Pilot-Scale Demonstration and Validation of the Horizontal Reactive Media Treatment (HRX™) Well for Passive In Situ Remediation

Blossom Nzeribe (nzeribbc@clarkson.edu), Meng Feng, Wen Li, and Michelle Crimi
(Clarkson University, Potsdam, NY)
Craig Divine, Jeffery McDonough, and Jack Wang (Arcadis U.S)

Background/Objectives. The horizontal reactive media treatment (HRX™) well is a novel in situ remediation approach for contaminated groundwater (GW) which involves the use of a horizontally drilled well filled with a granular reactive media. The well is installed in the direction of groundwater flow. Due to the "flow focusing" behavior resulting from the strong well-to-aquifer hydraulic conductivity difference, contaminated GW flows into the well and contaminants present in the stream sorb onto the reactive media and are treated or removed as GW flows through the well. Treated GW then leaves the well through the down gradient portion of the well screen. This study aims to demonstrate and validate the HRX™ well and associated design model by Arcadis for in situ treatment of GW contaminants by verifying existing reactive transport model representing HRX™ capture and validating flow and treatment in the HRX™ well using two different reactive media, granular activated carbon (GAC) and zero-valent iron (ZVI).

Approach/Activities. This study was conducted in two parallel phases: (1) laboratory tank system (LTS) and (2) field pilot-scale system (PSS). The LTS was conducted using a 55-gallon tank which served as the aquifer with a 1 inch slotted PVC well packed with a mixture of sand and ZVI emplaced within the tank. Flow and treatment in the well was tested by passing conservative (NaCl) and non-conservative tracers (methyl orange) and measuring their breakthrough. Meanwhile, capture within the well and aquifer was determined by measuring the flow rate of water through the well and the aquifer, and the hydraulic head throughout the aquifer using mini piezometers placed at different heights within the tank. The controlled field PSS is ongoing at a field site at Clarkson University in a hydraulically isolated test pit approximately 20 feet long × 6 feet wide × 6 feet deep by placing an 8-inch diameter slotted HRX™ well filled with GAC within the center of the pit. Flow is created in the PSS by pumping water to induce a hydraulic gradient across the pit, maintaining a constant lower head on the effluent end relative to the influent end. Pressure and water levels throughout the test pit are measured using 1-inch diameter piezometers and pressure transducers to validate the reactive transport model representing well capture.

Results/Lessons Learned. Findings from the LTS confirmed that a substantial amount of water is captured in the well from the flow rates and water level measurements conducted within the well and the aquifer. Results from the tracer tests showed that both tracers had a faster breakthrough in the well relative to the aquifer, confirming higher hydraulic conductivity, flow and treatment in the well. Also, there was a decrease in the concentration of the methyl orange from the well outlet indicating a reaction with ZVI in the well confirming treatment in the well. Results/findings from the PSS is expected to validate the existing reactive transport model by Arcadis which predicts that HRX™ well effectively captures and treats a significant amount of impacted GW and that the capture zone is a function of the reactive media and aquifer permeability. This study will help provide information on unanticipated issues of scale up and guide decisions related to implementation of the HRX™ well technology while validating the existing reactive transport model by providing data for HRX™ capture, flow focusing and treatment efficiency.