

## BIOLOGICAL AMENDMENTS FOR EXCAVATIONS & PIT APPLICATIONS

*Why pay so much for just oxygen when you can buy bacteria, multiple electron acceptors, nutrients, and a surfactant for less? These products provide fast, complete biodegradation of ...*

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

*...and more!*

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Environmental consultants conducting excavation and source removal activities at UST sites are looking for cost-effective biological enhancement products they can apply to open excavation pits to stimulate biodegradation of residual petroleum contaminants in soil and groundwater. To do it right, here is what you need to know:

**Necessary Components:** Most consultants have been told by vendors that an oxygen-release product is all they need for bioremediation. **This is fundamentally incorrect**, and gives an incomplete understanding of biological processes. Oxygen and other electron acceptors are only one aspect of stimulating effective bioremediation. Other fundamental requirements include nutrients, a desorption agent, and the addition of hydrocarbon-degrading bacteria. Used in combination, all of these components will produce real, measurable degradation of residual TPH constituents.

**Mass Balance:** ETEC's approach is to obey the fundamentals of bioremediation by adding the correct mass of electron acceptors (oxygen, nitrate, and sulfate) based on an estimated mass of residual TPH. ETEC products also include a desorption agent (bioremediation only occurs in the dissolved phase!), the correct ratio of nitrogen, phosphorous, and other nutrients, and concentrated, pre-activated petroleum-degrading bacteria.



**Application:** ETEC can apply these products for you, or you can apply them yourself using a water truck or a small tank and pump. These products can be applied in minutes so you can backfill the excavation pit and finish your work without delay. Our field technicians are also available for emergency response projects, and can be on-site within 24 hours.

# WHAT'S THE BIG DIFFERENCE?

ETEC's products for excavation pits include critical nutrients that are required for microbial activity, as well as petroleum-degrading bacteria and a desorption agent to maximize contact with soil contaminants; oxygen-release products provide none of these components. Not only that, but ETEC can provide on-site application assistance. Other comparisons with oxygen-release products are included in the following table.

Product Information	ETEC Enhancements	Oxygen-release products
FDEP Acceptance	Yes	Yes
Packaging	50-lb. plastic bags, plastic buckets	Plastic buckets
Physical Composition	Dry, white granular product	Dry, white powder
Class 1 Oxidizer	Yes	?
Changes in groundwater pH	No	Yes
Nutrients (macro- and micro-) Included	Yes	No
Bacteria and Biosurfactant Included	Yes	No
Type of Electron Acceptor	Oxygen, Nitrate, Sul-fate	Oxygen
% Electron Acceptor	60%	17%
Electron Acceptor-to-TPH Ratio	5:1	3:1
Field Application Assistance	Yes - Included	No - Not Included
Application Method(s)	1. Dry product directly into excavation 2. Dissolve in solution for spray application (preferred)	1. Dry product directly into excavation 2. Mix product w/ water for slurry application
Amount of product required to degrade 100 lbs. TPH	833 lbs.	1765 lbs.
Cost (\$/lb.)	<b>\$3.50</b>	<b>\$8.00</b>
Cost (\$/lb. of TPH degraded)	<b>\$29.16</b>	<b>\$140.80</b>

As this table shows, when you compare the cost per pound of TPH that can be degraded, ETEC's enhancements are **4.5 TIMES CHEAPER** than oxygen-release products, **AND** you get microbes, nutrients, and the desorption agent! The choice is obvious.

## Other Oxygen-release Product Disadvantages

As the oxygen-release product breaks down and releases dissolved oxygen, it changes chemically. The original product is either calcium oxyhydroxide or magnesium peroxide. As the oxygen is liberated, either calcium hydroxide or magnesium oxide is formed. Both of these compounds are strong bases, which will increase the pH of the surrounding groundwater to levels higher than what is acceptable for biological activity (> 9 standard units).

Oxygen-release products are also insoluble, and can fill pore spaces and effect groundwater flow. Even if adequate oxygen is being supplied, nutrient-limited conditions will soon develop because most groundwater systems contain very little nitrogen, phosphorus, and micronutrients. Because efficient microbial degradation is dependent upon a large population of bacteria, if sufficient nutrients are not supplied, the community will not grow large enough for visible results.