







# Patented Injection Ready 60% SRS®-SD Small Droplet Emulsified Vegetable Oil (EVO) Substrate for Maximum Radius of Influence United States Patent #RE40,448

Terra Systems patented "*injection ready*" <u>60% SRS®-SD</u> Small Droplet Emulsified Vegetable Oil Substrate is added to the groundwater to rapidly generate reducing conditions and provide the necessary carbon and hydrogen to support native or introduced microorganisms (*Dehalococcoides*) for the biodegradation of chlorinated solvents such as tetrachloroethene (PCE) and trichloroethene (TCE) to innocuous end products including ethene and ethane.

### **Key Communication Points**

- The 0.6 um droplet size results in better substrate distribution for the client, easier substrate injectability for the driller and fewer injection points for the consultant thereby lowering costs
- Provides 73% fermentable carbon
- Has >98% biobased content
- Includes sodium or potassium lactate to kick-start the anaerobic degradation process, nutrients and Vitamin B<sub>12</sub> a micronutrient, which *He et al.* 2007 demonstrated is an important micronutrient to enhance dechlorination activity.
- The nonionic emulsifier (does not have a charge) results in better distribution and bacteria contact for the client because the substrate does not readily stick to the positively charged soil particles.
- It arrives as a homogenous *injection ready substrate*, which results in lower field labor costs from inefficient field mixing.
- Proven effective with PCE, TCE, TECA, DNAPL (Sabre Project), Perchlorate, TCA, Cr<sup>6+</sup>, TNT, Uranium and Nitrate.
- Proven effective at military installations (Andrews AFB, Dover AFB, Beale AFB, Ft. Gillem, Fort Dix, Camp Bullis, Aberdeen Proving Ground, etc.), dry cleaners, semiconductor manufacturers, fabricators and manufacturing firms that use and clean metal parts (air conditioners, dishwashers, etc.).

# Table I: SRS®-SD Small Droplet Emulsified Vegetable Oil Substrate Specifications

Ingredient	Percent	Description	Benefit
Food Grade U.S. Grown	60%	Locally sourced soybean	Long lasting slow release source of carbon and
Soybean Oil		oil.	hydrogen.
Food Grade Soluble	5.5%	Rapidly biodegradable	Fast release source of carbon and hydrogen to
Substrate		soluble substrate	rapidly generate anaerobic conditions
Proprietary Food Grade Nutrients	<1%	Proprietary organic and inorganic nutrients such as yeast extract, nitrogen and phosphorus.	Nutrients have been demonstrated to support the growth of the anaerobic microbial population.









		INCORPORATED		
Proprietary Food Grade Emulsifiers, Preservatives and other Organics	7.5%	Proprietary nonionic emulsifier and other organics	Maximum radius of influence due to small droplet size and nonionic emulsifier in moderate to fine sand, silt and clay aquifers	
Vitamin B <sub>12</sub>	<1%	250 μg/L of Vitamin B <sub>12</sub>	He et al. 2007 demonstrated Vitamin B <sub>12</sub> to be an important micronutrient to enhance dechlorination activity with 25 µg/L providing maximum stimulation	
Median Oil Droplet Size (microns)	NA	0.6 μm	Maximum radius of influence due to small droplet size and nonionic emulsifier in moderate to fine sand, silt and clay aquifers	
рН	6.5 - 7	6.5 - 7	Optimum microbial activity	
Organic Carbon (wt%)	73%		60% soy bean oil and 13% from lactate, nutrients, emulsifiers and VB <sub>12</sub>	
Zero Carbon Footprint	0%		Certified by The CarbonNeutral Co., SRS <sup>®</sup> 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<sup>®</sup> emulsified vegetable oil substrates

- Arrives injection ready
- Nutrients are premixed into the SRS during the manufacturing process ensuring a homogenous substrate and avoiding the additional labor cost of mixing in the field
- Vitamin  $B_{12}$  is premixed into the SRS<sup>®</sup> during the manufacturing process ensuring a homogenous substrate and avoiding the additional labor cost of mixing in the field
- Sodium lactate, which kick starts the anaerobic process is premixed into the SRS<sup>®</sup> 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

**<u>Result</u>**: A consistent emulsified vegetable oil substrate, which arrives *ready to inject* for maximum distribution in the aquifer.

#### 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.







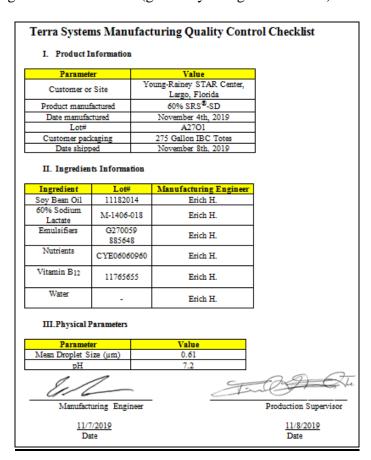


The lack of QA/QC in the field

#### Terra Systems QA/QC

Terra Systems owns and operates a state-of-the-art US based "*just-in-time*" manufacturing plant with an inhouse 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<sup>®</sup> 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. The smaller the droplet, the more effective the distribution and ease of injection.
- 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 GRAF (generally recognized as safe).











<u>Packaging</u>: Terra Systems patented SRS<sup>®</sup> Family of EVO substrates can be shipped in 5-gallon buckets, 55-gallon drums, 275-gallon IBC totes, 275-gallon cardboard totes or bulk tankers.

