



Equilibrium and kinetic studies of copper (II) ion uptake by modified wheat shells

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Received 26 October 2010; Accepted 23 February 2012

ABSTRACT

Natural adsorbents such as shells of unmodified wheat (RW), and modified wheat (MW) were assessed for Cu(II) adsorption from aqueous solutions. The removal of Cu(II) by these adsorbents from aqueous solution was investigated by using several parameters such as modification, contact time, temperature and pH. The extent of Cu(II) removal increased with increasing contact time, temperature and pH and also with modification by Reactive Orange 122 of adsorbent. The experimental data were analysed by the Langmuir and Freundlich models of adsorption. It was found that the Freundlich equation fits better than the Langmuir equation. In addition, the adsorption data obtained at different temperatures of Cu(II) by adsorbents were applied to pseudo first-order, pseudo second-order and Weber-Morris equations, and the rate constants of first-order adsorption (k_1), the rate constants of second-order adsorption (k_2) and diffusion rate constants (k_3) at these temperatures were calculated, respectively. The rates of adsorption were found to conform to pseudo second-order kinetics with good correlation ($R^2 \geq 0.989$). The data obtained from adsorption isotherms at different temperatures were used to calculate some thermodynamic quantities such as free energy of adsorption (ΔG°), enthalpy (ΔH°), and entropy (ΔS°). It is found that ΔG° is negative, indicating that the nature of adsorption process for Cu(II) is spontaneous. The positive value of ΔH° indicates that the adsorption of Cu(II) onto adsorbents is an endothermic process. The positive value of ΔS° reflects the affinity of the adsorbent for Cu(II). As a result, the present work indicates that the wheat shells MW chemically by Reactive Orange 122, possess more efficiency in adsorbing Cu(II) ions than the unmodified one (RW).

Keywords: Adsorbents; Wheat shells; Kinetics; Thermodynamics; Modification; Reactive orange 122

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