Assessment of Downhole Membrane-Diffused Hydrogen for Stimulating Uranium Reduction and Immobilization

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ABSTRACT

The most common technology currently used for restoring groundwater at in-situ recovery (ISR) uranium mining sites is reverse osmosis (RO) and reinjection of the permeate. However, this practice does not restore the formation to its original reduced state, and in many cases groundwater uranium concentrations are not restored to pre-mining baseline levels. This study was performed to evaluate the effectiveness of introducing dissolved hydrogen into a post-mined formation at an ISR mining site to stimulate reduction and immobilization of residual soluble uranium. The main objectives of this research project were: (1) to develop and optimize a system for minimizing air entrainment during water injection when employing a membrane gas-transfer device for down-hole hydrogen infusion; and (2) to assess whether injecting dissolved hydrogen using the membrane gas-transfer device can promote immobilization of dissolved uranium in groundwater to near or below pre-mining concentrations. Approximately 30,000gallons of groundwater were pumped to the surface and then re-injected into the subsurface while being supplied with dissolved hydrogen using the downhole membrane gas infusion device. The groundwater was pumped back to the surface after several monthsto evaluate the extent to which dissolved uranium had been removed. Initial results indicate an approximately 80% reduction in soluble uranium concentration was achieved. Microbial analyses indicated a significant increase in iron-reducing bacteria, but less significant increases in sulfate-reducing bacteria.