EMERGING AND UNDER UTILIZED ASSESSMENT TECHNOLOGIES FOR DETERMINING DEGRADATION RATES FOR IN SITU NATURAL ATTENUATION CAPACITY

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In situ degradation rates are typically determined through calculating decreases in chemical concentrations over time from long term ground water monitoring programs. This practice becomes costly and time exhaustive.

A field study was conducted using existing but under utilized remedial investigative tools to assess the feasibility of using these techniques to determine degradation rate kinetics quicker and cheaper than the traditional approach. The field study was conducted at a petroleum distribution facility in New Jersey, where a gasoline and off site source of tetrachloroethylene (PCE) had become co-mingled.

The objective of this project was to create a protocol of sequential tests, to determine if un-amended natural attenuation was a sufficient remedial strategy for the site, or if bio-stimulation or bioaugmentation was necessary, and to quickly and cost effectively screen these processes to select the remedial strategy at the site that will have the most probability of success.

The techniques assessed were:

- Bio-Traps™ coupled with microbial analyses (PLFA and rPCR-DNA) to establish background microbial conditions. Bio-traps are a novel, in well sampling device often referred to as an in-well microcosm. Bio-films, which rapidly form within the bio-traps, are analyzed for a presence/absence and abundance determination for known microbial groups documented to degrade, in part or fully, the compounds of interest.
- Bio-Traps™ augmented with electron acceptors (oxygen, nitrate and sulfate) were used to determine the target contaminant degradation rates when exposed to these different electron acceptors (bio-stimulation).
- A series of single-well, “push-pull” tests to determine in situ kinetics and microbial processes in the same wells. “Push-pull” tests consist of the injection of prepared test solutions into existing site wells. The test solution contained the same electron acceptors (oxygen, nitrate and sulfate) used in the Bio-Trap study in addition to a conservative tracer (bromide) to segregate abiotic and biotic in situ degradation rates of

the chemicals of interest over time (short term) when exposed to different bio-stimulation substrates.

The Bio-Traps “baited” with electron acceptors were loaded with a ^{13}C-labeled benzene and passive flux meters to quantify mass reduction of the ^{13}C-labeled benzene to compare the bio-stimulated degradation rates to unamended degradation rates, to determine if natural attenuation as a stand alone remedy was sufficient or if bio-stimulation produced significantly better results. Furthermore, the different substrates were screened to identify which one, from a mass reduction per unit dollar rate, had the best probability of favorable results at the site, for a full scale implementation.

Lastly, the bio-degradation rates from the Bio-trap and “push-pull” studies were compared for similarities, and contrasted with the overall site degradation rates generated from years of ground water monitoring at the site.