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Enhancing Bioremediation through In Situ Sorption of Extremely Low Chlorinated Solvent Concentrations at a High-Speed, Italian Railway Station

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Background/Objectives. Italy has some of the most stringent target levels in Europe; mainly for chlorinated hydrocarbon compounds (CHC) and these levels are typically in the low µg/L or sub- µg/L range. An urban development site adjacent to the new high-speed railway station in Bologna (Italy) was the focus of remediation efforts where a historical CHC contamination had been observed and characterized by a long-term monitoring activity. CHC concentrations were lower than 1 mg/L and usually ranged between 10-100 µg/L. The contamination was present in two aquifers, characterized by different geology.A new dispersed liquid activated carbon (LAC) technology was selected as a means of securing dissolved phase contaminant removal and biodegradation even at very low concentrations, potentially approaching the S_{min} for the target solvent and the common point of bioremediation stall. The LAC technology incorporates a regeneration process, allowing for a completely passive treatment following installation (with no need of any mechanical plant installation). There is also no requirement for repeated applications, which is ideal on this complex site, where the presence of a busy train station, a residential neighborhood and redevelopment works make the minimization of site activities a specific prerequisite.The challenge of the treatment of two different aquifers at the same time has been solved by using fixed injection points incorporating a series of non-return valves corresponding to the depth of treatment in each aquifer allowing for accurate and tailored dosage application without any risk of cross-contamination.This application is of interest as being both the first use and the first full-scale application of the technology in Europe.

Approach/Activities. Prior to technology selection, preliminary laboratory tests were performed at the University of Rome La Sapienza. Based on the column test results, the full-scale design was completed and the remediation plan approved by regulators on first presentation. A pilot test was performed in 2015, with its main objectives being: the evaluation of injection best practice for this site, product distribution and contaminant mass reduction. The full-scale application has been completed in two out of four of the treatment areas, and first monitoring results are available.

Results/Lessons Learned. Due to the rapid effect on the contamination provided by this technological approach, it has been possible to observe very good reduction rates within only few weeks from the application. The parent compound, PCE, has already shown reductions of one order of magnitude, with daughter compounds showing a reducing trend rather than sequential increase and decrease within the groundwater as can be expected from traditional enhanced biological dechlorination.As the initial phase of treatment by this technology is a physical process of adsorption, (which then promotes and enhances the biodegradation to extremely low concentrations) the distribution of the product in the subsurface must be performed in a careful and controlled manner, to ensure requisite distribution and treatment; particularly if results of less than 1 µg/L or ‘non-detect’ are to be achieved.It is anticipated that at

time of the conference, further full-scale results will be available, in order to provide information on the long-term trend of the groundwater treatment onsite.