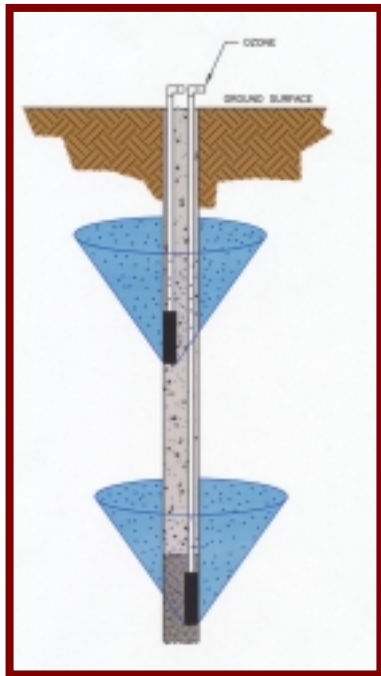


Introduction to Ozone Injection Technology



Ozone is a highly reactive chemical that has proven to be effective in destroying a wide variety of organic chemicals, including MtBE and chlorinated VOCs. Ozone destroys organic chemicals through the process of chemical oxidation, which breaks the targeted organic chemical down into carbon dioxide and water. Ozone is commonly used in aboveground treatment systems for treatment of wastewater and is widely used to treat extracted groundwater generated from pump-and-treat remediation systems.

An affordable and flexible alternative to large pump and treat systems, LFR uses the KVA C-Sparge™ System, a self-contained ozone-air sparging panel. The 110V panel operates as follows:

- ◆ Generated ozone is injected through tubing to a microporous sparge point designed to generate very small (i.e. approximately 50 micrometers in diameter) bubbles.
- ◆ Ozone micro bubbles are forced out into the surrounding water-bearing formation.
- ◆ A control panel regulates the frequency/duration of ozone injections.
- ◆ Ozone injected into the formation comes into contact with impacted groundwater, where contaminants in groundwater volatilize into the ozone bubble and are oxidized (destroyed).

This technology has the following advantages over other remedial approaches:

- ◆ Low capital equipment costs.
- ◆ Minimal site disturbance.
- ◆ Equipment is self-contained and compact (2' x 3').
- ◆ Technology has the potential to substantially decrease the mass and concentration of contaminants in a short time period (i.e., weeks).
- ◆ Does not require vapor control since the contaminants are destroyed rather than transferred from one phase to another.

LFR Levine·Fricke has been remediating contaminated sites throughout the country since our inception in 1969. Our vast experience with innovative, as well as conventional, remedial technologies allows us to bring cost-effective site closure to environmentally challenged properties.



A Success Story: Ozone-Air Sparging Pilot Test at an MtBE Site in Long Island, New York

Background

LFR Levine-Fricke conducted a pilot study to evaluate the efficacy of an ozone and air-sparging system for *in-situ* treatment of methyl tertiary-butyl ether (MtBE) and benzene, toluene, ethylbenzene and xylenes (BTEX) impacted groundwater at a gasoline spill site on Long Island, New York. Two ozone-air sparge points were installed at different depths in a single borehole to maximize the conical diffusion of the gasses in the medium- to coarse-grain sand aquifer. Monitoring wells were installed at twelve and twenty-eight feet downgradient of the sparge points to measure the magnitude of hydraulic effect and to monitor changes in groundwater quality resulting from addition of ozone and air.

Results

Pressure data from down-hole transducers and measurements of dissolved oxygen in groundwater were used to evaluate the area of influence of the sparging system. These data confirmed that the ozone-air sparge system had a down-gradient radius of influence of at least 28 feet.

Changes in MtBE concentration in groundwater were monitored and destruction rates estimated using analytical results from weekly samples collected from the monitoring points. The graphs at right plot MtBE concentration versus time for LFR-4 (12 feet down-gradient of the sparge well) and LFR-2 (28 feet down-gradient of the sparge well).

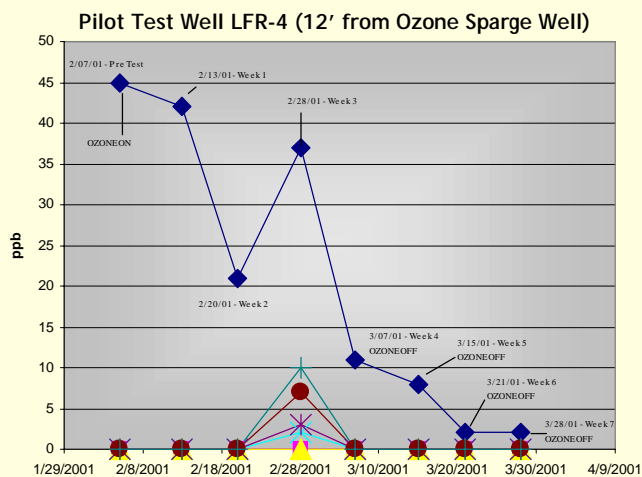
After four weeks of ozone-air sparging, MtBE concentrations in LFR-2 decreased from 6,300 parts per billion (ppb) to 1,700 ppb, a 73% destruction rate. MtBE concentrations continued to decrease for three weeks after the four-week ozone-air sparging period to 79 ppb, a 99% destruction rate, at week 7. BTEX concentrations in LFR-2 realized similar decreases.

LFR-4 MtBE concentrations decreased from 45 ppb to 11 ppb in the four week ozone-air sparge period, a 76% destruction rate. MtBE concentrations continued to decrease for three weeks after the four-week ozone-air sparging period to 2 ppb, a 96% destruction rate, at week 7. BTEX was not initially detected in this well, however a spike in BTEX concentrations occurred after two weeks of ozone sparging.

Conclusions

LFR has performed a successful pilot clearly demonstrating the efficacy of the ozone and air sparging technology for remediation of MtBE and BTEX impacted groundwater. This innovative remedial technology is a cost-effective and timely alternative for the conventional pump and treat remedial technologies.

MTBE and BTEX Concentrations vs. Time



Pilot Test Well LFR-2 (28' from Ozone Sparge Well)

