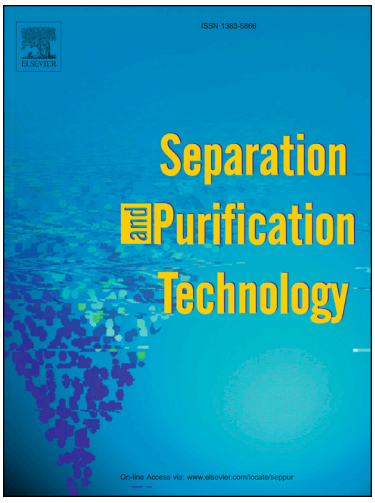

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Feasibility of using nanoscale zero-valent iron and persulfate to degrade sulfamethazine in aqueous solutions

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Abstract

This study investigates the effectiveness of the nanoscale zero-valent iron and persulfate (nZVI/PS) process in degrading sulfamethazine (SMT) in aqueous solutions. nZVI was formed using a rotating packed bed with blade packings. The dominant generated free radical in the nZVI/PS process for degrading SMT was $SO_4\bullet^-$. nZVI can gradually release Fe^{2+}, which subsequently activates PS to form $SO_4\bullet^-$, increasing the efficiency of degradation of SMT by this process. The effects of the PS/nZVI molar ratio, initial SMT concentration, and inorganic anions on the efficiency of degradation of SMT were also studied. A PS/nZVI molar ratio of 1/0.5 in the nZVI/PS process was chosen to reduce the required nZVI dosage at PS concentrations of 0.5, 1, and 2 mmol/L. The efficiency of degradation of SMT declined as the initial SMT concentration was increased. Inorganic anions (SO_4^{2-}, HCO_3^-, NO_3^-, Cl^- ions) at high concentrations inhibited the degradation of SMT and their suppressive effects followed the order $SO_4^{2-} > HCO_3^- > NO_3^- > Cl^-$. The efficiency of degradation of SMT using the formed nZVI significantly exceeded that using commercial nZVI that was purchased from Centron Biochemistry Technology. At an nZVI dosage of 56 mg/L, a PS concentration of 2 mmol/L, and an initial SMT concentration of 10 mg/L, the efficiency of degradation of SMT was 93% after 5 min in the absence of inorganic anions. Therefore, the nZVI/PS process is highly effective in degrading SMT in aqueous solutions.

Keywords: Nanoscale zero-valent iron; Persulfate; Sulfamethazine; Antibiotic