highly commended
Best In-Situ-Treatment

bb AWARDS Brownfield Briefing Awards 2011

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COMBINED STEAM ENHANCED EXTRACTION (SEE, TUBA®) AND THERMAL CONDUCTIVE HEATING (TCH, THERIS®)

SITE The South, United Kingdom

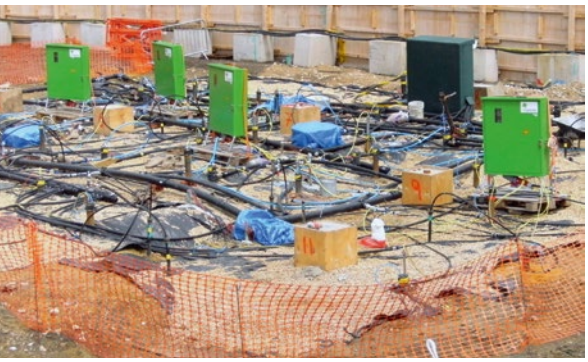
COMBINED IN-SITU THERMAL TREATMENT (ISTT)
- steam enhanced extraction with air-co-injection (SEE, TUBA® method)
- thermal conductive heating (TCH, THERIS® method)

PLUME TREATMENT
anaerobic bioremediation after ISTT

CONTAMINANTS OF CONCERN
BTEX, VOC, pesticides, herbicides

VOLUME 9,000 m³

DEPTH OF TREATMENT TARGET ZONE
19 m bgl shallow and deep aquifer; aquitard inbetween



A total of **18,000 tonnes** of highly contaminated soil and groundwater have been successfully treated using a combination of ex-situ and in-situ remediation techniques, including **in-situ thermal treatment (ISTT)**. Here, we combined **SEE (steam enhanced extraction with air-co-injection; TUBA® method)** and **TCH (thermal conductive heating, THERIS® method)** for a highly efficient source zone mass removal to a depth of up to **19 m bgl** in a complex, **multilayered aquifer/aquitard formation to address two separate dissolved phase groundwater plumes.**

Waste solvents and herbicide residues had been stored in an underground tank and resulted in significant contamination within shallow soils and groundwater. Primarily **BTEX and chlorinated solvents** (e.g. Chloroform) with up to 150,000 µg/l total VOC, significantly elevated SVOC concentrations (up to 100,000 µg/l) and **List I pesticides and herbicides** (total up to 414 µg/l) had been detected. Further investigation of the deeper aquifer unit at >14 m depth also confirmed significant concentrations of compounds of concern (CoC's).

A former building had been **demolished** and a former waste chemical tank had been **excavated** down to 6 m bgl preliminary to remediation works. For source zone removal, the shallow and deep sand aquifer source zones were treated by **steam injection with air-co-injection (SEE, TUBA®)** combined with **dual-phase recovery**. The clay aquitard was treated using **thermal conductive heating (TCH, THERIS®)** combined with **high-vacuum multi-phase recovery**. Our automated and remote controlled measurement systems were monitoring soil temperatures as well as VOC mass recovery. We conducted data management and remediation supervision from abroad.

The in-situ thermal treatment (ISTT) achieved soil temperatures of up to **103°C** in the shallow and deep sand aquifers and **104°C** in the clay aquitard. During this in-situ thermal source zone treatment, within only 4 months, a total mass removal of **326 kgs of VOC's, 2 kgs of SVOC's** and **1 kg of pesticides/herbicides** could be achieved. Concentrations of the most prevalent COC's have been reduced during treatment by **more than 99%**, as demonstrated by ongoing groundwater monitoring and soils analysis in each layer pre/post remediation. The subsequent reduction in pollution burden for all compounds to be achieved is considered to be at least **35 kgs** of chlorinated VOC's over the course of residual treatment. The short ISTT time and the low **settlements of less than 1 mm per metre heating depth** enabled an **immediate start of foundation and superstructure works** for a new building **after ISTT removal**.

Residual dissolved contaminants in the plume were treated in both aquifers through **enhanced reductive dechlorination (ERD). Controlled release organic substrates** (3D Micro-emulsion and hydrogen release compound primer) were injected, to promote enhanced reductive dechlorination following active source zone treatment.

The residual in-situ treatment was enhanced through continued high-vacuum extraction and groundwater recovery/treatment after cessation of thermal treatment, using the pre-treated (warm) groundwater as the feedstock for diluting the ERD substrate rather than cold, sterile mains water supply.

The project was characterised as **highly commended** in the category **Best In-Situ-Treatment** for the **Brownfield Briefing Award 2011**.

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METHODS & ENGINEERING:

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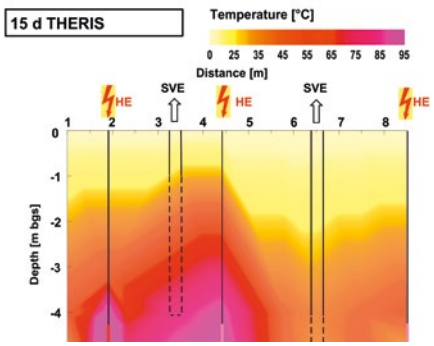
Low-permeable, wet soil like silt, loam, marl and clay or solid rock like clay stone, Keuper marl or slate can be remediated economically and ecologically in only a few months using in-situ thermal treatment. The THERIS® method includes the installation of heater wells into soil and aquitard, the following vaporisation of volatile contaminants like chlorinated hydrocarbons (CHC), BTEX or mobilisation of oil-phase and a controlled removal of vapour and liquids. Hence, contaminated source zones are removed from the unsaturated zone and the groundwater within a few months. Our remediation systems are also applied beneath buildings during their residential or industrial use or in fractured rocks (e.g. slate). Ex-situ thermal remediation is applied to treat soil contaminated with CHC, BTEX, PAH and pesticides. Variable heat power and heating design enable an easy realisation of remediation projects with different boundary conditions.



Sustainable efficiency by automised process monitoring

Insufficient monitoring in Brownfield remediation can lead to significant increases in costs. Our remote monitoring systems with automated data collection and analysis are being used for efficiency enhancement in many remediation projects. Automated monitoring of temperature in soil, water and plant-technology or in soil piles offers significant advantages for the remediation management. Other economically efficient areas of application for remote monitoring systems are groundwater monitoring, hydrogeological questions or pressure measurements for optimisations in plant operation. You can also benefit from our long-term practical experience and our modern equipment including mobile environmental laboratories.

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