

In situ groundwater remediation following an oil-tanker spill

CASE STUDY

Integrated chemical and biological approach rapidly remediates MTBE and petroleum hydrocarbons

INTRODUCTION

A fuel tanker truck over-turned on a small road in northern Italy, spilling over 36,000L of diesel and petrol. The fuel impacted a canal, flood defences, soils and groundwater in the immediate vicinity.

Emergency oil spill response was carried out, with impacted soils and the road surface removed and replaced. An underground pipeline was flushed out and sorbent booms were placed in the adjacent canal to catch and remove the oil.

A site investigation was completed concurrently with the oil-spill response in order to identify the subsurface contamination, build an initial Conceptual Site Model (CSM) and develop plans for remediation. MTBE, petroleum hydrocarbons (TPH) and BTEX were found to be within the soil – concentrated within the capillary fringe.



Fig. 1 The site prior to in situ remediation

The groundwater was also found to be impacted and requiring remediation. A remedial options appraisal was completed, considering technical feasibility, sustainability, time and cost and a combined in situ chemical oxidation (ISCO) and enhanced aerobic natural attenuation (ENA) approach was chosen.



SITE TYPE

Public road spill
(next to canal)



GEOLOGY

Fine sand with silt



CONTAMINANTS

MTBE, TPH, BTEX
approx. 1000 µg/L



PROJECT DRIVER

Restore environment following
truck spill accident



TREATMENT

In Situ Chemical Oxidation and
Enhanced Bioremediation



TECHNOLOGIES

RegenOx[®],
ORC Advanced[®]



REMEDIAL APPROACH AND PLANNING

An integrated remedial approach of ISCO and ENA was selected to treat the soil in the ‘smear zone’ and within the groundwater. The treatment area was approximately 400m² with a target depth from 2 to 4m BGL. This combined solution was chosen due to low costs. There was no requirement for fixed installations or maintenance of site equipment (e.g. pump and treat) in a public area. Only a single mobilisation was needed as the combination of technologies provided: a rapid reduction in high levels of contamination and a long term treatment of the residual mass from a single application.

APPLICATION INTO EXCAVATION



Where soils had been removed during the oil spill response phase and within the flood defence pits, the treatment could be applied by BELFOR through simple application into the base of the excavation. The ISCO agent, **RegenOx** was poured into the base and mixed with the soils at the bottom using an excavator bucket. In the initial phase of the treatment the RegenOx provided enhanced desorption of the very high levels of contamination sorbed to the soils. This meant that some of the residual mass could be manually removed through skimming and total fluids removal. For three days following the application, 3m³ of highly impacted water was removed from the open excavation.



The RegenOx targeted the high levels of contamination on the soils and in the groundwater, rapidly reducing the contaminant mass over 4-5 weeks. The residual partially oxidised hydrocarbons are more bioavailable and biodegradable, and so the approach is synergistic with the ENA phase of the treatment.

ORC Advanced was then applied inside the excavation, providing a controlled release of dissolved oxygen to stimulate and maintain the growth of aerobic microbes, enhancing the biological degradation of the residual contamination for up to a year from this one application.

DIRECT PUSH APPLICATION

Outside of the excavation area, a single direct push injection campaign was completed in two areas.

The area with higher contamination received co-injection of **RegenOx** and **ORC Advanced** in 16 injection points located on a regular grid with 3 meters spacing.

In the downgradient area, lower concentrations of contamination meant that only ENA was required. Here, **ORC Advanced** was injected into 10 direct push locations. The **ORC Advanced** was co-applied with **ORC Primer**, which provided a short-term (1-3 month) release of oxygen to create aerobic conditions in the aquifer more rapidly, after which **ORC Advanced** maintained the long-term treatment needed to reach low concentrations.



Fig. 4 Excavation pit after treatment by BELFOR



Fig. 5 Mixing and injection of RegenOx and ORC Advanced

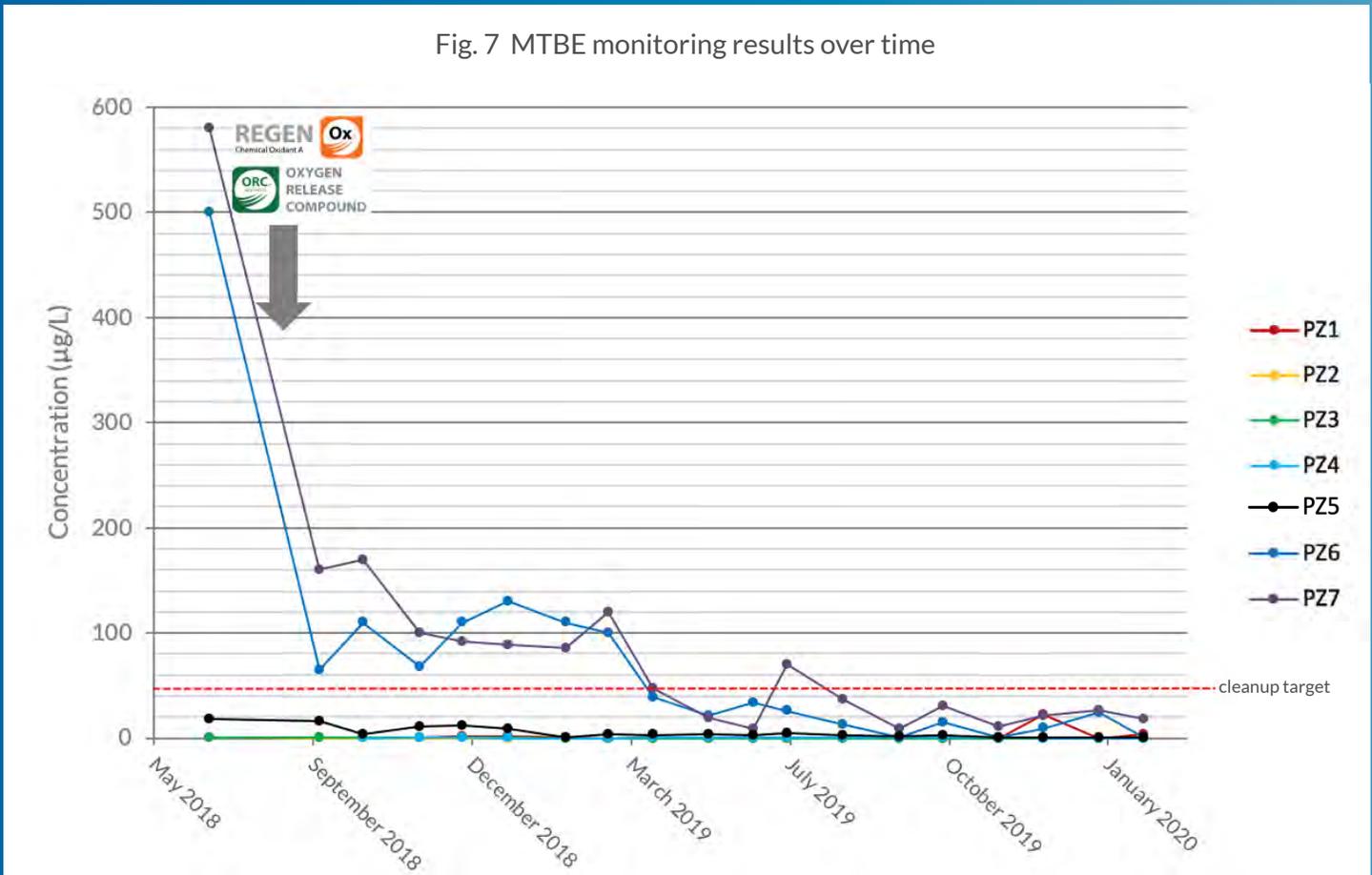


Fig. 6 Direct push injection

RESULTS

Post application monitoring showed a sustained decline in contaminants concentrations in all of the impacted monitoring wells. MTBE, considered the main contaminant of concern for groundwater, decreased consistently from > 500 µg/l to below the remediation goal (40 µg/l) over approx. 12 months, with subsequent monitoring shows a continuous declining trend, see figure 7.

Fig. 7 MTBE monitoring results over time



Dissolved oxygen values confirm the long-term release provided by ORC Advanced. Due to the controlled-release of dissolved oxygen, the measured O₂ values never reached saturation, therefore ensuring that there was no loss of oxygen to the atmosphere. All available oxygen was released over time into the groundwater to support aerobic biological degradation of the contamination.

“ The collaboration with REGENESIS, both during the design phase and the operational phase of the remediation works, has enabled us to apply cutting-edge technologies that reached the remediation objectives in a short period of time, whilst respecting the surrounding environment and minimising impacts on the commercial activities on the site. ”

Nicola Veglia, QHSE Manager



CONCLUSIONS

Compliance and validation testing was performed in the presence of the local public authorities, and site closure has been achieved approximately two years after the oil spill event. Monitoring will continue for the next two years to confirm long-term stability of the results achieved.

The rapidity and certainty of the remediation was possible thanks to careful planning of the numerous phases of the oil spill response and the choice of combined and complimentary remedial technologies.

Communication formed a key part of the success too, with close co-operation between all the stakeholders involved (BELFOR, environmental consultant, REGENESIS and the insurance company), as well as regular communication with the public bodies in charge of approval and control.



ABOUT THE CONTRACTOR

BELFOR is a multinational company (BELFOR Holding Inc.) and a leader in post-accident remediation. They clean up, rehabilitate and restore sites, plants and structures that have been affected by accidents and disasters of various kinds, such as fires, floods, natural disasters and pollution. BELFOR has been trading for over 70 years and has 11,100 employees spread across 450 branches in 55 countries.

In Italy, it has been operating since 1989. With a national network of more than 120 resources and an Operational Logistics Platform composed of 80 specialized technicians and collaborators, the company responds promptly and competently 24 hours a day, 7 days a week, 365 days a year, supporting companies, public bodies, professionals as well as owners of damaged homes. To learn more about BELFOR services, visit www.belfor.it or email info@it.belfor.com.

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