Treatment of Benzene Contamination using Rhizoremediation at a Petrochemical Facility in Brazil

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Background/Objectives. Phytoremediation, the use of plants to degrade toxic contaminants in the environment, involves a different number of processes. Rhizoremediation systems rely on a synergistic relationship between suitable plants and their root associated microbial communities, when degradation is facilitated through a rhizosphere effect where plants exude organic compounds through their roots and thereby increase the density and activity of potential hydrocarbon-degrading microorganisms in the area surrounding the roots. The chemical facility is located in Rio de Janeiro, at an environmentally protected area. The existing benzene contamination impacts an area of approximately 120,000 sq. meters, in concentrations of up to 900 mg/L. This approach will be used in areas where concentrations are below 10 mg/L, which comprises approximately 90% of the plume area.

Rhizoremediation is being used to slow down the groundwater flow towards the bay and at the same time provide the ideal rhizosphere to enhance bacterial and fungal activity and degrade the VOCs.

Approach/Activities. A bench-scale pilot test was performed to determine the potential for in situ bioremediation at the site. The test was designed to evaluate the effectiveness of anaerobic and aerobic ISB to treat the benzene. The test concluded that benzene-degrading bacteria existed at the soil and groundwater at the site, and that oxygenation of the media favored the reduction of the VOCs. Another study is being conducted between several native plants to the region to determine which ones will be more efficient on the overall objective of the project, which is to slow down the groundwater flow towards the bay and at the same time provide the ideal rhizosphere to enhance bacterial and fungal activity and degrade the VOCs.

Results/Lessons Learned. The treatability tests indicated a removal efficiency of 99.8% or higher reductions in benzene and complete reductions of toluene, ethylbenzene, and total xylenes. Oxygenation of the sand soil and groundwater would provide for greater and more rapid reductions in VOCs. The pilot test activities will be conducted between March and June 2019 and this paper will present the treatability tests and the pilot test results with special attention to the performance and implementation of the field programs, challenges imposed by the Site and technology conditions and optimizations applied to address the overall performance of the strategy. Full-scale field work implementation is scheduled to start in November 2019. The paper will also include the environmental agency response to the proposed rhizoremediation technology, and the strategy used to convey the technology both to the agency and the communities around the site.