Use of Treatability and Pilot Testing for Comparative Evaluation of Chemical Reduction, Bioremediation, and Chemical Oxidation Technologies

Gary Cronk (JAG Consulting Group, Inc.)

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An evaluation was performed to compare viable groundwater VOC treatment technologies for multiple sites, some with different VOC suites of concern, at a confidential Air Force Base. Initially, a series of treatability tests was performed to evaluate the VOC treatment efficiency of chemical reduction, enhanced bioremediation, and chemical oxidation technologies. The first set of treatability tests evaluated abiotic chemical reduction using multiple doses of zero valent iron (ZVI). A second set of treatability tests evaluated the use of Biogeochemical Reductive Dechlorination (BiRD) technology. BiRD technology begins by stimulating indigenous sulfate-reducing bacteria to form iron sulfide minerals, which subsequently reduce chlorinated compounds by pathways similar to those of ZVI. Bioremediation technology using emulsified vegetable oil (EVO) and dairy whey was evaluated to assess the suitability of enhanced reductive dechlorination (ERD) as a supplement to the ZVI approach. By enhancing the reduction potential and sustaining anaerobic conditions, TCE may be degraded more effectively by ERD without accumulation of daughter products. Lastly, chemical oxidation technology was evaluated using stabilized hydrogen peroxide (SHP). The SHP approach was tested on a plume containing carbon tetrachloride and chloroform as well as TCE, to evaluate its destruction efficiency on these recalcitrant compounds and its effect on hexavalent chromium formation.

All four technologies were selected for further evaluation in the field via implementation of a pilot testing program to further identify alternative solutions. Subsurface delivery of the chemical reagents via borehole placement and pneumatic fracturing were evaluated, along with construction of a simulated permeable reactive barrier (PRB) to mitigate offsite migration of VOCs near the property boundary. Important factors evaluated in the pilot testing included the implementation and recurring operational costs, the reaction kinetics, in-situ delivery techniques, and integration of multiple technologies to address all COCs. The results will be incorporated into site specific Feasibility Studies.