PARTNERS IN ENVIRONMENTAL TECHNOLOGY

SERDP Strategic Environmental Research and Development Program

ESTCP

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INSIDE THIS ISSUE

3 Workshops Influence FY 2008 Solicitations

6 New Environmental Restoration Efforts Now Under Way

10 SERDP Congratulates Principal Investigators and Fellowship Recipients

11 New Documents Posted in Online Library

SERDP FY 2008 Request for Proposals Released in November; ESTCP's Solicitation to be Released in January

SERDP has issued both a Core and a SERDP Exploratory Development (SEED) solicitation. The Broad Agency Announcement was released on November 9, 2006. Pre-proposals are due January 4, 2007. The federal Call for Proposals also was released on November 9. Federal proposals are due March 8, 2007. All proposals in response to the SEED solicitation are due March 8, 2007.

Please visit www.serdp.org under the *Funding & Opportunities* link for additional information on these solicitations.

In early January, ESTCP will release its FY 2008 solicitation. Details will be available at www.estcp.org under the *Opportunities* link.

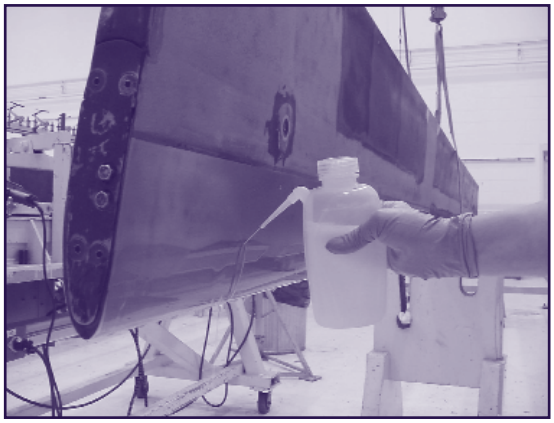
From Conceptualization to Commercialization: SERDP and ESTCP Develop Environmentally Friendly Surface Preparation Method for Weapons System Repair

The Department of Defense (DoD) is increasingly using adhesive bonding to join components and perform repairs that keep aircraft and other weapons systems in service. The integrity of these bonds is critical as failure could compromise the performance and safety of these weapons systems. Adhesive bonding performance is dependent on proper preparation of the metal substrate surfaces prior to applying the adhesives that hold a component or patch in place. Methods traditionally used for surface preparation involve the use of hazardous materials such as hexavalent chromium, a known carcinogen, and result in the generation of hazardous waste. An environmentally benign surface preparation alternative developed and commercialized for use on weapons systems with SERDP and ESTCP support not only provides environmental and cost benefits but also enhances mission readiness by decreasing equipment repair time and downtime.

To date, high-performance processes used by DoD and the private sector to prepare metal substrates for adhesive bonding involved anodizing or etching the substrate with a strong acid or base and applying hexavalent chromium for corrosion protection. The need to rinse these chemicals from the metal surface after preparation results in a hazardous waste stream. Typically, etching or anodizing is followed by applying a primer containing high levels of volatile organic compounds (VOC) as well as hexavalent chromium. Attempts to use alternative processes typically led to poor bonded joint performance and resulted in significant rework and increased risk to aircraft and crews. As regulations for hexavalent chromium exposure, hazardous waste disposal, and air emissions became more stringent, DoD needed improved alternatives to prepare substrates for adhesive bonding without adversely affecting bonded joint performance.

Applying a waterborne adhesion promoter to the metal substrate via sol-gel technology represents a viable alternative to the current hexavalent chromium- and VOC-containing surface preparation methods. Sol-gel, a contraction of "solution-gelation," is a process that has been around for many years but has been studied only in the last 15 years for preparing metal surfaces for adhesive bonding. Sol-gel coatings act as an interface between the metal substrate and the polymer-based adhesive or primer. The molecules in the sol-gel solution contain certain functionalities that chemically bond to the polymer and other functionalities that are attracted to the metal substrate. This direct chemical bonding mechanism results in superior adhesion that, in turn, helps the treated surface resist moisture attack and achieve long-term durability.

With SERDP and ESTCP support, researchers from the Air Force Research Laboratory, Naval Air Systems Command, U.S. Army Armament Research Development and

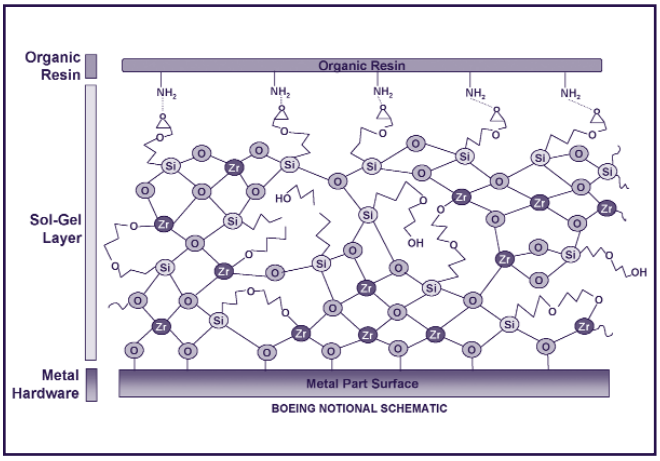


With SERDP and ESTCP support, researchers have developed and successfully demonstrated the cost-effectiveness and environmental benefits of the sol-gel process for metal adhesive bonding to repair military weapons systems.

See SOL-GEL TECHNOLOGY, page 2

Engineering Center (ARDEC), and Boeing have developed and refined the sol-gel processes for metal adhesive bonding and demonstrated that DoD can easily and effectively implement them for both depot- and field-level applications. Beginning in the mid-1990s, under the SERDP project *Non-Chemical Surface Preparation (WP-130)*, researchers from Boeing developed a sol-gel formulation intended specifically for use in metal surface preparations for adhesive bonding. A follow-on SERDP project, *Sol-Gel Technology for Low VOC, Non-Chromated Adhesive & Sealant Applications (WP-1113)*, focused on developing the processes by which the sol-gel solution would be used to prepare aluminum, titanium, and stainless steel surfaces for adhesive bonding. Both safety-of-flight-critical as well as less critical applications were considered, with the latter being able to employ simpler, quicker procedures more amenable to field-level application. With this foundation firmly established, the sol-gel technology recently was demonstrated and validated to be an effective, environmentally friendly alternative to conventional adhesive bonding surface preparation technologies on Air Force, Navy, and Army weapons systems under the ESTCP project *Demonstration/ Validation of Sol-Gel Surface Preparation for Metal Adhesive Bonding (WP-0204)*.

The unique sol-gel solution developed through SERDP and demonstrated under ESTCP is commercially available as AC-130 from AC Tech in Garden Grove, California. It contains no hexavalent chromium and negligible VOCs. With ESTCP support, the sol-gel technology was demonstrated for F/A-18, CH-46, and C-5 aircraft applications. In each of these demonstrations, sol-gel was proven to be an effective alternative, with tests showing sol-gel bond performance to be as good as or better than the performance of existing surface preparation methods. The demonstrations verified that the sol-gel technology was feasible and could be implemented at maintenance facilities across DoD for a wide variety of adhesive bonding applications with significant cost savings.



Sol-gel acts as an interface between metal substrates and the adhesive or primer. This unique chemical bonding ensures superior adhesion.

The sol-gel technology is applicable to many weapons systems, not only in the Services but also with original equipment manufacturers (OEM), and implementation provides substantial environmental and cost benefits. Using sol-gel instead of the current surface preparation process, DoD will decrease hexavalent chromium exposure, VOC emissions, and generation of hazardous wastes. Because the sol-gel process is faster than existing technologies, repairs are performed more rapidly—increasing throughput at maintenance facilities and decreasing equipment downtime. This streamlining translates to substantial cost savings. It is estimated that sol-gel surface preparation is resulting in an annual savings of $660,000 for C-5 aircraft depot-level bonding applications. For CH-46 aircraft repair, estimates show a cost avoidance of $300,000 per year over a 10-year period. A similar cost avoidance would be realized on the F/A-18 for bonded repairs, and F/A-18 horizontal stabilizer applications have already produced substantial payoffs.

SERDP and ESTCP's 10-year commitment helped ensure that the environmentally friendly sol-gel technology for metal adhesive bonding evolved from a concept to a commercialized product routinely used for depot-level and field-level bonding on the C-5 and CH-47 aircraft, as well as on Boeing commercial aircraft. More than 12 other weapons systems have also used the sol-gel technology, and numerous other applications continue to be explored by DoD and the private sector. Sol-gel is currently used by Air Force air logistics centers and bases, naval aviation depots, weapons systems OEMs, and several commercial airlines. This innovative surface preparation technique enhances the structural integrity of weapons systems through adhesive bonding, while providing significant environmental benefits and reducing the costs associated with maintenance and repair. Conservative estimates indicate a DoD cost savings of more than $2.3 million per year with current and future applications of this technology.

For more information, please contact Mr. James Mazza, U.S. Air Force, Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright-Patterson Air Force Base, OH, at (937) 255-7778 or via e-mail at james.mazza@wpafb.af.mil. ◆

Workshops Identify High-Priority Science and Technology Needs

SERDP and ESTCP Respond with Targeted Solicitations

Over the past 9 years, workshops sponsored by the SERDP and ESTCP programs have proven to be a unique and invaluable forum for identifying DoD's high-priority environmental needs. With participation by a variety of renowned experts providing diverse viewpoints from the military services, academia, and industry, each topical workshop (1) examines the current state of the science and engineering, (2) identifies gaps in knowledge and technology, and (3) prioritizes those gaps against DoD needs to determine where investments in research, development, test, and evaluation (RDT&E) could have the greatest impact on DoD's ability to address its environmental requirements. SERDP and ESTCP use this proven approach to develop solicitations for proposals and seek innovative solutions to DoD's high-priority needs.

Two workshops held in 2006 (highlighted below) addressed the characterization and remediation of dense nonaqueous phase liquid (DNAPL) source zones and environmentally benign metal plating and finishing for weapons platforms. Two additional workshops co-sponsored with the DoD Legacy Resource Management Program held later in the year identified RDT&E needs and expanded DoD partnerships with the cultural resources management community as well as with organizations that manage threatened, endangered, and at-risk species (TER-S) throughout the Pacific Islands region. Outcomes from these two other workshops will be presented in reports to be made available on the SERDP and ESTCP web sites. Results of all four workshops are already impacting current and future SERDP and ESTCP investment decisions.

SERDP and ESTCP Expert Panel Workshop on Reducing the Uncertainty of DNAPL Source Zone Remediation

March 7-8, 2006 ◆ Baltimore, Maryland

Participants

Forty representatives of the Air Force, Army, and Navy; Department of Energy (DOE); the Environmental Protection Agency (EPA); academia (Arizona State University, Clemson University, Colorado School of Mines, Colorado State University, Georgia Institute of Technology, Purdue University, Queens University, Rice University, Stanford University, Tufts University, University of California-Davis, University of Florida, University of Utah, University of Waterloo); and private industry (Camp Dresser & McKee Inc., CH2M HILL, Environmental Resources Management, GeoSyntec Consultants, GeoTrans, Inc., Groundwater Services, Inc., Haley & Aldrich, Inc., HydroGeoLogic, Inc., IST Inc., Malcolm Pirnie, Inc., North Wind Inc.).

DoD Need

Chlorinated solvents are the most prevalent contaminants at DoD sites. These solvents are released into the

See DNAPL WORKSHOP, page 4

SERDP and ESTCP Metal Finishing Workshop

May 22-23, 2006 ◆ Washington, DC

Participants

Fifty representatives from the Office of the Secretary of Defense (OSD); Army, Navy, Air Force, and Coast Guard Depots; Research Laboratories and Weapon Systems Program Manager's Offices; Propulsion Environmental Working Group (PEWG); private industry (Boeing, Pratt & Whitney, General Electric (GE), United Technologies Research Center (UTRC), Integrated Technologies Inc., Lockheed-Martin Corp, Faraday Technology, DemVal Inc, Caterpillar Inc., Curtis Metal Finishing, Sauer Engineering, Hughes Associates); and academia (Ohio State University and Purdue University) as well as Rowan Technology and The Policy Group.

DoD Need

Hard chrome, cadmium (Cd), and hexavalent chrome (Cr^{+6}) are used on all DoD weapons platforms to inhibit corrosion of weapons systems components that operate in harsh environments. New environmental regulations in

See METAL FINISHING WORKSHOP, page 4

DNAPL WORKSHOP, from page 3

subsurface as DNAPL that can persist for centuries and are both difficult and costly to remediate. Regulatory and public interest in the treatment of DNAPL source zones has been increasing despite the difficulties and uncertainties involved. SERDP and ESTCP have sponsored more than 40 projects designed to provide effective guidance and develop innovative technologies for more effective and less costly source zone characterization and remediation. While great progress has been achieved, significant challenges remain.

Workshop Objectives

The objectives were to define future research and demonstration needs and to provide guidance on whether, and under what circumstances, source zone remediation should be attempted; reasonable objectives for DNAPL source zone remediation at specific sites; and how to measure progress toward achieving those objectives.

Format

The workshop included introductory presentations to provide background for the workshop discussions, a poster session to highlight relevant research and demonstrations, and breakout sessions focused on three key areas (DNAPL source zone characterization, remediation, and long-term monitoring/remedial endpoints) and on prioritization of RDT&E needs to reduce the uncertainty of DNAPL source zone remediation.

Results

In addition to specific RDT&E needs, which are identified and prioritized in the final report (see *Products* section on page 5), the following overarching issues emerged:

Integrate Decision-Making Processes for Characterization and Remediation. The inherent uncertainties in addressing DNAPL source zones require an "observational approach," continually updating the conceptual site model, constantly evaluating all new information, and having available contingency plans to address plausible variations from anticipated conditions.

Improve Understanding of Source Function and Plume Response. The source function, or the rate of contaminant release into the ground-water flow, and the downgradient water quality response to source treatment are difficult to assess yet key to understanding and assessing the benefits of DNAPL source zone treatment.

Develop More Cost-Effective Methods. There is a need to improve the effectiveness while reducing the costs of characterizing, remediating, and monitoring source zones, as well as to develop guidance for the optimal uses of existing methods.

Establish Realistic Expectations for Treatment. The impacts of source zone treatment on remediation time

See DNAPL WORKSHOP, page 5

METAL FINISHING WORKSHOP, from page 3

the United States, Europe, and Asia are limiting or prohibiting the use of these toxic materials. Although military applications are exempt from the European regulations, these materials will become increasingly difficult and expensive to use as they are phased out of the private sector. In the long term, as environmentally benign alternatives become more widely available and accepted, it is likely that the military exemptions will disappear, subjecting DoD equipment that is sold or used abroad to the same stringent regulations faced by the private sector.

Workshop Objectives

The objectives were to strategically guide future environmental RDT&E investments and to support the transition of demonstrated environmentally benign metal plating and finishing technologies that meet or exceed performance standards for DoD weapons platforms.

Format

A plenary session that provided DoD, industry, and regulatory overviews was followed by breakout sessions grouped by types of weapons platform components and plating materials. The breakout session topics included hydraulic and pneumatic actuators; turbine engines for vehicles, ships, and aircraft; structural (load-bearing) components; gun barrels and small components (fasteners, pins, etc.); chrome plating (line-of-sight and non line-of-sight); Cd plating (line-of-sight and non line-of-sight); and Cr^{+6} pre- and post-treatments.

Results

Workshop attendees identified RDT&E needs that are applicable to the entire metal finishing industry as well as those specific to particular materials and applications. A complete list of metal finishing environmental technology needs is provided in the summary report (see *Products* section on page 5). Some of the major areas where future investments would be beneficial include the following:

Qualify Commercial Products. Commercial alternatives for Cd and Cr^{+6} exist but are not qualified for military use. Commercial products likely could be used as-is or adapted for many DoD applications.

Establish Valid Test Methods. A number of inadequacies in test methods were identified, particularly in hydrogen embrittlement and corrosion testing.

Develop Alternative Coatings that will not Spall. Spalling, the breaking off of metal surface coatings, is a problem with some hard chrome alternatives, especially those used in high stress applications such as landing gear on carrier-based aircraft. The elimination of spalling

See METAL FINISHING WORKSHOP, page 5

Program Development Update

SERDP

Proposals selected in response to the FY 2007 Core and **S**ERDP **E**xploratory **D**evelopment (SEED) solicitations were presented to the SERDP Scientific Advisory Board (SAB) for review at its September and October 2006 meetings, and the remaining projects will come before the SAB at its March 2007 meeting. Forty-seven projects were recommended for funding from the Core solicitation and eight projects from the SEED solicitation. Principal Investigators for projects approved by the SAB are being contacted to submit Project Plans and Obligation/ Expenditure Plans, as well as schedule project kickoff conference calls with the appropriate SERDP Program Manager. The SERDP Council met on September 28, 2006, and approved the FY 2007 Program Plan and the FY 2008 investment guidance. On November 9, SERDP released the FY 2008 Core and SEED solicitations. Seventeen Statements of Need (SON) were issued for the Core solicitation and two SONs for the SEED solicitation. Visit www.serdp.org and follow the *Funding Opportunities* link for details regarding the FY 2008 SON and schedule for submission.

ESTCP

In September 2006, full proposal submitters presented their proposed work to the ESTCP Technical Committees (ETC). Recommendations were made to the the ESTCP Director, who has selected projects to be funded in FY 2007, and proposal acceptance letters have been sent. Principal Investigators also are being contacted to submit Project Plans and Obligation/Expenditure Plans, as well as to schedule project kickoff conference calls with the appropriate ESTCP Program Manager. These plans must be submitted prior to release of FY 2007 funding.

The FY 2008 solicitation is planned for release early in January 2007. Watch www.estcp.org for details on these funding opportunities. ◆

DNAPL WORKSHOP, from page 4

frames are uncertain, and the likely endpoints for treatment or for transition to passive approaches and technologies are not well understood.

Analyze Existing Data. Critical evaluation of the rapidly increasing experience in source zone remediation could improve understanding of real-world costs and performance and provide valuable lessons learned for future projects.

Transfer Technologies. There is a need to disseminate information and develop best-practices manuals for project managers and remediation contractors.

Products

A final report documenting the workshop's results is now available in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org using W-06 as the Search Word. SERDP has released one FY 2008 Statement of Need (SON) as a result of this workshop on *Improved Understanding and Prediction of Plume Response to DNAPL Source Zone Architecture and Depletion*. Opportunities for further improvement in the characterization and remediation of DNAPL source zones will be discussed at the Partners in Environmental Technology Technical Symposium & Workshop. ◆

METAL FINISHING WORKSHOP, from page 4

would make alternative coatings better candidates for implementation.

Eliminate Cadmium on Fasteners. Fasteners are widely used by all of the Services to attach or join metal components. The elimination of Cd from this component would be a major step in the overall reduction of Cd from DoD applications.

Qualify Chromate Alternatives for all Major Applications and Develop Design Guidelines. Many alternatives to chromates are currently available; however, these alternatives typically work for only a few specific applications. If design guidelines are established, engineers and designers will be able to select a chromate alternative for specific applications more easily.

Products

A summary report of the workshop findings is available in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org using W-05 as the Search Word. SERDP has released two FY 2008 SONs as a result of this workshop—one on cadmium-free high strength fasteners and a second on understanding the mechanisms of how non-chrome inhibitors work. The Partners in Environmental Technology Technical Symposium & Workshop will feature the workshop's results and will support the transition of relevant technologies to the user community. ◆

Spotlight on SERDP and ESTCP FY 2006

Throughout 2006, new initiatives in all SERDP and ESTCP focus areas have

SERDP and ESTCP initiatives in Environmental Restoration focus on the technologies and strategies required to clean and restore contaminated sites, both to ensure that the lands can continue to be used for military training and to protect the health of the people who live and work on and near these sites. SERDP research and development efforts funded in FY 2006 are examining the distribution and impacts of subsurface remedial amendments; processes impacting the fate and transport of contaminants in sediments; development and placement of amendments for in situ remediation of contaminated sediments; and environmental fate and transport, containment, and treatment of energetic and propellant material releases on testing and training ranges. ESTCP investigators are demonstrating state-of-the-art technologies and approaches for characterizing, remediating, and monitoring contaminants of concern in groundwater, soil, and sediments, as well as developing guidance and design tools for remedial project managers to select and implement technologies in the field. Results from these initiatives will help DoD address the challenges of range sustainment and implement efficient and cost-effective approaches to remedy the effects of past practices.

SERDP Research

Additional information on these efforts can be found at www.serdp.org under the Research Projects *link.*

Development of Environmental Data for Navy, Air Force, and Marine Munitions (ER-1480)

Principal Investigator: Jay Clausen/U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC)-Cold Regions Research and Engineering Laboratory (CRREL)

To complement SERDP-funded research on energetic residues at Army ranges, this project will provide a greater level of understanding of the deposition and fate of energetic residues on Air Force, Navy, and Marine Corps ranges. Information obtained will allow DoD to identify those munitions and munitions constituents posing a threat to the environment and aid the Services in conducting range assessment studies and developing range sustainability plans.

Characterization and Fate of Gun and Rocket Propellant Residues on Testing and Training Ranges (ER-1481)

Principal Investigator: Tom Jenkins/U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC)-Cold Regions Research and Engineering Laboratory (CRREL)

While transport process descriptors have been developed for all the principal high explosives, their transformation products, and their formulations, similar data for propellant constituents and formulations that are crucial to transport predictions and risk assessment are lacking. The objective of this project is to define the distribution and fate of propellant residues associated with the firing of munitions.

Dissolution Rate, Weathering Mechanics and Friability of TNT, Comp B and Octol (ER-1482)

Principal Investigator: Bonnie Packer/Army Environmental Center

This project will obtain the scientific data required to characterize explosive residues from military munitions. Specifically, researchers will quantify how quickly detonation residues of TNT, Comp B, and Octol disaggregate and dissolve and then use the data to model contaminant fate as a function of particle size. Dissolution is the rate-limiting step preceding biodegradation or aqueous transport.

Control of Manganese Dioxide Particles Resulting from In Situ Chemical Oxidation Using Permanganate (ER-1484)

Principal Investigator: Michelle Crimi-Martin/East Tennessee State University

In situ chemical oxidation (ISCO) using permanganate is increasingly being applied at hazardous waste sites. The objective of this project is to identify and evaluate a stabilization aid that will facilitate transport of manganese dioxide particles, products of the reaction of permanganate with organic contaminants and naturally-reduced subsurface materials, to avoid their deposition in well screens, filter packs, and subsurface areas of high contaminant saturation.

Fundamental Study of the Delivery of Nanoiron to DNAPL Source Zones in Naturally Heterogeneous Field Systems (ER-1485)

Principal Investigator: Greg Lowry/Carnegie Mellon University

Dense nonaqueous phase liquids (DNAPL) represent a long-term source of soil and groundwater contamination. This project will (1) determine the hydrogeochemical processes governing the migration and distribution of nanoiron in DNAPL-contaminated zones of a naturally heterogeneous subsurface and (2) quantify the effect of nanoiron treatment on DNAPL source mass, architecture, and contaminant mass emission.

Multi-Scale Experiments to Evaluate Mobility Control Methods for Enhancing the Sweep Efficiency of Injected Subsurface Remediation Amendments (ER-1486)

Principal Investigator: John McCray/Colorado School of Mines

The efficiency of in situ remediation technologies that involve injecting remediation amendments into the subsurface is often limited by the ability to obtain an efficient sweep of these amendments within the target zone of contamination. In this project, researchers will investigate and elucidate the processes that control the subsurface distribution of injected remediation amendments within geologic heterogeneities.

Development and Optimization of Targeted Nanoscale Iron Delivery Methods for Treatment of NAPL Source Zones (ER-1487)

Principal Investigator: Linda Abriola/Tufts University

The objective of this project is to investigate nanoscale zero-valent iron (ZVI) systems that will increase chloroethene destruction through targeted delivery. Application guidelines will be developed to optimize the use of nanoscale ZVI delivery systems for effective treatment of heterogeneous DNAPL source zones.

Enhanced Reactant-Contaminant Contact Through the Use of Persulfate In Situ Chemical Oxidation (ER-1489)

Principal Investigator: Richard Watts/Washington State University

This project will investigate the potential for persulfate to diffuse into low permeability regions of the subsurface, promoting contact with contaminants to enhance their in situ destruction. Use of activated persulfate can expand ISCO capabilities beyond the treatment of chlorinated ethenes, including benzene, toluene, ethylbenzene, and xylene (BTEX); polychlorinated biphenyls (PCB); and chlorinated alkanes.

Initiatives in Environmental Restoration

been highlighted. This issue features Environmental Restoration efforts.

Improved Monitoring Methods for Performance Assessment During Remediation of DNAPL Source Zones (ER-1490)

Principal Investigator: Robert Siegrist/Colorado School of Mines

Common and widely employed practices for monitoring DNAPL compounds in the subsurface are not clearly understood and may lead to flawed conclusions regarding in situ remediation effectiveness. The objective of this project is to develop an enhanced understanding and improved methods for obtaining and utilizing monitoring data from groundwater samples and direct-push cores.

Rational Selection of Tailored Amendment Mixtures and Composites for In Situ Remediation of Contaminated Sediments (ER-1491)

Principal Investigator: Upal Ghosh/University of Maryland Baltimore County

Most DoD aquatic environments are burdened by multiple contaminants, commonly consisting of both organic and inorganic compounds. This project will identify, screen, compare, and contrast potential amendment mixtures for their optimal performance, both alone and in combination, to address such complex mixtures. Researchers also will develop a rational selection process for use of these multifunctional amendments.

Quantifying Enhanced Microbial Dehalogenation Impacting the Fate and Transport of Organohalide Mixtures in Contaminated Sediments (ER-1492)

Principal Investigator: Max Haggblom/Rutgers University

The objectives of this project are to (1) extend techniques and amendments that enhance microbial dehalogenation for placement in sediments contaminated with organohalide mixtures, including PCBs, polychlorinated dibenzo-p-dioxins and furans, and chlorinated pesticides and (2) develop methods and tools to monitor the effectiveness of the biostimulation process. Remediation of organohalide-contaminated sediments in situ avoids the redistribution of contaminants and decreases overall costs.

Reactive Capping Mat Development and Evaluation for Sequestering Contaminants in Sediments (ER-1493)

Principal Investigator: Amy Hawkins/Naval Facilities Engineering Service Center

In situ capping with chemically reactive materials can provide a physical barrier to remobilization of sediment-bound contaminants and a means to sequester dissolved contaminants as they out-flux through the cap via groundwater flow. This project will develop a mixture of chemically reactive materials suitable for incorporation in an engineered geotextile mat to create a composite active capping system capable of widespread deployment to effectively sequester both metal and organic contaminants.

An Integrated Field and Laboratory Study of the Bioavailability of Metal Contaminants in Sediments (ER-1494)

Principal Investigator: Nicholas Fisher/Stony Brook University

In this project, researchers will evaluate the bioavailability of arsenic, cadmium, chromium, and lead from sediments with divergent characteristics and relate this information to the phase speciation of these metals in the sediments. An understanding of the geochemical and biological processes governing uptake allows models to be established for making site-specific predictions of how metals will bioaccumulate.

Modeling and Decision Support Tools Based on the Effects of Sediment Geochemistry and Microbial Populations on Contaminant Reactions in Sediments (ER-1495)

Principal Investigator: Jeanne Van Briesen/Carnegie Mellon University

The objective of this project is to provide a better understanding of the geochemical factors influencing PCB biodegradation and to develop a model capable of assessing site-specific biodegradation potential based on measured parameters. The model will incorporate congener-specific biodegradation pathways, geochemically modified microbial population parameters, and uncertainty analysis to evaluate the likelihood of natural attenuation or the success of bioremediation.

Using Passive Polyethylene Samplers to Evaluate Chemical Activities Controlling Fluxes and Bioaccumulation of Organic Contaminants in Bed Sediments (ER-1496)

Principal Investigator: Philip Gschwend/ Massachusetts Institute of Technology

Current methods for assessing contaminant mobility and bioavailability require extraction and analysis of sediments, with subsequent interpretation of the data using sediment-water partition coefficients that are poorly known and using the assumption that sorption equilibria have been established. This project will demonstrate the efficacy of using polyethylene strips to assess the hazard posed by sediment beds contaminated by organic pollutants such as polycyclic aromatic hydrocarbons (PAH) and PCBs.

Development of Accurate Methods for Characterizing and Quantifying Cohesive Sediment Erosion Under Combined Current-Wave Conditions (ER-1497)

Principal Investigator: Joseph Gailani/U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC)-Coastal and Hydraulics Laboratory

The objective of this project is to develop methods for reliably measuring and predicting erosion of contaminated fine-grained sediments under bottom shear stress conditions that represent combined wave and current action. These methods will reduce the uncertainty that now complicates risk assessment and evaluation of remediation options for contaminated sediments.

Sustainable Range Management of RDX and TNT by Phytoremediation with Engineered Plants (ER-1498)

Principal Investigator: Neil Bruce/University of York, United Kingdom

This project will engineer transgenic grasses to contain and degrade RDX in the root zone of explosives-contaminated soil. Since munitions often consist of both RDX and TNT, it also will be necessary to engineer resistance to TNT, as this explosive is highly toxic to plants. These plants promise to provide a self-sustaining, inexpensive, and environmentally friendly approach that can be used over large areas of land to prevent groundwater contamination.

Phytoremediation for the Containment and Treatment of Energetic and Propellant Material Releases on Testing and Training Ranges (ER-1499)

Principal Investigator: Jerald Schnoor/The University of Iowa

Phytoremediation represents a cost-effective and sustainable long-term strategy for risk management at military testing and training ranges. The objective of this project is to understand the mechanisms by which toxic energetic compounds, susceptible to biodegradation, are detoxified in contaminated subsurface soils by plants native to the site, either by direct uptake and transformation in plant tissues or by microbial activity in the rhizosphere.

See ENVIRONMENTAL RESTORATION INITIATIVES, page 8

Spotlight on SERDP and ESTCP FY 2006

Throughout 2006, new initiatives in all SERDP and ESTCP focus areas have

Plant-Based Containment/Treatment of Energetic Material Releases for Application on Testing and Training Ranges (ER-1500)
Principal Investigator: Petronella Best/U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC)-Environmental Laboratory
This project seeks to advance the capabilities for phytoremediation of distributed source contamination on training and testing ranges. Researchers will identify herbaceous plant species that are tolerant of range-relevant contaminants, quantify their phytoextraction and phytostabilization capacities for RDX and TNT, and assess explosives containment and leaching in vegetated soil cores.

Innovative In-Situ Remediation of Contaminated Sediments for Simultaneous Control of Contamination and Erosion (ER-1501)
Principal Investigator: Anna Sophia Knox/Savannah River National Laboratory
The objective of this project is to develop an active capping technology that contains and stabilizes a wide range of contaminants (metals, PAHs, and PCBs) in marine and freshwater environments by designing in situ stabilization treatments that combine chemical and biological amendments. Leveraging both active and passive methods, the system will simultaneously reduce contaminant toxicity and/or bioavailability while creating a resistant barrier that reduces the disturbance of subsurface sediments.

Application of Tools to Measure PCB Microbial Dechlorination and Flux into Water During In-Situ Treatment of Sediments (ER-1502)
Principal Investigator: Joel Baker/University of Maryland
Recent studies have shown that strong-sorbing materials such as soot and activated carbon present in sediment significantly reduce bioavailability of hydrophobic pollutants. This project focuses on how these particles influence microbially mediated dehalogenation reactions and dissolved-sorbed partitioning of PCBs into water. Two new assessment tools will be employed to quantify the bioavailability of sediment-bound contaminants and evaluate the efficacy of in situ activated carbon treatments.

Biological Processes Affecting Bioaccumulation, Transfer, and Toxicity of Metal Contaminants in Estuarine Sediments (ER-1503)
Principal Investigator: Celia Chen/Dartmouth College
This project will investigate fundamental pathways and processes controlling the movement of metal contaminants from estuarine sediments to biotic receptors. Specifically, the exposure, bioaccumulation, trophic transfer, and toxicity of mercury, arsenic, cadmium, and lead will be studied in intertidal sediments and associated benthic food webs. Researchers also will develop tools for assessing the site-specific availability of metals and evaluating changes in food webs resulting from metal contamination.

Rhizosphere Bacterial Degradation of RDX, Understanding and Enhancement (ER-1504)
Principal Investigator: Stuart Strand/University of Washington
Microbial communities are known to use RDX as a source of nitrogen, but their natural activities in many soil and groundwater environments are not sufficient to remove the toxic compounds to levels required by regulation. Manipulation of the plant community offers a way to enhance microbial degradation of RDX with a minimum of expense and maintenance. This project will focus on understanding the relationship between rhizosphere bacteria and host plants in environments exposed to munitions.

An Enzymatic Bioassay for Perchlorate (ER-1530)
Principal Investigator: John Coates/University of California, Berkeley
Several highly sensitive techniques based on ionic chromatography, mass spectrometry, and Raman spectrometry have been developed for low-level perchlorate detection. However, all these techniques are expensive and require highly trained personnel. The objective of this project is to develop a highly sensitive and specific analytical colorimetric assay for the rapid identification of perchlorate in environmental samples.

ESTCP Demonstrations

Additional information on these efforts can be found at www.estcp.org under the Technologies *link.*

Development of DoD Guidance for Monitored Natural Recovery at Contaminated Sediment Sites (ER-0622)
Principal Investigator: Victor Magar/ENVIRON International Corporation
The objective of this project is to develop a DoD guidance document for monitored natural recovery (MNR) at contaminated sediment sites. The guidance document will establish the principles and evaluation criteria for comprehensively and cost-effectively evaluating MNR as a remedial option. Thorough and consistent evaluation of the physical, chemical, and biological processes that contribute to MNR can reduce environmental risk to DoD site owners and remedial project managers (RPM).

In Situ Chemical Oxidation for Groundwater Remediation: Technology Practices Manual (ER-0623)
Principal Investigator: Robert Siegrist/Colorado School of Mines
ISCO has the potential to be a prominent remediation technology for application to DoD sites where groundwater is contaminated by organic chemicals. This project will advance a standard-of-practice that enables more predictable, cost-effective application of ISCO by developing and testing an integrated protocol built on a framework of decision-support tools for determining site-specific viability and best practices.

Demonstration and Evaluation of Solid Phase Microextraction for the Assessment of Bioavailability and Contaminant Mobility (ER-0624)
Principal Investigator: Danny Reible/University of Texas at Austin
This project will develop and standardize a procedure using solid phase microextraction (SPME) devices for measuring freely dissolved pore water concentrations and demonstrate the relationship of these measurements to contaminant flux, bioavailability, and bioaccumulation under field conditions, with the aim of improving assessments of potential exposure and risk and the ability to manage contaminated sediments.

Initiatives in Environmental Restoration

been highlighted. This issue features Environmental Restoration efforts.

Enhanced Monitored Natural Attenuation of Dichloroethene Through Manganese Addition (ER-0625)
Principal Investigator: Robert Borden/North Carolina State University
Field studies have shown that tetrachloroethene and trichloroethene often naturally attenuate to dichloroethene (DCE) without intervention. However, at many sites, DCE persists, and low levels of DCE can migrate thousands of feet. The objective of this project is to develop and demonstrate a process that enhances the natural capacity of an aquifer to degrade DCE as well as vinyl chloride by increasing the amount of bioavailable manganese dioxide.

Development of a Design Tool for Planning Aqueous Amendment Injection Systems (ER-0626)
Principal Investigator: Robert Borden/North Carolina State University
This project will develop a set of tools to assist design engineers in developing effective, reasonably efficient systems for distributing aqueous amendments for in situ treatment of groundwater contaminants. Primary applications for the tools will be for design of ISCO systems using permanganate and in situ anaerobic bioremediation (ISAB) systems using soluble substrates and emulsified oil. As technology evolves, this general approach should be applicable to the distribution of other aqueous amendments.

Loading Rates and Impacts of Substrate Delivery for Enhanced Anaerobic Bioremediation (ER-0627)
Principal Investigator: Bruce Henry/Parsons Corporation
Effective application of enhanced in situ anaerobic bioremediation depends primarily on the delivery of appropriate levels of substrate amendments in the subsurface and the development of optimal geochemical conditions for anaerobic biodegradation to occur. In this project, investigators will compare techniques used to calculate or design substrate loading rates, conduct and evaluate field process monitoring efforts to optimize injection scenarios, and determine the effectiveness and cost of these methods.

Validation of Sampling Protocol and Promulgation of Method Modifications for the Characterization of Energetic Residues on Military Training Ranges (ER-0628)
Principal Investigator: Alan Hewitt/U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC)-Cold Regions Research and Engineering Laboratory (CRREL)
This project will promulgate guidance for sampling activities associated with characterizing the surface loading of energetic residues on military training ranges. If adopted, the sampling guidelines and proposed modifications to Environmental Protection Agency (EPA) Methods 8330 and 8095 for processing these samples will result in more accurate estimates of explosive concentrations on training ranges and facilitate management decisions.

Adaptive Long-Term Monitoring at Environmental Restoration Sites (ER-0629)
Principal Investigator: Karla Harre/Naval Facilities Engineering Service Center
Given the importance and expense of long-term monitoring (LTM), it is essential that resources be directed towards obtaining only the essential data needed for monitoring current conditions and detecting changes in those conditions relative to remediation targets. The objective of this project is to demonstrate and validate the use of the Hazard Management System Inc. (HMSI) monitoring system for reducing costs and improving effectiveness of LTM through adaptive assessment while achieving remediation goals.

Demonstration/Validation of the Snap Sampler Passive Groundwater Sampling Device (ER-0630)
Principal Investigator: Louise Parker/U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC)-Cold Regions Research and Engineering Laboratory (CRREL)
The objective of this project is to demonstrate that passive (no-purge) groundwater sampling technology and the relatively newly developed Snap Sampler can provide technically defensible analytical data for the wide spectrum of analytes that are of concern to DoD. Where passive sampling is appropriate, data-quality improvements and cost reductions over low-flow sampling include better delineation of contamination with depth within the screened zone, reduced volumes of purge water waste, reduced labor, and reduced equipment costs.

Enhanced Degradation of Energetic Contamination in Live Firing Ranges Located in Tropical Environments (ER-0631)
Principal Investigator: Steven Spengler/Environet, Inc.
Concerns exist about the potential impact to the surrounding environment from the release of energetic compounds during live-firing range exercises conducted in the Pacific Region. This project will evaluate (1) in situ degradation of energetic compounds within open burning/open detonation (OB/OD) soils as a result of natural plant-mediated degradation and (2) in situ enhanced aerobic and anaerobic bioremediation with low-cost additives to promote the degradation of energetic compounds within the shallow vadose zone pore water and tropical soils.

Field Demonstration, Optimization, and Rigorous Validation of Peroxygen-Based ISCO for the Remediation of Contaminated Groundwater (ER-0632)
Principal Investigator: Richard Watts/Washington State University
Recent advances in the use of activated peroxygens (hydrogen peroxide and persulfate) for ISCO hold promise for the rapid remediation of dissolved, sorbed, and DNAPL contaminants. In this project, investigators will apply state-of-the-art peroxygen ISCO process chemistry and phased optimization to a representative field site to demonstrate its full potential, validate its effectiveness, and provide RPMs knowledge of more effective process conditions for peroxygen ISCO implementation.

SERDP Recognizes Award-Winning Principal Investigators and Fellowship Recipients

Congratulations to…

Dr. Jo Ann Ratto Ross, Ms. Jeanne Lucciarini, Ms. Danielle Froio, and Mr. Christopher Thellen from the Army Materiel Command, U.S. Army Natick Soldier Center, who were recently selected to receive a 2006 Army Research and Development Achievement (RDA) Award for developing nanocomposites for military food packaging. RDA awards recognize scientific and technical excellence or leadership. Under the SERDP project *Reduction of Solid Waste Associated with Military Rations and Packaging (SI-1270),* Dr. Ratto Ross and her project team are developing a nanocomposite packaging material that is biodegradable because it eliminates the need for a foil barrier. These environmentally friendly nanocomposites are expected to meet the operational and performance requirements of combat ration shelf life and lead to significant reductions in the amount of solid waste associated with military rations and packaging.

SERDP Principal Investigator **Dr. Virginia Dale,** Oak Ridge National Laboratory, who was awarded the Distinguished Scientist Award for 2006 from UT-Battelle for her scientific and personal accomplishments in advancing the science of ecology and in supporting natural resources management. Her identification and development of tools for resource managers has served both to develop new scientific approaches and understanding and to transfer that knowledge to decision makers. By helping develop the field of ecological indicators and tools to aid environmental decision making, Dr. Dale's ideas have contributed to evaluating conservation effectiveness and improving natural resources management on Department of Defense lands. Her work on identifying ecological indicators and conducting resource management with a broad-scale view and in depth understanding of ecological interactions has been tested on military installations and is influencing the way that resources are managed by five federal agencies and by nongovernmental organizations.

SERDP Principal Investigator **Dr. Tissa Illangasekare,** Colorado School of Mines, who received a grant under the Defense University Research Instrumentation Program (DURIP) to build a unique experimental setup for studying subsurface environmental processes. DURIP supports the purchase of state-of-the-art equipment that augments current university capabilities or develops new university capabilities to perform cutting-edge defense research. Of 933 proposals received, 183 awards totaling $40.4 million are being made to 88 academic institutions through this program. Dr. Illangasekare was awarded a grant for research instrumentation that involves a climate wind tunnel with variable temperature, wind speed, and humidity conditions that can be coupled to large soil tanks to study near-surface flow and transport problems in the vadose zone where the atmosphere provides boundary conditions.

Congratulations to…

…the five graduate students who were selected to receive fellowships from SERDP to attend the Ecological Society of America (ESA) 91st Annual Meeting August 6-11 in Memphis, Tennessee. These fellowships are awarded to increase awareness of conservation opportunities involving DoD and to promote future research. The award-winning students and their paper topics are as follows.

- **Ms. Elizabeth Boughton**
  University of Central Florida
  Wetland plant assemblages across an agricultural disturbance gradient in Central Florida

- **Ms. Carolyn Kurle**
  University of California Santa Cruz
  Introduced rats indirectly alter marine communities

- **Ms. Katherine Weeks**
  Clemson University
  How will your research contribute to management of natural resources on federal lands?

- **Ms. Sunshine Brosi**
  University of Tennessee, Knoxville
  Steps toward restoration of butternut Juglans cinerea L. to Southeastern North American forests

- **Ms. Sophie Parker**
  University of California, Santa Barbara
  Seasonal trends in N cycling in a California grassland

PROGRAM NOTES

SERDP

- **THE FY 2008 SERDP CORE AND SERDP EXPLORATORY DEVELOPMENT (SEED) SOLICITATIONS** were released on November 9. Visit www.serdp.org under the *Funding Opportunities* link for specifics about the Statements of Need and schedule.

ESTCP

- **THE FY 2008 ESTCP SOLICITATION** will be released on or about January 4, 2007. Visit www.estcp.org under the *Funding & Opportunities* link for specifics about the solicitation and schedule.

Recent Additions to the Online Library

The following are a sample of new publications now available in the SERDP and ESTCP Online Library (http://docs.serdp-estcp.org). Access them by entering the project number (e.g., 0125) under Search Word. Other documents may be accessed by entering a keyword or selecting the relevant search filters.

Environmental Restoration

- Cost & Performance Report: Push-Pull Tests for Evaluating the Aerobic Cometabolism of Chlorinated Aliphatic Hydrocarbons (ESTCP ER-9921)
- Protocol: Enhanced In Situ Bioremediation Using Emulsified Edible Oil (ESTCP ER-0221)
- Workshop Report: SERDP and ESTCP Expert Panel Workshop on Reducing the Uncertainty of DNAPL Source Zone Remediation (September 2006)
- Technical Report: Design Document for Passive Bioventing (ESTCP ER-9715)
- Technical Report: A Review of Biofouling Controls for Enhanced In Situ Bioremediation of Groundwater (ESTCP ER-0429)
- Final Report: Max Flux Tool Kit to Evaluate Groundwater Impacts, Attenuation, and Remediation Alternatives (ESTCP ER-0430)
- Final Report: Impacts of Fire Ecology Range Management (FERM) on the Fate and Transport of Energetic Materials on Testing and Training Ranges (SERDP ER-1305)

Munitions Management

- Cost & Performance Report: Laser Neutralization of Hazardous UXO (ESTCP MM-9909)
- Cost & Performance Report: Handheld, Broadband Electromagnetic UXO Sensor (ESTCP MM-0036)
- Cost & Performance Report: Handheld Sensor for Unexploded Ordnance Discrimination (ESTCP MM-0108)
- Cost & Performance Report: Decontamination of Test Range Metal Debris Using a Transportable Flashing Furnace (ESTCP MM-0412)
- Final Report: Statistical Methods and Tools for UXO Site Characterization (SERDP MM-1199)

Weapons Systems and Platforms

- Cost & Performance Report: Validation of Alternative to Ozone-Depleting Chemicals Used in Oxygen Line Cleaning (ESTCP WP-9910)
- Cost & Performance Report: Demonstration of the Replacement of the Dyes and Sulfur in the M18 Red and Violet Smoke Grenades (ESTCP WP-0122)
- Workshop Report: SERDP/ESTCP Metal Finishing Workshop Summary
- Final Report: A Field Program to Identify TRI Chemicals and Determine Emission Factors from DoD Munitions Activities (SERDP WP-1197)
- Final Report: Low-Cost and High-Impact Environmental Solutions for Military Composite Structures (SERDP WP-1271)

PARTNERS IN ENVIRONMENTAL TECHNOLOGY

STRATEGIC ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM (SERDP)

&

ENVIRONMENTAL SECURITY TECHNOLOGY CERTIFICATION PROGRAM (ESTCP)

INFORMATION BULLETIN

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FOR SERDP AND ESTCP

JANUARY 2007

January 4
Pre-proposals due in response to the SERDP FY 2008 Core Solicitation Broad Agency Announcement

A Federal Call for Proposals and a Broad Agency Announcement for ESTCP FY 2008 project funding to be released on or about this date

January 15
SERDP quarterly progress reports due for the first quarter of government FY 2007

ESTCP quarterly progress reports due for the first quarter of government FY 2007

FEBRUARY 2007

February 1
Full proposals requested from selected proposers responding to the SERDP FY 2008 Core Solicitation Broad Agency Announcement

February 5-9
Environmental Restoration (ER) In-Progress Review (IPR) meetings

FEBRUARY 2007

February 12-13
Sustainable Infrastructure (SI) In-Progress Review (IPR) meetings

February 14-16
Weapons Systems and Platforms (WP) In-Progress Review (IPR) meetings

February 27-March 1
Munitions Management (MM) In-Progress Review (IPR) meetings

MARCH 2007

March 8
Full proposals due in response to the SERDP FY 2008 SERDP Exploratory Development (SEED) Solicitation

Full proposals due in response to the SERDP FY 2008 Core solicitation Federal Call and Broad Agency Announcement

March 15
Pre-proposals due in response to the ESTCP FY 2008 Solicitation Broad Agency Announcement

RELATED CONFERENCES & EVENTS

January 22-25
Fourth International Conference on Remediation of Contaminated Sediments
Savannah, Georgia

Cosponsored by SERDP and ESTCP

For more information, visit http://www.battelle.org/environment/er/conferences/sedimentscon/default.stm.

May 7-10
The Ninth International Symposium on In Situ and On-Site Bioremediation
Baltimore, Maryland

Cosponsored by SERDP and ESTCP

For more information, visit http://www.battelle.org/environment/er/conferences/biosymp/default.stm.

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