SUMMARY OF CONTENT

There are ten papers in this fourteenth issue of Petroleum Technology Development Journal. The first paper *Synthesis and Characterization of Organo-bentonites for possible Use in the Removal of PAHs from Petrochemical Industries Wastewater Effluents*[1] is a research report which involved the synthesizing of organo-bentonites have been synthesized through ion-exchange reaction using benzyl dimethyl dodecyl ammonium (BDMDA), dioctadecyl dimethyl ammonium (DODMA) chloride; tetraphenyl phosphonium (TPP) and hexadecyl pyridinium (HDP) bromides. The unmodified and modified samples were studied with Fourier transform infrared (FT-IR) spectroscopy, X-ray diffraction (XRD) technique, and Scanning electron microscopy (SEM). The basal spacing of the unmodified bentonite was 17.123Å and after modification it increased to 22.071Å and 20.066Å at 1.0CEC for BDMDA and DODMA respectively. With 1.5CEC of TPP and 2.0CEC of HDP the basal spacing increased to 20.250Å and 18.205Å respectively. The FT-IR studies, according to the authors, also revealed structural differences between the modified and unmodified bentonite samples. The IR spectra of the modified bentonite, they say, showed C-H asymmetric stretching at 2928cm^{-1} for BDMD 2920cm^{-1} for DODMA and 2918cm^{-1} for HDP, symmetric stretching at 2853cm^{-1} for BDMD, 2851cm^{-1} for DODMA and 2851cm^{-1} HDP and bending vibrations at 1460cm^{-1} for BDMDA, 1469cm^{-1} for DODMA and 1469cm^{-1} for HDP with respect to long alkyl chains in BDMDA, DODMA and HDP. The vibration associated with pyridinium was observed at 1490cm^{-1} in HDP modified bentonite. The C=C stretching vibrations in the phenyl ring were at 1587cm^{-1} and 1441cm^{-1} while attachment of the phenyl rings to phosphonium ion were observed by the authors at 1587cm^{-1}, 1441cm^{-1}, and 1438cm^{-1} with respect to TPP modified sample. The authors report that the results of the SEM revealed a tendency towards *flakes/grain like formation and agglomeration.*

The second paper on *Optimization of Transesterification of Castor Oil through Response Surface Methodology*[2] is a study aimed at optimizing the yield of transesterification of castor oil methyl ester (COME) from castor oil, using response surface methodology (RSM). The authors report that they used RSM to analyse and optimize the operating variables for the transesterification process. Box – Behnken design (BBD) was employed to study the effects of reaction temperature (^{o}C), time (min), catalyst concentration (wt.%) and methanol to oil ratio (v/v) on the yield of COME. A total of 29 experimental runs which were generated by BBD were carried out. The results of RSM analysis, they report, indicated that reaction temperature, catalyst concentration and methanol to oil volume ratio were significant variables on the yield of COME. The coefficient of determination obtained ($R^2 = 0.9713$) showed a fitness of a second order model. The interactive effect of catalyst concentration and methanol to oil volume ratio exhibited a positive effect on the COME yield. The optimum conditions for the transesterification reaction based on the second - order quadratic model was found to be; temperature 46.88 ^{o}C, reaction time 107.41 min, catalyst concentration 1.03 wt.% and methanol to oil ratio 0.44 v/v. They conclude that the second order quadratic

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[1] S. L. Abdullahi and Professor A.A. Audu
[2] Akhabue, C. E. and Okpioba, E. E

model developed provides a statistical approach to predicting the optimum yield of COME.

The third paper by Audu[3] is on *Modelling of Biodiesel Reaction.* The author asserts that biodiesel is produced by a chemical reaction known as transesterification in which a triglyceride reacts with a primary alcohol to give an alkyl ester Biodiesel and a by-product Glycerol. The reaction is said to proceed to completion only when the primary alcohol is in excess, but there has not been any Mathematical Model to support the claim. The problem statement as formulated and analysed in this paper justifies the need to use excess primary alcohol for the reaction.

The fourth paper is on *Thermal Transient Analysis to Locate Hydrate Growth and Deposition in Natural Gas and Gas-Condensate Vertical Wells[4]* . The authors observe that ttransient flow of gas and gas-condensate in wells is a problem of industrial interest. They claim that studies abound in the use of pressure transient models in the analysis of hydrate formation, growth, and deposition in these wells, but no study in the use of thermal transient model in the evaluation of these crystalline solids in gas and gas-condensate in wells. They further emphasize that partial and/or complete well blockages stem out from the deposition of hydrates and other solids, but hydrate deposition happens to be the one having the most significant effect in the blockage of these wells leading to reducing flow capacity or total loss in productivity. This research is therefore aimed at developing and using thermal transient analytical model to locate hydrates growth and deposition in vertical wells. To accurately do this, the conservation of material, momentum and energy conservation which were the governing equations was applied to solve the transient flow of gas and gas-condensate in pipelines with respect to their diameter. The application of these conservation equations resulted into nonlinear hyperbolic equations, which were arranged in a canonical form and solved analytically using method of characteristics.

Developed model revealed that hydrate formation or growth and deposition in these fluids well is a function of fluid and solid mechanics, changes in fluid and surrounding conditions, fluid composition and flow rate variation. Solutions of the resulting equations include consideration of flow rate, shear stress and compressibility factor to hydrate growth along pipeline. The results were compared with the field and literature data and a sensitivity analysis was carried out to determine the effects of these varied parameters in the formation, growth, and deposition of hydrates in gas and gas-condensate wells.

The fifth paper[5] is on *Performance Evaluation of a Solar Photo-Voltaic Pilot Biodiesel Plant*. It is a presentation of a method for producing Bio-diesel (fatty acid alkyl ester), from vegetable oils of non-edible seeds or used cooking oil with a homogeneous catalyst, preferably an alkali, dissolved in a primary alcohol to form a liquid-liquid mixture. The liquid-liquid mixture is pumped through a static mixer, for preliminary

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[4] Oluwatoyin Akinsete, Kessiena Arhata And Sunday Isehunwa

[5] By T O K Audu, *et al*

agitation and reaction into the main stirred-tank reactor where the triglycerides are converted / transesterified into fatty acid alkyl ester, the Bio-diesel. The method also provides for further turbulent agitation in a centrifugal contactor separator to ensure maximum conversion of the reactants to products and facilitate the separation of the bio-diesel from the by-product glycerol. The transesterification is conducted at atmospheric pressure and a temperature slightly below the boiling point of the primary alcohol which is recovered from the products through flash evaporation. A Solar Photo-Voltaic Assisted Bio-diesel Plant, designed for sequential modular operation, with a high potential for replication as a model for dissemination and transfer of Bio-diesel production technology in Nigeria, has been developed, constructed, and tested. According to the authors, the Performance Characteristics of the Pilot Plant, with special reference to the Static Mixer and Centrifugal Contactor Separator incorporated in the design show that a reasonable Bio-diesel yield of 86.8% to 96% can be achieved in 4 to 5 minutes after the reaction.

Oil residue in exhumed fractured Precambrian basement rock of the Northern Benue Trough, Nigeria: Implication for oil exploration in the Northern Benue Trough is the sixth paper.[6] It is a study presents for the first-time field, petrographic and geochemical evidence of oil residue in exhumed fractured Precambrian basement rocks of the Northern Benue Trough. The studied oil residues which are brittle solids, are believed to have been emplaced into fractures of the basement rocks as conventional light oils, but have been degraded. Pyrite crystals are closely associated with the fractured basement reservoir. These pyrite crystals are inferred to have a biogenic origin attributed to microbial activity as part of the biodegradation processes. Total ion current (TIC) fragmentogram of the saturate fractions of the studied oil residue shows progressive depletion of chromatographically resolved hydrocarbons relative to the unresolved hydrocarbon mixture, forming an unresolved complex mixture (UCM) hump consistent with oils that have undergone biodegradation. Pristane (Pr) and Phytane (Ph) are present on the *m/z* 85 fragmentogram in abundance lower than those of the adjacent n-alkanes, resulting in Pr/nC17, Ph/nC18 and Pr/Ph ratios < 1.0, suggesting suboxic to anoxic depositional environment for the source of the oil. Sterane maturity parameters, $\alpha\alpha\alpha$ $C_{27}20S/(20S+20R)$, $\alpha\alpha\alpha$ $C_{28}20S/(20S+20R)$, and $\alpha\alpha\alpha$ $C_{29}20S/(20S+20R)$, are 0.50, 0.47, and 0.35, respectively, for the studied oil residue, consistent with oils derived from source rocks that have thermal maturities equivalent to early and peak oil generation. The trisnorhopane thermal indicators (Ts:Tm ratio) of 1.08, and 22S/(22R+22S) C_{32} homohopane isomerization ratio of 0.61 agrees with the sterane maturity parameters of the oil residue which implies that the source rock for the oil residue is within the oil window. Sterane distribution for the oil residue shows strong resemblance to the strerane distribution of extracts of Bima Shales, implying that the oil was sourced from shales of the Bima Formation. The basement rocks occur below a regional plane of unconformity which is inferred to have acted as an important migration pathway for the oil residue. The authors conclude that the occurrence of oil residue in fractures of the exhumed Precambrian basement rocks of the Northern Benue Trough implies that the fractured Precambrian basement rocks are important petroleum reservoir rocks in the region.

The seventh paper[7] is on *Detection of Overpressure in X Field in the Niger Delta*

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[6] Timothy Bata *et al*

[7] Lawrence Idahosa, *et al*

(Central Swamp Onshore Niger Delta basin) Using Well-log and Repeat Formation Tester Data, Well-log, and Repeat Formation Tester (RFT) data were used for the detection of overpressure in X Field in the Niger Delta, using sonic, gamma ray, density, and calliper logs and RFT data. ROKDOC software was used for the analysis of these data. The result, according to the authors, compared with the RFT log data. This they say, shows that the onset of overpressure was observed in Wells A and B depth below 7700ft and in Well C at a depth below 7150ft respectively. The report shows that the formation pressure gradient ranges from 0.836 psi/ft to 0.934 psi/ft for Well A, from 0.830 psi/ft to 0.928 psi/ft for Well B, and from 0.830 psi/ft to 0.967 psi/ft for Well C. They conclude that overpressures in the study area are because of compaction disequilibrium and secondary mechanism. That is the point at which fluids are no longer being expelled effectively due to low permeability as the rock attempts to compact.

The results of this study will be useful in assessing seal effectiveness, mapping of hydrocarbon migration pathways, trap configuration, basin geometry, basin modelling, and safe and economic drilling.

Acid Pre-Treatment and Enzymatic Saccharification of Sorghum Stalk for Cellulosic Ethanol Production, the eighth paper,[8] aims at investigating the effect of process variables during dilute acid pre-treatment and enzymatic saccharification of sorghum stalk for cellulosic ethanol production. The sorghum stalk was pre-treated at different reaction temperature (160 – 220 °C), dilute acid concentration (1 – 3 %v/v), solid/liquid ratio (0.06 – 0.15 g/ml) and time (5 – 15 mins). This was followed by fermentation to production and characterization of ethanol. Optimum conditions for pretreatment were reaction temperature of 210 °C, acid concentration of 3 % v/v, solid/liquid ratio of 0.1 g/ml and a reaction time of 10 mins. The authors observed that maximum percentage reducing sugar at this condition was 14%. The result of ethanol characterization revealed that the ethanol production meets the ASTM standard. They conclude that for this reason, sorghum stalk is a potential feedstock for the production of bioethanol.

The ninth paper[9] is on *Application of Data-Driven Self-Optimizing Control to Reservoir Production Optimization.* The authors note that reservoir waterflooding is one of the cheapest means of producing hydrocarbon from underground formation to the surface. They claim that a properly formulated control and optimization strategy will not only solve the process inevitable problems but will also lead the process to optimal operation. Previous optimization studies, they observe, are model-based, but reservoirs are highly complex, and therefore cannot be described and predicted accurately using models in their view. To counteract the effects of reservoir model/system mismatch, feedback control was suggested to be included in the optimization framework. In this work the principle of self-optimizing control (SOC) is used to derive controlled variable (CV) based on synthetic data. The authors claim to have previously implemented this methodology on a very small reservoir.

The present work extends the implementation to a realistically sized reservoir. In the methodology, the CV is formulated via a single regression step in which a measurement function is used to approximate the gradient of the objective function with respect to

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[8] I. A. Mohammed *et al*
[9] Alhaji Shehu Grema and Yi Cao

control. The developed CV is firstly implemented on a nominal model and then to various uncertain cases. The performance of the method is compared to that of open-loop solution technique, OC (based on optimal control theory) and then to a benchmark case. The developed CV is found to be robust in the presence of uncertainties. In one of the cases considered, the SOC method is found to be better than OC solution procedure by about 24.03%.

The tenth and final paper[10] on *Recession to Recovery: Essentials of Education and The Role of Petroleum Technology Development Fund in Capacity Building for Sustainable Hydrocarbon Development in Nigeria.* The authors present an update on the role of education in the economic recovery of a nation and Petroleum Technology Development Fund's [PTDF] experiences in the 21st Century strategic and sustainable educational funding for capacity building in Nigeria. They observe that the IPS model of education in Nigeria is quite unique because of its quality products and relevance to the modern day educational systems comparable to what is obtainable in other developed economies, noting further that high impact graduates that are fit and proper for the industry are hallmarks of the IPS.
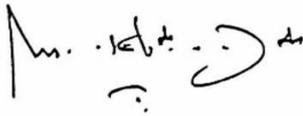
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[10] Neeka Jacob *et al*