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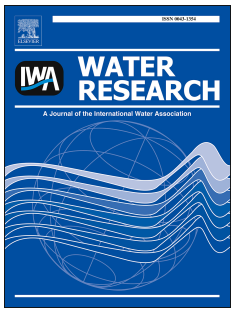

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Treatment of synthetic arsenate wastewater with iron–air fuel cell electrocoagulation to supply drinking water and electricity in remote areas

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Iron-air fuel cell, arsenate removal, electricity production, drinking water, remote areas

Abstract

Electrocoagulation with an iron–air fuel cell is an innovative arsenate removal system that can operate without an external electricity supply. Thus, this technology is advantageous for treating wastewater in remote regions where it is difficult to supply electricity. In this study, the possibility of real applications of this system for arsenate treatment with electricity production was verified through electrolyte effect investigations using a small-scale fuel cell and performance testing of a liter-scale fuel cell stack. The electrolyte species studied were NaCl, Na_2SO_4, and $NaHCO_3$. NaCl was overall the most effective electrolyte for arsenate treatment, although Na_2SO_4 produced the greatest electrical current and power density. In addition, although the current density and power density were proportional to the concentrations of NaCl and Na_2SO_4, the use of concentrations above 20 mM of NaCl and Na_2SO_4 inhibited arsenate treatment due to competition effects between anions and arsenate in adsorption onto the iron hydroxide. The dominant iron hydroxide produced at the iron anode was found to be lepidocrocite by means of Raman spectroscopy. A liter-scale four-stack iron–air fuel cell with 10 mM NaCl electrolyte was found to be able to treat about 300 L of 1 ppm arsenate solution to below 10 ppb during 1 day, based on its 60-min treatment capacity, as well as produce the maximum power density of 250 mW/m^2.