Deep Air Sparging—50 to 150 Feet Beneath the Water Table—for Thick Dissolved Plumes

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Pilot tests demonstrated that deep air sparging, 50 to 150 ft beneath the water table (bwt), is a viable alternative for treatment of a thick dissolved plume of petroleum hydrocarbon constituents at a former refinery. Site characterization revealed that the dissolved plume is approximately 130 ft thick. About 80% of the mass flux and highest dissolved concentrations occur in the upper 100 ft of the saturated zone. Nested air injection wells were constructed at discrete depths along with multiple, nested groundwater monitoring wells completed in the saturated and unsaturated zones. Air sparging at 50, 100, and 150 ft bwt exhibited positive changes in groundwater elevation, groundwater chemistry, vapor concentrations, and pressures (in both the unsaturated and saturated zones), indicating effective transport of the air. Stripping of volatile petroleum constituents from the groundwater appears to be the most immediate mass-removal mechanism, and oxygenation of the saturated zone is expected to significantly enhance biodegradation of less volatile petroleum constituents. In addition, vapor-phase nutrient injection is proposed.

Pulsed sparge tests at 50 and 100 ft bwt exhibited classic oscillatory dynamics of groundwater mounding, subsequent collapse, and transition to steady-state cycles. Similar response characteristics were observed at both of these depths, and the sparge wells established and maintained realistic injection pressures (40 to 60 psi) and flow rates (20 to 65 scfm). The sparge test at 150 ft bwt did not exhibit the typical oscillatory transitions in groundwater mounding. The 150-ft-bwt sparge well also required extremely high injection flow rates (100 to 300 scfm).

The evaluation was supported by tracer gas studies to determine the radius of influence (ROI). In general, the data support the theory that the ROI within the aquifer increases with air injection depth. However, there appears to be a limitation on the depth at which sparging can be practically implemented.