ABSTRACT

This study investigated the removal of heavy metals such as Ni(II), Cu(II), and Cr(III) in aqueous solutions by the synthesis of thiol-functionalized mesoporous silica-coated magnetite nanoparticles (TF-SCMNPs) with different pH levels, contact times, and adsorbent dosages. The synthesis of TF-SCMNPs samples occurred with simple co-precipitation methods. FT-IR, X-ray diffraction, SEM, energy dispersive X-ray, and VSM techniques were used for characterization of the prepared adsorbent. The removal efficiency of heavy metals by TF-SCMNPs was more than that of magnetite in similar conditions. The results showed that the maximum adsorption of TF-SCMNPs for Ni(II), Cu(II), and Cr(III) was obtained at pH 7, 10, and 10 during the contact time of 20 min, respectively. By increasing adsorption dosage the removal efficiency was increased. The study of the adsorption kinetic model revealed that the pseudo-second-order model was the best applicable one to describe the adsorption of Ni(II) and Cu(II), pseudo-first-order model for Cr(III) onto TF-SCMNPs. Adsorption data were analyzed by both Langmuir and Freundlich adsorption isotherms and the results showed that it was better described by the Langmuir model for Ni(II), Cu (II), and Freundlich model for Cr(III). The maximum adsorption capacities were estimated to be 4.476, 4.038, and 1.119 mg/g at optimum pH and room temperature for Cu(II), Ni(II), and Cr(III), respectively. TF-SCMNPs nanoparticles were maintained even after five successive cycles, suggesting a promising adsorbent for aquatic-contaminated heavy metals.

Keywords: Heavy metals; TF-SCMNPs nanoparticle; Kinetic and Isotherm models; Adsorption; Aqueous solutions