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Rapid and Efficient Removal of Lead from Water Using Chitosan/Magnetite Nanoparticles

Authors : Othman M. Hakami, Abdul Jabbar Al-Rajab

Abstract : Occurrence of heavy metals in water resources increased in the recent years albeit at low concentrations. Lead (PbII) is among the most important inorganic pollutants in ground and surface water. However, removal of this toxic metal efficiently from water is of public and scientific concern. In this study, we developed a rapid and efficient removal method of lead from water using chitosan/magnetite nanoparticles. A simple and effective process has been used to prepare chitosan/magnetite nanoparticles (NPs) (CS/Mag NPs) with effect on saturation magnetization value; the particles were strongly responsive to an external magnetic field making separation from solution possible in less than 2 minutes using a permanent magnet and the total Fe in solution was below the detection limit of ICP-OES (<0.19 mg L-1). The hydrodynamic particle size distribution increased from an average diameter of ~60 nm for Fe3O4 NPs to ~75 nm after chitosan coating. The feasibility of the prepared NPs for the adsorption and desorption of Pb(II) from water were evaluated using Chitosan/Magnetite NPs which showed a high removal efficiency for Pb(II) uptake, with 90% of Pb(II) removed during the first 5 minutes and equilibrium in less than 10 minutes. Maximum adsorption capacities for Pb(II) occurred at pH 6.0 and under room temperature were as high as 85.5 mg g-1, according to Langmuir isotherm model. Desorption of adsorbed Pb on CS/Mag NPs was evaluated using deionized water at different pH values ranged from 1 to 7 which was an effective eluent and did not result the destruction of NPs, then, they could subsequently be reused without any loss of their activity in further adsorption tests. Overall, our results showed the high efficiency of chitosan/magnetite nanoparticles (NPs) in lead removal from water in controlled conditions, and further studies should be realized in real field conditions.

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