Iodine Speciation and Potential for Bioremediation at the 200 West Hanford Site

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Iodine-129 is a long-lived fission product produced in nuclear reactors. It is considered a critical nuclear fuel waste form due to its long half-life (16 million years), high toxicity, and potentially high mobility in a subsurface environment. The 200 West area of the Hanford Site possess two dilute and laterally extensive I^{129} plumes from former disposal cribs with radioiodine concentrations of ~3.5 pCi/L. Present treatment options for these plumes are reliant upon hydraulic containment due to a lack of appropriate remediation technologies and a poor understanding of the fate and transport of I^{129}. Research on iodine's biogeochemical reactions, including the microbial population's effect on I^{129} speciation is critical to evaluating the risk associated with groundwater plumes.

Biotraps constructed from polyvinyl chloride pipe were filled with Ringold sand or control materials (i.e., glass beads) as media for microbial attachment, and were incubated in groundwater monitoring wells affected by the iodine plume for 50 or 150 days. Ion-extractable iodine species were predominately iodate, which is consistent with the species found in the groundwater. The rock fraction of the biotraps deployed in the higher and lower iodine regions of the plume exhibited a respective increase in iodine from 0.04 and 0.61 μg/g to 2.69 and 3.36μg/g.

Substrate from the traps was used to run batch experiments, which received water containing amendments of potassium iodide, potassium iodate and/or humic acid to study the effects of humic acid additions on iodine speciation in the presence of aquifer microbial communities. Soil and water from the traps and monitoring wells were analyzed for microbial diversity and activity, including the enrichment and quantification of iodide oxidizing bacteria, and the generation of clone libraries. Fingerprint data and clone identities show that the groundwater is dominated by 2-4 species of aerobic or microaerobic betaproteobacteria. Organisms enriched are being sequenced and physiologically characterized. Together these data will provide a detailed understanding of the importance of microbes on iodine speciation and determine the feasibility for in situ treatment and immobilization of I^{129}.