Secondary Geochemical Impacts of Bioremediation Observed in Glacial Till and Passaic Formation

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Background/Objectives. Various bioremediation projects had been monitored up to 5 years in New Jersey and New York. This summary will provide the observations and analyses of geochemical conditions changes occurred along with contaminant concentration reduction for all projects. The objective of this summary is to provide insights into the secondary geochemical conditions changes and guidance for future remediation, particularly in glacial till geology endemic to the northern New Jersey and New York region.

Approach/Activities. The observations are derived from four projects. The first project is a full-scale CVOCs bioaugmentation monitored for three years in northern New Jersey. The second project is a full-scale CVOCs bioaugmentation monitored for three years in central New Jersey. The third project is a full-scale CVOCs EZVI/bioaugmentation monitored for 2.5 years in New York City. The fourth project is a bench-scale treatability study that investigated biogeochemical degradation via iron sulfide and monitored various geochemical parameters.

Results/Lessons Learned. Among the four projects, two projects were bioaugmentation using EVO and SDC-9 while the other two projects also implemented abiotic degradations through iron and iron sulfide. The observations of the secondary geochemical changes focus on methane generation, iron formation, pH decrease, and their impact on DHC growth.

- Methane generation did not correlate to the TOC levels. More bioactivity (higher methane production) was observed when both biotic and abiotic paths existed. Because EVO was used during all projects, methane typically peaked at 18 months after injection in various geological conditions. In fractured bedrock aquifers, methane migrated much further than TOC and other geochemical changes. In overburden aquifers, methane was not a VI issue if sufficient vadose zone was present. However, methane levels could be in the LEL level when the vadose zone consisted of gravel backfill.
- The overburden and bedrock in New Jersey consist of iron-rich and sulfate-limited minerals. Soluble iron concentration increases of up to 700 mg/L was observed during two full-scale projects in New Jersey. The full-scale project in New York injected EZVI, but soluble iron was never above 30 mg/L. Iron generation seemed to be influenced by TOC (metabolic acids) level and soil type. Unlike methane, elevated iron was not observed beyond the target treatment zone. Iron sulfide was incidentally formed in an overburden area that was excavated and backfill with iron ore years before the injection
- Noticeable pH decreases were observed with all projects, except for the EZVI project. The most significant pH decrease was observed in the fractured bedrock aquifers. Most overburden projects showed sufficient buffer capacity. However, all pH decreases seemed to be transient and most decreases typically occur one year after the injection.
- DHC growth was highly influenced by the secondary geochemical changes. Although all projects used the SDC-9 culture, the most significant increase of DHC was observed with moderate TOC level, moderate iron formation, and neutral pH. Methane levels did not seem to impact DHC levels. High dosages of carbon substrate that induced the undesired geochemical changes was not always beneficial for DHC growth and bioremediation.

The field and bench-study observations of the geochemical changes will be analyzed for correlation, spatial, dosage, and response. The findings will be considered for future bioremediation applications.