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Synthesis of iron oxide (γ-Fe_2O_3) coated sand for adsorptive removal of arsenic from drinking water

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In recent years, arsenic (As) contamination of surface and groundwater has become an issue in many countries due to the weathering of As-containing rocks, industrial wastewater discharge, and the utilization of agricultural fertilizers. Ion exchange, coagulation, adsorption, co-precipitation, and microfiltration are the methods used to remove As from drinking water. Adsorption is a widely used method for removing As that exceeds the permissible level (10 µg l^{-1}) as per the drinking water guidelines recommended by the World Health Organization (WHO). Maghemite (γ-Fe_2O_3) nanoparticles (NPs) have gained a lot of interest owing to their ability to remove heavy metals from drinking water. Direct implementation of iron oxide NPs may present issues due to their tendency to agglomerate in aqueous media. Therefore, NPs are coated onto the filter material (sand). γ-Fe_2O_3 coated sand was prepared by a double coating process at 110 and 400 °C temperatures. The synthetic γ-Fe_2O_3 coated sand was characterized by Fourier Transform Infrared (FT-IR) and Raman spectroscopy. Characteristic Raman peak values of γ-Fe_2O_3 are observed in the 670 cm^{-1} and 1330 cm^{-1} band positions, and the IR peaks that were observed in the (450–460) cm^{-1} range can be attributed to Fe–O stretching vibrations. This work revealed that γ-Fe_2O_3 coated sand has a high affinity to remove both arsenite (As (III)) and arsenate (As (V)). The batch experiments showed the maximum adoption with γ-Fe_2O_3 coated sand for both As (III) and As (V) at pH 7.0, contact time of 7 hours, at 27 °C room temperature, and 25 g l^{-1} fixed adsorbent dose at 1.0 ppm initial As (III) and As (V) solutions. Maximum removal efficiency for As (III) and As (V) was 92.0% and 99.3% respectively under the aforementioned optimum conditions. The results indicate that γ-Fe_2O_3 coated sand can be used as an adsorbent for reducing both As (III) and As (V) concentrations from drinking water.

Keywords: *Adsorption, arsenate, arsenite, coating, γ-Fe_2O_3 nanoparticles*

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