**Ozone Tackles Groundwater Contamination**

**BY:**

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Water, water, every where, And all the boards did shrink; Water, water, every where, Nor any drop to drink.”

This well-known phrase from The Rime of the Ancient Mariner by Samuel Taylor Coleridge refers to the frustrations of ancient mariners surrounded by water unfit to drink. Originally published in 1798, it rings truer than ever today, and those same sentiments are now increasingly being voiced by landsmen as well. The purity of groundwater can no longer be taken for granted, and ozone is playing its part to keep our groundwater safe.

**Groundwater Contamination**

There are many causes of increased groundwater contamination, but one of the most insidious is Methyl tertiary-butyl ether (MTBE). MTBE is almost exclusively used as a fuel component in gasoline. It is one of a group of chemicals commonly known as oxygenates because they raise the oxygen content of gasoline. In the U.S. it has been used in gasoline at low levels since 1979 to increase its octane rating and help prevent engine knocking.

In 1995 high levels of MTBE were unexpectedly discovered in the water wells of Santa Monica, Calif. and subsequent U.S. findings indicated tens of thousands of contaminated sites in water wells across the country.

The International Agency for Research on Cancer, a part of the World Health Organization, maintains that MTBE cannot be classified as a human carcinogen; however, exposure to high levels of MTBE has significant non- cancer-related health risks. Although the extent of MTBE as a health risk is debatable, a transparent disadvantage is that MTBE ruins the taste of water even at low concentrations of 5 to 15 mg/L. As a result, significant concentrations of MTBE in drinking water are immediately detectable.

**Treatment**

Ozone has been used for many years in the treatment and removal of chemical contaminants in industrial wastewater, so it is not surprising that ozone would be enlisted to combat the growing problem of MTBE groundwater contamination. Ozone is a relatively unstable molecule comprised of three oxygen atoms. This instability means that it has a short lifespan and degrades rapidly in the environment, which makes ozone ideal for environmental remediation of contaminants.

Ozone can be introduced to the subsurface water as either a gas (ozone sparging) or a liquid (dissolved ozone injection). In its gas phase, ozone is typically introduced to the subsurface water through traditional air sparge wells. In its liquid phase, ozone dissolved in water is typically injected to the subsurface through injection wells, trenches or infiltration galleries. When ozone is dissolved in groundwater, the groundwater itself becomes a remediation agent. Dissolved ozone directly destroys the MTBE by chemically reacting with it to break the compound down into carbon dioxide and water, which obviously do not present a threat to human health or the environment. In addition, unreacted ozone will degrade to dissolved oxygen to enhance natural biodegradation of residual contaminants.

**Pilot Study**

A pilot study to evaluate the efficacy of ozone sparging systems for the treatment of MTBE-impacted groundwater was conducted at a gasoline spill site in Long Island, N.Y. Two ozone-air sparge points were installed at different depths in a single borehole to maximize the conical diffusion of the gases in the medium-to coarse-grain sand aquifer. Monitoring wells were installed at 12 and 28 ft down gradient 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.

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. Data confirmed that the ozone sparge system had a down-gradient radius of influence of at least 28 ft. Changes in MTBE concentration in groundwater were monitored and destruction rates estimated using analytical results from weekly samples collected from the monitoring points. After four weeks of ozone sparging, the MTBE concentrations were decreased from 6,300 parts per billion (ppb) to 1,700 ppb, a 73% destruction rate. MTBE concentrations continued to decrease to 79 ppb, a 99% destruction rate, in week seven. The success of this pilot project clearly demonstrates the efficacy of the ozone sparging technology for remediation of MTBE impacted groundwater.

Recent state laws have been passed to ban MTBE in certain areas. California and New York, which together accounted for 40% of U.S. MTBE consumption, banned the chemical starting Jan. 1, 2004, and as of September 2006, 25 states had signed legislation banning MTBE. It will be many years before the clean-up of MTBE is complete, but with the innovative uses of ozone available to us, the health of our groundwater is continually being improved.

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