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Efficient removal of Cd(II), Cu(II), Ni(II) and Pb(II) by polyamine-polyurea polymer modified with 2,4-dihydroxybenzaldehyde from synthetic and real wastewaters

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ABSTRACT

The present study reports a synthesis of novel polymeric sorbent of polyamine-polyurea polymer modified with 2,4-dihydroxybenzaldehyde (DMPPP) and analysing of its adsorption efficiency towards some metal ions including Cd(II), Cu(II), Ni(II) and Pb(II). The effect of variation in solution pH, adsorbent dose, initial metal ion concentration, contact time and temperature on the adsorption mechanism was studied. Adsorption of the metal ions was obtained maximum at pH of 6.0 and was reached to equilibrium in contact time of 120 min. The compliance of adsorption equilibrium data with Langmuir and Freundlich isotherm models were investigated and Langmuir model was found to be in better harmony with correlation coefficient values of over 0.99 for all metal ions. The maximum adsorption capacity (q_e) of DMPPP for Cd(II), Cu(II), Ni(II) and Pb(II) ions were found to be 105.3, 117.6, 137.0, 144.9 mg g^{-1}, respectively. The kinetics of heavy metal ions were assessed by pseudo-first-order, pseudo-second-order and intraparticle diffusion models. It is discerned that the kinetic mechanisms of the heavy metal ion adsorption on DMPPP were better expressed by the pseudo-second order kinetic model. Results obtained from thermodynamic studies were interpreted the process as endothermic with the positive values of ΔH, as spontaneous with the negative values of ΔG and as having an increased randomness with the positive values of ΔS. Desorption of Cd(II), Cu(II), Ni(II) and Pb(II) ions using 20 mL of 0.5 M HNO_3 solutions was found to be quantitative (≥90%). The developed adsorption technique using novel sorbent was also successfully applied to real wastewater to remove Cd(II), Cu(II), Ni(II) and Pb(II) ions.

Keywords: Chelating resin; Polymer; Adsorption; Removal; Heavy metal; Wastewater

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