Synthesis of the cotton cellulose based Fe (II)-loaded adsorbent for metal ions removal from wastewater

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Cotton impregnated with iron oxide (Fe$_3$O$_4$) nanoparticles (NPs) composite fibers (FeCt) were prepared by simple co-precipitation method and two of its different concentrations (0.5 g and 1 g) studied for the removal of mercury, chromium, cobalt, lead and nickel ions from aqueous solutions (at 2 to 8 ppm). Scanning electron microscopy (SEM) showed that the FeCt fiber possessed highly porous structures. The influence of several parameters such as a fixed temperature (25°C) and pH (5.5) value of the solution, contact time, metal ion concentration on the adsorption capacity of the FeCt was investigated in a batch adsorption mode. The kinetic data were analyzed by the pseudo-first-order and pseudo-second-order models and the experimental data were well described by the pseudo-second-order model. The equilibrium data were discussed by the Langmuir and Freundlich isotherm models and the adsorption isotherms were better fitted by the Langmuir equation. Generally, the enhanced adsorption capacity was exhibited by the sample FeCt at 0.5 g for Hg$^+$ and Ni$^+$ as 71.43 and 69.45 mg g$^{-1}$ respectively among all different concentrations of adsorbents and adsorbates used in the experiment however, the FeCt at 1 g showed highest adsorption capacity for Ni$^+$ removal as 75.76 mg g$^{-1}$. The competitive capacity of all five heavy metals onto the adsorbents followed the adsorption order as Ni(II)>Hg(II)>Pb(II)>Cr(III)>Co(II) that are related to the nature and the strength of electrostatic interaction among metal ions. The regeneration of the loaded adsorbent could be carried out by acidified thiourea that can show metal uptake capacity comparable to the fresh one over various cycles of adsorption/desorption.

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