Application of superparamagnetic polymer-coated magnetite nanoparticles for non-competitive removal of Cd(II) and Zn(II) from aqueous solutions

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ABSTRACT

Magnetic nanoparticles modified with cross-linked poly (acrylic acid-co-acrylamide) hydrogel (Fe3O4/copolymer) were fabricated by free radical polymerization of monomers in the presence of N,N-methylenebisacrylamide as cross-linker and dispersed Fe3O4 nanoparticles as core. The Fe3O4/copolymer composite was characterized by Fourier transform infrared spectrum (FT-IR), scanning electron microscopy (SEM), X-ray diffraction (XRD), thermal gravimetric analysis (TGA), and vibrating sample magnetometer (VSM). The fabricated magnetic nanocomposites were further utilized for non-competitive removal of Cd(II) and Zn(II). The adsorbent component, adsorbent dosage, concentration of the initial solute, and the pH of the solution were found to have significant effects on adsorption efficiency. The adsorption process was found to be well described by the pseudo-second-order rate model. Equilibrium studies indicated that the adsorption data followed the Langmuir model with the maximum adsorption capacity up to 142.8 and 111.1 mg/g for Cd(II) and Zn(II), respectively. Adsorbed metal ions were efficiently recovered by using a dilute HCl aqueous solution. The results of desorption/adsorption cycle revealed that the loaded Fe3O4/copolymer nanocomposite with metal ions could be effectively regenerated. Adsorption capacities and metal ions recoveries remained almost unchanged upon five reusing cycles of the adsorbent.

Keywords: Magnetic nanoparticles; Hydrogel polymer; Adsorption; Zinc; Cadmium

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