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# Generating Definitive Data for Biodegradation: Case Studies on Practical Use of Stable Isotope Probing

***Matthew Burns*** (matt.burns@wspgroup.com) (WSP | Parsons Brinckerhoff, Boston, Massachusetts, USA)
Christine Warford (christine.warford@wspgroup.com) and Judy Andrews (judy.andrews@wspgroup.com) (WSP | Parsons Brinckerhoff, Minneapolis, Minnesota, USA)
Daniel Liwicki (daniel.liwicki@wspgroup.com) (WSP | Parsons Brinckerhoff, Greenwood Village, Colorado, USA)

**Background/Objectives.** Horsepower-based remediation may not be the lowest cost class of cleanup technologies, but when designed and implemented properly, the expected results are usually achieved. The promise of greener, more efficient, and less costly cleanups is driving the remediation industry away from the "known" horsepower technologies toward manipulating unseen and not as well understood chemical and biological processes but, remediation professionals still want to have “known” information to stand behind. Stable isotope probing can provide such information where microbes use contaminants as electron donors.

**Approach/Activities.** The tools used by remediation professionals to assess, design and monitor performance in situ remediation are also radically different from tools used for traditional technologies. The new tools, commonly referred to as molecular biological tools (MBTs), can cut through the unseen and provide definitive and actionable data.

A class of MBTs, stable isotope probing involves tracking the fate of specially synthesized stable isotope ($^{13}C$) labeled contaminant to unambiguously identify biodegradation by incorporation of the label into biomass and dissolved inorganic carbon. Combining Bio-Trap samplers with stable isotope probing provides a powerful tool to definitively demonstrate engineered or naturally occurring biodegradation at contaminated sites.

**Results/Lessons Learned. Results/Lessons Learned.** Stable isotope probing concepts and applicability will be presented using three case studies. The case studies include predictive in situ microcosm studies to: Site 1) assess natural attenuation and stimulated degradation of petroleum compounds, Site 2) assess key degradation steps during abiotic and biotic treatment of mixed chlorobenzenes, and Site 3) define bioremediation performance of a combined in situ chemical oxidation (ISCO) and bioremediation pilot test for the treatment of benzene. Data from these studies were used to support full-scale implementation of natural attenuation at Site 1 and defined a novel chlorobenzene microaerophilic degradation pathway at Site 2. Site 3 activities are in progress and expected to be complete in early 2017.