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

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ABSTRACT

The magnetic nanoparticles, zinc–manganese ferrite ($Zn_{0.6}Mn_{0.4}Fe_2O_4$), were chemically added to polyurethane foam (PUF) to obtain the polymeric nanocomposite $Zn_{0.6}Mn_{0.4}Fe_2O_4$/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 mg g^{-1} 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 K_F = 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 μg L^{-1}, respectively, with a pre-concentration factor of 125. The removal of Cd and Cu from tap, lake and river waters, yielding a recovery from 89%–116% relative standard deviation (RSD = 0.8%–8.6%).

Keywords: Zinc–manganese ferrite nanoparticles; Polyurethane foam; Nanocomposite sorbent; Copper and cadmium; Lake, river and tap waters

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