Lowering the Carbon Footprint of Thermal Remediation Systems

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Background/Objectives. ERM was commissioned to investigate and treat legacy contamination beneath a building at an operational manufacturing site. The main contaminant of concern within soil and groundwater was chlorobenzene at concentrations indicative of the presence of DNAPL. A high-resolution site characterization investigation revealed DNAPL present within the heterogeneous clays, sands, silts and gravels underlying the site.

Approach/Activities. Sustainability was a key factor considered during the remedy and associated project lifecycle evaluation. In situ thermal treatment technology was ultimately selected as the remediation technique, as the multicriteria analysis conducted in accordance with the UK's Sustainable Remediation Forum (UK SuRF) framework, demonstrated this technology offered the greatest overall net sustainability benefit.

As a result of the analysis, the thermal design was built around enhancing system sustainability. For example, the remedial design included the use of gas fired burners to provide the heat input, used geochemical modeling to evaluate performance of the system if a reduction in the target treatment temperature was implemented, and used a thermal model to optimize the heater well spacing/energy input. One of the key sustainability factors included in the design was a reduction in the target treatment temperature (TTT). The design paradigm for thermal remediation has traditionally been heating to or above the boiling point of chlorobenzene (131°C) to achieve contaminant removal via volatilization. However, ERM evaluated using a lower TTT in order to take advantage of carbon dioxide gas release to remove the contamination via gaseous stripping (a process called low temperature Volatilization, or LTV). This approach allows for heating at temperatures lower than the co-boiling point reducing the TTT to circa 60ºC, resulting in a significant associated energy savings.

Once the TTT had been confirmed, a thermal model was constructed using PetraSim™ PC-based software. This informed the technical design and enabled heat input to be optimized, and hence the specification of the process equipment used. The model predicted a heat up time of circa 60 days and also showed that the optimum configuration comprised 26 DPVE wells and 14 gas fired heating wells within the approximately 900m2 treatment area. 30 temperature monitoring points were also installed within the treatment zone to allow the heating process to be monitored and optimized.

Results/Lessons Learned. The operational phase confirmed the design predictions and heating was completed within 56 days. The recovery system subsequently operated in isolation for several weeks afterwards to recover the remaining contamination via the LTV approach without additional heat input being required. Data showing the success of the thermal project will be presented along with an analysis of the carbon footprint of the LTV approach using the life cycle analysis (LCA) Simapro PC-based software. In addition, an estimated LCA will be given to compare the same project if the traditional higher temperature approach had been implemented to show the net benefit of the system from a sustainability standpoint.