PCE and Daughter Remediation in Limestone Bedrock: Brownfields Redevelopment of a Former Tubing Manufacturing Facility

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Background/Objectives. Virgin PCE used for parts cleaning was released from an AST into the shallow limestone bedrock at a former aluminum extrusion heat exchange tubing manufacturing facility in Louisville, Kentucky. The facility is developed with approximately a 1-story 145,000 square foot industrial warehouse/office building that exists on approximately 17 acres within an industrial park setting. The building was constructed in 1968 and is described as a plant that housed main manufacturing areas, raw and finished product storage areas, a quality control laboratory, and maintenance areas. The facility has remained vacant operations ceased in 2009. The soil is made up of Lacustrine deposits consisting of clay, silt, sand, and gravel. Underlying bedrock is Middle Silurian and is composed of stratified limestone and dolomite rock. Downhole geophysical and groundwater characterization methods determined contaminant migration in the shallow bedrock occurred along a bedding plane feature and extended to the subject site property line. Dual-phase extraction was utilized from 2002 through 2014 to prevent off-site migration of the release; however, source well concentrations began increasing following system shutdown. Interest in purchase of the facility spurred Brownfields redevelopment and in-situ remedies were evaluated for feasibility.

Approach/Activities. A very unique plume demands an equally inventive remediation strategy. Chlorinated solvents are normally viewed as electron acceptors while hydrocarbons are donors. The present site contained naturally occurring hydrocarbons comprised of mainly aliphatic compounds from crude oil (crude) comingled with CVOCs. CAT 100™ was chosen to target CVOCs over other technologies that target hydrocarbons, but the interaction of both contaminant classes with the activated carbon was of keen interest. Would one contaminant interfere with the other? CAT 100™ combines the power of metallic iron impregnated carbon with enhanced reductive dechlorination (ERD). CAT 100™ includes a complex carbohydrate (food grade starch) as a substrate donor and microorganisms to degrade the starch into small molecules beneficially used as donors. The substrate demand at this site is high, beyond that of just starch; however, and the crude could fill part of this need. An extra benefit of the starch is significant stimulation of biological activity and this promotes consumption of the crude as substrate and its direct degradation independent of the CVOCs. To further support this activity, a blend of microorganisms able to degrade the crude was also added. Urea was added to satisfy the overall balance of microbes and substrate as a source of nitrogen for crude degradation. CAT 100™ was installed in-situ for source mass reduction and as two (2) permeable reactive in situ barriers to halt further migration of contaminants from the source area. Remediation was implemented using a specialized injection system and straddle packer assembly using high flow rate (up to 180 gallons per minute) injections. Hydraulic connection was continuously monitored using pressure transducers emplaced across the treatment area.

Results/Lessons Learned. Real time well monitoring aided in optimizing the injection volumes and confirming that uniform distribution of the CAT 100™ slurry was achieved. The monitoring demonstrated that the area of influence (using a 300-gallon slurry volume) varied up to 250 feet. Performance groundwater monitoring has effectively demonstrated contaminant migration has ceased and contaminant destruction is continuing to occur across the treatment area. Co-metabolism is indicated in the post-performance groundwater monitoring data and suggests significant mass removal beyond that of ERD or Fe reduction alone is occurring and being sustained. The site was granted Managed Closure 18(b) in May 2017.