Antimethanogenic ISCR Approaches for Urban Dry Cleaner Sites: Source Mass Destruction and Dissolved Phase Dehalogenation

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Background/Objectives: In situ chemical reduction (ISCR) remedial approaches leverage the combined effects of biological and abiotic reductive processes. By combining fermentable substrates with reduced metals (e.g., ZVI) strongly reducing redox (Eh) conditions can be sustained (e.g., ORP values as low as, -350 to -550 MV) and the corresponding enhanced thermodynamic decomposition reactions allow for more effective mineralization of many COIs. Frequently, excessive methane generation is realized due to the favorable biogeochemical conditions created by conventional ISCR amendments and the ability of Archaea to rapidly multiply and compete for hydrogen resources.

Approach/Activities: The application of two antimethanogenic ISCR reagents (e.g., Provect-EZVI(CH4)™ and Provect-IR® were utilized to address subsurface contamination from the historical operations at two dry-cleaning facilities in the Midwest USA. The sites exhibited historical groundwater concentrations indicative of residual mass (e.g., concentrations exceeding 10% of the water solubility of parent compound, or 20,000 ppb PCE) in areas adjacent to suspected release points. Downgradient areas were impacted by chlorinated solvent COIs, namely PCE and significant concentrations of its catabolites TCE, cis1,2-DCE and lesser amounts of VC. Given the urban setting, the State of Indiana had special interest in assuring that the remedial action did not stimulate excessive methanogenesis which could create indoor air/vapor intrusion issues and other potential safety issues associated with high levels of methane.

Results/Lessons Learned: Biogeochemical monitoring at both sites exhibited the expected trends of rapid and significant decreases in ORP and near neutral pH conditions (ranging from 6.5 – 8). Monitoring data for the source area EZVI-CH4™ injections indicated that PCE concentrations decreased to non-detectable levels at both sites. Notably, methane monitoring data indicated controlled methanogenesis with screening limits for percent LEL and Total Volume percent only recording a few instances of exceedance predominantly during times when the SVE system was not operating. In general, areas treated with Provect-IR® have shown enhanced biogeochemical conditions and significant degradation of PCE and catabolites, without the generation of excessive methane. Detailed information on reagents applied and lessons learned during their full-scale field implementation will be presented along with results of field performance monitoring and costs for full-scale application.