Combined Surfactant and Oxidant Application for Simultaneous Contaminant Liberation and Destruction

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Background/Objectives. While surfactant use in remediation is often viewed as a promising strategy for site cleanups, this technology is sometimes met with reluctance due to concerns of contaminant liberation and offsite contaminant mobilization. The use of surfactants for desorption and emulsification of tightly sorbed, hydrophobic contamination from soil into the aqueous phase is a crucial step toward achieving complete or near complete in-situ chemical remediation of these contaminants. Application of surfactant alone will result in increased groundwater contaminant concentrations, which in the absence of an oxidant for in–situ destruction can lead to undesired contaminant mobilization. Optimized surfactants, when applied simultaneously with oxidants, deliver desorbed contaminants to the aqueous phase for destruction, limiting contaminant mobilization. Desorbed and emulsified contaminants, with exponentially increased surface area, are readily available for reaction with the simultaneously injected oxidant, significantly improving chemical oxidation efficiency. Surfactant Enhanced In-situ Chemical Oxidation (S-ISCO®) combines industry standard oxidants with proprietary plant-based, biodegradable surfactant blends, designed to be compatible with oxidants, to provide enhanced contaminant delivery, via surfactant desorption and emulsification, to oxidants for destruction. The injected homogenous surfactant-oxidant solution results in simultaneous desorption, emulsification, and oxidation of contaminants within a defined treatment area, avoiding undesirable mobilization.

Approach/Activities. Information will be presented based on field experience as well as laboratory data which addresses questions about surfactant use with oxidants in remediation. Methods and techniques for ensuring effective and efficient implementation of surfactants near sensitive receptors will be discussed. Examples will include data collected from a coal tar site located adjacent to a river in Queens, New York, where surfactants were successfully used in combination with oxidants, resulting in issuance of a certificate of completion from NYSDEC. Laboratory data will summarize a bench scale evaluation of the surfactant and oxidant interaction, with and without contaminant present.

Results/Lessons Learned. Monitoring data, from a site in close proximity to a major river, show how the surfactant and oxidant travel together within the boundary of the site, never posing risk to the nearby river. For example, during injections simultaneous concentrations of about 20 g/L surfactant, 20 g/L oxidant, and 215 mg/L TPH are present in a down gradient well within the treatment area. Further down gradient, significant decreases are observed, with all chemicals still present, at substantially reduced concentrations of about 1 g/L surfactant, 3 g/L oxidant, and 24 mg/L TPH. Finally, a strategically placed monitoring well, closer to the river, confirms no presence of treatment chemicals or contamination throughout or after implementation.

Data from laboratory tests demonstrates how the proprietary surfactants used in the S-ISCO process are sufficiently stable in the presence of an oxidant to enable efficient treatment and how a contaminant is oxidized first, before the surfactant is subject to destruction. These results show the surfactant remains stable in the presence of an oxidant and NAPL for the desired duration, whereas when NAPL is absent from the system the surfactant is eventually is oxidized.