Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2013.803785

52 (2014) 3096–3103
April

Taylor & Francis
Taylor & Francis Group

Removal of superparamagnetic corrosion products and contaminants from drinking water using activated carbon

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Received 10 August 2012; Accepted 22 April 2013

ABSTRACT

Particulate matter separated from tap water using columns of coarse and fine activated carbon was characterized by means of chemical analysis, magnetization measurements, X-ray diffraction (XRD) and scanning electron microscopy (SEM)—energy dispersive X-ray spectrometry (EDS). A large fraction of the solids accumulated on the activated carbon consisted of iron oxides, in particular magnetite nanoparticles, and of iron oxyhydroxides, specifically goethite and lepidocrocite. These species formed as a result of corrosion of iron or carbon steel pipes. The removal of various iron species was measured using a two-column system consisting of a column of coarse activated carbon followed by a column of fine activated carbon. The results indicated that coarse activated carbon was only effective in removing oxyhydroxide particles, while the fine activated carbon was also able to remove nanoparticles of anhydrous iron oxides such as magnetite and maghemite. In addition, it was observed that while a majority of the content of contaminants, such as lead and copper, was removed upon passing the water through the coarse activated carbon, a significant fraction of the contaminant content was only removed upon subsequently passing the water through the fine activated carbon. It was concluded that most of the content of lead, copper, and other contaminants was associated with the iron oxyhydroxides, but a sizeable fraction was associated with the magnetite nanoparticles. Thus, the results supported the assumption that the presence of contaminants associated with magnetite nanoparticles in drinking water can be a significant mode of contaminant transport through water distribution systems.

Keywords: Nanoparticles; Activated carbon; Iron; Contaminants; Drinking water

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