Combining In Situ Sorption and Bioremediation for the Management of a Chlorinated Solvent Plume at Low Concentration

Marco Petrangeli Papini (marco.petrangelipapini@uniroma1.it), Firoozeh Arjmand, Paolo Ciampi, and Carlo Esposito (University of Rome "La Sapienza", Italy)
Jeremy Birnstingl, Marcello Carboni, and Paola Goria (Regenesis Ltd.)
Simona Rossetti and Bruna Matturro (IRSA-CNR, Italy)
Lucia Cesta Incani and Manuele Bacchi (RFI, Italy)

Background/Objectives. The University of Rome "La Sapienza" has been commissioned to evaluate strategies for the management of the contaminated areas of the new High Speed Railway Station of Bologna (Italy), where historical chlorinated aliphatic hydrocarbons (CAHs) contamination has been found and characterized by a long-term monitoring activity (PCE, TCE and cis-DCE - concentrations ranged between 10-100 µg/L). Contamination is present in two aquifers with diverse geological characteristics, fine sand and lime in the superficial aquifer with a thickness of around 6 to 8 m, and higher permeable sand in the deeper aquifer with a thickness of 2 to 4 m. The Italian environmental legislation is among the most restrictive in Europe with some of the most stringent target levels especially concerning the CAHs. For example, the maximum contaminant levels (MCLs) for groundwater at the border of site properties are fixed to 1.1 and 1.5 µg/L for PCE and TCE, respectively. The combination of in situ sorption, through the injection of a "liquid activated carbon", with the enhancement of the biological reductive dechlorination, by electron donor amendment, was chosen as the most appropriate strategy for the site. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after one year appear particularly encouraging.

Approach/Activities. A thorough investigation of the site has been carried out (geological, chemical and biological) and integrated with a microcosm study. Based on the results, biological reductive dechlorination was recognized as a potential approach for the site remediation but the extremely low CAHs concentration and the consequent kinetic limitation made it unfeasible for the site. Thus, the possibility to use a new dispersed colloidal activated carbon technology (Plumestop™, Regenesis) to create an in situ adsorption zone potentially able to quickly reduce CAHs concentration (management of the potential risk) and to raise the kinetics of the biological reduction by locally increase the CAH concentration at the carbon surface was experimentally investigated as a site-specific remediation approach. A pilot test was then performed in order to optimize the injection best practice for the site, product distribution and contaminant mass reduction. The full-scale remediation plan was approved and completed and the monitoring results from the first year of operation are already available.

Results/Lessons Learned. Four different zones, with the highest CHC concentration, were selected for the intervention. Due to the rapid effect on the contamination provided by this technological approach, a very good reduction rates within only few weeks from the application was observed in all the treated zones. Depending on the zone specific characteristics, the relative relevance of sorption/biodegradation was different but after few months from the application the CHC concentration were stably reduced of more than two orders of magnitude. At the present time almost all the treated zones reached the very low target concentration for PCE, TCE, cis-DCE and VC. At the time of the conference, results from almost two years of monitoring will be available.