Results from a 1,4-Dioxane Biogeochemical Reactor Field Pilot Test

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Background/Objectives. Biogeochemical reactors (BGRs) are a unique green and sustainable remediation (GSR) technology used for the treatment of contaminant source areas and groundwater plumes. Six above-ground BGR treatment trains were pilot tested at a chemical manufacturing facility in North America (Site) for the treatment of 1,4-dioxane and residual chlorinated volatile organic compounds (CVOCs). This presentation provides an overview of the results from the first two phases of this pilot study, and an overview of the design and construction of the subgrade BGR planned to be constructed in 2023.

Approach/Activities. The BGR technology has been used for the remediation of chlorinated solvents and other contaminants over the past decade, but had not been field tested for treatment of 1,4-dioxane. BGRs utilize a variety of organic and inorganic amendments that are tailored to support biological treatment of contaminants. The use of locally sourced, non-refined or “waste” products in BGR construction promote the GSR aspects of this technology.

This 1,4-dioxane BGR pilot study was conducted at the Site using a series of microcosm reactors filled with different combinations of treatment media, with and without bioaugmentation. Groundwater was pumped from a nearby monitoring through the six different treatment trains that were designed for metabolic/co-metabolic treatment of 1,4-dioxane and residual CVOCs. Three of the treatment trains were bioaugmented with CB1190 bacteria culture and the remaining treatment trains relied on native site bacteria only.

The first phase of the pilot test was completed in 2020 (Treatment Trains 1, 2, 3, and 4) and a second phase was completed in 2021 (Treatment Trains 2, 5, and 6). During each phase, treatment trains were operated between Spring and Autumn for a minimum of 6 months to monitor 1,4-dioxane and CVOC reductions.

Results/Lessons Learned. Performance results and lessons learned from both phases of the above-ground BGR pilot study will be presented, including target contaminant analytes, field data monitoring, and microbial analyses. Based on field monitoring and analytical data, all six BGR treatment trains were shown to be effective at reducing 1,4-dioxane and CVOC concentrations. During Phase 2, up to 95 to 98% reduction in 1,4-dioxane was observed in Treatment Trains 5 and 6. Results from both Phase 1 and Phase 2 are being incorporated into a full-scale design for a subgrade BGR to be constructed at this Site in 2023.