Petroleum Technology Development Journal

SUMMARY OF CONTENT

There are eight papers in this thirteenth issue of Petroleum Technology Development Journal. The first paper **Kinetic Studies of Esterification of Rubber Seed Oil with Homogeneous Acid Catalyst for Biodiesel Production**[1] is an investigation of Kinetic studies of the esterification of free fatty acid (FFA) of rubber seed oil (RSO) for biodiesel production. Esterification of RSO was carried out in batch experiments using a 1 litre round bottom flask placed on a constant temperature magnetic stirrer. The effect of catalyst concentration (1 – 2.5 vol.%), methanol to oil ratio (1:5 – 1:2 v/v) and temperature (45 – 60 ^{o}C) on the acid value (AV) of the fatty acid methyl ester (FAME) was studied and analyzed by the authors. Integral method of kinetic data analysis for constant volume batch reactor systems was used to study the reaction kinetics with the assumption that the reaction was irreversible. The AV of the FAME was found to decrease as the catalyst concentration was increased. The authors also observed that methanol to oil volume ratio of 1:2 gave the least AV as time for esterification reaction was increased. At a temperature of 55^{o}C, the least AV was recorded after esterification reaction time of 90 min. The kinetics of esterification revealed a second order reaction in FFA with an average rate constant of 0.267 L/mol min. Activation energy and collision frequency factor were also estimated to be 21.2091 kJ/mol and 671.155 L/mol min respectively.

In the second paper **Comparison of Algebraic-KTGF and Transport-KTGF in Gas-Solid Flow Development in a Pilot-Scale Circulating Fluidised Bed (CFB) Reactor**[2]**, n**umerical simulations of isothermal turbulent gas-solid flow in the riser of a pilot-scale circulating fluidised bed reactor was carried out using FLUENT CFD software. A Eulerian-Eulerian multiphase flow model was used. The constitutive equations in terms of the granular temperature based on the kinetic theory of granular flow were used to determine the solids pressure, shear, and bulk viscosity. The granular temperature was then determined using both the algebraic and differential transport models. The k–ε model for the gas phase turbulence. The predicted particle velocity and concentration were compared with experimental data collected by Huang et al[3] in a riser of 15.1m in height and 0.10m in diameter with particles of 67μm mean diameter. In general, the measured trends were as predicted from both the models of granular temperature. However, the predictions obtained using the differential transport model for the granular temperature are in a better agreement with data compared with those obtained using the algebraic model.

In **Hydro-Cyclone De-Oiler Enhancement for Produced Water Treatment**[4], Ajie, Philip et al, investigated the effect of retrofitting and systematic upgrade of the Hydro-cyclone De-oiler unit during produced water treatment. The internal orifice of the oil

[1] Akhabue, C. E, and Okwundu, S. O.

[2] M. N. Idris, T. Mahmud and B. M. Gibbs

[3] Huang, W., Yan, A., and Zhu, J. (2007), *'Hydrodynamics and flow development in a 15.1 m circulating fluidised bed riser'*, *Chemical Engineering Technology*, **30(4)**, pp. 460-466

[4] Ajie, Philip; Aimikhe, Victor and Dulu Appah

reject cones attached to the end of the oil reject Liners was mechanically and sequentially increased and the performance tested from 1mm up to 2.0mm; and then dimensioned to a maximum of 3.0mm internal diameter. A single centrifugal pump (maximum flow-rate of 199m^3/hr (30,000 Barrels per Day) and a pressure of 10 -15 bar-g), was installed along a 6-inch produced water outlet spool of source production separator leading to the De-oiler. This according to the authors was done in order to boost the operating pressure of the Hydro-cyclone De-Oiler unit to at least, the threshold limit of 5.7 bar-g. Keeping the operating pressure of the De-oiler below 4.2 bar-g, increasing the internal diameter of the oil reject Liner Cone orifice, followed by soaking and cleaning up of the clogged Liner tangential inlet with a 4:1 dilute hydrochloric acid, resulted in an increase in the reject oil production rate from 1.19 barrels per day/orifice to 4.45 barrels per day/orifice (a 374% increase). The introduction of the booster centrifugal pump increased the hydro-cyclone operating pressure from an inlet pressure of about 3.5 bar-g to 7.0 bar-g, accelerated the outward acting centrifugal and G-forces to about 10 times its original value and increased the rising velocity of oil droplet size. The Hydro-cyclone De-oiler increased produced water throughput from the critical flow-rate of 77.0 m^3/hr to a maximum capacity of 201 m^3/hr. The main contribution of this research according to the authors, is the fact that produced water treatment unit Hydro-cyclone De-oiler oil reject flow-rate can be enhanced to about 177% with about 300% increase in initial oil reject cone orifice internal diameter; if the critical pressure drop ratio across the De-oiler or choked flow ratio is below 1.0 bar-g.

The paper on **Automatic First Break Picking from Pre-stack Seismic Section – Application in Sufyan Oil Field, Sudan**[5] describes first break picking as involving detecting the onset arrivals of refracted signals from a single signal source at the individual receiver in a receiver array. First-break picking can be done manually or automatically. This work outlines the procedures and benefits of automatic picking from first arrivals using monitor records obtained from reflection survey in Sufyan Oil Field, Sudan. The first breaking was done using SeisOptPicker. The authors claim to have ensured reliable picking by applying linear move out (LMO) to the data before picking. This they say was reversed after picking. The length, in milliseconds, of the time window for the automatic picker to look for the first arrival on a trace was set to a value of 20-ms to accommodate the large distance between the nearest and farthest offset. The start time search from last first break pick was set at 0 milliseconds. This means that it will not look for the pick at a time earlier than the current pick. Traces where the first arrival comes in earlier than the preceding trace were rejected. The results obtained from the automatic picks were compared with results from conventional refraction survey. The Sufyan prospect Low Velocity Layer (LVL) consists mainly of three layers from both refraction survey and parameters computed from first break automatic picks from production survey. The average thickness of first layer obtained from refraction was 20.0m as against 22.4m obtained from automatic picks. The velocities calculated for these layers are 435m/s and 400m/s from the refraction and automatic picks respectively. The second layer thicknesses obtained from the refraction survey and

[5] Eze, C. L. and Mbachi, C. N. C

automatic picks from production survey approaches are 52.8m and 50.0m. Their velocities in the same order are 931m/s and 800m/s. The consolidated layer average velocity calculated from refraction survey and automatic picks from production survey are 1850m/s and 1848m/s respectively. The authors conclude that LVL parameters obtained from automatic first break picks from production survey can be used for static corrections in the Sufyan oil field without conducting dedicated refraction surveys.

Oladele et al[6] in **Geological and Volumetric Risks Analysis of Hydrocarbon Reservoirs in "Mgt" Field, Deep Offshore Niger Delta, Nigeria** carried out a study of the reservoirs in MGT field, deep offshore Niger Delta Basin Nigeria with the aim of undertaking risk analysis of the identified prospects within the field through geological and volumetric assessments. Petrophysical analysis was carried out using two offset wells comprising gamma ray, resistivity, neutron, density, and sonic logs. Seven reservoir sands (A-G) with structural traps, were analysed through well log and seismic interpretation. Amplitude extraction generated on the reservoir sands showed that only reservoirs: C and E are of good quality and of possible hydrocarbon prospects. The hydrocarbon volume in place was estimated to be 46.4 and 386 million barrels for Reservoirs B and E respectively. The AVO generated for liquid factor indicated AVO Type III which points out a setting where unconsolidated reservoir sands are encased in higher impedance shales. The results of the study showed that MGT Field has a good hydrocarbon potential, however, the geological and volumetric risk analysis of the reservoirs revealed moderately low chance of success of the identified prospect.

In the paper, **Correlations for Predicting Vapour – Solid Equilibrium Constants**[7]**,** Fiberisima et al emphasizes the importance of reliability of prediction models in determining hydrate forming temperatures adequately. Most correlations as they found out vary significantly from experimental hydrate forming temperature data. The study is focused on developing correlations for predicting vapour solid constants for methane, ethane, propane, iso – butane, normal – butane, carbon IV oxide and hydrogen sulphide by extracting over 2000 data points from the GPSA chart. The correlations developed in this study were used to develop a computer program for predicting natural gas hydrate formation temperatures for mitigating the challenges posed by natural gas hydrate formation in process installations. The correlations gave correlation coefficients between 0.9 and 0.99. The computer model developed gave an average relative error of -3.73%, coefficient of correlation of 0.94 and a standard deviation of 5.9%.

In **Evaluation of Steady and Unsteady Flow Phenomena Using Computational Fluid Dynamics (CFD) Modelling Methodology in Circulating Fluidised Bed (CFB)/Fluid Catalytic Cracking (FCC) Reactor Systems**[8], the simulation framework was developed from the licensed computational fluid dynamics (CFD15) software to simulate the hydrodynamics of gas-solid flow in CFB/FCC riser reactors. The predictions from the commercial CFD code (CFX and fluent) were based on the Eulerian-Eulerian multiphase model using k-ε model. A validation using published experimental data from the open literature was conducted. The flow model is based on a Eulerian-Eulerian description of the phases where the kinetic theory for granular flow

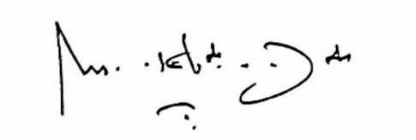
[6] Sunday Oladele, Samuel B. Olobaniyi, and Olanireti Odugboye
[7] Fiberesima, Tamunotonye; Aimikhe, Victor, and Dulu, Appah
[8] M. N. Idris, T. Mahmud, and B. M. Gibbs

(KTGF) forms the basis for the turbulence modelling in the solid phases. The authors say that in addition, to constant diameter and particle density, better understanding of the hydrodynamics of the gas-solid flow, under various loading of gas and solid flux were achieved. Within the limit of the computational error, it was found that the choice of the ANSYS Fluent solver provide the best understanding on the gas-solid hydrodynamics in CFB/FCC riser systems. Furthermore, the availability of transport KTGF in Fluent solver was a focus reason the concluded choices of establishing a better understanding of the gas-solid hydrodynamics in riser reactors were deduced.

The paper on **A Review of 3G Data on The Nigerian Benue Trough in View of Renewed Hydrocarbon Exploration Campaigns**[9] looks at the search for hydrocarbon in the Benue Trough. The authors explain that the Benue Trough, divided into lower, middle, and upper portions, is a SW-NE trending intracratonic basin containing Cretaceous-Tertiary sediment fill of up to 6,000 m. They observe that appreciable volumes of 3G (Geological, Geochemical, Geophysical) data had been generated on the basin by several previous workers and operating companies. Geological profiles juxtaposed against geophysical data, they note, have delineated more prospective areas in the basin where sediment thicknesses vis-à-vis depths to basement are relatively large. Organic geochemical data have been interpreted in terms of organic matter maturation, hydrocarbon generation, expulsion, and migration culminating in the understanding of the volume and stratigraphy of potential source rocks.

Consequently, in the Middle Benue Trough, source rock facies have been identified in the carbonaceous shales of the Keana-Awe, Ezeaku and Awgu Formations with most prospective parts covering the areas within and around Lafia, Loko, Dedere, Doma and Shabu where the Lafia Formation has added to the sediment thickness. In the Upper Benue Trough, source rock facies comprise the carbonaceous intervals within the Gongila, Pindiga and Fika Formations with more prospective areas covering the areas within and around Gombe, Gombe-Aba, Dukku and Akko where the Kerri-Kerri Formation has added to the sediment thickness. Previous efforts by Shell (SNEPCO) according to the authors have tested little oil and more gas in the Kolmani River-1 well drilled at Futuk near Alkaleri, spudding on the Kerri-Kerri and bottoming on the Yolde. They paper concludes that considered against analogs in similar rifted basins in Chad Republic, Sudan, Uganda and Kenya, there are real possibilities for commercial oil and gas discoveries in the Nigerian Benue Trough.

The Editorial Board is grateful to the researchers who were involved in this publication, authors of the articles, petroleum industry operatives, our technical adviser, anonymous external assessors, and paper reviewers, who have been consistent in assisting us to ensure that we continue to improve the quality of the journal as we sustain our commitment to publish twice yearly in January and July.



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[9] N. G. Obaje, C. O. Ofoegbu, I. Anzaku, B. Gbatse