PARTNERS IN ENVIRONMENTAL TECHNOLOGY

DoD EPA DOE SERDP Strategic Environmental Research and Development Program

ESTCP

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OCTOBER 1999
NUMBER 2

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PARTNERS IN ENVIRONMENTAL TECHNOLOGY

TECHNICAL SYMPOSIUM & WORKSHOP

Sponsored by SERDP and ESTCP

November 30-December 2, 1999
Hyatt Regency Crystal City
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Register Today!

ESTCP Funds Development of Treatability Test for Enhanced In-Situ Anaerobic Dechlorination

The Air Force is responsible for remediating approximately 600 sites that are contaminated with chlorinated solvents, such as perchloroethylene (PCE) and trichloroethylene (TCE). The Navy, Army, and private industry also have similar problems remediating sites contaminated with chlorinated solvents. In fact, a recent study revealed that up to 85 percent of Superfund sites contain chlorinated solvent-contaminated groundwater.

The majority of treatment and containment processes for contaminated groundwater involve pump-and-treat approaches costing approximately $0.25 per 1,000 gallons of water treated, plus the costs of well installation and construction of aboveground treatment systems. While pump-and-treat has been used for contaminant containment, few effective technologies exist that completely remove or destroy chlorinated solvents from groundwater in-situ.

Enhanced anaerobic dechlorination offers a cost-effective, active approach for destroying contaminants. In-situ anaerobic dechlorination involves adding non-toxic electron donor substrates to enhance the degradation of chlorinated contaminants by indigenous bacteria. Development of a validated treatability test for enhanced anaerobic dechlorination will facilitate this technology's rapid transition from research to full-scale implementation.

To fill this technology gap, researchers from the Department of Defense (DoD), the Environmental Protection Agency (EPA), industry, and academia developed the Reductive Anaerobic Biological In-Situ Treatment Technology (RABITT) Protocol for implementing enhanced in-situ anaerobic dechlorination and will validate the protocol through application at five DoD contamination sites. The Draft RABITT Protocol has been reviewed by leading professionals in microbiology, microbial ecology, biochemistry, hydrogeology, geochemistry, and field-scale engineering implementation.

Laboratory microcosm testing is a critical part of the protocol. The selection of an appropriate electron donor is an important design parameter for stimulating a population of microorganisms capable of fully dechlorinating PCE and TCE. The ability of yeast extract, propionate, lactate, butyrate, and lactate/benzoate to stimulate anaerobic dechlorination are all evaluated in laboratory microcosm testing.

The RABITT Protocol was implemented in the field in February 1999 at Cape Canaveral Air Station, FL.

The first site for protocol testing is located at Cape Canaveral Air Station, FL. Field implementation began in February 1999, and the relatively rapid onset of dechlorination observed in the Cape Canaveral microcosm studies was extremely encouraging. All electron donors that were tested stimulated the dechlorination of TCE to cis-dichloroethylene

See RABITT, page 5

S•U•C•C•E•S•S stories

SERDP-funded research and development efforts and ESTCP-funded demonstration and validation activities continue to provide a rapidly increasing number of outstanding technical advances. These developments are highly important and relevant to the Department of Defense (DoD), Department of Energy (DOE), Environmental Protection Agency (EPA), and many other user communities.

success story

Continuous Real-Time Monitoring of Hazardous Air Pollutants Ensures Compliance with Clean Air Act

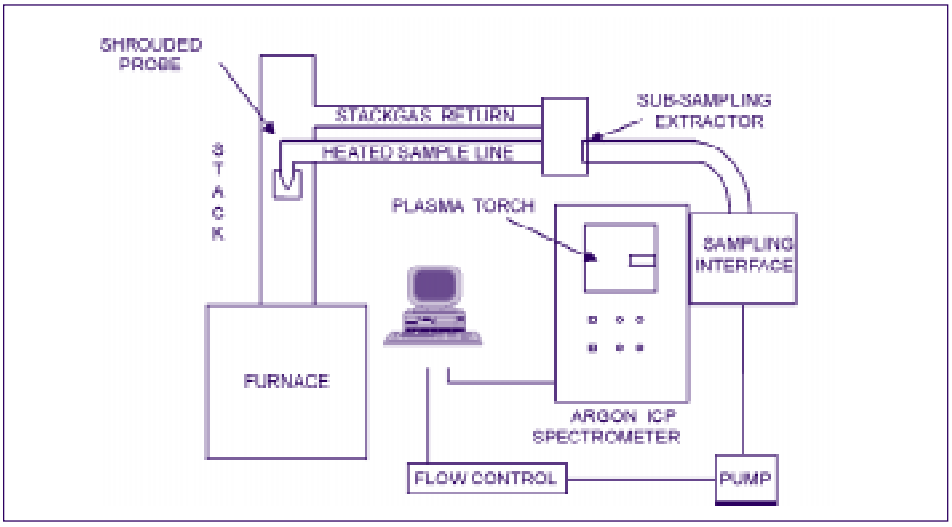
Compliance with Clean Air Act regulations for virtually all Department of Defense (DoD) waste combustors is achieved through careful waste characterization, trial burn air pollution assessments, and waste feed rate restrictions. For the combustion of waste munitions, incomplete waste characterization can increase the risk of non-compliant emissions of hazardous air pollutants, especially metals. Conventional methods of monitoring airborne hazardous metals in combustor stack emissions typically involve time-consuming manual sampling techniques that do not facilitate real-time pollution control. Therefore, continuous emissions monitors (CEM) were developed that are capable of providing analytical data in or near real-time which can then be used to control the waste feed process and ensure compliance of DoD waste combustors.

Through the ESTCP-funded project *Continuous Emissions Monitor for Hazardous Air Pollutant Metals*, researchers are performing validation testing in collaboration with the Environmental Protection Agency (EPA) and demonstrating the sustained performance of a prototype CEM. Validation testing of a prototype CEM system was performed in a controlled environment at a permitted full-scale incineration facility at the Tooele Army Depot in Utah. The prototype system, the TraceAIR multimetals continuous emissions monitor (TraceAIR MMCEMS), was developed under the Army's Demilitarization Technology Research and Development Program for Conventional Ammunition. The system employs automatic, isokinetic stack gas sampling and sample injection into an inductively coupled argon plasma (ICP) spectrometer, which detects and measures the atomic emissions of the excited hazardous metals in the sample (see the figure below). The system has a detection capability of less than one part per billion for all 14 air pollutant metals designated as hazardous by the EPA. The TraceAir MMCEMS uses a closed-loop process control, involving automatic control of the waste feed, in which the stack gas metal emissions, detected in near real-time, govern the effective feed rate of munitions waste into the incinerator.

Sufficient data were collected during the validation test to illustrate successful execution of the closed-loop process control scheme. The results of this exercise clearly demonstrate that when appropriate waste feed parameters are identified and implemented, munitions can be fed into the incinerator at a favorable rate, while the corresponding average emissions of offending metals are effectively regulated at levels that do not exceed permitted limits.

Validation, long-term evaluation, and optimization of the CEM for hazardous air pollutant metals will allow enhanced, emissions-based compliance under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) and Compliance Assurance Monitoring rules. The CEM also will enable implementation of Maximum Achievable Control Technology (MACT).

See CEM, page 3



Schematic Diagram of the Prototype TraceAir Multimetals Continuous Emissions Monitor

success story

Safe Deactivation of Energetic Materials and Beneficial Use of By-Products

The Department of Defense (DoD) faces many environmental and legal issues associated with the demilitarization of obsolete, excess, and off-spec energetic materials and assembled munitions. The DoD stockpile of energetic materials that needs to be destroyed is approximately 700,000 tons, and this amount increases at a rate of about 60,000 tons per year. The Department of Energy (DOE) also has a significant amount of weapons components that needs to be destroyed. To ensure compliance with increasingly stringent regulations, DoD and DOE require alternatives to open burning/open detonation (OB/OD).

Through SERDP-funding, an innovative alternative to OB/OD has been identified that will provide the safe destruction of energetic materials. Researchers working on this project identified a chemical process to react energetic materials with hypergolic chemicals, specifically organic amines, which neutralize the energetic materials. The organic amines react with TNT, RDX and Comp B at low temperatures leading to a safe breakdown of the explosive material without detonation. These reactions produce gaseous and liquid by-products. The gases were collected and analyzed by gas chromatography and infrared analyses and were found to consist of nitrous oxide, nitrogen, water, and carbon dioxide. Residual liquids from the reactions were analyzed by multi-element Nuclear Magnetic Resonance (NMR) and infrared methods. Reacting amines with RDX produces liquids containing amide groups. Reacting TNT with amines results in nucleophilic aromatic substitution leading to the formation of Meisenheimer's complexes and subsequent rearrangement to form C-N bonds. The liquid by-products for both RDX and TNT were found to be effective curing agents for conventional epoxy resins.

The epoxy polymers produced with the curing agents developed in this project were subjected to several safety and structural tests. The epoxy samples passed a burn test procedure based on the standard for Transportation of Dangerous Goods. Additionally, detonation tests have shown that the epoxy samples made with RDX curing agent by-products will not explode or detonate. Currently, toxicology testing of these polymeric products is under way to verify their safety and resistance to leaching of toxic compounds. Structural tests indicate that the mechanical properties of the polymers produced with these curing agents are comparable to control samples of epoxy formed from conventional resins and curing agents.

The results of this research indicate that a viable alternative to OB/OD exists for the destruction of energetic materials such as TNT, RDX, and Comp B. The method developed will meet DoD and DOE requirements for high throughput, cost-effectiveness, safety, and zero discharge of toxic chemicals to the environment. An added benefit of this technology will be the use of the by-products resulting from the deactivation of energetic materials.

For additional information, please contact Dr. Maher Tadros, Sandia National Laboratories, Albuquerque, NM, at (505) 845-8930 or via e-mail at metadro@sandia.gov. ◆

CEM, from page 2

This will greatly facilitate full Resource Conservation and Recovery Act (RCRA) compliance operation and public acceptance of new thermal treatment processes, such as plasma arc technology. Successful demonstration of the CEM system also will facilitate the granting of modifications to existing operating permits. This will result in long-term savings in the operation of all thermal treatment plants as well as savings in the start-up and permitting costs for new facilities. Cost savings from decreased trial burn requirements, simplification of the permit application process, reduced hazardous waste characterization, and reduced periodic compliance costs are estimated to be approximately $355,000/year per incinerator site. In addition to these cost savings, the CEM for hazardous air pollutant metals will provide an unprecedented ability to ensure that pollution controls are working properly and that emissions of hazardous air pollutant metals from DoD facilities are continuously within acceptable limits.

In keeping with SERDP and ESTCP's partnering philosophy, representatives from EPA were involved early in the demonstration test and have stated that they are extremely pleased with the success of the project. J. David Mobley, acting Director of EPA's Emissions, Monitoring and Analysis Division, agrees that the MMCEMS has a very strong potential for broadened applicability in a wide variety of waste incinerators, including chemical and medical waste disposal. He also envisions that future installations of this instrument can provide assurance to permitting authorities that exposure to toxic metal emissions from a given source is minimal or even eliminated. Mr. Mobley has offered to continue his partnership with ESTCP to explore the use of this technology with other incineration processes.

For additional information, please contact Mr. Curtis Anderson, U.S. Army, Picatinny Arsenal, NJ, at (201) 724-4287 or via e-mail at cander@pica.army.mil. ◆

success story

SERDP-Funded Researchers Advance Biological Treatment Processes for Contaminated Groundwater and Soil

The remediation of Department of Defense sites using existing technologies is problematic from an economic, technical, and political point of view. Currently used technologies are frequently invasive, requiring the movement of large volumes of soil and/or water, and they are also energy and materials intensive. In addition, many technologies simply move the contaminant from the ground to the surface where it still must be treated. To pursue innovative bioremediation solutions, the Federal Integrated Biotreatment Research Consortium (FIBRC) was established as a large, multi-faceted project to develop field-ready biotechnologies in each one of the following focus areas: 1) Explosives; 2) Polycyclic Aromatic Hydrocarbons (PAH); 3) Chlorinated Solvents; and, 4) Polychlorinated Biphenyls (PCB). The following details accomplishments under this umbrella project, specifically those involving work focused on bioremediation of explosives and chlorinated solvents.

Explosives

During FY99, SERDP-funded researchers focused on the degradation of dinitrotoluene (DNT), a major contaminant at the Badger Army Ammunition Plant (BAAP) Propellant Burning Ground (PBG). Until very recently, no technology existed for efficient biodegradation of DNT; however, discovery of bacteria that mineralize both isomers of DNT has enabled the development of an effective bioremediation strategy. Studies were conducted with DNT-contaminated soils from BAAP to provide the basis for full-scale implementation.

Studies to simulate in-situ remediation were conducted in glass columns filled with soil from the PBG. 2,4-DNT was degraded without a lag from 10.9 g/kg to 0.17 g/kg in the column inoculated with DNT-degrading bacteria. 2,6-DNT gradually declined to 0.02 g/kg from initial levels of 0.22 g/kg. In the uninoculated column, DNT degradation was preceded by a 10-day lag period. The results indicate the presence of an indigenous bacterial population capable of completely degrading 2,4-DNT in PBG soil. Such a population can be exploited in an engineered in-situ bioremediation strategy for the contaminated soil. Further studies are under way to determine the principal parameters to control for optimal DNT degradation.

Other DNT research at the PBG involved three former waste pits used primarily to dispose of DNT/benzene mixtures. At these sites, elevated levels of DNT are present to depths of 125 feet below grade. As a result of the contamination depth, ex-situ soil remedies are technically challenging and cost prohibitive. The Army installed an in-situ soil vapor extraction system in early 1998 to remove benzene from the soils. Based on the promising SERDP-funded bench-scale studies, the Army has designed a pilot-scale system for the in-situ biodegradation of the DNT-contaminated soil.

The Army's pilot-scale system includes the addition of water amended with phosphate buffer and micronutrients. Aerobic conditions will be maintained in the treatment zone by subsurface air injection. Nitrites produced by aerobic degradation will be controlled by producing an induced reduction zone in the aquifer downgradient from the treatment zone. The pilot system is planned to be complete in the fall of 1999. The Army is hoping to use the results to design and implement a full-scale system at the site.

Chlorinated Solvents

An effort funded under the FIBRC is attempting to demonstrate the feasibility of a treatment train approach to remediating the source zone of a dense nonaqueous phase liquid (DNAPL) contaminated aquifer. The Solvent Extraction Residual Bioremediation (SERB) process pursues enhanced removal of the source contaminants with cosolvent extraction and subsequent biodegradation of dissolved contaminants. If these technologies can be coupled successfully, the SERB could greatly reduce cleanup costs.

The alcohol flushing pilot test was performed successfully in August 1998. This pilot-scale test has demonstrated that the technology is very effective at solubilizing contaminants, such as perchloroethylene (PCE), making them susceptible to treatment by extraction and bioremediation. Analysis of the extraction well data shows that a significant mass of PCE (> 40 liters) was removed during the cosolvent extraction process. Dissolved phase PCE concentrations in the source zone area decreased immediately following the cosolvent flush and have rebounded, as expected, over the past year, while ethanol concentrations have remained at 10,000 mg/L. Groundwater monitoring has indicated that conditions conducive to reductive dechlorination have been created in this zone. Indications of reductive dechlorination of PCE are 1) formation of the daughter products, trichloroethylene (TCE), cis-dichloroethylene (DCE), vinyl chloride (VC), and ethene (ETH), 2) an increase in chloride, hydrogen, and methane concentrations, and 3) a decrease in sulfate concentrations. The SERB process has been successful at the pilot test site in removing a significant mass of PCE and enhancing the reductive dechlorination of the remaining dissolved phase contaminant.

Laboratory microcosm studies have been conducted to validate the field

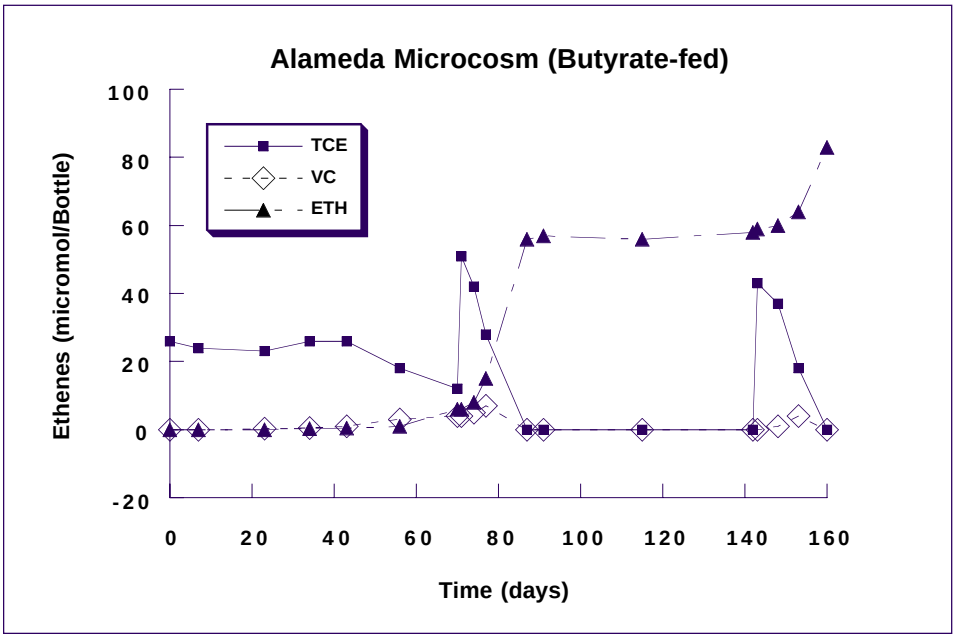
See FIBRC, page 5

RABITT, from page 1

(cis-DCE). Extent of conversion of cis-DCE to vinyl chloride (VC) and ethene (ETH) was dependent upon the donor added. Ultimately, lactate was chosen as the most suitable donor for field testing. It was added through a two-well communicating delivery system.

Data generated during six months of field operation shows exciting levels of reductive dechlorination. TCE and cis-DCE were transformed simultaneously after little lag time, resulting in an initial build up of VC. VC concentrations increased until day 70, after which ETH began to accumulate and VC concentrations decreased. By the end of the six months, concentrations of TCE and chlorinated daughter products were reduced significantly with ETH concentrations remaining elevated.

The second site for protocol testing is located at the Naval Air Station (NAS) Alameda, CA. Results from the Alameda microcosm studies again showed all donors supported complete conversion of TCE to ETH. Butyrate proved to be the most favorable donor for this site, based upon the most consistent and rapid conversion of TCE to ETH (see figure). After baseline sampling and tracer testing, injection of butyric acid began at NAS Alameda in June of 1999 using a recirculating groundwater system.



Encouraging results from the Alameda microcosm studies show complete conversion of TCE to ethene.

Upon completion of field testing at all five DoD locations, the protocol will be reevaluated and revised as needed. The final document will contain cost information for conducting the treatability tests and detailed technical information generated from the five demonstrations.

The draft protocol can be obtained from the ESTCP web site at **www.estcp.org** (click on the Technical Documents link). The final version of the protocol will be released in October 2001 upon completion of the field testing.

For more information regarding the RABITT Protocol, please contact Lt. Lisa Ackert, Air Force Research Laboratory, at (850) 283-6308 or via e-mail at Lisa.Ackert@tyndall.af.mil; Dr. Bruce Alleman, Battelle Memorial Institute, at (614) 424-5715 or via e-mail at allemanb@battelle.org; Dr. James Gossett, Cornell University, at (607) 255-4170 or via-mail at jmg18@cornell.edu; or Dr. Guy Sewell, EPA NRMRL, at (580) 436-8566 or via e-mail at sewell.guy@epa.gov. ◆

FIBRC, from page 4

test results. These studies indicate that the site materials contain indigenous organisms that dechlorinate PCE. Daughter products, TCE and cis-DCE, were formed in microcosms that contained ethanol as the electron donor. Molecular probing techniques have detected a *dehalococcaides ethenogens*-like organism that may be capable of complete dechlorination of PCE to ethene.

Summary

Other accomplishments under the FIBRC related to biotreatment of explosives and chlorinated solvents, as well as PAHs and PCBs, will be detailed in the SERDP Annual Report for FY99 that will be posted on the SERDP web site in the spring of 2000.

For more information regarding the DNT research, please contact either Dr. Joseph Hughes, Rice University, at (713) 285-5903 or via e-mail at hughes@wlnet.rice.edu or Dr. Jim Spain, Air Force Research Laboratory, at (850) 283-6058 or via e-mail at jspain@mlq.afrl.af.mil. For additional information about the SERB Process, please contact Dr. Guy Sewell, EPA NRMRL, (580) 436-8566 or via e-mail at sewell.guy@epa.gov. ◆

FY 2000 SERDP and ESTCP Funding Update

The FY 2000 Defense Appropriations Bill has been signed, and SERDP and ESTCP have fared well in a climate in which most environmental programs have seen their funding take sharp declines. Shortly, SERDP and ESTCP will distribute these funds to each project. Continuing projects and new start Federally-led projects can expect to receive their funds late this year. New start, non-Federally led project funding will be distributed upon issuance of contract awards.

SERDP has received $53.5 million as requested, with an additional $5 million for Congressionally-directed projects. SERDP will distribute these funds in accordance with the SERDP Council-approved investment strategy as follows:

Pollution Prevention	29%
Cleanup	28%
Conservation	17%
Compliance	13%
Undistributed Reductions and Support	13%

Based on a clear need to expedite demonstration and validation of emerging cleanup and other environmental technologies, **ESTCP** received $23.26 million in FY 2000, over 40 percent more than received in FY 1999. The Program content has been approved by Ms. Sherri Goodman, the Deputy Under Secretary of Defense for Environmental Security, and ESTCP will allocate FY 2000 funds as follows:

Cleanup (including UXO)	44%
Pollution Prevention	32%
Compliance	16%
Undistributed Reductions and Support	8%

TECHNOLOGY TRANSFER

SERDP/ESTCP Kudos To . . .

BETSY RICE, PH.D.—Army Research Laboratory (ARL), Aberdeen Proving Ground, SERDP Principal Investigator, for receiving an Army Research Laboratory 1999 Technical Achievement Award for authoring a paper entitled, "Predicting the Heats of Formation of Energetic Materials Using Quantum Mechanical Calculations." This award recognizes authors of authoritative work and is presented for publications that are expected to become "classics" in their field. Dr. Rice and her team conducted this research with ARL and SERDP support under SERDP Project *PP-695: Recycling Propellants in Nonpolluting Supercritical Fluids—Novel Computational Chemistry Models for Predicting Effective Solvents.* All calculations for this effort were performed at the DoD High Performance Computing Site at ARL.

The importance of this paper is that gun propellant formulators need both "heats of formation" of energetic materials and impetus (joules/gram) as input to Interior Ballistic Codes. This input allows a priori calculation of performance of the gun propellant system. Essentially, Dr. Rice's results allow candidate propellant formulations to be evaluated BEFORE the material is synthesized.

To demonstrate its effectiveness, Dr. Rice's group recently applied its computational tool to design a new energetic material to serve as an advanced propellant ingredient. Heats of Formation calculations were performed along with Heats of vaporization and sublimation calculations. This new molecule has never been made, yet their theory indicates that it is stable and performs similarly to M30 and JA2 propellants. The benefit of this new material is realized with a reduction of flame temperature by 800-1200 degrees Kelvin. This translates to significantly reduced erosion of the gun tube by hot combustion gases.

Computational design significantly reduces life-cycle costs by not only reducing erosion, but also reducing non-trivial waste streams and VOC emissions created during experimental formulation.

DAN BURCH and **KEITH SIMS**—Naval Surface Warfare Center (NSWC), Crane, ESTCP Project Managers, for receiving the Small Business Administration's Tibbett's Award that recognizes efforts that effectively use the Small Business Innovation Research (SBIR Program) and other small business opportunities to foster business growth of participating companies and assist them to achieve competitive capabilities.

Working with the Demil Technology team led by Dan Burch of NSWC, Crane, Dan and Keith helped pioneer the Navy's efforts in energetic materials resource recovery and reuse (R3) activities. Seeking alternatives to open burning-open detonation (OB/OD), the team developed innovative technologies for R3 of valuable energetic materials contained in military munitions. NSWC instituted the SBIR program as part of the Navy's Ordnance Reclamation Program in 1989 and developed a cadre of small business experience with R3 expertise. When the Army's Industrial Operations Command implemented a master demilitarization contract approach, a significant percentage of the work was allocated to small businesses having this expertise.

Dan is a Project Manager and Keith is a Project Engineer on the ESTCP project, *Recovery and Reuse of HMX/RDX from Propellants and Explosives.* This was one of several non-SBIR funding sources that continued support for R3 projects with TPL, Inc., a small firm that has significantly expanded its capability and has become a major contributor in the DoD's operational demil program.

JEFFREY B. MORRIS, PH.D—Army Research Laboratory, Aberdeen Proving Ground, SERDP Principal Investigator, for being issued a patent on September 14th of this year for the development of a method to separate and recover TNT from high explosives using Supercritical Fluid Extraction (SCFE), specifically SCF carbon dioxide. This work was supported by SERDP under project *PP-660: Extraction and Recycling of LOVA Propellants Using Supercritical Fluids.*

Alternatives to OB/OD of TNT-based high explosives include melt-out and steam-out of the explosive from the projectile casing. While these processes avoid OB/OD, they do not result in the separation of TNT from the high explosive filler, such as HMX or RDX. The SCFE invention develops a method to do so without the use of VOC solvents. SCF carbon dioxide is more selective than organic solvents in the separation of TNT from organic fillers, thereby allowing for clean recovery and reuse of costly ingredients as low value commercial biasing agents.

PROGRAM
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- **PROPOSED FY 2000 NEW START PROJECTS** were reviewed by the Scientific Advisory Board (SAB) in August, September, and October, and the SERDP Council met to approve the overall FY 2000 Program at its annual meeting in September. Contracts still are being negotiated for non-Federal selectees.
- **THE FY 2001 SOLICITATION** is expected to be released on or about November 17, 1999. SERDP Exploratory Development (SEED) Statements of Need will be released in a separate solicitation on or about January 7, 2000. Please check the SERDP web site for the latest information and schedule.
- **THE PROGRESS DATA FOR THE FIRST QUARTER OF GOVERNMENT FY 2000 IS DUE JANUARY 31, 2000.** For assistance, contact your Program Manager Assistant.
- **COPIES OF ALL PRODUCTS/ REPORTS PARTIALLY OR WHOLLY SUPPORTED BY SERDP** should be sent to Mike Hathaway at the SERDP Program Office in order to keep the SERDP Staff current on SERDP results and to broaden all aspects of technology transfer. These topics include copies of papers, reports, abstracts, presentations, patents, etc. For more information, contact Mike Hathaway at (703) 506-1400 ext. 542 or via e-mail at Mike_Hathaway@labat.com.

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- **NEW START PROJECTS SHOULD INITIATE MONTHLY FINANCIAL REPORTING BEGINNING DECEMBER 5, 1999.** For assistance, contact your Program Manager.
- **QUARTERLY REPORTS FOR THE FIRST QUARTER OF GOVERNMENT FY 2000 ARE DUE JANUARY 5, 2000.** Should you need assistance, contact your Program Manager.

E◆S◆T◆C◆P (continued)

- **A FEDERAL CALL FOR PROPOSALS AND BROAD AGENCY ANNOUNCEMENT SOLICITATION FOR ESTCP FY 2001 PROJECT FUNDING** is expected to be released in mid-January 2000. Please check the ESTCP web site for the latest information and schedule.
- **NEW PUBLICATIONS NOW AVAILABLE ON THE ESTCP HOME PAGE www.estcp.org**

Protocol:

Draft Protocol for Evaluating, Selecting, and Implementing Monitored Natural Attenuation at Explosives Contaminated Sites

Cost and Performance Reports:

Compliance

Thermal Spray Removal of Lead-Containing Paint on Steel Structures

Venturi/Vortex Scrubber and Pushed Liquid Recirculation System for Controlling/ Recycling Chromium Electroplating Emissions

Fury: Robotic In-Situ Inspection/Condition Assessment System for Underground Storage Tanks

Pollution Prevention

Spent Acid Recovery Using Diffusion Dialysis

Shock-Absorbing Concrete (SACON) Bullet Traps for Small Arms Ranges

Cleanup

Permeable Reactive Wall Remediation of Chlorinated Hydrocarbons in Groundwater

Phytoremediation of Constructed Wetlands

MTADS: Multi-Sensor Towed Array Detection System

Assessment of the Remote Minefield Detection System (REMIDS)

POL Sensor Validation of SCAPS

Joint Small Arms Remediation

Natural Attenuation of Explosives in Groundwater

Enhanced In-Situ Anaerobic Bioremediation of Chlorinated Hydrocarbons in Groundwater

PARTNERS IN ENVIRONMENTAL TECHNOLOGY

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OCTOBER 1999 ◆ NUMBER 2

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Information and ideas for future articles are always welcome. Address comments, suggestions, mailing list requests, and address changes to

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for serdp and estcp

NOVEMBER 1999

November 17
The FY 2001 Solicitation for SERDP to be released on or about this date

November 30-December 2
The SERDP and ESTCP Partners in Environmental Technology Technical Symposium & Workshop

DECEMBER 1999

December 5
ESTCP New Start Projects to initiate monthly financial reporting

JANUARY 2000

January 5
ESTCP Quarterly Reports for the first quarter of Government FY 2000 due

January 7
The SERDP Exploratory Development (SEED) solicitation to be released on or about this date

Mid-January
Federal Call for Proposals and Broad Agency Announcement for ESTCP FY 2001 Project Funding to be released

January 31
SERDP Progress Data for the first quarter of Government FY 2000 due

RELATED CONFERENCES & EVENTS

November 30 - December 2
1999 Partners in Environmental Technology Technical Symposium & Workshop
Hyatt Regency Crystal City
Arlington, VA
For more information, call (703) 736-4548 or visit our web sites at www.serdp.org and www.estcp.org.
Sponsored by SERDP and ESTCP.

December 6-9
4th Annual Joint Services Pollution Prevention/ Hazardous Waste Management Conference and Exhibition
Henry B. Gonzales Convention Center
San Antonio, TX
For more information, call (247) 259-2572 or send e-mail to tthomas@ndia.org.

Through September 2000
Training course on Permeable Reactive Barriers for Remediating and Managing Contaminated Groundwater
Training sessions to be held in 10 EPA Regional cities throughout the country.
For more information, see www.trainex.org/prb.

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