Permeable Reactive Barrier Update

solutions for groundwater remediation

May 2001

Six Years of Successful Operation

The first commercial full-scale PRB was constructed in Sunnyvale, California in February 1995. "For more than 5 years of operation, the subsurface permeable reactive barrier and slurry wall system has performed successfully as a final remedy for the site", (Sorel et al., 2000). The system consists of a 40 ft long and 15 ft deep treatment cell containing a 4 ft thickness of 100% granular iron. The system was constructed using a cofferdam formed by driving sheet piles, excavating the native soil, backfilling with granular iron and extracting the sheet piles. Results from over 20 sampling events indicate that the effectiveness of the treatment process has not been affected by precipitation of inorganic species or microbial fouling. The system replaced an existing pump-and-treat system at the site. Payback in terms of savings relative to the pump-and-treat operation occurred within 3 years.

"For more than 5 years of operation, the subsurface permeable reactive barrier and slurry wall system has performed successfully as a final remedy for the site."

Consultant: Geomatrix Consultants
Contractor: INQUIP Associates, Inc.

A Very Inexpensive Solution

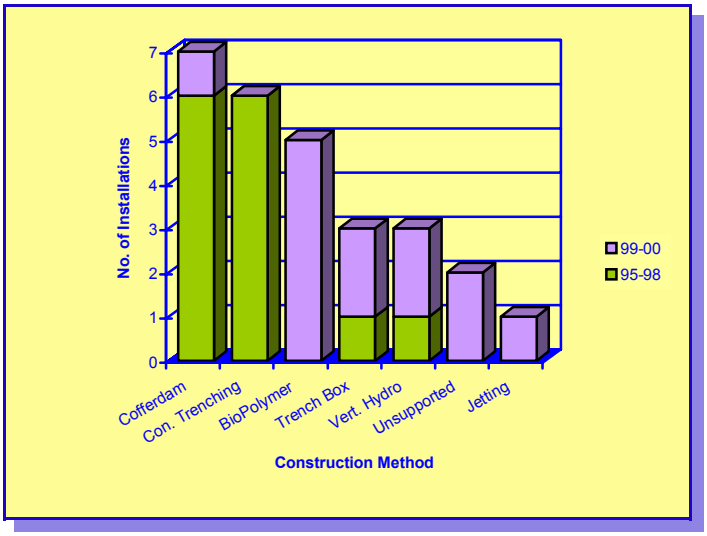
A 200 ft long, 20 ft deep and 1.5 ft wide PRB consisting of 20% iron and 80% sand by volume was emplaced using an open trench excavation in Ohio in 1999. The cost of iron and construction for this site was under $70,000. The geology primarily consisted of weathered shale, that allowed the trench to stay open during excavation, without the use of shoring.

Consultant: H_2W Environmental Consultants
Contractor: Pro-Terra Environmental Contracting Co.

Inside This Issue:

PRB Construction in Cleveland, Ohio November, 1999

Use of BioPolymer Slurry



ETI's May 2000 update discussed the emergence of biopolymer slurry methods as a cost-effective means of PRB installation, particularly at depths greater than 40 ft. The above reflects the increased use of this technique in recent applications. In addition to the installation described here, the method has been used to install PRBs at two other sites to depths of 70 ft. ETI has developed a set of construction specifications and QA/QC procedures unique to this installation method.

Longest Continuous PRB to Date!

Construction of the longest granular iron PRB continuous wall was completed at the Somersworth Landfill Superfund Site, New Hampshire in August 2000 using biopolymer slurry to stabilize an open trench over 900 ft in length, 30 to 40 ft in depth and 2.5 ft in flow through thickness. Over 3500 tons of granular iron were used in the installation! The PRB was installed in 30 to 50 ft long sections separated by metal I-beam end stops to allow individual sections to be excavated and backfilled without impacting activities in adjacent sections using biopolymer. Using this construction technique, challenging site conditions including depths to 40 ft, irregular weathered bedrock surface, shallow water table, geology consisting of sand, gravel and cobbles and limited space between landfill and wetland area were overcome. The use of a PRB at the site is expected to save over $10M relative to the pump-and-treat remedy.

Consultant: GeoSyntec Consultants
Contractor: Geo-Con

"Over 3500 tons of granular iron were used in the installation!"

Two PRBs Installed at U.S. DoD Facility

Following the success of an initial granular iron PRB installation at the Pease AFB, NH in August 1999, a second wall was installed in June 2000 using the same construction method. Both treatment systems were installed using a biopolymer slurry to stabilize an open trench during excavation. The first PRB installed at Site 73 was 150 ft in length, 35 ft in depth and 30 inches in thickness, consisting of 34% iron and 66% sand by volume. The "long-stick" excavator used at the site, was capable of digging to a depth of 60 ft. The second PRB, installed at Site 49, 150 ft in length, 15 ft in depth and 30 inches in thickness and consisted of 30% iron and 70% sand by volume. Several construction techniques could have been used to install the second shallow treatment system, but the biopolymer method was chosen because of its cost effectiveness and success at Site 73.

BioPolymer Trench Excavation at Pease AFB, New Hampshire August, 1999

Consultant: Bechtel Environmental, Inc. (Site 73)
Versar, Inc. (Site 49)
Contractor: Geo-Con

Largest U.S. DoD Installation to Date

The PRB installed at F. E. Warren AFB in Cheyenne, Wyoming was 568 ft in length, 20 to 40 ft in total depth and 4 ft in thickness. The continuous wall was constructed with 1750 tons of granular iron consisting of three different segments with varying amounts of iron, depending on anticipated influent VOC concentrations. Segment 1 consists of 100% iron and Segments 2 and 3 are iron sand mixes consisting of 25% and 38% iron by volume, respectively. The system was installed using a trench box that was 20 ft long, 20 ft high, 4 ft in width. Excavation took place in front of the box and the reactive material was placed into the back compartment of the box, which was pulled along the excavation. This construction method allowed for very rigorous quality control/quality assurance monitoring of the amount of iron placed in the trench. In order to use this technique to install iron in the depth range of 20 to 40 ft, a large bench was required.

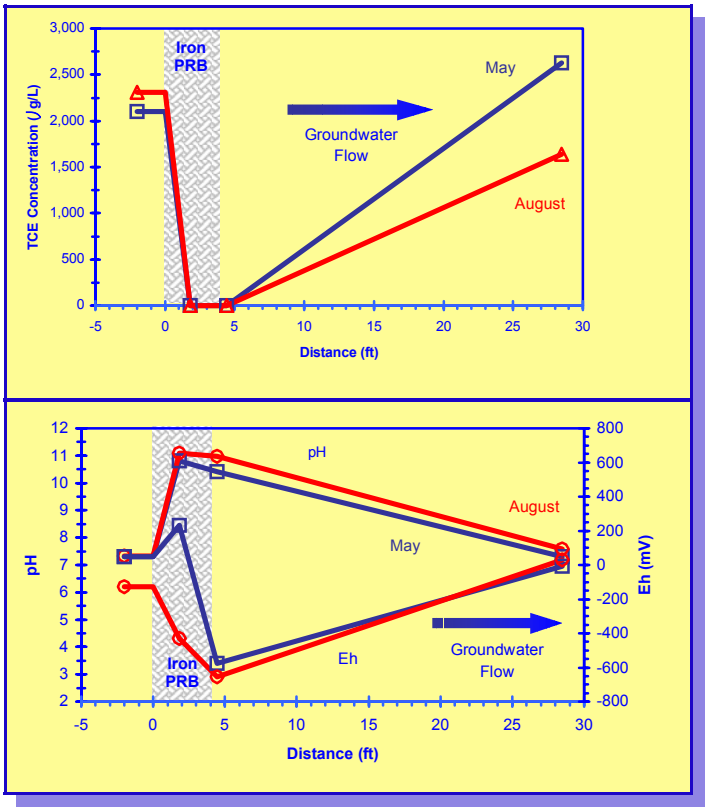
Results after 1.5 years operation indicate that all groundwater samples collected from performance monitoring wells within the iron and immediately downgradient are below the analytical detection limit. As shown below, the upgradient TCE concentration along the Segment 1 Transect entering the treatment zone is about 2200 µg/L. No detectable concentrations occur within or immediately downgradient of the PRB, TCE concentrations 30 ft downgradient remain unchanged; however, these concentrations are expected to decrease as sufficient clean groundwater passes through the system, allowing for the desorption effects to diminish over time. The trends for cDCE and tDCE are similar to those for TCE.

Permeable Reactive Barrier Construction at F.E. Warren AFB, Wyoming July, 1999

Trench Box Excavation at F.E. Warren AFB, Wyoming July, 1999

Trends in pH and Eh across Segment 1 (below) are consistent with other applications. The hydraulic gradient across the PRB is relatively flat and uniform, indicating that the natural groundwater flow pattern has not been adversely disturbed.

Consultant: URS Corporation
Contractor: Montgomery Watson
Kelchner Environmental



Recent References

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