NFESC

Permeable Reactive Treatment Wall

Construction of a treatment wall at NAS Moffett Field.

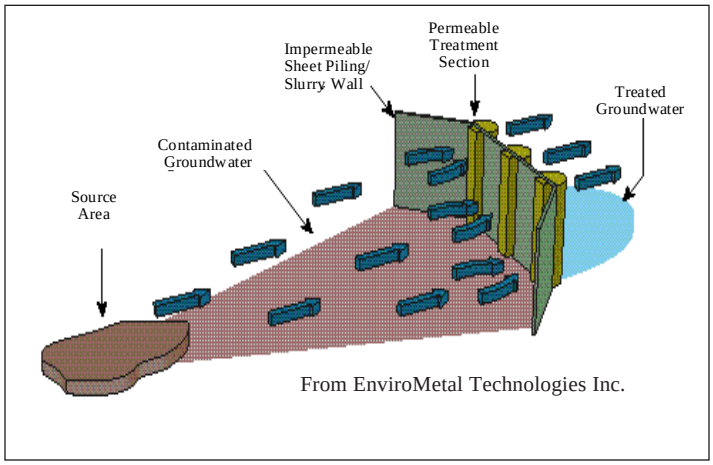
Naval Facilities Engineering Service Center
1100 23rd Avenue
Port Hueneme, CA 93043-4370

For technical assistance call
1-888-4-THE ESC (1-888-484-3372)
or
visit our Web site at:
http://www.nfesc.navy.mil

What is a Permeable Reactive Treatment Wall or Barrier?

Permeable treatment walls are structures installed underground to treat contaminated groundwater found at hazardous waste sites. Treatment walls or barriers are placed across the groundwater flow path typically using a funnel-and-gate system. The gate or reactive cell can be filled with various treatment media, which are selected for their ability to clean up specific types of contaminants. Zero-valent iron particles are commonly used in the treatment cell, which react with chlorinated solvents (i.e., TCE, PCE, DCE, VC, etc.) to produce non-toxic and easily biodegradable by-products such as light hydrocarbon chain C2-C5 compounds (ethanes, ethenes, etc.), chloride and iron ions, and hydroxides.

The reactive media are often bordered with sand or other porous materials (usually pea gravel), which encourage groundwater and contaminants to disperse and flow uniformly through the cell. The impermeable funnel walls, usually consisting of steel sheet piling or a cement/bentonite slurry, direct the groundwater flow toward the reactive treatment gate.



Funnel-and-gate system.

Reactive iron particles and pea gravel with monitoring wells.

Regulatory Acceptance

Approximately 12 reactive wall demonstration and full-scale implementation projects were installed in the United States and Canada in the past five years. The use of these passive treatment walls for groundwater remediation has been reasonably successful. The Environmental Protection Agency (EPA) Remediation Technologies Development Forum (RTDF) and the Interstate Technology Regulatory Cooperation (ITRC) have identified this groundwater treatment method as an emerging technology and are developing regulatory guidelines for its acceptance. Permeable treatment walls offer an alternative solution to the costly groundwater pump-and-treat systems.

NAS Moffett Field Pilot Study

The Naval Facilities Engineering Service Center (NFESC) and the Engineering Field Activity at San Bruno (EFA West), California, initiated a pilot study reactive wall project at the former Naval Air Station (NAS) Moffett Field in Mountain View, California. A 50-foot wide by 10-foot long by 25-foot deep funnel-and-gate system was installed across a TCE, PCE, and DCE contamination plume in April 1996. The Department of Defense (DOD), Environmental Security Technology Certification Program (ESTCP) has sponsored this pilot study to demonstrate and validate the permeable reactive wall technology, develop performance monitoring criteria, and provide cost effectiveness data. The NFESC has involved two contractors, Battelle Memorial Institute and PRC/Tetra Tech EMI, to develop and implement the performance monitoring plan. After 1-1/2 years of collecting performance monitoring data, the results have been very positive. Upgradient concentrations near the reactive wall [TCE (2,900 micrograms per liter [ug/L]), DCE (280 ug/L), and PCE (26 ug/L)] were either reduced to non-detectable levels or were below the maximum contaminant levels within the first two feet of the iron cell. Bromide tracer testing and flow meters were used to verify positive flow through the iron cell. NFESC will publish a technology evaluation report on the Moffett Field demonstration project scheduled for public distribution.

Advantages

- The reactive treatment wall passively remediates contaminated groundwater in-situ, using the natural flow properties of a site.
- Sites can be productively used during clean up.
- No external energy is required or consumed.
- No aboveground structures are required.
- Contaminated groundwater can be treated at about 1/4 the estimated cost of pump-and-treat systems.
- Long term operation and maintenance costs are low to non-existent (potentially needing to replace the iron media every 10 to 20 years).
- Treatment walls can be modified to treat various contaminants and concentrations.

Disadvantages

- Potential clogging from biological or chemical precipitates, requiring additional maintenance.
- Potential construction complications with above-ground structures and underground utilities.
- Current technology only allows for relatively shallow usage of up to approximately 40 to 50 feet below ground surface.
- Increased short term capital expenditures for construction and installation versus long term expense of pump-and-treat.

Permeable Reactive Wall Technology Application Team

The NFESC Permeable Reactive Wall Technology Application Team (TAT) is developing the necessary services to implement this innovative technology at chlorinated solvent contaminated sites throughout the Navy and Marine Corps. We are currently partnering with the DOD, EPA, Department of Energy, academia, and private industry through several permeable barrier working groups to find cost-effective, alternative solutions for groundwater remediation, that will reduce the risks to public health and the environment.

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Parking area after construction, NAS Moffett Field.

Will a Reactive Wall Work at my Site?

Ideal locations for installation of permeable reactive treatment walls:

- Relatively porous, sandy, silty, or silty-sand soils; site heterogenity is usually not a problem
- Shallow contamination (of less than 50 feet), based on current construction technologies
- Confining layer beneath the contamination
- Sufficient groundwater flow velocities

Successful application requires a proficient knowledge and understanding of the hydrogeologic characteristics of the site, specific groundwater flow conditions, and subsurface contaminants. Site-specific bench scale studies and groundwater modeling are recommended prior to the design and implementation of reactive treatment walls. According to the EPA (1996), up to 20% of all DOD and Superfund chlorinated hydrocarbon sites could benefit from this technology.

For more information contact:

Restoration Development Branch, ESC411
(805) 982-0469, DSN: 551-0469, Fax: 982-4304

or

Technical Application Branch, ESC414
(805) 982-1657, DSN: 551-1657, Fax: 982-4304