# A Combined Remedy of In Situ Chemical Oxidation and Aerobic Bioremediation to Treat the Emerging Contaminant Tetrahydrofuran

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**Background/Objectives.** A Midwestern industrial facility, which historically used tetrahydrofuran (THF) as part of its operations, resulted in contamination of the shallow soil and groundwater with concentrations as high as 1,500 mg/kg and 400 mg/L, respectively. THF, a suspected carcinogen, is an emerging contaminant at many industrial sites due to its risk to human health. Because of the potential risk pathways at the site, the governing environmental agency required remediation of the THF. In situ remediation was favored due to its non-intrusive nature and cost savings when compared to soil/groundwater removal, but due to the novelty of this contaminant, little information was available regarding suitable techniques for THF remediation in the subsurface. This posed a significant obstacle to achieving progress toward site closure. A literature review demonstrated that in wastewater treatment, THF has been readily degraded using advanced oxidation methods. Thus, a remediation program consisting of in situ chemical oxidation (ISCO) and aerobic bioremediation seemed very likely to be successful and was selected for the project site.

**Approach/Activities.** Treatability tests using a mixture of catalyzed sodium persulfate and an advanced oxygen releasing compound (ORC) were performed by an independent laboratory at varying dosages to demonstrate efficacy of this concept and to optimize the final dosage for a full-scale application. The test consisted of a low and high dosage of the reagent mixed with site soils/groundwater and left for 28 days. The low dosage consisted of 10 g/L of the catalyzed sodium persulfate and 1.3 g/L of the ORC while the high dosage consisted of 50 g/L of the catalyzed sodium persulfate and 6.5 g/L of the ORC. Following the successful treatability test, a full-scale treatment was implemented using the ISCO and aerobic bioremediation approach. Using direct push technology (DPT) methods, approximately 20,000 pounds of catalyzed sodium persulfate and 2,000 pounds of the ORC reagents were mixed with water into a 15 to 20% solution and injected at the site over multiple planned applications events.

**Results/Lessons Learned.** The laboratory treatability showed that after 28 days, THF concentrations were reduced by about 65% for the low dose and >99% for the higher dose. The results demonstrated that this ISCO to bio approach could be effective. Following the full-scale treatment, the results of the post-application sampling demonstrated reduction of THF in both soil and groundwater of up to 99% which has significantly reduced the plume footprint. This presentation provides practitioners with a remedial framework for successful treatment of novel and emerging contaminants such as THF to navigate towards site closure. The importance of distribution of the reagents and application specifications will be highlighted during this talk as it pertains to optimizing treatment. The results of these efforts show that this novel and emerging contaminant can be readily treated using a combined treatment of ISCO and aerobic bioremediation.