In Situ Microcosms Demonstrate Value in Optimizing In Situ Remediation

Matthew Burns (matt.burns@wsp.com), Matthew Porter, and David Carstens
(WSP, Boston, MA, USA)
Scott Haitz and Pam Groff (WSP, Herndon, VA, USA)

Background/Objectives. It was not too long ago that many groundwater contaminants were considered recalcitrant to biological and chemical treatments and remedial efforts regularly fell short of achieving goals. Now with better knowledge of metabolic and abiotic degradation pathways, remediation professionals have many potentially viable treatment options available along discrete or combined degradation pathways. However, potential activity along these pathways is highly variable, and requires site-specific assessment. In situ microcosm (ISM) studies can aid in identifying site-specific active pathways and optimizing amendment formulations to stimulate those pathways. ISM studies provide a fail small and succeed big opportunity to fine-tune in situ remediation processes and treatment outcomes.

Approach/Activities. Three sites where ISM studies provided actionable data will be presented. The studies include halogenated aliphatic and halogenated aromatic contaminants. All ISMs were incubated within groundwater monitoring wells. Solid phase media included activated carbon analogs for two of the sites and a sandstone matrix for the third. Exogenous amendments were introduced within the ISM during the two carbon analog media ISM studies and directly to the aquifer through a nearby injection well for the sandstone ISM study. Each study evaluated simulative effects on degradation pathways by examining impacts on contaminant concentration and geochemistry. Compound specific isotope analysis (CSIA) was employed to confirm the degradation of target compounds and nucleotide-based diagnostics, quantitative polymerase chain reaction (qPCR) stable isotope probing (SIP), were performed to identify and quantify the microbial communities present.

Results/Lessons Learned. Unexpected degradation pathways were identified in two of the three studies and later stimulated successfully at field scale at each of the sites. The third study supported a pilot test which included application an activated carbon based sorptive media. The study provided degradation information from the solid phase matrix greatly supplementing data available from the aqueous phase at sites treated with sorptive media. Collectively, these studies demonstrate the value of using ISMs to identify degradation pathways and to demonstrate degradation directly on solid phase matrices.