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Synthesis and use of nanomagnetic MnO_2 adsorbent for removing Pb(II) and Cd(II) ions from acid aqueous solutions

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ABSTRACT

A nanoadsorbent based on δ-MnO_2 and Fe_3O_4 was synthesized and assessed as an adsorbent for removing some heavy metals from acidic aqueous solution. The δ-MnO_2 adsorbent was prepared in aqueous alkaline medium using an oxidative precipitation methodology in presence of superparamagnetic magnetite particles previously synthesized. The adsorbent was chemically, physically and magnetically characterized using several analytical techniques. The resulting adsorbent consists of nanoparticles with sizes below 1 μm forming larger agglomerated structures with a mean size ranging between 6 and 9 nm. The nanoparticles have superparamagnetic properties that allow separating the metal-loaded sorbent particles from the treated aqueous solution using conventional magnets. Pb(II) and Cd(II) adsorption tests were carried out showing that the metals adsorption increases with the pH of the aqueous solution, which is consistent with the observed adsorbent zeta potential measurements. Pb(II) and Cd(II) equilibrium experiments were conducted, and the results were studied using Langmuir and Freundlich isotherm models. Adsorption kinetics experiments were carried out separately for both metallic ions. A pseudo-second-order adsorption kinetics model explained well the experimental data.

Keywords: Magnetic adsorbent; MnO_2; Nanoparticles; Toxic ions; Adsorption; Removal

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