

Magnetic nanocomposite of zinc–manganese ferrite/polyurethane foam for adsorption of copper and cadmium from water

Abstract

The magnetic nanoparticles, zinc–manganese ferrite ($\text{Zn}_{0.6}\text{Mn}_{0.4}\text{Fe}_2\text{O}_4$), were chemically added to polyurethane foam (PUF) to obtain the polymeric nanocomposite $\text{Zn}_{0.6}\text{Mn}_{0.4}\text{Fe}_2\text{O}_4/\text{PUF}$. Characterization of the nanoparticles and the nanocomposite was made by X-ray diffraction, scanning electron microscopy, high-resolution transmission electron microscopy, and vibrating sample magnetometer. The prepared nanocomposite showed adsorption efficiency of 95% and 94% for Cu and Cd, respectively at a pH of 6.5, a shaking time of 60 min, and a composite dosage of 0.2 g. Adsorption kinetics followed a second-order model, with $k_2 = 3.02$ and $4.05 \text{ mg g}^{-1} \text{ min}^{-1}$ and adsorption capacity was 20.4 and 11.1 mg g^{-1} , respectively. The Freundlich model best described the adsorption isotherm, $n = 0.93$ and 0.88 and $KF = 0.64$ and 0.31 L g^{-1} , and $R^2 = 0.988$ and 0.980 , respectively. The quantification limits are 0.9 and $1.4 \mu\text{g L}^{-1}$, respectively, with a preconcentration factor of 125. The removal of Cd and Cu from tap, lake and river waters, yielding a recovery from 89%–116% relative standard deviation ($\text{RSD} = 0.8\%$ – 8.6%).