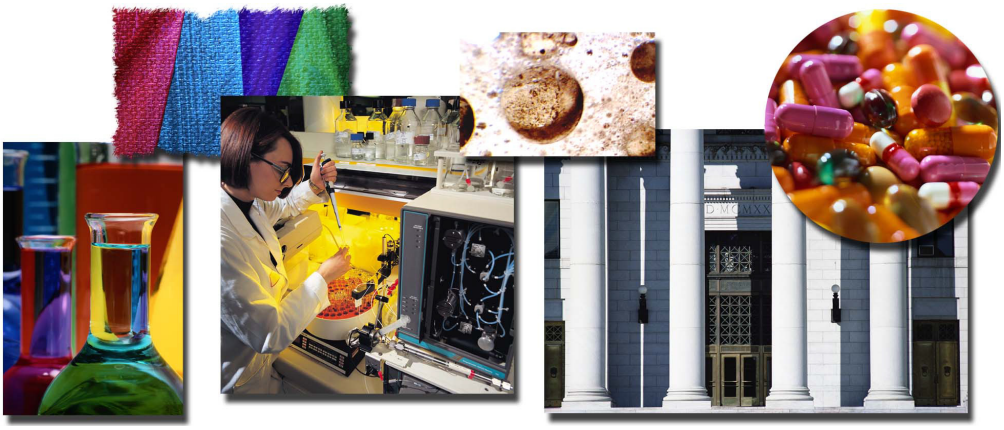
National Aeronautics and Space Administration

Technology Opportunity

Emulsified Zero-Valent Iron (EZVI)

The National Aeronautics and Space Administration (NASA) seeks to license the NASA-developed technology Emulsified Zero-Valent Iron (EZVI) for use in commercial applications. Developed at the John F. Kennedy Space Center (KSC), this process provides for the in situ treatment of dense nonaqueous phase liquids, or DNAPL's. This technology is one of the few methods available that can treat the DNAPL source. EZVI also overcomes the limitations of current DNAPL treatment technologies by providing a method that is quick, effective, and cost-competitive. EZVI is part of NASA's technology transfer program. This program seeks to promote the commercial use of NASA-developed technologies. KSC has filed a patent application for EZVI. Based on the success of bench-scale testing, the technology was also accepted into the U.S. EPA Superfund Innovative Technology Evaluation (SITE) Program.



Potential Commercial Uses

Thousands of sites across the United States face problems with DNAPL contamination. The EPA has reported that DNAPL's are present at 60% to 70% of all sites on the Superfund National Priorities List. Emulsified Zero-Valent Iron is a versatile technology that can be used at many of these locations.

Applicable sites may include:

- Dye and paint manufacturers
- Dry cleaners
- Chemical manufacturers
- Metal cleaning and degreasing facilities
- Leather-tanning facilities
- Pharmaceutical manufacturers
- Adhesive and aerosol manufacturers
- Government facilities

Benefits

- **Directly treats contaminant source:** Numerous methods are available for treating dissolved phase contaminants, but EZVI is one of the few technologies that can effectively treat the DNAPL source.
- **Does not mobilize contaminants:** Many DNAPL treatment methods, such as solvent flushing and thermal techniques, can mobilize DNAPL's to previously uncontaminated areas. In contrast, EZVI treats contaminants in place with no mobilization.
- **Requires less treatment time:** Although traditional pump-and-treat systems can require decades of operation for complete DNAPL removal, remediation with EZVI takes only two to three months. This time frame also includes equipment set-up and tear-down.
- **Reduces treatment costs:** EZVI is estimated to cost $27 per kilogram of DNAPL treated, making it cost-competitive with pump-and-treat, thermal treatment (e.g., steam injection, six-phase heating), and in situ chemical oxidation.

- **Produces less-toxic and more-easily degradable byproducts:** Other technologies, such as in situ chemical oxidation, can generate chlorinated daughter products (e.g., vinyl chloride) that can be harmful to the environment. In contrast, EZVI produces small quantities of hydrocarbons, such as ethene, that are relatively nontoxic and naturally degraded.
- **Is environmentally safe:** EZVI is made from environmentally friendly and biodegradable materials.
- **Is being evaluated by the U.S. Environmental Protection Agency (EPA):** Based on the success of bench-scale tests, EZVI is being field tested by the EPA under the SITE Program.

The Technology

Thousands of DNAPL-contaminated sites have been identified across the United States; however, few technologies exist that can treat DNAPL's in a timely and cost-effective manner. For example, traditional pump-and-treat methods can require decades of treatment time and operational costs. Other methods that treat DNAPL's in place, such as steam injection and radio-frequency-heating, are expensive and can cause contaminant mobilization. NASA's EZVI technology overcomes these limitations by providing a method that is quick, effective, and cost-competitive. EZVI involves placing nanoscale zero-valent iron particles into a surfactant-stabilized, biodegradable oil-in-water emulsion. This emulsion is injected into the DNAPL-contaminated zones of the subsurface. The DNAPL is then pulled into the emulsion where the contaminant reacts with the zerovalent iron. Through a process known as reductive dehalogenation, the DNAPL and its daughter products are degraded into ethene and other hydrocarbons. These by-products are finally broken down through biological activities in the subsurface.

Options for Commercialization

NASA seeks qualified companies to commercialize the Emulsified Zero-Valent Iron technology. This and other technologies are made available by the KSC Technology Commercialization Office through a variety of licensing and partnering agreements. These include patent and copyright licenses, cooperative agreements, and reimbursable and nonreimbursable Space Act Agreements.

Contact

If your company is interested in the Emulsified Zero-Valent Iron technology or if you desire additional information, please reference Case Number KSC-12246 and contact:

Jeff Kohler
Innovative Partnership Program
Mail Code: KT-F
Kennedy Space Center, FL 32899
Telephone: (321) 861-7158
FAX: (321) 867-2050
Jeffrey.Kohler-1@ksc.nasa.gov

Commercialization Checklist

- Patent Pending
- ✓ U.S. Patent
- Copyrighted
- ✓ Available to License
- Available for no-cost transfer
- Seeking industry partner for further codevelopment