Adsorption of copper ions by coffee residues

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ABSTRACT

This study employed coffee residues to remove copper ions from wastewater. The effects of copper concentration, coffee residues dosage, ionic strength and temperature on adsorption of copper ions by coffee residues were evaluated. Pseudo first-order, pseudo second-order, intraparticle diffusion and Bangham models were adopted to evaluate experimental data and thereby elucidate the kinetic adsorption process. Additionally, this study used the Langmuir, Freundlich, and Redlich-Paterson isotherms to describe equilibrium adsorption. The adsorption percentage of copper ions increased as coffee residues dosage and temperature increased. Conversely, the adsorption percentage of copper ions decreased as copper concentration increased. The pseudo second-order model best represented adsorption kinetics. Based on the regressions of intraparticle diffusion and Bangham models, experimental data suggest that the adsorption of copper ions onto coffee residues involved intraparticle diffusion, but that was not the only rate-controlling step. The equilibrium adsorption of copper ions is best fitted in the Redlich-Paterson isotherm. The capacity of coffee residues to adsorb copper ions was 7.9 mg/g (25°C). The enthalpy (ΔH0) and entropy (ΔS0) were 20.681 kJ/mol and 213.3 J/mol K, respectively. The values of enthalpy and entropy both indicate that the adsorption of copper ions onto coffee residues was a physisorption process. The exhausted coffee residues were regenerated by HNO3 extraction and the re-adsorption efficiency was approximately 50%.

Keywords : adsorption、coffee residues、copper、kinetics、thermodynamic

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