

Surfactant-Enhanced Extraction to Expedite Remediation of a Carbon Tetrachloride Source Zone at an Active Grain Elevator Facility

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Background/Objectives. The site is located in Kansas City, Kansas and currently operates as an active grain elevator facility. The site entered into the Voluntary Cleanup and Property Redevelopment Program (VCPRP) in 2000 following groundwater and soil detections of grain fumigant constituents of concern (COCs), including carbon tetrachloride, in the vicinity of a former fumigant aboveground storage tank (AST). Following source area investigation and groundwater plume delineation activities, dual-phase extraction (DPE) was implemented in 2007 for the removal of COCs in source area soils and groundwater. Groundwater is encountered at the site approximately 7 to 8 feet below ground surface (bgs).

After several years of DPE operation, resulting in the removal of over 9,000 pounds of total VOCs, a subset of source area extraction wells continued to exhibit elevated COC groundwater concentrations. A high resolution site characterization (HRSC) investigation, including the use of membrane interface probe (MIP) technology, was conducted to assess the nature and extent of residual COC mass in the source area and provide data required for the evaluation of alternatives that could expedite source area remediation. The investigation results indicated significant sorbed-phase COC mass, generally limited to the shallow, sandy interval of an area bound by the DPE wells exhibiting elevated COC concentrations. Light non-aqueous phase liquid (LNAPL) heavily impacted with the site COCs was also identified. Surfactant enhanced extraction (SEE) was subsequently identified as an effective and sustainable source zone remediation alternative because of the technology's ability to quickly and efficiently remove a concentrated, but relatively isolated and shallow zone of contaminant mass with relatively low surfactant application concentrations. In addition, the existing DPE infrastructure could be utilized to implement SEE at the site, thereby minimizing the cost and carbon footprint of the remedial strategy.

Approach/Activities. Ivey-sol® surfactants are biodegradable, environmentally friendly compounds that can enhance organic contaminant extraction by promoting desorption and lowering the surface tension of groundwater. These effects increase contaminant mobility and enhance recovery. Burns & McDonnell conducted a SEE pilot study at the site in April and May 2015 to evaluate the efficacy of the technology under site-specific conditions. The pilot study included single-well "Push-Pull™" tests and multi-well "point-to-point" tests using a solution consisting of 1 to 2 percent (by volume) Ivey-sol® 106 surfactant. In general, the solution was gravity fed into each well to achieve a targeted injection radius, then allowed to remain in the formation for a prescribed residence time period. The surfactant solution, groundwater, and liberated COCs were subsequently extracted using the DPE system.

Results/Lessons Learned. Based on a comparison of baseline and initial post-SEE groundwater monitoring results, the pilot SEE application achieved carbon tetrachloride concentration reductions of up to 99 percent. Full-scale SEE will be conducted in September 2016 to address remaining COC mass within the source zone and allow for permanent shutdown of the DPE system. Full-scale SEE observations, analytical results, and performance evaluation will be included in the final presentation.