NETTS PROJECT/DEMONSTRATION SUMMARY

Title: HiPOx Advanced Oxidation Process
MTBE Wellhead Treatment, NCBC-49-00

Lead PI/Affiliation: Applied Process

Date/Duration:
Initiated - 8/00
Completed - 9/02

Abstract:
The EPA National Risk Management Research Laboratory will evaluate five remediation technologies for reducing the concentration of MTBE in contaminated groundwater. Each technology will be evaluated under one or more of the following conditions: (1) in situ and ex situ source area (both BTEX and MTBE present), (2) in situ MTBE devolved phase portion of a plume, and (3) ex situ wellhead protection.

Advanced oxidation process (AOP) using ozone and hydrogen peroxide to create hydroxyl free radicals with extremely high oxidizing potential are well documented. They work by rapidly oxidizing organic contaminants into non-hazardous compounds such as carbon dioxide and water. This oxidation process occurs in the aqueous phase and does not increase the temperature or pressure of the water because it occurs at very low concentrations.

Generation of hydroxyl radicals begins with the reaction in which hydrogen peroxide dissociates into hydroperoxide ions (HO_2^-), which then react with ozone to form the ozonide radical (O_3^-) and hydroperoxide radical (HO_2). Through a series of reactions and intermediates, the hydroperoxide radical decomposes to form another ozonide radical ion, which reacts with water to form hydroxyl radicals. Reactants such as MTBE are oxidized by the free radicals to form intermediates and eventually CO_2 and H_2O.

HiPOx incorporates high pressure, high precision distribution of ozone and reagents, and high efficiency mixing to maximize mass transfer; manages localized reagent and ozone concentrations; and reduces the mass-transfer limitation on the overall oxidation rate by several orders of magnitude. High ozone concentrations (8-10 wt. %), high operating pressure (35-45 psig vs. ambient pressure), and efficient, in-line mixing are combined to maximize transfer and reaction efficiency. HiPOx systems use a series of injection modules. Hydrogen peroxide and ozone are injected at 20-60 psig. The dosed fluid flows immediately through a mixing section followed by a reaction zone specifically designed for the required residence time.

Primary Objective 1: Will the technologies reduce the concentration of MTBE to below 5 ppb?
Primary Objective 2: Will the technologies produce an effluent that meets or exceeds all relevant State of California MCLs for applicable contaminants?
Primary Objective 3: When subjected to uniform formation conditions (UFC), does the effluent meet TTHM and HAA5 requirements of the Stage 2 DBPR?
Primary Objective 4: Will the removal efficiency (percent removal) change over time for these technologies?

From late 1984 to early 1985, approximately 10,800 gallons of gasoline leaked from two storage tanks and piping under the Naval Exchange (NEX) gas station at the Naval Base Ventura County Port Hueneme Site (NBVC). Since 1985, the Navy has taken actions to prevent any further damage to the environment from the leaks. The MTBE remediation technologies demonstrated at NBVC Port Hueneme Site are part of the overall strategy in the NEX Plume Management plan for containment and control of the plume to prevent any further damage to the environment.

Results/Conclusions: Ongoing project
Publications: None