Flow-through experiments for bacteriophage MS2 removal by iron oxide-impregnated fiberglass

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ABSTRACT

In this study, iron oxides were impregnated on the surface of fiberglass (Fe-fiberglass) to remove bacteriophage MS2 from water. The Fe-fiberglass was characterized using field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectrometer (EDS), and X-ray diffractometry (XRD) analysis. The FESEM image showed that iron oxides covered the majority of the Fe-fiberglass surface as a heterogeneous layer. The EDS analysis indicated that the major elements of the Fe-fiberglass were oxygen (30.85 wt.%), carbon (28.61 wt.%), and iron (12.58 wt.%). The XRD pattern demonstrated that the iron oxides impregnated on the Fe-fiberglass were maghemite ($\gamma$-Fe$_2$O$_3$) and goethite ($\alpha$-FeO(OH)).

Flow-through column experiments were performed for chloride (Cl), a conservative tracer, and bacteriophage MS2 to quantify the bacteriophage removal by the Fe-fiberglass. The mass recoveries of Cl and MS2 in the raw fiberglass were 96.7 and 93.4%, respectively, indicating that the bacteriophage removal by the raw fiberglass was almost negligible. The mass recoveries of MS2 were 41.6–47.4% in the Fe-fiberglass, showing that the Fe-fiberglass was efficient in the removal of bacteriophage. In the presence of (bi)carbonate ions, the mass recovery of MS2 in the Fe-fiberglass was 63.1%, indicating that the bacteriophage removal could be reduced due to the competition for sorption sites between (bi)carbonate and bacteriophage. This study demonstrated that bacteriophage removal by fiberglass could be improved via the impregnation of iron oxides.

Keywords: Bacteriophage MS2; fiberglass; flow-through experiment; iron oxide impregnation; virus removal

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