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Characterization of nanoscale zero valent iron modified by nonionic surfactant for trichloroethylene removal in the presence of humic acid: A research note

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ABSTRACT

Trichloroethylene (TCE) is a common contaminant in water and groundwater, known as suspected carcinogens, and its presence in the environment is of significant concern. Nano-scale zero-valent iron (NZVI) has emerged as an excellent reduction catalyst due to fast degradation of chlorinated solvents. However aggregation of NZVI is a serious limitation. In this study, NZVI was coated with nonionic surfactant to overcome its aggregation and to enhance its dispersion. The synthesized NZVI using water-based solution method produced nanowire-like structures mostly and a few portion of NZVI showed a spherical shape. For the modification of NZVI by surfactant, the amount of Tween 80® used to be adsorbed onto NZVI was ca. 8 mmol/kg of NZVI. The volume size distribution of the obtained surfactant modified NZVI (SNZVI) increased to $d_{90\%}$ (cumulative size at 90%) = 2.03 μm and at 0.79 μm of mean size, while that of bare NZVI had diameter with $d_{90\%}$ (cumulative size at 90%) = 14.12 μm and at 4.54 μm of mean size. The maximum adsorption amount of humic acid (HA) onto SNZVI was 18.70 mg/g and that of NZVI was 20.05 mg/g. For TCE removal in the presence of HA, SNZVI was not enhanced for TCE removal efficiency, compared with NZVI removal. And TCE removal using SNZVI was inhibited as HA concentration increased, but TCE degradation efficiency increased at high concentration of HA. Based on reduction of size and the reactivity of SNZVI, the present results can be applied for in situ groundwater remediation.

Keywords: Nanoscale zero valent iron; Trichloroethylene; Nonionic surfactant; Humic acid

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