Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2020.25773

194 (2020) 133–142
August

Simple iron-based sludge processing for low-cost, efficient heavy metal adsorbent (the case study)

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Received 27 September 2019; Accepted 28 February 2020

ABSTRACT

This paper presents a scalable method for the conversion of iron-based sludge obtained as a side-product of wastewater treatment technology into a readily applicable adsorbent for toxic ions removal from aqueous environments. In the first step, iron-based sludge was prepared with a neutralized acidic iron(III) sulfate solution which was added into industrial wastewater. After dehydration, a sample was calcinated at 500°C. The prepared magnetic material contained approximately 50% iron in a form of nanocrystalline maghemite/magnetite composite mixture. scanning electron microscopy and Brunauer–Emmett–Teller measurements showed that the material was composed of micrometric agglomerates of non-porous nanocrystallites with a specific surface area of 66 m^2/g. This iron-based sludge adsorbent was used for real wastewater treatment. Despite the quantity of competitive toxic ions present, approximately 50% of the present arsenate oxyanion could be removed without previous wastewater pre-treatment. Compared to the real water sample, maximum uptake of As(V) from the model solution was ca 23% higher. The rate of adsorption was also comparably higher for the model solution with k = 0.273 g/mg/min.

Keywords: Wastewater treatment; Sludge processing; Iron-based adsorbent; Maghemite/magnetite composite; Toxic ions removal

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