Functionalized nano magnetic Fe$_3$O$_4$–SiO$_2$ core–shell as efficient adsorbent for removal of Pb$^{2+}$ from aqueous solutions

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ABSTRACT

Development of reliable adsorbents with high adsorption capacity, fast adsorption–desorption kinetics is of significant importance. Nanosized magnetic particles having high surface area and unique advantage of easy separation by external magnetic field are considered as potential adsorbents for removal of heavy metal cations from aqueous solutions. In this research, synthesis of Fe$_3$O$_4$–SiO$_2$ core–shell and its efficiency for removal of Pb$^{2+}$ from aqueous solution has been reported. In order to increase the adsorption capacity, the magnetic adsorbent was modified with 2-aminothiophenol. The modified adsorbent was characterized by Fourier transform infrared spectroscopy, scanning electron microscopy, Brunauer–Emmett–Teller and thermogravimetry techniques. At optimized conditions, the adsorbent capacity of 60 mg g$^{-1}$ was obtained. The adsorption process was kinetically fast, and more than 60% of the adsorption capacity was obtained within 10 min. The magnetic nanoparticles carrying the target cation were easily separated from the solution by applying an external magnetic field. Regeneration of the used adsorbent showed that its capacity slightly declined with the number of regeneration. However, 83.71% of initial adsorption capacity was remained after four-step regeneration cycle.

Keywords: Core–shell; Magnetic nanomaterial; SiO$_2$; Functionalization; Adsorption; Pb$^{2+}$

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