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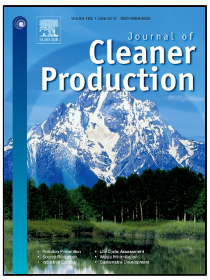

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Efficient removal of arsenate from oxic contaminated water by colloidal humic acid-coated goethite: batch and column experiments

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Abstract

Arsenic (As) contamination of groundwater frequently occurs and there is a need for cost-effective *in situ* remediation techniques. The injection of iron oxide colloids coated with humic substances has been proposed. This technology is based on injecting mobile humic acid-coated goethite colloids that are subsequently deposited by aggregation in the contaminated zone where the ionic strength is large, thereby creating an *in situ* reactive barrier for As. While coagulation and deposition are desirable for colloid immobilization, its effect on adsorption properties have been previously overlooked. This study was set up to investigate if i) humic acid-coated goethite colloids retain their As(V) adsorption properties after coagulation in quartz sand and ii) if batch As(V) adsorption data can predict As immobilization in columns at variable flow conditions. Equilibrium batch adsorption experiments showed that humic acid-coated goethite colloids coagulated and deposited on quartz sand have equal As(V) adsorption capacity, but two-fold lower affinity than humic acid-goethite colloids in suspension. This results indicated that there were some interactions between the sand and colloids but the overall adsorption capacity was not affected. Column experiments using sand coated with humic acid-goethite colloids (2.80 mg goethite g^{-1} sand) and stepwise injection of As(V) (1 4.9 mg As L^{-1}) showed a highly efficient As(V) removal from the liquid phase as the outflow As(V) concentrations remained below the drinking water limit (10 µg As L^{-1}) until about 45% of the sorbent capacity (30 mg As g^{-1} goethite) was reached. The flow rate dependent leachate As concentrations, including responses to stop-flow events, illustrated non-equilibrium sorption. The equilibrium batch adsorption