Top 4 Tips for Evaluating MNA @ Petroleum Sites

Depending on site conditions, monitored natural attenuation (MNA) can be an effective site management strategy at petroleum-impacted sites. Below are some of our top tips when evaluating the feasibility and performance of MNA:

1. Consult the applicable regulatory agency for guidance documents.

In addition to EPA and other federal agencies, many states have developed guidance documents detailing prerequisites for the MNA application, exclusion criteria, data collection requirements, and preferred data analysis methods.

2. Use multiple lines of evidence (chemistry, geochemistry, microbiology) to evaluate the feasibility and performance of MNA as a site management strategy.

Chemistry: Typically, the first line of evidence in evaluating MNA is demonstrating that contaminant concentrations are decreasing or stable with a statistical approach such as the Mann-Kendall Test.

Geochemistry: While not linked to a specific contaminant of concern, comparison of electron acceptor concentrations (e.g. DO, nitrate, iron, sulfate, methane) in background vs impacted wells can provide an indirect indication of microbial activity.

Microbiology: **See Top Tips 3 and 4** - Molecular biological tools (MBTs) are now routinely employed to directly and conclusively evaluate biodegradation as a component of MNA.

3. Submit groundwater samples or Bio-Trap® samplers from a background well and select monitoring wells within the plume for **QuantArray®-Petro** or **CENSUS® qPCR** analysis.

What are the concentrations of BTEX degraders? MTBE degraders? **QuantArray®-Petro** and **CENSUS® qPCR** are performed to quantify specific functional genes (e.g. anaerobic benzene carboxylase, toluene dioxygenase) responsible for biodegradation of BTEX, PAHs, and other petroleum hydrocarbons. Compare results for impacted monitoring wells to background concentrations. Higher concentrations of these key functional genes in impacted monitoring wells indicates growth of contaminant degraders within the dissolved plume and the potential for biodegradation during MNA.

4. Consider a **Stable Isotope Probing (SIP)** study to conclusively determine whether biodegradation of a specific contaminant of concern (e.g. benzene) is occurring under existing site conditions.

Is biodegradation occurring? In a **SIP** study, a Bio-Trap® sampler is amended with a specially synthesized ^{13}C form of the contaminant of concern (e.g. ^{13}C-benzene) and deployed in an impacted monitoring well for approximately 30-45 days. The ^{13}C serves as a “label” or “tracer”. If biodegradation of the contaminant occurs during the deployment period, the ^{13}C label will be incorporated into the end products of biodegradation — biomass and CO_2. Thus, the detection of ^{13}C enriched biomass or ^{13}C enriched dissolved inorganic carbon conclusively demonstrates that *in situ* biodegradation of the contaminant occurred providing a strong line of evidence supporting the feasibility of MNA.

Bonus Tip

Consider an ***In Situ*** **Microcosm (ISM)** study to compare MNA to enhanced bioremediation options such as injection of an oxygen releasing material.

During remedy selection, project managers often evaluate enhanced bioremediation options as well as MNA as site management strategies. ISMs provide a cost-effective approach to simultaneously evaluate multiple treatment options in the field.

For more information, full white papers on QuantArray®-Petro, Stable Isotope Probing (SIP), and In Situ *Microcosms (ISMs) are available on the Resources section of the Microbial Insights website (www.microbe.com).*

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