ISCO or ISCR – Site-Specific Factors to Consider when Selecting a Remedial Approach

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Many chlorinated hydrocarbon compounds (CHCs) can be degraded via either oxidative or reductive processes. Accordingly, various oxidizing and reducing agents have been developed to remediate impacted environments. Each of these agents offers seemingly unique features and are effective on a varying range of CHCs. The purpose of this paper is to summarize initial screening criteria and guidelines to be considered when selecting between an ISCO or ISCR approach, including a review of geochemical parameters impacting the dosing requirements and potential factors inhibiting performance. FMC (Adventus) uniquely offers both activated persulfate for *in situ* chemical oxidation (ISCO) and iron-based technologies for in situ chemical reduction (ISCR) and therefore, as a group, have a broad understanding of challenges and advantages surrounding both methods.

In general, if the targeted environment is hypoxic (oxygen limited), it seems intuitive to employ an ISCR strategy. Conversely, an ISCO strategy would likely be more effective in an oxic environment. Chemical oxidants will oxidize natural organics and reduced inorganics, and the ISCO loading requirements will therefore be higher for soils high in organic content. Particularly for soils with lower CHC concentrations, ISCO may become cost prohibitive if the CHC oxidant demand makes up a smaller fraction of the total oxidant demand of the soil. The presence of competing electron acceptors such as oxygen, nitrate, iron(III), manganese and sulfate will increase the loading requirements for ISCR.

The composition of the constituents of interest (COIs) also needs to be considered. ISCR is active towards a wide range of halogenated compounds, but are not very effective for petroleum based hydrocarbons such as BTEX. The ISCO technologies reactivity toward different COIs are diverse and heavily dependent upon activators and application technique. Broadly one can say that activated persulfate is effective for treatment of all forms of organic compounds, so long as the compound has a sufficient solubility in water.

Other important factors to consider when selecting a remedial approach include the type of application (source removal, plume control or both), presence of free product (*e.g.*, NAPL), desired clean-up time, longevity of the material in the subsurface, secondary environmental impacts including break-down products and effect on the solubility of metals, and health and safety issues. There are also situations when the different technologies can be successfully combined, for example by applying ISCO in the source area coupled with an ISCR permeable reactive barrier for plume control.