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Adsorption of methylene blue onto acid-treated mango peels: kinetic, equilibrium and thermodynamic study

Ali H. Jawad[a,b*], N.F. Hanani Mamat[b], Mohd Fauzi Abdullah[b], Khudzir Ismail[a]

[a]*Coal and Biomass Energy Research Group, Faculty of Applied Sciences, Universiti Teknologi, MARA, 40450 Shah Alam, Selangor, Malaysia, Tel. +60 49882571; email: ali288@perlis.uitm.edu.my, ahjm72@gmail.com (A.H. Jawad), Tel. +60 355444562; email: khudzir@salam.uitm.edu.my (K. Ismail)*
[b]*Coal and Biomass Energy Research Group, Faculty of Applied Sciences, Universiti Teknologi, MARA, Arau Campus, 02600 Arau, Perlis, Malaysia, Tel. +60145050781; email: nanihanani49@yahoo.com (N.F.H. Mamat), Tel. +60 49882737 email: mohdfauziabd@perlis.uitm.edu.my (M.F. Abdullah)*

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ABSTRACT

Mango (Mangifera indica L.) peel, an abundant residue of the food industry and kitchen waste, was used as an alternative source of activated carbon. In this work, mango peels activated carbon (MPAC) was prepared by chemical activation with H_2SO_4. The physical properties of the MPAC were evaluated through the bulk density, ash content, moisture content, and iodine number. The surface characterization of MPAC was achieved using fourier transform infrared (FTIR), scanning electron microscopy (SEM), and the point of zero charge (pH_{PZC}) method. Batch experiments were carried out for the adsorption of methylene blue (MB) onto MPAC surface. The operating variables studied were adsorbent dose, initial solution pH, initial dye concentration and contact time, and temperature. Langmuir, Freundlich, and Temkin isotherms were used to analyze the equilibrium data at 303 K. The kinetic uptake profiles are well described by the pseudo-second-order model, and the Langmuir model describes the adsorption behaviour at equilibrium. The maximum adsorption capacity of MPAC with methylene blue was 277.8 mg g^{-1}. Various thermodynamic parameters such as standard enthalpy (ΔH^o), standard entropy (ΔS^o) and standard free energy (ΔG^o) showed that the adsorption of MB onto MPAC was favourable and endothermic in nature. Thus, this study demonstrated the potential of using mango peels waste as cheap and efficient raw materials to produce activated carbon for MB removal.

Keywords: Mango peels; Activated carbon; Methylene blue; Adsorption; Biomass; Activation

*Corresponding author.