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Rapid and effective removal of Cr(VI) from aqueous solutions using the FeCl₃/NaBH₄ system

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Abstract

A new emergency treatment technology for rapid and effective removal of hexavalent chromium [Cr(VI)] from aqueous solutions by direct addition of ferric chloride (FeCl₃) and sodium borohydride (NaBH₄) in sequence to Cr(VI) solutions under magnetic stirring conditions was proposed in this study. Various reaction conditions, such as solution pH and Fe(III)/Cr(VI) and FeCl₃/NaBH₄ molar ratios were investigated. The results showed that 97.6-99.9% of 50 mg/L Cr(VI) can be removed from aqueous solutions within 3 min in the initial pH range of 3.5-6.0 with Fe(III)/Cr(VI) and FeCl₃/NaBH₄ molar ratios of 1.0:1 and 1:3.0 respectively at 298 K, which was significantly better than that of FeCl₃ and NaBH₄ alone. This indicated that a synergistic effect existed. Jar tests demonstrated that Cr(VI) was reduced to Cr(III) mainly by NaBH₄ under a strong acidic condition in which the hydrogen ions were largely provided by the hydrolysis of FeCl₃. In addition, co-precipitation of ferric and trivalent chromic ions occurred. The adsorption of ferric compounds also contributed to the loss of a relatively higher concentration of Cr(VI). Experimental results and

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