Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies
May 22-27, 2017 Miami, Florida

Combined ISCO/Bioremediation for In-Place Soil Treatment

Jeff Ogden (Fehr-Graham, Inc.) and
Jim Mueller (Provectus Environmental Products, Inc)

Background/Objectives: Shallow, unsaturated clayey soils at two sites in the Midwest USA were contaminated by organic contaminants. Site "A" (Mendota, a manufacturer of tractor components, specifically for the farming industry) had an estimated 500 tons of soil containing mixed petroleum and chlorinated solvents, exceeding soil saturation limits in many cases (PCE > 35,000 ppm, toluene > 4,000 ppm); the remedial goals were to reduce concentrations below soil saturation limits, calculated to be approximately 2,000 ppm for PCE and 1,000 ppm for toluene. Site "B" (LaSalle, a copper wire and cable manufacturer) had an estimated 250 tons of impacted soil representing a source of vinyl chloride in groundwater at about 1 mg/L (remedial goal was < 0.04 mg/L). Active facility operations were present at both sites, hence the remedial objectives were to rapidly reduced COI concentrations in a safe and effective manner *i.e.*, materials easy to handle on site; no extreme activation chemistries such as heat or grossly elevated pH, and – importantly - a one-time application event to minimize disruptions to facility operations.
Approach/Activities: Provect-OX® is a dry powder containing sodium persulfate and ferric oxide that can be easily applied into a subsurface environment via direct mixing, hydraulic fracturing, pneumatic fracturing, and direct push injection of slurries or liquids. Ferric iron can safely activate persulfate which quickly yields sulfate- and ferrate-radicals to effectively oxidize chlorinated solvents, petroleum hydrocarbons and other organic compounds such as pesticides in soil, sediment and groundwater. Importantly, the process also enhances subsequent utilization of sulfate and iron as terminal electron acceptors for facultative redox reactions for improved biodegradation of any residual COIs. This combination of chemical and biological treatment mechanisms allows for more cost-efficient dosing of the product while supporting long-term, sustained, secondary bioremediation processes to manage residuals and prevent contaminant rebound (COI rebound is a common problem encountered with conventional ISCO technologies). Alternative methods of stimulating secondary biodegradation processes using oxygen release compounds (such as calcium or magnesium oxyhydroxide) are limited in that they will remain active for only a few months, after which time their oxygen release potential is exhausted. Iron, on the other hand, remains in place and active for many years. Additional benefits include: i) does not generate excessive heat / off-gases, and ii) it not mobilize heavy metals or lead to the generation of secondary impact issues such as elevated arsenic, chromium resulting from grossly elevated pH.
Results/Lessons Learned: Site A was treated with 12,100 lbs of reagent via direct soil mixing over a 5 day period; Site B was treated with 2,700 lbs of reagent via direct injections over a 1 day period. Both sites were successfully treated within a very short period of time. This presentation will outline field applications, summarize the data below, and review total project costs.

Site	Starting COI Conc.	Ending COI Conc.	Treatment Time
A soil	**38,000 ppm PCE** **4,000 ppm toluene**	**900 ppm PCE** **< 100 ppm Toluene**	**1 week**
B water	**0.7 mg/L VC**	**0.2 mg/L VC**	**< 2 days**

Proposed Session:

Bioremediation Implementation Practices
Session 2i (1c): Incorporating Bioremediation in Treatment Trains
Alternative Session 1c: Ex Situ Biological Treatment

Platform Requested

Corresponding Author:

Jeff Ogden JOgden@fehr-graham.com
Fehr Graham Engineering & Environmental
221 East Main Street - Suite 200
Freeport, IL 61032
Phone: (815) 235-7643

Presenting Coauthor:

Jeff Ogden JOgden@fehr-graham.com
Fehr Graham Engineering & Environmental
221 East Main Street - Suite 200
Freeport, IL 61032
Phone: (815) 235-7643

Coauthors:

Jim Mueller jim.mueller@provectusenv.com
Provectus Environmental Products, Inc.
2871 West Forest Rd, Suite 2
Freeport, IL 61032
Phone: (815) 650-2230