



ENVIRONMENTAL

Solutions on Site

TM

MicroBoost

**NUTRIENT ADDITIVE SOLUTION
FOR TREATMENT OF PETROLEUM
HYDROCARBON WASTES**

EFFECTS OF HYDROCARBONS IN THE SOIL

- Causes severe plant and crop damage
 - Reduced growth
 - Reduced yield
 - Reduced germination

OIL TOLERANCE OF SOME CROPS

CROPS CONTENT

OIL & GREASE

Yams, carrots, sugarbeets, lawngresses	< 0.5 wt%
Ryegrass, oat, barley, corn, wheat, beans, soybeans, tomato	< 1.5 wt%
Peas, cotton, potato, sorghum	< 3.0 wt%
Perennial grasses, coastal bermudagrass, trees, plantain	> 3.0 wt%

WHAT IS BIOREMEDIATION ?

- In nature, microbes in the soil (in the presence of moisture) are undergoing a process of digestion, respiration, fermentation, synthesis (growth), and reproduction.
- All microbial activities are mediated by the action of organic catalysis or ***enzymes***.

WHAT IS BIOREMEDIATION ?

- Complex organic molecules cannot directly pass through the cell wall of microbes. Instead, they are broken down into small, water soluble and transportable compounds.

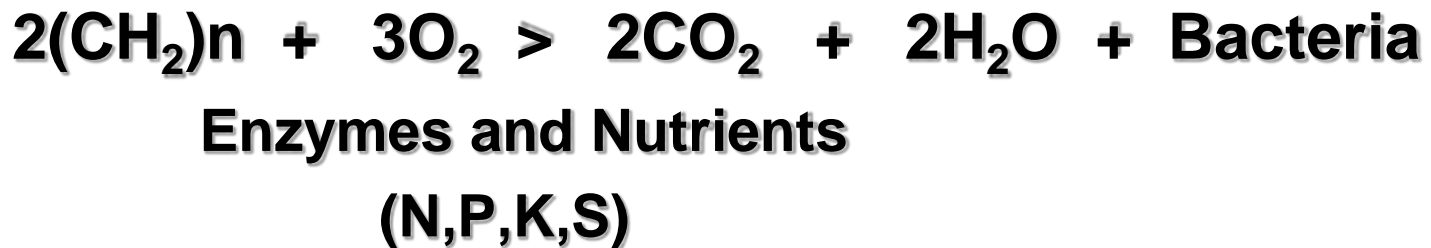


Exoenzyme Hydrolysis

Small, 2-3 carbon fragments are used by microbes to provide energy for their growth.

WHAT IS BIOREMEDIATION ?

- Microbial organisms need N & P and trace amounts of K and S to make enzymes, protein and more microbes.



WHY DOES BIOREMEDIATION WORK ?

- It is based on natural biological processes of aerobic and anaerobic nutrient metabolism.
- Many environmental wastes are structurally similar to naturally occurring molecules (e.g. fats, oils, greases, waxes, carbohydrates, etc.) routinely encountered by microbes as natural food.

WHY DOES BIOREMEDIATION WORK ?

- The more closely a compound resembles the naturally occurring metabolic process, the more likely and rapidly it can be degraded by indigenous microbes.
- The more complex the compound, the more difficult it is to degrade.
- Bacteria and fungi are abundant in the soil, and can be exploited favorably.

REQUIREMENTS FOR BIODEGRADATION

- Biodegradable organic waste
- Suitable microbes
- Oxygen
- Moisture
- Nutrients (N,P,K,S)
- Trace elements
- Optimum temperature (68⁰ - 90⁰ F; < 95⁰ F)
- Compatible soil / water chemistry
 - pH (5-9) - metals - salt - etc.

ELEMENTS OF BIOREMEDIATION

- Environment
- Contaminants
- Microbes

Understanding and manipulation of these elements are the key to successful bioremediation.

OXYGEN REQUIREMENT

- Biooxidation



- i.e. 3 lbs. Oxygen / lb. Carbon*

- Formation of biomass reduces oxygen demand

- 0.8 to 1.7 lbs. Oxygen / lb. Carbon*

- Process inefficiency can increase non-specific oxygen demand

- 5 lbs. Oxygen / lb. Carbon*

BIODEGRADABILITY PETROLEUM HYDROCARBONS

AROMATICS

1 Ring	Easy
2 Rings	Easy
3 Rings	Moderate
4 Rings	Moderate
5 Rings	Slow
6 Rings	Very Slow

ALKANES

Straight Chains	Easy
Branching	Slow Rates
Cyclic Alkanes	Moderate

BIODEGRADABILITY PETROLEUM HYDROCARBONS

SOURCES OF HYDROCARBONS

Gasoline	Easy
Jet Fuel	Easy
Kerosene	Easy to Moderate
Diesel	Easy to Moderate
Lubricating Oil	Moderate
# 6 Fuel Oil	Moderate to Hard

BIOREMEDIATION ASSESSMENT

- **Contaminant Characterization**
 - Qualitative
 - Quantitative
 - Biodegradability
 - Nutrient requirements
- **Site Characterization**
 - Surface features, e.g., topography, utilities, etc.
 - Source and extent of contamination
 - Geochemistry, e.g., pH, moisture, background nutrients,...
 - History of site
 - Regulatory issues

BIOREMEDIATION ASSESSMENT

- **Microbial Characterization**
 - Microbial population
 - Viability
 - Microbial stimulatability
 - Bioaugmentation
 - Biocidal elements?
 - Salts?

NUTRIENT REQUIREMENTS

- N,P,K Requirements
 - 0.5 - 1.0 lb. N / 100 lb. C
 - 0.1 - 0.3 lb. P / 100 lb. C
 - 0.1 - 0.3 lb. K / 100 lb. C
- Micronutrient demand is influenced by:
 - Mineralogical composition of soil
 - Background levels

WHAT IS *MicroBoost*™ ?

A water soluble nutrient additive solution specially designed to Accelerate biological activity in the soil.

ROLE OF *MicroBoost*™ IN BIOREMEDIATION

- Improves oxygen supply
- Improves in-depth moisture availability
- Improves nutrient supply
- Improves microbe availability to contaminants
- **RESULT:** *Accelerated biodegradation of organics*

WHY USE *MicroBoost*™ ?

- Promotes the growth and activity of microorganisms present in the soil.
- Provides concentrated nutrition to microorganisms.
- Improves oxygen and water supply to microbes.
- Improves microbe availability to contaminants.
- Non-toxic and non-hazardous.
- Cost-effective.
- Environmentally safe.
- Easy to apply.

MicroBoost™ REQUIREMENT

Influenced by:

- Soil composition
- Hydrocarbon and organic contents
- Nature and degree of inorganic contents of soil

Optimization of the MicroBoost™ function:

- Tilling/aeration of soil
- Irrigation
- Temperature
- Complementary additives

MicroBoost™ REQUIREMENT

Analytical information on soil:

- Total Petroleum Hydrocarbons
- Total Organic Carbon
- Cation Exchange Capacity
- Exchangeable Sodium Percentage

MicroBoost™ APPLICATION GUIDELINES

- Sample soil to establish existing contaminant levels (TPH 413.1 or 418.1).
- Remove excess free oil and treat sodium damaged soil.
- Determine extent of damage in soil to be treated (depth and surface area).
- Establish proper *MicroBoost*™ application rate.
- Till or disc soil.
- Apply *MicroBoost*™ solution onto the contaminated area (spray, till, or inject).
- Note and adjust soil pH.
- Irrigate the site heavily with fresh water.
- Monitor site periodically (samples, etc.).