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Enhancement in the Removal of High Viscosity Oil Through Steam Injection

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Background/Objectives. Environmental investigations carried out in an oil unloading area in a Black Carbon facility identified the presence of free phase of aromatic oil in the soil and groundwater. The company used the oil as a raw material, which is characterized by a blend of aromatic compounds, with densities ranging from 0.8 to 1.2 g/cm^3 and with high viscosity. The local geology is composed of colluvial/alluvial deposits of clay, sand, and cuttings. The related saturated zone has hydraulic conductivities around 10^{-5} cm/s, resulting in an underground flow velocity of approximately 5 m/year. At the base of these sediments, about 6 meters deep, there is a compact clay layer that serves as a physical barrier for the vertical migration of the compounds identified in the aquifer.

Approach/Activities. The system designed and implemented for the removal of free phase intended to extract both the product adsorbed in the soil and the light and dense phases of oils. The system was comprised of wells for water vapor injection, which increased the aquifer temperature, reducing the viscosity of the free phase, and wells for dual phase extraction, through which free phase, groundwater, and vapors were removed. Therefore, the combination of the temperature increased and the generation of hydraulic gradients by groundwater pumping favored the migration of the free phase towards the extraction wells, where it was extracted. The pumped groundwater and the oily phase were transferred to a recovery system, while the extracted vapors were burnt in the company's furnaces. The separated oily and aqueous phases were also reused in the production of black carbon.

Results/Lessons Learned. In the 12 initial months of operation, the remediation system removed approximately 7 m^3 of free phase. In the two following years, the system removed an additional amount of 1 m^3, pointing out that the free phase extraction technique had been exhausted. By the end of the extraction, no potential risks were indicated according to theHHRA.