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Adsorption of methylene blue onto coconut (*Cocos nucifera*) leaf: optimization, isotherm and kinetic studies

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ABSTRACT

Fallen coconut leaves (CLs) are agricultural wastes largely available in Malaysia. In this study, we utilized CLs as a low-cost adsorbent for adsorptive removal of methylene blue (MB), a cationic dye from aqueous solution. Response surface methodology was employed to investigate the effects of operational parameters on MB removal efficiency. The investigated variables included adsorbent dosage (0.5–1.5 g/L), initial MB concentration (10–50 mg/L), initial solution pH (4–10), and agitation time (5–45 min). The analysis of variance was incorporated to test the adequacy of the model. The highest MB removal efficiency was achieved by simultaneous interactions between adsorbent dosage with pH, adsorbent dosage with agitation time, and pH with agitation time. Other simultaneous interactions showed lower effects. The optimum adsorbent dosage, initial MB concentration, initial solution pH, and agitation time were 1.26 g/L, 19.01 mg/L, 8.65, and 5.00 min, respectively. Under optimal conditions, high removal efficiency for MB was observed as 86.38%, and the equilibrium adsorption isotherms and kinetics were investigated. The Langmuir, Freundlich, and Temkin models of adsorption were used to analyze the experimental data. Pseudo-first-order and pseudo-second-order models were also employed to analyze the kinetic data obtained at different MB initial concentrations. The adsorption kinetics closely followed the pseudo-second-order model. Based on the Langmuir model, the maximum adsorption capacity of MB on the CL surface was 112.35 mg/g at 27 ± 2°C.

Keywords: Adsorption; Methylene blue; Coconut leaves; Low-cost adsorbent; Optimization; Response surface methodology

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