Ozone-Enhanced Air Sparging of Trichloroethylene in a Pilot-Scale Aquifer

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Difficulties arise in remediation of chlorinated solvents due to their chemical properties (low solubility, slow degradation rates). Ozone-enhanced air sparging was evaluated in a laboratory experiment where the ozone was used as an oxidant to degrade trichloroethylene (TCE) *in situ.* Ozone has been shown to overcome some of the diffusion limitations thus increasing the gas/contaminant contact. There are few controlled laboratory studies quantifying remediation rates by injecting ozone in soil. This research evaluates the effectiveness of ozone-enhanced air sparging in a well-controlled pilot-scale apparatus to simulate field conditions.

Experiments were conducted in a 7.3-m x 7.3-m x 2.4-m high Pilot-Scale Aquifer, “sandbox”, with a uniform distribution of poorly sorted fine to very coarse sand. A significant advantage of this setup compared to a small-scale laboratory study is that it provides a spatially accurate three-dimensional representation of an aquifer system. Therefore, the results of this experiment better reflect field performance.

The experiment was divided into 3 phases: Phase I – Plume Development, the Phase II – Air Sparging, and Phase III – Ozone-Enhanced Air Sparging. TCE mass exiting the sandbox reached 95% of the injected mass in Phase I. The outlet flux during Phase II exhibited 85% of the mass of TCE injected. During Phase III, the outlet mass flux of TCE was 59% of the input flux. The experiments also mapped contaminant concentrations in two vertical arrays of sampling ports parallel to flow showing interaction with the sparging zone.

This experiment exhibited enhanced removal of TCE due to the injection of ozone into the gas stream. Gas/contaminant contact was limited due to channeling of both the TCE plume and sparge gas. Even with relatively homogeneous media, the plume migrated down-gradient of the inlet wells in small concentrated channels with very little mixing.