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Carbonization of corn (*Zea mays*) cob agricultural residue by one-step activation with sulfuric acid for methylene blue adsorption

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ABSTRACT

Corn (*Zea mays*) cob, an agricultural biomass residue, was carbonized by chemical activation with H_2SO_4 and examined for its suitability as a low-cost adsorbent for methylene blue (MB) adsorption from aqueous solution. Carbonized corn cob (CCC) was characterized by a CHNS-O analysis, Fourier transform infrared spectroscopy, scanning electron microscopy, X-ray diffraction (XRD), Brunauer–Emmett–Teller, and *point-of-zero charge* (pH_{pzc}) analysis. Batch mode adsorption studies were conducted by varying operational parameters such as adsorbent dosage (0.02–0.20 g), solution pH (3–10), initial MB concentrations (50–300 mg/L), and contact time (0–360 min). The equilibrium data were well correlated by the Freundlich isotherm compared with Langmuir and Temkin models. The maximum adsorption capacity (q_{max}) of CCC for MB adsorption at equilibrium was 216.6 mg/g at 303 K. The kinetic uptake profiles were well-described by the nonlinear pseudo-first-order model. The thermodynamic adsorption parameters such as standard enthalpy ($\Delta H°$), standard entropy ($\Delta S°$), and standard free energy ($\Delta G°$) showed that the adsorption of MB onto CCC surface is endothermic in nature and spontaneous under the experimental conditions. The above-mentioned results indicate that the CCC can be feasibly employed for the removal of MB from aqueous solution.

Keywords: Carbonization; Corn cob; Low-cost adsorbent; Sulfuric acid; Adsorption; Methylene blue

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