Biodegradation of Bis(2-chloroethoxy)methane by Two Bacterial Cultures in Support of a Field Pilot at a Historic Chemical Production Facility

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Background/Objectives. Groundwater and soil at a historic chemical production facility in the southeastern United States is impacted by a host of compounds including bis(2-chloroethoxy)methane (BCEM, up to 730,000 µg/L), 2-chloroethanol, bis(2-chloroethyl) ether (BCEE), 1,4-dioxane (DX), 1,2-dichloroethane, and 1,2,3-trichloropropane. Three separate water bearing zones, ranging from 15 to 110 ft bgs, are affected. Ongoing pump-and-treat actions at the site have been successful at controlling plume migration, but additional in situ and ex situ methods are being evaluated to cost-effectively degrade these constituents of concern (COCs) to enable site closure. Specifically for BCEM, degradation mechanisms—especially biological—are poorly understood; however, it was hypothesized that the biodegradation pathways for BCEM (and 2-chloroethanol) could be similar to those for BCEE. To address the COC profile at the site, two bacterial strains (*Xanthobacter sp.* strain ENV481 and *Pseudonocardia sp.* strain ENV478) were targeted.

Approach/Activities. Initial screening experiments for biodegradation of targeted site constituents by strains ENV481 and ENV478 demonstrated that these organisms were capable of degrading those COCs. To support a field pilot, a bench-scale experimental design was developed to understand the effects of the site-specific chemical and geochemical profile on bioaugmentation activity and survivability. Additionally, a separate study in COC-spiked growth medium was conducted to identify the scope of compounds that each organism could degrade and to identify the potential degradation pathways for BCEM and 2-chloroethanol.

Results/Lessons Learned. This bench-scale project demonstrated that ENV478 and ENV481 were capable of degrading the BCEM, 2-chloroethanol, BCEE, and DX in soil and groundwater microcosms from the site. Additionally, the study identified the process boundary conditions of pH, salinity, and COC concentrations that the organisms could tolerate and evaluated degradation rates over a range of cell densities. Data and conclusions from this study led to and directly impacted a pilot study, which will be described separately.