



Advancing the Science of
In Situ Groundwater Remediation

Petroleum Hydrocarbon Remediation Technologies



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Surfactant-Enhanced Aquifer Remediation (SEAR)

Powered by TASK™ (Tersus Advanced Surface Kinetics)

TASK™ is a specialized formulation engineered to mobilize non-aqueous phase liquids (NAPLs) and enhance their recovery from subsurface environments. Tersus develops site-specific chemistries based on in-depth knowledge of microemulsion science and capillary behavior.

How It Works

Traditional SEAR systems often rely heavily on solubilization, requiring large amounts of surfactant. TASK™ takes a more effective route:

- **Interfacial Tension Reduction:** Our surfactants reduce the energy at the oil–water boundary, allowing trapped NAPL to flow freely and be recovered.
- **Middle-Phase Microemulsion Formation:** TASK™ formulations promote the creation of a special blend of oil and water that maximizes NAPL mobilization.

Why TASK™ Is Different

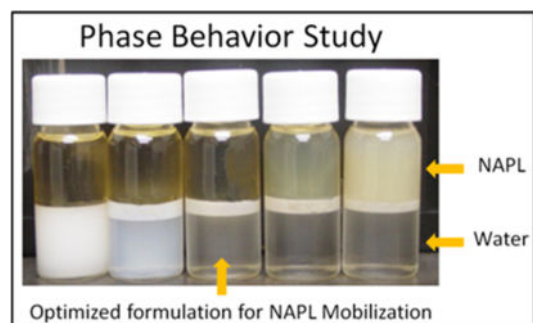
Tersus tailors each surfactant formulation using actual site samples—NAPL, groundwater, and soil—to ensure maximum NAPL mobilization. Our lab testing focuses on:

- Minimizing oil–water interfacial tension
- Forming middle-phase microemulsions (optimal for NAPL mobilization)
- Designing fast-breaking emulsions (easier separation and treatment)

The Role of Middle-Phase Microemulsions

Surfactant systems that balance oil and water solubility form a middle-phase microemulsion—a thermodynamically stable mixture containing roughly equal oil and water volumes. This phase represents the condition of lowest interfacial tension and maximum NAPL mobilization.

When your site's NAPL and groundwater samples are tested in our lab, we use them to fine-tune the surfactant formulation to consistently achieve this optimal system in the field.



Why Mobilization is More Effective Than Solubilization

Most surfactant products on the market designed for SEAR create an oily water that can be difficult to clean up. Our TASK formulations create a middle-phase microemulsion that mobilizes NAPL so it can be more easily removed, which then eliminates the need for extra chemicals or treatment.

The TASK Advantage & Comparison

Feature	Traditional SEAR	TASK™
Surfactant Dose	High	Low (as low as 0.9%)
Emulsion Type	Oily water	Middle-phase microemulsion
Waste Volume	High	Reduced
NAPL Recovery	Limited	Maximized

Laboratory Treatability Studies

Our lab studies include:

- **Phase behavior testing** to identify optimal salinity for ultra-low interfacial tension (IFT)
- **Soil and groundwater interaction testing** to ensure stability
- **Column tests** to optimize injection strategies and surfactant volumes

Comprehensive Field Support and Delivery Systems

Tersus offers additive injection and groundwater recirculation systems for pilot, short or long-term projects. Customized leases and terms allow you to meet project budgets.



Engaging Tersus to support your field effort improves the likelihood of success while minimizing the risks associated with managing complex soil and groundwater remediation projects.

Enhancing Anaerobic Bioremediation

Nutrisulfate®

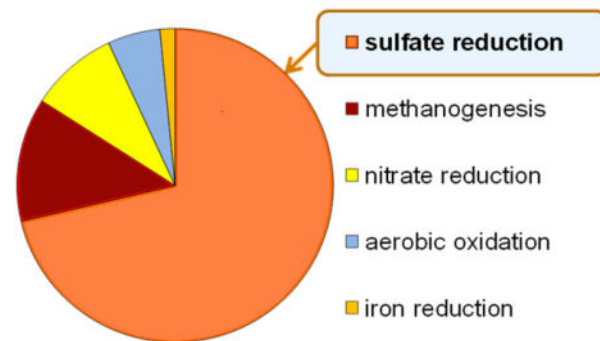
Enhanced aerobic bioremediation technologies such as air sparging or the use of oxygen releasing compounds such as *TersOx™* are commonly used to accelerate naturally occurring *in situ* bioremediation of petroleum hydrocarbons and fuel oxygenates such as MTBE and TBA by indigenous microorganisms. However, oxygen depletes fast and these aerobic indigenous microorganisms often become out populated, not functioning well particularly in high contaminant concentrations areas. Moreover, the oxygen technologies have to overcome anaerobic conditions before becoming effective.

In fact, sulfate reduction and methanogenesis are the dominant natural degradation processes at most sites. Adding oxygen to the anaerobic portion of the plume may thus be disadvantageous to these processes.

Our *Nutrisulfate®* family of products stimulate biodegradation by providing a soluble, readily available electron acceptor solution. In the presence of elevated sulfate, anaerobic groundwater bacteria use BTEX, MTBE and other petroleum hydrocarbons for carbon and energy while mineralizing the hydrocarbons to carbon dioxide and water. Sulfate addition enhances natural conditions and reduces the carbon footprint when compared to conventional remediation.

Nutrisulfate® is a high sulfate metabolic supplement designed to enhance the kinetics and efficiency of microbial systems specifically related to bioremediation of BTEX, MTBE, TBA and other petroleum hydrocarbons. The increase in kinetics and efficiency decreases remediation times and reduces the amount of substrate / amendment required.

Significance of Sulfate
Sulfate reduction is the predominant electron accepting process for the degradation of hydrocarbons



Sulfate Enhanced Bioremediation



Nutrisulfate® BioBoost

Tersus Environmental introduces *Nutrisulfate® BioBoost*, the next generation in sulfate-enhanced bioremediation. This advanced formulation not only supplies sulfate to stimulate anaerobic degradation of petroleum hydrocarbons but also delivers essential nitrogen and phosphorus nutrients to support robust microbial communities.

Product Description

Nutrisulfate® BioBoost is an advanced nutrient amendment formulated to enhance anaerobic biodegradation of petroleum hydrocarbons. Building upon the proven efficacy of Nutrisulfate®, this enhanced formulation includes additional nitrogen and phosphorus sources to support microbial growth and activity.

Key Features

- **Enhanced Nutrient Profile:** Combines sulfate, nitrogen, and phosphorus to optimize microbial activity
- **Quick-Release Granular Form:** Ensures rapid dissolution and availability in the subsurface
- **Versatile Application:** Suitable for various delivery methods, including direct-push and injection wells
- **Effective on a Range of Contaminants:** Demonstrated efficacy on BTEX, MTBE, TBA, and other petroleum hydrocarbons

Benefits

- Stimulates anaerobic microbial activity for effective degradation of BTEX, MTBE, TBA, and other petroleum hydrocarbons
- Provides essential nutrients (N and P) to support microbial growth
- Enhances sulfate-reducing conditions in the subsurface
- Quick-release formulation ensures rapid nutrient availability
- Compatible with various application methods, including direct-push and injection well

Application Guidelines

Application rates should be determined based on site-specific conditions, including contaminant concentrations and geochemical parameters. A typical starting point is to achieve a sulfate concentration of 250–1,500 ppm in the treatment zone, adjusted based on the demand factor (DF) related to BTEX levels:

- DF = 1 for BTEX ≤ 1,000 ppb
- DF = 2 for 1,000 ppb < BTEX ≤ 5,000 ppb
- DF = 3 for BTEX > 5,000 ppb

Adjustments may be necessary based on pilot testing and site-specific data.

Why Choose Nutrisulfate® BioBoost

By integrating additional nutrients into the proven Nutrisulfate® platform, BioBoost offers a comprehensive solution for sites requiring enhanced bioremediation performance. Its balanced formulation supports microbial growth and accelerates contaminant degradation, leading to shorter remediation timelines and improved outcomes.

In Situ Sorption and Biodegradation

NutriBind®

Combining Powdered Activated Carbon with an Electron Acceptor to Stimulate Biodegradation
Now available for both Aerobic and Anaerobic Bioremediation

Designed to address the challenges in soil and groundwater remediation, *NutriBind®* is a powdered reagent that once applied delivers rapid contaminant concentration reduction (days) combined with accelerated bioremediation. When mixed with water, the resulting slurry contains elevated electron acceptors to increase efficiency of electron donor (hydrocarbon contaminants) utilization.

NutriBind® has a dual function. It immediately binds and immobilizes contaminants in soil and groundwater, quickly removing them from the mobile phase. The high surface area provides a matrix favorable for microbial colonization and growth. Treatment of the sorbed contaminants is further accomplished through enhanced aerobic bioremediation or sulfate enhanced bioremediation, depending on the formulation selected.

NutriBind® stimulates biodegradation by providing a readily available electron acceptor, *TersOx™* for enhanced aerobic bioremediation or *Nutrisulfate®* for sulfate enhanced bioremediation. In the presence of elevated electron acceptors, groundwater bacteria use BTEX, MTBE and other petroleum hydrocarbons for carbon and energy while mineralizing the hydrocarbons to carbon dioxide and water. Oxygen (aerobic bioremediation) or sulfate (anaerobic bioremediation) addition enhances natural conditions and reduces the carbon footprint when compared to conventional remediation.

Features & Benefits

- *NutriBind®* treats both water and soil
- Immediate solution with predictable results
- Rapidly reduces dissolved-phase plumes in days/weeks
- Stops plume migration and protects sensitive receptors
- Addresses matrix back diffusion
- Cost effective treatment alternative
- Available with powdered adsorbent media that meets NSF/ANSI Standard 61



Enhanced Aerobic Bioremediation

TersOx™ Powder

TersOx™ is a specially formulated calcium peroxide that produces a controlled-release of molecular oxygen designed to assist in the aerobic bioremediation of hydrocarbons in soil and groundwater. TersOx™ stimulates natural degradation of petroleum hydrocarbons such as benzene, toluene, ethylbenzene and xylenes (BTEX). This is not a chemical oxidation product. The high ratio of O₂ in TersOx™ provides a long-term oxygen source for up to 12 months upon hydration under ideal conditions. This sustained release of oxygen stimulates indigenous bacteria, accelerates bioactivity, and promotes increased contaminant removal.

TersOx™ Features & Benefits

- *Controlled-release of molecular oxygen to support aerobic microbial biodegradation*
- *Long-term source of oxygen to the subsurface*
- *Clean, low-cost, non-disruptive application*
- *No operations and maintenance costs*
- *Complimentary site evaluation from Tersus Environmental*



Waterloo Emitter™

The Waterloo Emitter is a simple, low-cost device designed for the controlled and uniform release of oxygen, or other bio-enhancing amendments, to encourage and sustain the growth of microorganisms required for *in situ* bioremediation of contaminated groundwater.



The patented technology (U.S. Patent # 5,605,634) enables steady, direct diffusion of oxygen into an aquifer through pressurized silicone or LDPE tubing. Continuous, consistent release of oxygen into the tubing creates the ideal concentration gradient driving this passive system, without 'bubbling off' excess oxygen.

Emitters are ideal for the bioremediation of BTEX and MTBE using oxygen. The diffusive process provides immediate bioavailability of molecular oxygen for aerobic biodegradation enhancement; therefore, no

loss of the amendment gas occurs. The Waterloo Emitter can also encourage desirable abiotic reactions (pH adjustment, hydrolysis, etc.).

Petroleum Hydrocarbons Remediation Technologies

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Vadose Zone

- *In-Situ Chemical Oxidation (ISCO)*
- Aerobic Biostimulation
- *In Situ Sorption and Bioremediation*

2

Saturated Zone LNAPL Remediation

- Surfactant-Enhanced Aquifer Remediation (SEAR)

3

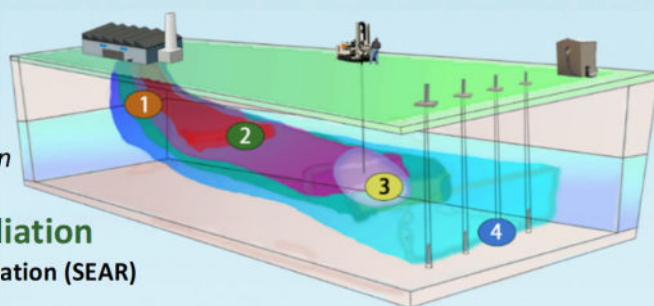
Dissolved Phase

- *In-Situ Chemical Oxidation (ISCO)*
- *Carbon-Based Injectates (CBI)*
for *In Situ Sorption and Bioremediation*
- Anaerobic Oxidative Biostimulation
- Bioaugmentation

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Leading Edge

- Aerobic Biostimulation
- Bioaugmentation



Professional Services

- Contaminant Mass Flux Measurements
- Environmental Forensics
- Performance Monitoring Plans

Field Services

- Treatability Studies
- Deployment Assistance
- Turn-key Services

REQUEST A SITE EVALUATION AND COST ESTIMATE

If you have a project and need a remediation solution, visit tersusenv.com/support and complete the Site Evaluation Form. Our team will then reach out to offer options that best suit your goals.

Sales and Technical Support

For every zone of your plume, we've got you covered!



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