Verification of CL-Out's Effectiveness at a New Jersey Industrial Site

Project Summary

Industrial solvents were found in the ground water at a former industrial site on an unused airfield in New Jersey. The contamination was mainly found in ground water in thick coastal sediments. Prior to selection of a full-scale remedy, a pilot study was completed to verify the effectiveness of CL-Out® bioremediation and to develop site-specific performance information for the full-scale remediation design. The pilot study consisted of a single injection of CL-Out microbes into the aquifer and sampling ground water at various distance around the injection points. The ground water sampling results showed that the TCE concentrations decreased 66% 40 feet down gradient of the injection point. The TCE was destroyed without producing vinyl chloride as a by product. With the demonstrated success of bioremediation at this site, the full-scale application of CL-Out bioremediation is scheduled to begin in the first quarter of 2010.

Geology and Hydrogeology

The site is on a coastal plain where the geology is characteristically interbedded silt and sand deposits. The affected aquifer is unconfined system of silty sand from the ground surface to at least 100 feet deep. The hydraulic conductivity is estimated to be 36 to 420 ft/day with an effective porosity of 30%. The ground water is relatively aerobic with background dissolved oxygen concentrations of 0.27 to 2.25 mg/L and oxidation-reduction potentials of 105 to 230 millieq.

Contamination

The main contaminant at the site was TCE. There were also lower concentrations of other chlorinated ethenes and 1,4 dioxane. The TCE concentrations in the plume were as high as 180 ug/L. The TCE plume area was estimated to be over 60 acres.

The pilot study was implemented in an area where the TCE concentrations were at moderate levels in the range of 30 to 60 ug/L. The plume, however, was dispersed below the water table at 60 to 90 feet below ground surface, while the water table was at approximately 25 feet below grade.

Pilot Study Design

CL-Out organisms and dextrose were injected by direct-push drilling at two locations 10 feet apart perpendicular to the direction of ground water flow. The injections started at 90 feet deep and continued as the drill stem was extracted to 60 feet. Two 55-gallon drums of hydrated CL-Out were injected at each location. This volume provided sufficient CL-Out microbes to yield the target microbial population of 1,000,000 colony forming units per milliliter (cfu/ml) of ground water.

Monitoring was conducted in individual and nested wells at variable distances around the injection points. The nested wells had screened intervals at 60, 75 and 90 feet deep. Surrounding monitoring wells were sampled to assess the progress of the remediation. The following table shows the pre-treatment and post-treatment TCE concentrations in down gradient monitoring wells at the middle of the plume (75 to 85 feet deep).

Sampling Location	Background	Post Injection			
	5/22/07	14 days 8/7/07	30 days 8/21/07	60 days 9/17/07	90 days 10/17/07
Background 10 feet up gradient	54	54	49	45	55
20 feet down gradient	38	17	15	14	13
40 feet down gradient	52	42	18	12	17

The concentrations of vinyl chloride and other potential anaerobic breakdown products were not detected during the pilot study.

The following table shows the trend in 1,4-dioxane concentrations during the pilot study. While the upgradient concentration fluctuated, the down gradient concentrations decreased to below or near the detection limit at 20 and 40 feet downgradient.

Sampling Location	Background	Post Injection			
	5/22/07	14 days	30 days	60 days	90 days

		8/7/07	8/21/07	9/17/07	10/17/07
Background 10 feet up gradient	11	7.9	21	6.6	7.0
20 feet down gradient	6.9	0.0	0.89	0.0	0.0
40 feet down gradient	25	0.0	1.8	0.0	2.2

Dissolved oxygen and ORP were monitored during the pilot study and showed aerobic conditions were maintained without an oxygen supplement.

Conclusions

The pilot study demonstrated that CL-Out bioremediation was effective in degrading TCE without the production of DCE or vinyl chloride and simultaneous removal of 1,4-dioxane. It was also able to remove as much as 100% of the 1,4-dioxane. While more than 60% contaminant reduction was achieved, a higher rate of reduction may be achieved with a greater microbial density or repeat inoculations.