Treatment of As(V) and As(III) by Electrocoagulation Using Al and Fe Electrode

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Abstract

A batch electrocoagulation (EC) process with bipolar electrode and potentiodynamic polarization tests with monopolar systems were investigated as methods to explore the effects of electrode materials and initial solution pH on the As(V) and As(III) removal. The results displayed that the system with Al electrode has higher reaction rate during the initial period from 0 to 25 minutes than that of Fe electrode for alkaline condition. The pH increased with the EC time because the As(V) and As(III) removal by either co-precipitation or adsorption resulted in that the OH positions in Al-hydroxide or Fe-hydroxide were substituted by As(V) and As(III). The pH in Fe electrode system elevate higher than that in Al electrode because the As(V) removal substitutes more OH position in Fe-hydroxide than that in Al-hydroxide. EC system with Fe electrode can successfully remove the As(III) but system with Al electrode cannot because As(III) can strongly bind to the surface of Fe-hydroxide with forming inner-sphere species but weakly adsorb to the Al-hydroxide surface with forming outer-sphere species. The acidic solution can destroy the deposited hydroxide passive film then allow the metallic ions liberate into the solution, therefore, the acidic initial solution can enhance the As(V) and As(III) removal. The over potential calculation and potentiodynamic polarization tests reveal that the Fe electrode systems possess higher over potential and pitting potential than that of Al electrode system due to the fast hydrolysis of and the occurrence of Fe-hydroxide passive film.