Prolonged Effects from Short-Term In Situ Microcosm Deployment in Monitoring Wells at a Chlorinated Solvents Remediation Site

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Background/Objectives. Historical degreasing operations at an aircraft parts manufacturing facility located near St. Louis, Missouri resulted in chlorinated solvent groundwater contamination that presented unacceptable risks to occupants of onsite industrial buildings and downgradient, offsite residential dwellings. Elevated levels of tetrachloroethylene (PCE), trichloroethylene (TCE), and their daughter products (i.e., *cis*-1,2-dichloroethylene and vinyl chloride) are present within the shallow saturated overburden and underlying bedrock. The groundwater plume extends from the area of the former degreaser at the Facility into the adjacent residential and industrial/commercial areas to the south and southeast of the Facility. Treatability studies were completed in 2020 within overburden (low-permeability clay) and shallow bedrock (shale) hydrostratigraphic units as part of the response action evaluation for the site. One of the technologies selected for treatability testing was enhanced in situ bioremediation (EISB).

Approach/Activities. Several shallow overburden and shallow bedrock monitoring wells, located in both source and plume treatment areas, were selected for evaluation during the EISB treatability study. In-well sampler units were used to conduct in situ microcosms to evaluate the presence and activity of multiple biodegradation mechanisms in each well. Each in situ microcosm assembly included three individual units – a monitored natural attenuation (MNA) unit containing only unamended media, a bio-stimulation (BioStim) unit containing media amended with electron donor, and a bio-augmentation (BioAug) unit containing media amended with electron donor and inoculated with a microbial culture. The microcosm units were deployed for approximately 75 days to allow the sample media to reach equilibrium with ambient aquifer conditions, including the formation of representative microbial colonies. Upon retrieval, the sampler units were submitted to a laboratory for analysis of microbial, chemical, and geochemical parameters.

Results. The results of the EISB treatability study generally indicated that EISB could meet the clean-up goals for the groundwater plume, assuming adequate distribution of nutrients into the low permeability clay material. The MNA and BioStim units showed potential of biodegradation with generally increased biological activity in BioStim units. However, the BioAug units showed levels of biodegradation that were often orders of magnitude higher than those achieved in the MNA unit. Based on this study, the combined addition of an electron donor and bioagumentation culture offered the greatest potential for growth and survival of microbial populations responsible for complete anaerobic reductive dechlorination of site contaminants. Typically, the effects of sampler deployment are short lived, and wells are anticipated to return to background conditions in a relatively short time. However, since sampler deployment and retrieval in 2020, prolonged effects have been detected in the wells where were deployed. PCE and TCE concentrations have been significantly reduced in these wells. Additional sampling for microbial populations was conducted in 2021, which indicated that the microbial communities introduced in the BioAug units have continued to thrive and proliferate in the wells where the samplers were deployed. The BioAug culture did also significantly raise the concentration of microbial strains capable of degrading vinyl chloride over the course of the deployment, and more detections of indigenous strains were observed in the August 2021 sampling event. It is anticipated that the effects of sampler deployment have been continued to be observed due to the initial presence

of contaminant-degrading microbes at the site, low groundwater flux throughout the Site, and Site conditions favorable for microbial growth.