

## **Enhanced Bioremediation for a TCE Source Area Combined with Biosparging for Dissolved Plume Management**

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Geosyntec identified and delineated a chlorinated volatile organic compound (CVOC) plume with a trichloroethene (TCE) source area of approximately ½ acre and a dissolved plume comprised primarily of vinyl chloride (VC) in excess of 100 acres at NASA's Vehicle Assembly Building (VAB) at the Kennedy Space Center (KSC) in east-central Florida. The remedial strategy for this site was to treat the source area and protect the sensitive surface water/wetland area adjacent to the VAB. To accomplish this, a multi-component remedial strategy was designed and implemented, which includes enhanced bioremediation using biostimulation in the TCE source area, a biosparge wall, and natural attenuation monitoring (NAM) in the low-concentration areas of the dissolved plume.

Enhanced bioremediation of the source area was implemented by direct injection of dilute ethyl lactate (10,000 mg/L) every other month for one year into 45 permanently installed injection wells. Source area monitoring revealed TCE concentration reductions ranging from 70 to 99%, *cis*-1,2-dichloroethene (cDCE) concentration reductions ranging from 60 to 99%, and vinyl chloride (VC) concentration increases ranging from 25 to 50%, with a 50 to 90% total mass reduction in source area monitoring wells during the first six months. Quantitative real-time PCR (qPCR) on samples collected from source area monitoring wells revealed *Dehalococcoides* cell counts ranging from  $2.0 \times 10^7$  to  $7.0 \times 10^7$  cells per liter, and *vcrA* (VC reductase gene) gene copies ranging from  $1.0 \times 10^4$  to  $2.0 \times 10^6$  gene copies per liter. Initial data suggests that sufficient electron donor for reductive dechlorination of TCE is being provided, and that the proper organisms for complete dechlorination are present.

A portion of the dissolved VC plume was discharging into a wetland and designated Outstanding Florida Water (OFW). A biosparge wall was installed to create a zone of elevated dissolved oxygen (DO) to promote aerobic degradation of dissolved VC. The area of the plume impacting the wetland/OFW had VC concentrations ranging from 100 to 1,000 µg/L. The biosparge wall consists of 25 biosparge wells covering a length of 360 ft which are operated on a cycled basis at an individual air flow rate of 3 cubic feet per minute. Monitoring of the biosparge wall since system startup has revealed the presence of elevated DO throughout the area of the barrier. VC concentrations in monitoring wells on the downgradient side of the biosparge wall have decreased to non detectable levels.

NAM is being utilized in the low concentration area of the dissolved plume which is not impacting sensitive habitats and where there is no exposure pathway. Monitoring of 21 wells throughout the low concentration dissolved plume is achieving the objective of documenting that the plume is stable and that VC concentrations are generally declining over time.