CAP18™ Biobarrier Designs to Remediate Plumes in High Flow Aquifers

Dan Bryant, DBI Remediation Products, LLC, 10420 Hague Road, Suite D, Fishers, IN 46038

Tom Zychinski, Burns & McDonnell Inc., 17 Cassens Court, Fenton, MO 63026

Tracy Cooley, Trevor Gustafson, Steve Hoffine, and Tim Stecher

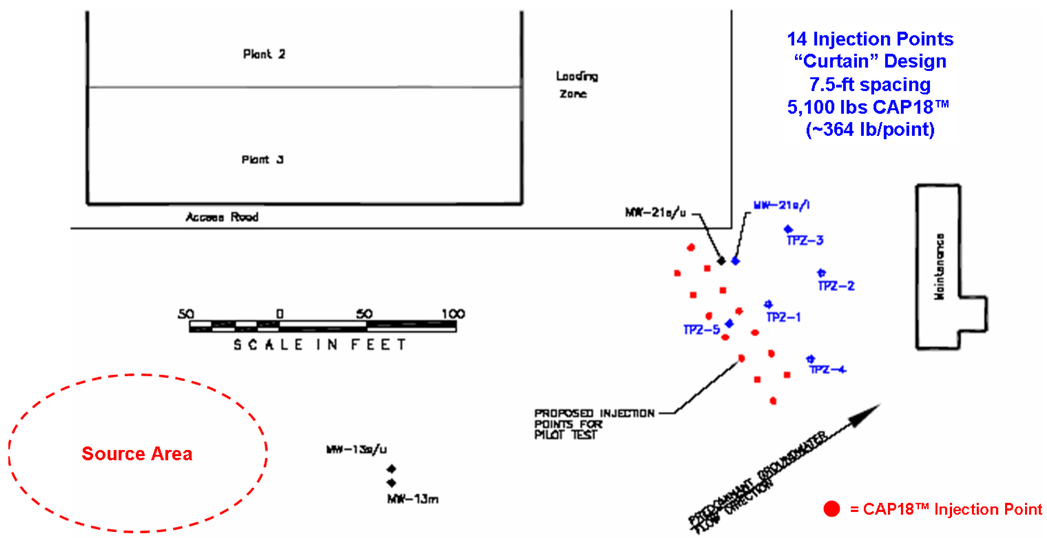
Burns & McDonnell, Inc., 9400 Ward Parkway, Kansas City, MO 64114

Remediation of chlorinated VOC plumes in permeable, high-flow aquifers is challenging because of the plume sizes, groundwater flow rates, contaminant flux, and large water volumes that must be treated. CAP18™ is a relatively immobile, yet easy to inject and cost-effective substrate designed to stimulate anaerobic bioremediation. CAP18™ provides a significant advantage over other substrates in these environments because CAP18™ is less mobile and thus more likely to form and maintain a reactive flow-through, biobarrier-type treatment zone. Two pilot tests were conducted at industrial sites in central Kansas with high seepage velocity, large plume areas, and moderately low chlorinated VOC concentrations. The pilot test objective was to determine if CAP18™ could be applied using flow-through, biobarrier designs.

The pilot studies are considered successful by both the clients and the regulators. CAP18™ has been proposed as the full-scale remedy at both sites with injection planned for the summer of 2007.

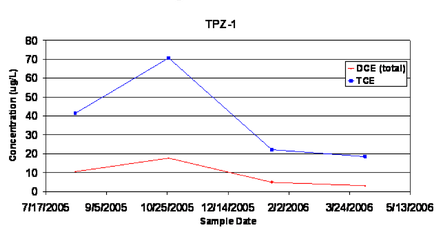
SITE 1

At Site 1 a plume extends approximately 1,600 feet downgradient from the source. Maximum baseline groundwater VOC concentrations in the pilot test area were 303 ug/L TCE, 106 ug/L cis-1,2-DCE, and vinyl chloride not detected. In August 2005, a pilot test was implemented using 5,100 lbs of CAP18 ™ injected via 14 direct-push injection points arranged in one flow-through biobarrier. The biobarrier consisted of two rows of seven injection points each, spaced at 15 feet between points in a row, for an effective spacing (perpendicular to groundwater flow) of 7.5 feet. The monitoring network consisted of five temporary wells and one permanent well. Four sampling events were conducted between August 2005 and April 2006. Results show more anaerobic conditions and lower VOC concentrations extending more than 50 ft downgradient from the biobarrier. Maximum VOC concentrations were 112 ug/L TCE and 74 ug/L cis-1,2-DCE. Vinyl chloride has remained non-detectable.



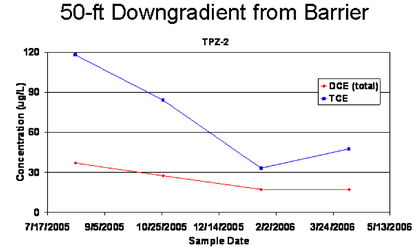
EXAMPLE RESULTS

TPZ-1 Results
10-ft Downgradient from Barrier



55% Reduction in TCE
71% Reduction in DCE

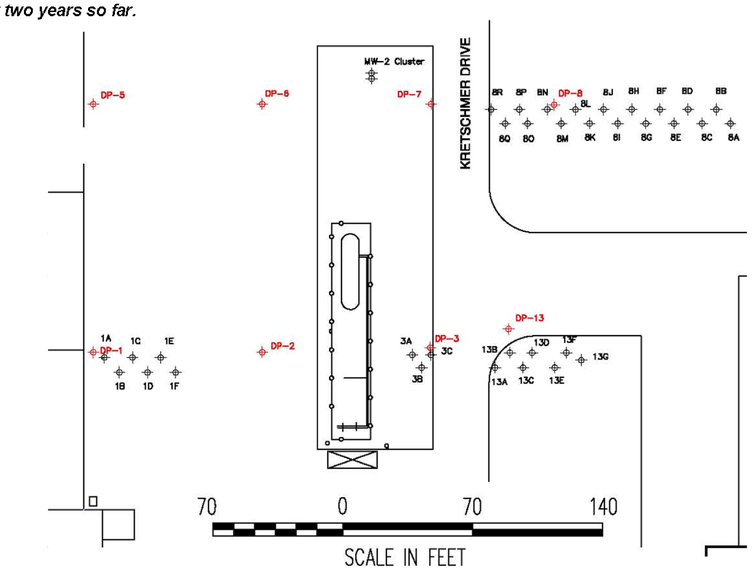
TPZ-2 Results
50-ft Downgradient from Barrier



60% Reduction in TCE
54% Reduction in DCE

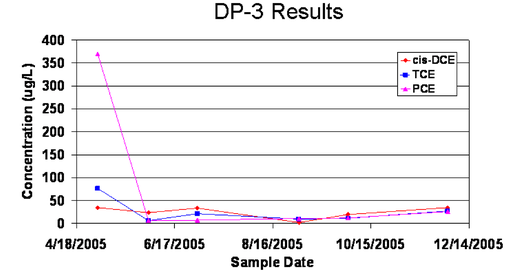
SITE 2

At Site 1 a plume extends approximately 1,700 feet downgradient from the source. Groundwater VOC concentrations are relatively low (maximum concentrations: 370 ug/L PCE, 285 ug/L TCE, 247 ug/L cis-1,2-DCE, vinyl chloride not detected). In May 2005, an SVE system was installed in the source area, and a pilot test was implemented with 5,950 lbs of CAP18™ injected via 34 direct-push injection points arranged in three biobarriers. Each biobarrier consisted of two, offset rows of injection points spaced at 15 feet between points in a row, for an effective spacing (perpendicular to groundwater flow) of 7.5 feet. A total of 24 temporary well locations and two monitoring wells were sampled between June 2005 and March 2007, with some points sampled up to seven times in that period. Data from the large number of sample locations illustrate an advancing front extending downgradient from each biobarrier, characterized by more anaerobic conditions and higher TOC. The maximum concentrations were reduced to 2.2 ug/L PCE, 16.7 ug/L TCE, and 79.1 ug/L cis-1,2-DCE. Vinyl chloride was first detected in March 2006 at three locations. ***The CAP18™ treatment has persisted for two years so far.***



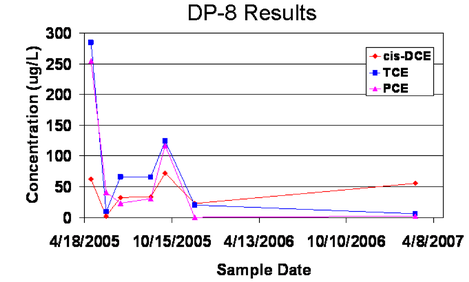
EXAMPLE RESULTS

DP-3 Results



93% Reduction in PCE
65% Reduction in TCE
No change in cis-DCE

DP-8 Results



>99% Reduction in PCE
98% Reduction in TCE
11% Reduction in cis-DCE