MODELLING OF BREAKTHROUGH ADSORPTION AND KINETICS OF SO2 AND O2 ON FECL3.6H2O TREATED ACTIVATED CARBON FROM PALM SHELL PRECURSOR

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Abstract

As an alternative to flue gas desulphurization (FGD) in abatement of SO₂ from the atmosphere, breakthrough adsorption behaviours of SO₂ were studied on sustainable agro-based palm kernel shell (PKS) activated carbon impregnated with Ferric Chloride Hexahydrate (FeCl₃.6H₂O) solution in a fixed bed adsorption column at standard temperature and pressure. PKS activated carbon produced was tested for its physicochemical properties using SEM, FTIR, TGA and nitrogen adsorption at 77K. As a control, breakthrough adsorption behaviour of SO₂ was conducted in comparison with that of oxygen in terms of breakthrough time, adsorption kinetics and gas-solid equilibrium positions. The kinetics of the adsorption process was very fast at the beginning but went slowly as it proceeded with time. In order to validate the breakthrough pattern of SO₂ adsorption in a fixed bed column of activated carbon in terms of adsorption kinetics and equilibrium position, the experimental kinetics of adsorption rate is compared with the simulated adsorption using pseudo-first-order, pseudo-second-order and Avrami kinetic models to determine which model best fits the experimental kinetic data. The experimental equilibrium sorption capacity was also compared with simulated result using the Freundlich, Sips, and Toth model to depict SO₂ - activated carbon equilibrium isotherm. Fitting accuracy of each kinetic and equilibrium model with experimental results were determined by their respective nonlinear coefficient of determination (R²) values. From results obtained, the simulated predictions using the models fits the experimental data at the flowrate of 100 mL/min, atmospheric temperature and pressure.