Removal of Ni(II) and Co(II) ions from aqueous solution using teak (*Tectona grandis*) leaves powder: adsorption kinetics, equilibrium and thermodynamics study

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Received 19 March 2014; Accepted 14 November 2014

**ABSTRACT**

In the present study, batch experiments were carried out to elucidate the potential of teak leaves powder (TLP) to remove Ni(II) and Co(II) ions from aqueous solution. The TLP was characterized by Brunauer, Emmett and Teller surface area, Fourier transform infrared spectroscopy and scanning electron microscopy. Effects of various process parameters such as initial pH (2–8), adsorbent dose (1–10 g L⁻¹), initial metal ion concentration (25–200 mg L⁻¹), contact time (5–120 min) and temperature (303–323 K) were investigated in their respective range and their optimum conditions were ascertained. Maximum percentage removal of 75.64 and 76.04% was achieved for Ni(II) and Co(II) ions, respectively, at their respective optimum pH of 6 and 5, adsorbent dose of 8 and 6 g L⁻¹ in an equilibrium time of 30 and 60 min at 303 K. Adsorption kinetics was analyzed by pseudo-first-order, pseudo-second-order, Elovich and intraparticle diffusion kinetic models. It was found that the adsorption of both the metal ions followed pseudo-second-order kinetic model. Adsorption isotherms were modelled with Langmuir, Freundlich, Tempkin and Dubinin–Raduskevich models and their isotherm constants were calculated. The equilibrium data fitted well to the Langmuir isotherm model for adsorption of both Ni(II) and Co(II) ions on TLP. Thermodynamic parameters such as change in Gibb’s free energy, change in enthalpy and change in entropy were calculated to predict the nature of adsorption process. The calculated thermodynamic parameters showed that the adsorption of Ni (II) and Co(II) ions on TLP were feasible, spontaneous and endothermic in nature.

**Keywords:** Adsorption; Teak leaves powder; Nickel; Cobalt; Kinetics; Isotherms; Thermodynamics

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