Design, Construction and Installation Verification of a 1200' Long Iron Permeable Reactive Barrier

by

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ABSTRACT:

Zero valent iron reactive permeable barriers can remediate chlorinated solvent contaminated groundwater by abiotic degradation of the halogenated volatile organic compounds into harmless daughter products. The conventional means of installing such reactive barriers is by a combination of flow barrier funnels and permeable gates. Azimuth controlled vertical hydraulic fracturing is an alternate mode of placing iron reactive barriers in situ, which results in significant cost savings and allows these systems to be installed at greater depths than conventional technologies. Orientated vertical fracturing technology has been used to place permeable iron reactive barriers at a number of sites in silts, sands and gravel at both shallow and moderate depths greater than 100'. During installation, the fracture geometry is monitored in real time by down hole active resistivity, and hydraulic pulse interference tests are used after installation is complete to verify the barrier's continuity and hydraulic effectiveness.

This paper presents the design, construction and field installation verification tests of a full scale orientated vertical hydraulic fracture placed iron reactive barrier in silt and sand sequences installed at a Superfund site in Virginia. Pre construction monitoring indicated that the site groundwater was contaminated with chlorinated solvents in the range of thousands of ppb of tetrachloroethene (PCE) and trichloroethene (TCE). The iron permeable reactive barrier (PRB) extends approximately 1,200' in length, and was constructed from a depth of 5' down to a total depth of 44', and was completed in June 2002. The iron filings were transported into the ground in a cross linked gel, and the azimuth controlled vertical hydraulic fracturing technology formed a vertical barrier of average thickness of 4.5" from the injection of approximately 700 tons of iron filings.

The installation of the iron reactive permeable barrier was monitored by precision weight measurement and metering of the iron filings into each frac well casing and the installed geometry of the PRB was monitored in real time by the active resistivity method. The PRB thickness was verified by inclined profiling using a driven electrical conductivity probe at nine (9) locations along the PRB alignment. High precision hydraulic pulse interference tests were conducted both pre and post PRB installation to ensure the PRB did not impede the natural groundwater flow regimes. The PRB's degradation performance is currently being monitored by a series of upgradient and downgradient groundwater monitoring wells.