



Terra Systems Core Competencies

Research and Product Development

Terra Systems scientists have been developing in situ bioremediation technology since the 1980's. Our roots go back to Richard Raymond, Sr. who received the first patent, U.S. Patent No. **3,846,290** for in situ bioremediation of petroleum hydrocarbons in the 1970's while at Sun Oil Company. Today, led by President Richard Raymond, Jr., Terra Systems, Inc. offers proven anaerobic and aerobic in situ bioremediation products and unsurpassed technical support.

Terra Systems focuses on customer's day-to-day problems so we invest heavily in Research & Development working with clients to develop products to solve real technical issues like our development of:

| Description | Product | Year |
|---|------------------------|------|
| An emulsified vegetable oil substrate with a anionic emulsifier for improved retention in highly permeable aquifers contaminated with nitrate | SRS [®] -NR | 2015 |
| An emulsified oil/iron product with superior injectability for anaerobic biodegradation and abiotic reduction. | SRS [®] -EZVI | 2013 |
| A large droplet emulsified vegetable oil substrate with a proprietary anionic emulsifier for high groundwater flowrates, fractured bedrocks, and permeable reactive barriers. | SRS [®] -FRL | 2011 |
| A small or large droplet emulsified vegetable oil substrate with a proprietary reductant to accelerate metals reduction in a mixed chlorinated plume. | SRS [®] -M | 2010 |



The foundation of our **Family** of emulsified vegetable oil products is Terra Systems U.S. Patent No. **6,398,960**

B1 for the use of emulsified vegetable oil substrate for reductive dechlorination of chlorinated solvents.



Terra Systems was a member of the RTDF project that was first to demonstrate anaerobic bioaugmentation with *Dehalococcoides* to promote the complete transformation of TCE and DCE to ethene and ethane at Dover Air Force Base, DE (Ellis et al 2000). Terra Systems also participated in the SABRE (Source Area BioRemediation) project in the UK that demonstrated anaerobic bioremediation of DNAPL TCE at a site in the UK using SRS, bioaugmentation, and pH buffering.

Terra Systems is involved in two pilot projects in Orleans and Falmouth MA evaluating permeable reactive barriers to treat nitrate from septic systems on Cape Cod. The goal is to promote denitrification before the nitrate enters salt water ponds and causes eutrophication.

References:

Ellis, D. E., E. J. Lutz, J. M. Odom, R. J. Buchanan, Jr., C. L. Bartlett, M. D. Lee, M. R. Harkness, and K. A. DeWeerd. 2000. Bioaugmentation for accelerated *in situ* anaerobic bioremediation. *Environ. Sci. Technol.* 34:2254-2260.

SABRE. <https://www.claire.co.uk/projects-and-initiatives/34-sabre>

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