NON-DETECT ACHIEVED AT FLORIDA SPILL SITE

CASE STUDY:
PetroFix Applied at Site to Reach Target Goals Within 60 Days

REGENESIS®

HIGHLIGHTS

IN SITU APPROACHES NOT AFFECTED BY SEVERE WEATHER
As a passive system, PetroFix was not affected by power outages or storm damage from Category 5 Hurricane Michael

MET TARGETS WITHIN 60 DAYS
Unlike other approaches applied onsite, PetroFix met targets within 60 days and has remained below this target level for a year

EFFECTIVELY DEGRADES CONTAMINANTS
PetroFix was able to degrade the petroleum contaminants within a fast-moving, 150-yard plume

FULL-SCALE APPLICATION PLANNED
Due to the successful pilot test results, AET LLC has applied for a full-scale application through the FDEP

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OVERVIEW

A multi-use convenience store site located in Panama City Beach, Florida was impacted by contamination from a leaking underground storage tank (UST). A 2007 report determined that 1,000 gallons of fuel were discharged from this tank and subsequently contaminated the soil and water table. From 2012 to 2015 two firms conducted various remedial actions at the site prior to Advanced Environmental Technologies, LLC (AET) taking over the remedial project. Prior actions included the removal of the three USTs, a bioremediation system and soil excavation. In 2016, AET took over remediation efforts onsite under a pay-for-performance agreement and prepared a remedial action plan (RAP) modification. The first treatment approach involved injecting hydrogen peroxide and nutrients into existing wells using direct push injections. While the approach was initially successful reducing contaminant levels during the first 30 days, it did not sustain contaminant reduction. As of October 2017, the groundwater concentrations remained above cleanup levels.

Interested in applying a more effective solution, AET sought out a technology that was affordable and would be guaranteed to lower the contaminant levels below the target levels. AET partnered with REGENESIS to conduct a pilot test using its new PetroFix activated carbon amendment. PetroFix is successful in high concentration source areas because it provides a permanent, *in situ* sorptive and biologically permeable reactive barrier (PRB). AET chose this technology because it offered a cost-effective solution that would quickly address the groundwater concentrations.

Just 60 days after the PetroFix pilot test injection, the contaminant concentrations were below detection and have remained so after one year post-injection. AET is pleased with these results and has applied for a full-scale application through the Florida DEP.

60 days after PetroFix was applied, contaminant concentrations dropped to below detection and have remained so after 1 year

BACKGROUND

This site formerly dispensed gasoline and had three 6,000 gallon USTs in use at the facility. During an annual storage tank site inspection in 2007, the report noted that the middle tank (UST-2) failed a tightness test and exhibited product loss. A further report determined that 1,000 gallons of fuel was discharged from this tank which was then taken out of service. Further assessments determined that free product was present in the water table.

Following this conclusion, soils were excavated during tank removal and a bioremediation system was installed and operated from 2012 to 2015. During the 1st quarter of 2015, this system was removed and groundwater monitoring began in preparation for a remedial action plan (RAP) modification. The RAP modification called for an injection of hydrogen peroxide and nutrients into existing wells using direct push drilling technology injections which took place from February 29, 2016 through March 4, 2016. Post Application Remedial Monitoring (PARM) sampling has been conducted quarterly since then. As of quarter 6 in October 2017, the groundwater concentrations remained above cleanup target levels. MW-8 was particularly concerning because it is offsite and downgradient with some of the highest contaminant levels. Following this remediation attempt, AET partnered with REGENESIS to treat the ongoing contamination.

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PROJECT TIMELINE

January 15, 2007

Annual storage tank facility site inspection report indentified UST 2 as leaking UST

March 19, 2007

Assessment activities conducted including soil sampling

June 5-8, 2007

The 3 USTs were removed and soil excavations took place. It was concluded that free product was present at the water table

July 2012-April 2015

A bioremediation system operated

February 29-March 4, 2016

Hydrogen peroxide and nutrients were injected using direct push drilling technology injections

October 12, 2017

PARM sampling indicates groundwater concentration remains above cleanup target levels

February, 2018

Baseline sampling was conducted in preparation for PetroFix injection

March 26-29, 2018

1,700 lbs PetroFix and electron acceptors were injected in 13 DPT points around MW-8

April 4, 2019

Concentrations remain below cleanup target levels

PetroFIX™ Remediation Fluid

TREATMENT

The PetroFix pilot test injection was applied at MW-8 which had the highest contamination. This well is located in a vacant lot across the road from the convenience store. Prior to the injection, baseline sampling was conducted at MW-8 and downgradient well MW-16 for BTEX, PAHs, and TRPH. Because this was a pilot test using a new innovative technology, samples were measured for additional parameters such as microbial counts, alkalinity, total organic carbon, and chemical oxygen demand.

Over three days, 1,700 pounds of PetroFix and electron acceptor salts were injected into 13 points around MW-8. The injections were completed using direct push technology and started at 20 feet below ground surface (bgs) and stopped at 10 feet bgs. The direct push rod was driven to the terminus depth of 20 feet and a pump was used to inject the chemical through the drill rod as the rod was removed from the ground. The injections were most commonly completed at pressures of approximately 50 PSI and almost entirely under 100 PSI due to fine, compacted sands, and had even distribution as verified through soil cores (see upper right image). After the injection, the boreholes were filled with cement grout to land surface. Active groundwater monitoring was conducted quarterly following the pilot test.

PetroFIX™ Remediation Fluid

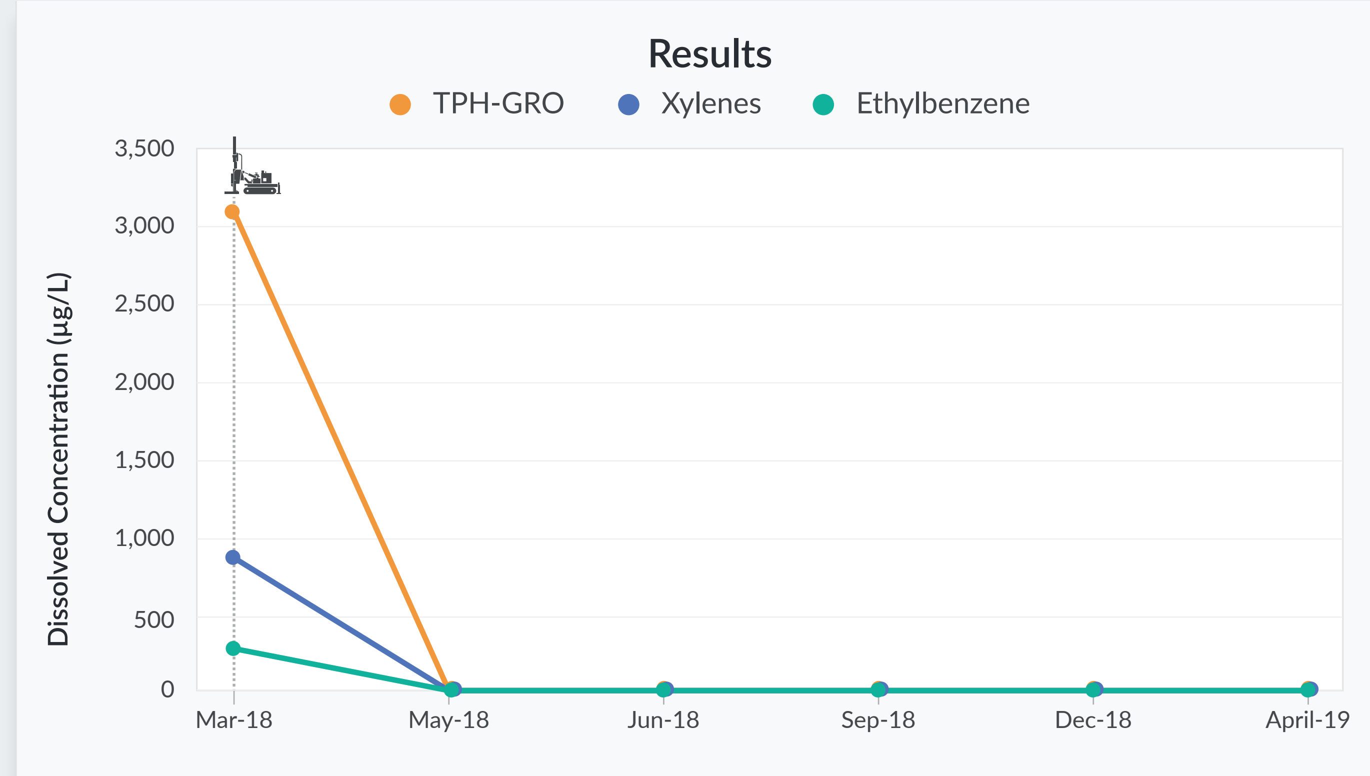
TECHNOLOGY

PetroFix Remediation Fluid is a concentrated, water-based, activated carbon suspension specifically designed to remediate petroleum spills and provide immediate results for gas station and UST sites. Safe, fast, effective, and easy-to-apply, PetroFix is designed to first remove hydrocarbons from the dissolved phase by adsorbing them onto activated carbon particles and then stimulating hydrocarbon biodegradation by adding electron acceptors. PetroFix offers an *in situ* remediation approach designed specifically for sites where PHC levels are above regulatory standards for complete remediation at the lowest total cost-to-closure. This safe and effective technology is paired with the PetroFix Design Assistant, an online design tool that enables users to individually tailor their site designs and self-apply PetroFix.

PetroFIX™ Remediation Fluid

Key Benefits:

- Affordable and reliable
- Applied under low pressure
- Tailored site design
- Simple online design assistant



All groundwater results post-injection are non detect.

RESULTS

In just 60 days after the injection, the petroleum contaminants were below detection. After one year, no exceedances of petroleum groundwater and surface water cleanup target levels (GCTLs) were observed in MW-8. Of further interest was documenting that hydrocarbon-degrading bacteria were thriving at the site which is evidence that hydrocarbons were being biodegraded from the PetroFix. QuantArray Petro analysis from Microbial Insights verified that microbes associated with petroleum hydrocarbon degradation maintained robust populations following application, including total bacteria, sulfate degraders and PM-1 which degrades for MTBE and other hydrocarbons. AET is impressed by the remarkable results in such a short period of time and in September, 2018 the firm applied for an Innovative Technologies Acceptance Letter.

> ***"The results were amazing. Total petroleum contaminant concentrations hit cleanup target levels in 60 days and have remained below target levels for over a year. This is the most exciting remediation technology that I have seen in my 36 years of practice."***

– Gordon Dean
Vice President, AET, LLC

ABOUT THE CONSULTANT

As the Vice President of the largest petroleum assessment and remediation company in Florida, Mr. Dean provides senior engineering support for remedial actions and consulting services for clients purchasing environmentally distressed properties nationwide. Mr. Dean is a Professional Engineer (PE) in multiple states with more than 36 years of experience in the assessment and remediation of hazardous waste and petroleum contaminated sites. Mr. Dean has been the seller/doer responsible for procurement and management of more than $750 million in total contracts. Mr. Dean holds a B.S. in Chemical Engineering from the University of Florida and has spoken at numerous environmental conferences on effective approaches in petroleum assessment and remediation approaches.

Gordon Dean
Vice President
Advanced Environmental Technologies, LLC

ABOUT AET

Advanced Environmental Technologies, LLC (AET) is a nationally recognized provider of comprehensive environmental solutions. Experts at environmental science and engineering AET offers the ability to translate proven experience into on-site construction and field logistics.

Established in 1998, AET offers a complete range of environmental services from initial site reconnaissance through site remediation and closure. In today's business climate of increasingly complex environmental issues, regulations, and requirements, as well as increasing public and private sector awareness of environmental issues, AET provides a unique alternative in meeting the diverse environmental service needs of our clients.

AET staff provides practical, hands-on experience treating the full range of environmental contaminants in multiple media. This includes solving problems involving hydrocarbons, solvents, pesticides, toxic metals, and other chemicals that may be present in soils, sediments, sludge, groundwater, surface water, and air. AET's streamlined structure supports a proactive project management style to control schedules and costs and provides efficient and equitable service to our clients.

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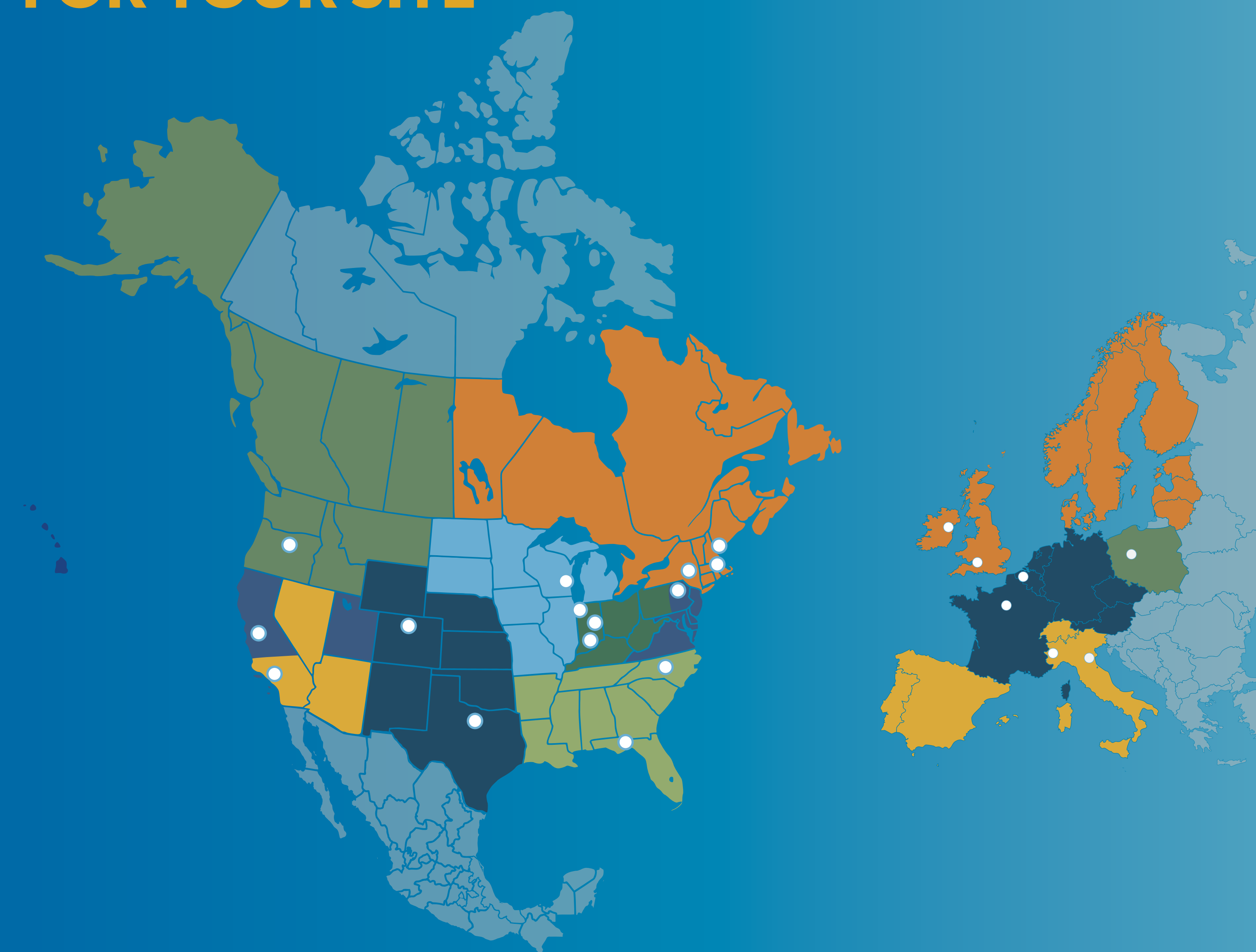
WE'RE READY TO HELP YOU
FIND THE RIGHT SOLUTION FOR YOUR SITE



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