Adsorptive removal of Ni(II) from aqueous solution on 110-H resin: optimization through response surface methodology

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ABSTRACT

The Box–Behnken design of the response surface methodology was employed to optimize three most important adsorption parameters (initial Ni(II) concentration, pH, and adsorption temperature) and to investigate the interactive effects of these variables on Ni(II) adsorption capacity of 110-H resin. According to analysis of variance and response surface analyses, the experiment data were excellently fitted to the quadratic model. The corresponding optimal parameters of adsorption process are listed as following: temperature at 35°C, initial pH of 6.57, and initial Ni(II) concentration of 0.33 mg/mL. Under optimum adsorption conditions, the adsorption capacity of Ni(II) was 188.5 mg/g, in well accordance with the predicted value by the model (192.88 mg/g). The adsorption kinetics and equilibrium data were well fitted to the pseudo-second-order model and the Langmuir isotherm model, respectively. Thermodynamic parameters (∆G, ∆S, and ∆H) suggested that the adsorption process was endothermic and spontaneous in nature. Desorption study revealed that Ni(II) can be effectively eluted by 2.0 mol/L HCl solution, and the recovery was 100%. The characterization by Fourier Transform infrared and SEM was performed. Meanwhile, the 110-H resin has been successfully applied in the removal of Ni(II) in natural water samples with satisfactory results.

Keywords: 110-H resin; Ni(II); Adsorption mechanism; Thermodynamic; Response surface methodology

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