Top 4 Tips for

Evaluating Remediation Options @ Chlorinated Solvent Sites

Molecular biological tools (MBTs) provide actionable data during site assessment that impacts remedy selection at sites impacted by chlorinated solvents. Below are some of our top tips when evaluating monitored natural attenuation (MNA), enhanced bioremediation, and combined bio/in situ chemical reduction (ISCR) as treatment options:

1. Perform an **In Situ Microcosm (ISM)** study to simultaneously compare MNA, biostimulation, and bioaugmentation as treatment options.

Results from laboratory microcosms do not always correlate to the field, and pilot studies are too expensive to be used to screen multiple remediation approaches. **ISMs** are field-deployed microcosm units containing passive samplers that provide the microbial, chemical, and geochemical data to cost-effectively evaluate multiple remediation options. An ISM assembly for a chlorinated solvent site typically has three units: an unamended MNA unit, a BioStim unit amended with an electron donor, and a BioAug unit containing a commercial culture and an electron donor.

2. Include **QuantArray®-Chlor** analysis during site assessment/remedy selection along with chemical and geochemical lines of evidence.

Are *Dehalococcoides* and other halorespiring bacteria present under existing conditions? At what concentrations? Is electron donor addition or bioaugmentation needed? **QuantArray®-Chlor** provides accurate quantification of a broad spectrum of halorespiring bacteria and functional genes to evaluate anaerobic biodegradation of chlorinated solvents.

Is MNA feasible? Is aerobic co-oxidation likely in downgradient sections of the plume? Should a primary substrate be added? **QuantArray®-Chlor** includes quantification of functional genes encoding a variety of oxygenases (e.g. soluble methane monooxygenase) capable of co-oxidation of TCE and other chlorinated compounds.

3. Also consider submitting groundwater samples from select monitoring wells for **Compound Specific Isotope Analysis (CSIA)**.

For many chlorinated compounds including PCE and TCE, **CSIA** can be used to conclusively determine whether contaminant degradation (biotic or abiotic) has occurred. In addition to an initial evaluation, **CSIA** and **QuantArray®-Chlor** results from site assessment/remedy selection also serve as the baseline to assess the effectiveness of remediation options including biostimulation, bioaugmentation, and combined bioremediation/ISCR.

4. Don't forget about abiotic degradation, particularly for MNA and dilute plumes. Submit soil or sediment samples for **Magnetic Susceptibility** and **Abiotic Testing Packages**.

A variety of iron-bearing minerals and clays are capable of abiotic degradation of PCE, TCE, and carbon tetrachloride. Some also catalyze degradation of chlorinated ethanes, cis-DCE, and vinyl chloride. To evaluate the potential for abiotic degradation, **Magnetic Susceptibility** provides an inexpensive and valuable estimate of the quantity of magnetite in an environmental sample. The abiotic package also includes **X-Ray Diffraction (XRD)** to detect crystalline forms of iron sulfides (FeS) mackinawite and pyrite. Also consider **AMIBA** (Aqueous and Mineralogical Intrinsic Bioremediation Assessment) which would include analyses like acid volatile sulfide (AVS), chromium-extractable sulfide (CrES), weak acid soluble ferrous and ferric iron (WAS-Fe) and strong acid soluble ferrous and ferric iron (SAS-Fe).

Many groundwater treatment technologies for chlorinated solvents rely upon the in situ formation of iron-bearing minerals like FeS to catalyze abiotic degradation. However, evaluation of these solid phase minerals and/or processes is often inferred from groundwater sampling because of the significant challenges and costs associated with the collection of solid phase samples.

The **Mineral Trap Sampler (Min-Trap™)** technology is a new, cost-effective in situ monitoring tool for collecting mineralogical data to manage in situ remediation programs. The Min-Trap™ can be deployed in an existing monitoring well and provides direct feedback on the formation and stability of reactive minerals while eliminating the need for drilling.

For more information, please visit the Resources section of the Microbial Insights website (www.microbe.com).

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