

Methods for Accelerating Nitrate Reduction Using Zerovalent Iron at Near-Neutral pH: Effects of H₂-Reducing Pretreatment and Copper Deposition

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Abstract

Both surface treatments, H₂-reducing pretreatment at 400 degrees C and the deposition of copper as a catalyst, were attempted to enhance the removal of nitrate (40 (mg N) L⁻¹) using zerovalent iron in a HEPES buffered solution at a pH of between 6.5 and 7.5. After the iron surface was pretreated with hydrogen gas, the removal of the passive oxide layers that covered the iron was indicated by the decline in the oxygen fraction (energy dispersive X-ray analysis) and the overlap of the cyclic polarization curves. The reaction rate was doubled, and the lag of the early period disappeared. Then, the deposition of copper onto freshly pretreated iron promoted nitrate degradation more effectively than that onto a nonpretreated iron surface, because of the high dispersion and small size of the copper particles. An optimum of 0.25-0.5% (w/w) Cu/Fe accelerated the rate by more than six times that of the nonpretreated iron. The aged 0.5% (w/w) Cu/Fe with continual dipping in nitrate solution for 20 days completely restored its reactivity by a regeneration process with H₂ reduction. Hence, these two iron surface treatments considerably promoted the removal of nitrate from near-neutral water; the reactivity of Cu/Fe was effectively recovered.