SULFUR AND NITROGEN REMOVAL OF MODEL FUEL USING ACTIVATED CARBON DERIVED FROM OIL PALM SHELL

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ABSTRACT

This research was done to understand the suitability and effectiveness of oil palm shells (OPS) as low cost adsorbents via physically activation with carbon dioxide (CO_2) as an adsorbent for desulphurization and denitrogenation of a model fuel under different concentration. Batch mode experiments were conducted to study the effects concentration of Benzothiophine, Quinoline and Indole. Activated carbon (AC) was prepared at three different activation temperatures (500°C, 600°C, and 700°C), which was characterized with Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and a mercury intrusion porosimeter. After adsorption, the solution was analysed with a Gas Chromatography (GC). Equilibrium adsorption isotherms and kinetics were investigated. The experimental data were analysed by the Langmuir and Freundlich models of adsorption. The adsorption isotherm data were fitted well to Langmuir isotherm and the most adsorption capacity on the best suited AC for Benzothiophene, Quinoline, and Indole were 3.64 mg/g, 4.19 mg/g and 2.98 mg/g respectively. The rates of adsorption were 0.19409 h^{-1}, 0.08411 h^{-1}, and 0.02883 h^{-1} for the adsorption of Benzothiophene, Quinoline, and Indole respectively. The kinetic data obtained at different concentrations have been analysed using a pseudo-first-order, pseudo-second-order equation and intraparticle diffusion equation. The pseudo-first-order model best described the sorption process and was employed in predicting the rate constant, equilibrium sorption capacity as well.

ABSTRAK

Kajian ini dijalankan untuk memahami kesesuaian dan keberkesanan kulit kelapa sawit (OPS) sebagai adsorben kos rendah melalui fizikal pengaktifan dengan karbon dioksida (CO_2) sebagai adsorben untuk desulfurisasi dan denitrogenation daripada bahan api model di bawah kepekatan yang berbeza. Eksperimen mod batch telah dijalankan untuk mengkaji kesan kepekatan di Benzothiophine, Quinoline dan Indole. Diaktifkan karbon (AC) telah disediakan pada tiga suhu yang berbeza pengaktifan (500 ° C, 600 ° C dan 700 ° C), yang dicirikan dengan Mengimbas Mikroskopi Elektron (SEM), Fourier Transform Infrared Spektroskopi (FTIR) dan pencerobohan merkuri porosimeter. Selepas penjerapan, penyelesaian dianalisis dengan Kromatografi Gas (GC). Keseimbangan isoterma penjerapan dan kinetik telah disiasat. Data ujikaji dianalisis oleh Langmuir dan Freundlich model penjerapan. Data penjerapan isoterma telah fi tted baik untuk Langmuir isoterma dan kapasiti penjerapan yang paling di AC yang paling sesuai untuk Benzothiophene, Quinoline dan indole adalah 3.64 mg/g, 4.19 mg/g dan 2.98 mg/g. Kadar penyerapan adalah 0,19409 h^{-1}, 0,08411 h^{-1}, dan 0,02883 h^{-1} untuk penjerapan Benzothiophene, Quinoline dan indole masing-masing. Data kinetik diperolehi pada kepekatan yang berbeza telah dianalisis menggunakan pseudo-tertib-pertama, persamaan pseudo-tertib-kedua dan persamaan resapan intrapartikal. Model pseudo-tertib-pertama digambarkan proses erapan dan telah digunakan dalam meramalkan kadar tetap, kapasiti keseimbangan penyerapan juga.