

Remediation of Hydrocarbon-Contaminated Sites Using High Frequency Investigation/Sampling as Design Tool: Scandinavian Approach

Gabriele Giorgio Ceriani (ggc@ejlskov.com) (Ejlskov A/S, Århus, Denmark)

Background/Objectives. A series of hydrocarbon and other contaminated sites have been, since 2010, treated across Scandinavia and Finland by using an innovative approach consisting of performing a site validation investigation through a remedial design characterization (RDC) combining the use of the membrane interphase probe (MIP) tool and collection of high frequency soil samples. This initial step has allowed the completion of in situ remediation projects (performed using Trap & Treat® BOS 200®) under different contractual framework agreements such as performance based remediation (PBR), fixed price, time guarantee and the more common time and materials.

Approach/Activities. After receiving the site investigation data from the clients, the conceptual site model (CSM) data gaps were identified and a tailored RDC was designed to encompass the already known contaminated areas and define potential additional sources with the final aim of assessing the overall lateral and vertical extent of the soil contamination, enabling the users to assess to the best extent possible the total soil contamination mass present on site and how this is distributed across the subsurface.

The first step consists of performing a series of MIP points (generally located in a regular grid) at regular distances to evaluate the contamination profile across the site both laterally and vertically. Once the lateral and vertical assessment of the contamination had been consistently delineated soil sampling activities are carried out. Generally, 50% or more of the MIP points locations are sided by soil core locations performed via direct push / dual casing technique. Soil samples, within PVC liners, are collected every 50 cm or even more frequently based on the vertical contamination profile information gathered during the MIP investigation.

Results/Lessons Learned. The implementation of the RDC approach prior to performing any remediation work has proven highly successful in order to correctly establish the areas and depths to be remediated. As a consequence, the injection loadings associated to the use of the Trap & Treat® technology are designed with much higher accuracy and allowing the usage of the client budget more efficiently. Seven projects have been completed (including remediation) since 2010 by performing an RDC. Out of these seven projects:

- 3 projects have reached a no further action (NFA) stage within 12-24 months post remediation works.
- 1 project conducted under PBR contract has reached seven out of the eight milestones within 24 months post remediation works and its entering (in September 2017) negotiations for an NFA. A 60-month timeframe for complete milestones achievement was set.
- 1 project conducted under fixed price contract is close to reach the 1 µg/L target for benzene and NFA years ahead of the planned timeframe (24 months post remediation compared to 60-72 months).
- 1 project conducted in the summer/fall of 2016 is undergoing a series of post injection groundwater monitoring events. Highly positive results are observed by the time of submission of the abstract (August 2017)
- 1 project conducted in the summer of 2017 under a time guarantee contract has been successfully carried out within the planned timeframe and post remediation data are not yet available (by August 2017).