

Bioremediation as a Reclamation Technology at a 1,2-Dichloroethane-Contaminated Site

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Extended Abstract

Enhanced bioremediation technology was tested in an industrial area in northern Italy, contaminated by high levels of 1,2-dichloroethane. The site had previously been characterized by laboratory studies, such as microcosm tests and molecular analysis, to identify the presence of a biodegradation potential and the occurrence of natural attenuation processes. Redox potentials of groundwater were indicative of anaerobic conditions; moreover, vinyl chloride was never found as reaction product, indicating the prevalence of a dihaloelimination mechanism. Microcosm studies were also useful to select the best amendment to enhance biodegradation of the pollutant. Organic acids such as sodium acetate, formate or lactate, as well as complex substrates like cheese whey or molasses were tested to enhance dehalogenation activity of bacteria. Sodium lactate was chosen as the best amendment for the bacterial community present at the site. A pilot test started in 2015 and monitoring is still ongoing; three injections of amendment were performed, two of them based on sodium lactate and the last based on a lactate-containing, slow-release compound, in order to avoid repeated injections. The average concentration of the pollutant dropped from 1100 ppm to 150 ppm in the first 18 months of treatment, confirming the activity of a robust consortium of bacteria resistant to high concentrations of the solvent. Molecular analysis was performed to monitor the level of marker gene, *dcaA*, coding for a reductive dehalogenase isolated at the site [1], and the presence of *Geobacter sp.*, which was identified as the main species active in biodegradation; the structure and the changes in the microbial population were followed by Illumina or Ion Torrent sequencing analysis. The relative percentage of *Geobacter sp.* on the total species identified at the site raised after each injection of amendment and lasted for some months. The same trend was noted for the marker gene, *dcaA*, underlining the direct relationship between the two markers. Besides, Compound-Specific Isotope Analysis (CSIA) was used for both qualitative and quantitative estimation of degradation processes. Pre-treatment CSIA data in the area are consistent with natural attenuation processes active at the site, as shown by significant fractionation on ¹³C at some locations together with a decrease for 1,2-DCA concentration over time. CSIA analysis of 1,2-DCA before and after the injection of amendments has shown specific trends of isotopic enrichment with pattern specific for different areas in the treated zone. The best conditions for optimal biodegradation rates has been selected and the treatment will be extended to the whole contaminated area.

References

- [1] M. Marzorati, F. de Ferra, H. Van Raemdonck, S. Borin, E. Alliffranchini, G. Carpani, L. Serbolisca, W. Verstraete, N. Boon and D. Daffonchio, "A novel Reductive Dehalogenase, identified in a contaminated groundwater enrichment culture and in *Desulfitobacterium dichloroeliminans* strain DCA1, is linked to dehalogenation of 1,2-dichloroethane," *Appl. Environ. Microbiol.*, vol 73, no. 9, 2007.