

# Nutrisulfate®



- Aqueous solution for easy injection & distribution
- Acts as a buffer to maintain neutral pH
- Enhances sulfate reduction, a dominant subsurface bio-depletion process
- Efficient, affordable, and effective solution
- Demonstrated on MTBE, BTEX, TBA and petroleum hydrocarbons

## Principle

Historically, aerobic biodegradation was assumed to be primary natural degradation process for petroleum hydrocarbons in aquifers. However, geochemical data indicate that most sites have multiple natural processes occurring concurrently, and that anaerobic processes account for more than eighty to ninety percent of the hydrocarbon mass being degraded.

**Nutrisulfate®** (U.S. Patent No. 7,138,060) stimulates 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. The increase in kinetics and efficiency decreases the remediation time and reduces the amount of substrate/amendment required.

## Advantages

- Clean, low-cost, non-disruptive application
- Decreases remediation time
- Enhances abiotic bioremediation
- Stimulates naturally occurring degradation processes

## Field Application Design

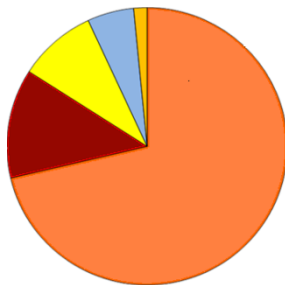
Nutrisulfate® is dosed by considering sulfate addition responses to applications at the site. Application rates depend on a demand factor used as a multiplier applied to a minimum 250 ppm sulfate:

### Demand factor (DF):

- |             |                              |
|-------------|------------------------------|
| DF = 1 when | BTEX ≤ 1,000 ppb             |
| DF = 2 when | 1,000 ppb ≤ BTEX ≤ 5,000 ppb |
| DF = 3 when | BTEX ≥ 5,000 ppb             |

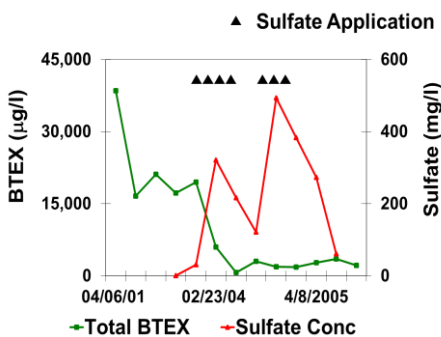
This demand factor can be modified based on site specific information including pilot testing, previous site applications and background sulfate concentrations.

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



- Aerobic oxidation
- Nitrate reduction
- Iron reduction
- Sulfate reduction
- Methanogenesis

### Sulfate-Enhanced Bio (SEB) Case Study



On sites where previous applications of Nutrisulfate have been rapidly utilized, demand factors (DF) as high as 6 may be used (= 1,500 ppm sulfate in the treatment zone).

## Product Content

Chemical Name	CAS Number	Composition (% wt.)
Sulfate	8001-22-7	13
Nutrients (Nitrate/methylene urea, urea)	57-13-6	<1
Nutrients (Potassium)		<1
Nutrients (Phosphorous)		<1
Yeast Cells	n/a	Proteins; Amino Acids; Peptides; Vitamins; Minerals; Proteinates; Nucleic Acids; Beta-Glucans; Lysine; Leucine
Extracellular Metabolites	n/a	Peptides; Organic Acids; Oligosaccharides; Nucleotides; Amino Acids; Esters; Alcohols

## Product Characteristics

Parameter	Specification
Specific Gravity	1.3
Solubility in water	soluble
Flash Point	n/a
Appearance	Slightly tainted colored water-based brine

## Packaging Options

- 55-gallon poly drums
- 275-gallon IBC totes
- Bulk tankers

## Recycling

Due to cost and liability considerations, most of our clients do not ship empty containers back to Tersus. Fortunately, you can find local recycling services located throughout the United States. Their business is to collect, prepare and resell used drums.