Bioaugmentation after Thermal Conductive Heating in Overburden and Bedrock

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Background/Objectives. At a former industrial facility located in northern New Jersey, Langan successfully remediated the soil impacts of chlorinated volatile organic compounds (CVOCs), DNAPL, and naphthalene NAPL to meet the stringent New Jersey Soil Remediation Standard (NRSRS) using thermal conductive heating. The thermal treatment focused on the source area. During thermal treatment, contaminant concentrations increased in the adjacent groundwater wells in the overburden and bedrock. After the thermal treatment was terminated in 2015, groundwater concentrations decreased, but some wells still showed higher contaminants levels than their baseline levels. A bioaugmentation program will be implemented in the Fall of 2018 to remediate the remaining groundwater impact in the overburden and the fractured bedrock aquifers.

Approach/Activities. Groundwater sampling events were conducted during and after the thermal treatment to obtain the geochemical and biological changes through the thermal treatment. An injection targeting both overburden and bedrock will be completed in November 2018. The injection entails delivering different carbon substrates, bioaugmentation culture, and buffering reagents.

- Emulsified lecithin was selected as the main substrate for the overburden because lecithin's properties facilitate the distribution in the low permeability formation. Meanwhile, EVO with large droplets was selected as the substrate for the fractured bedrock because EVO was approved to sustain in a nearby high flow aquifer.
- SDC-9 was selected as the bioaugmentation culture. A high dosage is to be applied to the overburden because the thermal treatment seemed to sterilize the DHC population.
- pH decreases and excess iron formation were observed in fractured bedrock in Northern Jersey. Thus, a mixture of buffering reagent was selected for the overburden and bedrock aquifer.

Results/Lessons Learned. The thermal treatment significantly enhanced natural attenuation in the bedrock aquifer and also changed the geochemical conditions of overburden. After thermal treatment, TOC increases along with high level of DHC were observed in the nearby bedrock wells, which also showed total contaminant decreases. The thermal treatment slightly increases groundwater pH and reduces electron acceptors in the overburden. However, the thermal treatment seemed to reduced DHC population to below detection limit for two years in the overburden. Lastly, because of the low permeability formation, the groundwater table was depressed within the thermal treatment area and groundwater temperature was significantly higher than the background two years after the thermal treatment.

The upcoming bioaugmentation will provide more insights into the potential influence of the thermal treatment for the active bioremediation, the impact the remaining heater well casing, performance of different carbon substrates under different hydraulic conditions, and also secondary impacts from the active bioremediation.