SERDP & ESTCP Announce 2015 Projects of the Year

Notable Efforts Include Research on Lighting Controls That Save Energy & Reduce Costs

THE STRATEGIC ENVIRONMENTAL Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) have selected nine Projects of the Year in recognition of outstanding research and technology developments that will benefit the U.S. Department of Defense (DoD). These efforts are helping DoD enhance its mission capabilities, improve its environmental performance, and reduce costs. The following are recipients of this honor and descriptions of their award winning projects. Additional information is available at www.serdp-estcp.org.

Energy and Water ESTCP Project of the Year

Dynamic Exterior Lighting for Energy and Cost Savings in DoD Installations

Dr. Satyen Mukherjee
Philips Research, a division of Philips Electronics North America Corporation

Exterior lighting accounts for nearly ten percent of the electricity consumed at DoD military installations. Many of the existing exterior lighting systems use inefficient high pressure sodium or metal halide lights that are controlled with photosensors, which turn lights on regardless of

Dynamic lighting controls have the potential to reduce DoD's energy usage and provide significant cost savings.

usage patterns. Dr. Satyen Mukherjee of Philips Research and his team demonstrated that military installations can achieve significant electricity savings, by implementing efficient light emitting diode (LED) lighting sources and smart lighting controls.

The project evaluated three exterior lighting applications at U.S. Army Base Fort Sill, Oklahoma:

1. Dynadimmer for parking lots
2. Starsense for street lighting
3. Lighting on Demand for maintenance areas

Dynadimmer is a standalone fixture-by-fixture control architecture that uses a preprogrammed dimming profile integrated in the LED driver to reduce the light levels during periods of low occupancy. Starsense is a radio frequency mesh-networked system in which each light fixture is controlled independently using an outdoor lighting controller added to each LED fixture. The Lighting on Demand system couples the Starsense mesh network with motion detection sensors, allowing dynamic adaptive control of the light levels in each fixture.

Advanced controls with LED light sources reduced energy consumption for exterior lights by 60 to 90 percent depending on the application. These energy savings were achieved while also improving the quality of light in terms of color rendering and brightness. In all three systems, the lighting levels measured in the demonstrations exceeded Illuminating Engineering Society of North America illuminance requirements.

The DoD could use efficient LED lighting sources and smart controls to achieve significant energy savings and improve illumination in exterior lighting applications at their military installations across the country.

Environmental Restoration ESTCP Project of the Year

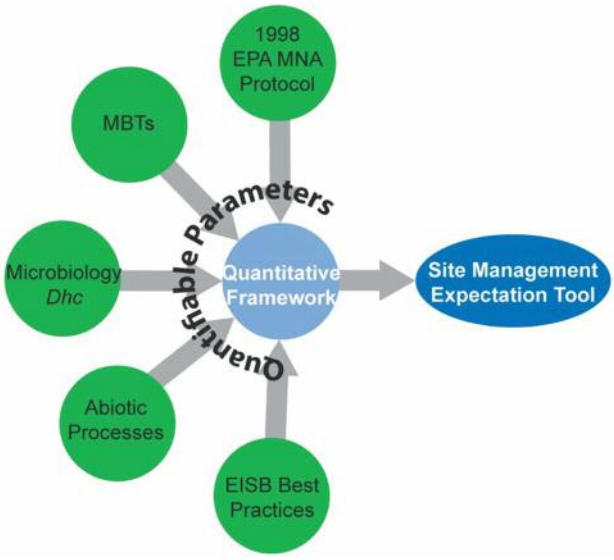
Development and Validation of a Quantitative Framework and Management Expectation Tool for the Selection of Bioremediation Approaches at Chlorinated Solvent Contaminated Sites

Ms. Carmen A. Lebrón, Private Consultant (formerly of the Naval Facilities Engineering and Expeditionary Warfare Center)

Chlorinated solvents are the most prevalent groundwater contaminants, with an estimated 15,000 to 25,000 contaminated sites in the United States. Naturally-occurring biological and abiotic processes contribute to contaminant attenuation in most hydrogeological systems, including contaminated aquifers. Over the years, monitored natural attenuation (MNA) and enhanced bioremediation have become common remedial approaches. At sites where natural processes alone are sufficient to meet site-specific remediation goals, MNA is implemented as the most cost-effective remedy. At sites where MNA is not sufficient to meet remediation goals, it may be necessary to enhance biological and/or abiotic degradation processes to jump start natural attenuation.

Ms. Carmen Lebrón and her team developed BioPIC, a systematic approach and management expectation tool for determining if MNA, biostimulation, and/or bioaugmentation will be the most appropriate remedy, based on site-specific conditions at contaminated groundwater sites. BioPIC uses the quantitative relationships among biotic and abiotic parameters that contribute to the degradation of chlorinated ethenes to assist a user in determining the best pathway to selectively enhance degradation. The tool allows the user to confirm degradation and subsequently aid in the determination of the relevant degradation pathway(s) based on the assessment of specific analytical parameters.

This pragmatic approach will generate comprehensive and defensible remediation strategies, as well as reduce both capital and operation and maintenance costs for groundwater remediation. It can also minimize potential environ-



BioPIC provides an approach for determining the most appropriate remediation strategy based on a site's specific conditions.

mental impacts of more invasive bioremediation treatment options. Overall, BioPIC will aid remediation project managers in evaluating and selecting the most appropriate biologically-mediated remediation strategy for a given chlorinated-solvent contaminated site.

Resource Conservation and Climate Change ESTCP Project of the Year

Aerial Application of Acetaminophen-Treated Baits for Control of Brown Tree Snakes

Dr. Brian S. Dorr
U.S. Department of Agriculture's (USDA) National Wildlife Research Center

An ESTCP-funded project has developed a methodology to combat the brown tree snake infestation on the island of Guam.
USDA Wildlife Services

Infestations of the brown tree snake (*Bioga irregularis*) have led to the extirpation of all but two of the 12 native forest birds on the island of Guam. In addition, the snakes have caused millions of dollars in damage to the island's electrical power distribution system. An anticipated increase in the U.S. military presence on Guam will increase the flow of outbound cargo that could overtax the present operational control methods, such as trapping, hand capture, and canine inspection of outbound cargo; which deter the spread of snakes from Guam to other locations that are conducive to the snake's habitat, including Hawaii.

An ESTCP-funded project led by Dr. Brian Dorr from the USDA's National Wildlife Research Center demonstrated an aerial control method deploying dead neonatal mice baits treated with acetaminophen, which is toxic to the snakes, in order to reduce snake populations in forested sites on Guam. The treated mice were individually attached to four-foot-long paper flag streamers and deployed by hand from helicopters. The baits entangle the treated mice in vegetation above ground level, where they can be consumed by brown tree snakes. Some of the mice were implanted with a radio transmitter for tracking purposes.

This demonstration resulted in a significant and sustained reduction in the indices of snake numbers at the demonstration sites. The team is now working to develop an automated bait delivery system, which will provide for rapid bait release and reduce overall delivery costs.

Weapons Systems and Platforms ESTCP Project of the Year

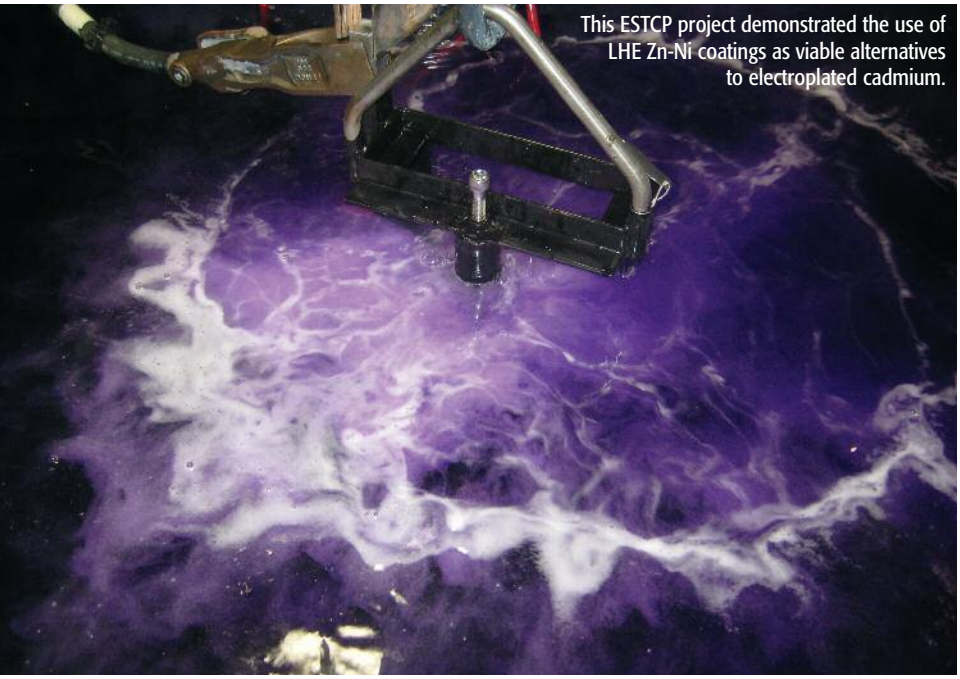
Demonstration/Validation of Zinc-Nickel as Replacement for Cadmium/Cyanide Plating Process for Air Force Landing Gears

Mr. David Frederick
417th Supply Chain Management Squadron (SCMS),U. S. Air Force (USAF) Landing Gear Team

Replacement of cadmium plating in aircraft landing gear manufacturing and maintenance is a high priority for the DoD. Military aircraft maintenance depots use cadmium plating extensively to apply corrosion resistant coatings to various high-strength steel aircraft components during manufacture, repair, and overhaul. Wastes generated from these plating operations must abide by strict U.S. Environmental Protection Agency (EPA) emissions standards and Occupational Safety and Health Administration permissible exposure limits. The operational costs to comply with these rules and the increased turnaround times for processing of components require DoD to find an environmentally benign alternative to cadmium.

Mr. David Frederick of the 417th SCMS, USAF Landing Gear Team, and his team demonstrated the use of low hydrogen embrittlement (LHE) zinc-nickel (Zn-Ni) for a wide variety of applications. The LHE Zn-Ni meets or exceeds all acceptance criteria for coating quality, adhesion, fatigue, corrosion, and hydrogen embrittlement. Based on test results and in-field performance tracking, LHE Zn-Ni

has been implemented within the Air Force overhaul facility and is being adopted by industry as an alternative to cadmium plating. Under the ESTCP-funded project, Hill Air Force Base has processed more than 1,000 landing gear components using LHE Zn-Ni. Some of these components have been flying on aircraft for the past three years. Numerous commercial entities have tested and accepted LHE Zn-Ni, and installed LHE Zn-Ni plating lines following the USAF lead. In addition, several DoD maintenance depots are exploring the utility of Zn-Ni plating based on the success of this project.



This ESTCP project demonstrated the use of LHE Zn-Ni coatings as viable alternatives to electroplated cadmium.

The LHE Zn-Ni coatings for military aircraft landing gear that were successfully demonstrated and transitioned by this project will help eliminate environmental and worker safety concerns associated with cadmium used in DoD plating operations.

Environmental Restoration SERDP Project of the Year

Lead and Antimony Speciation in Shooting Range Soils: Molecular Scale Analysis, Temporal Trends, and Mobility

Dr. Thomas Trainor
University of Alaska Fairbanks

Soil contamination is a concern at many firearms training facilities. Lead is the primary metal of concern, as it makes up approximately 90 percent, by mass, of a typical bullet and is a common constituent in rockets, mortars, grenades, and Howitzer rounds. In addition to lead, a number of other potentially toxic trace metals and metalloids are of concern. Bullet alloys generally include antimony, arsenic, bismuth, and silver; copper or nickel jacket commonly form bullet casings. Fragments of bullets and other munitions debris are highly susceptible to oxidation and weathering processes in soil systems, leading to the release of aqueous metal or metalloid species into soils. The potential for metals or metalloids stored in soils to migrate from ranges into surface or subsurface aquatic systems is a human health and environmental concern.

Dr. Thomas Trainor of the University of Alaska Fairbanks and his team have conducted an in-depth analysis of the changes in lead and antimony speciation that occur over time in range soils. They constructed shooting range impact berms to observe the progression of metal oxidation and track the evolution of mobile species that form as a result of fragment weathering processes, under field conditions. Through this effort, they determined the efficacy of soil amendments to reduce metal and metalloid mobility and developed surface-specific analytical tools to complement traditional geochemical analytical methods. The team is now completing studies that will further the understanding of the factors that control the mobility and speciation of lead and antimony in soils, that enhance the use of passive sensors and surface-specific speciation methods, and that test promising remediation scenarios, based on cost-effective chemical amendments to the soils.

The results of this study have improved the understanding of lead and antimony mobility through range soils. This comprehensive understanding of the processes controlling mobilization versus retention of species, associated with bullet fragment weathering in small arms training range soils, is essential for assessing long-term environmental risk, for understanding the efficacy of remediation scenarios, and for identifying what materials to incorporate into future training range or impact area designs. This work will lead to technical guidance for remediation program managers and regulators to monitor geochemical conditions pertinent to weathering of munitions constituents in soils and surrounding environments.

Munitions Response SERDP Project of the Year

Continuous Monitoring of Mobility, Burial, and Re-Exposure of Underwater Munitions in Energetic Near-Shore Environments

Dr. Peter Traykovski
Woods Hole Oceanographic Institution

Long Time Series Measurements of Munitions Mobility in the Wave-Current Boundary Layer

Dr. Joseph Calantoni
Naval Research Laboratory

Assessing and predicting the burial, mobility, and re-exposure of underwater munitions is an important component of the management and potential remediation of underwater munitions sites. Munitions from former or active DoD installations may migrate underwater or to the near-shore environment and become re-exposed, which would pose human safety concerns. Multiple DoD research efforts are working to improve understanding of the hydrodynamic mechanisms that drive munitions burial and mobility, and current research aims to quantify these forces within parameterized models.

Dr. Calantoni and his team deployed their equipment to record in-situ time-series measurements of boundary layer processes responsible for munitions mobility.

Dr. Traykovski and his team at Woods Hole Oceanographic Institution approached this problem by collecting field measurements on munitions in the highly energetic, sandy, near-shore environment of Long Point, Massachusetts. Continuous measurements were obtained using in-situ rotary sidescan sonar and an ultra-short baseline acoustic tracking system. They found that the migration of munitions was highly dependent on sandwave migration, munitions density, and storm event strength. By collecting high quality data sets and developing foundational models, Dr. Traykovski has provided a baseline for understanding the factors that influence munitions migration and set the standard for future research.

Dr. Calantoni and his team at the Naval Research Laboratory deployed equipment to record in-situ time-series measurements of boundary layer processes responsible for munitions mobility while simultaneously monitoring the mobility of surrogate munitions. They obtained sector scanning sonar imagery measurements within a highly energetic, sandy environment at Duck, North Carolina, and Panama City Beach, Florida. The project team observed munitions burial at multiple water depths (6 meters (m) and 8 m) and incorporated these observations into analyses of horizontal and lateral munitions mobility. These datasets provide information that will be used to verify and validate existing mobility models and develop new conceptual models for fate and transport of munitions. The data collected for this study highlight the role of hydrodynamics, near-shore bathymetry, and munition density in determining the mobility of munitions.

Resource Conservation and Climate Change SERDP Project of the Year

Hydroecology of Intermittent and Ephemeral Streams: Will Landscape Connectivity Sustain Aquatic Organisms in a Changing Climate?

Dr. Julian D. Olden
University of Washington

Dr. David A. Lytle
Oregon State University

Intermittent and ephemeral streams play a significant role in supporting the ecological diversity in the south-

The ecological information on ephemeral and intermittent stream ecosystems obtained by this project will help DoD managers better conserve the biodiversity in this region.

western United States. Long-term use of military installations and ranges in this region is, in part, dependent on the ability to maintain the continued ecological functioning of the land base in this region, where dryland streams provide critical habitat and population connectivity for obligatory aquatic species. Improvements in the fundamental understanding of the links between hydrologic and ecological processes in arid and semi-arid environments will aid resource managers in the proactive conservation of species at risk and their habitats on and around DoD installations.

A SERDP-funded project led by Dr. Julian Olden of the University of Washington and Dr. David Lytle of Oregon State University examined how hydrology, hydrologic connectivity, and other riverine characteristics influence the community structure and population genetics of amphibian and aquatic insect species on Fort Huachuca, Arizona, and in the surrounding Sky Island mountain ranges. By employing field studies, quantitative modeling in relation to hydrology, riparian vegetation, geomorphology, and innovative molecular genetics, the project team quantified stream characteristics at multiple spatial scales and showed how aquatic species with different life-history strategies respond to dryland stream ecosystems in the Southwest.

This project provided key ecological information on ephemeral and intermittent stream ecosystems that contain most of the biodiversity in the southwestern United States and for which DoD has significant management responsibility. These results will not only help DoD managers better conserve this biodiversity today, but also in the future under a changing climate.

Weapons Systems and Platforms SERDP Project of the Year

Novel Coatings Systems for Use as High Performance Chemical Agent Resistant Powder Topcoats

Mr. Mark J. Wytiaz
The Sherwin-Williams Company

Chemical Agent Resistant Coatings (CARC) are used by DoD for the protection of military assets. Current solvent-borne and water-dispersible CARC topcoats contribute approximately 2.3 million pounds of volatile organic compounds (VOC) and hazardous air pollutants to the environment each year. For decades, DoD has recognized the need to develop powder coatings, which contain no solvents, as a means to greatly reduce these emissions. The key challenges to developing powder coatings for CARC topcoats are achieving chemical warfare agent resistance, extremely low gloss, and superior exterior durability.

Mr. Mark Wytiaz of Sherwin-Williams and his team established a fundamental understanding of coatings materials and their interactions, which led to the successful development of a CARC powder topcoat technology. They produced topcoats in Tan 686, Green 383, and Black 37030, which together represent nearly 95 percent of the military's needs. The new CARC coatings use blends of incompatible resins, formulated with low loadings of highly efficient fillers and pigments that are key to meeting the low-gloss requirement.

The three CARC powder topcoats have been or are being qualified against the military specification requirements for

This micrograph shows the novel resins used to formulate new chemical agent resistant powder coatings.

listing on the Qualified Products Database. Field trials verified coating performance and validated the success of the project. Coatings products are currently in transition to original equipment manufacturers, maintenance depots, and the Defense Logistics Agency.

These innovative powder coatings offer the benefits of a technology that is absent of solvent, emits nearly zero VOCs, can be recycled, and is compatible with existing CARC systems. In addition, testing to-date proves that the exterior durability of this coating is superior to any liquid CARC system, supporting DoD's initiative for corrosion prevention and mitigation.

About SERDP & ESTCP

SERDP and ESTCP are DoD's environmental research programs, harnessing the latest science and technology to improve DoD's environmental performance, reduce costs, and enhance and sustain mission capabilities. SERDP and ESTCP respond to environmental technology requirements common to all of the military Services, complementing the Services own research programs. The programs promote partnerships and collaboration among academia, industry, the military Services, and other Federal agencies. Investments are managed in five program areas:

1. Energy and Water
2. Environmental Restoration
3. Munitions Response
4. Resource Conservation and Climate Change
5. Weapons Systems and Platforms

SERDP and ESTCP are independent programs managed from a joint office to coordinate the full spectrum of efforts, from basic and applied research to field demonstration and validation.

SERDP is DoD's environmental science and technology program, planned and executed in partnership with the Department of Energy and the EPA, with participation by numerous other Federal and non-Federal organizations. The program focuses on cross-service requirements and pursues solutions to the Department's environmental challenges while enhancing and sustaining military readiness.

ESTCP is DoD's environmental technology demonstration and validation program. Project researchers conduct formal demonstrations at DoD facilities and sites in operational settings to document and validate improved performance and cost savings. Demonstration results are subject to rigorous technical reviews to ensure that the conclusions are accurate and well supported by data.

For more information, visit www.serdp-estcp.org. ⚓

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