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Removal of phenol from aqueous solutions using adsorbents derived from low-cost agro-residues

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ABSTRACT

Adsorption of phenol from its aqueous solutions using activated carbon, prepared from tomato stem, in a batch process was investigated. The preparation of charred tomato stem (CTS) activated carbon involved carbonization of the precursor previously impregnated with ortho-phosphoric acid activating agent (activating agent volume (ml) by precursor weight (g) ratio set at 1:1) at 470°C for 2 h. Equilibrium and kinetic studies were carried out using phenol solutions of various concentrations (20–100 mg/L). The adsorbent was characterized via electron probe microanalysis (EPMA) associated with energy dispersive spectrometry (EDS), Fourier transform Infrared analysis, pore volume and BET surface area determinations. Parametric study of the adsorption process was also conducted. The equilibrium adsorption data were elucidated using Langmuir, Freundlich, Dubinin–Radushkevich and Temkin isotherm models. Equilibrium data fitted satisfactorily to the Langmuir model; the maximum adsorption capacity was 41.6667 mg/g at 308 K. Pseudo-first-order and pseudo-second-order models suitably validated the adsorption kinetics while the intraparticle diffusion model and Boyd kinetic model examined the diffusion mechanism involved therein. Desorption studies were conducted using water, absolute ethanol (100% v/v) and 0.1 (N) NaOH solution as desorbing agents. Thermogravimetric analysis examined the thermal stability and regeneration potential of the CTS activated carbon.

Keywords: Activated carbon; Adsorbent; Isotherm models; Equilibrium; Kinetics

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