Use of MBTs to Define Technical and Economic Efficacy

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Background/Objectives. Deeper knowledge of contaminant degradation pathways and analytical capability to demonstrate degradation along these pathways is fundamentally changing remediation approaches away from conventional horsepower-based technologies toward in situ remedies. A key aspect of implementing successful in situ remedies is the use of MBTs to provide actionable data on treatment efficacy along highly site-specific degradation pathways. These data enable the cost to closure for in situ remedies to be better defined and compared to conventional liability management strategies.

Approach/Activities. Actionable MBT data collection strategies and life-cycle cost comparisons between conventional and in situ technologies will be presented for several sites. At each site, data collection plans were designed to assess activity along naturally-occurring or simulated degradation pathways in a fail small/succeed big approach that utilized in situ microcosms and pilot-scale testing. Site-wide in situ remedy implementation costs were then scaled and compared to actual or estimated life-cycle costs for conventional treatment systems. The sites that will be discussed include:

- A long-term liability management site where decommissioning a hydraulic containment system and implementing a series of combined in situ remedies is desired to address a large dissolved chlorinated solvent plume. At this site, qPCR and CSIA were used to assess natural attenuation, a source area emulsified zero valent iron pilot test, and a high-volume bioremediation pilot test.
- A site with a large, oxic, dilute TCE plume with no apparent degradation products present. At this site, both cometabolic oxidation and abiotic reduction were assessed using qPCR, CSIA and magnetic susceptibility. Additionally, carbon-14 TCE assays were performed ex situ to quantify degradation rates along both pathways. Resultant degradation rate data was used to construct a four-dimensional reactive fate and transport model.
- A large chlorinated VOC plume in fractured sandstone where back diffusion is a confounding factor. At this site, a PlumeStop® plus bioremediation combined remedy pilot test was assessed using aquifer matrix in situ microcosms, deployed before amendment application, combined with qPCR and CSIA. The microcosm construct overcomes the sample collection constraints associated with analyte partitioning from the aqueous phase and allowed for the direct assessment of degradation occurring on the PlumeStop® activated carbon particle.

Results/Lessons Learned. MBTs data successfully demonstrated degradation along specific biological and abiotic pathways at each site presented. At all but one of the sites, discounted lifecycle cost models also showed an economic case for implementation of the in situ remedy. The combination of technical and economic efficacy at these two sites provided stakeholders with the actionable data needed to define and approve/fund full-scale implementation of the in situ remedies.