

## Integrated in situ remediation of honing oil in a chalk aquifer, UK

### Enhanced vacuum extraction, chemical oxidation and biodegradation



#### Summary

At an active factory, the spillage of 'honing oil', a heavy oil used as a lubricant in metal machining, occurred in the oil recovery plant on the side of the main building. The oil infiltrated the vadose zone and entered the groundwater via fractures in the weathered chalk under the site. This resulted in high levels of dissolved phase contamination and some Light Non Aqueous Phase Liquid (LNAPL) on the ground. The contamination posed a potential offsite liability for the site owner and so it was determined that active remediation should be voluntarily completed.

#### Treatment

REGENESIS employed a sequential remedial approach:

- **Enhanced vacuum extraction of the LNAPL**
  - To avoid the installation of a pump and treat system on the busy site, 3 mobilisations of a vacuum tanker was used to provide total fluids removal.
  - Recovery was enhanced through multiple injections of PetroCleanze, an inorganic, oxidative surfactant.
  - This temporarily promoted rapid desorption of the heavy oils adsorbed to the bedrock within the 'smear zone'.
  - By desorbing this contaminant mass, the vacuum extraction was able to remove more mass, shortening the remedial programme.
  - This depleted the contaminant mass on the soils, reducing the potential 'rebound' due to desorption.
- **In Situ Chemical Oxidation (ISCO)**
  - ISCO was completed at the downgradient edge of the treatment area to target high levels of dissolved phase contamination and prevent egress of any contamination mobilized during the PetroCleanze treatment.
  - This was completed using RegenOx, which is alkaline and suitable for use in calcareous formations.
  - ISCO was also used across the treatment area following the last enhanced vacuum extraction event, in order to target the residual high levels of dissolved phase contamination prior to bioremediation.

#### Remediation Details

**Site Type:**

Industrial

**Project Driver:**

Voluntary

**Remediation Approach:**

Enhanced Vacuum Extraction,  
In Situ Chemical Oxidation,  
Enhanced Natural Attenuation

**Technologies:**

PetroCleanze®, RegenOx®,  
ORC-Advanced®

#### Geology

x	Bedrock (chalk)
	Gravel
	Sand
	Clay

#### Medium

x	Groundwater
	Saturated Soil
x	Smear Zone

#### COC

	Metals
	Chlorinated VOCs
x	Petroleum Hydrocarbons

**COC Concentration Levels:**

LNAPL

**Treatment Depth:**

5m BGL - 8m BGL

**Treatment Area:**

125m<sup>2</sup> total

**Remediation Cost:**

£30,000

**Injection Grid:**

5 pre-installed wells

• **Enhanced Aerobic Biological Degradation**

- ORC Advanced was injected with the RegenOx in order to create highly aerobic conditions, increasing the biomass of microbes that would aerobically degrade the residual dissolved phase contamination.
- This single application provides a controlled release of oxygen into the groundwater for up to 12 months.
- This treatment targeted the dissolved phase contamination in the mobile groundwater in the chalk fractures and also provided prevention of rebound due to back-diffusion from the contamination located in the primary porosity of the chalk matrix.

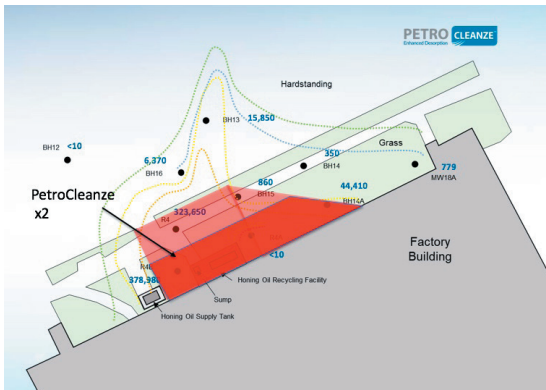


Fig. 1 Enhanced Desorption and Contaminant Extraction

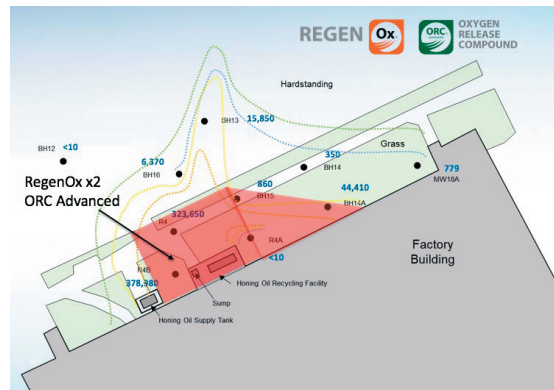


Fig. 2 In Situ Chemical Oxidation (ISCO) and Enhanced Natural Attenuation (ENA)

**Results**

The treatment produced a rapid reduction in the contaminant mass on the site. All LNAPL was removed from the groundwater. Dissolved phase concentrations were reduced by 98% through the combination of treatment processes, see graph 3. The contaminant concentrations remained low and rebound was avoided through the depletion of adsorbed mass and contamination within the immobile porosity.

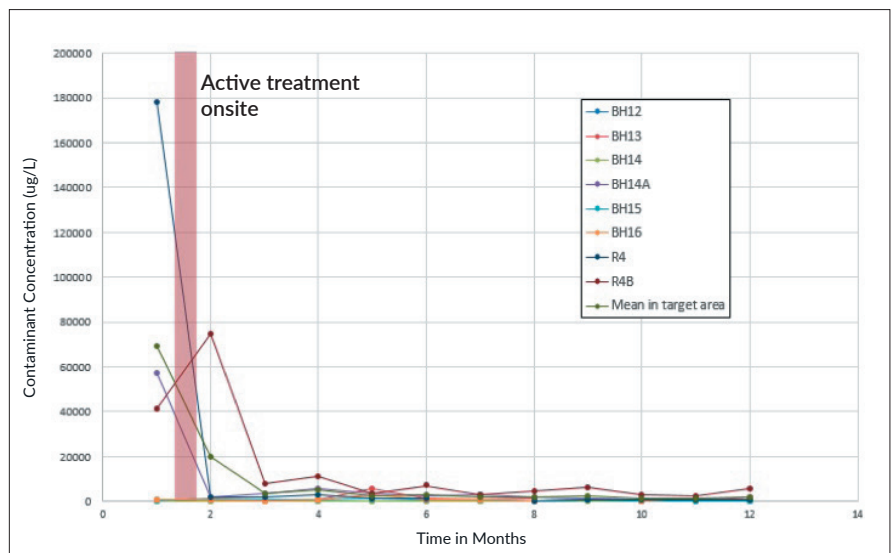


Fig. 3 Groundwater TPH Concentrations

**Conclusion**

- Enhanced vacuum extraction avoided the installation of abstraction equipment onsite and reduced the treatment programme.
- A combination of approaches targeted each contaminant phase in order to provide the most efficient technique for each level of contamination, from LNAPL to low dissolved phase.
- A rapid and dramatic reduction in the contaminant concentrations was achieved.
- Low concentrations were maintained through the targeting of sources of rebound via desorption and back-diffusion.

For more information or to discuss your project, please contact:

Jack Shore  
 REGENESIS  
 District Manager UK & Scandinavia  
 jshore@regenesi.com  
 +44 (0) 1225 61 81 60