

Multiple In Situ Technology Pilot Tests for Gas Work DNAPL and LNAPL Groundwater Contamination

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Background/Objectives. In the northeastern part of central Stockholm there has been a large industry area that is now being converted to residential housing and to some extent commercial and office area. Among the industries is a gas work producing City Gas for the greater Stockholm area until the 1980s. There were enormous amounts of coal that used to produce gas and coke, and a number of other commercial products from the byproduct coal tar (e.g., pure benzene). The activities have left very complicated soil, groundwater and sediment contamination situations with some challenging problems to be solved. One of those is the contaminated groundwater at great depth down to 20 m below ground level (app. 18 m below groundwater level). The City of Stockholm therefore engaged RGS Nordic to perform pilot tests with several in situ methods, to find viable solutions to the problem. The geological conditions are also very challenging with large boulders in one area and at other places the soil consists of very hard and diverse backfill overlaying clay and thereafter sand containing stones making drilling works very difficult.

Approach/Activities. In early 2017 there was a period of detailed site investigations including targeted sampling to obtain data to select placement and design for the different pilot tests. Due to limited space, the number of pilot tests were cut from seven to six. The tests were mainly chemical oxidation with different products to target high concentrations of PAH compounds (mainly varieties of hydrogen peroxide and persulfate containing products). For benzene and naphthalene there were also tests with enhanced natural attenuation with oxygen release compounds, both in coarse and dense soil layers. Pumping was also introduced for determining the hydraulic conductivity. A bench-scale test to see the possibilities with thermal methods was also completed. The site works for the pilot tests were done June - September 2017. To maintain a high comparability between the pilot tests, all injection works were performed by direct push injection.

Results/Lessons Learned. The contaminated groundwater was situated in a very complex geological setting that proved to be difficult to penetrate for sampling and for adding sufficient volumes during the injections. The pump test was also hard to perform with good result. Several drilling methods and equipment were tested before we could get sufficient design data. One important lesson was therefore the need to allow time and budget for testing of drilling equipment and methods to achieve good quality sampling and performance of the injection works on site. The results of the pilot tests are expected to be available in October 2017. Selection of methods for full scale remediation is planned to be done early 2018 and should therefore be available and possibly can the full-scale work be started by the time of the conference.