Functional Microbial Changes During Lactate and HRC-Stimulated Bioreduction of Cr(VI) in Hanford 100H Sediments

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To demonstrate the feasibility of a cost-effective remediation technology, using lactate-stimulated bioreduction of dissolved Cr(VI) to form an insoluble mineral precipitation of Cr(III), we conducted bench-scale investigations of sediment samples collected at the Hanford 100H area. Sediments were first saturated with water containing 1000 ppb Cr(VI) and then exposed to sodium lactate, HRC®, HRC Primer, HRC-Extended Release (HRC-X™), Metals Remediation Compound (MRC™) and a no carbon solution. HRC is a polylactate compound with different degrees of polymerization to control its viscosity and solubility in water. MRC is an organosulfur and polylactate combination that reacts directly with Cr, at least initially. In less than 1 week, MRC reduced Cr(VI) to undetectable concentrations, though the abiotic MRC control had only been reduced by 65%. By 3 weeks all the biotic HRC and lactate combinations had undetectable Cr(VI) while the abiotic controls for each had 40-61% of the Cr(VI) remaining. The sediment with no additional carbon source also showed a 64% reduction in Cr(VI) after 3 weeks, whereas the abiotic control had only a 12% reduction in Cr(VI). The HRC compounds performed equally well, while the MRC gave a faster response, although much of this response was abiotic. Phospholipid fatty acid analyses (PLFA), terminal restriction fragment length polymorphisms (TRFLP), clone libraries, direct cell counts, and 16s rDNA microarray analysis demonstrated that the initial densities of microbes is very low ($<10^4$ cells/g), but after biostimulation was typically $>10^8$ cells/g. Microbial diversity was low but sulfate reducers, *Arthrobacter* spp. and *Geobacter* spp. dominated the samples. The results demonstrate that even in low biomass and diversity environments biostimulation of Cr-reducers can occur and that their functional relationships can be evaluated by various molecular techniques.