

Chromium Bio-Immobilization at the Hanford 100H Site: Geochemical Response to Slow Release Electron Donor

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The focus of these studies is to understand the coupled hydraulic, geochemical, and microbial conditions necessary to maximize Cr(VI) bioreduction and minimize Cr(III) reoxidation in groundwater. Here we present analysis of the geochemical response following the application of slow release electron donor during a field-scale treatability study. At the Hanford, WA 100H field site, two new wells were drilled and equipped — injection Well 699-96-45 and a monitoring and pumping Well 699-96-44. Samples were taken at intervals pre- and post-injection of a ¹³C-labeled slow release polylactate compound (HRC) used to stimulate indigenous microbial populations not of sufficient density to immobilize hexavalent chromium. Redox potential, pH, dissolved oxygen (DO), nitrate, chromium (VI), and sulfate concentrations in groundwater were monitored. Stable isotope enrichment in dissolved inorganic pools was followed and a fluorescent antibody used to visualize the presence of a sulfate reducer. Following HRC injection (27 days) reducing conditions (-130 mV) had established with a corresponding disappearance of DO and nitrate. Cr(VI) concentrations declined steadily over 6 weeks. Analysis of delta ¹³C ratios in dissolved inorganic carbon confirmed microbial metabolism of the labeled HRC. Hydrogen sulfide production was first observed after about 20 days post-injection and this corresponded with the enrichment of a *Desulfovibrio* species identified using fluorescent antibodies. DO and nitrate began to return to up-gradient concentrations two months after HRC injection, despite this bacterial densities remained high (>10⁷ cells/ml) and Cr(VI) concentrations in the monitoring and pumping wells remained below up-gradient concentrations. Cr(VI) was successfully removed from groundwater at a contaminated site using a slow release polylactate compound as electron donor and carbon source. Geochemical analysis of groundwater coupled with stable isotope and microbial monitoring allowed for accurate tracking of microbial processes during this field treatability study.