Adsorption of Cd(II) ions onto polyamine-polyurea polymer modified with pyromellitic dianhydride

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ABSTRACT

In this study, polyamine-polyurea polymer was synthesized using toluendiisocyanate and polyethyleneimine. It was then modified using pyromellitic dianhydride. The polymer so obtained (PMPPP) was used for the adsorption of Cd(II) metal ions from aqueous solutions using a batch adsorption system to simulate the adsorption characteristics of wastewater applications. The effects of pH, dosage, contact time, initial concentration, and temperature were investigated. The optimum pH value was found to be 6.0, and the contact time required to reach equilibrium was 120 min. The Cd(II) adsorption equilibrium data were found to be more in line with the Langmuir equation than the Freundlich model. The maximum adsorption capacity of PMPPP for Cd(II) was calculated to be 94.3 mg g⁻¹. Kinetics studies showed that Cd(II) adsorption followed the pseudo-second-order equation. Thermo-dynamic investigations revealed endothermcity, spontaneity, and an increased randomness of Cd(II) adsorption onto PMPPP. Polymer was characterized by Fourier transform infrared spectroscopy, theremogravimetric–differential thermal analysis, scanning electron microscopy, and nitrogen adsorption/desorption isotherms.

Keywords: Cd(II); Polyamine-polyurea polymer; Adsorption; Removal; Heavy metal; Wastewater treatment