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Separation of nickel(II) ions from synthetic aqueous solutions with novel dimethylglyoxime-modified Amberlite IRA-420: kinetic and equilibrium studies

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ABSTRACT

In this study, the kinetic and equilibrium results obtained for Ni(II) ions sorption with different initial concentrations onto dimethylglyoxime-modified Amberlite IRA-420 (DMG-AMB) were analyzed. Fast equilibrium was reached after only 10 min where the removal percentage increased from around 60% to 90% with nickel(II) ions concentrations ranged from 3.0 to 15.0 mg/L. On the other hand, the capacity of the adsorbent increased linearly from 0.2 to 1.4 mg/g. The analysis of the kinetic data indicated that the sorption was a second-order process. An ion-exchange mechanism may have existed in the Ni(II) ions sorption process with DMG-AMB. The Ni(II) ions uptake by DMG-AMB quantitatively evaluated with equilibrium sorption isotherms. The maximum sorption capacity, determined from the Dubinin–Radushkevich (D–R) isotherm, was 15.067 mg/g. Moreover, diffusion mechanism of Ni(II) ions was described by different removal–diffusion models. The diffusion rate equations inside particulate of Dumwald–Wagner and intraparticle models were used to calculate the diffusion rate. The actual rate-controlling step involved in the Ni(II) ions sorption process was determined by the further analysis of sorption data by the kinetic expression given by Boyd.

Keywords: Metal ions removal; Ni(II) ions; Cation–anion exchanger; Amberlite IRA-420; DMG

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