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Adsorption of methylene blue dye from aqueous solution by novel biomass *Eucalyptus sheathiana* bark: equilibrium, kinetics, thermodynamics and mechanism

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ABSTRACT

This study was undertaken to evaluate the adsorption potential of a naturally available, cost-effective, raw eucalyptus bark (EB) (*Eucalyptus sheathiana*) biomass, to remove organic methylene blue (MB) dye from its aqueous solutions. Effects of various process parameters such as initial dye concentration, adsorbent loading, solution pH, temperature, presence of salts, mixture of dyes and surfactant onto MB dye adsorption by bark material were studied. Significant effect on adsorption was witnessed on varying the pH of the MB solutions. Results showed that the optimum pH lies between 7.4 and 10.0. The extent (%) of MB adsorption from aqueous solution decreased with the increase in the initial MB dye concentration, but increased with rise in temperature. The extent of MB dye adsorption was found to be enhanced due to increase of salts concentration. This is because of salting-out-effect, which comprises the changes of various short range forces. The overall kinetic studies showed that the MB dye adsorption by EB biomass followed pseudo-second-order kinetics. The mechanism of MB dye adsorption was analysed by intra-particle diffusion model and desorption study. Free energy change of adsorption (ΔG°), enthalpy change (ΔH°) and entropy change (ΔS°) were calculated to predict the nature of adsorption. The Langmuir adsorption isotherm model yields a better correlation coefficient than the Freundlich model and the dimensionless separation factor "R_L" indicated favourable adsorption process. The maximum Langmuir monolayer adsorption capacity of raw EB for MB dye was found to be 204.08 mg/g at 30°C. A single-stage batch adsorber design for MB dye adsorption onto EB biomass has been presented based on the Langmuir isotherm model equation. The results obtained in this study suggest a promising future for inexpensive raw EB biomass as a novel adsorbent and a better alternative to activated carbon adsorbent used for the removal of MB dye from dye bearing effluents.

Keywords: Eucalyptus bark biomass; MB adsorption; Desorption; Kinetic model; Isotherm

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