

CHALLENGING LEAKING UNDERGROUND STORAGE TANK (LUST) SITE RAPIDLY REACHES CLOSURE

CASE STUDY:
ISCO/Biodegradation Approach
Achieves Rapid Closure for a 30-Year
Open LUST Case

ARIZONA 30-YEAR LUST SITE REACHES CLOSURE WITH OUTSIDE-IN APPROACH USING PERSULFOX.

ISCO and Biodegradation Amendment Strategy Employed to Successfully Treat Challenging Site



An active gasoline station in Springerville, Arizona was listed as a hazardous Leaking Underground Storage Tank (LUST) site by the state of Arizona Department of Environmental Quality (ADEQ). After 30 years as an open LUST case, REGENESIS® was contacted to perform ISCO and bioremediation. Thorough Design Verification Testing (DVT) confirmed the proper application of the remedial solution. Two separate injection events were conducted approximately one month apart. Both events included injections at 15 injection wells installed in a weathered bedrock formation over a range of depths. The first round of injections included a combination of PersulfOx® and ORC Advanced®, while the second round of injections contained only PersulfOx. After the 6,250 square foot area was treated, there were reductions of up to 90% for BTEX concentrations (2,000 µg/L to 20 µg/L Benzene). REGENESIS Remediation Services completed the project in a cost-effective manner and site closure has been approved by the Arizona Department of Environmental Quality (ADEQ).



HIGHLIGHTS

- ➔ The client, a global petroleum company, and its predecessors have spent more than three million dollars performing corrective actions at this site. REGENESIS Remediation Services' approach cost was estimated at \$260,000 (or \$27 per cubic yard) to effectively treat the plume and reach closure.
- ➔ Innovative "Outside-In" approach incorporated an injection design that started from the perimeter of the treatment area and progressed toward the center of the plume.
- ➔ First event application completed within seven days with a second event completed in nine days the following month without disruption to active site.
- ➔ Closely managed injection wells ensured proper distribution and avoid surfacing.
- ➔ Innovative design testing verified accurate and efficient treatment of the contaminant plume.
- ➔ REGENESIS worked with the fuel provider's safety protocol and underwent additional training to meet or exceed on-site inspections throughout the remedial application.

BACKGROUND

An active gasoline station in Springerville, Arizona was listed as a hazardous Leaking Underground Storage Tank (LUST) site by the ADEQ. After 30 years of partial remediation using a number of approaches, REGENESIS was contacted by the environmental consultant to perform two separate injection events approximately one month apart. Both events included injections at 15 injection wells installed in a weathered bedrock formation over a range of depths. The first round of injections included a combination of PersulfOx and ORC Advanced. The second round of injections contained only PersulfOx.

During both injections, PersulfOx and ORC Advanced were successfully applied within the treatment area and at the targeted treatment interval of 18 to 60 ft. bgs. Low to moderate injection pressures and application flow rates were observed at each of the injection well locations, indicating good distribution of the amendments. Increases in dissolved oxygen, conductivity, pH, and oxidation-reduction potential were observed, indicating good distribution and influence of the PersulfOx and ORC Advanced remediation chemistry.

SITE CHALLENGES:

This leaking underground storage tank (LUST) site presented a formidable challenge to remediation efforts. Over the past 30 years, several remediation attempts have included free product removal, soil vapor extraction, and underground storage tank removal. Although significant mass was reduced, BTEX concentrations remained at an unsafe level. Due to persistent, unsafe levels of BTEX contamination, REGENESIS was approached by the client to help develop an effective approach to achieve site goals. In addition, the location of the site posed its own unique challenges. This site was located in an urban area and was surrounded by residential and commercial properties. The close proximity to busy streets and active businesses created added difficulties to the remediation of this site. However, REGENESIS was able to create a plan for remediation that did not involve any nearby business closure or disruption to the surrounding area.

No Disruption to Active Businesses



Active gas station and nearby restaurant, senior living, and daycare businesses were not impacted by remedial activities

Innovative Approach Led to Closure

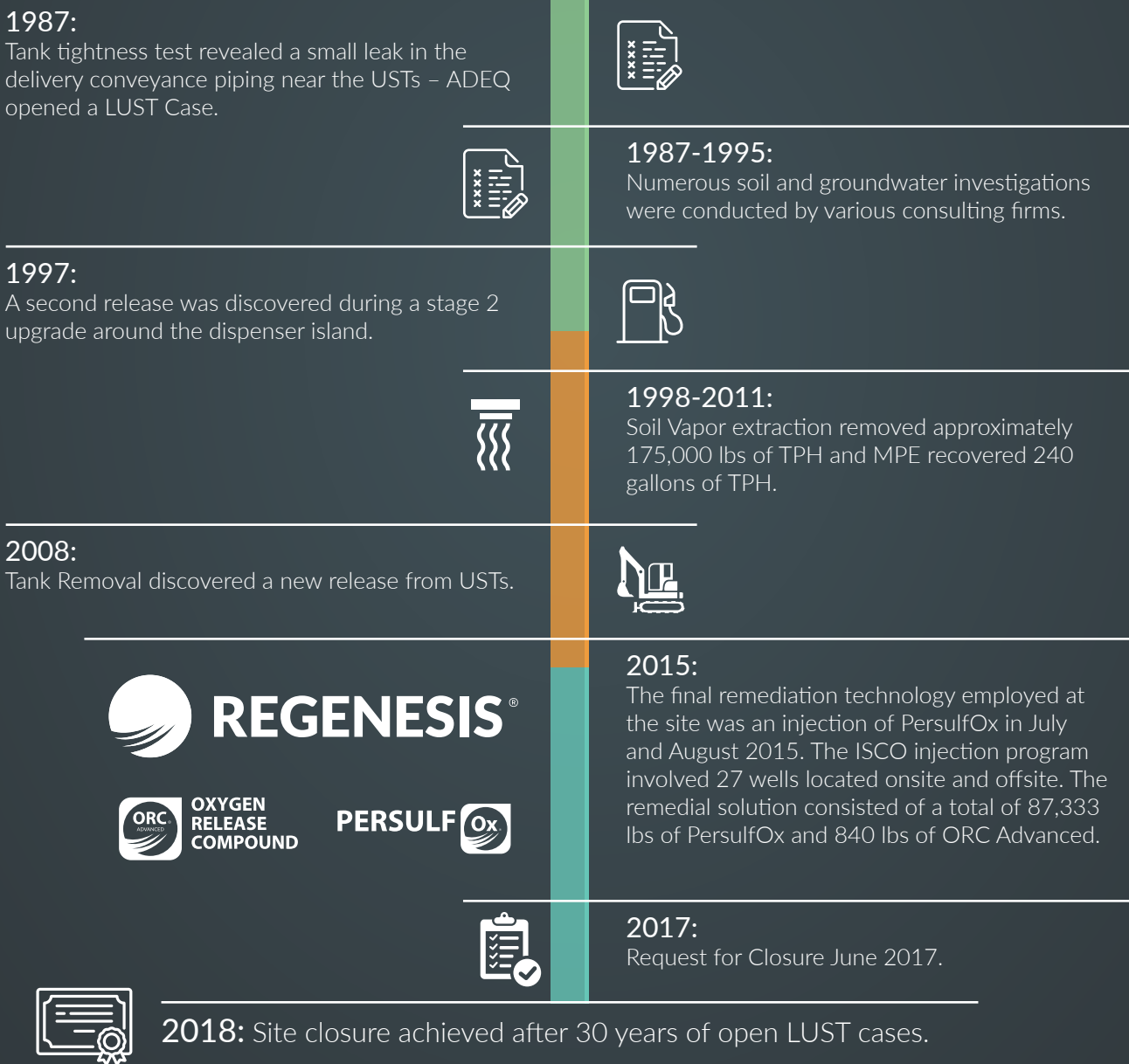


After a range of remedial approaches over 30 years proved unable to achieve closure, the final combined remedy from REGENESIS using ISCO and biodegradation brought the site to closure

PROPERTY USAGE TIMELINE



PROJECT TIMELINE



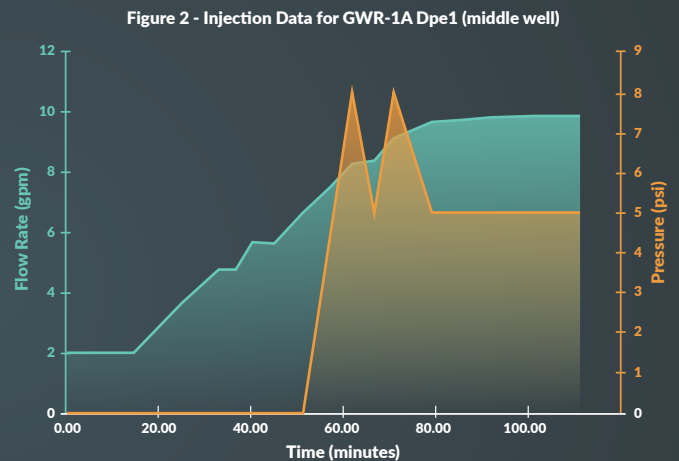
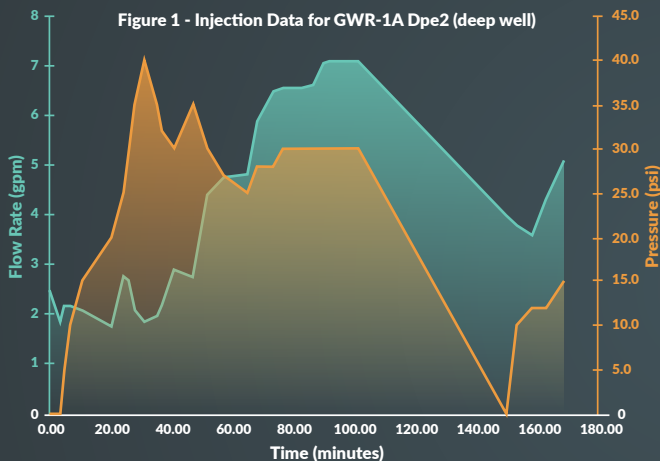
DESIGN VERIFICATION TESTING:

Prior to implementation of the full-scale injection approach, a pre-field remediation test was used to ensure the proper application of the remedial solution. The pre-field testing consisted of a clear water injection test that served three important goals.

- ➔ The test gathered data concerning the hydraulic response and feasibility of injecting the proposed PersulfOx volume.
- ➔ It determined the potential flow rates into the target treatment zone lithology.
- ➔ The test was used to discern the viability of the existing onsite nested monitoring wells and whether these wells were screened within a hydraulically separate or a continuous unit.

RESULTS OF CLEAR WATER INJECTION TEST:

Low to moderate flow rates and low pressures were applied on test well GWR-1A (Dpe2) (deep well) without daylighting of the water injected. Approximately 80 minutes into the clear water test the flow rate appeared to stabilize near 7.0 gpm at a pressure of 30 psi (Figure 1). Low to high flow rates and very low pressures were applied on test well GWR-1A (Dpe1) (middle well) without daylighting of the water injected. Approximately 80 minutes into the clear water test the flowrate stabilized at approximately 10 gpm at a pressure of 5 psi (Figure 2).





CONCLUSION OF THE CLEAR WATER TEST:

The results proved that the geology present at the site was conducive to the injection of the proposed volume of PersulfOx. The results also allowed for the existing 14 nested monitoring wells to be used as injection wells. The nested wells appeared to be screened within the same continuous, geologic unit.



TREATMENT

The 6,250 square foot area was treated with two applications. For each *in situ* injection, approximately 43,667 lbs. (23,127 gallons) of PersulfOx was applied as a 20% solution using the 27 vertical injection wells already on site. Approximately 840 lbs. of ORC Advanced was co-applied with the PersulfOx during the first injection event. The second injection event consisted only of PersulfOx. Fifteen of the wells are screened in the upper aquifer zone (up to 25' thick) with a total depth of 45 feet bgs. Twelve are screened in the lower aquifer zone (up to 10' thick) and vary from 38 to 60 feet bgs.

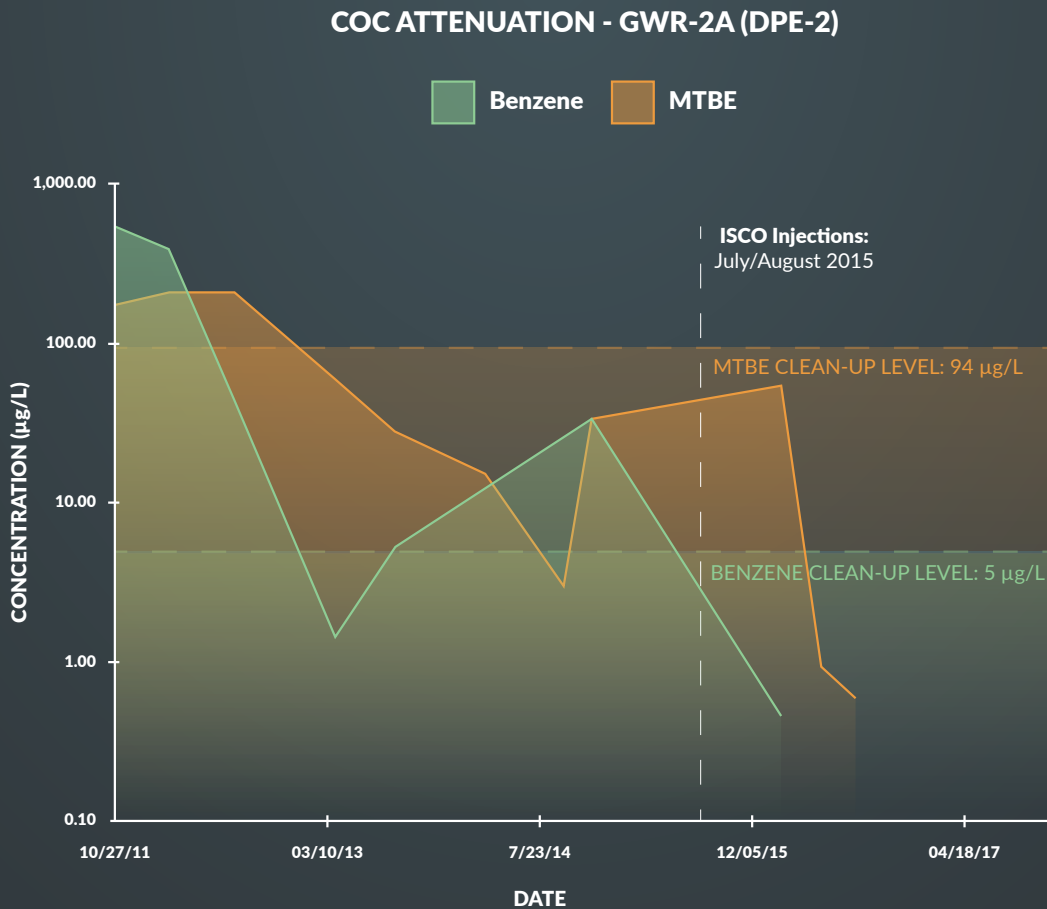
Application Information:	PERSULF 	 OXYGEN RELEASE COMPOUND
First Injection:	43,667 lbs	840 lbs
Second Injection:	43,667 lbs	-

RESULTS

During both injections, PersulfOx and ORC Advanced were successfully applied within the treatment area and at the targeted treatment interval of 18 to 60 ft. bgs. Low to moderate injection pressures and application flow rates were observed at each of the injection well locations, indicating good distribution of the amendments. Increases in dissolved oxygen, conductivity, pH, and oxidation-reduction potential were observed, indicating good distribution and influence of the PersulfOx and ORC Advanced remediation chemistry.

After the 6,250 sf area was treated, there were reductions up to 90% for BTEX concentrations (2,000 µg/L to 20 µg/L Benzene). Closure has been granted by ADEQ. Total project time from injection to closure is estimated to be 2.5 years. The client, a global petroleum company, and its predecessors have spent more than three million dollars performing corrective actions at this site.

REGENESIS Remediation Services' approach cost was estimated at \$260,000 (or \$27 per cubic yard) to treat the plume.



TECHNOLOGY



The Original Oxygen Release Compound (ORC®) is an engineered, oxygen release compound designed specifically for enhanced, *in situ* aerobic bioremediation of petroleum hydrocarbons in groundwater or saturated soils. Upon contact with groundwater, this phosphate-intercalated magnesium based material becomes hydrated producing a controlled-release of molecular oxygen (10% by weight) for periods of up to 12 months on a single application. Many remediation professionals choose to use ORC Advanced due to its higher % by weight oxygen content (17% ORC Advanced vs. 10% ORC).

Key Benefits:

- Decreased time to site closure, degradation rates accelerated up to 100 times faster than natural attenuation.
- A single ORC application can support aerobic biodegradation for up to 12 months
- Minimal site disturbance, no permanent or emplaced aboveground equipment, piping, tanks, power sources
- No operations and maintenance – lower costs and greater efficiency/reliability than engineered mechanical systems, oxygen emitters
- Simple and easy application using a variety of available methods

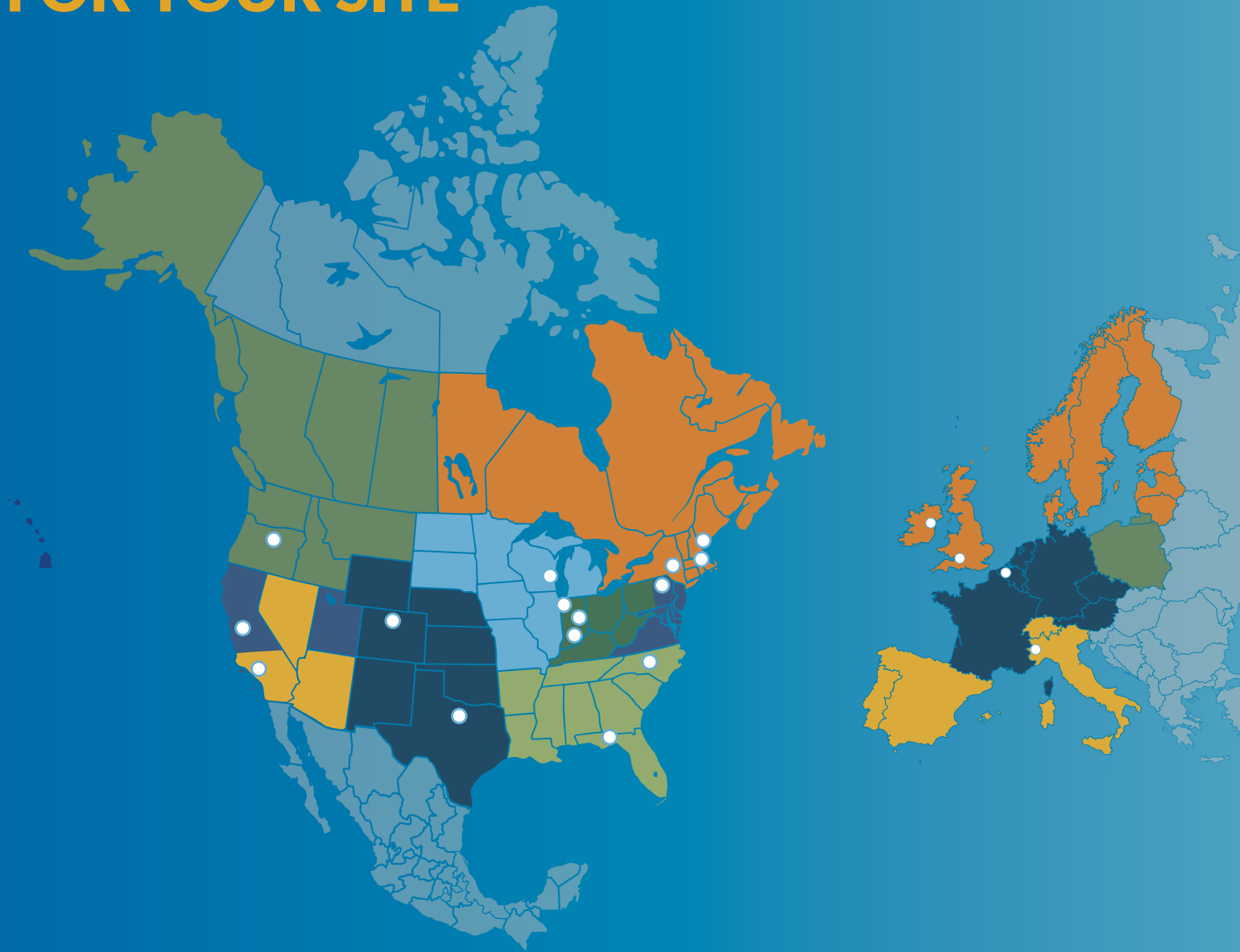


PersulfOx is an advanced *in situ* chemical oxidation (ISCO) reagent that destroys organic contaminants found in groundwater and soil through abiotic chemical oxidation reactions. It is an all-in-one product with a built-in catalyst which activates the sodium persulfate component and generates contaminant-destroying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

Key Benefits:

- Promotes rapid and sustained *in situ* oxidation of a wide-range of organic contaminants
- Contains a built-in catalyst that remains active through the entire lifespan of the persulfate oxidation reaction
- The catalyst also eliminates the need for the co-application of alternate and potentially hazardous activation chemistries
- Contaminant oxidation performance equivalent to best alternative persulfate activation methods
- Fewer health and safety concerns than with use of traditional activation methods such as heat, chelated metals, hydrogen peroxide or base
- Single component product results in simplified logistics and application
- No additional containers or multi-step mixing ratios required prior to application
- Compatible with combined remedy approaches including enhanced biodegradation

WE'RE READY TO HELP YOU FIND THE RIGHT SOLUTION FOR YOUR SITE



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