

BIOREMEDIATION WITH SOY

Emulsified soybean oil emerges as cost-effective solution for environmental cleanup.

BIOREMEDIATION INDUSTRY OVERVIEW

Groundwater pollution by toxic chemicals is a widespread problem threatening our drinking water sources. Environmental cleanup, or remediation, of groundwater is a costly and growing industry that utilizes various technologies. One of those technologies is anaerobic bioremediation, which utilizes various organic compounds such as carbon and electron donor (hydrogen) sources to activate native microbes in the groundwater and soil that accelerate the biodegradation of groundwater contaminants. These contaminants include chlorinated solvents, explosive residues (perchlorate, RDX, TNT), acid mine drainage, nitrates and heavy metals.

Groundwater bioremediation cleanup project work is accomplished by environmental consulting/contracting firms, which utilize various formulated proprietary substrates or amendments that stimulate the chemical reduction of pollutants to nontoxic elemental compounds.

TRADITIONAL REMEDIATION PROCESSES

Traditionally, contaminated groundwater has been remediated by a process called Pump & Treat. The water is pumped above ground, filtered through a medium such as activated carbon and pumped back down. This is a costly process. Other processes include the installation of a deep trench across and through the groundwater aquifer that is then filled with scrap iron (Iron PRB – Permanent Reactive Barrier) or organic materials, such as bark mulch, all of which biodegrade, release hydrogen and reduce the contaminants to harmless residues.

ANAEROBIC BIOREMEDIATION

More recently, in situ (in place) anaerobic bioremediation processes have been developed that involve the injection, through wells drilled into an aquifer, of organic compounds called substrates. The substrates biodegrade, providing food for naturally occurring bacteria, and release hydrogen that reduces and degrades the pollutants. These substrates include molasses, corn syrup, cheese whey, sodium lactate and emulsified soybean oil.

THE EOS® PROCESS

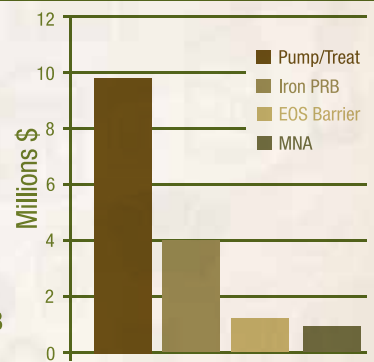
The EOS® (Edible Oil Substrate – Emulsified Soybean Oil) process was patented by Robert C. Borden, P.E., Ph.D., of North Carolina State University in the United States (June 2002) and Europe (June 2007). The EOS process covers the use of emulsified “edible” plant oils, such as soy oil, for groundwater bioremediation. Over eight years of field trial evaluation, the EOS Process has emerged as the most cost-effective process technology for in situ groundwater bioremediation. It has become widely accepted as a primary commercial treatment method by the environmental consulting/contracting industry. The process is effective and lasts longer (more than three years), due to slow degradation and hydrogen release, than other available substrate processes, which need to be reinjected much more frequently.

EOS® REMEDIATION SHOWN TO BE COST-EFFECTIVE



Benefit – Lower Life Cycle Costs

- 30 yr. Net Present Value (Quinton et al.)
- 600 ft. wide x 80 ft. deep
- Every 5 yr.
 - 25%
 - Reinject oil
 - Replace 25% of wells
- Monitoring same as iron PRB



Promoting Readiness through Environmental Stewardship



BIOREMEDIATION WITH SOY

MARKET POTENTIAL - SOY-BASED BIOREMEDIATION PRODUCTS

The bioremediation market is difficult to define because discovery of contaminated sites is ongoing and securing funding to remediate them is a priority. The use of soybean oil-based bioremediation products and processes is a treatment alternative that is becoming an industry-standard process technology.

There are some unrelated data sources that provide some idea of the magnitude of the market potential for soy products.

HAZARDOUS WASTE SITES

The Department of Energy (DOE) estimates it would cost \$150 billion to restore the thousands of sites identified as being contaminated with chlorinated solvents, perchlorates, explosives, metals and nuclear waste. One such site, the Pantex munitions depot near Amarillo, Texas, is currently being remediated with soybean emulsion process technology and is estimated to use 2 million pounds of soy oil emulsion product per year for 30 years. The Department of Defense (DOD) has reportedly budgeted about \$4 billion to clean up military bases.

MINING - ACID MINE DRAINAGE (AMD)

There are up to 500,000 abandoned mines in the United States, many with acid groundwater problems. Fifty of those are superfund sites that could cost millions of dollars per site to restore.

MARKET DEMAND FOR SOY

One supplier of soy oil emulsion products estimates the current U.S. bioremediation market to be about 1 billion dollars per year. Soy oil-based products are being used on 200-300 cleanup sites as EOS®, EVO (Emulsified Vegetable Oil) or straight soy oil.

Current annual soy oil use for bioremediation is in excess of 5 million pounds and growing. The use of EVO processes is expanding internationally as well in Japan, Europe, Australia and South America.

SOY-BASED BIOREMEDIATION PRODUCT SUPPLIERS

EVO is a generic term used by the industry for emulsified soybean oil because EOS® is a trade name of EOS® Remediation, the licensee that supplies the emulsion. There are currently six suppliers of soy oil products for the groundwater bioremediation market:

- *EOS® Remediation* – “EOS®” products, series of soybean oil-formulated emulsion products
- *RNAS (Remediation and Natural Attenuation Services)* – “Newman Zone” EVO products, soybean oil emulsions
- *Terra Systems* – “SRS” (Slow Release Substrate) products, soybean oil emulsions
- *Carus Corp.* – “CAP18,” straight soybean oil and “CAP18-ME” – soy oil with 10 percent SME (soy methyl ester)
- *Regenesis* – “3DMe” Microemulsion with soybean oil C-18 fatty acids
- *JRW Bioremediation* – “LactOil” – Soybean oil (45 percent) and ethyl lactate (35 percent) emulsions and concentrates
- *Tersus Environmental Systems* – “EDS-QR” – Water-mixable soybean oil emulsion concentrates (92 percent soy oil)

These companies sell soy oil-based products to environmental consulting/contractors who bid for and execute the site remediation work, which often takes five to 10 years to complete.

ABOUT USB

The 69 farmer-directors of USB oversee the investments of the soy checkoff to maximize profit opportunities for all U.S. soybean farmers. These volunteers invest and leverage checkoff funds to increase the value of U.S. soy meal and oil, to ensure U.S. soybean farmers and their customers have the freedom and infrastructure to operate, and to meet the needs of U.S. soy's customers. As stipulated in the federal Soybean Promotion, Research and Consumer Information Act, the USDA Agricultural Marketing Service has oversight responsibilities for USB and the soy checkoff.

FOR MORE INFORMATION, VISIT: SOYNEWUSES.ORG

