



Advanced
Bioremediation
Solutions

Aerobic - Oxidative Remediation Solutions Guide

2017



The Market's **Most Effective** Aerobic Remediation System

DO-IT™

Dissolved Oxygen
In situ Treatment **System**



Accelerated Results



Continuous Delivery



DO Levels > 40-ppm



Site Specific System

The key to ETEC's Dissolved Oxygen In situ Treatment (**DO-IT™**) approach is its application as a closed loop groundwater recirculation system.

Extracted groundwater is oxygenated (with greater than 40-ppm levels of dissolved oxygen) and amended with nutrients and secondary acceptors by our **Super-Ox™** equipment, which then injects this treatment water back into the subsurface. Consistent recirculation of oxygen-rich, nutrient-rich treatment water satisfies several critical requirements of all in situ bioremediation systems, including:

- ✓ Constant and appropriate delivery of bioremediation products to support accelerated biological degradation of contaminants.
- ✓ Continuous movement of the injected treatment water through the contaminated soil and groundwater for optimum contact with dissolved and adsorbed contaminants.
- ✓ Control the distribution amended groundwater to specific zones throughout the target area and establish hydraulic control while inducing localized groundwater gradients.

Complete Biological Degradation Of:

GASOLINE/MTBE/TBA
DIESEL
HEATING OIL
BENZENE
TOLUENE
ETHYLBENZENE
XYLENES
NAPHTHALENE
AVIATION FUEL
JET A
JP-4
JP-5
JP-8
MOTOR OIL
HYDRAULIC OIL
KEROSENE
AND MORE

DO-IT™

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The Market's **Most Effective** Aerobic Remediation System

Super-OxTM Dissolved Oxygen In situ Treatment **Equipment**

Our Super-OxTM equipment platform has a unique pure oxygen mixing system that increases the dissolved oxygen levels in the injection water to greater than 40 parts per million (ppm). Super-OxTM systems are automated groundwater recirculation and oxygenation systems designed to optimize DO mass delivery for effective in situ bioremediation. Using the Super-OxTM system in conjunction with our soluble biological enhancements results in rapid subsurface cleanup of contaminated soil and groundwater. The Super-OxTM Water Treatment models include an integrated bioreactor for groundwater treatment prior to reinjection.

- ✓ DO LEVELS > 40-PPM
- ✓ INDUCED HYDRAULIC GRADIENTS
- ✓ MAXIMUM OXYGEN MASS DELIVERY
- ✓ HYDRAULIC CONTROL
- ✓ NUTRIENTS & SECONDARY ELECTRON ACCEPTORS
- ✓ AUTOMATED - TELEMETRY

Model	Home 5-HHO	10-P	10-M	10-C	Automatic (10-, 20-, 40-A)	Water Treatment (10-, 20-, 40-WT)
Flow Rate, gpm	5	10	10	10	10, 20, 40	10, 20, 40
Injection Stations	1	1	1	6	10, 10, 20	10, 10, 20
Product Injection	Manual	Manual	Manual	Manual	Automated	Automated
Bioreactor	No	No	No	No	No	Yes
Mobility	Portable	Portable	Trailer	Fixed	Fixed	Fixed
Insulation/Heating	Add-On	No	No	Add-On	Yes	Yes
Length	30 in.	48 in.	12 ft	48 in.	12, 14, 16 ft	12, 14, 16 ft
Width	28 in.	28 in.	5 ft	28 in.	8 ft	8 ft
Height	30 in.	30 in.	4 ft	30 in.	7 ft	7 ft
Customization	No	No	No	No	Yes	Yes

Super-OxTM

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AEROBIC-OXIDATIVE
REMEDICATION SOLUTIONS

The Market's **Most Effective** Aerobic Remediation System

Super-OxTM Dissolved Oxygen In situ Treatment Equipment



Accelerated Results



Continuous Delivery

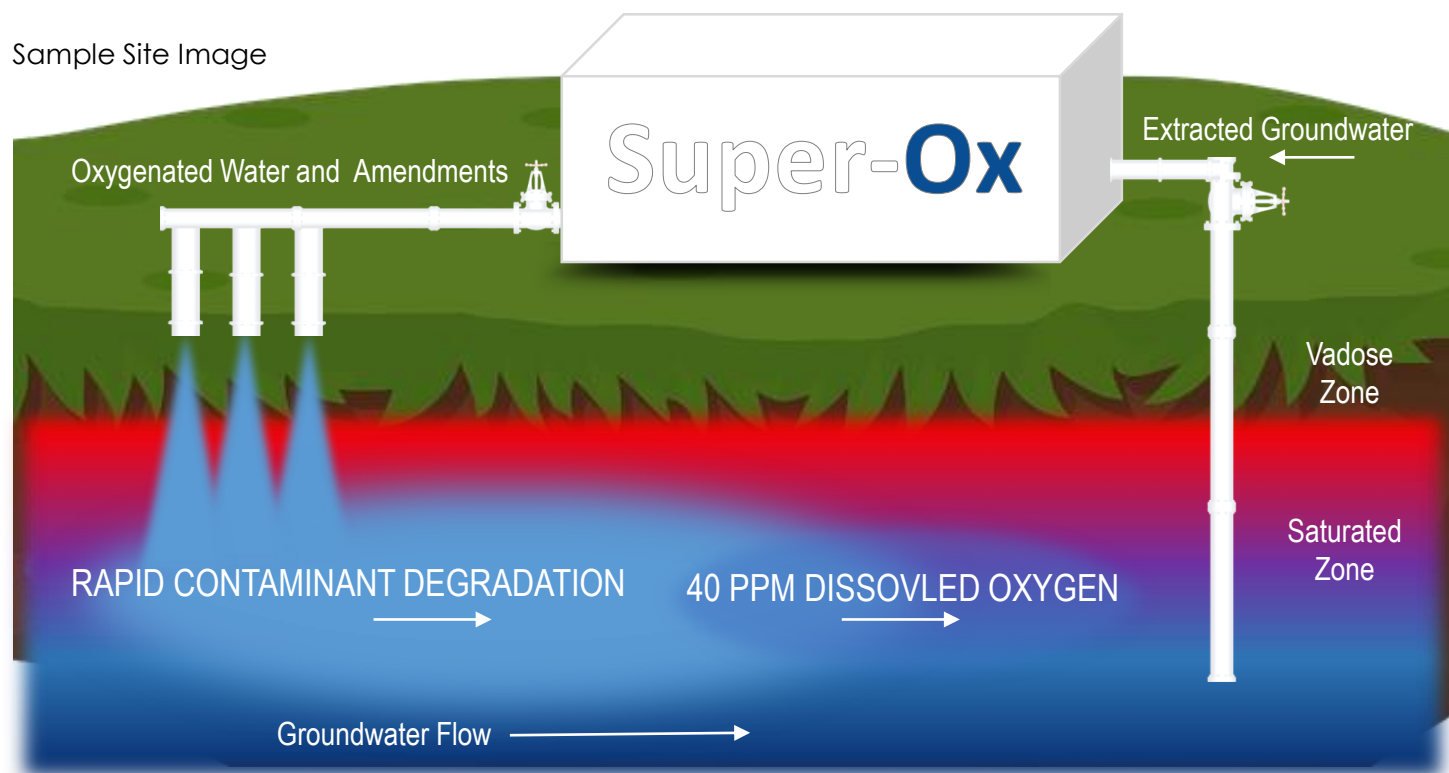


DO Levels > 40-ppm



Site Specific System

Sample Site Image



Super-OxTM

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INFO@ETECCLLC.COM



(971) 222-3616

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Super-OxTM Equipment Line



The Water Treatment models come standard with 10, 20, or 40 gpm flow rates and include an integrated bioreactor for above-ground water treatment prior to reinjection or discharge. Automated product application and reinjection through a customizable multi-station controller. Fully insulated and heated. Top of the line!



The Automatic models come standard with 10, 20, or 40 gpm flow rates. Includes automated biological product application and reinjection of highly oxygenated water through a customizable multi-station controller. Fully insulated and heated. Great for larger sites. Systems can be combined to create concentration specific recirculation loops to address large plumes (i.e. source area, mid-plume and downgradient control).



The 10-Plus (10-P) and 10-Custom (10-C) models provide a cost-effective, space saving option for smaller sites with limited space. These units provide the same high levels of dissolved oxygen as the larger units. The 10-P includes only a single injection station, while the 10-C has a customizable up to six-station automatic controller.



The 10-Mobile (10-M) provides the same convenient features of the 10-Plus, along with an integrated tank and easy-to-move trailer. Great for pilot testing.

**For smaller units ask about
the Model 5 - Home Unit ***

Super-OxTM

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Destroys contaminants by creating the right conditions to support bioremediation

PetroBacTM

Effective, Low-Cost Hydrocarbon Degradation Bundle

PetroBacTM Stimulant Bundle includes our flagship TPH Bacterial Consortium (EZT-A2TM) and Enzyme Accelerator (EZT-EATM).

The PetroBacTM Stimulant Bundle works together with our Custom Blend Nutrients ([CBNTM](#)) to mobilize and degrade TPH, BTEX, MTBE, naphthalene, and many other organic contaminants. Proven again and again on hundreds of sites, PetroBacTM completely mineralizes contaminants to CO₂ and H₂O with no by-products!



PETROBACTM STIMULANT BUNDLE

PetroBacTM is your answer for low-cost hydrocarbon cleanup using robust, adaptable bioremediation. Recommended for all active petroleum related bioremediation projects to maximize contact between the contaminants (dissolved and adsorbed) and the bacteria. Bioremediation is a contact technology – the bacteria must physically contact the hydrocarbon food source, and the electron acceptors (oxygen, nitrate, sulfate) to biochemically oxidize the contaminants.

- **EZT-EATM - ENZYME ACCELERATOR** Enzyme Accelerator is a biological enhancement designed to mimic extra-cellular enzymes. EATM improves the efficiency of both enzymes and bacteria by enhancing hydrolysis, or the “coming together” of the water-based biological enhancements with oil-based contaminants. EATM is recommended for most enzyme and bacterial applications.
- **EZT-A2TM - TPH BACTERIAL CONSORTIUM** is a biological consortium for the destruction of petroleum hydrocarbons. A2TM supplies of a large population of pre-acclimated bacteria to optimize initial growth of a healthy, in-situ, hydrocarbon-degrading microbial population. Continuous addition via recirculation ensures populations stay elevated through out the remediation project. We recommend A2TM for all active hydrocarbon related bioremediation projects.

While EATM and A2TM are available separately, these products were designed to complement each other for complete, rapid remediation.

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PetroBacTM

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Destroys contaminants by creating the right conditions to support bioremediation

CBNTM

Enhanced Biological Attenuation Custom Blend Nutrients

Nutrients For Bioremediation

Typically combined with our PetroBacTM bundle, CBNTM is a nutrient amendment designed specifically for enhanced attenuation and bioremediation of petroleum hydrocarbon constituents (gas, BTEX, diesel, oil) in soil and groundwater. It contains a balanced blend of macro-nutrients (nitrogen, phosphorus, and potassium), micro-nutrients, and secondary electron acceptors (nitrate and sulfate) that bacteria need to thrive.

Essential Components

CBNTM contains the essential building blocks that all bacteria need in order to produce new cell mass and perform cellular functions. Biological processes utilize nutrients according to a Carbon: Nitrogen: Phosphorus (C:N:P) ratio of 100:20:5. Therefore, in order to degrade 1,000 lbs. of TPH, a minimum of 200 lbs. of Nitrogen and 50 lbs. of Phosphorus will be required by the microbial population. These masses of nutrients are not naturally available in most groundwater systems, and must be supplied externally during active bioremediation in order to ensure uninhibited contaminant degradation.

Application Info

CBNTM is fully soluble in water, with no measurable viscosity and a maximum solubility of approx. 1 lb. per gallon of water. The mixing ratio can be adjusted depending upon the application method. Appropriate ongoing nutrient addition should be determined by soil/GW sampling for ammonia, nitrate, and orthophosphate.

Product Information	CBN Nutrient TM Characteristics
Packaging	50-lb. plastic bags
Physical Composition	Dry, white granular product
Changes groundwater pH	No
Nutrients (macro- and micro-) included	Yes
Water Soluble	Yes
Type of Electron Acceptor(s)	Nitrate, sulfate
% Electron Acceptor	> 60%
Field Application Assistance	Yes, upon request
Application Method(s)	<ul style="list-style-type: none">• Apply dry to open excavation• Mix in solution for spray application or injection

CBNTM

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PetroSolv™

Effective, Biodegradable, Low-Cost Non-Ionic Surfactant

PetroSolv™ is a low cost, biodegradable, non-ionic surfactant specially-formulated for cleaning, soil flushing and enhanced free product recovery. PetroSolv™ is also applicable for vapor suppression of volatile organic constituents.

Properties and Characteristics

PetroSolv™ represents a major advancement in natural, biodegradable surfactant products – extremely effective yet environmentally responsible. PetroSolv™ is formulated for cost effective, simple specification and application. Additional product information includes:

Product Information	PetroSolv™ Characteristics
Packaging	5-gallon plastic jugs, 55-gallon drums or 275 gallon totes
Physical Composition	Clear or milky liquid
Changes groundwater pH	No
Water Soluble	No
Type of Surfactant	Non-ionic
Tracer Dye	Upon request
Effective Emulsification of:	LNAPL & DNAPL
Typical Injection Solution Strength	1-10%
Field Application Assistance	Yes, upon request
Safe for workers	Yes
Biodegradable	Yes
Typical Application Method	Dilute PetroSolv™ with water to make working solution

- ETEC manufactures, distributes and provides technical support
- Non-ionic surfactant designed for free-product recovery of petroleum or solvents
- Emulsifies and solubilizes free-product and soil bound contaminants
- Quantity estimates are based on impacted soil volume and extractable groundwater volume
- Use in conjunction with groundwater extraction or recirculation.

PetroSolv™
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