Desalination and Water Treatment
www.deswater.com
11 (2009) 192–203
November
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doi: 10.5004/dwt.2009.801

Characterization and utilization of activated carbons prepared from coffee residue for adsorptive removal of salicylic acid and phenol: Kinetic and isotherm study

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Received 27 February 2009; Accepted 9 August 2009

ABSTRACT

In this work, coffee residue was used as source material to prepare activated carbons by chemical activation with zinc chloride. The influence of impregnation ratio (zinc chloride/coffee residue) on the physical and chemical properties of prepared carbons is studied in order to optimize this parameter. Texture properties of these carbons were determined by measuring the adsorption of nitrogen at 77 K. The nitrogen adsorption isotherms were interpreted by BET and Dubinin–Radushkevick (D-R) equations. The nature of carbon surface functionalities was studied by Boehm titration method. Phenol and salicylic acid removal from aqueous solutions by adsorption onto the prepared activated carbons was investigated. The effect of parameters such as pH, agitation time, initial phenol and salicylic acid concentrations, temperature, adsorbent dosage and particle size on phenol and salicylic acid removal were observed. In addition, adsorption kinetics and adsorption isotherms study were realized. Maximum phenol removal was obtained at pH 3 and 20°C, while for salicylic acid it was obtained at pH 3 and 25°C. In the isotherm studies, Langmuir and Freundlich isotherm models were applied and it was observed that the phenol experimental data were perfectly described by the Langmuir model while the salicylic acid experimental data were correctly fitted by both Langmuir and Freundlich equations. Batch adsorbent capacity (q_m) was calculated as 55 mg/g for phenol and 128 mg/g for salicylic acid. The rates of adsorption were found to conform to pseudo-second-order kinetics with good correlation.

Keywords: Coffee residue; Activated carbon; Salicylic acid; Phenol; Adsorption; Isotherm; Kinetic; Modelling

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