INNOVATIVE APPROACH REDUCES BENZENE TO ACHIEVE CLOSURE

CASE STUDY:
PersulfOx, PlumeStop, and ORC Advanced Applied to Quickly Reduce Benzene Levels to Non-Detect

REGENESIS®

REGENESIS®

Overview

Combined Remedy Approach Treats Petroleum Hydrocarbons At Gas Station To Achieve Site Closure

PERSULF Ox

Exceptional benzene reduction using PersfulOx quickly reduced contaminant levels within a short timeframe

Design Verification Testing (DVT) fine-tuned the application to increase effectiveness

anteagroup

Design-verified injections ensured successful contact with the *in situ* chemical oxidant, PersulfOx

PLUME STOP
Liquid Activated Carbon

Addition of PlumeStop application ensured against back diffusion to help reach site closure

A gas station in Greenville, Alabama had petroleum hydrocarbon contamination in the subsurface for decades. This site is part of an environmental liability transfer and Antea Group®, an international engineering and environmental consulting firm, assumed the liability for this site. Antea Group required an effective remedial solution that would result in rapid site closure. Antea Group partnered with REGENESIS® to create a remedial design using an *in situ* chemical oxidation (ISCO) treatment paired with an aerobic bioremediation technology to ensure a complete treatment of this site.

High benzene concentration remaining in one monitoring well (MW21) was the contaminant of concern. To achieve mass reduction, an initial injection of the *in situ* chemical oxidation reagent PersulfOx® was followed 60 days later by an injection of PlumeStop® Liquid Activated Carbon and ORC Advanced®. PlumeStop was utilized to sorb petroleum hydrocarbons and prevent rebound; ORC Advanced allowed for more rapid biological degradation of petroleum hydrocarbons. The first injection of PersulfOx achieved non-detect concentrations, and the subsequent injections of PlumeStop prevented any matrix back diffusion. Two quarters of post-injection sampling show that the benzene remains below detection levels. After the success of this remedial treatment, Antea Group's submission for site closure was approved. They submitted a well-abandonment work plan and are now in the final process of producing the closure well plan to complete the work at this site.

Background

Active Gas Station Requires Rapid Remediation and Closure

Historically, this site has operated as a gas station and will remain so under new ownership. Due to the site's gasoline dispensing operations, petroleum hydrocarbon contamination was present in the subsurface. Antea Group assumed liability of this site and required a remedial solution that would treat the contamination successfully in a short time frame. A quick site closure was key because of the cost-savings it would provide.

Timeline

Combined Remedy Leads to a Cost-Effective Closure at Active Gas Station

June 2018

PersulfOx Injection

PERSULF Ox

August 2018

PlumeStop and
ORC Advanced Injection

PLUME STOP Liquid Activated Carbon

ORC ADVANCED OXYGEN RELEASE COMPOUND

December 2018

First Sampling Event

February 2019

Second Sampling Event

March 2019

Site Closure Achieved

Treatment

A Combined Remedy Approach Leads to Rapid Closure

Prior to the full-scale application, REGENESIS conducted Design Verification Testing (DVT) at the site to evaluate the injection plan and to tailor it to provide optimal results. DVT is a pre-application, data collection process employed by REGENESIS to verify design assumptions of a site's chemical and geological conditions and allows for calibration of a design prior to finalizing the full-scale remedial strategy. At the Greenville site, the DVT consisted of a clear water injection test to calibrate the target treatment zone's capacity to accept the designed injection volumes. This data also allowed for refinement of the injection spacing and anticipated radius of influence. The testing evaluated the design plan for effective pore volume, the radius of influence, and injection spacing. Following the DVT, the remediation plan included an enhanced sorption technology amended with an aerobic bioremediation technology. These technologies were utilized to sorb petroleum hydrocarbons and prevent rebound while allowing for rapid biological degradation of the petroleum hydrocarbons.

Soil settling tubes that were collected as part of the DVT at discrete vertical intervals to evaluate the distribution of fine versus coarse particles as it relates to the identification of mass storage versus transport zones in the target treatment area. This step allows for more efficient application and distribution of reagents to achieve maximum reagent-contaminant contact.

The application was completed without disruption to the business at the busy gas station site prior to a holiday weekend.

Treatment Process

2,985 Gallons of PersulfOx

3,082 Gallons of PlumeStop

319 Gallons of ORC-Advanced

2,985 gallons of PersulfOx were prepared on-site and injected at 14-25 feet below ground surface (ft bgs) using direct push technology into 13 injection points. 3,082 gallons of PlumeStop and 319 gallons of ORC-A were injected at 15-21 ft bgs using direct push drilling with retractable injection screens into 12 injection points.

PERSULF Ox

Injected at 13 points, 14-25 ft bgs

PLUME STOP Liquid Activated Carbon

ORC OXYGEN RELEASE COMPOUND

Injected at 12 points, 15-21 ft bgs

Technology Used In Order of Application Events

PersulfOx, ORC Advanced & PlumeStop

PersulfOx® is an *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.

ORC Advanced® is an engineered, oxygen release compound designed specifically for enhanced, *in situ* aerobic bioremediation of petroleum hydrocarbons in groundwater and saturated soils. Upon contact with groundwater, this calcium oxy-hydroxide based material becomes hydrated producing a controlled-release of molecular oxygen (17% by weight) for periods of up to 12 months on a single application. Oxygen is required by microorganisms to transform organic contaminants (such as petroleum hydrocarbons) into carbon dioxide, water and microbial cell mass. More importantly, the new and readily available oxygen produced by ORC Advanced accelerates aerobic biodegradation processes up to 100 times faster than natural degradation rates. ORC Advanced provides remediation practitioners with a significantly faster and effective means of treating petroleum contaminated sites.

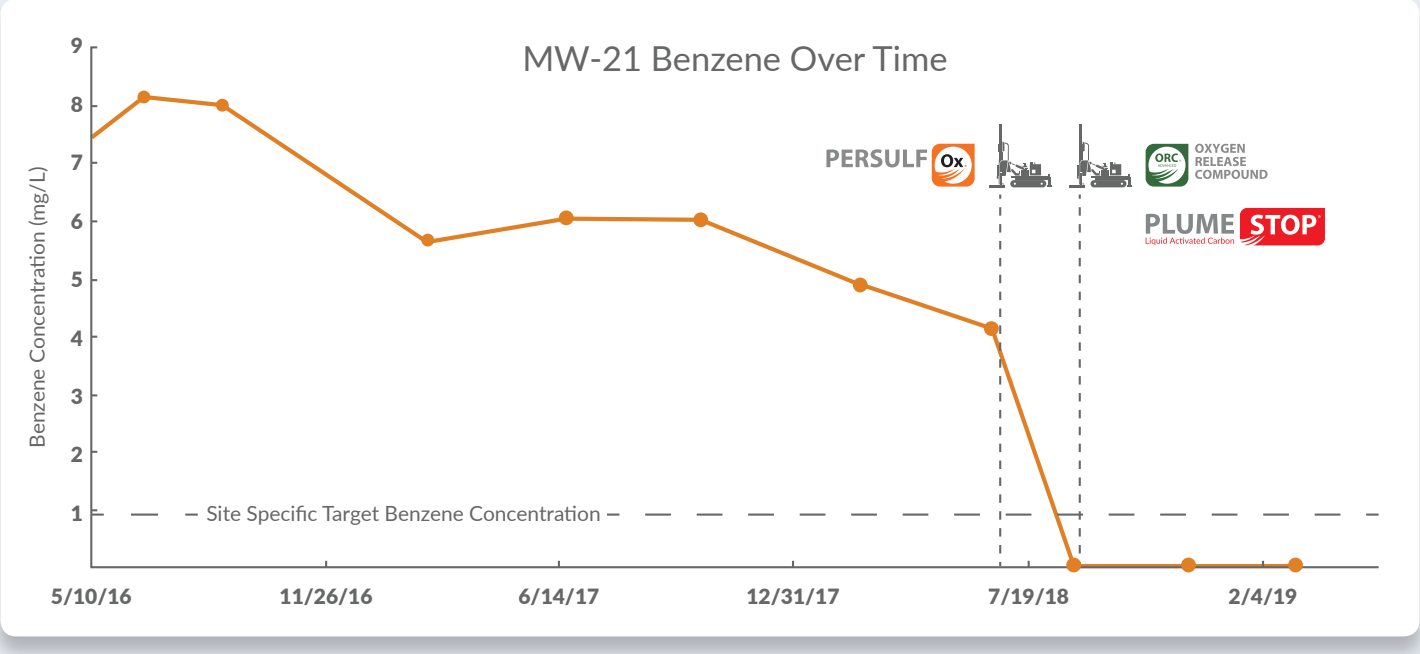
PlumeStop® Liquid Activated Carbon™ is an innovative groundwater remediation technology designed to address the challenges of excessive time and end-point uncertainty in the *in situ* remediation of groundwater contaminants. PlumeStop is composed of very fine particles of activated carbon (1-2µm) suspended in water through the use of unique organic polymer dispersion chemistry. Once in the subsurface, the material behaves as a colloidal biomatrix binding to the aquifer matrix, rapidly removing contaminants from groundwater, and allowing for permanent contaminant biodegradation.

Results

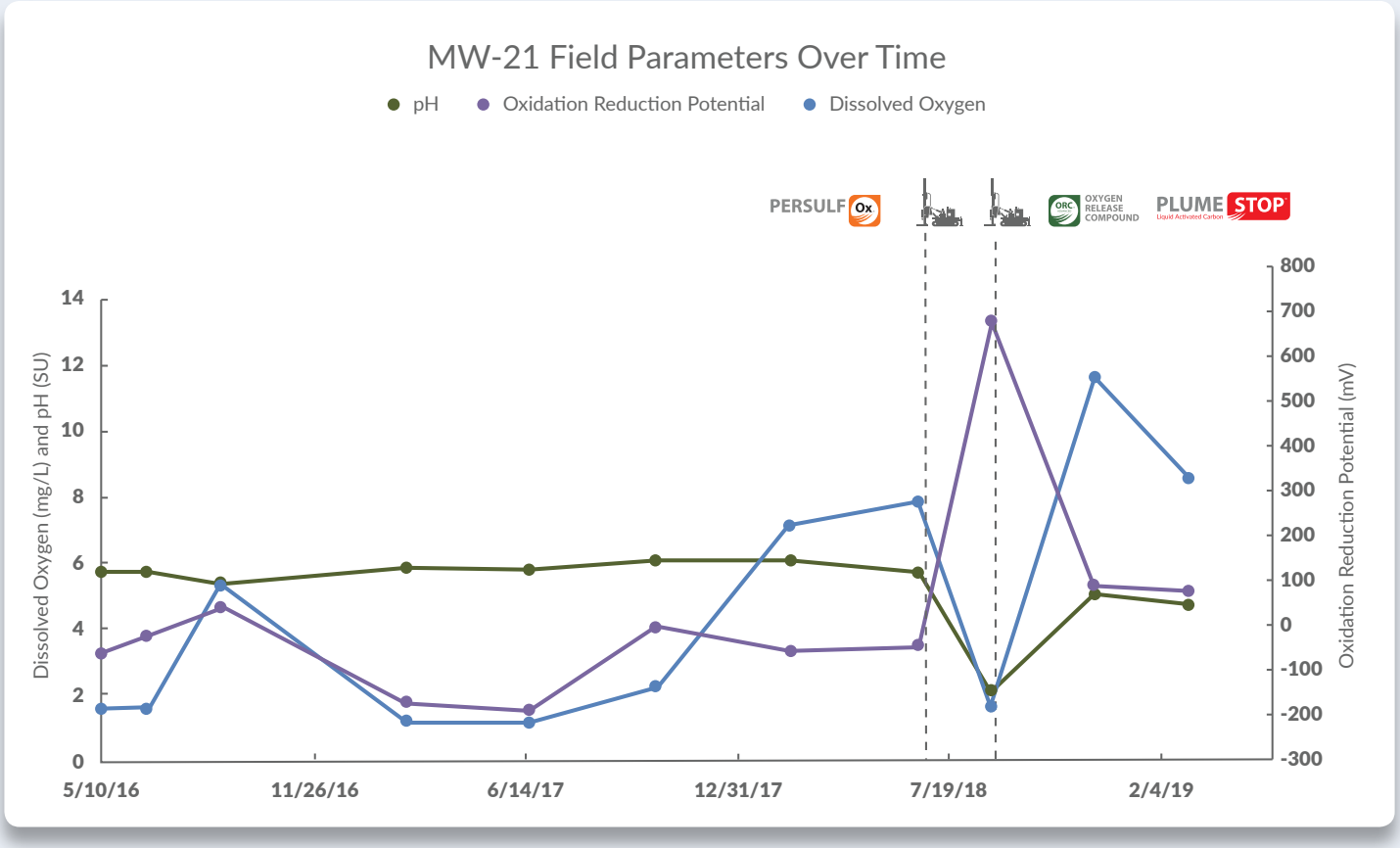
Site Closure Achieved Following Two Quarters of Sampling

Quickly following the combined application of PersulfOx, PlumeStop, and ORC Advanced, the benzene levels dropped to non-detect and have remained below detection levels after two quarters of sampling. These exceptional results have removed the liability of the contamination at this site and Antea Group was granted site closure.

Monitoring Results



Graphs chart benzene contaminant levels, pH, Oxidation Reduction Potential and Dissolved Oxygen levels present in MW-21 pre- and post-application. The site was granted closure following two quarters of post-application monitoring.



The Consultant

About Antea Group

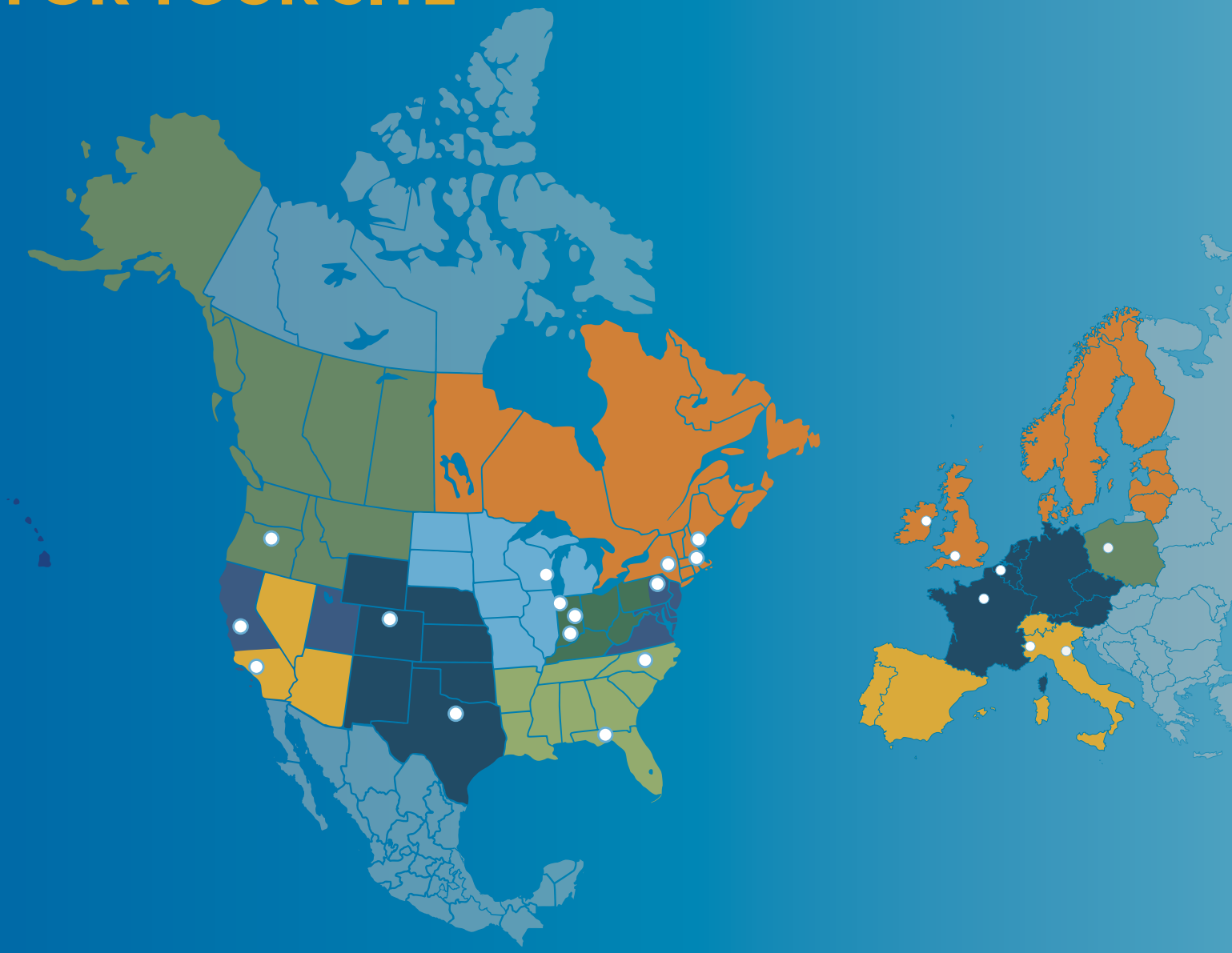
Antea Group is an international engineering and environmental consulting firm. With access to more than 3,300 employees on 6 continents, they serve clients ranging from global energy companies and manufacturers to national governments and local municipalities. Antea Group includes the Belgian, Dutch, French and United States engineering and consultancy operations of Oranjewoud N.V.

5910 Rice Creek Parkway
St. Paul, MN 55126 USA
Tel: +1 651 639 9449

REGENESIS®

WE'RE READY TO HELP YOU

FIND THE RIGHT SOLUTION FOR YOUR SITE



Global Headquarters

1011 Calle Sombra
San Clemente, CA 92673 USA
Ph: (949) 366-8000
Fax: (949) 366-8090

Europe

Bath, United Kingdom
Ph: +44 (0) 1225 731 447

Dublin, Ireland
Ph: +353 (0) 1 9059 663

Torino, Italia
Ph: +39 (0) 11 19781549

Ieper, België
Ph: +32 (0) 57 35 97 28

www.REGENESIS.com

©2019 All rights reserved. REGENESIS, PersulfOx, PlumeStop and ORC Advanced are registered trademarks of REGENESIS Bioremediation Products. All other trademarks are the property of their respective owners.

REGENESIS®