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Low-cost and eco-friendly activated carbon from modified palm kernel shell for hydrogen sulfide removal from wastewater: adsorption and kinetic studies

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ABSTRACT

Palm kernel shell is an abundant agricultural by-product in Malaysia, which is mainly used for producing activated carbon (AC) via the process called physicochemical activation. The applicability of AC derived from palm kernel shell (ACPKS) was investigated for the removal of dissolved H_2S from wastewater. ACPKS was characterized by energy-dispersive X-ray, Fourier transform infrared spectroscopy, Brunauer–Emmett–Teller surface area and scanning electron microscope. The batch mode was utilized for studying adsorption capacity. The effects of various parameters were evaluated and these parameters were then optimized. Parameters such as initial concentration (500 mg/L), dose (100 mg/L), pH (7), agitation speed (150 rpm) and contact time (14 h) for removing dissociated H_2S were optimized. Equilibrium data for H_2S adsorption on ACPKS were fitted using the Langmuir, Freundlich, Temkin, and Dubinin–Radushkevich isotherm models. The experimental data were comparable to the predictions of Langmuir equation, where the maximum monolayer adsorption capacity of 524.2 mg/g was found. The pseudo-first-order, pseudo-second-order, and intraparticle diffusion models were employed for simulating the experimental data for the adsorption kinetics. Among these models, the pseudo-first-order model was the best fitting model based on the correlation coefficients (R^2) and normalized standard deviation (sum of squared error). The current study shows that ACPKS is the promising adsorbent for removing H_2S from wastewater and other aqueous solutions.

Keywords: Palm kernel shell; Hydrogen sulfide; Activated carbon; Adsorption isotherms; Water treatment; Kinetics

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