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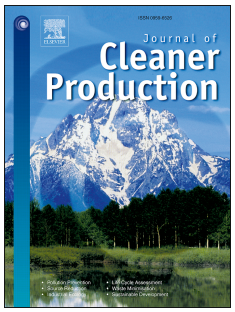


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# Synthesis and characterization of microporous activated carbon from coffee grounds using potassium hydroxides

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## Abstract

In this study, new activated carbons (ACs) from coffee grounds were synthesized using different impregnation ratios of KOH. The obtained materials were characterized by the Fourier Transform Infrared Spectroscopy (FTIR), Boehm titration, $N_2$ adsorption-desorption isotherms and Scanning Electron Microscopy (SEM). The results of the FTIR and Boehm titrations indicate the presence of many functional groups on the ACs surface. Basic groups determined from the Boehm titration show a strong dependence on the impregnation ratio. $N_2$ adsorption-desorption isotherms show an augmentation of the adsorbed volume for high impregnation ratios. This is due to the well-developed microporosity which increases with increasing the impregnation ratio. The maximal specific surface area obtained from the BET measurement was found to be 1,778 $m^2 g^{-1}$ for an impregnation ratio of 36 mmol of KOH/g of precursor. The prepared ACs were tested for their removal efficiency for the phenol (Ph) and methylene blue (MB) molecules. Batch adsorption tests were performed and the effects of contact time, initial concentration and temperature were investigated. The adsorption kinetic parameters were determined by fitting with the pseudo-first and pseudo-second order models to the experimental data. An evaluation of both the correlation coefficients ($R^2$) and the adsorbed amount per unit mass of adsorbent ($Q_e$) at equilibrium indicates that Ph and MB adsorption by ACs are satisfactorily described by the pseudo-second order model. The experimental adsorption equilibrium data were fitted to the Langmuir and Freundlich models. The effect of temperature on the adsorption was studied and the thermodynamic parameters: enthalpy ($\Delta H°$), entropy ($\Delta S°$) and free energy ($\Delta G°$) were determined for each molecule. The adsorption for Ph and MB was found to be thermodynamically spontaneous ($\Delta G° < 0$), although it was exothermic ($\Delta H° < 0$) for Ph and endothermic ($\Delta H° > 0$) for MB.

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