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Large surface area activated carbon from low-rank coal via microwave-assisted KOH activation for methylene blue adsorption

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ABSTRACT

Merit Kapit (MK) as a low-rank Malaysian coal was utilized as a precursor to develop a large surface area activated carbon (MKAC) via a microwave-induced KOH activation. The characterizations of the raw MK and MKAC were investigated by surface area analysis, scanning electron microscopy, X-ray diffraction, Fourier transform infrared, elemental analysis (CHNS) and point of zero charge (pH_{PZC}) method. The surface area of MKAC was remarkably increased up to 1,100.18 m²/g compared with 332.61 m²/g of MK before activating process. The adsorptive properties of the MKAC with methylene blue (MB) was conducted at different adsorbent dose (0.3–3.6 g/L), solution pH (2–12), initial dye concentrations (25–350 mg/L), contact time (0–240 min) using batch mode operation. The impregnation ratio is 1:2 (MK:KOH), microwave power of 600 W, and radiation time of 15 min resulted in MKAC with a monolayer adsorption capacity of 200 mg/g for MB at 30°C and carbon yield of 63.6%. The kinetic profiles were described by the pseudo-second-order kinetics. Thermodynamic functions indicate a spontaneous and endothermic nature of the adsorption. This study introduces MK as a promising renewable precursor for developing a large surface area activated carbon.

Keywords: Coal; Activated carbon; KOH activation; Microwave irradiation; Adsorption; Methylene blue

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