

Overcoming Limitations of In-Situ Remediation using Chemical Oxidizers and Bio-amendments for Petroleum Hydrocarbons and Chlorinated Solvents.

James A. Jacobs, RG, REA, CHG, Environmental Bio-Systems, Inc.

Petroleum hydrocarbons and chlorinated solvents can be treated in-situ using chemical oxidants as well as bioremediation amendments. In-situ remediation of these compounds uses contact chemistry between the treatment liquids and the contaminants. Although laboratory demonstrations of chemical oxidation for both target chemicals and aerobic bioremediation of petroleum hydrocarbons and anaerobic bioremediation of chlorinated solvents are well documented. Transferring the technologies to the subsurface makes the remediation process much more complex, given the large numbers of variables associated with each site. Several key limitations of in-situ remediation must be carefully examined during the remedial action plan phase of the remediation design. After completing numerous in-situ projects, performance in the field can be optimized and enhanced. Factors to evaluate include the lithologic and contaminant characteristics, the delivery system, properties of the treatment chemicals, target remediation goals set by the regulators or property owners, and time and financial constraints.

The in-situ delivery system must be compatible with the lithologic character of the aquifer or vadose zone. Jetting technology is one in-situ delivery system wherein a treatment liquid is injected under high-pressure into the subsurface. At high pressures (up to 5,000 psi), the radius of influence around injection ports has been documented to exceed 10 feet, even in low permeability soil. Optimum lithologies for jetting remediation however, are gravel to fine sand, although silty clays have been treated. Spacing of injection ports is critical in the planning and budgeting of the in-situ project.

Successful in-situ projects generally include the following factors: an evaluation of treatment chemical reaction times, consideration of chemical stabilizers or catalysts, a detailed subsurface characterization before and after treatment with several soil and groundwater samples. After a complete review of the existing laboratory by a qualified chemist and hydrogeologic data, the chemical stoichiometry and chemical compatibility of treatment chemicals in the environment is necessary. Next, a detailed bench or laboratory test is recommended prior to a pilot-scale project or full scale remediation. Since each site has a unique set of hydrogeologic, chemical and biological factors, the initial subsurface sampling and chemical and hydrogeological evaluations are critical in proper in-situ design of the pilot-scale project. Several in-situ remediation case studies will be discussed to evaluate the key factors in chronology of the project and the ultimate outcome. In one recent California San Joaquin case, crop oil was reduced by over 40 percent in the vadose zone using an acidified hydrogen peroxide injection. The treatment zone was near a railroad spur, making more conventional methods, such as excavation, more difficult. After one in-situ treatment event, case closure was obtained by the consultant within several months.

James A. Jacobs, R.G., R.E.A., C.H.G.
Environmental Bio-Systems, Inc.
707 View Point Road
Mill Valley, CA 94941
Tele. (415) 381-5195
Fax: (415) 381-5816
e-mail: augerpro@sbcglobal.net