PCE – Perchloroethylene Cleanup Options

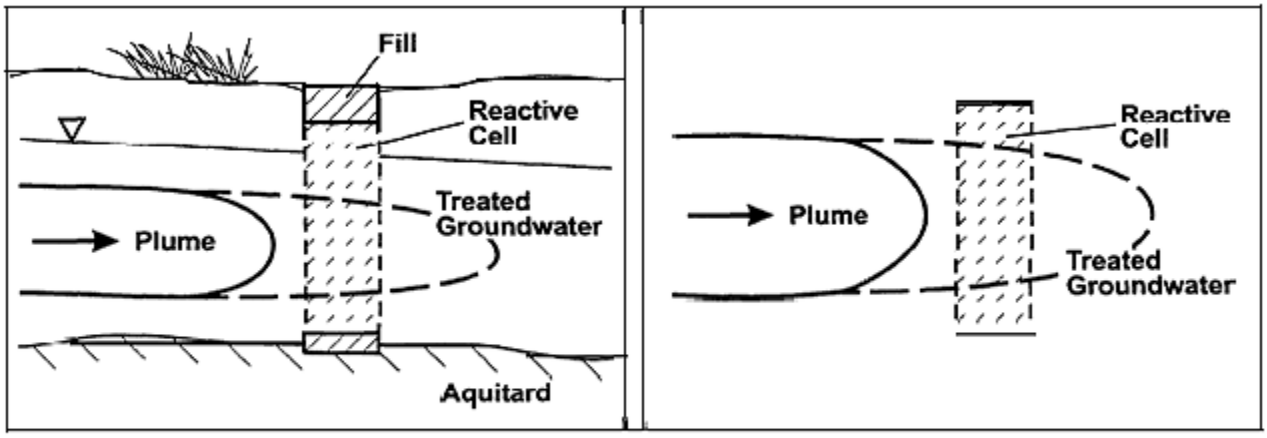
Remediating Groundwater

Technologies for cleaning up PCE-contaminated groundwater include pump and treat, in situ bioremediation using injection of reducing compounds to promote bacterial breakdown of the chlorinated compounds, chemical oxidation, permeable reactive barriers (PRBs), and air sparging/SVE. These technologies are discussed at length at http://www.drycleancoalition.org/tech/.

An effective treatment for groundwater is the use of permeable reactive barriers (PRBs). PRBs are a standard remedial option for groundwater and a generally cost-effective alternative to pump-and-treat systems, which have long-term operation and maintenance (O&M costs).

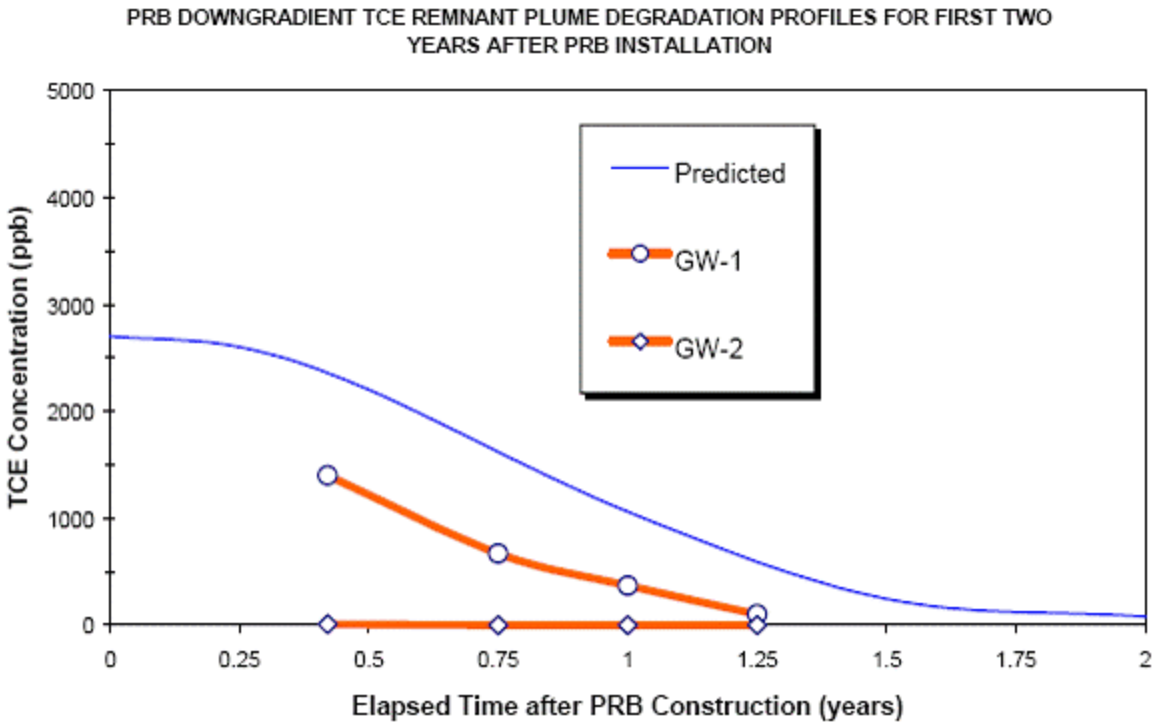
There are different types of reactive materials used in the "reactive cell" portion (where the chemical action is) of the PRB. The effectiveness of PRBs for chlorinated solvents, such as PCE, is based on the fact that these solvents degrade best under anaerobic (without oxygen) conditions, by a process known as "reductive dechlorination."

Under aerobic (oxidizing) conditions, there is little chemical change in PCE as it migrates in shallow oxygenated groundwater (such is the case for our shallow groundwater in Vegas). With a PRB in place, and as the groundwater plume of chlorinated solvents passes through the porous barrier of a strong reducing agent (such as granular zero-valent iron), the chlorines are stripped from the chlorinated solvent, and the treated groundwater exits the downgradient side of the PRB.



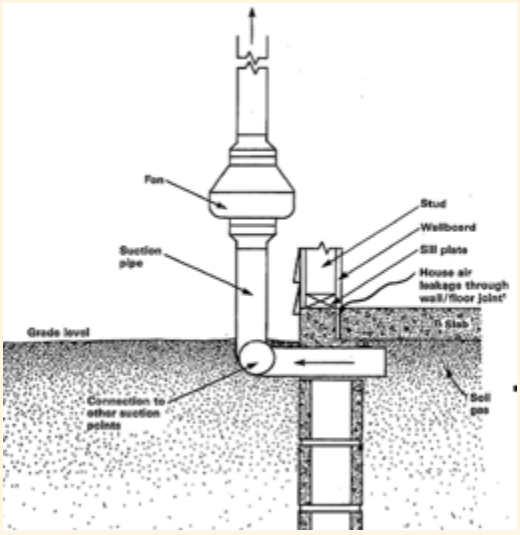
(a) Elevation View of a Permeable Barrier (b) Plan View of a Continuous Reactive Barrier Configuration

Below is a figure showing field results from one PRB installation for treating groundwater contaminated with another chlorinated solvent, trichloroethylene (TCE). As you can see, dramatic reductions in TCE concentrations were achieved within a year or two after installation of the PRB.



PRB Downgradient Groundwater Monitoring Data

Remediating Indoor Air in Cases of Vapor Intrusion



There is a very effective and reasonably priced system that can immediately reduce the levels of PCE found in indoor air due to vapor intrusion of PCE vapors in soils. These systems are called subslab depressurization systems (SSD), and typically cost from $2,000 to $20,000 per home.

Preventing soil gas entry is the focus of SSD. It involves sealing the foundation and depressurizing the soil. Sealing cracks and holes with epoxies and caulks, and sealing the crawl space from the rest of the house are all methods with some application.

SSD can reduce vapor levels by as much as 99%. Suction puts the soil at a lower pressure than the inside of the home, preventing inward migration of soil gas.

Installing an SSD system involves sinking ventilation pipes below the foundation and continuously pumping out air by running a small fan. SSD systems were developed to mitigate intrusion of naturally occurring radon gas, but are equally effective for mitigating the intrusion of solvent vapors.

Photos of residential subslab depressurization (SSD) systems. Vapors are extracted through the use of a small fan, then harmlessly vented to the outdoors where they quickly disperse.

Photos of residential SSD system

Remediating Soils

Soil remediation technologies typically used for cleanup of PCE are fairly common and include such technologies as excavation and removal, soil vapor extraction (SVE), and bioventing. Excavation is the digging and removal of contaminated soil followed by off-site disposal or treatment. SVE involves placing a negative pressure on wells in the vadose zone to pull contaminated soil vapors from the subsurface soils. Bioventing involves the enhancement of biological activity to degrade solvents in the vadose zone using passive venting techniques.

A Word About Units of Measure

All the different concentration units can be confusing; different units of measure are used for PCE in soil, in groundwater, and in soil gas and air.

Concentrations of PCE in soil are typically reported as milligrams per kilogram (mg/kg), which is equal to parts per million (ppm), or as micrograms per kilogram (µg/kg), which is equal to parts per billion (ppb).

Concentrations of PCE in groundwater are typically reported as milligrams per liter (mg/L), which is equal to ppm, or, more commonly, as micrograms per liter (µg/L), which is equal to ppb.

Concentrations of PCE in air are typically reported as micrograms per cubic meter (µg/m3), which is equal to 0.001 µg/L. Because gases expand with change in temperature and pressure, the conversion of µg/m3 requires a calculation to be converted to parts per billion per volume (ppbv).