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Synthesis of Activated Carbon from Spent Tea Leaves for Aspirin Removal

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Abstract

Adsorption capacity of activated carbon prepared from spent tea leaves (STL-AC) for the removal of aspirin from aqueous solution was investigated in this study. Preliminary studies have shown that treatment with phosphoric acid (H_3PO_4) increased removal efficiency of STL-AC. Characterizations on STL-AC revealed excellent textural properties (1200 $m^2 \cdot g^{-1}$, 51% mesoporosity), as well as distinctive surface chemistry (1.08 $mmol \cdot g^{-1}$ and 0.54 $mmol \cdot g^{-1}$ for acidic and basic oxygenated groups, pH_{pzc}=2.02). Maximum removal efficiency of aspirin observed was 94.28% after 60 minutes when the initial concentration was 100 $mg \cdot L^{-1}$, 0.5 g of adsorbent used, pH 3 and at a temperature of 30 °C. The adsorption data were well fitted to Freundlich isotherm model and obeyed pseudo-second order kinetics model. The adsorption of aspirin onto STL-AC was exothermic in nature (ΔH^{Θ}= -13.808 $kJ \cdot mol^{-1}$) and had a negative entropy change, ΔS^{Θ} (-41.444 $J \cdot mol^{-1}$). A negative Gibbs free energy, ΔG^{Θ} was obtained indicating feasibility and spontaneity of the adsorption process. The adsorption capacity of AC-STL (178.57 $mg \cdot g^{-1}$) is considerably high compared to most adsorbents synthesized from various sources, due to the well-defined textural properties coupled with surface chemistry of STL-AC which favours aspirin adsorption. The results demonstrate the potential of STL-AC as aspirin adsorbent.**Keywords:** activated carbon; spent tea leaves; aspirin; adsorption; kinetics; isotherm