

## EX-SITU REMEDIATION OF PCE AND TCE IN SOILS USING A PROPRIETARY, PERSULFATE-BASED OXIDATION TECHNOLOGY

Peter J. Palko, P.E., CHMM, Chuck Elmendorf, Kevin D. Dyson, EIT (**Panther** Technologies), Medford, NJ, USA; Frank Sessa (FMC Corporation), Philadelphia, PA, USA



Soils and groundwater at the subject site had become contaminated with levels of perchloroethylene (PCE) and trichloroethylene (TCE) at concentrations in excess of 20,000 mg/kg and 100 mg/l, respectively, significantly above risk-based remedial standards set by the New Jersey Department of Environmental Protection (NJDEP). Because the PCE and TCE in soil presented an ongoing source of groundwater contamination, soil remediation comprising source area removal was a top remedial priority at the site. Groundwater studies and an interim groundwater recovery/treatment system are ongoing at the site.

The initial unsaturated soil remedy selected for this site included in-situ, enhanced anaerobic reductive dehalogenation (ERD). However, due to heterogeneous soils, which included a significant amount of clay and a depth to groundwater greater than 35 feet below grade, this technology was challenged by the NJDEP. **Panther** Technologies, Inc. (**Panther**) proposed a fast track delineation of site soils followed by an onsite ex-situ chemical oxidation approach including treatment cell construction (including a 100,000 cubic foot negative pressure structure), wetlands removal, steel sheet piling, water storage and treatment, soil excavation and treatment, vapor control and treatment, perimeter and work zone air monitoring, soil backfilling, and final wetlands restoration. The ex-situ chemical oxidation technology implemented by **Panther** was an aggressive approach specifically designed to assure mass removal of PCE and TCE to below site-specific treatment standards and allow re-use of the soil on-site in an expedited time frame due to an impending real estate transaction.

With chemistry support from FMC Corporation, **Panther** implemented a chemically catalyzed persulfate technology to remediate 40,000 tons of contaminated soils containing approximately 32,000 lbs of CVOCs at the site. After extensive bench-scale testing of different oxidation technologies including other forms of catalyzed persulfate (heat and iron) as well as sodium permanganate, a new combination of oxidants (FMC patent pending) was implemented at the site to overcome the challenges represented in a full-scale field application where ambient temperatures in the Northeast drop to below 0° F during the winter. Following excavation, chemical application and mixing, an extensive post-treatment soil sampling quality assurance plan was implemented to ensure soils met the re-use criteria of less than 5 mg/kg prior to backfilling.

Two major benefits of applying chemically catalyzed persulfate included the elimination of PCE and TCE in soil (preventing continued mass flux into groundwater) and on-site re-use of the treated soils as opposed to costly offsite disposal as hazardous waste. This remedy saved our client over \$6,000,000 in off-site disposal costs. The treatment of 40,000 tons of soils from a site wide average of greater than 1,000 mg/kg with highs in excess of 20,000 mg/kg to less than 5 mg/kg in less than a 72-hour period per 1000 ton batch represented the largest application of chemically catalyzed persulfate oxidation ever performed and solidifies this technology as an innovative and cost-effective approach to remediation of recalcitrant compounds in soil and groundwater. The design of this technology can (and in most cases must) be customized to meet the specific characteristics of a given site to assure successful application.