

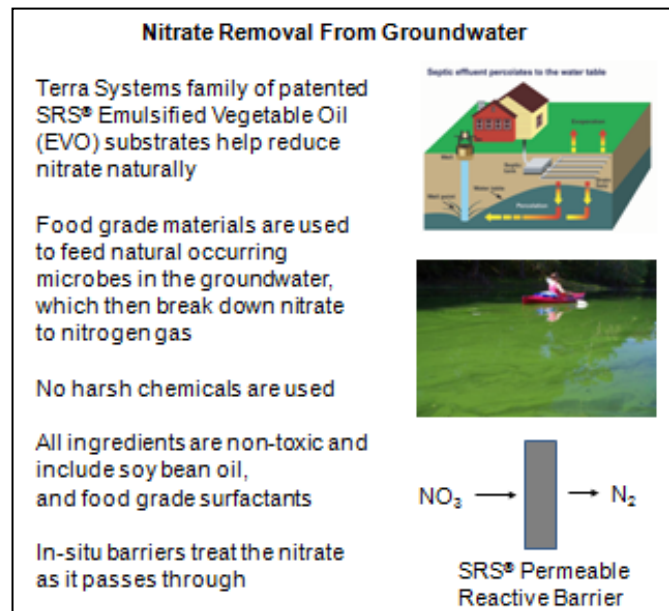


Patented *Injection Ready* 60% SRS[®]-NR Large Droplet Emulsified Vegetable Oil (EVO) Substrate for Nitrate Reduction

United States Patent #RE40,448

The anaerobic bioremediation process uses native microorganisms to degrade nitrate to the innocuous end product nitrogen gas. Terra Systems' new and patented slow release organic substrate SRS[®]-NR is added to the groundwater to generate reducing conditions and provide the necessary carbon and hydrogen to support reduction of the nitrate.

SRS[®]-NR, which is manufactured using specialized equipment in our Claymont, Delaware plant has a larger droplet size and includes a proprietary anionic surfactant which will stick to soil particles and is designed specifically for applications where adherence to the formation is key to making contact with the bacteria. It is particularly useful in PRB's and high groundwater flow formations such as fractured bedrock formations or sands. It is designed to release bio-available hydrogen over a period of 1 to 3 years thus enhancing the long-term biological reduction of the nitrate. SRS[®]-NR optimizes the naturally occurring biodegradation system by supplying the rate limiting factor (in this case hydrogen) in the reduction of nitrate.



Key Communication Points

- 60% SRS[®]-NR is designed for use in nitrate contaminated aquifers with high groundwater flowrates (>180 ft/year), Fractured Rock Formations or Permeable Reactive Barriers (PRB's). It is also used for remediation treatment near streams, rivers and estuaries.
- The 5 μm droplet size results in better substrate retention in the subsurface.
- The anionic emulsifier (has a negative charge) results in better retention because the substrate sticks more readily to the positively charged soil particles. It is specifically engineered to adhere to the formation, make contact with the bacteria and minimize the potential impact on nearby surface water.
- Provides 73% fermentable carbon.
- Has >98% biobased content.
- Includes sodium or potassium lactate to kick-start the anaerobic degradation process.

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- It arrives as a homogenous *injection ready substrate*, which results in lower field labor costs from inefficient field mixing.
- Proven effective for Nitrate reduction.
- Proven effective in preventing nitrate migration into estuaries from septic systems in several towns in Cape Cod.

Table I: 60% SRS[®]-NR Large Droplet Emulsified Vegetable Oil (EVO) Substrate Specifications for Nitrate Reduction Specifications

Ingredient	Percent	Description	Benefit
Food Grade U.S. Grown Soybean Oil	60%	Locally sourced soybean oil.	SRS [®] -NR is added to the groundwater to generate reducing conditions and provide the necessary carbon and hydrogen to support biodegradation of nitrate.
Proprietary Food Grade Emulsifiers	5- 15%	Proprietary anionic emulsifier	The proprietary emulsion package used with SRS [®] -NR combined with Terra Systems specialized manufacturing equipments results in a large droplet size emulsified soybean oil to more effectively adhere to the high groundwater flow formations.
Food Grade Soluble Substrate	5.5%	Rapidly biodegradable soluble substrate	Fast release source of carbon and hydrogen to rapidly generate anaerobic conditions
Median Oil Droplet Size (microns)	NA	5 µm	The 5 mm droplet size results in better substrate retention in the subsurface.
pH	6.0 - 7	6.0 - 7	Optimum microbial activity
Organic Carbon (wt%)	73%		60% soybean oil and 13% from lactate and emulsifiers
Zero Carbon Footprint	0%		Certified by The CarbonNeutral Co., SRS [®] has a carbon neutral footprint when it arrives at the job site.
Biobased Content	98%		Certified under USDA Biopreferred Program

Injection Ready Manufactured Emulsion

Terra Systems *Family* of patented SRS[®] emulsified vegetable oil substrates

- Arrives injection ready
- Sodium lactate, which kick starts the anaerobic process is premixed into the SRS[®] during the manufacturing process - ensuring a homogenous substrate and avoiding the additional labor cost of mixing in the field
- Arrives at the site with a zero-carbon footprint
- Certified under the USDA Biopreferred Program with >98% biobased content

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Result: A consistent emulsified vegetable oil substrate, which arrives *ready to inject* for maximum retention in the aquifer to support the biodegradation of nitrate.

It Avoids Field Mixing and Their Hidden Costs Such As:

- The cost of inadequate distribution due to variable droplet size and emulsion inconsistency
- The inability to accurately determine if you have 100% emulsification
- The lack of QA/QC in the field

Terra Systems QA/QC

Terra Systems owns and operates a state-of-the-art US based "*just-in-time*" manufacturing plant with an in-house quality control laboratory for strict quality assurance of the emulsion, droplet size and pH. A Microscope with "*Droplet Size Calculation Software*" calculates the "*mean*" droplet size for each batch of SRS[®] before we transfer to a bucket, drum, tote or tanker for shipment to the customer. With every shipment, we include a QA/QC sheet for the actual batch that the customer receives. Included are:

- **Date Manufactured:** Freshly manufactured products have a longer shelf life in the field. Avoid buying substrates that have been stored for >1 month as fermentation can start and the pH will be negatively impacted.
- **pH:** We provide the pH of the product the day it is shipped
- **Droplet Size:** is a key measure of how effective the client can distribute the substrate in the sub-surface. **Lot#'s for all the ingredients:** This is especially useful if the driller accidentally hits a discharge pipe and the consultant needs to provide documentary evidence of what exactly was injected to the regulatory agency. All of our ingredients are GRAS (generally recognized as safe).

Packaging: Terra Systems patented Family of SRS[®] substrates can be shipped in 5-gallon buckets, 55-gallon drums, 275-gallon IBC totes, 275-gallon cardboard totes or bulk tankers.

