Application of a low-cost bagasse carbon-red mud (BCRM) adsorbent for adsorption of methylene blue cationic dye: adsorption performance, kinetics, isotherm, and thermodynamics

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ABSTRACT

To understand adsorption property of bagasse carbon-red mud (BCRM), a low-cost adsorption material prepared from waste solid red mud and bagasse, for disposal of organic dyes in wastewater, the adsorption of methylene blue (MB) from aqueous solution on BCRM has been studied, and the adsorption treatment of real textile wastewater was also investigated. Characterization of BCRM was achieved by scanning electron microscope and nitrogen adsorption–desorption analysis. Effects of adsorption time, BCRM dosage, initial concentration, temperature, and initial pH on the adsorption of MB were explored. From the characterization of adsorbent, it can be seen that the prepared BCRM was a porous material composed of particles with rough surface and loose structure, and an excellent mesoporous material with high specific surface area and good mesopore structure. The adsorption results showed that the data fitted better with pseudo-second-order kinetic model ($R^2 = 0.9995$) than pseudo-second-order kinetic and intraparticle diffusion models. Langmuir model was better fit isotherm for MB adsorption on BCRM than Freundlich and Dubinin–Radushkevich adsorption isotherms. It can be drawn that MB adsorption on BCRM was a monolayer adsorption and the adsorption occurred at specific homogeneous sites on the adsorbent. The results of adsorption thermodynamics indicated MB adsorption on BCRM was a spontaneous, endothermic, and physical process. The adsorption treatment of real textile wastewater by BCRM implied BCRM was an effective and regenerable adsorbent for removal of dye from wastewater.

Keywords: Red mud; Bagasse; Adsorption; Kinetic; Isotherm; Thermodynamics; Textile wastewater

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