The Foam Means it's Working

Corinna, Maine.
Soil Contaminated with 1,2,4 trichlorobenzene

Sulfuric acid and sodium persulfate tankers

Tanker containing 50% hydrogen peroxide for Fenton's Reagent

Containment trench around tankers

An Army Corps of Engineers team led by Dr. Ian Ogersby evaluates the in situ chemical oxidation (ISCO) of contaminants at a superfund site in Corinna, Maine. Two ISCO reagents, persulfate and Fenton's reagent, are evaluated in side-by-side tests.

Chemical oxidation is a fast-acting approach to contaminated site cleanup. Seen as an alternative to the plodding and costly pump-and-treat process, In Situ Chemical Oxidation (ISCO) is an emerging technology that can rapidly reduce groundwater contaminant concentrations when applied at highly contaminated sites or source areas. This year's ISCO Platform Session featured experts from industry and academia who discussed the intricacies of ISCO chemistry and showcased the latest methodologies.

"This isn't just ivory tower research. What we're doing experimentally, they're applying in the field."

Because it is an in situ remediation technique, ISCO can be applied without major site disturbance and can be used to treat parts of the subsurface, like the soil beneath buildings or storage tanks, that would normally be inaccessible. Oxidants (e.g. permanganate, Fenton's Reagent, ozone, persulfate) injected into the subsurface of a contaminated site initiate a chemical reaction that destroys a variety of groundwater contaminants, including chlorinated solvents, polyaromatic hydrocarbons and petroleum products.

The ISCO reaction naturally evolves gases that cause foaming in the groundwater. The foam can sometimes be seen as it rises up through cracks and crevasses to the soil surface, reminiscent of that famous frothing science fair project, the baking soda and vinegar volcano. Though it may look a little odd to the untrained eye, as one session speaker said, "the foam means it's working."

Interest in the ISCO session has been increasing steadily since it first appeared in the conference agenda several years ago. The novelty and effectiveness of ISCO methods has stimulated the interest of many conference-goers, and the challenge of refining this relatively new technique is common ground for conversation among ISCO researchers and remediation engineers. Unlike in the controlled conditions of a laboratory, an in situ chemical reaction can be influenced by the myriad environmental variables of the subsurface. The complications inherent to this technique

Protective equipment area

Scott Crawford, B.S., M.S. UMass Lowell

Deepti Krishnan Nair, M.S. UMass Lowell

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By Loren Walker www.L2W.cc

were summed up succinctly in the title of a presentation by Ian Ogersby, of the U.S. Army Corps of Engineers: "ISCO Technology Overview – Do You Really Understand the Chemistry?"

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The primary challenge is choosing the right oxidant for the right job, according to Mark Kauffmann of ENSR International. "For example, if you have a small source area, you can pick something that's really quick and reactive with only a short radius of influence," Kauffmann explains. "If you need something to hit a longer plume, you'll want to use a slower acting oxidant." In addition to plume size, the kind of contaminant and soil type influence the choice of oxidant.

"Soils really control the situation," says Cifford Bruell, UMass Lowell Professor of Environmental Engineering and Conference Co-Director. "Soils may have a higher fraction of organic carbon, they may vary in their soil chemistry or mineralogy, they may have a high concentration of iron, a high pH or a low pH. All of these things really throw a monkey wrench into the problem; it's not straightforward."

Bruell sees ISCO as a good example of effective technology transfer from academic institutions to industrial applications. Innovative approaches to the remediation of environmental contaminants in soils and groundwater is something he and his colleagues at the University have been talking about for more than twenty years. Now some of those people, including former students, are in the private sector. And these companies, Bruell says, "are very interested in our in situ chemical oxidation experiments because they're implementing the same thing in the field. It's tied in. We work hand-in-glove on some of these operations. So, this isn't just ivory tower research that has no real application; what we're doing [experimentally] they're applying in the field."

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"Soils really control the situation."


Dr.s Ian Osgerby, Clifford Bruell, and Richard Watts


Andy Boeckeler from Nobis Engineering


Deepti and Scott with ferrous sulfate and citric acid


Batch tanks used to prepare injection solutions (e.g., Fe2+), lines then connected to batch tanks


Lines carrying chemicals to injection wells


Sulfuric acid injection pump used to acidify aquifer


Injection well screened 30-35 ft below ground surface (BGS)


Sulfuric acid injection in progress


Injection system by Kara Kelly, B.S., M.S. UMass Lowell

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