REGENESIS®

Bedrock Application of ORC Advanced Allows for Site Closure

In situ remediation achieves 99% reduction of total TPH

Case Summary – Petrol Filling Station, Wiltshire UK

A former fuel service station site was to be redeveloped as part of a major road construction project. The groundwater was impacted with total petroleum hydrocarbons (TPH), methyl tert-butyl ether (MTBE) and benzene, toluene, ethylbenzene and xylenes (BTEX) from leaking underground storage tanks (USTs). It was determined that remediation works were required at the site to eliminate the risk posed to human health and the environment, targeting elevated concentrations of TPH, MTBE and BTEX in the groundwater.

Remediation approach

Mouchel Consulting (now WSP Global) contacted REGENESIS for an *in situ* remediation solution.

ORC ADVANCED® OXYGEN RELEASE COMPOUND

ORC Advanced® was selected to enhance the aerobic bioremediation of the petroleum hydrocarbons in groundwater. In the remediation design, REGENESIS adjusted the injection spacing and application rates for the highly contaminated source area (BH103, IIW14) and the moderately contaminated plume area to allow for optimum treatment of each zone.

Application Details	
Soil Type	Bedrock, Limestone
Treatment Area	500 m^2
Treatment Thickness	3m – 6m BGL
ORC Adv. Applied	975 kg
Injection Spacing	3m Source area 4m Plume area
Application Rate	8.5 kg/m Source area 7.5 kg/m Plume area

Contaminants of Concern	Targets
TPH	no target
Benzene	100µg/L
Toluene	300µg/L
Ethylbenzene	300µg/L
Total Xylene	60µg/L
MTBE	300µg/L

ORC Advanced slurry prepared before injection

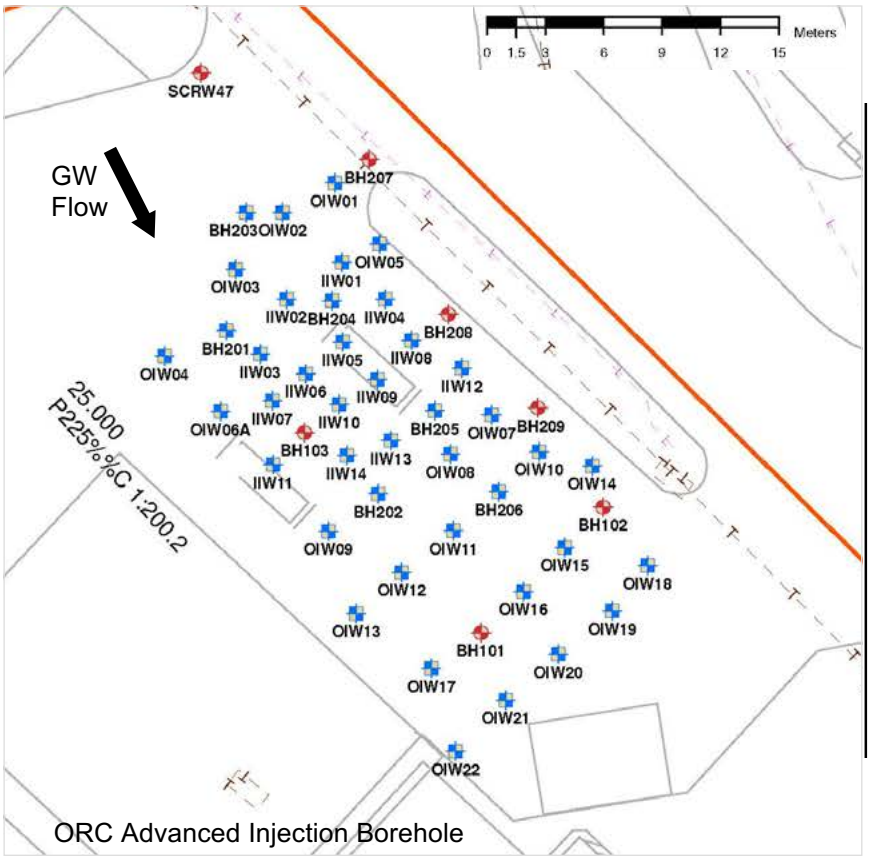
Pump outlet connected to well head

About the technology

ORC Advanced is an engineered, oxygen-release compound developed for enhanced, *in situ* aerobic bioremediation of petroleum hydrocarbon contaminants in groundwater and saturated soils.

Containing 17% by weight molecular oxygen, ORC Advanced provides a controlled release of molecular oxygen-an electron acceptor that optimizes microbial utilization in a treatment zone for up to 12 months post-application.

ORC Advanced was mixed with water to form a slurry prior to injection. Due to the presence of underlying fractured limestone bedrock, ORC Advanced was applied into specially installed injection wells completed across the target site.



Results

99% **Reduction in total TPH**

99% reduction in total TPH concentrations at location IIW14 in the central source area

Aquifer parameters

The effectiveness of the ORC Advanced application was observed within weeks of the injection. Aerobic aquifer conditions were quickly established and dissolved oxygen (DO) levels increased from an average of 3.7mg/L pre-treatment to a maximum of 11.95mg/L at 42 days after the ORC Advanced injection. The controlled-release nature of ORC Advanced will sustain these conditions for an estimated 12 months after application.

Groundwater results

- 99% reduction in total TPH concentrations at location IIW14 in the central source area;
- 98% reduction in total TPH in surrounding plume area;
- 60% reduction in MTBE levels across entire plume area;

Remedial goal for MTBE, TPH and BTEX was reached across the site within approx. three months of the ORC Advanced application.

Figure 1

IIW14 - TPH (C5-C35) concentrations over time

TPH concentrations over time.

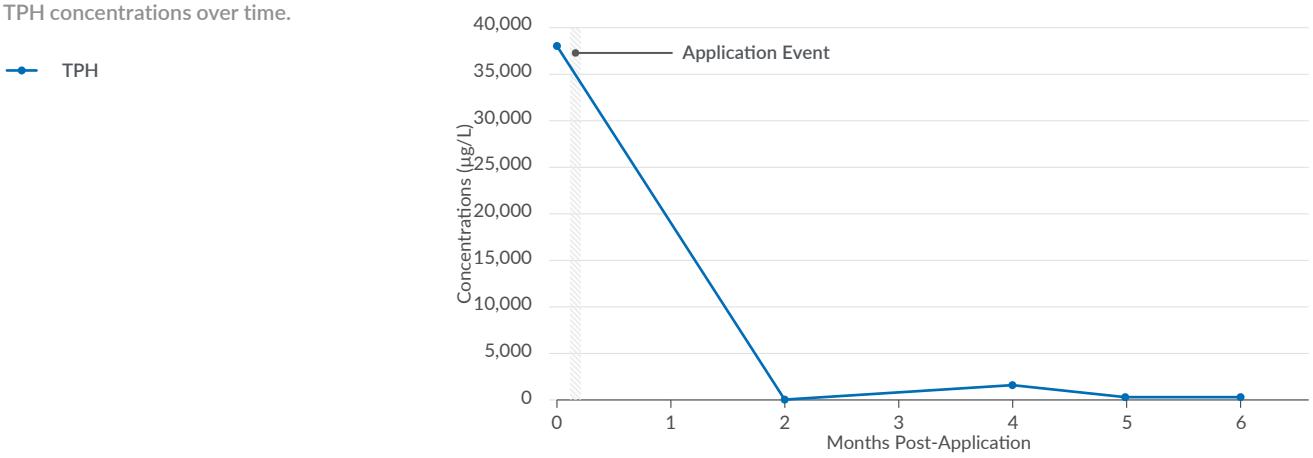


Figure 2

IIW14 - MTBE concentrations over time

MTBE concentrations over time.

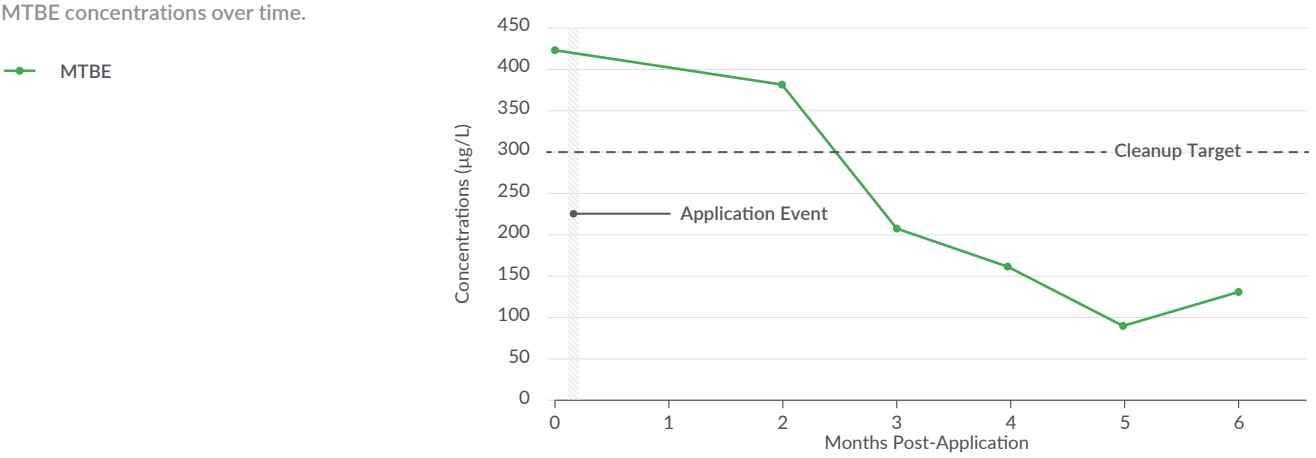
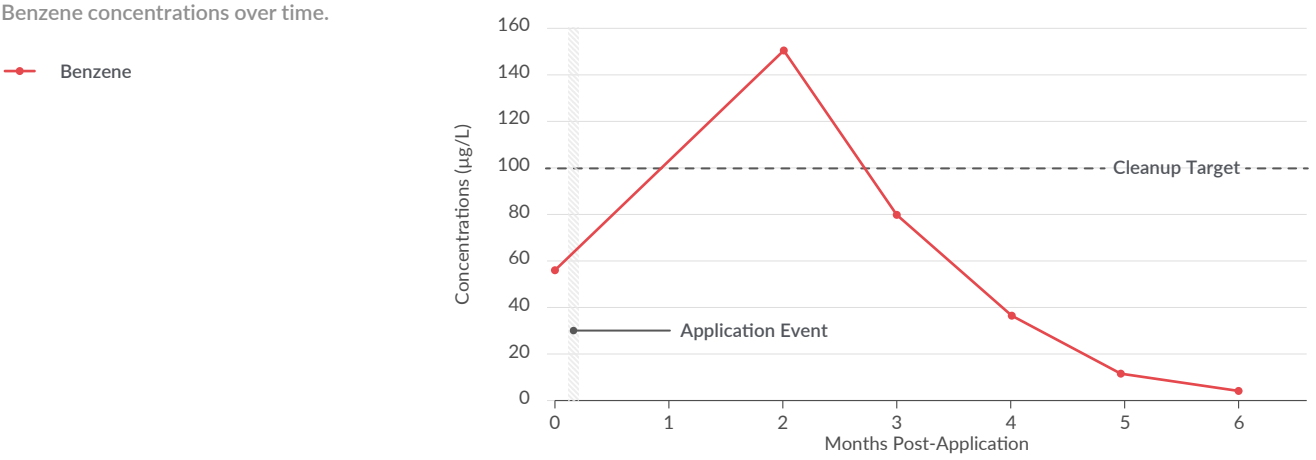


Figure 3

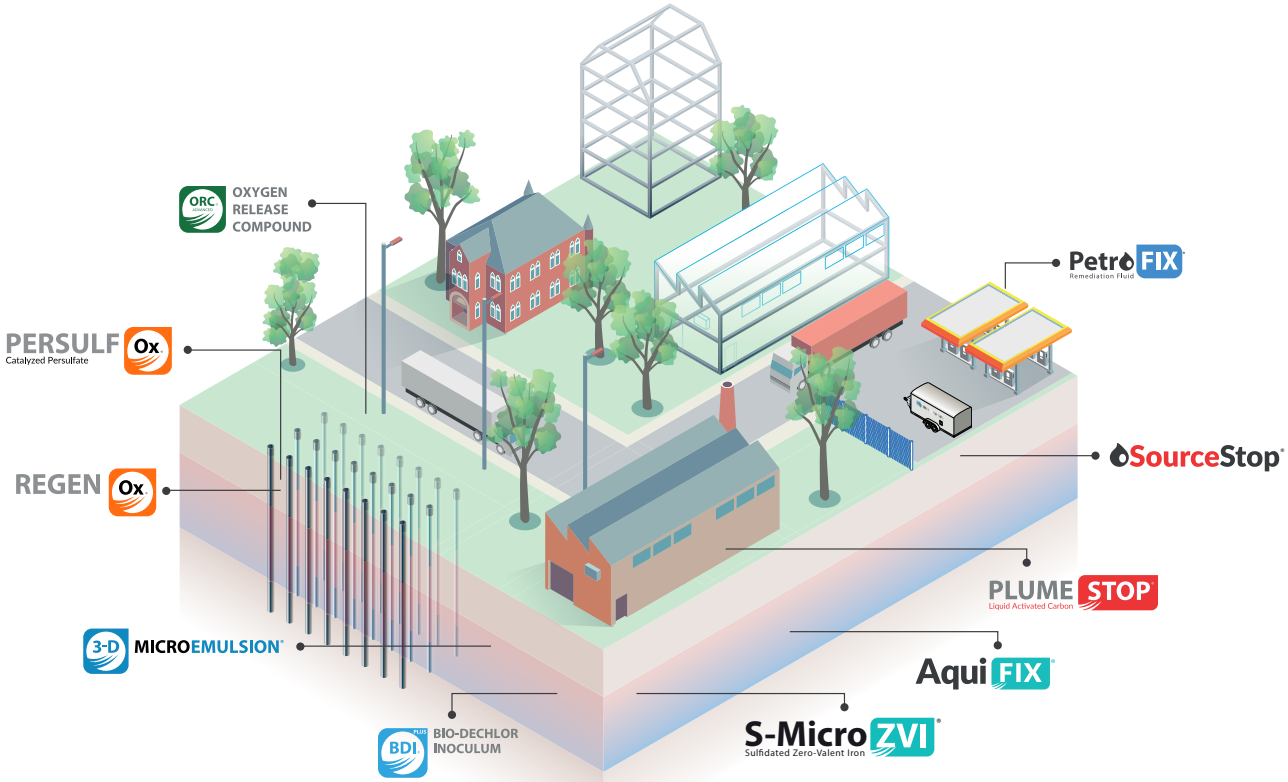
IIW14 - Benzene concentrations over time

Benzene concentrations over time.



Conclusion

The *in situ* application of ORC Advanced rapidly established aquifer conditions suitable for enhanced aerobic biodegradation of the contaminants of concern. Concentrations of TPH, MTBE and BTEX in the groundwater were reduced to below the remedial goals and site closure was achieved. The remediation works were completed economically and within programme, despite fractured bedrock conditions, which allowed the development of the site for road construction.



PlumeStop® Liquid Activated Carbon™ is composed of very fine (1-2 micron-size) activated particles suspended in water through a unique, organic polymeric dispersion chemistry that resists clumping and allows permeation through aquifer materials. PlumeStop sorbs to the aquifer matrix soon after injection, rapidly removing contaminants from the groundwater to eliminate risk. It can be co-applied with electron donors, electron acceptors, or used as a stand-alone amendment to treat most organic groundwater contaminants.

SourceStop® prevents leaching of PFAS from soils and halts further migration in groundwater to eliminate the risk to downgradient receptors. Available in Liquid and Solid formulations, SourceStop's colloidal activated carbon (CAC) technology provides unsurpassed distribution, penetrating and permanently coating impacted soils. Engineered for easy application, rapid results and long-term treatment, SourceStop is an adaptable and affordable solution for PFAS sites.

PetroFix® is a colloidal activated carbon technology used to remediate total petroleum hydrocarbons (TPHs) from contaminated environments. Petrofix uses a proprietary formula of activated carbon to adsorb total petroleum hydrocarbons. It then adds electron acceptors to stimulate hydrocarbon biodegradation.

RegenOx® is an *in situ* chemical oxidation (ISCO) reagent used to directly oxidize contaminants. Its unique catalytic component generates a range of highly oxidizing free radicals that rapidly and effectively destroy a range of target contaminants including both petroleum hydrocarbons and chlorinated compounds. RegenOx is an injectable, two-part ISCO reagent combining a solid sodium percarbonate based alkaline oxidant (Part A), with a liquid mixture of sodium silicates, silica gel and ferrous sulfate (Part B), resulting in a powerful contaminant destroying technology.

PersulfOx® is an advanced *in situ* chemical oxidation (ISCO) reagent that destroys organic contaminants found in groundwater and soil through abiotic chemical oxidation reactions. It is an all-in-one product with a built-in catalyst which activates the sodium persulfate component and generates contaminant-destroying free radicals without the costly and potentially hazardous addition of a separate activator.

ORC Advanced® is an engineered, oxygen-release compound developed for enhanced, *in situ* aerobic bioremediation of petroleum hydrocarbon contaminants in groundwater and saturated soils. Containing 17% by weight molecular oxygen, ORC Advanced provides a controlled release of molecular oxygen-an electron acceptor that optimizes microbial utilization in a treatment zone for up to 12 months post-application.

3-D Microemulsion® is an easy-to-apply remedial amendment for the *in situ* treatment of chlorinated solvent-contaminated aquifers. The patented technology, applied as a micellar suspension, provides a controlled, self-distributing hydrogen source to facilitate biologically mediated enhanced reductive dechlorination. 3-D Microemulsion's unique chemistry enables its distribution by naturally flowing groundwater while persisting for years after injection, resulting in much greater treatment coverage and faster degradation rates than other electron donor amendments.

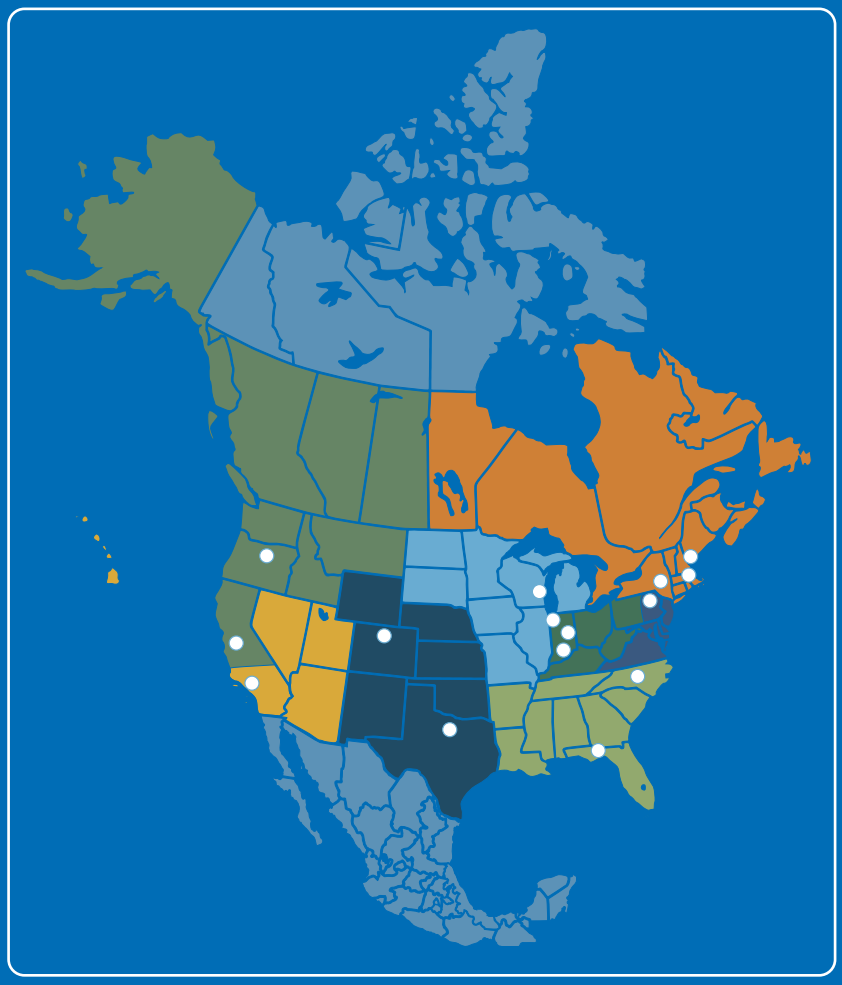
AquiFix™ is a solid, colloidal remediation amendment for the *in situ* treatment of chlorinated solvent-contaminated aquifers, designed for direct mixing and co-application with PlumeStop. The novel formulation, patent-pending, includes a nutrient-enriched, solid-phase, fatty acid source that quickly establishes and sustains enhanced reductive dechlorination over long timeframes (e.g., ten years post-injection). AquiFix's optimized hydrogen release profile significantly improves remediation efficacy and reduces life-cycle costs to treat these contaminants.

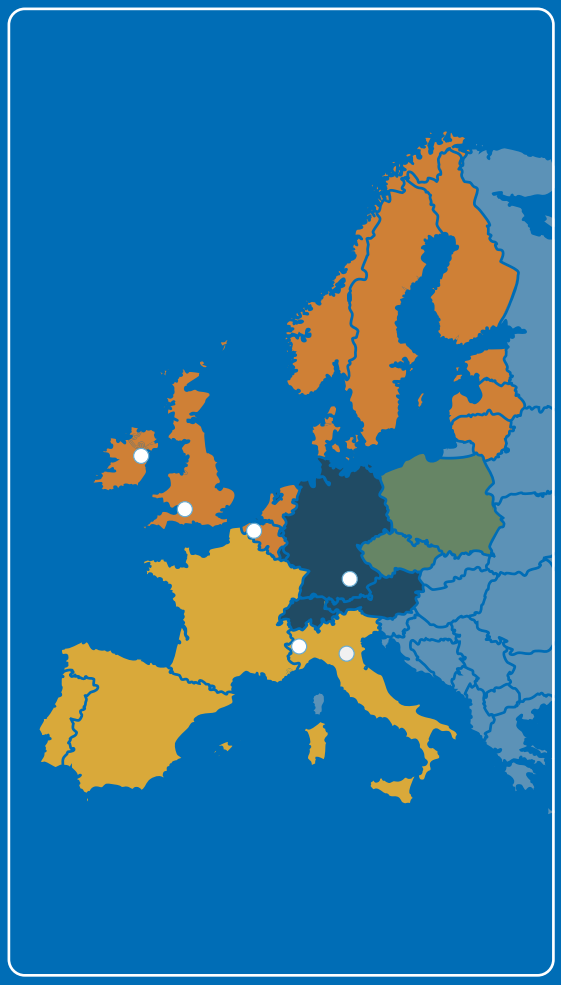
BDI PLUS® (Bio-Dechlor INOCULUM Plus) is an enriched natural consortium containing *Dehalococcoides sp.* and other dechlorinating microbes for biologically augmenting enhanced reductive dechlorination remedies. Co-applied with electron donor amendments such as 3-D Microemulsion and AquiFix, BDI PLUS has proven to improve chlorinated solvent remediation efficiency.

S-MicroZVI® is a colloidal suspension of sulfidated zero-valent iron that promotes the destruction of a wide range of organic pollutants including chlorinated solvents, pesticides, haloalkanes and energetics. S-MicroZVI is engineered to promote rapid contamination degradation through multiple pathways which leads to faster cleanup while minimizing daughter product formation. Compared to larger particle size ZVI products, S-MicroZVI's 2-3 micron-sized particles, suspended in a proprietary polymer, make it easy to handle and simple to inject, leading to significantly better reagent distribution.

REGENESIS®

We're ready to help you find the right solution for your site





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