosion inhibitor mixture containing 1–benzylimidazole and potassium iodide (KI), for the protection of stainless-steel SS 316L during acid corrosion at 60°C . The inhibitor mixture significantly lowers the alloy corrosion rate and behaves like a mixed-type inhibitor with greater anodic inclination. The mixture delivers an efficiency > 80 %, as confirmed by weight loss, potentiodynamic polarization and cyclic voltammetry characterizations. The inhibitor mixture also enhances passivation of the alloy and mitigates against surface microstructural degradation, based on scanning electron microscopy (SEM) characterization.

TS68 - CHARACTERIZATION OF BAMBU CLAY: AS A POTENTIAL SOURCE FOR ZEOLITE Y SYNTHESIS

[*]Abdullahi Musa

The National Agency for Science and Engineering Infrastructure (NASENI), Abuja

[*]Corresponding author: abdulmusavespa@gmail.com

ABSTRACT

Bambu clay is mined in Wamba Local Government Area (LGA) of Nasarawa State. Over the past several decades, the clay has been intensively used in ceramics formulation and pot-making by the indigene of bambu village in the LGA. Clay mineral has several technological applications in the industry which include ceramics, cements, latex, paint, catalysts for petroleum refining, water treatment, cosmetics and others. In this study, the characterization analysis was conducted so as to determine the potential of bambu clay for zeolite Y synthesis. The results of the analyses reveal that the bambu clay is suspected to be bentonite with Si/Al ratio of approximately 2:0, kaolinite and quartz were predominantly. The surface area is 150.40 m2g-1, pore volume 0.0780 cm3g-1 and pore radius 2.920nm and increase to 530.40 m2g-1, pore volume 0.0780 cm3g-1 and pore radius 2.920 nm after structural changes as a result of calcination and consequently, platy plate lump together appears, indicated the presence of crystalline silica which is evidence of amorphous materials. From these analyses, when compared with other research work, Bambu clay is a potential source for zeolite Y synthesis.

TS69 - Design and Development of Arduino-Based Temperature Monitoring System for a Portable Haemodialysis System

Aminah A. SULAYMAN[1*], Dauda O. ARAROMI[1], Olugbenga E. AYODELE[2]

[1] *Department of Chemical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria*
[2] *Department of Medicine, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria*

[1*]aasulayman@lautech.edu.ng, 1doararomi@lautech.edu.ng 2gbengaayox@yahoo.ca

* Corresponding author

ABSTRACT

Haemodialysis (HD) is a life-saving treatment option for end-stage kidney disease patients to remove excess fluid, substances and waste products through a semi-permeable membrane (dialyser, also known as the artificial kidney). This makes HD a perfect illustration of the synergy between chemical engineering principles and medical care. Although commercial haemodialysis machines are available, high cost, large space consumption, and accessibility to poor masses are significant concerns. This work develops an Arduino-based temperature monitoring system for a low-cost portable haemodialysis machine. In vitro HD system design was verified by experiment using porcine blood, and it can monitor blood and dialysate temperature in real-time using Arduino microcontroller. The accuracy of the designed HD system was determined using Urea Reduction Ratio (URR) and Creatinine Reduction Ratio (CRR). Results of the URR and CRR obtained were 71.97% and 65.29%, respectively. The developed HD system can be used to monitor temperature during haemodialysis.

TS70 - Assessing the Risks Due to Liquefied Petroleum Gas Plants Using Both Quantitative and Qualitative Techniques

Charles Anigbogu[1], Usman Abubakar-Zaria[1,*], and Saidu Muhammad Waziri [1]
[1]*Department of Chemical Engineering, Ahmadu Bello University, Zaria*
[1]*Charles_anigbogu@yahoo.co.uk,* [2]uabubakar@abu.edu.ng, [3] augayya@yahoo.com ;
Corresponding author

ABSTRACT
Fire and overpressure hazards continue to be sources of serious concern in Liquefied Petroleum Gas (LPG) plants which is evidenced by several LPG plant explosion incidents. This research aims to assess fire and overpressure risks due to two case study LPG plants, namely: NAVGAS Sphere and SHIRASH Bullet LPG plants with holding capacities of 4189m3 and 62.2 m3 respectively. Quantitative risk assessment was carried out using the event tree method and ALOHA software tool. While the event tree generates the frequency of the different fire consequences obtainable, the ALOHA predicted the safe zone due to each fire. Based on the analyses, the maximum jet-fire length expected in both NAVGAS and SHIRASH LPG gas plants were 61m and 58m respectively from the epicenter, the safe zone in the event of overpressure for NAVGAS and SHIRASH LPG gas plant was 3300m, and 871m respectively, while maximum Blast overpressure radii were found to be 299m for NAVGAS sphere and 274m for SHIRASH Gas plant respectively. From the study, both plants present a danger to the population within their fire radii.

TS71 - Fuzzy Logic Control of Tomato Conversion in a Triple-Effect Evaporator

Mojirade M. OLORUNTOBA[1*] and Folahan P. IBITOYE[1]

[1]*Department of Research and Development, Prototype Engineering Development Institute, Ilesa, Nigeria*

[1*]mojitoba@yahoo.com, [1]folaibitoye@yahoo.com,

[*]Corresponding author

ABSTRACT
Triple-effect evaporator used in tomato paste industry is one of the largest evaporation process which may be found in an industry. The economy of tomato paste manufacturing depends strongly on the triple-effect evaporator. The implementation of Fuzzy Logic Control in triple-effect evaporator for a 5 ton/h processed tomato juice initially at 5% concentration to 35% tomato paste concentration was adequately studied. It was concluded that most of the output parameters, such as tomato paste concentration; water removed; volumetric flow rate; and area decrease with increasing steam economy (SE); only mass of flow rate increases with increasing SE. Also, the tomato paste concentration increases as the number of effect (NE) increases. The choice of the SE and the NE which is needed was determined with the assistance of the Fuzzy Logic Control considered before the design of tomato paste production facility.

TS72 - Exergy Analysis of a Novel Biodiesel Production Process Integrated with Power Generation

Olajide, G. I. * and Usman, M. A.[1]
Department of Chemical Engineering, University of Lagos, Lagos, Nigeria
[1]musman@unilag.edu.ng; *+2348023186445*
**Corresponding author:* gbolagade.olajide@live.unilag.edu.ng ; *+2348100391852*

ABSTRACT
Biodiesel is often said to be part of the solution to the energy crisis. A major stumbling block to its widespread commercialization is the dilemma in the disposal of glycerol – if it is thrown away it harms the environment; if it is combusted it produces little energy. A third option, though, is to use it, and this option has attracted a lot of research recently. Mehrpooya et al. (2020) have proposed and simulated processes to reform the glycerol, producing electricity. In this paper, exergy analysis was carried out on one of the proposed processes, in order to make it more energy efficient. The process route was simulated, and the necessary data was then extracted from the simulation results and used to carry out exergy analysis. The exergy analysis revealed that the components to be targeted for optimization are the distillation column for purification of the esterification products (T100), the series of splitters used to purify the bottom product of the above-mentioned column (SP100 and SP101), and the neutralizer (R200). This equipment are the sources of 95, 58.5, 160.2-, and 64.5-kW exergy destruction respectively: together causing over 57% of the entire process's energy inefficiencies. Optimization of these equipment will result in a much more energy-efficient process route.