Application of Helium and Sulfur Hexafluoride as Tracer Gasses to Optimize Air Sparging Performance

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Background/Objectives. Helium and sulfur hexafluoride were used as tracer gases for startup and pilot testing activities at a former industrial facility to optimize air sparging performance in remediating chlorinated ethenes and chlorinated methanes in groundwater at two commercial/industrial sites. Changes in the concentrations of tracer gasses, volatile organic compounds (VOCs), and general chemistry were measured using field monitoring and laboratory analyses. First, helium in soil vapor was measured in the field to provide real-time data during testing activities. This was followed by laboratory measurements of sulfur hexafluoride dissolved in groundwater, which supplemented water level and dissolved oxygen measurements to indicate the radius of influence of the air sparging wells and determine the flow and pressure for optimum stripping efficiency. Groundwater remediation at the site has been implemented using air sparging and soil vapor extraction systems.

Approach/Activities. A pipe rack with appropriate fittings, flow regulators, and pressure gauges was used to add both tracer gasses simultaneously at controlled concentrations between the air compressor and the air sparging wells. Several groundwater and soil vapor monitoring wells were installed at various distances and depths around the air sparging test wells. In selected groundwater monitoring wells, down-well probes were used to collect real-time water level, dissolved oxygen, and other monitoring data continuously during testing activities. Helium measurements were made with a portable helium detector capable of measuring concentrations as low as 25 parts per million (ppm)—approximately 0.02 percent of the maximum injected helium concentration. Fittings were attached to the wellheads to enable potential measurement of air flow and helium at the groundwater monitoring wells while the down-well probes were in place. Helium measurements were also made at soil vapor extraction wells and soil vapor probes. Air sparging wells were operated at progressively higher flow rates in stages over the course of two days to identify the minimum flow rate needed to attain a cost-effective radius of influence. Sulfur hexafluoride in groundwater was analyzed by gas chromatography.

Results/Lessons Learned. Although helium was observed in air samples from the monitoring wells within a few hours of sparging, it generally did not exceed detection limits in soil vapor extraction wells or probes. Sulfur hexafluoride data was particularly useful for evaluating the radius of influence of air sparging wells, particularly where dissolved oxygen concentrations in groundwater were elevated before testing was performed: changes in dissolved oxygen and VOC concentrations generally correlated with increased sulfur hexafluoride.