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U.S. ARMY
ENVIRONMENTAL CENTER

ENVIRONMENTAL TECHNOLOGY DIVISION

Innovative Technology Demonstration, Evaluation and Transfer Activities

FY 1997 ANNUAL REPORT

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Introduction

This report contains information on environmental technology projects "in progress" at the U.S. Army Environmental Center's Environmental Technology Division (ETD). These project summaries will help readers to better understand the division's work and capabilities.

Technology is a major weapon in the Army's efforts to defend the nation and protect its environment. Through these programs, the U.S. Army Environmental Center gives the Army ready access to the most effective and affordable environmental tools.

Our Mission

ETD adapts, demonstrates and delivers tools to help the Army sustain readiness, protect resources and improve soldiers' quality of life. Our programs enable the Army to test and implement cost-effective technologies in pollution prevention, conservation, compliance and cleanup. From cleanup devices to better ways of doing business, these innovations protect the environment while supporting military operations, installation management and materiel development.

Our Technology Development and Transfer program connects technology developers and users in three important stages:

- **Adapt**
  We assess Army environmental needs and work with researchers and future users to adapt technologies in government labs or find "off the shelf" commercial tools with potential military application.
- **Demonstrate**
  We produce "real world" cost and performance data by testing lab-proven technologies in field demonstrations.
- **Deliver**
  We help transfer successful products to the Army community, tracking technology performance and user needs even after the demonstration.

Program Support

ETD's experienced scientists and engineers, with expertise in all environmental areas, are organized into functional teams that address these areas. They provide the support necessary to move the technology from the laboratory to the field.

Pollution Prevention

The Army tries to eliminate pollution from all operations and activities. ETD demonstrates and transfers cost-effective industrial process changes and technologies designed to prevent pollution.

Conservation

The Army manages 24 million acres of land, which include a variety of natural and cultural resources. ETD supports Army efforts to protect these irreplaceable resources while providing realistic stages for military training.

Compliance

Army installations must comply with laws and regulations governing wastewater discharge, noise abatement, air quality, and management of solid and hazardous waste. ETD programs keep the Army ready to meet constant changes in environmental laws.

Cleanup

Many Army sites hold remnants from past training, testing and industrial operations. ETD supports Army efforts to clean up these areas by providing cost-effective technologies to remove pollutants from soil, surface water and groundwater.

What's Inside?

The FY 1997 ETD Annual Report is organized by the following categories:

- **Pollution Prevention**
- **Conservation**
- **Compliance**
- **Environmental Cleanup**
- **Project Focus: Range XXI**
- **Project Focus: SCAPS**
- **Project Focus: UXO**
- **Other Environmental Areas**
- **Appendices**

Project descriptions are organized into several sections:

- **Purpose**
  What problem does the project address?
- **Benefits**
  How does the project help its users?
- **Technology Users**
  Who will use the technology?
- **Background**
  Why develop such a technology?
- **Description**
  How does the technology work? What's the development approach?

- **Applicability**
  What environmental research and development requirements or laws does this project meet?
- **Accomplishments and Results**
  So far, what results have been achieved?
- **Limitations**
  What limitations might affect the use of this technology?
- **Resource Support**
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- **Follow-On Program Requirements**
  What additional requirements are anticipated?
- **Point of Contact**
  Who do I contact for more information?
- **Program Partners**
  What organizations are participating in the project?

  (Appendix B contains a consolidated list of partners.)
- **Publications**
  Selected publications relating to the project.

Section headings that do not apply to the project are omitted.

Pollution Prevention

ANTIFREEZE RECYCLING DEMONSTRATION

While antifreeze is an essential fluid used in Army and Department of Defense (DoD) vehicles, it presents a management challenge due to its toxicity and widespread use. Recycling antifreeze will protect the environment and conserve operation and maintenance resources that would otherwise be spent on disposing old and purchasing new antifreeze.

PURPOSE

To gain experience in installing, training and operating DoD-approved antifreeze recycling units.

BENEFITS

Recycling antifreeze will reduce disposal costs for ethylene glycol, which is one of the top 10 chemicals in the Toxic Release Inventory report. Recycling antifreeze is cost effective and has a payback period of about two years.

TECHNOLOGY USERS

Army installation staff, maintenance personnel and environmental coordinators.

BACKGROUND

In 1993, the Mobility Technology Center - Belvoir approved two commercially available antifreeze recycling systems that met the specifications for MIL-A-46153. These systems include the KFM Corporation's *Cool'r Clean'r Coolant Purification System* and the Finish Thompson Inc.'s *BE Series (BE-15 or BE-55) Coolant Reclaimer Systems*. These systems were approved in the laboratory but had never been tested in the field. This project aims to develop user-friendly manuals for both recycling systems and transfer that information to the field for Army use.

DESCRIPTION

Military specifications require changing antifreeze at specific intervals, a practice that generates millions of gallons of waste antifreeze. This project demonstrates commercial antifreeze recycling technology in Army motor pools. The results will be user-friendly manuals and acceptance of recycled antifreeze — thereby lowering vehicle maintenance costs.

This project has installed approved units at four operating sites, under U.S. Army Forces Command, U.S. Army Training and Doctrine Command, U.S. Army Reserve Command and the National Guard Bureau. The purpose is to gain experience installing, starting up and operating these units and to publish the lessons learned for Armywide use. Researchers will develop training and maintenance guidance for Army-specific use of this equipment.

Once the demonstration is complete, user manuals will be updated and sent to Army users. These manuals will present a step-by-step approach to antifreeze recycling, allowing soldiers in the field to operate the unit.

Accomplishments and Results

Units have been installed at four demonstration sites at Fort Belvoir, Virginia. The field demonstration there was scheduled for completion by November 1997. Field manuals also should be updated by that time.

As part of a one-year demonstration to judge the system's ability to process used military MIL-A-46153 antifreeze, a Cool'r Clean'r System was installed at the 88th U.S. Army Regional Support Center in Indianapolis, Indiana. A BE-55C Coolant Recycler was installed at the Department of Logistics Maintenance Facility at Fort Drum, New York, as part of a one-year field demonstration. A BE-55C Coolant Reclaimer was installed at Camp Dodge in Johnston, Iowa, for a one-year field test.

Applicability

Andrulis Report Requirement:

- 3.7.d Substitution and Recycling of Antifreeze

Point of Contact

Peter Stemniski

Program Partners

U.S. Army Environmental Center
TACOM Fluids and Fuels Group
Fort Bliss, Texas
Camp Dodge, Iowa
88th Regional Support Command, Indiana
Fort Drum, New York

Publications

Antifreeze Recycling User's Guide (available from POC).
Belvoir Research, Development and Engineering Center, Letter Report 94-2.

Aqueous-Based Cleaner Evaluation and the ChemFree Project

Many Department of Defense (DoD) facilities have experienced problems with PD-680, a dry cleaning and degreasing solvent, for maintenance and repair activities. Numerous federal, state and local regulations limit the use of PD-680 because of its classification as a toxic substance, a flammable material and a hazardous waste after use or extended storage.

Purpose

To provide technical data on the ChemFree SW-2 SmartWasher System, an aqueous-based cleaning system, which can be used to evaluate and determine the aqueous-based cleaner's applicability and ability to meet U.S. Army Forces Command's (FORSCOM) diverse maintenance and repair requirements.

Benefits

The protocol developed under this effort will provide the Army a much needed tool with which to evaluate aqueous cleaners proposed as potential solvent substitutes. Identification of solvent substitutes will significantly reduce the monetary and regulatory burdens associated with the use, handling, storage and disposal of hydrocarbon-based solvents such as PD-680.

Technology Users

Army maintenance and repair operations.

In addition, per Army Regulation (AR) 70-12, the U.S. Army Tank-Automotive and Armaments Command Research, Development and Engineering Center's (TARDEC) Mobility Technology Center (MTC) Fuels and Lubricants Division is the DoD executive agent for all ground fuels and lubricants and manages the PD-680 federal specification. As such, MTC is responsible for evaluating, qualifying, approving and authorizing solvents required for operation and maintenance of all Army materiel, including aviation and ground systems.

Background

In June 1996, FORSCOM awarded a mandatory-use contract to ChemFree for the purpose of providing parts-cleaning services to installation maintenance activities. After a short-term trial use, a few installations either refused to use ChemFree or removed the parts washers already in place. These actions were taken by the maintenance activities due to reports of rusting and corrosion of parts and equipment after being cleaned with the ChemFree SmartWasher system.

To resolve the controversy, FORSCOM requested that the U.S. Army Environmental Center (USAEC) provide assistance focused on substantiating or disproving field-performance claims. The effort has been initiated to determine the performance, safety and quality capabilities of the ChemFree aqueous-based cleaner.

Description

This effort has been initiated to determine the performance, safety and quality capabilities of the ChemFree aqueous-based cleaner. Due to the lack of a protocol appropriate for determining performance information for aqueous-based solvents, a test protocol is being developed that will provide methods and criteria for evaluating potential aqueous-based solvent substitutes. Thus, there will be added benefit to the Army, and possibly DoD, derived from having a tool to evaluate potential aqueous-based solvent substitutes.

The test protocol is in the final stages of preparation and test execution will begin once the test protocol is approved by all relevant stakeholders. The proposed test protocol consists of three subtests: cleaner evaluation; material compatibility; and service test. The cleaner evaluation subtests will determine the basic characteristics of the cleaning solution. The material compatibility subtests will determine the compatibility of the cleaner with the materials that FORSCOM wants cleaned. The service test will provide a quick indication of how effective the ChemFree cleaner is for the actual parts provided by FORSCOM. Both test protocol development and test execution are being performed by the U.S. Army Aberdeen Test Center (ATC).

Applicability

Andrulis Report Requirements:

- 3.4.a Alternatives to Ozone Depleting Substances
- 3.1.a Solvents/Cleaner Substitution/Recycling
- 2.1.a Volatile Organic Compound Emission Control

Executive Order 12856 requires a 50% reduction in the total release of toxic chemicals to the environment by December 31, 1999.

The National Emission Standards for Hazardous Air Pollutants rule requires a 59% reduction in toxic solvents and a 63% reduction in chlorinated solvents. Many federal, state, and local regulations limit the use of PD-680 due to its classification as a hazardous waste.

Accomplishments and Results

The last effort to identify environmentally compliant products was a Defense Logistics Agency (DLA) program conducted by MTC in 1995 to identify environmentally compliant solvents (ECS) capable of replacing the existing PD-680 solvents. This program evaluated 82 commercially available ECS to determine whether they perform equivalent to PD-680. Of the 23 ECS found to perform equivalent to PD-680, eight were selected and subjected to field demonstrations at Fort Hood, Texas; Fort Lewis, Washington; and Kelly AFB, Texas. The candidate ECS representing two types — odorless hydrocarbons or hydrocarbons with D-LIMOMENE additive — were successfully used to clean weapons systems, ground vehicles and equipment, and aviation materiel. All candidate ECS are nontoxic, not listed under any EPA toxic or hazardous classification, and perform as well as existing PD-680 products.

The Air Force and Navy have been contacted to determine what efforts they have conducted and to prevent duplicating their efforts. The Air Force gained limited experience with the ChemFree SmartWasher during a six-month field test and evaluation sponsored by the Air Force Management and Equipment Evaluation Program (MEEP). During the field test the cleaner was only tested on vehicle parts and steam plant machinery. The test resulted in favorable findings and a National Stock Number was assigned to the product.

The Navy uses vendor-furnished performance information to make its hydrocarbon-based solvent substitution procurement decisions. The Navy has indicated that it does not have a standard or evaluation program in place to verify vendors' performance claims.

Limitations

The use of PD-680 is specified in roughly 800 maintenance manuals (or lube orders) that are tied to specific military specifications. It is virtually impossible to identify an aqueous-based substitute that will be appropriate for all applications. Thus, once a potential aqueous-based solvent replacement is identified, more rigorous bench and field tests may be required. In addition, TRADEC-MTC has indicated that all lube orders that specify use of PD-680 will have be reviewed to determine the appropriateness of PD-680 replacement.

Resource Support

U.S. Army Forces Command

Follow-On Program Requirements

Cost data associated with replacement of solvents with aqueous products is not widely available within the Department of the Army. Where cost data is available it is generally on an installation-by-installation basis and sketchy at best. Recent efforts to identify these costs have been unsuccessful due to the reluctance of many installations to divulge this information. Future efforts should focus on developing uniform reporting criteria before data are compiled. Concerns in compiling this information range from those over procurement and contractor proprietary information issues, to national security interests.

Point of Contact

A.J. Walker

Program Partners

U.S. Army Forces Command
U.S. Army Environmental Center
U.S. Army Aberdeen Test Center
U.S. Army Aviation and Missile Command
U.S. Army Tank-Automotive and Armaments Command
U.S. Army Armament Research, Development and Engineering Center
U.S. Army Acquisition and Pollution Prevention Support Office

PUBLICATIONS

William Newton, et. al., “Draft Final Abbreviated Test Plan of the ChemFree Enzyme-Based Aqueous Solvent Performance Test,” TECOM Project No. 9-CO-1 60-000-387, August 1997.

In-Sik Rhee, Carlos Venez., “Field Demonstration for PD-680 Solvents Replacement,” TARDEC Technical Report No. 13730, October 1996.

In-Sik Rhee, Carlos Venez., Karen Von Bernewitz, “Replacement of PD-680 Solvents for General Maintenance of DOD Equipment,” TARDEC Technical Report No. 13643, September 1995.

TARDEC Technical Advisory Message #92, Substitutes for PD-680, Dry Cleaning and Degreasing Solvent, November 1996.

Fuel Filtration Additive Unit

Maintenance of equipment stored for deployment often generates large quantities of waste as fuels and other fluids degrade and must be changed. Purifying these fluids provides a means to eliminate diesel fuel waste.

Purpose

To eliminate, through reclamation, the need for expensive disposal of contaminated diesel fuel.

Benefits

The Fuel Filtration Additive Unit (FAU) has not been recognized through a formal requirement document, though it has been listed as a fuel handling equipment requirement by the Army Quartermaster School. By developing a performance-based purchase description, existing commercial and government standards for diesel fuel will be incorporated without mandating a specific design. This will allow installations to adapt the FAU to their specific environmental needs. The FAU will increase vehicle readiness, provide a tool for the "one fuel on the battlefield" concept, and save money by reducing fuel disposal costs and utilizing contaminated fuels. The FAU eliminates the need for expensive disposal of contaminated diesel fuel, which is considered a hazardous waste.

Technology Users

Army installations, depots and other DoD facilities.

Background

The FAU is used to reclaim diesel fuel, which can be considered a hazardous waste. The nature of tactical vehicles forces them to experience long dormancy periods. During this period, diesel fuel tends to break down, creating free water and allowing for microbial buildup and deposits. These contaminants disrupt vehicle operation by plugging filters, increasing motor wear, and decreasing engine performance. The FAU provides a quick, efficient, and inexpensive means of removing these contaminants while injecting additives to prevent further fuel decomposition.

Many facilities have utilized the FAU unit. A prototype unit has been used at Fort Stewart, Camp Pendleton, Twenty-Nine Palms and Blount Island Marine Command. Blount Island was so impressed that it bought its own FAU with numerous additions and upgrades.

Description

The FAU approach will aid the user community by developing a performance-based purchase description. The description will be based on a market survey of fabricators and vendors for the FAU. This will be achieved by placing a notice in the Commerce Business Daily. A field test plan will be created to assist the user in the application of the FAU and additive injections during field operations. Finally, there will be a need to continue assisting in procurement, training, field support, and technology transfer to fulfill the user needs.

Applicability

Andrulis Report Requirement:

- 3.9.f Direct Reuse of Waste Oil

Accomplishments and Results

Blount Island Command uses its unit to clean every vehicle fuel cell coming off the prepositioned Marine ships after their 30-month cruise. The command reported a payback period of less then one year on its FAU unit; savings in diesel fuel disposal and replacement paid for the unit.

The FAU prototype has helped several installations deal with fuel-contamination problems. In addition, Combat Equipment Group Asia is interested in purchasing up to three units to fulfill its mission.

The original unit continues to demonstrate its usefulness around the country. The purchase description has been completed and is available for public release. An article was placed in the *Army Logistician* for technology transfer purposes.

Limitations

The FAU is a collection of off-the-shelf technologies, so costs vary. The purchase description will help users design and contract for the production of their own FAU.

Follow-On Program Requirements

Support for Military District of Washington (MDW) will continue through the preparation of a procurement package for the FAU. The draft report of the performance purchase description will also be completed.

Fact sheets are being created on the FAU. Blount Island Command is willing to dedicate space on its World Wide Web home page to explain the FAU, and information regarding these projects will be added to the USAEC Home Page.

Fort Belvoir has created a guidance manual. Through FY 1998, the project will assist installations in procurement of FAUs, collect cost and performance information on existing equipment, and create a “decision tree” and draft report.

Point of Contact

Dennis Teefy

Program Partners

U.S. Army Environmental Center
TACOM Fuels and Lubricants Technology Team
Aberdeen Test Center, Test and Evaluation Command (TECOM)

Publications

Purchase Description of the FAU.

Hazardous Waste Quantification at a Representative FORSCOM Installation

Except for activities operated by private contractors at installations, filing Emergency Planning and Community Right-to-Know Act (EPCRA) reports is a relatively new requirement for the Army. Methods for characterizing waste streams will help installations determine which potential releases must be reported and which are exempt from reporting requirements.

Purpose

To identify overall chemical usage and hazardous waste streams at a representative U.S. Army Forces Command (FORSCOM) installation, then process the data to identify potential releases of EPCRA Section 313 exempt and non-exempt Toxic Release Inventory (TRI) chemicals.

Benefits

By characterizing their waste streams, installations can determine which potential releases can be classified as EPCRA Section 313 exempt and non-exempt TRI chemicals.

Technology Users

Army installations with EPCRA reporting requirements.

Background

The Emergency Planning and Community Right-to-Know Act of 1986 was crafted to provide the public with information on toxic and hazardous chemicals processed by industrial facilities in their communities. EPCRA also created emergency planning and notification requirements to protect the public from releases of extremely hazardous substances. Except for activities operated by private contractors at installations, filing EPCRA reports is a relatively new requirement for the Army. The requirement originates with Executive Order 12856 (signed in August 1993), which directs federal facilities to comply with EPCRA and the Pollution Prevention Act of 1990. Before August 1993, Department of Defense policy directed the Army to conform to the intent of EPCRA regarding Threshold Planning Quantity and release notifications, but not submitting EPCRA Section 312 Tier II and Section 313 Toxic Release Inventory Form R reports.

EPCRA requires that chemical manufacturers and processors report data on emissions and disposal of 643 toxic chemicals to the TRI. EPCRA also requires facilities that have hazardous substances to comply with emergency planning, notification and reporting requirements. Executive Order 12856 requires the Army and other federal agencies to comply with all requirements of EPCRA including TRI reporting and emergency planning requirements.

The Environmental Protection Agency may decide that the U.S. Army non-industrial and troop-based installations are not meeting the full intent of EPCRA Section 313 TRI reporting. Therefore, the EPA may repeal some of the DoD non-mission related EPCRA Section 313 TRI exemptions. By expanding the scope of EPCRA-regulated activities, a tremendous burden may be placed on FORSCOM headquarters and installations. Therefore, as a proactive measure, an investigation of the potential impact of expanded EPCRA TRI reporting is warranted.

DESCRIPTION

Representatives from the U.S. Army Construction and Engineering Research Laboratories visited Fort Lewis, Washington, and collected data necessary for this project. Data collected for the final report will show which chemicals might no longer be exempt from TRI reporting. This will give Army installations a chance to evaluate what could happen if some TRI chemicals become non-exempt in the future.

ACCOMPLISHMENTS AND RESULTS

Fort Lewis was selected as the most representative FORSCOM installation.

RESOURCE SUPPORT

VEPP

FOLLOW-ON PROGRAM REQUIREMENTS

Circulate final report to Army installations.

POINT OF CONTACT

Peter Stemniski

PROGRAM PARTNERS

U.S. Army Forces Command
U.S. Army Construction and Engineering Research Laboratories
Fort Lewis, Washington

Hydraulic Fluid Recycling

The Army uses large quantities of hydraulic fluid when operating various types of equipment. Installations face high costs to dispose of used hydraulic fluid. By recycling hydraulic fluid to Army specifications, installations will reduce waste quantity and disposal charges, allowing for more money to be spent on troop training.

Purpose

To reduce costs and increase readiness by developing an affordable way to recycle used hydraulic fluid to Army specifications.

Benefits

Extending the life of Fire Resistant Hydraulic Fluid (FRH) will save money, which could be used for increased troop training and readiness. Maintenance schedules would be easier to follow because procurement of FRH would decrease. "In-line" monitors in the recyclers will provide a simple means of determining FRH batch cleanliness, assuring maintenance personnel of the quality and readiness of the fluid. By installing an in-line sensor the machines will be more user friendly, cost-effective and better able to meet military needs by increasing automation of the system.

Installations also can use decision trees and cost and performance data from this project to determine the feasibility of using this technology.

Technology Users

Army depots and other Department of Defense (DoD) facilities.

Background

Hydraulic fluid is currently disposed of as a hazardous waste. The military uses large quantities of FRH in a variety of materials from bridge launchers to forklifts.

Hydraulic fluid recyclers have been field-tested and the primary targets for future use have been Army depots such as Anniston Army Depot, Alabama. Purchase price for new FRH is roughly $10 per gallon; it costs less than 20 cents to reclaim a gallon of FRH. The procurement needs of new fluid would be reduced 75%. Many installations could recoup the cost of their initial investment in the first year of reclamation.

Description

A field demonstration and analysis studying the feasibility of recycling hydraulic fluid shows that when mixed with 25% virgin material, the recycled fluid meets all specification performance requirements. Lessons learned from that demonstration show a need for real-time fluid analysis. The current project focuses on the need to place in-line sensors to determine the particulate and water content of the fluid being recycled.

FRH recycling utilizes past research in the viability and field demonstration of commercially available recycling units. Further analysis determined which units produce FRH that meets military specifications. Cooperative Research and Development Agreements (CRADAs) were established to leverage government and private efforts to improve design of the recyclers while increasing user friendliness. The monitors were tested for accuracy and compared to conventional laboratory analysis.

Applicability

Andrulis Report Requirement:
3.9.f Direct Reuse of Waste Oil

Accomplishments and Results

CRADAs were signed with two companies interested in adding in-line sensors to their hydraulic fluid recyclers. Pall Aerospace and SESCO Inc. have begun fitting their existing machines with monitors and testing their accuracy. The Pall Aerospace unit has been validated but the SESCO unit testing has not begun.

The Military District of Washington (MDW) and other Army environmental user community representatives have expressed the need for evaluating existing commercial systems capable of reducing waste streams produced from used hydraulic fluid and contaminated motor fuel. The U.S. Army Environmental Center (USAEC) sponsored this work through the U.S. Army TACOM Mobility Technology Center and recently negotiated a project order and statement of work.

The hydraulic fluid recycling draft and final report of the monitoring unit test has been submitted. A fact sheet has been completed on hydraulic fluid recycling. Articles have appeared in the *Environmental Update* and are scheduled to appear in the *Army Logistician*.

Limitations

Users of this technology must be aware that hydraulic fluid recycling will require improved cleanliness, organization and used fluid separation. The installation must make a commitment to good housekeeping.

Follow-On Program Requirements

USAEC is working with Aberdeen Test Center (ATC) to create a decision tree, gather cost and performance data, and field test the improved units. These field demonstrations are necessary to prove to users that this technology is valid. ATC is determining installations best suited for this technology and aiding in the establishment of a test program.

Other requirements include:

- Complete testing.
- Finalize report on hydraulic fluid recyclers.

Points of Contact

Dennis Teefy
Edward Engbert

Program Partners

U.S. Army Environmental Center
TACOM Fuels and Lubricants Technology Team
SESCO Inc.
Pall Aerospace
Aberdeen Test Center

Publications

CRADA Report: Pall Hydraulic Fluid Recycling Unit with Automatic Cleanliness Monitoring System.

Purdy, Ellen M., Mowery, Ralph B. and Rutkowski, Sgt. Donna M. TARDEC Technical Report No. TR-13731. MIL-H-46170 Hydraulic Fluid Recycling Field Demonstration. U.S. Army Tank-Automotive and Armaments Command Research and Development Center, Warren, Michigan. October 1996.

User's Guide For Recycling Military Hydraulic Fluid. U.S. Army TACOM, Mobility Technology Center-Belvoir, Fort Belvoir, Virginia. May 1997.

Low Volatile Organic Compound (VOC) Chemical Agent Resistant Coating (CARC) Demonstration

Protective coatings developed for Army-unique requirements, such as camouflage and chemical agent resistance, must achieve rigorous performance standards while complying with federal and state air pollution laws. The Army needs coatings that will protect soldiers in war and protect the environment in peace. Low VOC coatings will accomplish both requirements.

Purpose

To successfully field a water-reducible Chemical Agent Resistant Coating with a VOC level of 220 g/L.

Benefits

Water-reducible CARC will cut VOC emissions by about 48%. A water-reducible CARC with a VOC level of 220 g/L can save at least 4 million pounds of VOCs per year in the application of the coating.

Technology Users

Army, Air Force, Marines and Navy.

Background

Most Army vehicles and equipment are painted with a special paint that is chemical agent resistant. This paint is very high in solids and VOC content, and has required a solvent carrier to apply the paint.

During application, CARC releases 420 grams of VOCs per liter. Federal and local Clean Air Act regulations restrict the amount of VOCs emitted during application of the coating. As more stringent VOC regulations spread across the nation, more facilities will be unable to use the existing solvent-borne CARC unless the installation installs expensive air-scrubbing systems.

Description

This demonstration will apply a water-reducible CARC to Army vehicles and test its durability, so the Army can change its current specification and allow use of a less-hazardous formulation.

Applicability

Andrulis Report Requirement:

- 3.2.a Improved Chemical Agent Resistant Coating Techniques

Clean Air Act
Occupational Safety and Health Act

Accomplishments and Results

The Army Research Laboratory has successfully developed a water-reducible CARC, which has passed all agent tests for the colors green, brown, black and desert tan.

In 1998, the water-reducible CARC will be applied to equipment including a Hemit, HMMWV and MLRS launcher at Fort Sill, Oklahoma. A 2,800-panel matrix was created to determine which type of coating adheres to substrates.

Resource Support

For FY 1996, the program was supported by VEPP funds.

Follow-On Program Requirements

- The water-reducible CARC will be field tested at depots before being approved for depot use. Once the final specification is completed, depots will be able to use the water-reducible CARC.
- Finalize the draft specification for the water-reducible CARC.
- Begin working on manuals for the water-reducible CARC.
- Begin final test evaluation using original equipment manufacturers chosen earlier by the Army, Marines and Navy.

Point of Contact

Peter Stemniski

Program Partners

U.S. Army Environmental Center
U.S. Army Research Laboratory Coatings Research Team

Oil-Water Separation Technology

Oil-water separators at installations often fail due to inadequate maintenance. As a result, oil is not being separated through oil-water separators but discharged with the water. Making installations aware that operation and maintenance plans are needed will help to decrease the number of violations associated with oil-water separators.

Purpose

To make installations aware of the operation and maintenance involved with oil-water separators

Benefits

Making installations aware of proper operation and maintenance will decrease the chance of oil-water separators being shut down due to high oil and grease concentrations in the effluent. Mission readiness will also be enhanced.

Technology Users

Department of Defense (DoD) facilities using oil-water separators.

Background

Oil-water separators are designed to separate oil and solids from water that is being discharged to a given source. However, some commercially available oil-water separators cannot handle the complex military waste stream, primarily the high solid and oil grease concentrations. Also, many installations do not properly maintain oil-water separators, thus rendering them ineffective. Installations need to be made aware of the necessary operation and maintenance involved with oil-water separators.
Improved guidance is needed for a range of military operations that includes washracks, POL stations, steam cleaning and aircraft maintenance. Operations and maintenance needs to be a priority consideration.

Description

Installations need to develop an operation and maintenance schedule with their oil-water separators. If completely malfunctioning, then new oil-water separators need to be purchased and properly maintained.

Three installations will take part in a demonstration of operation and maintenance procedures. The results will be documented. At the conclusion of the demonstration, a “lessons learned” guide will be made available for all DoD users, making them more aware of the proper operation and maintenance associated with oil-water separators.

Applicability

Andrulis Report Requirements:

- 2.2.e Oil Water Separator Technology
- 2.6.c. Develop Removal/Treatment Technologies for Oil and Greasy Waste
- 3.7.c. Improve Oil-Water Separation Technologies

Accomplishments and Results

- Partnered with the U.S. Air Force, U.S. Navy and Army AESAP, and submitted Environmental Security Technology Certification Program (ESTCP) proposal for oil-water separators evaluation.
- Surveyed 1383s from 1995 and sent memorandum to Army users; established relationship with Air Force and Tyndall Air Force Base, Florida.
- Project order sent to U.S. Army Aberdeen Test Center (ATC) and U.S. Army Construction Engineering Research Laboratories (USACERL) for three evaluations of oil-water separators.
- Site visit conducted to view oil-water separator modifications and upgrades in preparation for demonstration.
- Attended Air Force MAJCOM Water/Wastewater conference and partnered with Tyndall AFB for the third site demonstration.
- Completed site visits and evaluations.

Resource Support

VEPP

Follow-On Program Requirements

A video, "Proper Design and Maintenance of Oil-Water Separators," produced by the Air Force Center for Environmental Excellence (AFCEE) will be supplied as a training aid.

At the conclusion of the three evaluations, a "lessons learned" package will be available for installations to learn more about what to look for when purchasing an oil-water separator.

This project began as an extension to the closed-loop washrack evaluation. Because not every Army installation needs closed-loop washracks, oil-water separators need to be further investigated with particular emphasis on maintenance procedures.

Point of Contact

Peter Stemniski

Program Partners

U.S. Army Environmental Center
U.S. Navy
Tyndall AFB, Florida
Air Force Center for Environmental Excellence

Publications

"Selection and Design of Oil-Water Separators at Army Facilities," Engineering Technical Letter - U.S. Army Corps of Engineers, August 1994.

Washrack Recycle Treatment System Evaluation

Washracks for Army ground vehicles often consume significant amounts of water on an installation. As costs of providing water and treating wastewater increase, the water requirements for a washrack must be reduced.

Purpose

To field test two commercially available closed-loop washracks; to obtain reliability and maintainability data.

Benefits

At the conclusion of this project a "lessons learned" user's guide will be available for all interested Army users.

Technology Users

Department of Defense installations.

Background

Many installations purchase closed-loop recycle treatment systems to end their water compliance problems. However, no reliability or maintainability data exist concerning these systems.

Washracks at military facilities can be called upon to handle many types of vehicles, from standard automobiles to armored personnel carriers or tanks. Closed-loop washracks are becoming very popular because there is very limited discharge needed. This project will use an independent tester to evaluate two commercially available closed-loop systems in a military environment, and produce reliability and maintainability data.

Description

Both closed-loop washrack systems in this demonstration are available for purchase within the military. Both manufacturers have different systems to fit user needs.

Applicability

This project was conceived following a letter from users representing Military District of Washington (MDW), Army Training and Doctrine Command, (TRADOC), Army Forces Command (FORSCOM), and the National Guard Bureau (NGB) to look into closed-loop recycling.

Clean Water Act (CWA)
Resource Conservation and Recovery Act (RCRA)

Accomplishments and Results

A Memorandum of Agreement between U.S. Army Environmental Center (USAEC), U.S. Army Aberdeen Test Center (ATC), and private industry was signed for the loan of the Landa WaterMaze 7023A washrack recycle system.

In 1995, MDW and the Major Commands submitted a user request to USAEC. In 1996, funds were allocated, the evaluation began and contract teams were assembled.

Other accomplishments include:

- Held kickoff meeting and MDW site visits.
- Completed test plan.
- Finished Landa evaluation and changed over to RGF evaluation.
- Completed 13-week evaluation of the RGF system.

Resource Support

VEPP

Follow-On Program Requirements

- Develop and circulate the "lessons learned" user's guide.
- Prepare final report.

Point of Contact

Peter Stemniski

Program Partners

U.S. Army Environmental Center
U.S. Army Aberdeen Test Center
U.S. Army Construction Engineering Research Laboratories
Landa Incorporated
RGF Environmental Group

Conservation

DEMONSTRATION OF PLANT SPECIES SELECTION SOFTWARE FOR LAND REHABILITATION

Military training and construction activities often damage native vegetation. Revegetation efforts often fail due to improper selection or mixing of seed species and failure to consider site conditions and intended use. Effective plant species selection will increase land recovery success and speed of land recovery, increasing training opportunities and improving readiness.

PURPOSE

To demonstrate and validate the VegSpec plant species selection software.

BENEFITS

Planting the appropriate species, in the best way possible, increases the success of land rehabilitation and reduces future maintenance costs.

TECHNOLOGY USERS

Installation natural resource managers.

BACKGROUND

Although thousands of woody and herbaceous plant species are commercially available for revegetating damaged lands, industry experts say 10% to 35% of revegetation projects fail, depending on the geographic region. Among the most frequently cited reasons for failure are improper selection and mixtures of species. Frequently, the species selected are not adapted to site conditions or intended land use.

DESCRIPTION

VegSpec is an automated "expert" system that helps land managers select plants for land reclamation projects. By eliminating guesswork in plant species selection, VegSpec enhances revegetation success rates, thereby reducing costs. VegSpec includes land reclamation practices, such as cover crops, critical area planting, windbreaks, filter strips, and planting pastures, ranges and trees. It requires the user to identify the desired practice, soil series, nearest climate station and brief site information.

Based on user input, VegSpec produces a list of plant species adapted to the site. Users may limit the list by identifying specific reasons for planting, such as erosion control, restoring native plant communities, stabilizing slopes, vegetative screening and creating wildlife habitat. Users may add other objectives and constraints, such as palatability, growth season and fire tolerance. VegSpec compares user objectives with a database of more than 2,000 plant species.

VegSpec lists plant species that meet the selection criteria for user review. After the user makes a selection, VegSpec calculates a seeding rate and evaluates the mixture for potential compatibility problems. VegSpec then guides planting operation design, including planting dates, seed placement, planting method, site preparation, temporary cover and soil amendments. Installation demonstration projects for VegSpec have been completed on abandoned roads and trails at Fort Riley, Kansas, and in areas damaged by intensive military maneuvers at Fort Carson, Colorado. The installations' land managers used VegSpec to generate species list for replanting. The areas revegetated with the species mixes suggested by VegSpec have been compared with adjacent areas revegetated simultaneously with traditional seed mixes. Fort Carson planted in fall 1995 and Fort Riley planted in spring 1996; each was monitored through 1997.

Applicability

Andrulis Report Requirements:

- 4.2.i Land Rehabilitation
- 4.3.a Mitigating Army-Unique Impacts
- 4.3.c Plant Materials Study
- 4.3.d Erosion Control

Accomplishments and Results

Seeding at Fort Riley was successful. Though seeds failed to germinate at Fort Carson — due mainly to drought conditions — another planting was scheduled for fall 1997. A final report on the demonstration is scheduled for a December 1997 release.

VegSpec Version 1.0, released publicly in August 1997, contained only the plant selection utility. The practice design utilities (such as seeding rates, date of planting, method of planting and suggested weed control measures) were released with VegSpec 2.0 in October 1997. The climatic and soils data needed to run VegSpec are linked directly via the Internet. VegSpec is available for Department of Defense use on the World Wide Web at http://plants.usda.gov. VegSpec Version 1.0 was temporarily password-protected to allow a limited number of users to provide feedback before the "expert" system was made available to the public. Users can type in the password "planter" to access VegSpec Version 1.0 on the Web. Comments can be made directly in the system by clicking on the "Comments" button presented on many of the on-line screens.

Resource Support

Cuts to Legacy Program funding in FY 1995 affected the VegSpec program. The U.S. Army Environmental Center (USAEC) picked up the funding effort to continue the demonstration and transfer the VegSpec software package to Army users.

Point of Contact

Kim Michaels

Program Partners

U.S. Army Environmental Center
U.S. Army Construction Engineering Research Laboratories
Fort Carson, Colorado
Fort Riley, Kansas
Natural Resources Conservation Service

Dust Control Material Performance on Unsurfaced

Roadways and Tank Trails

Dust from unsurfaced roadways and tank trails presents large environmental and safety problems for Army installations. Excessive wear and tear on military vehicles as well as human health and safety factors have caused a need for efficient, cost-effective techniques for dust control. This project provides Army installations with a systematic evaluation of five dust control agents, their application rates, and maintenance requirements. This evaluation process can be used on other agents as well, setting the stage for an Armywide dust control program.

Purpose

To evaluate the effectiveness, cost, and maintenance requirements associated with several dust control agents when used on road segments and tank trails. This information will provide guidance to Army environmental and safety managers in developing an aggressive and cost-effective dust control program.

Benefits

Effective dust control will reduce fugitive dust, increase safety and improve air quality, thus decreasing the risk of accidents, reducing excessive vehicle repair and creating a healthier training environment.

Technology Users

Installation training area and natural resource managers.

Background

Fugitive dust from wheeled and tracked vehicle training creates many problems, most notably those associated with safety, air quality, military vehicle maintenance requirements, and tactical considerations. Dust clouds generated from roads and tank trails impair the visibility of military vehicle operators, increasing the likelihood of accidents and injury. Excessive dust from tank trails acts as a respiratory irritant to military vehicle operators and is a safety and air quality hazard when it drifts into nearby housing and administrative areas or onto adjacent highways and streets. Excessive wear on military vehicles results from dust invading engines and turbine compartments, air filtering systems, and other sensitive mechanical and electrical components. Finally, dust generated from wheeled and tracked vehicle movement provides an unmistakable signature to enemy forces in a tactical scenario.

An aggressive dust control program can minimize these problems, but requires a systematic evaluation of dust control agents, application rates, and maintenance requirements in order to be labor and cost-effective.

Description

Recently, the commercial market has offered many materials that are environmentally safe. These products have proven successful on the commercial market and show promise on unimproved roadways where rough terrain makes traditional road maintenance difficult and costly.

The products are not petroleum-based and in some instances are by-products of agricultural crops.

The U.S. Army Environmental Center (USAEC) and the U.S. Army Construction Engineering Research Laboratories (USACERL) evaluated and compared several types of dust control agents for their long-term effectiveness, cost, and maintenance requirements. These products are: calcium-ammonium lignosulfonate (known commercially as Lignin LS-50), polyvinyl acrylic polymer emulsions (TopSeal and SoilSement), soy bean by-products (SoySeal6) and calcium chloride (Dust Fyghter). The products were applied with liquid distributors. The equipment is simple to operate and readily available at most Army installations.

Dust control agents were demonstrated at Fort Hood, Texas, and Fort Sill, Oklahoma. The products were compared in large-scale field tests under carefully controlled and replicated conditions. The test results allow Army installations to provide realistic training while maximizing environmental compliance and safety.

Applicability

Andrulis Report Requirements:

- 4.2.i Land Rehabilitation
- 4.2.l Develop and Perform Maintenance on Land
- 4.3.b Safety Issues
- 4.3.d Erosion Control
- 4.5.b Reduce Maintenance
- 4.5.e Wind Blown Particles, the Next Crisis in the West

This project was completed September 30, 1996. It has been discussed in the *Environmental Update* and has generated widespread interest. The technical report has been distributed.

Accomplishments and Results

The project was briefed at the FY 1996 LRAM (Land Rehabilitation and Maintenance) Conference to a positive response. Project results also were briefed at the 23rd American Defense Preparedness Association (ADPA) Environmental Symposium and Exhibition in April 1997.

Follow-On Program Requirements

The data collected from this demonstration will help develop a Dust Control Summary and Guidance Document, which will be completed in FY 1998.

Point of Contact

Kim Michaels

Program Partners

U.S. Army Environmental Center
U.S. Army Construction Engineering Research Laboratories
Fort Hood, Texas
Fort Sill, Oklahoma

Publications

USAEC/USACERL Technical Report: Dust Control Material Performance on Unsurfaced Roadways and Tank Trails, September 1996.

Invasive Weed Control

Invasive weeds are an environmental problem, especially on military training installations where soil disturbance is common. Methods to control these weeds will help the Army maintain realistic training areas, preserve native plant populations, enhance wildlife habitat and sustain the nation's natural resource base.

Purpose

To determine which installations have problems with exotic, invasive weeds; determine which measures of control exist or are being researched; and set up a control demonstration for the five most serious weed species.

Benefits

Control of invasive exotic weeds will maintain healthy biological diversity on Army lands, as well as preserve native plant population bases, enhance wildlife populations and diversity, ensure continued use of training lands, and enhance the Army's image as a responsible environmental steward.

Technology Users

Installations with invasive weed problems.

Description

This project will determine which installations have the most exotic invasive weed problems by species and acres of invasion. It then will determine what measures of control exist or are being researched for the particular species, and set up a control demonstration for each of the most serious weed species or infestations on the installations where they exist. This demonstration will be held in cooperation with a university or agricultural experiment station.

Accomplishments and Results

The project has been proposed and can be modified, depending on the scope of work.

Follow-On Program Requirements

- Determine which installations have severe problems with exotic invasive weeds.
- Visit one or more installations.
- Research exotic weed control methods.
- Select demonstration sites and select a university, research station or other institution to assist in the project.
- Design project(s).
- Complete project evaluation.
- Prepare and present technical paper(s).

Point of Contact

David Lorenz

Land Based Carrying Capacity (LBCC)

The Army's primary missions are to train soldiers and test weapons and defense systems. Trainers and land managers realize that training and testing areas must be realistic, ecologically healthy and ready for long-term use. Land Based Carrying Capacity (LBCC) technologies will help installations estimate current and predict future land condition status and establish the relationship between training load and land condition.

Purpose

To demonstrate and validate three products that apply directly to the improvement of the environmental component of the ATTACC model. These products could also serve as stand-alone tools for natural resources and land management activities.

Benefits

LBCC technologies will help installations estimate current and predict future land condition status and establish the relationship between training load and land condition.

Technology Users

Army trainers, land managers and natural resource managers.

Background

Installation land and natural resource managers need efficient tools, models, and techniques to characterize, integrate constraints, and quantify the capability of land and natural resources to support military training and testing missions. Installation training managers need to identify carrying capacity of training lands, predict the impacts of land-based usage, understand risk associated with use, and analyze decisions to provide training flexibility versus environmental or ecological damage.

Description

This project will be demonstrated at Fort Hood and Fort Bliss, two major training and testing facilities in Texas that represent distinct, subtropical temperate and ecological regions. These installations have also been used or have been proposed for use in the ATTACC project.

Three products will be demonstrated and validated:

- Improvements to the RUSLE equation, specifically a vegetation index derived method to extrapolate the "C" cover factor measured at Land Condition Trend Analysis (LCTA) sites, and an improved "LS" slope length and steepness factor based on the unit stream power theory and upslope contributing area.
- A community or ecological dynamics simulation (EDYS) model with the capability to predict changes in species composition and plant community dynamics in relation to training load.
- A training distribution and load model that applies the characteristics of doctrinally based training and spatial terrain characteristics to predict the pattern and intensity of the training load over the landscape.

Technical work will be completed in-house by U.S. Army Construction Engineering Research Laboratories (USACERL) except as noted in the task summary below.

Task 1

Validation of USLE/RUSLE and Improvements

LS Factor: Three different approaches to the calculation of the LS factor will be tested and compared. These are: 1) the approach used by the ATTACC model whereby LS values derived from LCTA field plots are averaged by soil map unit and assigned to all mapping polygons representing those soil map units; 2) calculation of LS values using a traditional straight-line Geographic Information System (GIS) approach; and 3) calculation of LS values based on sediment transport capacity by incorporating upslope contributing area and the unit stream power theory. The latter two approaches will be applied with both 10 m and 30 m resolution digital elevation models.

C-Factor

The USLE C-factor is calculated based upon ground cover, aerial cover and drip height. The RUSLE C-factor is based upon the same three measurements used to calculate USLE C-factor, plus two additional components: below-ground vegetative biomass and prior land use. This effort will involve the calculation of two C-factors. One will be calculated as defined by USLE and one will be calculated as defined by RUSLE. The three parameters that both C-factors have in common (ground cover, aerial cover, drip height) will be measured in the field using established LCTA field methods and permanently established LCTA transect locations.

C-Factor/Remote Sensing

Similar to Subtask 2, where comparisons will be made between USLE and RUSLE C-factors and their overall effect on erosion status estimates, this task will compare methods for spatial extrapolation of C-factor estimates. Within the current ATTACC model, the USLE/RUSLE C-factor is estimated and spatially extrapolated by simply calculating the mean C-factor value for all LCTA plots located within relatively large mapping units of unique soil classification and spectral class. A combined remote sensing/field survey approach for spatially extrapolating these same C-factor estimates will be compared with the current method and validated with a subset of the LCTA transect data.

Task 2

Training Use Distribution

The overall approach is to collect validation data from Fort Hood training areas then use this data to determine how well the existing Fort Hood disturbance map extrapolates historical use patterns. These activities will be planned and executed in the following phases: 1) development of sampling design; 2) field collection; and 3) analysis and reporting.

Task 3

Complete disturbance module of community dynamics simulation model

The objective is to collect post-treatment data from existing military impact study sites, reduce the data, and analyze the data for the purpose of parameterizing the operator function of the military disturbance module of the community dynamics simulation model and then complete the module parameterization and test accuracy of output based on controlled inputs. Begin the independent validation and demonstration process by setting up one field validation plot at both Forts Hood and Bliss.

Task 4

Develop a watershed application of the community dynamics simulation model for Ashe juniper; demonstrating juniper control and improved water quality, quantity and protection from erosion.

Accomplishments and Results

Fort Hood, Fort Bliss, the U.S. Army Environmental Center and USACERL met to plan the project. The project was well received and has been implemented successfully at both demonstration installations.

Follow-On Program Requirements

Improvements to the Universal Soil Loss Equation (USLE) and RUSLE, including crossover error testing to be demonstrated at Fort Hood, will be fully funded with FY 1997 funds. The training use distribution map validation, to be demonstrated at Fort Hood, will be fully funded with FY 1997 funds. Validation of the community dynamics simulation model will be demonstrated at both Forts Hood and Bliss, however, it will only be partially funded with FY 1997 funds as outlined in the tasks above. The FY 1998 and FY 1999 funds will be required to complete the demonstration and validation of this technology.

Point of Contact

Kim Michaels

Program Partners

U.S. Army Environmental Center
U.S. Army Construction Engineering Research Laboratories
Fort Hood, Texas
Fort Bliss, Texas
U.S. Army Training and Doctrine Command
U.S. Army Forces Command
Army Training Support Center

ProbeCorder: Pen-Based Computing for Field Recovery of Subsurface Testing

Army installations face increased requirements for documenting archeological resource inventory and assessment, as well as geomorphologic and other soil studies. Cultural resource managers need tools to free staff to focus on other cultural and environmental challenges. ProbeCorder is a pen-based software tool designed to maximize subsurface testing efficiency by automating the routine collection, integration and storage of probe data in the field.

Purpose

To provide installation cultural resources managers with proficient and efficient data collection abilities. The system automates the recording of subsurface testing data derived from archeological resource inventory and assessment, as well as geomorphologic and other soil-related studies.

Benefits

The system will effectively reduce the overall cost of subsurface surveys, and significantly enhance data integrity and information retrieval capabilities. While geared toward installation, archeologists and cultural resource managers, the system has potential for use in other areas that need automated data collection.

Technology Users

Installation cultural resources managers.

Background

Archeological site discovery is an expensive aspect of historic property inventory faced by the installation in areas where these sites are either obscured by dense vegetation or where they are buried by more recent sedimentation episodes. Both situations require subsurface testing for reliable site discovery and geomorphologic assessment. Subsurface testing is also routinely used to assess the stratigraphic integrity of archeological sites, which is an important criterion for determining significance and potential eligibility to the National Register. These procedures are extremely costly and labor-intensive because they involve repeated, closely spaced probing by means of shovel-testing, post-holing, bucket auguring, deep coring or backhoe trenching. Procedures for field data collection and post-field data integration and processing should be as efficient as possible to reduce high costs.

The system's cost-effectiveness is achieved by eliminating the tedious and error-prone database entry and digitizing required by using multiple paper-field forms and sketch maps.

The National Historic Preservation Act (NHPA) requires that all federal land-managing agencies, including the Department of Defense (DoD), conduct baseline inventories of historic properties and consider the effects of their undertakings on properties on, or eligible for, the National Register of Historic Places.

Description

The project involved:

- Evaluations of commercially available hardware and software comparable to those on which ProbeCorder was developed. The results of this evaluation were documented and incorporated into the ProbeCorder user's manual to allow installation resource managers to make informed decisions on which equipment best suits installation needs.
- Implementation of end-user customization capability for the ProbeCorder to allow picklists to be modified through a graphical user interface, and completion of a full range of on-line "help" screens to guide the user through the entire ProbeCorder data recording and output process.
- U.S. Army Environmental Center (USAEC) production and transfer of the ProbeCorder software package to installations and agencies. ProbeCorder was demonstrated at Fort Leonard Wood, Missouri; Fort Riley, Kansas; and Fort Campbell, Kentucky. The results of the demonstration have been implemented into the system after coordinating results with USAEC.

Applicability

Andrulis Report Requirements:

- 4.1.a Identification and Protection of Sites
- 4.1.b Complete Historic Resource Inventory
- 4.1.g Site Significance Assessment

Accomplishments and Results

After field testing ProbeCorder, USAEC "QA/QC" tested the software and the U.S. Army Construction Engineering Research Laboratories (USACERL) made the minor, recommended adjustments to the software and user's manual. The software package is ready for production and distribution (scheduled for early 1998).

Follow-On Program Requirements

At the program midpoint, Camp Dodge, Iowa (National Guard), was added to the demonstration. The Camp Dodge demonstration field tested ProbeCorder in both natural and cultural resource environments, expanding ProbeCorder's application.

Point of Contact

Kim Michaels

Program Partners

U.S. Army Environmental Center
U.S. Army Construction Engineering Research Laboratories
Fort Campbell, Kentucky
Fort Leonard Wood, Missouri
Fort Riley, Kansas
Camp Dodge, Iowa

Publications

"User's Manual for ProbeCorder (Version 1.0) Data Collection Software."

Soil Bioengineering on Streambanks

Streams and rivers on many Army installations face the threat of erosion. Soil bioengineering solutions involving vegetation and structural systems will help restore streambanks and provide long-term protection against erosion.

Purpose

To demonstrate simple, effective, cost-efficient soil bioengineering techniques on streambanks before erosion causes sedimentation, water pollution, loss of riparian habitat, loss of area use and compliance problems.

Benefits

Applying cost-effective soil bioengineering practices in the early stages of streambank deterioration can:

- Eliminate the need for large-scale, expensive reclamation efforts such as surface armoring, gravity retaining walls, and rock buttresses.
- Curb soil erosion.
- Stop stream degradation.
- Retain riparian habitat.
- Retain use of area.
- Provide for wildlife habitat.

Technology Users

Army installations where streams or rivers are subject to erosion.

Description

Demonstrations will be held on four installations in different parts of the country. The objective is to be within traveling distance of all installations so range and resource managers can attend the demonstrations. Demonstration dates (per installation) will be determined after methods are selected and plant materials are ordered.

"Hands on" training sessions will show trainers and resource managers how to determine their needs and select soil bioengineering practices for their installations.

Follow-On Program Requirements

- Conduct project at Fort Sill, Oklahoma.
- Select three additional installations for project.
- Initiate, install and monitor project at other locations.
- Repair or adjust projects as necessary.

Point of Contact

David Lorenz

Publications

U.S. Department of Agriculture Engineers Handbook, Chapter 18, "Streambank and Shoreline Protection."

Numerous articles, conferences and workshops on soil bioengineering.

Sources of Plant Materials for Land Rehabilitation

Military training can damage land, and Army installations need to select the right plant species when planning land rehabilitation projects. A database of information on native plants will help Army land managers plan and carry out successful land rehabilitation and maintenance activities.

Purpose

To verify a list of vendors providing indigenous seeds and starter plants throughout the United States for input into an automated system being developed to help land managers restore and maintain natural vegetative species.

Benefits

Land managers will be able to use the information in the resulting database to plan and expedite land rehabilitation projects. Resources required to identify local vendors should decrease significantly at the installation level.

Technology Users

Army installations, particularly those with large, heavily used land tracts.

Background

Military land managers and trainers are charged with planning and implementing land rehabilitation and maintenance to minimize environmental degradation and improve the safety and realism of the training mission. One step in the rehabilitation and maintenance process is to purchase appropriate plant materials, particularly endemic or locally adapted species.

The source list resulting from this effort includes information on plant material vendors in each state. Managers and trainers can contact the vendors to solicit bids.

Description

Researchers began this task by purchasing a vendor list from a company that specializes in extracting and compiling business information from telephone directories. Using the key phrase "seeds and bulbs retail," the researchers identified about 3,650 businesses across the U.S. They then called every business on the list to eliminate those that sell only crop seed and cross-referenced the resulting list with the PMSource plant vendor database maintained by the Soil Conservation Service. They removed duplicate names and called additional vendors from PMSource to verify that they were still in business. Other sources of information included:

- "1994 Buyer's Guide," Land and Water 37 (November/December): 32-80.
- Harker, D., Evans, S., and Harker, K., Landscape Restoration Handbook (Lewis Publishers, Boca Raton, Florida, 1993).
- International Erosion Control Association, 1993-1994 Products and Services Directory (Steamboat Springs, Colorado, 1993).
- Soil and Water Conservation Society, Sources of Native Seeds and Plants (Ankeny, Iowa, 1987).
- Soil Conservation Service, Directory of Wetland Plant Vendors, U.S. Army Corps of Engineers, Waterways Experiment Station, Wetlands Research Program Technical Report WRP-SM-1.

Applicability

Andrulis Report Requirements:

- 4.3.c Plant Materials Study
- 4.5.j Reintroduction of Native Species

Accomplishments and Results

Researchers consolidated the original source list and additional handwritten information gathered by U.S. Army Construction Engineering Research Laboratories (USACERL) into a Microsoft Access database. Once the information was placed into the database, duplicate entries were deleted. All vendors were contacted and questioned to determine whether seeds or starters for the following indigenous plants were supplied: trees, shrubs, grasses, forbs and wetland species. Vendor information was either updated or deleted based on response. The World Wide Web was then queried to identify additional vendor sources. A total of 395 new seed and starter vendors were identified and added to the database using the Department of Agriculture's Plant Material Centers. The revised source list includes information for a total of 1,141 vendors supplying indigenous plant seeds or starters.

Limitations

The source list is a "best attempt" to identify vendors. By no means does it include all state vendors.

Point of Contact

Kim Michaels

Program Partners

U.S. Army Environmental Center
U.S. Army Construction Engineering Research Laboratories

Publications

USACERL, "Sources of Plant Materials for Land Rehabilitation (Revised)," 1997.

Tactical Concealment Area (TCA) Planning and Design Guidance Document

Installation trainers and environmental resource managers need tools to help them combat the problems of training site degradation and rehabilitation. The U.S. Army Environmental Center (USAEC) and U.S. Army Construction Engineering Research Laboratories (USACERL) have developed a planning and design tool to help trainers and land managers enhance installation training resources using suitable development techniques that will provide enhanced wildlife habitat, protection of environmental resources and soldier safety.

Purpose

To demonstrate the applicability, usefulness, and viability of an installation-based tactical concealment guidance document. This document will give the installation the opportunity to create and integrate tactical concealment into total training area design. The document will also provide sufficient guidance, allowing the installation to complete work in-house rather than by contract.

Benefits

An approach to training land design that realizes a systematic integration of training and environmental requirements to enhance and expand an installation's training resources. The technology will help create more realistic training areas, protect natural and cultural resources, and enhance environmental stability.

Technology Users

Army trainers and installation natural and cultural resources managers.

Background

The development and use of well-designed tactical concealment enhances training realism and effectiveness by providing cover and concealment in a tactical training environment. The added benefit of isolating potentially hazardous areas and protecting sensitive areas from training activities suggests that tactical concealment needs to be carefully designed and integrated into the total training area design and the environment to optimize effectiveness and overall environmental stability. The first tactical concealment design done in the United States was implemented at Fort Riley, Kansas. The design constructed was a cluster of horseshoe-shaped islands. Subsequent tactical concealment areas at other installations followed the Fort Riley design with slight modifications. Recent observations of the designs' military use indicate flaws; efforts are being taken to evaluate these flaws and to eliminate them in future planning and design of tactical concealment.

Description

The TCA guidance document is a holistic approach that considers an installation's training needs, existing resource conditions and environmental constraints in planning and designing realistic training areas. The result is greater safety, less equipment damage, fewer environmental impacts, and enhanced training realism. The TCA guidance document details how to integrate both training and environmental considerations into the planning process and how to effectively implement the design. The guidance document gives installations the opportunity to complete work in-house rather than contracting out the work, saving money and affording installations more control over their projects.

The TCA guidance document is being field tested at several demonstration sites: Camp Bullis, Texas; Fort Hood, Texas; Camp Guernsey, Wyoming; and Camp Ripley, Minnesota. The demonstrations will prove the utility and applicability of the guidance document at Army installations. Direct user input from the demonstration sites (as well as comments from other installations and major commands and expertise from the Army Training Support Center) is being integrated into the document.

Applicability

Andrulis Report Requirements:

- 4.2.a Land Capability/Characterization
- 4.3.a Mitigating Army-Unique Impacts
- 4.2.i Land Rehabilitation

Integrated Training Area Management Requirements:

- 7 Integrate Training and Environmental Requirements
- 9 Maintain and Repair Land

Accomplishments and Results

This project was well received when briefed at the FY 1996 Army Integrated Training Area Management (ITAM) Workshop and the FY 1997 National Guard ITAM Workshop. Two National Guard sites — Camp Guernsey and Camp Ripley — joined the project in June 1997 and are attempting to fit into the demonstration schedule. Demonstration results (to date) will be briefed at both FY 1998 ITAM workshops.

Follow-On Program Requirements

Installation monitoring will take place past the "project complete" stage. It may be necessary for installations to complete site modifications to better service their training missions.

Point of Contact

Kim Michaels

Program Partners

U.S. Army Environmental Center
U.S. Army Construction Engineering Research Laboratories
U.S. Army Training Support Center
U.S. Army Training and Doctrine Command
U.S. Army Forces Command
National Guard Bureau
Fort Hood, Texas
Camp Bullis, Texas
Camp Guernsey, Wyoming
Camp Ripley, Minnesota

Publications

The final guidance document is to be published in January 1999.

Vegetative Buffer Strips

Firing ranges, dirt roads and other sites on Army installations are prone to erosion. Natural vegetation buffers can improve environmental conditions and compliance by slowing stormwater runoff and trapping sediments and pollutants.

Purpose

To demonstrate conservation buffer strips — which are strips of land maintained in permanent vegetation — to help control pollutants and manage other environmental problems.

Benefits

Use of vegetative buffer strips on Army installations will slow stormwater runoff, trap sediment, enhance water infiltration, trap fertilizers and pesticides, break down bacterial and viral pathogens, trap heavy metals, reduce effects of wind and dust, protect troops and provide tactical concealment.

Technology Users

Army installations where firing ranges, troop and vehicle assembly areas, high-traffic corridors, dirt roads and other areas are prone to erosion.

Description

This demonstration will take place on an installation area with serious erosion problems. It will apply a holistic approach to curbing storm water runoff and erosion of soil and pollutants by implementing appropriate conservation buffer strips.

Examples of buffer strips include:

- Filter strips.
- Riparian (streamside) forest buffers.
- Contour buffer strips.
- Field (range) borders.
- Windbreaks and shelterbelts.
- Grass hedges.
- Grassed waterways.
- Filter strips designed as tactical concealment.

Accomplishments and Results

The project has been proposed and can be amended to meet site conditions and other needs.

Follow-On Program Requirements

- Select site and begin design process.
- Prepare site for planting (may include earth work).
- Install remainder of project (final grading, planting).
- Monitor project.
- Redesign and repair as necessary.
- Evaluate project.
- Prepare technical report.

Point of Contact

David Lorenz

Vegetation Wear Tolerance

Erosion can affect the quality of training sites and the environment on Army installations. Revegetating eroded areas with species best able to tolerate heavy vehicle and troop traffic will reduce erosion, keep lands open for training and maneuvers, and save time and money.

Purpose

To determine which vegetative species are the most tolerant to wear from troop and vehicle traffic on individual installations within a climatic region.

Benefits

Revegetating eroded areas with species best able to tolerate heavy vehicle and troop traffic will reduce erosion, keep lands open to training and maneuvers, and save time and funds.

Technology Users

Installation range and natural resource managers.

Description

Demonstrations using vegetation thought to best reclaim eroding land and withstand wear from troops and vehicles will be conducted at three installations within a regional climatic area, on two or three dominant soil types.

After selecting the region and installation for the initial demonstration, researchers will select best-known species for use by installation and climatic region (including soils). They will design a test and demonstration project that can be used at all sites for statistical analysis and evaluation. They will then select specific sites on the installations and install the demonstration.

The demonstrations will be monitored for about three to four years. The demonstrations will have controlled troop and vehicle traffic, submitting the plants to diverse levels of wear. Based on the test results, certain species will be recommended for installation- and region-wide use. The species may be installation-specific to one or more soils, or may be adaptable to all installations and soils within the climatic region. Information on these species will be added to the VegSpec computer program so natural resource and range managers can easily identify and select the plants best suited for their revegetation needs.

Accomplishments and Results

This is a proposed project and may be changed to allow for expansion or new requirements.

Follow-On Program Requirements

- Review installations and select demonstration sites.
- Initiate project on all sites by preparing them for planting.
- Plant projects on all installations.
- Review all sites for stands and replant if necessary.
- Monitor project; make sure vehicle and foot traffic is applied according to the project plan.
- Record results, summarize data, prepare technical report and publish results.

Point of Contact

David Lorenz

Compliance

Aluminum Ion Vapor Deposition

Metal coating processes at Army depots may produce hazardous wastes and threaten workers' safety. Aluminum provides an improved coating, greater process flexibility and enhanced environmental operations.

Purpose

To support technology transfer and implementation of Aluminum Ion Vapor Deposition (AIVD) at Tobyhanna Army Depot (TOAD), Pennsylvania.

Benefits

AIVD offers several advantages over cadmium electroplating:

- No hazardous wastes are generated.
- Avoids employee exposure to hazardous materials.
- Reduces loading to wastewater treatment plants.
- Environmental permits are not required.
- Outperforms cadmium coatings in preventing corrosion in acidic environments.
- Coatings can be used in high temperature service (925 °F versus 450 °F for cadmium).
- Permits thicker coatings and provides better uniformity of coating on edges and corners than solution electroplating.

Technology Users

Army depots.

Background

The U.S. Army Environmental Center (USAEC) has long supported hazardous waste minimization (HAZMIN) initiatives at Army Materiel Command industrial operations. Specific initiatives relating to Industrial Operations Command facilities have included demonstrating and implementing AIVD at Anniston Army Depot, Alabama.

Industrial fabrication and maintenance activities conducted at Army depots typically include metal plating operations. For many years, metal parts have been electroplated with cadmium coatings, which provide protection from corrosion. However, cadmium is a toxic metal and electroplating generates significant quantities of wastes such as spent plating baths, sludge and rinse waters. Cadmium wastes are regulated by the Environmental Protection Agency as hazardous waste under the Resource Conservation and Recovery Act (RCRA). Treatment of spent solutions and rinse waters in on-site industrial wastewater treatment plants also generates cadmium-contaminated sludge, which is regulated as hazardous waste. Further, cadmium exposures in the workplace are regulated by the Occupational Safety and Health Administration (OSHA). Cadmium contamination in fumes, dust and mists, which commonly occur in industrial operations, is tightly regulated.

The inherent difficulties in safely handling toxic materials in the workplace and the increasing costs associated with management and disposal of hazardous wastes have become incentives for generating less hazardous waste and preventing pollution at the source. Aluminum surface coatings can be substituted for cadmium in many applications. AIVD is a clean technology that can be used to apply aluminum coatings to metal and other substrates, including plastics and composites.

Description

AIVD, a surface-plating technology, applies aluminum coatings without generating hazardous waste. It also reduces employee exposures to cadmium and provides corrosion protection. Activities have focused on technical support and technology transfer at TOAD to support the evaluation and acquisition of AIVD technology. Work has included preparing economic analyses and equipment bid specifications and providing technology transfer materials.

Letterkenny Army Depot (LEAD), Pennsylvania, received HAZMIN technical assistance for treatment of methylene chloride contamination in paint-stripping rinse waters.

Applicability

Andrulis Report Requirement:

- 2.3.e Alternatives for Hazardous Materials Used in Production Process

Accomplishments and Results

- Provided implementation technical support to Tobyhanna, which included an economic analysis for an AIVD system, a work order for AIVD system installation, and collecting information on AIVD technology and coatings.
- Visited Anniston and Corpus Christi Army Depots to observe existing AIVD systems and discuss acquisition, equipment options and operation, and lessons learned with operators.
- Conducted a technology search for methods of treating wastewater contaminated with methylene chloride.

Limitations

The AIVD coating is not a universal substitute for cadmium. Replacement of current plating technology must be evaluated case-by-case (often for individual parts). Part specifications that require cadmium coatings cannot be substituted for AIVD coatings without approval of the part's owner or manager.

Follow-On Program Requirements

- Due to funding delays, AIVD will not be implemented at TOAD until FY 1999.
- The information provided under this effort will serve as background and guidance information for depot personnel at TOAD or other interested facilities during the evaluation and acquisition of AIVD plating technology as a replacement for cadmium electroplating.

POINT OF CONTACT

Gene Fabian

PROGRAM PARTNERS

U.S. Army Environmental Center
Anniston Army Depot, Alabama
Corpus Christi Army Depot, Texas
Letterkenny Army Depot, Pennsylvania
Tobyhanna Army Depot, Pennsylvania

PUBLICATIONS

Final report, "Technical Support for Reduction of Methylene Chloride Contamination in Paint-Stripping Rinse Waters at LEAD," February 1996. Report Number SFIM-AEC-ET-CR-96004.

Final report, "Technical Support for Implementation of Aluminum Ion Vapor Deposition at Tobyhanna Army Depot," February 1996, Report Number SFIM-AEC-ET-CR-96006.

Composting of Nitrocellulose Fines

Munitions manufacturing processes may generate nitrocellulose fines, but disposal of these fines is difficult because of their reactive nature. Composting may provide a safe, cost-effective means of disposal.

Purpose

To demonstrate composting as an environmentally acceptable method to render nitrocellulose (NC) fines inert.

Benefits

A safe and environmentally acceptable method to dispose of nitrocellulose fines. Composting has been shown to render NC fines inert and result in a useful soil amendment. Incineration is not required.

Technology Users

Army ammunition plants.

Background

Open burning is no longer permitted in several states and is expected to be banned nationally in the future. Open detonation is also the least acceptable form of disposal because of uncontrolled pollution by-products. In its role as the DoD manager for conventional munitions, the Army must be able to dispose of production wastes from propellants, explosives and pyrotechnic materials.

Regulatory requirements for the disposal of nitrocellulose fines are undefined. NC fines are not toxic substances, but they are reactive. To dispose of NC fines, their reactivity needs to be reduced. Composting is an approach that is being studied as a potential method to render NC fines inert.

Description

In composting, a controlled biological process, microorganisms convert biodegradable hazardous material to innocuous, stabilized by-products, typically at elevated temperatures between 50 - 55 °C. The increased temperatures result from heat produced by the microorganisms as they degrade the organic material in the waste. The NC fines are mixed with bulking agents and organic amendments, such as wood chips and animal and vegetable wastes, to enhance the porosity of the mixture. Maintaining moisture content, pH, oxygenation, temperature, and the carbon-to-nitrogen ratio achieves maximum degradation efficiency.

Composting offers an alternative treatment technology for:

- Remediation of soils contaminated with NC fines.
- Disposal of NC fines stored at Army facilities.
- Disposal of NC fines generated from the production of nitrocellulose.

Applicability

Andrulis Report Requirements:

- 1.3.a Remediation of Explosives in Soil
- 1.3.m Soil Bioremediation
- 2.2.a Develop Treatment Technologies for Wastewaters from Munitions Production
- 2.3.a Alternatives to OB/OD

Accomplishments and Results

An evaluation of various options for recovering, treating and disposing of nitrocellulose in the manufacturing wash streams at Radford Army Ammunition Plant (RAAP), Virginia, indicated that biological treatment may provide a feasible disposal alternative for NC fines wastes.

A field demonstration at Badger Army Ammunition Plant, Wisconsin, determined that composting can successfully biologically degrade the NC in soils contaminated with NC-based propellants.

Viable compost mixtures have been identified that include the necessary biodegradable substrate and bulking agents to promote microbial metabolic activity for the degradation of NC fines.

A safety hazards analysis of the NC fines/compost mixtures has been performed to determine the quantity of NC fines that can be placed in a compost pile and avoid flame and shock propagation. Sensitivity testing has been performed to determine the response of various NC fines concentrations and amendments to impact, friction and electrostatic discharge.

The regulatory requirements associated with disposal of composted fines have been evaluated as well as the logistics and economic feasibility of NC fines compost disposal. Based on the regulatory and logistics assessments, composting of NC fines is feasible.

Limitations

- Composting NC fines is feasible; however, it is more expensive than other potential methods of disposal.
- Composting requires substantial space.
- Composting increases the volume of material because of the addition of amendment material.
- Prior analytical methods used to determine the NC fines content in the compost produced disputable results.
- A definitive analysis method is not currently available.

Follow-On Program Requirements

Further investigation of less-expensive methods of NC fines disposal should be investigated prior to demonstration of composting.

POINT OF CONTACT

Gene Fabian

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Materiel Command
Radford Army Ammunition Plant, Virginia
Badger Army Ammunition Plant, Wisconsin

PUBLICATIONS

Technical report, Engineering/Cost Evaluation of Options for Removal/Disposal of NC Fines, USATHAMA Report AMXTH-TE-CR-87134, September 1987.

Technical report, Field Demonstration-Composting of Propellants Contaminated Sediments at the Badger Army Ammunition Plant (BAAP), USATHAMA Report CETHA-TE-CR-89061, March 1989.

Technical report, Process and Economic Feasibility of Using Composting Technology to Treat Waste Nitrocellulose Fines, USATHAMA Report CETHA-TE-CR-91012, March 1991.

Technical report, Composting of Nitrocellulose Fines - Hazards Analysis, USAEC Report Number SFIM-AEC-ET-CR-95083, October 1995.

Technical report, Composting of Nitrocellulose Fines - Regulatory and Logistical Feasibility - RAAP Installation, USAEC Report Number SFIM-AEC-ET-CR-95086. December 1995.

Technical report, Composting of Nitrocellulose Fines - Regulatory and Logistical Feasibility - BAAP Installation, USAEC Report Number SFIM-AEC-ET-CR-95087. December 1995.

Pink Water Treatment Technology Research Task

Army ammunition plants produce explosives-contaminated water known as pink water. The plants meet discharge requirements by using granular activated carbon (GAC) to remove contaminants from pink water. The explosives-laden GAC — classified as a hazardous waste — is either regenerated or incinerated. More effective technologies are being sought to avoid the generation of this hazardous waste.

Purpose

To evaluate alternatives to granular activated carbon (GAC) treatment of pink water.

Benefits

A cost-effective alternative to GAC absorption that does not generate a hazardous waste when treating pink water will help Army installations meet stringent regulations pertaining to water effluent quality.

Technology Users

Army ammunition plants.

Background

Army ammunition plants perform two functions that generate a waste stream known as pink water. These functions are (1) load, assemble, and pack (LAP), and (2) demilitarization of munitions. Associated housekeeping and processing operations create the wastewater stream. Typical sources are wash down and wash out of munitions and laundering workers' clothing. Pink water typically contains photochemically active trinitrotoluene (TNT). The photoreactive products color the water. Besides TNT, pink water usually contains cyclotrimethylene-trinitramine (RDX) and cyclotetramethylene-tetranitramine (HMX). The composition of the pink water depends on process materials and operations, and thus is highly variable. The reference value established in this work is 200 parts per million (ppm) dissolved energetic related materials.

Army ammunition plants meet discharge requirements by using GAC to remove contaminants from pink water. The explosives-laden GAC, classified as a K045 hazardous waste, is either regenerated for reuse or incinerated for disposal. More effective technologies are being sought to avoid the generation of this hazardous waste.

Description

Concurrent Technologies Corporation (CTC), the operating contractor of the National Defense Center for Environmental Excellence (NDCEE), under the initial Statement of Work (SOW) from the U.S. Army Environmental Center (USAEC), was tasked to identify and evaluate the technologies as Phase I. This entailed surveying the literature, assessing regulatory issues related to pink water, identifying candidate technologies, developing performance criteria and evaluation methods, selecting promising candidates for detailed evaluation, down-selecting to the best five technologies based on the performance criteria, and issuing a Phase I final report. The five technologies selected were Large Aquatic Plants (Biological) Treatment, GAC Thermophilic (Biological) Process, Fenton's Chemistry (Advanced Oxidation Process) Process, Electrolytic Process (Mixed Oxidants) and Fluidized Bed Bioreactor Process.

Under Phase II, CTC was tasked to perform bench-scale tests on the five technologies using pink water generated from LAP operations at McAlester Army Ammunition Plant (MCAAP), Oklahoma, and pink water generated from demilitarization activities at Milan Army Ammunition Plant (MAAP), Tennessee. This entailed identifying vendors for the selected technologies, requesting test plans and safety plans from the vendors, determining critical process parameters and evaluation criteria, demonstrating and validating the five bench-scale technologies, evaluating the technologies versus the performance criteria, recommending the three best technologies for the pilot scale demonstration, and issuing a Phase II final report.

Under Phase III, CTC was tasked to plan for operation of up to three technologies at 2 gallons per minute (gpm). This entails developing detailed engineering specifications, submitting an outline of a test and implementation plan, submitting an outline of a demonstration and validation proposal, and issuing a Phase III final report.

An SOW has been written by USAEC to direct CTC to perform Phases IV through VI. Phase IV is the design fabrication, installation and debugging of the demonstration plant(s). Activities will include selecting engineering design subcontractors, preparing detailed design estimates, finishing detailed designs, selecting ammunition plant demonstration location(s), fabricating the demonstration plant(s), and issuing a Phase IV final report. Phase V is operating and evaluating the demonstration plant(s). Activities include operating the plant(s) for 180 days, evaluating them per the test plan, and issuing a Phase V final report. Phase VI is finalization and follow-through. Activities include revising operating documentation based on lessons learned in the pilot-scale demonstration(s), providing follow-on training, and providing follow-through support.

Applicability

Andrulis Report Requirement:

- 1.2.a Explosives in Groundwater

Accomplishments and Results

The Phase I literature search is complete and a report has been submitted. Five technologies were selected for bench-scale testing. Phase II testing of the five bench-scale technologies is complete and CTC has submitted an approved Phase II final report. CTC submitted an approved program management plan/task plan for Phase III. USAEC approved an SOW for Phases IV through VI.

Follow-On Program Requirements

- Develop detailed designs for pilot test plants.
- Select Army ammunition plants for full-scale demonstration.
- Fabricate the demonstration plants.
- Install and debug demonstration plants.
- Operate demonstration plants for 180 days.
- Evaluate demonstration plants per test plan.
- Issue Phase V final report.

POINT OF CONTACT Louis Kanaras

PROGRAM PARTNERS
U.S. Army Environmental Center
Concurrent Technologies Corporation
National Defense Center for Environmental Excellence
McAlester Army Ammunition Plant, Oklahoma
Milan Army Ammunition Plant, Tennessee

PUBLICATIONS
Phase I Report, May 1995.
Resource Utilization Plan.

Plasma Arc Technology Evaluation

Hazardous waste disposal is increasing in scope and cost. Because liability may remain for years following disposal, the costs are often high. These costs directly impact ongoing operations because many disposal charges are paid from operations funds. Plasma Arc Technology may provide a viable, permanent disposal alternative without long-term liability.

Purpose

To evaluate the process capability of Plasma Arc Technology (PAT) for the ultimate destruction of hazardous item components; to verify slag suitability for regular landfill disposal; to identify potential hazards associated with the process emissions; and to develop qualified cost estimates for large-scale operations.

Benefits

The technology lends itself to "hard to treat" wastes such as hazardous wastes candidates that would have to be disposed of in a hazardous waste landfill. By virtue of a waste containing one or more hazardous substances even after treatment by more conventional methods (i.e., open burning of pyrotechnic wastes that would fail the Toxicity Characteristic Leachate Procedure (TCLP) test due to the high barium, lead or chromium content), or military munitions for which there are no documented demilitarization procedures, or those military munitions that will result in generation of hazardous wastes upon attempts at demilitarization (i.e., thermal batteries used in various missiles that contain lead, silver, cadmium, barium and chromium, as well as nickel and lithium, which are all toxic and/or carcinogenic and as a result of this combination of ingredients, no suitable disassembly/demilitarization has been worked out). For extremely toxic wastes such as chemical agents, chemical-agent contaminated materials or radioactive waste, or for situations when handling should be minimized, PAT may be the necessary treatment process. Same for hazardous waste candidates that allow PAT to be cost-effective due to extensive characterization requirements both before and after processing, need for segregation or pre-treatment requirements, need for post-treatment being required for conventional treatment technologies, or need for treatment trains to treat hazardous waste with both inorganic and organic chemicals of concern.

PAT can be applied to the following types of candidate waste streams: waste paints; solvents; oily debris; labpacks of chemicals; sludge with metals; sandblast grit with lead (grit and/or paint chips); still bottoms with solvents and metals; paint debris; wastes from maintenance (oil, solvent, metals); used oil with solvents and metals; low-level radioactive wastes with solvents; oils and solid consumables; chemical agent contaminated materials; incineration ash failing TCLP due to heavy metals; and other problematic wastes.

Technology Users

DoD facilities that contain "hard to treat" waste.

Background

The U.S. Army needs better disposal methods for environmentally hazardous and complex military wastes. Substances of particular concern to the Army include organics, inorganics, heavy metals, mixtures of organics and inorganics, chemical agents and chemical agent contaminated materials, medical wastes, and asbestos, which are toxic, carcinogenic, or both.

With the PAT application to hazardous wastes destruction gaining great advances worldwide, a feasibility study by the U.S. Army Construction Engineering Research Laboratories (USACERL) addressed asbestos vitrification (glassification) through PAT, which it co-developed with the Georgia Institute of Technology through the U.S. Army Corps of Engineers Construction Productivity Advancement Research (CPAR) program. In 1992, a joint study was conducted by the Armament Research Development and Engineering Center (ARDEC) and USACERL to investigate the feasibility of using plasma arc pyrolysis to destroy and permanently render inert armament-related hazardous waste.

Chemical manufacturers have used PAT for more than 30 years. NASA used it in the 1960s to simulate re-entry conditions during spacecraft development. The metallurgical industries later used PAT to prepare high-purity metals and to manufacture aluminum and steel.

Description

Concurrent Technologies Corporation (CTC), the operating contractor for the National Defense Center for Environmental Excellence (NDCEE), was tasked by the U.S. Army Environmental Center (USAEC) to select candidate waste materials for Phase I testing that can be treated by PAT.

Wastes selected for treatment during Phase I: Open burning-ground soil from Picatinny Arsenal containing heavy metals and energetics; Longhorn Army Ammunition Plant sludge containing heavy metals; spent blast media (glass/plastic composite and walnut shell) from Letterkenny Army Depot; and medical incineration ash from Medical Research Institute for Chemical Defense (Aberdeen Proving Ground), spiked at Retech with chemicals frequently found in hospital wastes.

Task 2 entails identifying a subcontractor able to treat the candidate waste materials in a suitable plasma-waste system, based on criteria specified in the Statement of Work. The PAT system should be able to destroy the selected waste materials.

Task 3 involves conducting and monitoring Phase I and Phase II testing, performed in accordance with a government-approved test plan and a quality assurance/quality control (QA/QC) plan. The slag should not be leachable, and the emissions should comply with the federal Clean Air Act. Outreach materials prepared to promote PAT will include a video, a descriptive brochure, a technical applications and analysis report, and information entered into the NDCEE's Environmental Information Network and the Defense Environmental Network and Information eXchange (DENIX). A cost estimate and procurement and design-fabrication guidance also will be prepared.

PAT applies to the following waste types:

- Concentrated liquid organic hazardous wastes. These wastes, including polychlorinated biphenyls (PCBs), paint solvents, and cleaning agents, are the most expensive to destroy. Chlorinated solvents and chlorofluorocarbons (CFCs) processes are in development. PAT is not affected by halogen concentrations.
- Low-level radioactive or mixed wastes. Plasma treatment offers the potential for the highest volume reduction and the formation of vitrified slags with the highest melting points. Its major advantage is requiring fewer steps to form the immobilized slag, because the same technology works for compaction and vitrification.
- Municipal solid wastes. These wastes, currently incinerated, contain combustible materials and could be hazardous because of metal content. PAT may be used to vitrify the ashes from the incinerator to eliminate hazardous materials.
- Medical wastes. Similar to municipal wastes, medical wastes have higher moisture content. PAT applies to these wastes if they contain metallic contaminants and if transfer to an incinerator is too expensive.
- Solid wastes contaminated with organic hazardous materials. These wastes include contaminated soils and containers filled with hazardous liquids (PCBs, chemicals, warfare agents). Plasma arc will destroy the organic toxins, vitrify the solid materials to an unleachable compact state, and remove contaminants such as HCl and volatilized metals.
- Concentrated wastes resulting from soil-washing operations.
- Wastes from manufacturing processes. This type of hazardous waste contains metal such as chromium, cadmium, and zinc as metallic dusts from metallurgical processes (e.g., electric arc furnace dust). This PAT application is attractive because recovery of a raw material makes the process more economical. For example, iron, zinc, and aluminum all can be recovered.
- Hazardous waste candidates from various installations for which no acceptable waste disposal options exist. These include waste disposal challenges such as high costs, residual wastes after treatment with conventional technologies, incompatibility with waste treatment systems, or other legitimate reasons (i.e., permitting issues) that would preclude conventional treatment options.

APPLICABILITY

Andrulis Report Requirements:

- 1.3.a Remediation of Explosives in Soil
- 1.3.e Soil Inorganic
- 1.4.c Heavy Metals
- 1.4.b Pesticides and PCBs
- 1.4.d Lead Contamination
- 1.4.g Asbestos Contaminated Facilities

Accomplishments and Results

Retech Inc. was the vendor selected to supply PAT equipment and perform the demonstration at its facility. Retech's equipment, Plasma Arc Centrifugal Treatment (PACT 1.5-foot diameter) was used in the USACERL/ARDEC work and a PACT 6 unit was used in Butte, Montana, to destroy hazardous wastes of interest to the Department of Energy (DOE) and pyrotechnic-related wastes for ARDEC.

Four candidates were selected for the initial feasibility tests: thermal batteries; metals-contaminated soil; incineration ash; and reject pyrotechnic smoke assemblies. All were successfully treated by PACT 1.5 at the Retech facility.

For this demonstration, Retech built a PACT 2 (2-foot diameter) able to process up to 100 pounds per hour, approximately four times the ability of the PACT 1.5. It should help determine reasonable process costs for larger systems while still determining mass balances, an integral part of this demonstration. Although Retech could collect valuable information on validating destruction of various waste streams in the PACT 6 system, it could not determine mass balances. Phase I testing was completed with successful Destruction and Removal Efficiencies (DREs) and non-leachable slags achieved in all test trials. The air quality met California standards except in the case of silver. Changes in the system will provide acceptable silver emission levels during Phase II testing.

Phase II hazardous waste materials evaluated included: waste paint from the U.S. Naval Base at Norfolk, Virginia; garnet blast media from McClellan Air Force Base, California; simulated oil-contaminated sorbent used by the tri-services and private industry; and soil spiked with dichlorobenzene (which was rated as a much more difficult compound to incinerate than chemical agents). Phase II testing has been completed. A final technical report, video and procurement/design fabrication guidance package on the PAT are available.

Limitations

This technology costs more than many conventional technologies and should find its niche in the "hard to treat" wastes.

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
Retech Inc.
U.S. Army Construction Engineering Research Laboratories
Georgia Institute of Technology
Armament Research Development and Engineering Center
Concurrent Technologies Corporation
National Defense Center for Environmental Excellence

PUBLICATIONS

Chapman, C.D., and Cowx, P.M., "Treatment of EAF dust by the Tetronics Plasma Process," Steel Times, June 1991.

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Orfeuil, M., Electric Process Heating, Battelle Press, Columbus, Richland, Washington, 1987.

Barton, G.T., Kolak, N.P., and Lee, C.C. "The New York State Waste Disposal Project," Waste Technology Journal, Westinghouse Waste Technology Services Division, Second Quarter 1984.

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Bhat, G.K., "Technical and Commercial Aspects of Plasma Heat Applications in Primary Melting, Secondary Remelting and Refining Operations," Journal of the Vacuum Society, April 1981.

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Bonizzoni, G., Plasma Arc Technology for Toxic Waste Treatment and Metal Production: Industrial Applications and Perspectives, Istituto de Fisica del Plasma, Via Bassini 15, 20133, Milano (Italy).

Malloy, Michael G., "High-Tech Waste Treatments Set to Take Off," Waste Age, March 1992.

"The Plasma Torch: Revolutionizing the Foundry Fire," prepared by the Electric Power Research Institute, EPRI Journal, October 1986.

Vitrification of Ash from a Municipal Solid Waste Incinerator (MSW) for the City of Bordeaux, France, Dr. Louis Circeo, Construction Research Center of Georgia Institute of Technology, October 1993.

Plasma Arc Vitrification, Richard C. Eschenbach, Retech Inc. (Presented at the EPA's Fourth Forum on Innovative Hazardous Wastes Treatment Technologies: Domestic and International, San Francisco, California, November 17-19, 1992).

Reduction of Hazardous Air Pollution Emissions from Electroplating Operations

Electroplating operations support Army manufacturing and maintenance requirements by protecting weapons and support system surfaces. Electroplating operations often release hazardous air pollutants. To maintain operation functionality, these releases must be controlled.

Purpose

To develop venturi/vortex scrubber technology for controlling and recycling chromium electroplating emissions.

Benefits

A venturi/vortex scrubber will save money and pollute less than conventional technologies.

Technology Users

Chromium electroplating and anodizing are used extensively throughout DoD. Currently, the Army has seven installations (the Navy has eight, and the Air Force has five with such operations). Current stringent regulations have forced many installations to close their operations.

Background

Chromium has qualities that are difficult to substitute, such as hardness, high reflectance, high corrosion resistance, low coefficient of friction, high heat conductivity, and excellent wear resistance. Because of these properties, chromium electroplating is used in coating military hardware and armament. Unfortunately, electroplating and chromium anodizing operations create hexavalent chromium, a hazardous air pollutant. The inefficiency of the process creates byproduct gases that rise to the plating surface, creating a chromic acid mist above the electroplating tanks. Conventional technologies for controlling this pollutant are end-of-pipe control devices, such as packed bed scrubbers and composite mesh screens. These devices are expensive, noisy, and use large amounts of energy and water. The result is that an air pollution problem is turned into a water pollution problem that must be treated.

Description

While conventional technologies use extensive ventilation systems to pull emissions away from the process and treat them downstream, the venturi/vortex scrubber pulls liquid particulate emissions back into the plating solution to be recycled. The device consists of a series of drains inside the plating tank that draws plating solution down by gravity where the liquid particles are scrubbed by the plating solution through several turns and bends. The gas/liquid mixture flows into a separate vessel to be separated. The liquid is recycled back to the plating tank while the gases are purged through the secondary filter/condensers to remove any remaining particulate. This also prevents emissions by pulling liquid containing bubbles of the byproduct gases down the vortex drains.

Capturing these bubbles before they reach the surface greatly reduces emissions. Recirculating the plating solution also eliminates the need for additional tank circulation. Conventional air circulation promotes emission generation by contributing additional bubbles. The entire device is located inside the plating tank except for the liquid recycle pump and the secondary filters. It is intended to replace conventional emission control technologies.

This technology will be installed in one chromium electroplating tank at each of the demonstration sites: Marine Corps Logistics Base in Albany, Georgia, and Hill Air Force Base, Utah. Installation and operation will involve personnel employed by the demonstration site. Once installed, normal production will begin and the device's performance evaluated. The demonstrations will confirm the technology's ability to control emissions to regulatory levels without affecting plating quality and operational practices.

A second demonstration is necessary to confirm the technology's performance. The test plan will evaluate plating quality while sampling ambient air and air emissions, all performed during normal production operations. The final test plan will be approved by the U. S. Environmental Protection Agency (EPA) before testing begins. Records of costs incurred for the design, installation, and operations will be kept to predict future implementation costs. Because this device offers large potential energy savings, wastewater treatment, and chromium recovery, a pollution prevention evaluation will be performed to quantify the benefits.

Applicability

Andrulis Report Requirement:

- 3.b. Compliance-Emission Reduction

Accomplishments and Results

Design complete and installed at Cherry Point Naval Aviation Depot. Testing complete at Cherry Point Naval Aviation Depot.

Resource Support

For FY 1996, this program was supported by the Environmental Security Technology Certification Program.

Follow-On Program Requirement

- Complete design and installation at Hill Air Force Base.
- Complete testing at Hill Air Force Base.
- Complete pollution prevention analysis.
- Complete final report.
- Complete technology transfer package.
- Approve EPA compliance requirements.

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
U.S. Environmental Protection Agency

Retrofitting Conventional Gravity Oil-Water Separators

Military installations can retrofit existing conventional oil-water separator systems with new technologies, potentially saving millions of dollars in replacement costs.

Purpose

To demonstrate and validate a technology for retrofitting oil-water separator systems with oleophilic tube packs.

Benefits

This technology could potentially save the Department of Defense (DoD) thousands of dollars in oil-water separator replacement costs.

Technology Users

Army and other DoD installations.

Background

For about 20 years, a technology using plastic tubes has been available to fit inside conventional gravity-type oil-water separators. These plastic tubes are oleophilic, meaning that oil attaches to them, thus enhancing separation. The proprietor of this technology (AFL Industries) claims that wastewater passing through the tubes will discharge less than 10 mg/L of oil and grease in the effluent.

Description

A six-month field demonstration at Fort Lee and Fort Belvoir, Virginia, will look at reliability and maintainability data from the separators retrofitted with these tube packs. Effluent from the separator will be closely evaluated to see if the technology can be applied to military wastewater.

Using "lessons learned" from development of the Site Characterization and Analysis Penetrometer System (SCAPS) World Wide Web page and the Federal Remediation Technologies Roundtable (FRTR) Remediation Technologies Screening Matrix, this project will develop a "strawman" Web page. Government-furnished information will be reviewed and used as the basis for screening matrix development. Vendor information and other relevant available information will be obtained and used to support and expand the matrix. Several installations may be selected for site visits to collect additional information and for consideration as demonstration sites. The matrix will be linked to selected applicable documents.

Applicability

Andrulis Report Requirements:

- 2.2.e. Oil-Water Separator Technology
- 2.6.c. Develop Removal/Treatment Technologies for Oil and Greasy Waste
- 3.7.c. Improve Oil-Water Separation Technologies

Accomplishments and Results

FY 1998 Environmental Security Technology Certification Program (ESTCP) proposal promoted to Phase II review for compliance.

Follow-On Program Requirements

- Initial site visits to Fort Lee and Fort Belvoir to select separators for the evaluation.
- Begin evaluation of retrofitted separators
- Finish evaluation at Fort Lee and Fort Belvoir.
- Complete final report.

Point of Contact

Peter Stemniski

Publications

Engineering Technical Letter, U.S. Army Corps of Engineers, "Selection and Design of Oil-Water Separators at Army Facilities," 26 August 1994.

Reuse of Waste Energetics as Supplemental Fuels

Munitions production and demilitarization generate waste energetics that require disposal. Past disposal practices could have regulatory or financial impacts. Incorporating waste energetics in fuels for installation boilers may reclaim the energy and reduce disposal costs.

Purpose

To develop a technology for reusing waste energetics as a fuel oil supplement in industrial boilers.

Benefits

Supplemental-fuels technology could provide a cost-effective alternative to incinerating waste energetic materials. It could become an alternative to open burning /open detonation (OB/OD) which soon may not be an option due to environmental concerns associated with the process. Potential safety hazards may also be mitigated if a beneficial use can be found for the large stockpile of these obsolete munitions, scrap and off-specification materials now being stored indefinitely.

Technology Users

Many DoD facilities using industrial boilers; any installation involved in the manufacture of explosives and propellants; installations involved in munitions demilitarization, rocket motors, etc., that contain explosives and/or propellants; and depots containing obsolete or off-specification explosives or propellants.

Background

Waste energetic materials (propellants, explosives, and pyrotechnics) are generated in significant quantities by the U.S. Army due to the generation of off-specification materials during production, as well as in the demilitarization of obsolete munitions filled with these energetic materials. The Army, as the sole DoD manager for explosives, is evaluating and developing safe, environmentally acceptable, alternative disposal and reuse technologies for its waste energetic materials stockpile. These materials — propellants, explosives, and pyrotechnics — are commonly called PEP. Unserviceable materials remain from PEP manufacturing, munitions assembly, and demilitarization of obsolete conventional munitions. About 2.5 million pounds of scrap energetic materials are generated each year. Moreover, about 200,000 tons of conventional munitions required demilitarization in 1990.

The U.S. Army Environmental Center (USAEC) began investigating the feasibility of reusing energy from waste energetic materials to produce steam and electricity in 1984. Because explosives are a major waste energetic material in the Army's inventory, USAEC began investigating the potential use of TNT, RDX, and Composition B (60% RDX, 40% TNT) as supplemental fuels.

The disposal alternatives for these unserviceable PEP materials are OB/OD and incineration. OB/OD is the preferred method, but its use requires a Subpart X permit under the Resource Conservation and Recovery Act (RCRA). Because of environmental concerns, OB/OD is approved case-by-case. Incineration of energetic materials is uneconomical. To burn safely, energetic materials are mixed with about 75% water to form an energetic/material water slurry. The process requires water, which dramatically increases fuel costs, to prevent detonation during the handling and feed process. Although OB/OD and incineration are acceptable disposal technologies, neither takes advantage of the material's energy content.

Description

Roy F. Weston Inc., involved in the design of the pilot-scale boiler and pilot-scale testing at Hawthorne Army Ammunition Plant, was awarded a task order contract to help Indian Head Division, Naval Surface Warfare Center (IHDIV, NSWC):

- Identify data gaps from previous laboratory and bench-scale testing on explosives and propellants supplemental fuels testing, and recommend testing to optimize implementing the technology.
- Identify nitrous oxide abatement technologies that can be incorporated on a typical full-scale boiler system (at an Army installation) to ensure compliance with new Clean Air Act regulations.
- Identify slurry nozzles suitable for firing wet-ground explosives and propellant/fuel oil slurries.
- Provide operational and maintenance support during the pilot-scale demonstration on both explosives and propellants.

Research has demonstrated successful disposal of waste-solvated explosives in the laboratory (1985), bench-scale studies (1988), and pilot-scale tests at Los Alamos (1989) and Hawthorne (1991). The boiler used in the pilot-scale test at Hawthorne was a Cleaver-Brooks Model M4000, two million BTU water-tube boiler, one-tenth the size of most boilers at Army facilities. The prototype explosive-dissolving and blending system was proven during the demonstration, and the technology demonstrated potential as an effective method to recover energy from waste explosives. Diluted TNT solutions (1%) safely and effectively blended with fuel oil and cofired, achieved a 99.99% destruction rate and removal efficiency (DRE).

The primary operational and safety problems resulted from the inability to keep TNT in the solution during testing at low temperatures. Nitrous oxide (NOx) emissions increased significantly when cofiring even a 1% TNT/No. 2 fuel-oil solution.

Applicability

Andrulis Report Requirements:

- 2.C.1.b Solid-PEP-Demil/Disposal
- 2.A.1.a Air-Combustion-Products-General

Accomplishments and Results

Weston has submitted final reports on NOx abatement technologies, recommended slurry nozzles, and submitted a draft report on data gaps and recommended testing. Weston also has arranged for a subcontractor to perform necessary solubility and viscosity studies to fill in the data gaps identified in the study.

IHDIV, NSWC has been preparing the boiler and is having it certified for the demonstration, which was anticipated to start in November 1995. The boiler internals were plugged with scale and needed to be replaced in 1995. New agitators, which were deemed necessary by IHDIV, NSWC personnel due to insufficient mixing of original agitators, were installed in 1995. A lab particle size mixing study was conducted by IHDIV, NSWC personnel in 1995. Atomizers, a mass flow meter, and a solvent meter were installed in 1995. An inert demonstration on the system was conducted in 1996. An in-situ particle size analyzer was installed in 1996. A technical review on the supplemental fuels system was conducted in 1996. A surfactant study, melting process study, and a grinding study were conducted by IHDIV, NSWC personnel in 1996. The Continuous Emissions Monitor (CEM) was installed and certified in 1996. Baseline emissions testing was completed in July 1997. TNT and Composition B testing were completed in December 1997. The homogenizing tank was installed in September 1997.

Limitations

Mature slurry nozzles with recirculation capabilities must be used. Another limitation is the need to identify ideal solvents for their solubility and viscosity, economics, and health effects, should solvation prove to be the preferred approach for firing explosives-supplemented fuels.

Resource Support

The Strategic Environmental Research and Development Program (SERDP) provided support for this project.

Follow-On Program Requirements

The pilot-scale equipment has moved to IHDIV, NSWC, Indian Head, Maryland, where the Navy and the Army, as a result of a 1994 Memorandum of Agreement, will develop the technology together.

Recommended modifications to the supplemental fuels system, as a result of the pilot-scale test at Hawthorne, are incorporated into the equipment design. Initial testing at IHDIV, NSWC will use TNT-supplemented fuel (1%, 10 %, 15 %) and Comp B-supplemented fuel (1%, 4 %, 8 %) at various excess air percentages.

Follow-up testing will investigate supplementing fuel with nitrocellulose (NC), nitroguanidine (NQ), AA2 double-based propellant, and Otto Fuel. The propellants will be wet-ground and mixed with fuel oil and will be fired through a slurry nozzle into the burner. Comparisons between solvation and wet-grinding will determine the preferred approach for firing the explosives-supplemented fuels. A final report will be prepared at the conclusion of the testing as well as an operations manual and a video depicting system operation. Equipment modifications will be made and "as modified" drawings will be prepared, if necessary. A cost analysis will then be performed and a procurement/fabrication package will be prepared.

Other requirements include:

- Technical report on explosives
- Otto Fuel test
- Nitroguanidine test

- Identification of a full-scale demo location
- Nitrocellulose test
- Technical report on propellants

POINT OF CONTACT

Louis Kanaras

PROGRAM PARTNERS

The U.S. Army Environmental Center
Roy F. Weston Inc.
Indian Head Division, Naval Surface Warfare Center

PUBLICATIONS

Technical report, Utilization of Energetic Materials in an Industrial Combustor, USATHAMA Report AMXTH-TE-TR 85003, June 1985.

Technical report, Testing to Determine Chemical Stability, Handling Characteristics, and Reactivity of Energetic-Fuel Mixtures, USATHAMA Report AMXTH-TE-CR-87132, April 1988.

Technical report, Pilot-scale Testing of a Fuel Oil-Explosives Cofiring Process for Recovering Energy from Waste Explosives, USATHAMA Report AMXTH-TE-CR-88272, May 1988.

Technical report, Phase I: Pilot Test to Determine the Feasibility of Using Explosives as Supplemental Fuel at Hawthorne Army Ammunition Plant (HWAAP) Hawthorne, Nev., USATHAMA Report CETHA-TE-CR-91006, April 1991.

Technical report, Laboratory Tests to Determine the Chemical and Physical Characteristics of Propellant-Solvent-Fuel Oil Mixtures, USATHAMA Report CETHA-TE-CR-90043, April 1990.

Technical report, Technical and Economic Analyses to Assess the Feasibility of Using Propellant-No. 2 Fuel Oil Slurries as Supplemental Fuels, USATHAMA Report CETHA-TE-CR-91046, September 1991.

Technical report, Zero-Gap Testing of Propellant-No. 2 Fuel Oil Slurries, USATHAMA Report, CETHA-TS-CR-92005, January 1992.

U.S./Germany Data Exchange Agreement

"Preventive defense" presents a new opportunity for nations to prevent war by sharing their military experiences. Through Data Exchange Agreements (DEAs), the United States and other countries can share technical expertise and data to tackle common environmental challenges and improve quality of life. The U.S. military has engaged in a DEA with Germany since 1986.

Purpose

To promote sharing of environmental research and development (R & D) information among engineers and scientists of the U.S. and Germany. The DEA's focus expanded in 1994 to include joint field demonstrations.

Benefits

Sharing information and expertise will benefit technology research and development efforts.

Background

Attention to the environment began with the first Earth Day in 1970 and initially, the U.S. military was a reluctant participant. Today, however, the U.S. Department of Defense (DoD) is a major supporter and protector of the environment.

After 50 years of fighting the Cold War, "preventive defense" presents a new opportunity. One way for nations to prevent war is to share their military experiences "one-to-one." Every country has a military that faces similar environmental challenges. These militaries can use their experiences in a positive manner to help improve quality of life. The United States has completed or is pursuing international agreements with several countries, including the Netherlands, Russia, Norway, Sweden, Spain, Turkey, Poland, Hungary, and the Czech Republic.

The U.S. government seeks to make the environment a significant part of foreign diplomacy. To make DEAs successful, the Defense Department must pull U.S. authorities and resources together to share as multi-agencies with other countries.

Mr. Gary Vest, the Principal Assistant Deputy Under Secretary of Defense (Environmental Security), once commented that DEAs often lack a demonstrated effort to document useful environmental technology information and distribute it in a comprehensive manner so that all appropriate people will benefit from it. He commented that many DEAs are under critical observation and that this level of exchange and activity must be demonstrated for DEAs to continue to receive support.

Description

The U.S. Army Environmental Center (USAEC) promotes exchange activities within this DEA. USAEC supports planning, organizing, and participation at meetings. Overall exchange meetings occur every 18 months; Technical Project Officer (TPO) exchange meetings occur every six months. Meeting locations alternate between the United States and Germany.

The U.S./Germany DEA consists of four individual DEAs:

- DEA 1311 (Hazardous Materials/Pollution Prevention/Air)
- DEA 1520 (Soil Remediation)
- DEA 1521 (Water Remediation)
- DEA 1522 (Demilitarization and disposal of conventional munitions)

The main U.S. participants:

- Mr. Gary Vest, Principal ADUSD(ES), who is the U.S. Policy Overview Person.
- U.S. Army ERDEC, which is U.S. Overall Project Officer (Dr. Randall Wentsel).
- USARDEC, which serves as the TPO for DEAs 1311 and 1522.
- USAEC Environmental Technology Division (Mr. Jim Arnold), which is the TPO for DEA 1520.
- U.S. Air Force Armstrong Lab, which serves as the TPO for DEA 1521.

The main German participants:

- Federal Office for Defense Technology and Procurement, which is the German Overall Project Officer.
- Dr. Roland Dierstein, of the Federal Armed Forces Science Agency for NBC Protection, who is the TPO for soil remediation.

Applicability

The Department of the Army established the U.S./Germany DEA in 1986; it was chartered by the Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health (DASA-ESOH). The USAEC Environmental Technology Division was tasked with serving as the U.S. TPO for DEA 1520, “Soil Remediation.”

Accomplishments and Results

The U.S./Germany DEA has been active since 1986. In October 1996, U.S. and German engineers and scientists met in Koblenz, Germany, at the Federal Office for Defense Technology and Procurement to exchange environmental technical information under U.S./Germany DEA Annexes DEA-A-94-GE-1311/1520/1521/ and 1522.

The following platform and poster presentations were made on DEA 1520:

- Tri-Services Activities in Ecological Risk Assessment (U.S., platform).
- Man Portable Ordnance Detection System (U.S., platform).
- Demonstration of SCAPS VOC Detection Capabilities (U.S., platform).
- Phytoremediation of Explosives in Groundwater using Constructed Wetlands (U.S., platform, Water Group/Soil).
- Soil Remediation by Bioventing and Bio-Slurping of the Former NPA-Air Force Base Preschen (Germany, platform).

- Bioventing at the Tank-Barracks Neuruppin (Germany, platform).
- Origin and Content of Heavy Metals in the Soil of the Handgranade Range Oerbke (NATO Training Area Bergen) (Germany, platform).
- Analyses of Soil Samples Taken From Munitions Training Ranges in Germany, Fall 1995 (U.S., poster session).
- Evaluation of Low Cost Sorbents for Treatment of Metals Contaminated Water and Waste Streams (poster session).
- Unexploded Ordnance Advanced Technology Demonstrations (U.S., poster session).
- Risk Assessment Methodology for Use in Managing U.S. Army Sites Containing Unexploded Ordnance (poster session).
- Conversion of TNT to Biodegradable Products by Alkaline Treatment (poster session).
- Surfactant Enhancement of Soil Slurry Biotreatment of Explosives-Contaminated Soils (poster session).

FOLLOW-ON PROGRAM REQUIREMENTS

The U.S./Germany overall gathering meeting for all DEAs is scheduled for April 1998 in the United States.

POINT OF CONTACT

Edward Engbert

Cleanup

BIOVENTING OF POL CONTAMINATED SOILS

Many operational facilities have POL-contaminated soils, and excavation for remediation can disrupt Army operations. Bioventing offers an alternative to excavation and incineration, relying on existing microorganisms to remediate the waste.

PURPOSE

To transfer bioventing technology to the Army from the Air Force for use in remediating POL contaminated sites on Army installations.

TECHNOLOGY USERS

Army installations.

BACKGROUND

Many Army sites are contaminated with petroleum, oils and lubricants (POL). These sites include aircraft areas, maintenance areas, leaking storage tanks, burn pits, chemical disposal areas, disposal wells and leach fields, landfills and burial pits, firefighting training areas, and surface impoundments.

POL contamination in the unsaturated (vadose) zone exists in four phases: vapor in the pore spaces; sorbed to subsurface solids; dissolved in water; or as non-aqueous phase liquid (NAPL). The nature and extent of transport are determined by the interactions among contaminant transport properties (e.g., density, vapor pressure, viscosity, and hydrophobicity) and the subsurface environment (e.g., geology, aquifer mineralogy, and groundwater hydrology).

Common treatment technologies for POL in soil include excavation and landfilling, biodegradation, incineration, soil vapor extraction (SVE), and low-temperature thermal desorption. Implementing in-situ remediation techniques would greatly reduce cleanup costs for POL-contaminated sites.

DESCRIPTION

Bioventing was developed by the Air Force Center for Environmental Excellence (AFCEE). Bioventing is the process of providing naturally occurring soil microorganisms with oxygen to promote in-situ degradation of POL. The basic elements of a bioventing system include a well, or series of wells, and a blower system that pumps air through the wells and into the ground.

This transfer effort consists of treatability studies and pilot-scale demonstrations at various sites. Testing bioventing under real scenarios will build confidence in the technology and increase awareness among Army users.

Based on AFCEE and commercial applications, costs for operating a bioventing system range from $10 to $60 per cubic yard. The time required to clean up a site ranges from 1 to 5 years to remove benzene, toluene, ethylbenzene, and xylene (BTEX) constituents and 2 to 10 years to remove total petroleum hydrocarbons (TPH). Many factors can affect cost and duration, including contaminant type and concentration, soil permeability, well spacing and number, pumping rate, and off-gas treatment. For these reasons, initial treatability studies need to be performed to determine bioventing's effectiveness at each site. Bioventing does not require expensive equipment and can be left unattended for long periods. Typically, only periodic maintenance and monitoring is conducted.

Accomplishments and Results

In May 1997, the pilot system at Fort Carson, Colorado, was scaled up to provide full-scale remediation. One-year testing is scheduled for May 1998.

The pilot system at Fort Rucker, Alabama, should provide full-scale cleanup. Yearly testing in July 1997 found that residual BTEX, and to a lesser degree TPH, compounds in site soils between 20 feet and 40 feet have been greatly reduced. High concentrations of BTEX and TPH likely remain in the perched saturated zone. Operation of the system for an additional year should eliminate the potential for contaminant leaching.

Limitations

In May 1997, annual testing of the pilot system at Fort Bliss, Texas, indicated that biological activity had decreased while contaminant levels remained elevated. This phenomenon has occurred at several of the southwestern desert sites where bioventing systems have operated for extended periods. The decrease in biological activity may be due to a variety of factors, such as low soil moisture or nutrient availability.

The time required to clean up a site ranges from 1 to 5 years to remove BTEX constituents and 2 to 10 years to remove TPH.

Follow-On Program Requirements

Issue contract to demonstrate and promote use of bioventing and intrinsic remediation technologies to the Army. Tasks include:

- Site investigation and treatability study expansion for the Fort Carson site
- Continued support for one year and, if appropriate, site closure evaluation for the Fort Rucker site.

Points of Contact

Gene Fabian
Tanya Lynch

Program Partners

U.S. Army Environmental Center
Fort Bliss, Texas
Fort Rucker, Alabama
Fort Carson, Colorado

The major source of error associated with an analytical result is derived from sampling, yet little has been done to improve the process. A cost-effective method to truly determine the distribution of contaminants will benefit the site remediation efforts.

PURPOSE

To create a procedure whereby the error associated with the collection of soil samples can be applied correctly to the analytical results.

BENEFITS

A cost-effective method to determine the distribution of contaminants will benefit the site remediation process.

TECHNOLOGY USERS

Army installations with explosives-contaminated soils.

BACKGROUND

While it is known that the major source of error associated with an analytical result is derived from sampling, little has been done to improve the process. Previous sampling was based on a specified grid approach, which resulted in extreme sampling error for non-homogenous distributed contaminants, such as explosives. True determination of the distribution of contaminants, in a cost-effective manner, is fundamental to the site remediation process.

DESCRIPTION

An HMX/TNT-contaminated site will be assessed. A final report will document the sampling and analytical errors associated with short-range and longer-range analyte distributions for this site. The report also will document improvements in site characterization that result from the use of a compositing-based sampling procedure and on-site analysis, and address whether this approach reduced sampling error to acceptable levels for this site.

Additional sampling and analysis studies will be conducted to demonstrate the effectiveness of the combination of on-site analytical methods and simple composite sampling procedures. Sites contaminated with RDX and NG will be sampled (if available) as well as a non-explosives contaminated site to assess whether levels of heterogeneity at these sites are similar to those observed for sites contaminated with TNT, DNT, ammonium picrate, and HMX.

APPLICABILITY

Andrulis Report Requirements:

- 1.1.c Cleanup Goals
- 1.3.a Remediation of Explosives in Soil

ACCOMPLISHMENTS AND RESULTS

In Phase 1 of this project, several explosives-contaminated sites were intensely sampled to obtain information on the short range heterogeneity of analyte distribution as a function of the specific contaminant, mode of contamination, and soil type. Both on-site analytical methods and off-site laboratory analysis were conducted on soils sampled.

In FY 96, these results were used to compute overall analytical error. The on-site analytical methods for TNT, DNT, and picric acid provided data that were adequate for site assessment at much lower cost. Based on these results, various strategies to minimize the sampling error were considered and a larger scale sampling strategy proposed.

This approach was evaluated in Phase 2 at a site contaminated with HMX and TNT. Analysis of larger scale sampling and analytical results indicated that an approach based upon discrete grab sample collection and analysis could not adequately describe analyte concentrations. A rapid compositing approach was assessed and the analysis of these results shows that this is the best approach for sampling non-homogeneous distributed contamination. This composting approach was further validated at a site contaminated with RDX and TNT. It also underwent preliminary testing at an impact range, to demonstrate its feasibility of use.

FOLLOW-ON PROGRAM REQUIREMENTS

Demonstrate approach, full-scale, at an impact range.
Evaluate correlation's between field analytical results and laboratory analytical results, especially for RDX.

POINT OF CONTACT

Martin Stutz

PUBLICATIONS

CRREL Special Report 96-15, Assessment of Sampling Error Associated with Collection and Analysis of Soil Samples at Explosives-Contaminated Sites.

Field Sampling and Selecting On-Site Analytical Methods for Explosives in Soil -EPA Federal Facilities Forum Issue. EPA ORD/OSWER Report EPA/540/R97/501, November 1996.

CRREL Special Report (97-22), Assessment of Sampling Error Associated with Collection and Analysis of Soil Samples at a Firing Range Contaminated with HMX.

Follow-On Reactivity Study of Primary Explosives in Soil

Soils contaminated with explosives must be considered reactive unless research proves otherwise. Determining the actual safety threshold level for primary explosives will allow remediation managers to protect workers while conserving resources for remediation.

Purpose

To conduct tests at various primary explosive concentrations and moisture levels, establishing a safety threshold reactivity level and developing a database at higher confidence levels.

Benefits

The study will provide a better understanding of the overall safety threshold reactivity levels of primaries. This information will help determine safe concentration levels for personnel to investigate primary explosives-contaminated soil areas on Army installations.

Study results will also be used by the Department of Transportation (DOT) to establish a hazardous waste classification for primary explosive waste, by Department of Defense (DoD) Explosives Safety Board, and by private industries involved in manufacturing primary explosives.

Technology Users

Army industrial facilities, Formerly Used Defense Sites, and industries involved in manufacturing primary explosives.

Background

Since World War I, munitions have been manufactured in the United States using a variety of energetic materials, including propellants, explosives, and pyrotechnic (PEP) materials. Many manufacturing sites contain explosives-contaminated soil from operations such as load, pack and repack, maintenance, storage, disposal, and demilitarization. Some of these sites contain primary explosives, such as lead azide, lead styphnate, and nitroglycerin (NG).

The Army's site restoration criteria regarding cleanup priority and technology would be incomplete without safety data for soils contaminated with primary explosives. This data will be used to develop protocols for sampling, handling, cleanup alternatives, and transportation of explosives-contaminated soil.

The Army's Remedial Investigation and Feasibility Study (RI/FS) activities at installations contaminated with primary explosives have been suspended until the specifics outlined under the following "Applicability" section are complete. The Transportation Department must establish hazardous-waste classifications for primary explosive wastes.

The Army's mission for site cleanup includes propellants, explosives, pyrotechnics, unexploded ordnance, industrial waste, and hazardous waste. DoD site cleanup goals cannot be accomplished without a characterization of soils contaminated with primary explosives.

The Army will use the study results to investigate installations undergoing RI/FS investigations, such as Picatinny Arsenal, New Jersey; Joliet Army Ammunition Plant, Illinois; and Sunflower Army Ammunition Plant, Kansas.

Description

This study will enhance the military's ability to meet Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) requirements for controlling hazardous waste from cradle to grave. The military must have a thorough understanding of the wastes generated from different activities conducted under its control to be in compliance with CERCLA and RCRA. This is especially true in the area of explosives, which have significant safety concerns along with environmental concerns. Through compliance with laws and better understanding of explosives handling and remediation, the military can continue to provide troops with the reliable and maintainable explosives needed to fulfill their training mission.

The technical approach of the Follow-On Reactivity Study is:

- Evaluate existing reactivity testing procedures used for primary explosives to determine applicability and develop alternative reactivity testing protocols, if appropriate.
- Develop a database at higher confidence levels to verify the unqualified positive reaction that occurred at 7 % (see "Accomplishments").
- Establish threshold initiation-level values for these primary explosives and establish safe-handling criteria.
- Investigate possible explosive segregation or concentration of wet samples (moisture levels).
- Develop optimal burn times and publish standard procedures.
- Plot probit graphs and calculate confidence levels.
- Evaluate primary reactivity levels in different soil types and fill data gaps.
- Evaluate effects of soil compactness and soils contaminated with larger primary explosives agglomerates.
- Develop a procedure to collect and prepare samples for analysis.

Applicability

Andrulis Report Requirement:

- 1.5.g Hazard/Risk Assessment of Military Unique Compounds

Accomplishments and Results

The evaluation of existing reactivity procedures has been completed and alternative reactivity testing protocols have been established. These test protocols will measure the force, over-pressure (sound) and/or pipe damage as criteria to differentiate a "Go" from a "No Go" for safety threshold reactivity levels.

The test results for lead azide indicated soil compaction was not a significant factor for reactivity in the baseline soil. The threshold initiation-level (TIL) for the shock test occurred at an explosive concentration of 2 % lead azide at dry conditions. The TIL for the flame test occurred at an explosive concentration of 4 % lead azide at dry conditions. The results showed that the reactivity was reduced in moisture levels below 15 % in soils. Moisture levels above 15 % appeared to increase reactivity, which must be further investigated. The results of probit testing with mixtures of NG and soil yielded a TIL for the Deflagration-to-Detonation Transition (DDT) test at an explosive concentration of 12 % NG at dry conditions. The TIL for the U.S. Gap test occurred at an explosive concentration of 13 % NG at dry conditions. Tests at 15 % moisture saturated the NG soaked soil and corrupted the results. Tests were not performed.

Safe Handling Criteria were developed for generic field operations for soils contaminated with primary explosives. A hazard analysis was conducted for sampling, excavating, handling and remediation operations. Sensitivity lab data were generated for initiation of mixtures of lead azide and soil from impact, friction, and electrostatic discharge (ESD). This data was used as the basis for developing designed and operating criteria to establish an acceptable level of risk for generic field operations. Since the analysis was conducted for generic operations, hazard analysis for specific field operations is recommended before conducting any remediation efforts. Sampling and handling is considered the most hazardous field operation, from the standpoint of personal injury, because the operator maintains “hands on” contact with the contaminated soil.

Follow-On Program Requirements

Additional work on lead azide/soil reactivity at elevated moisture must be done to resolve the increased reactivity at moisture levels above 15 %. A soil characterization study must be done to resolve the issue of different reactivity levels associated with different soil types. Also, a Remediation Safety Field Manual must be developed to provide equipment requirements for handling explosives and recommend practices for redemption and disposal.

Point of Contact

William Houser

Program Partners

U.S. Army Environmental Center
Department of Defense Explosive Safety Board
Defense Evaluation Support Activity
Department of Transportation
Global Environmental Solution (Alliant Techsystem Company)
TRW, Inc.

Publications

Reactivity Testing of Primary Explosives Final Report Number: SFIM-AEC-TS-CR-94057. Contract Number: DACA31-91-D-0079. May 1994.

Follow-On Reactivity Study of Primary Explosives in Soil; Report Number SFIM-AEC-ET-CR-97015, May 1997.

In-Situ Electrokinetic Remediation for Metals-Contaminated Soils

Remediating heavy metals in environmentally sensitive areas presents a challenge to Department of Defense (DoD). Often, these sites are used as wildlife habitats and as public recreation areas. Technologies such as electrokinetic remediation allow for non-intrusive remediation.

Purpose

To conduct a joint project with the Navy to demonstrate the use of electrokinetics to clean up heavy metals in soils.

Benefits

Electrokinetic remediation is being demonstrated because of its potential to be less invasive in ecologically sensitive areas and more cost effective than other metals-removal technologies.

Technology Users

Military installations with metals-contaminated soils.

Background

Military activities are primary contributors to metals contamination in soil. Military operations, such as small arms training, electroplating and metal finishing, explosive and propellant manufacturing and use, and using lead-based paint on ships and at military facilities, have resulted in vast areas of land contaminated with metals. This creates a need to develop cost-effective remediation tools. Current technologies include solidification/stabilization methods and excavation, followed by landfilling of the contaminated soils. These methods are very expensive and may only provide temporary solutions to the contaminant problem. A low-cost method of extracting the contaminants from the soil without soil excavation is needed to effectively address this problem. Electrokinetics has been identified as a possible method of performing in-situ extraction of the metals contaminants from the soils.

Description

Heavy metals are an environmental problem, especially in an aqueous environment. Because metals are charged particles, it is possible to use an electric current to move those particles.

The site selected for the full-scale electrokinetic soil remediation demonstration is at the Point Mugu Naval Air Weapons Station (NAWS) in Ventura County, California. The installation is approximately 50 miles northwest of Los Angeles, California and comprises approximately 4,500 acres. NAWS Point Mugu is situated in the western portion of the Ventura Basin with the Santa Monica Mountains directly to the east.

The demonstration area is known as Site 5. This is a large area where many industrial and military operations were conducted. The specific area of study is approximately 1/2 acre in and around two waste lagoons located in the center of Site 5. These unlined lagoons were used between 1948 and 1978 to receive wastewater discharge, which included up to 60,000-gallons of photovoltaic fixer, small quantities of organic solvents, rocket fuel, and approximately 95 million gallons of plating rinse water. The waste pits, located in a tidal marsh area, measure approximately 30 feet by 90 feet and range in depth from 4 feet to 5 1/2 feet. They are surrounded by an elevated berm approximately 2 feet above the water level. The waste pit lagoons typically contain standing water, which fluctuates with the tides. The area around the pits is bounded by Beach Road on the south side and the tidal marsh on the remaining three sides.

An emergency action was performed in 1994, removing approximately 117 cubic yards of material to limit exposure of resident and migratory birds and reduce the potential source of contamination for surface and groundwater. This area is inhabited by the light-footed Clapper Rail, a federally and state-listed endangered species, as well as other species. Before the emergency removal, the levels of chromium, cadmium, copper, nickel, and silver were high. After the emergency action, surface sampling in the pits indicated that cadmium and chromium levels still exceeded Total Threshold Limit Concentrations described in the California Code of Regulations (Title 22, Section 66261.24). California will not allow any further soil excavation from this site. Other potential chemical contaminants of concern at this site are arsenic, beryllium, Aroclor-1260, tetrachloroethane, trichloroethene, manganese, and fluoride. Activities are restricted by the presence of endangered species.

Applicability

Andrulis Report Requirements:

- 1.4.d Lead Contamination
- 1.3.e Soil Inorganic
- 1.5.f Alternatives to Pump and Treat

Accomplishments and Results

- The U.S. Army Waterways Experiment Station (USAWES) treatability study is complete.
- Initial site characterization is complete.
- Electrokinetics market research is complete.
- Demonstration plan has been developed.
- Site preparation plans (i.e., barrier wall, site facilities layout, services requirements) are complete.
- An implementation plan that includes development of a guidance manual will be developed as the project progresses.

Follow-On Program Requirements

- USAWES treatability study.
- Initial site characterization.
- Electrokinetics market research.
- Demonstration test plan.
- Site preparation.
- Electrokinetics system installation.
- Technology monitoring and site management.

Point of Contact

Gene Fabian

Program Partners

U.S. Army Environmental Center
Point Magu Naval Air Weapons Station, California
U.S. Army Waterways Experiment Station

Low-Profile Air Stripping System at Letterkenny Army Depot

Air stripping is an effective method of eliminating volatile compounds from water. Installation of a low-profile air stripping system on a site at Letterkenny Army Depot, Pennsylvania, will help remove volatile organic compound (VOC) contamination and treat a water supply for livestock.

Purpose

To prepare and implement a final design of a low-profile air stripping system for the Rowe Spring site at Letterkenny Army Depot, a National Priorities List site.

Benefits

If installed successfully, this innovative use of a conventional system will help to clean up volatile organic compound VOC contamination while minimizing impact on residential areas and providing a treated water supply for livestock.

Technology Users

Letterkenny Army Depot

Description

- A contract will be awarded to complete the final design and to construct the treatment system.
- System will be constructed and effluent testing will initiated.

Applicability

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)
- Clean Water Act (CWA)
- Resource Conservation and Recovery Act (RCRA)

Follow-On Program Requirements

- Contract award pending availability of funding.
- Issue draft version final design.
- Complete system construction.
- Start treatment system and initiate effluent testing.

Point of Contact

Scott Hill

Publications

Demonstration Off-Post Groundwater Treatment Plant (Rowe Spring): Concept Design Report, July 1996.

Peroxone Treatment of Explosives-Contaminated Groundwater

Explosives-contaminated groundwater is a problem at many Army installations. A cost-effective technology to treat this contamination is required. Current technologies do not provide destruction of the contamination. Peroxone is being evaluated to determine if it offers an opportunity to effectively treat groundwater at low cost.

Purpose

To evaluate the performance and cost effectiveness of the Peroxone Advanced Oxidation Process for the treatment of explosives in groundwater.

Benefits

Peroxone is a destructive technology, destroying the explosives contaminant.

Technology Users

Department of Defense (DoD) sites containing explosives-contaminated groundwater.

Background

A number of DoD sites have groundwater that contains explosives, propellant materials and wastes. The explosives in groundwater occur on and off the installation. The Army user community has ranked "explosives in groundwater" as the fourth-highest requirement in environmental restoration research and development.

The current method for treatment of explosives-contaminated groundwater, granular activated carbon (GAC), can be cost- prohibitive depending on the extent of the contamination. Additionally, GAC does not destroy the contaminants. Processes that are more cost-effective than GAC and result in the actual destruction of the contaminants are being sought for the restoration of DoD sites.

The U.S. Army Waterways Experiment Station (USAWES) has completed its field study at Cornhusker Army Ammunition Plant, Nebraska. The U.S. Army Environmental Center (USAEC) has completed its evaluation of a full-scale system. A final report is scheduled for publication in January 1998.

Description

This technology derives from advanced oxidative chemistry and involves the production of hydroxyl radicals that react with and destroy most organic materials. With performance and cost comparable to GAC, advanced oxidation processes have been used commercially to purify drinking water and wastewater, but not to treat explosives-contaminated groundwater or process water. This project is the demonstration of an advanced oxidation process for explosives-contaminated water as an alternative to using GAC adsorption.

This project provides a full-scale demonstration of peroxone oxidation and will determine the effectiveness of peroxone treatment of explosives in groundwater. The demonstration and data analysis are complete. Reporting and documentation will follow.

Validated data on the cost and effectiveness of this demonstration and documents explaining how to implement this technology will go to users, if applicable.

APPLICABILITY

Andrulis Report Requirements:

- 1.2.a Explosives in Groundwater
- 1.2.b Organics in Groundwater
- 1.2.c Solvents in Groundwater

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

Resource Conservation and Recovery Act (RCRA)

ACCOMPLISHMENTS AND RESULTS

The system was installed at Cornhusker Army Ammunition Plant and the demonstration completed. Data collected includes influent and effluent concentrations, cost of equipment and resources, operational and maintenance costs, and other pertinent information. A final report will include a cost analysis and all documented information.

Preliminary cost data indicate the peroxone process is more expensive than GAC at moderate or low contaminant (below 1.5 ppm) concentrations.

LIMITATIONS

System parameters need to be optimized to decrease operational costs.

FOLLOW-ON PROGRAM REQUIREMENTS

The researchers plan a follow-up effort to transfer the peroxone technology (if applicable), using the data from this demonstration, with implementation and design guidelines included.

POINT OF CONTACT

James Heffinger

PROGRAM PARTNERS

U.S. Army Environmental Center
Cornhusker Army Ammunition Plant, Nebraska
U.S. Army Corps of Engineers, Omaha District
U.S. Army Waterways Experiment Station
U.S. Army Construction Engineering Research Laboratories
TRW

Phytoremediation in Hawaii

Phytoremediation is the use of plants to absorb or destroy contaminants in the environment. Demonstrating phytoremediation as a solution for upgrading sewage effluent from a Hawaii military installation will not only improve the military's role as a sound environmental steward, but promote economic development in the Pacific region.

Purpose

To demonstrate, as delineated by congressional language, agriculturally based remediation technologies to restore contaminated military and civilian sites, emphasizing those sites located in fragile Pacific island ecosystems. Phytoremediation can be classified as agriculturally based remediation.

Benefits

Demonstrating phytoremediation as a solution for a range of problems will not only improve the military's role as a sound environmental steward, but allow for economic development within the Pacific region. Transferring the ability to construct and maintain wetland systems will allow for sustainable development of businesses and will help to educate both the private and military sectors about this topic. Acceptance of this alternative technology by Environmental Protection Agency (EPA) Region IX will help its chances of being accepted elsewhere.

Technology Users

Installations with sewage effluent, contaminated groundwater or other surface water issues.

Background

Water is of significant value in the Pacific island system. Therefore, recycling and reuse of water is a necessity. Often, the military and private sector depend on one another for water recycling and reuse. Phytoremediation is key in providing an alternative means of cleaning water for reuse. In this particular effort, sewage effluent from the military can be treated through phytoremediation and used to irrigate crops in the private sector.

Description

This effort is being conducted through an association with the U.S. Department of Agriculture (USDA) and the U.S. Army Environmental Center (USAEC). A principal working group has been formed between USAEC and USDA to define demonstration sites, problems to be addressed, technology to be used, and overall approach. The group is selecting potential sites for phytoremediation. Interest is high in treating sewage effluent from Schofield Barracks, Hawaii. This would be a relatively easy effort and a "success story" for the team. Tennessee Valley Authority (TVA) has the expertise to implement a wetland system for sewage effluent.

Applicability

Phytoremediation is applicable to the cleanup of a wide range of contaminants, from excess nutrients in municipal wastewater to explosives residue on military installations.

Accomplishments and Results

Meetings were held in October and November 1996 to discuss the approach and potential sites. Information on sites in Hawaii was received from the Army and Navy. Discussions have started with the Pacific major command regarding Schofield Barracks, Hawaii. TVA is preparing a cost estimate, with very limited data, for a wetland to further treat Schofield's sewage effluent.

U.S. Army Pacific (USARPAC) was introduced to the team in January 1997.

Resource Support

Congressional funding has been received to support this effort.

Follow-On Program Requirements

Disburse and obligate funds to the demonstration team.

Point of Contact

Darlene F. Bader

Program Partners

U.S. Army Environmental Center
U.S. Department of Agriculture
U.S. Army Construction Engineering Laboratories
Schofield Barracks, Hawaii.
Tennessee Valley Authority
U.S. Army, Pacific

Phytoremediation of Explosives in Groundwater Using Constructed Wetlands

Many Department of Defense (DoD) sites have groundwater contaminated with explosives. Demonstrating cost-effective methods to treat this contamination will allow installations to conduct restoration using reliable, accepted, and effective processes. Phytoremediation, which is the use of plants and microbes, provides an opportunity to treat large volumes of groundwater at lower costs.

Purpose

Current groundwater cleanup technologies, such as granular activated carbon (GAC) and advanced oxidation, are labor intensive and costly. A cheaper and less labor-intensive process known as phytoremediation uses plants and microbes to degrade explosives. This project is demonstrating the use of phytoremediation as an alternative technology.

Benefits

Benefits derived from successful wetlands phytoremediation of groundwater are destruction of organic contaminants and lower treatment costs. This demonstration has shown a 46 % cost avoidance in using constructed wetlands over GMF/GAC. Amortized over 30 years, wetlands yield $1.82 per kgal of water, of which $1.52 per kgal is for operation and maintenance. GMF/GAC yields $3.97 per kgal, of which $3.39 per kgal is operation and maintenance.

The savings can be applied to other installation operations or restoration efforts.

Technology Users

Army and DoD installations with explosives-contaminated groundwater. Milan Army Ammunition Plant (MAAP) in Milan, Tennessee, is the site of the current field demonstration. MAAP is incorporating phytoremediation into a Record of Decision.

Background

Numerous DoD sites across the country have groundwater contaminated with explosives. Current technology, such as GAC, requires additional disposal. Ultraviolet oxidation systems require significant capital investment and labor and utilities expenses for the life of the project.

An alternative such as phytoremediation can provide lower maintenance and capital costs. Typically a GAC system costs $2 million to $8 million for construction and $1.5 million annually (for 30 years) per site. Recent estimates place phytoremediation costs at $200,000 per acre to construct and $20,000 an acre (per year) to operate and maintain. For a site treating 500,000 gallons per week, the potential cost savings are $2 million.

Description

The Environmental Protection Agency (EPA) identified the plant enzyme nitroreductase as being able to degrade TNT. In the initial phase of the project, plants native to Tennessee that contain the enzyme were challenged with explosives contaminated water from the site. The three submergent and three emergent species that best reduced TNT and RDX, along with parrotfeather, were selected for the second phase.

In the second phase, two distinct systems were constructed, lagoon and gravel-based. The lagoon system, consisting of two cells in series, was planted with submergent species in two feet of groundwater. The groundwater will be treated by the plants, naturally occurring microbes, and sunlight. The gravel-based wetland contains emergent plant species in both cells. The first cell is operated anaerobically (to degrade RDX) and the second cell is aerobic. This aerobic cell is a reciprocating wetland. Reciprocation, which is the movement of water between cell compartments, further enhances water quality.

Phytoremediation can be used as a pretreatment for other technologies or as a final "polishing" technology.

Applicability

Andrulis Report Requirements:

- 1.2.a Explosives in Groundwater
- 1.2.b Organics in Groundwater
- 1.2.c Solvents in Groundwater
- 1.2.f Alternatives to Pump and Treat

Accomplishments and Results

The wetlands were in operation from June 1996 to September 1997. The lagoon system, while degrading TNT, was not effective at degrading RDX under the demonstration parameters. The system also required more attention in coaxing submergent species to grow in the contaminated groundwater.

The gravel bed system is more effective at degrading TNT and RDX. Since October 1997 the gravel bed system has been operating under parameters that will allow for the design of a 200 gallon-per-minute (gpm) facility at the installation.

Limitations

Use of phytoremediation in constructed wetlands may be limited by cool weather, time constraints and space requirements.

Resource Support

This program is supported by the DoD Environmental Security Technology Certification Program.

Follow-On Program Requirements

This project requires continued monitoring throughout the project life.

Point of Contact

Darlene F. Bader

Program Partners

U.S. Army Environmental Center
Tennessee Valley Authority
U.S. Army Waterways Experiment Station

Publications

Demonstration Plan, USAEC Report SFIM-AEC-ET-CR-95090.
Batch Study, USAEC Report SFIM-AEC-ET-CR-96166.
Flow Through Study, USAEC Report SFIM-AEC-ET-CR-96167.
Screening Submersed Plant Species, USAEC Report SFIM-AEC-ET-97052.

Phytoremediation of Lead in Soil

Lead in soil can jeopardize the continued operation of training ranges as the lead may leach into groundwater or surface water. Phytoremediation, which is the use of plants, offers a reliable method for removing lead from the soil.

Purpose

To demonstrate the effectiveness of lead remediation in soil using phytoremediation.

Benefits

Benefits from successful phytoremediation of lead-contaminated sites are lead removal from the soil and lead recovery for off-site disposal or recycling, which allows for non-restrictive site use. Future costs of monitoring and maintaining a hazardous site or landfilled hazardous waste would be eliminated, as would the long-term liability associated with hazardous waste. Phytoremediation minimizes site disturbance and limits dispersal of contaminants, in contrast to excavating and landfilling soil. Phytoremediation costs are much less than conventional methods. Phytoremediation of 1 acre to a depth of 50 cm is estimated to cost $60,000 to $100,000, whereas excavating and landfilling the same soil volume is estimated to cost from $400,000 to $1.7 million.

Technology Users

Army and Department of Defense (DoD) installations with lead contaminated soil.

Background

Disposal and burning of scrap ammunition and powder, firing range use, and similar activities have resulted in lead contaminated soils at a number of DoD installations. Current treatments are excavation and landfilling, soil washing, or immobilization through chemical treatment. As a result, the metals are neither destroyed nor reclaimed. Liability, long-term monitoring, and restricted land use all contribute to high costs.

Phytoremediation, specifically the technique of phytoextraction, is an alternative technology. Phytoextraction is the use of plants to pull metals out of the soil solution and into the plant structure. This project will conduct process optimization and treatability studies to determine the most efficient plant species, leachate concerns, levels of soil amendments, amendment application, and fertilization effects on lead accumulation and extraction. These efforts will be leveraged into a field demonstration at Twin Cities Army Ammunition Plant (TCAAP) in Minnesota.

Description

Optimization and treatability efforts were conducted by the Tennessee Valley Authority (TVA). Two soils, a silty clay and a loam, which differ in chemical properties but have similar lead content (3,200 mg of lead per kg of soil), were selected for these efforts. The following tasks were completed:

1) Chelate screening to determine the most effective chelate and the optimum chelate concentration and soil pH for the greatest lead solubilization.
2) Chelate application to determine the best chelate application method and monitor the persistence of the chelate in soil.

3) Plant screening to determine the lead uptake efficiency of cool and warm season plants and the optimum chelate concentration and soil pH for greatest lead removal by plants.

4) Determine the potential of foliarly applied phosphate to decrease lead toxicity and enhance biomass growth.

5) Soil leaching study as a result of lead solubilization.

Results from these efforts will be integral to the design of a field demonstration at TCAAP. Two different locations at TCAAP, each a different soil type, will be planted with crops in 1998 to assess lead removal from soil.

Applicability

Andrulis Report Requirements:

- 1.4.d Lead Contamination
- 1.3.e Soil Inorganic
- 1.4.c Heavy Metals

1.I.4.j Improved Isolation and Treatment of Heavy Metals in Soil (Navy)

Heavy Metals in Excavated Soil Treatment (Air Force)

Accomplishments and Results

The efforts by TVA have determined that corn (Canadian) and white mustard will be the warm and cool season crops to be planted. Chelate application and timing is being refined before planting in spring 1998. Efforts will begin shortly on developing the field design and demonstration plan.

Limitations

Time constraints, as well as the depth and degree of contamination.

Resource Support

Funding has been provided by USAEC and the Department of Defense Environmental Security Technology Certification Program.

Point of Contact

Darlene F. Bader

Program Partners

U.S. Army Environmental Center
Twin Cities Army Ammunition Plant, Minnesota.
Tennessee Valley Authority

Plant Uptake and Weathering Studies on Composted Explosives-Contaminated Soil

Composting explosives-contaminated soil has been demonstrated as a cost-effective way to reduce explosives in soil. Following composting, the soil is often returned to the site. Long-term studies are needed to determine if transformation products from the explosives will weather, or if plants will extract these transformation products from the composted soil. These studies will provide the information necessary for environmental protection and compliance.

Purpose

To gather data from controlled greenhouse studies using both human-consumable plants and range plants to answer concerns regarding plant uptake of explosives transformation products, and long-term weathering studies.

Benefits

Establishing the weathering characteristics and the susceptibility for plant uptake of explosives transformation products will facilitate regulatory approval.

Technology Users

Army and Department of Defense (DoD) installations with explosives-contaminated soil.

Background

Composting has been developed as a cleanup technology for explosives-contaminated soil. However, the technology does not achieve complete explosive mineralization, raising questions about its effectiveness. TNT transformation products appear to be strongly bound to the compost material and are not extractable. This project will test the availability of TNT transformation products from composted soil for plant uptake or release in the soil by plant root exudates. Long-term weathering studies will be conducted to determine the stability of compost when exposed to weathering.

Composting explosives-contaminated soil costs about 40% less than incineration, a traditional cleanup method. Numerous installations are considering composting as a cleanup technology. However, the question of TNT mineralization keeps the technology from being accepted without reservation by the academic community, regulatory community, and Corps of Engineers. Even though the transformation products are not extractable, there is concern that plants and long term exposure to weather may release these products.

Description

The project team consists of the U.S. Army Environmental Center (USAEC) as the lead agency and the Tennessee Valley Authority (TVA) as the performer. The project consists of four elements: shipping finished compost from Umatilla Army Depot Activity, Oregon, to TVA and producing control compost from soil and amendments from Umatilla at TVA; developing and testing analytical methods; conducting greenhouse studies; and conducting long-term weathering studies. All testing will be conducted at TVA's facility in Muscle Shoals, Alabama.

Composting was used at Umatilla to treat explosives-contaminated soil from two lagoons. This composted soil will be shipped to TVA for testing. Amendments used at Umatilla and uncontaminated soil from Umatilla will be shipped to TVA to produce a control compost to be tested along with the contaminated soil compost.

Finished compost from Umatilla will be used in long-term weathering studies to determine what happens to compost when exposed to sunlight, weather, and soil microbes. Different mixtures of compost and soil will be placed in large pans and exposed to the elements. Leachate will be collected and analyzed along with compost/soil samples over a 3-year period. The compost/soil mixtures will not be manipulated in any manner during the weathering study.

A total of nine plants will be tested with the Umatilla compost and control compost. The vegetable crops to be tested include radishes, kale, bush beans, tomatoes, and chives. The range crops to be tested include alfalfa, sorghum, red top, and winter barley. Roots, stems and leaves, fruit, and soil around the root ball will be tested.

Analytical methods exist for explosives in soil and water, but the suitability of these methods to detect transformation products in plant-tissue extracts are not certain. Personnel from the Cold Regions Research Engineering Laboratory (CRREL) and U.S. Army Waterways Experiment Station (USAWES) will help chemists from the U.S. Army Environmental Center (USAEC) and TVA determine the efficiency of these methods.

Applicability

Andrulis Report Requirement:

- 1.3.a Remediation of Explosives in Soil

Accomplishments and Results

- The test and safety plans have been prepared and approved.
- The finished compost, compost amendments, and uncontaminated soil have been shipped from Umatilla to TVA.
- Using information from USAWES, CRREL and USAEC, TVA has developed an improved method for analyzing explosives residue in plant tissue.
- Weathering studies have been initiated and several leachate samples collected from rainfall on the pans. This study will run through 1999.
- The control compost has been prepared.
- Lab and greenhouse testing to establish the maturity of the control and Umatilla compost is complete.
- TVA has initiated the plant uptake studies, which will continue until June 1998. Two of the nine plants, radish and kale, have been harvested and are being analyzed. The remaining plants will be grown and harvested before June 1998.

RESOURCE SUPPORT

Funding is provided from the Defense Environmental Restoration Account (DERA) program.

FOLLOW-ON PROGRAM REQUIREMENTS

- Complete plant studies.
- Complete weathering studies.
- Prepare final report.

POINT OF CONTACT

Wayne Sisk

PROGRAM PARTNERS

U.S. Army Environmental Center
Tennessee Valley Authority
U.S. Army Waterways Experiment Station
Cold Regions Research Engineering Laboratory

Range Rule Risk Assessment — Range Rule Risk Model (R3M)

The Department of Defense (DoD) has proposed a Range Rule that identifies a process for evaluating appropriate response actions on closed, transferred, and transferring ranges. The U.S. Army Environmental Center is developing a methodology — known as the Range Rule Risk Model (R3M) — that will help assess health and environmental risks posed by these ranges.

Purpose

To develop a risk assessment methodology for use in implementing the Range Rule.

Benefits

The R3M will serve as the DoD-approved method for evaluating ranges under the Range Rule. It also may be used to evaluate unexploded ordnance (UXO) on ranges not covered specifically by the Range Rule and as a framework in parallel evaluations of human health risks posed from physiologic and physical injuries.

Technology Users

DoD ranges being evaluated under provisions of the Range Rule.

Background

DoD has drafted a Range Rule that identifies a process for evaluating appropriate response actions on closed, transferred, and transferring ranges. Response actions will address safety, human health, and the environment. The Range Rule contains a five-part process that is not inconsistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and tailored to the special risks posed by military munitions and military ranges. This five-part process includes: (1) range identification, (2) range assessment, (3) range evaluation, (4) recurring reviews, and (5) range close-out.

To satisfy this process, the U.S. Army Environmental Center (USAEC) is developing a three-component risk evaluation methodology — known as Range Rule Risk Methodology, or R3M — that includes qualitative risk evaluation (QRE), streamlined risk evaluation (SRE), and detailed risk evaluation (DRE) methodologies.

Many of the R3M components come directly from other methods used in range evaluation and response actions. The R3M effort serves to combine, improve or develop the necessary components into a single cohesive process that has been fully reviewed and approved by all DoD components and the U.S. Environmental Protection Agency (EPA).

Description

The project includes several steps:

- Develop the concept method consisting of three parts — qualitative range evaluation (QRE), streamlined range evaluation (SRE) and detailed range evaluation (DRE) — meeting requirements of the Range Rule.

- Coordinate development with DoD, EPA, the Range Rule Partnering Initiative and the public.
- Support partnering initiatives and public information forums (PIFs).
- Gain DoD and EPA approval of R3M (as interim final) before promulgation of the rule.
- Develop a risk management strategy for the R3M.
- Develop validation criteria and validate the R3M during the first year of rule implementation.
- Revise R3M based on validation and prepare the final R3M model.

Applicability

- DoD Range Rule
- EPA Munitions Rule
- CERCLA
- Resource Conservation and Recovery Act (RCRA)

Accomplishments and Results

- Developed draft strawman method for review by DoD and EPA R3M teams.
- Strawman reviewed by DoD and EPA teams.
- R3M draft version developed based on DoD and EPA teams' comments.
- R3M draft version reviewed by DoD and EPA teams.
- Draft R3M approved for public comment release.

Follow-On Program Requirements

- Initiate validation and risk management strategy development effort.
- Initiate R3M validation and revision to final version
- Final model (one year after Range Rule promulgation).

Point of Contact

Scott Hill

Program Partners

Department of Defense
Environmental Protection Agency
Range Rule Partnering Initiative

Publications

Public Information Forum fact sheet.

Remediation of Air Streams Contaminated with Trichloroethylene Using Biofiltration at Anniston Army Depot

Air stripping is an effective method of eliminating volatile compounds from water. Following stripping, the volatile compounds must be controlled to prevent release into the atmosphere. Biofiltration provides effective and total treatment at reasonable costs. Biofiltration of trichloroethylene (TCE) contaminated air streams can destroy such air contaminants without creating secondary waste streams. Biofiltration will allow depots to support DoD operations at lower costs.

Purpose

To demonstrate biofiltration's effectiveness to destroy TCE removed from groundwater on a production scale system at Anniston Army Depot, Alabama.

Benefits

Biofiltration will destroy contaminants and not produce a secondary waste stream. Early economic evaluations predict that biofiltration will be less expensive than Granular Activated Carbon (GAC). The system could be adapted to other industrial operations that produce solvent-contaminated air streams

Technology Users

Any DoD operation with a solvent air discharge.

Background

Packed column air strippers are currently in use at five Army installations and several Air Force bases. Capture of TCE and other chlorinated solvents on GAC is effective, but expensive. Some air-stripper systems discharge to the air — which may be prohibited under new air regulations — and some capture the off gas on GAC. Biofiltration offers the ability to destroy air contaminants without producing a secondary waste stream.

Description

The biofilter system is an upscale version of a 3 cubic feet per minute (CFM) system operating for the past three years at the Tennessee Valley Authority (TVA) testing different volatile compounds. The system uses propane gas as a co-substrate to feed the microorganisms, alternately feeding propane and TCE or other solvents. This system will handle methylene chloride and other compounds that are toxic to methanotrophic systems. The filter bed is composed of pelletized composted chicken litter, pine bark, and chopped kenaf with pulverized limestone as a buffering agent. The bed at TVA has operated without additional materials or changes.

This project consists of three phases: design, installation, and testing. The design phase will produce the design for and procure a system to treat 100 CFM. The installation phase will install the system at one of the Anniston Army Depot's air stripper systems. The treatment phase will include biofilter startup, acclimation, and operation for approximately 14 months. System acclimation will require approximately six weeks once the bed is inoculated with microorganisms.

The operational period will allow for testing all system parameters, such as: varying the contaminant concentration in the feed air stream; the most effective sequencing of the propane gas feed and the contaminant air stream; excess moisture and dry conditions in the biofilter; winter-to-summer temperature extremes; and the degree to which the system can be automated.

Applicability

Andrulis Report Requirement:

- 1.2.c Solvents in Groundwater

Accomplishments and Results

The test plan and safety plan have been prepared and approved.
The equipment design has been completed, the equipment procured and assembled and the system installed at Anniston Army Depot.
The system was ready to be inoculated in November 1996 when Anniston Depot personnel notified TVA that EPA was going to conduct an installation groundwater dye test and that all pumps would be stopped until sometime in spring 1997.

The dye test was extended to July 1997. The state gave permission to feed surrogate TCE-contaminated air to the system to complete the acclimation period and to initiate startup of the biofilter system in order to avoid further delay.

The filter bed was inoculated; propane and surrogate feed were initiated to acclimate the bed and to obtain startup data.
Initial data indicated TCE removal rates at, or above, those seen in smaller scale tests at TVA.

An ISDN phone line with voice and high-speed data transfer channels is being installed to transfer data electronically from the site to TVA and to remotely control the on-site gas chromatograph.
Preliminary testing using depot groundwater as the TCE source has begun. The test program will be under way as soon as the depot stabilizes the groundwater supply.

Resource Support

DERA

Follow-On Program Requirements

Complete testing and prepare draft technical report.
Complete brochure and video.

Point of Contact

Wayne Sisk

Program Partners

U.S. Army Environmental Center
Tennessee Valley Authority
Anniston Army Depot, Alabama

Remediation of Chemical Agent Contaminated Soils Using Peroxysulfate

Chemical agents have been used or buried at many locations. Chemical agent contaminated soils must be cleaned to acceptable levels. Peroxysulfate has been shown to effectively degrade similar organic materials and shows promise as a method to remediate soils contaminated with chemical agents.

Purpose

To demonstrate peroxysulfate's effectiveness for the treatment of soils contaminated with chemical agents.

Benefits

Adapting an existing technology to treat soils contaminated with chemical agents will provide a "proven" alternative treatment.

Technology Users

Any installation with soil contaminated by chemical agents.

Background

In the United States there are 227 sites at 93 locations where non-stockpiled Chemical Warfare Materials (CWMs) have been buried or discharged. These materials may exist as mortar rounds, aerial bombs, rockets, projectiles, storage containers, or discharged material in drain fields. CWM may have migrated into the groundwater at some sites. The search continues for more sites where CWM may be buried.

The Department of Defense (DoD) emphasis in chemical agent cleanup has been in stockpiled materials, and limited emphasis has been placed on these nonstockpiled materials. Cleanup technologies will need to address agent remediation as well as any degradation products that pose an environmental concern. It is unlikely that any in-situ technologies will be suitable because much of the CWM appears to be buried in containers. Tennessee Valley Authority (TVA) has extensive experience using peroxysulfate compounds in the remediation of soils contaminated with organics (PCBs and atrazine). Because peroxysulfate compounds have been investigated for surface decontamination of Chemical Warfare Agents (CWAs), it seems prudent to investigate their effectiveness on CWA contaminated soils.

Description

Peroxysulfate compounds are water soluble and do not require light or metal catalyzed activation. They react rapidly with CWAs such as HD, GB, and VX, and are more stable in soils than comparable oxidants such as hydrogen peroxide. These characteristics make peroxysulfates ideal for soil remediation.

Phase I aqueous treatability studies have been completed for all CWA simulants. Phase II soil treatability studies with all CWA simulants have also been completed.

Phase I was to evaluate peroxysulfate reactions with agent simulants. Aqueous solutions of chemical warfare agent simulants, CEES, DIMP, and 0-methyl-s-methylphenylphosphonothioate, were exposed to strong oxidants, peroxydisulfate and peroxymonosulfate. Reaction rates for simulant disappearance in solution were obtained by analyzing the reaction solution with gas chromatography, ion chromatography, and high-pressure liquid chromatography. Reaction products and intermediates were detected, and confirmation that the simulants were completely mineralized (degraded to C02, P04, CI, and S04) were obtained. Reaction results between the simulants and peroxymonosulfate and peroxydisulfate were compared. The final product distributions, ability to mineralize the contaminants, and the effects of elevated temperatures were assessed. Comparisons between hydrolysis and peroxysulfate reaction rates were also made. This work was necessary to obtain enough background knowledge on CWA degradation by peroxysulfate compounds to follow reactions in more complex matrices, such as soils.

In Phase II, soils were spiked with CEES, DIMP, and 0-methyl-s-methylphenylphosphonothioate. The soils were slurried in an aqueous peroxysulfate solution, agitated, and sampled periodically. The soils were analyzed for the parent contaminant and any degradation products. Degradation rates were compared with hydrolysis rates. The reaction time and peroxysulfate dose level required for complete contaminant degradation were determined. Several soil types were investigated to ensure that the technology would be applicable at a variety of sites. Comparisons were made between peroxymonosulfate and peroxydisulfate. Information was gathered on the ability (or inability) of each oxidant to scavenge side reactions with soils.

Applicability

Andrulis Report Requirements:

- 1.3.b On-Site Treatment of Organics Contaminated Soils
- 1.5.a Chemical Warfare Material

Accomplishments and Results

Preliminary results with heated peroxdisulfate solutions show a capability for treating soils contaminated with all three CWA (VX, GB, and HD) simulants. The study results indicate that, at temperatures ranging from 75 C and 90 C, peroxysulfates degraded between 99.999 % and 99.9999 % of the exposed simulants within three hours. Evidence of nearly complete mineralization of the HD and VX simulants was observed when peroxdisulfate was used. However, the GB simulant's reaction intermediates were not completely mineralized and the VX simulant's reaction intermediates took about 10 hours to degrade. TVA prepared a cost-benefit analysis and a conceptual design for a remediation unit, in addition to submitting a final report to the U.S. Army Environmental Center (USAEC) in August 1997.

The development of a conceptual design for a small (750 pounds of soil per shift) batch demonstration plant indicates that the unit could be constructed for approximately $450,000. The plant is designed to be transportable and could be used both as a demonstration plant and as a post-demonstration treatment facility.

POINT OF CONTACT Louis Kanaras

PROGRAM PARTNERS U.S. Army Environmental Center
Tennessee Valley Authority

Remediation Technologies Screening Matrix and Reference Guide

In the past, numerous government agencies, divisions and branches produced documents to help their environmental project managers make intelligent decisions on technologies to use for site cleanup. Lack of coordination led to duplication of effort among these various agencies. The Federal Remediation Technologies Roundtable has developed a guide to serve as a neutral platform from which to evaluate technologies.

Purpose

To update the Federal Remediation Technologies Roundtable (FRTR) Remediation Technologies Screening Matrix and Reference Guide while producing a real-time, easy-to-update document.

Benefits

The electronic document will serve as a neutral platform for environmental remediation technology. The Screening Matrix will serve as an unbiased medium from which those interested in remediation technologies can research initial information sources. The initial time and effort invested to update and cross-reference the document into a "one-stop-shopping" format will save time and effort for each user.

This project is expected to help demonstrate and foster cooperation among Department of Defense (DoD) and all federal agencies, and provide an improved technology transfer product to both the environmental technology user community and the research-and-development community.

Technology Users

Army, public agencies and private organizations.

Background

In the past, numerous agencies, divisions, and branches of the government produced documents as tools for their environmental project managers to make intelligent decisions on technologies to use for site cleanup. The Federal Remediation Technologies Roundtable (FRTR) sponsored the production of the FRTR Remediation Technologies Screening Matrix and Reference Guide (2nd Edition) to eliminate the duplication of efforts of the member agencies. Knowledge of environmental cleanup technologies has since increased, dating the information in the 2nd Edition. There is a need to update and improve the Screening Matrix.

Description

The document will be formatted electronically to allow for quick and easy updating. The update will also commit the Roundtable members to work together, leveraging funds and resources and preventing duplication of effort.

Technologies included in the update were selected by the committee representatives. Each agency had the option of taking the lead for each technology. They also have the option to serve as a review entity for each technology.

Once the technology description is written, it will be reviewed by those interested. The technology description will be formatted in HTML, integrated with all necessary hyperlinking, and placed on the Internet for universal use.

The current World Wide Web (WWW) version of the Screening Matrix and Reference Guide is located on the Federal Remediation Technology Roundtable home page. The updated version will replace this document. There will be efforts to continually update and ensure the document's integrity.

Accomplishments and Results

Committee members have met and established the personal relationships necessary to coordinate the update effort. The Air Force, Naval Facilities Engineering Service Center, U.S. Army Corps of Engineers Missouri River Division, the Environmental Protection Agency (EPA) Innovative Technology Office, and EPA Risk Reduction Engineering Laboratory began exploring ways to either send funding for support contractors or delegate time from their agency's support contractor to the update effort.

There has been successful leveraging of funds from the Navy and Air Force. The EPA has donated a considerable amount of contractor support. The other agencies have donated numerous in-house personnel hours toward the document.

The review process for the Screening Matrix has been established and is ongoing. Individual agencies are taking responsibility for coordinating their internal reviews of the document. Reproduction and creation of CD-ROMs also will be the sole responsibility of the individual agencies (to focus shareholders' money toward the document rather than production of the Screening Matrix).

Limitations

As a result of numerous conference calls and meetings, an analysis of the document by the member agencies has revealed the following limitations:

- It reached the practical limit in terms of how much can be reported and distributed economically in a paper format (600 pages).
- It contains outdated reference information and no longer contains a complete up-to-date set of basic cleanup technologies.
- It focuses primarily on mature technologies at the exclusion of newer developing technologies.
- Although it was also produced in an electronic format, more advanced and desirable reporting techniques exist using the capabilities of the WWW.

Follow-On Program Requirements

- Initiate additional update efforts based on agreed future plans, and existing U.S. Army Environmental Center (USAEC) and FRTR member agency in-house and USAEC contract support capabilities.
- Receive additional agency funding contributions.
- Modify existing USAEC contract statement of work and award additional funds for tasks as identified by FRTR member agencies.

- Coordinate and execute update efforts.
- Complete update efforts.

Points of Contact

Dennis Teefy
Edward Engbert

Program Partners

U.S. Army Environmental Center
Naval Facilities Engineering Service Center
Air Force Center for Environmental Excellence
U.S. Environmental Protection Agency
U.S. Geological Survey
Department of Energy

Publications

The electronic (HTML) version of the third edition can be found on the Internet at www.frtr.gov.

SALTSBURG CNS TEAR GAS LANDFILL PROJECT

Several private facilities in the United States provided military-unique compounds to the Department of Defense (DoD). In many states, past manufacturing and disposal practices have resulted in contamination. This project will help a site owner identify innovative environmental remediation technologies to address contamination resulting from the landfilling of 300 to 1,700 drums of CNS tear gas fluid.

PURPOSE

To assist the site owner of Federal Laboratories Area 15A CNS Tear Gas Landfill, TransTechnology Corporation, in its efforts to identify viable remediation technology alternatives for the site; to perform a fate, transport, and effects study to determine the environmental end-points for the contaminants of concern.

BENEFITS

Knowledge and experience will be developed regarding CNS tear gas fluid (i.e., chloroacetophenone, chloroform and chloropicrin) components in a landfill environment. Analytical methods will be developed and refined for determining the existence of these compounds in environmental samples. A fate, transport and effects study for tear gas will be performed, the decontaminated area will be modeled, and viable technologies will be identified for potential implementation at the landfill.

TECHNOLOGY USERS

Primary user is TransTechnology Inc. (the site owner); secondary users are the Pennsylvania Department of Environmental Protection (PaDEP) and the Department of the Army.

BACKGROUND

The Saltsburg Federal Laboratory facility manufactured tear gas and other military-unique products for the United States Department of War. The past site owner disposed of these materials according to commonly accepted practices of the time and before specific waste-disposal regulations were implemented. In the late 1940s, an estimated 300 to 1,700 barrels of tear gas — 55 gallons each — were buried in Area 15A.

This project is being performed by the U.S. Army Environmental Center (USAEC) under congressional appropriation and Department of the Army request.

DESCRIPTION

This project will utilize innovative site characterization technologies in conjunction with scientific study to demonstrate and determine the efficacy of engineering and scientific approaches for remediation and delineating the levels and extent of contamination at Area 15A.

The Army's strategy for the Saltsburg Tear Gas Landfill Project entails a three-pronged approach, with each element of the Army's strategy building upon knowledge, findings, and experience realized from the other prongs. It includes:

- Demonstrate innovative engineering and scientific approaches for delineating the current extent and level of contamination resulting from the 500 to 1,500 deteriorating, 55-gallon drums of CNS tear gas fluid in landfills. This will be conducted in a manner that will fill in gaps in existing site characterization documentation provided by TransTechnology.

- Conduct a fate, transport, and effects study, analysis, and modeling for CNS tear gas fluid and its degradation products. The information obtained from this study will be a vital link in determining the human health and risk effects, and potential for remediation through natural attenuation.
- Develop and implement a program for hydraulic conductivity characterization using the boreable flowmeter testing. A numerical groundwater flow model will be constructed and calibrated using hydrogeological data for the site. A contaminant transport model will then be generated and calibrated using existing water quality data. The calibrated transport model is necessary for meaningful evaluation of potential remediation alternatives. Results of the laboratory studies of degradation, soil sorption and transport will be used for model simulations of remediation alternatives.
- Identify remediation options and evaluate the technical merits of those options for addressing contamination types that exist at Area 15A.

Applicability

Under the framework of the Andrulis Report, this project may potentially meet these requirements:

- 1.1.f Non-Invasive Field Techniques
- 1.1.i Standard Analytical Methods for Army Unique Compounds
- 1.1.k Alternative Techniques for Sub-Surface Characterization
- 1.2.b Organics in Groundwater
- 1.2.f Alternatives to Pump and Treat
- 1.3.h Determine Natural Attenuation Rates of Army-Unique Compounds
- 1.5.a Chemical Warfare Material Fate/Transport Predictions

Accomplishments and Results

- Briefed TransTechnology Corporation, Federal Laboratories, PaDEP and U.S. Rep. Murtha's Office.
- Provided support to the Department of the Army, Office of the General Counsel (HQDA) to assist with negotiations and acceptance of the Army's proposal for the site.
- Conducted Saltsburg project site visit and kick-off meeting at PaDEP with TransTech Federal Laboratories, PaDEP, Representative Murtha's Office, USAEC and the Tennessee Valley Authority (TVA).
- Obtained relevant historical records and information regarding the environmental condition and site characterization of Area 15A.
- Performed a site walkover of the tear gas landfill and gathered information.

- Sampled groundwater from existing production wells on site.

Sample Collection for Studies

- Draft work plan reviewed by USAEC, TransTechnology, and PaDEP. Revisions made based on comments received from reviewers.
- Final work plan completed May 1997.
- Soil and groundwater samples collected from the Saltsburg site.
- Soil collected for use in fate and effects study to be conducted at TVA facilities in Muscle Shoals, Alabama.
- Soil and groundwater collected for use in methods development work for the Direct Sampling Ion Trap Mass Spectrometer (DSITMS) at Oak Ridge National Laboratory in Oak Ridge, Tennessee.

DSITMS Site Demonstration

- Oak Ridge National Laboratory started work on the development of analytical methods for identifying the three components of CNS tear gas: chloroform, chloropicrin and chloroacetophenone.
- Work plan for the on-site demonstration developed.

Site Contaminant Modeling

- Hydrogeologists reviewed existing TransTechnology reports to identify data gaps in site characterization of Site 15A.
- Recommendations made for additional hydraulic characterization work to support numerical flow and transport modeling.
- Program developed and implemented for hydraulic conductivity characterization using borehole flowmeter testing.
- Calibrated transport model necessary for meaningful evaluation of potential remediation alternatives.

Fate and Effects Study

- Draft test plan reviewed by the U.S. Army Environmental Center (USAEC), TransTechnology, and PaDEP. Revisions made based on comments received from reviewers.
- Test plan for the fate and effects laboratory study was completed in May 1997.
- Reviewed literature and accumulated information on the properties of chloroform, chloropicrin and 2-chrloroacetophenone.
- Prepared radiolabeled tear gas compounds for use in the study.

Limitations

Available site characterization data for Area 15A suggest that the plume of CNS tear gas contaminants is migrating off the TransTechnology Area A15 site toward a third-party industrial site to the south.

Due to legal issues that prohibit access to the property bordering Area A15 to the south, site characterization data has either not been collected or is not available. Thus, since uncertainty exists regarding current spatial distributions of the CNS contaminants and the transport model initial conditions, assumptions will have to be made regarding the parameters for this area in the site model.

Resource Support

FY 95 RDT&E funding. Congressional line item; Environmental Quality Technology, Saltsburg Remediation Technology.

Follow-On Program Requirements

- Select and implement innovative remedial option for Area 15A.
- Abate the release of chloroform and chloropicrin into both groundwater and surface water discharging to the Conemaugh watershed.

Point of Contact

A.J. Walker

Program Partners

U.S. Army Environmental Center
TransTechnology Inc.
Pennsylvania Department of Environmental Protection
Tennessee Valley Authority

Publications

Environmental Site Assessment, Federal Laboratories, Inc., Saltsburg, Pennsylvania, Earth Sciences Consultants Inc., July 1985.

Removal Site Evaluation/Feasibility Study, Federal Laboratories Facility, Saltsburg, Pennsylvania, Earth Sciences, Inc., October 1992.

Summary of Site Characterization Studies, Federal Laboratories Facility, Saltsburg, Pennsylvania, Earth Sciences Inc., October 1992.

Draft Risk Assessment for Remedial Alternatives, Federal Laboratories Facility, Saltsburg, Pennsylvania, ICF Kaiser Engineers, October 28, 1992.

1996 Budget Proposal United States Department of Defense, Environmental Cleanup of Federal Laboratories Plant No. 3 and The Demonstration of Innovative Remediation Technology, Saltsburg, Pennsylvania, TransTechnology Corporation, December 29, 1994.

Supplemental Investigations Report, Federal Laboratories Facility, Saltsburg, Pennsylvania, Conestoga-Rovers and Associates, September 20, 1995.

Test Plan for Phase II of the Tear Gas Fate and Effects Study, Tennessee Valley Authority, January 1997.

Sample Collection Plan for Soil and Groundwater Near Area 15A at the Federal Laboratories Facility Saltsburg, Pennsylvania, Tennessee Valley Authority, January 1997.

Technology Demonstration Plan, "Measuring CNS Contaminants In-Situ and In Near Real-Time Using Direct Sampling Ion Trap Mass Spectrometry," Tennessee Valley Authority, October 1997.

Slurry Biotreatment of Explosives-Contaminated Soils

Army industrial installations face high costs to clean up soil contaminated by past explosives operations. Remediating these sites is a prerequisite for environmental protection and beneficial reuse by the Army. These installations require cost-effective techniques to treat large volumes of explosives-contaminated soils. The U.S. Army Environmental Center (USAEC) has tested soil slurry biotreatment (bioslurry) as an alternative to incineration.

Purpose

To prove that explosives-contaminated soil degradation in a soil slurry bioreactor is both possible on a large scale and an affordable alternative to incineration.

Benefits

Contaminated soil can be treated and returned to its original location.

Technology Users

Department of Defense (DoD) installations containing areas of explosives-contaminated soils.

Background

Past production and handling of conventional munitions left explosives in soils at many Army installations. Depending on the concentrations of explosives — mainly trinitrotoluene (TNT), cyclonite (RDX) and cyclotetramethylene (HMX) — the affected soils can pose reactivity and toxicity hazards. Because these explosives can migrate from the soils into groundwater, the affected soils should be treated to eliminate threats to human health or the environment. Incineration, the traditional proven cleanup technology, is costly and not readily accepted by regulators and the public.

The Army has searched since the 1980s for alternatives to incineration. Extensive tests have shown that bioremediation — the use of living organisms to remove pollutants from soil or water — can be a cost-effective treatment. These microorganisms can digest materials such as explosives, fuels, or solvents; this process is enhanced by providing the microorganisms favorable conditions. The U.S. Army Environmental Center (USAEC) has field-tested several bioremediation methods including windrow composting and soil slurry reactor biotreatment.

Description

In 1995, USAEC conducted a soil slurry bioremediation test at Joliet Army Ammunition Plant (JOAAP), Illinois, with Argonne National Laboratory as the performer. Conditions were established to encourage microorganism growth and demand for the contaminants. Because the process maintains optimum conditions and the slurry is mixed to maintain contact between the microorganisms and contaminants, slurry processes are faster than many other biological processes.

Bioslurry technology requires excavation and soil screening to remove oversize rocks and plant roots, mixing soil with water to form a slurry in a reactor, and removal of the slurry from the reactor. Explosives degradation also requires a co-substrate (e.g., molasses), pH between six and seven, and aerobic-anoxic operation. In this study, the native microbial population degraded explosives in soil. Four reactors (350 to 380 gallons) were operated at the JOAAP; a control with no co-substrate, 20% and 10% weekly replacement (by volume) reactors, and a 5% daily replacement reactor.

This design allowed investigation of different soil (and therefore TNT [2, 4, 6-trinitrotoluene]) loading rates. The target soil slurry was 15% (weight/weight). Explosives concentrations in soil were 2,000 to 8,000 mg/kg. Environmental conditions were identical for all reactors, and temperature, pH, and dissolved oxygen were similar.

Applicability

Andrulis Report Requirements:

- 1.3.a Remediation of Explosives in Soil
- 1.3.b On-Site Treatment of Organics Contaminated Soils
- 1.3.c Explosives/Organics Contaminated Sediments
- 1.3.m Soil Bioremediation
- 2.3.d Develop Alternative Technologies to Mitigate Contaminated Soil

Accomplishments and Results

The bioslurry system shows potential to remove explosives, particularly TNT, from soil. At JOAAP, aerobic bioslurry was used to reduce TNT, HMX, and RDX concentrations in soil. In this process, soil and water were mixed to create a slurry (the soil suspended in water maximizes microbial contact). The microorganisms are native to the contaminated soil. Molasses was added to spur microbial growth and activity. Metabolic fate studies of field samples showed up to 20% of the contaminant completely mineralized and given off as CO2. Another 55% of the contaminant showed up as organic acids and carbon fragments in the biomass, indicating a high degree of contaminant breakdown.

Other results:

- The system removed more than 99% of TNT, RDX and HMX from soil.
- Aerobic/anoxic cycling enhances degradation (minimizes accumulation of metabolic intermediate byproducts).
- Metabolic fate and high degree of breakdown.
- Product suitable for land application.
- Process water can be recycled.
- Molasses was most effective and cost-effective co-metabolite or co-substrate.
- Degradation activity slows below 20 0C.
- The biological process is robust and can adapt to a variety of soil concentrations and temperatures. During normal operating conditions, soil loading can be increased to maximize throughput, and in cold weather, minimizing additions of contaminated soil will enhance system survival.

USAEC examined the addition of surfactant to enhance the bioavailability of the contaminant in solution. Treatability studies performed by the U.S. Army Waterways Experiment Station showed increased solubilization of TNT from soil with surfactant addition. USAEC field trails in 1995 using the same food-grade biodegradable surfactants showed more rapid initial reduction of TNT, but its byproducts accumulated in the reactor for longer periods, compared to biotreatment without surfactants. Consequently, process enhancements to bioslurry treatment of explosives-contaminated soils afforded by surfactant additional appear to be minimal.

In 1997 at Iowa Army Ammunition Plant (IAAAP), the DoD Environmental Security Technology Certification Program sponsored a field demonstration of aerobic-anoxic bioslurry treatment, side-by-side with a commercial anaerobic process, the Simplot Anaerobic Bioremediation Ex-situ (SABRE). Lined lagoon reactors were scaled up to treat up to 80 tons of soil in a batch. The demonstration provided performance results, and a conceptual engineering design and cost estimates for a full-scale application of slurry biotreatment for IAAAP's remedy selection. This data also is applicable to other explosives-contaminated sites.

Limitations

- Oversized rocks and plant roots must be removed before bioslurry use.
- Organic co-substrate needed.
- pH greater than six to seven.
- Cold temperatures slow microbial metabolism rate.

Points of Contact

Mark Hampton
Wayne Sisk

Program Partners

U.S. Army Environmental Center
Joliet Army Ammunition Plant, Illinois
Iowa Army Ammunition Plant, Iowa

Publications

Feasibility of Biodegrading TNT-Contaminated Soils in a Slurry Reactor, Technical Report CETHA-TE-CR-90062, U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland, prepared by Argonne National Laboratory, Illinois, June 1990.

Feasibility of Biodegrading Explosives-Contaminated Soils and Groundwater at the Newport Army Ammunition Plant, Technical Report CETHA-TS-CR-92000, U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland, prepared by Argonne National Laboratory, Illinois, June 1991.

A Laboratory Study in Support of the Pilot Demonstration of a Biological Soil Slurry Reactor, Technical Report SFIM-AEC-TS-CR-94038, U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland, prepared by Argonne National Laboratory, Illinois, July 1995 (available in print and on CD-ROM).

Field Demonstration of Slurry Reactor Biotreatment of Explosives-Contaminated Soils; USAEC Report No. SFIM-AEC-ET-CR-96178; December 1996 (available in print and on CD-ROM).

SOLAR DETOXIFICATION OF CONTAMINANTS REMOVED FROM SOIL

Many Department of Defense (DoD) installations require remediation of soil contaminated with volatile organic compounds. Existing decontamination techniques may require large amounts of energy. Installations in regions that receive much sunlight may use solar energy for remediation. The heat of the sun can provide the temperatures necessary to destroy contaminants in soil.

PURPOSE

To evaluate solar energy for destruction of contaminants removed from soil at DoD sites.

BENEFITS

A soil-remediation system using solar energy may cost less and work more effectively than conventional technologies used by the Army to destroy organic contaminants. The process is doubly attractive for soil remediation because it can destroy contaminants without increasing the demands on traditional energy sources.

TECHNOLOGY USERS

DoD sites containing soil contaminated with volatile organic compounds.

BACKGROUND

Excavation and off-site disposal of organic contaminated soils is very expensive. On-site incineration is hindered by lack of public acceptance. Destruction of organic contaminants by solar energy may be more cost-effective than other current methods and not carry the public relations problems of on-site incineration.

DESCRIPTION

There is a need for a less costly alternative to off-site disposal of contaminated soils or on-site incineration. This project is a congressional item to investigate, design, and build a system that uses solar energy to destroy chemical contaminants. It is a collaboration among the EPA Risk Reduction Engineering Laboratory (RREL), the Department of Energy National Renewable Energy Laboratory (NREL), and the U.S. Army Environmental Center (USAEC).

The system applies to semivolatile, volatile organic compounds (VOCs) and petroleum, oil and lubricants (POLs). Operational costs are comparable to existing remediation technologies. Destruction and removal efficiency of at least 99.99% has been demonstrated.

Decontamination of soils and groundwater often requires heat to volatilize or destroy the contaminant — solar energy is a heat source. The system can use vacuum extraction to remove the contaminants from soils. The contaminants can then be condensed and fed to a solar reactor. The contaminants are destroyed by photochemical and thermal reactions.

APPLICABILITY

Andrulis Report Requirement:

- 1.3.b On-Site Treatment Processes for Organic Contaminated Soils

Accomplishments and Results

A field demonstration was completed at Science Application International Corporation's (SAIC) test site near Golden, Colorado, in June 1997. A surrogate waste mix of seven VOCs representing common contaminants found at Army installations was treated in a solar reactor. A destruction efficiency of greater than 99.99% was achieved, but products of incomplete combustion were comparable to conventional incineration.

Limitations

The system requires high levels of solar insolation.

Follow-On Program Requirements

Results of the demonstration showed promising results. Equipment design optimization testing will be necessary before the system can be fielded.

Point of Contact

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Program Partners

U.S. Army Environmental Center
Department of Energy National Renewable Energy Laboratory
Environmental Protection Agency (EPA) Risk Reduction Engineering Laboratory
Science Applications International Corporation

Publications

Potential Feasibility of Using Solar Energy for Gas-Phase Destruction of Toxic Chemicals, USATHAMA Report CETHA-TS-CR-92049, Pacific Northwest Laboratory, July 1992.

Preliminary System Design for Solar Detoxification; Interim Report 1, USAEC Report ENAEC-TS-CR-93094, Science Applications International Corporation, March 1993.

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Preliminary System Design for Solar Detoxification of Soils; Final Report, Task 1, USAEC Report ENAEC-TS-CR-93093, Science Applications International Corporation, June 1993.

Transportable Hot Gas Decontamination

Facilities contaminated with explosives or chemicals often require destructive or expensive cleanup. Destructive cleanup may prevent some equipment from being reused, resold as scrap or buried as nonhazardous waste. Hot gas decontamination provides more effective decontamination than other methods and does not destroy the material being cleaned.

Purpose

To conduct a field demonstration of a transportable hot gas decontamination system, which can be used to decontaminate explosive/ propellant-contaminated underground piping and sewer lines that have been excavated.

Benefits

This technology will offer a cost-efficient alternative to open burning/open detonation, which is the current method of decontaminating underground piping. Hot gas decontamination technology generates controlled "regulatory acceptable" emissions, reduces personnel hazards, allows a quality control/quality assurance program, and will allow for some reuse of the decontaminated material (while allowing the non-reusable material to be discarded as scrap).

Past investigations show this technology may also have utility for decontaminating process equipment or scrap materials contaminated with chemical agents or other hazardous wastes in equipment or areas with small internal diameters or hard to reach areas that preclude steam cleaning. Using hot gas technology also eliminates contaminated process water associated with steam cleaning operations.

Technology Users

Sites where Department of Defense (DoD) installation restoration or base closure activities have left an abundance of energetics-contaminated piping or sewer lines, process equipment, or other energetics-contaminated debris of suitable size; installations interested in potential transfer of the transportable hot gas decontamination for treatability studies and cleanup activities.

Background

Hot gas decontamination can be used to decontaminate explosive/propellant-contaminated underground piping and sewer lines that have been excavated. This technology is also applicable for other energetic contaminated items that can fit into the internal working diameter of the hot gas decontamination chamber (10 feet long x 6 feet high x 4.5 feet wide), such as mines and shells being demilitarized or other process equipment and scrap materials contaminated with energetics.

Description

This technology applies to any piping or process equipment of suitable size with internal surfaces or parts that are hard to decontaminate with physical methods or with contaminated surfaces that retain contamination even after surface decontamination.

The study involves identifying sites where installation restoration or base closure activities have left an abundance of energetics-contaminated piping or sewer lines, process equipment, or other energetics-contaminated debris of suitable size, as well as installations interested in potential transfer of the transportable hot gas decontamination system for treatability studies and cleanup activities.

This advanced technology effort builds upon a 1990 demonstration of larger equipment at Hawthorne Army Ammunition Plant (HWAAP), Nevada, where the technology proved feasible for remediating explosives-contaminated sewer pipes and process equipment.

Applicability

Andrulis Report Requirements:

- 1.4.e Recycling/Disposal Options for Building Materials
- 1.4.h Nondestructive Decontamination of Facilities

Accomplishments and Results

The contractor, Roy F. Weston, identified furnace and afterburner manufacturers to design and detail transportable hot gas decontamination components to system specifications. Weston also shop-tested and shipped components to Alabama Army Ammunition Plant (ALAAP), the site selected for the field demonstration. The firm developed safety and test plans and site-specific engineering. Weston installed the system and received approval from the Alabama Department of Environmental Management on the Treatability Study Test Plan.

The hot gas process was found to be effective for treating items contaminated with TNT, RDX, and tetryl. A 5X decontamination level is achieved at operating conditions of 600°F (steady state) for one hour. No detectable levels of explosives were observed in the stack emission during the stack testing program. The process can meet mandated air quality emissions requirements, thus making it available for implementation as a viable 5X decontamination technology.

Deliverables included: final technical report, final video, technical brochures, application and analysis reports, cost and performance reports, operations and maintenance manuals, and procurement and fabrication analysis reports.

Following the demonstration program at ALAAP, the transportable hot gas decontamination unit was shipped to and modified by Tennessee Valley Authority (TVA) to remove the flame from inside the decontamination chamber. TVA also has purchased a dedicated CEM system, which is now part of the hot gas decontamination system.

Limitations

Components must be able to fit into the transportable hot gas decontamination furnace. However, the system can be configured for decontamination of much larger components with an air blower and appropriate ducting. The larger contaminated components are decontaminated in the hot gas chamber while contaminated vapors are being ducted to the thermal oxidizer.

Resource Support

The follow-on effort is being funded by the Industrial Operations Command.

Follow-On Program Requirements

Industrial Operations Command (IOC) has funded a cleanup effort at Newport Chemical Depot (NECD) in Newport, Indiana, using this transportable hot gas decontamination unit to dismantle the depot TNT plant's piping and equipment and sell it as surplus property. This effort is scheduled to take place between 1997 to 1999.

Point of Contact

Louis Kanaras

Program Partners

U.S. Army Environmental Center
Alabama Army Ammunition Plant
Roy F. Weston
Tennessee Valley Authority

Publications

Identification and Evaluation of Novel Decontamination Concepts, USATHAMA report DRXTH-TE-CR-83211, July 1983.

Technical report, Development of Novel Decontamination and Inerting Techniques for Explosives-Contaminated Facilities, Laboratory. Evaluation of Novel Explosives Decontamination Concepts, USATHAMA Report AMXTHE-TE-TR-85009, March 1985.

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Technical report, Task Order 2, Pilot Test of Hot Gas Decontamination of Explosives-Contaminated Equipment at HWAAP Hawthorne, Nevada, USATHAMA Report CETHA-TE-CR-9003, June 1990.

Technical report, Hot Gas Decontamination of Explosives-Contaminated Items, Process and Facility Conceptual Design, USAEC Report SFIM-AEC-ET-CR-94118, January 1995.

Technical report, Field Demonstration of the Hot Gas Decontamination System, USAEC Report SFIM-AEC-ET-CR-95011, February 1995.

Technical report, Demonstration Results of Hot Gas Decontamination for Explosives at Hawthorne Army Depot, USAEC Report SFIM-AEC-ET-CR-95031, September 1995.

U.S. Army National Environmental Technology Test Sites (NETTS) Program

In 1990 Congress established the Strategic Environmental Research and Development Program (SERDP) to expedite the transfer of environmental technologies from basic research and early developmental stages to actual field demonstration. SERDP established the NETTS Program, a Tri-Service/Environmental Protection Agency (EPA) partnership, to facilitate the demonstration, evaluation and identification of cost-effective technologies for scale up or implementation by the user community.

Purpose

To expedite demonstration, evaluation, and transfer of effective environmental technologies aimed at characterizing, remediating, or monitoring sites contaminated with explosives and other aromatic constituents.

Benefits

Immediate benefits from an integrated demonstration and evaluation program include: (1) the identification of achievable and cost-effective cleanup goals; (2) establishment of a research and development platform for advancement of remediation technologies; (3) acceleration of innovative technologies acceptance as presumptive remedies for reducing cleanup time and costs; (4) well-documented engineering packages, where appropriate, for the broader application of effective technologies; (5) return on investment and cost savings of SERDP-sponsored and other technology demonstrators; and (6) wider understanding of contaminants' fate and transport.

In addition, by including private technology demonstrators, regulators, users, and the public in the demonstration planning process, each NETTS test location provides opportunities for identifying and developing acceptable cost-effective technologies for transfer to other government agencies and the private sector, thus resulting in lower remediation costs for the government.

Technology Users

Federal government and private sector facilities.

Background

Under the Strategic Environmental Research and Development Program (SERDP), each service established and managed test sites that provide federal and private sector technology developers a place to test their technologies. The Army's test site is Volunteer Army Ammunition Plant, Chattanooga, Tennessee. Program objectives have been achieved, including fully characterizing the sites and provision of a basic infrastructure, so that the technology developers have facility, utility, and analytical access. Under the auspices of SERDP, NETTS test sites focus on solving military-unique priority contaminant situations and concerns.

Description

The technical approach employed by the U.S. Army NETTS program entailed in-depth delineation and characterization of contaminant and hydrogeologic conditions at Volunteer Army Ammunition Plant (VAAP) and other Army installations and facilities for the purpose of providing viable test locations for comparative demonstration, evaluation, and analysis of a technology's theory, design, and operation. Site characterization efforts conducted involved determining actual volumes and concentrations of contaminated soil to designate areas for comparative demonstration. Data from these investigations and Installation Restoration groundwater sampling investigations were incorporated into a comprehensive site characterization document. Useful aspects of the site characterization document that assist principal investigators and project managers in making decisions are the identification of other analytes or contaminants present on site, such as metals, which may interfere with a particular technology's performance. Descriptions of environmental conditions at the test sites are also depicted with tables, charts, graphs and three-dimensional drawings.

The Army NETTS analytical laboratory, located at the VAAP National Test Location (NTL), is dedicated to technology demonstration analytical support but may also be used by DoD components such as Base Realignment and Closure (BRAC) or Installation Restoration (IR) project managers for QA/QC. The NETTS laboratory, which has been validated by the U.S. Army Environmental Center (USAEC), provides: expedient sample analysis and turnaround times; an effective platform for assuring QA/QC on-site; and significant cost savings for laboratory analysis. It is available to all NETTS NTLs.

During technology demonstrations, cost and performance parameters for various environmental characterization and remediation technologies are monitored and recorded. Cost and performance data are collected in conformance with the structure, guidelines and criteria identified in SERDP's NETTS Cost and Performance Database. In this manner critical technology demonstration data can be accessed for further analysis or for consideration in cleanup strategies where cost-effective and innovative techniques are sought.

At the conclusion of each demonstration, an Application Analysis Report (AAR), prepared by the Principal Investigator (PI), and a Technology Application Analysis Report (TAAR), prepared by the Test Location Manager (TLM), are published. These reports, respectively, provide both the demonstrator's and TLM's analysis and interpretation of the technology's demonstration results and potential for implementation at actual cleanup sites. Where appropriate, engineering design, fabrication and procurement guidance will be provided to potential users, regulators, public and commercial interests.

Once a given technology is fielded, scientists and engineers from USAEC's Environmental Technology Division (ETD) remain committed to supporting the user in problem solving, implementation or expansion.

Applicability

Andrulis Report Requirements:

- 1.2.a Explosives in Groundwater
- 1.2.b Organics in Groundwater

- 1.3.a Remediation of Explosives in Soils
- 1.3.b On-Site Treatment of Organics Contaminated Soil
- 1.3.c Explosives/Organics Contaminated Sediments
- 1.3.h Determine Natural Attenuation Rates of Army-Unique Compounds
- 1.3.m Soil Bioremediation

Accomplishments and Results

During FY 1993, USAEC screened several candidate facilities and installations from the Installation Restoration Program to select suitable explosives NTLs. By the end of FY 94, USAEC negotiated and coordinated the establishment of VAAP as the Army's first NETTS NTL. In FY 95 the Army conducted in-depth site characterization, developed test site infrastructure and performed administrative, logistical, and oversight functions necessary to establish VAAP as an NTL. These activities included: conducting site and environmental assessments; permit and regulatory review; development of site-specific management and health and safety plans; test site infrastructure development; on-site analytical laboratory setup and validation; and coordination with potential government and private industry technology demonstrators.

The first project to use the VAAP test site for a field test was the Site Characterization and Analysis Penetrometer System (SCAPS). During summer 1995, sensors developed to detect explosives in soil and groundwater were field-tested at VAAP with additional prove-out completed during summer 1996. Another first was realized during early 1996 when the Army NETTS program hosted its first private industry participant. From January 1996 to May 1996 the ECOCHOICE system, developed by Eco Purification Systems, was demonstrated. The ECOCHOICE system is based on catalytic oxidation of pollutants on a fixed bed reactor.

During summer 1996 two additional efforts, both SERDP funded, were performed at the VAAP NTL. The first effort was a collaboration between the U.S. Environmental Protection Agency, the U.S. Army Center for Health Promotion and Preventive Medicine and the Virginia-Maryland Regional College of Veterinary Medicine. The effort focused on studying the effects of explosives and heavy metals contamination on wildlife, with the objective of identifying bioindicators of sublethal stress in rodents, fish and amphibians. The second effort involved a phytoremediation pilot study, which tested the ability of various submerged and emergent aquatic plants to remove nitroaromatic compounds from groundwater. The study examined the impact of dynamic system operation on contaminant removal rates as well as the effects of various hydraulic retention times.

USAEC also managed the development and publication of the Guidelines for Quality Technology Demonstrations document, which will assist the DoD services and EPA NETTS partners in their efforts to implement common demonstration standards and uniform analytical protocols.

In December 1996 USAEC's ETD commissioned a study and report estimating the volume of explosives- contaminated soil requiring remediation at selected Army installations as of March 1997. The report, "New Lower Estimates for Soils Contaminated with Secondary Explosives and the Associated Implications," published in June 1997, estimates the total cost for treating this soil. The report also describes the process and assumptions used to identify installations with known or suspected contamination, identifies sites likely to require treatment, and estimates the volume of contaminated soil at each site. Finally, it compares this new soil volume estimate with a previous estimate, explains the difference, and describes the implications of these results.

Limitations

Due to recent budget cuts in SERDP research and development projects and programs and the lack of explosives remediation technologies ready for transition from developmental stages to the field for demonstration, the Army NETTS NTL has been slated for closure by the SERDP Program Office. However, due to the available infrastructure and detailed site characterization data available, the site will still be available for demonstrations, field tests and studies on a case-by-case basis through special arrangements made with the VAAP commander's representative and on-site contractor. Demonstrated technologies should be amenable to a soil environment of a clay-loam overburden underlain by karst features.

Resource Support

SERDP

Follow-On Program Requirements

The lack of technologies transitioning from basic research and bench-scale stages for test and evaluation justifies discontinuing fiscal expenditure and full-time NETTS infrastructure operation. Preliminary findings from the ETD-commissioned study to determine existing volumes of explosives cleanup, however, suggest that roughly 669,000 cubic yards of soil remain that require cleanup. Conjointly, 73 %, or 514 yards, of the total estimate are on installations where cleanup is in progress. It therefore follows that the volume of soil remaining that will require cleanup in the future and can be influenced by research and development is only 155,000 cubic yards. Thus, potential cost savings derived from new technologies to treat soils contaminated with explosives should be great enough to recoup development cost and provide cumulative savings.

Point of Contact

A.J. Walker

Program Partners

U.S. Army Environmental Center
U.S. Army Industrial Operations Command
Volunteer Army Ammunition Plant, Tennessee
TCI Americas, Inc.
Tennessee Valley Authority
TRW, Inc.
Demonstration of Defense National Environmental Technology Demonstration Program, Guidelines for Quality Technology Demonstrations, SERDP, December, 1995.

Publications

Volunteer Army Ammunition Plant DoD National Environmental Technology Test Sites Management Plan, USAEC, March 1996.

Site Characterization of Volunteer Army Ammunition Plant Technology Demonstration Area, USAEC, December 1995.

Environmental Assessment for Establishment of a National Test Location at Volunteer Army Ammunition Plant, USAEC, November 1995.

Health and Safety Plan - National Environmental Technology Test Sites, Volunteer Army Ammunition Plant, USAEC, June 1995.

Quality Assurance Project Plan - National Environmental Technology Demonstration Program Test Site, Volunteer Army Ammunition Plant, USAEC, May 1995.

Louisiana Army Ammunition Plant DoD/National Environmental Technology Test Sites Management Plan, USAEC, March 1996.

Environmental Assessment for Establishment of a National Test Location at Louisiana Army Ammunition Plant, USAEC, November 1995.

Health and Safety Plan - National Environmental Technology Test Sites, Louisiana Army Ammunition Plant, USAEC, November 1995.

Project Focus: Range XXI

RANGE XXI: BRINGING THE ENVIRONMENT TO THE BATTLEFIELD

The U.S. Army Environmental Center (USAEC), in conjunction with the Combat Training Support Directorate, Deputy Chief of Staff-Training, Training and Doctrine Command, has developed Range XXI, the environmental component of the Army's Force XXI program.

The Range XXI program will provide new technologies and methods that will allow the Army to continue training under realistic conditions and maintain readiness. Range XXI will directly support the Army trainer by providing tools to reduce the impact of environmental laws and regulations on training operations. Several Range XXI projects are under way to evaluate and demonstrate cost-effective environmental technologies and techniques for small arms ranges. These technologies will maximize the Army's potential while maintaining compliance with applicable laws and regulations.

Fort McPherson Impact Berm Redesign and Construction

The soil on many DoD small arms ranges contains lead from test and training activities. Effective design of range areas and impact berms will minimize the potential for migration of lead off site and reduce maintenance requirements. As a result, these ranges will experience lower maintenance costs, greater availability for training, and improved environmental protection.

Purpose

Design and construct a berm at Fort McPherson's Qualification Training Range that will minimize the environmental impacts of erosion, reduce maintenance requirements and ensure compliance with environmental laws and regulations.

Benefits

Implementing new berm technologies at Fort McPherson, Georgia, will minimize maintenance requirements and aid compliance with the Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Clean Water Act without impact to training.

Technology Users

Department of Defense (DoD) installations with small arms ranges.

Background

Many DoD sites have soils that contain heavy metals due to extensive training on small arms ranges. Numerous facility closures have occurred due to the buildup of lead — a RCRA listed toxic material — in the soil. To prevent such closures and minimize environmental impacts on Army training and readiness, new technologies are being developed and implemented.

Normal training operations deposit heavy metals from bullets into the soil on small arms ranges. Environmental engineering techniques are necessary to minimize the migration of heavy metals within and away from the range facility. At active sites such as Fort McPherson's Qualification Training Range, these techniques will prevent pollution and allow the facility to provide effective, realistic training while maintaining a high level of environmental stewardship.

Description

Fort McPherson and the U.S. Army Environmental Center (USAEC), in conjunction with the Army Training Support Center (ATSC) and the U.S. Army Construction Engineering Research Laboratories (USACERL), have implemented innovative environmental technologies for the redesign of Fort McPherson's Qualification training Range. The objective of this effort was to provide Fort McPherson with an environmentally sound training range while evaluating the performance of the stabilization technologies for Armywide implementation.

Results from the Environmentally re-engineered Small Arms Range Demonstration at Fort Rucker, Alabama, as well as the latest slope-stabilization technologies, were used to develop the Fort McPherson impact berm design.

Several design features were implemented, including:

- Addition of a soil amendment, polyacrylamide (PAM), to achieve optimum engineering potential (i.e., maximum soil adhesion properties).
- Compacting soil to optimum moisture and maximum density and implementing a gabion retaining wall to enable a stable, low-maintenance 45-degree slope in the lower impact area.
- Vegetating the berm with a hearty cover of zoysia grass to minimize the erosional effects of runoff.
- Installing a gutter system to the roof of the Qualification Training Range to direct rainwater away from the impact berm.

Applicability

Andrulis Report Requirements:

- 1.3.e Soil Inorganic
- 1.4.c Heavy Metals

Accomplishments and Results

- The project order was accepted by the USACERL in FY 1996.
- Designs were coordinated between USAEC, USACERL, Fort McPherson, the Combat Training Support Directorate, DCS-T, Training and Doctrine Command, and the U.S. Army Engineering and Support Center, Huntsville.
- The construction was performed by a specified subcontractor under USACERL.
- The berm was constructed on schedule.
- Technology performance evaluation period has commenced.

Resource Support

Funding provided by Fort McPherson and USAEC.

Follow-On Program Requirements

USAEC will evaluate the performance of the implemented impact berm design for one year. Successful design aspects will be used in future applications. Fort McPherson intends to apply lessons learned from this effort to redesign and build a 300-meter impact berm at Fort Gillem, Georgia.

Point of Contact

Lisa Miller

Program Partners

U.S. Army Environmental Center
Fort McPherson, Georgia
U.S. Army Construction Engineering Research Laboratories
Combat Training Support Directorate, Deputy Chief of Staff-Training (DCS-T), Training and Doctrine Command
U.S. Army Engineering and Support Center, Huntsville

Green Ammunition

Millions of small arms rounds are fired annually on military ranges during training and testing activities. These projectiles contain lead, a federally listed toxic material, and may pose an environmental risk to soil, sediments, surface water and groundwater. Replacing lead in conventional projectile with a tungsten core will minimize environmental compliance impacts on training and help to avoid costly cleanup efforts.

Purpose

To provide the Department of Defense (DoD) with nontoxic small-caliber combat ammunition that will meet U.S. and NATO performance standards. The project will focus on eliminating toxic components in the projectile core.

Benefits

This program will revolutionize small-caliber ammunition. This next generation of ammunition, while benign to the environment, will have potentially enhanced lethality and functionality. Environmental restrictions on training U.S. military personnel will be minimized. Training realism and effectiveness will be greatly enhanced, while future cleanup costs may be eliminated. Furthermore, DoD will be the international leader in these technologies and the environmental stewardship shown will enhance both public image and trust. This program will develop a nontoxic cartridge that will eliminate the environmental and hazardous effects that are associated with current ammunition.

Technology Users

U.S. Army Armament Research Development and Engineering Center (ARDEC), Small Caliber Ammo Branch

U.S. Army Infantry Center (USAIC)

U.S. Army Research Laboratory (ARL)

Naval Weapons Support Center-Crane (NSWC)

Naval Air Warfare Center-China Lake

U.S. Air Force Security Police Agency (AFSPA)

Department of Energy (DOE) Oak Ridge National Laboratory (ORNL)

DOE-Los Alamos National Laboratory (LANL)

DOE-Kansas City Facility (KCF)

Background

Lead in soil, sediments, surface water and groundwater has been confirmed through investigations conducted at Army, Navy, Marine Corps, and Air Force small arms ranges throughout the United States and Europe. Lead uptake studies in vegetation at a Marine Corps range in Quantico, Virginia, showed lead levels as high as 23,200 ppm. Remediation has proven to be extremely expensive. Furthermore, inspections of National Guard indoor ranges during 1986 to 1988 resulted in 812 ranges being shut down due to high levels of lead contamination, both surface and airborne, and they will require costly renovations to meet Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) standards. About 689 million rounds of small arms ammunition (.22-caliber through .50-

caliber) are fired annually during DoD training, with an additional 10 million rounds fired annually by DOE. The annual amount of heavy metal introduced into the environment from this training is approximately 3 million pounds.

The lead projectile cores and lead compounds used in primers create dust and fumes when fired. Shooters and range operators are exposed to dangerously high levels of airborne lead. The Army Center for Health Promotion and Preventive Medicine has conducted studies at firing ranges that show projectiles account for 80% of airborne lead released, while the remaining 20% comes from primer combustion. The studies also indicate that 40% of inhaled lead is dissolved in the bloodstream and 10% is absorbed directly by the body. Once in the body, lead is very difficult to remove.

Description

The Joint Non-Toxic Working Group was established in 1995 by ARDEC as a multi-service cooperative forum of DoD, DOE, private industry and academia experts. ARDEC is responsible for overall program management and execution.

The U.S. Army Environmental Center (USAEC) has provided funding in support of eliminating toxic components from the projectile core. This focus is due to the lead buildup from rounds in small arms range impact areas resulting in non-compliance with environmental laws and regulations.

The next generation of small arms projectiles relies on innovative material usage to reproduce and improve upon the physical, ballistic and mechanical properties of lead. Composite materials such as metal powders in nylon, or high-density metal particulates bonded together with light metals, are being examined as nontoxic replacements for lead.

Concurrent with the USAEC-funded demonstration of a 5.56 mm nontoxic projectile alternative, other efforts will target the toxic components in the cartridge primer and manufacturing process. A cost-effective producibility demonstration of nontoxic small-caliber ammunition will also be performed.

Of primary concern at outdoor ranges is the introduction and dispersion of tungsten throughout the environment. Development of the toxicity and environmental recovery information to support recycling or closed-loop use of the materials, and data on environmental effects, are being determined. Additional leaching, environmental corrosion, and biological uptake tests will be performed to fully define stability and mobility characteristics. Study results will guide projectile formulation such that all materials will be stable and recoverable. Projectile design, constituent materials, and processing will be optimized to support the maximum recovery and recyclability of this next generation of projectile materials. USAEC will specify recovery and recycle methods and provide for the pilot-scale demonstration. Adequate information regarding the use, release and mobility of the high-density constituents under consideration, specifically tungsten, is considered crucial for acceptance.

Demonstrating the producibility of the nontoxic projectile is as critical as the performance demonstrations. If the items cannot be produced in a cost-effective, environmentally compliant fashion, then the technology will fail. Lake City Army Ammunition Plant (LCAAP), Missouri, is the Army's principal supplier of small-caliber ammunition. The producibility testing of the nontoxic projectile proposed above will be performed at LCAAP. Additionally, other environmental issues regarding production methods, machinery, and support materials for small-caliber ammunition manufacture will be addressed.

Producibility testing will be used to minimize production costs and provide feedback to the projectile and primer designers. Production rates of 1,200 items per minute require special consideration in item design and manufacture. Performing producibility tests will assure that item unit-costs stay within 10% of current ammunition production costs.

In the future, USAEC plans to provide funding for qualification tests and type classification of the new, toxic-free 5.56 mm cartridge for full Armywide implementation. At the start of Phase II, the composite materials identified in Phase I will be refined to eliminate any deficiencies. Approximately 100,000 slugs of the successful candidates from Phase I (i.e., tungsten/nylon and tungsten/tin) will be purchased from Texas Research Institute and Powell River Laboratories, Inc., respectively. A task order contract will be prepared for LCAAP to assemble and load M855 cartridges using the composite projectile slugs. Several cartridges from each lot will be subjected to standard production verification testing to ensure their safety and performance. All cartridges will then be shipped to Aberdeen Proving Ground, Maryland, for qualification testing.

Army Test and Evaluation Command (TECOM) qualification test requirements and ammunition quantities will be finalized. Tests not conducted during Phase I that have the highest likelihood of revealing projectile-related deficiencies will be conducted first. Some of these tests will include environmental conditioning (hot and cold temperature cycling), rough handling, and barrel erosion. These tests will be used to further narrow the selection to one material candidate. The remainder of the TECOM testing will include, but not be limited to, electronic pressure, velocity and action time, dispersion, and penetration. If both candidates meet all requirements, the result will be two qualified alternate materials instead of one.

During Phase III, the technology will be transitioned to the 7.62 mm and the 9 mm projectiles and demonstration/ testing of those configurations will be performed. Concurrent with the manufacture and testing activities, a corrosion and life-cycle cost analysis will be performed for all three calibers. This effort will examine product cost from raw material processing through manufacture, use, and eventual disposal or recycling.

APPLICABILITY

Andrulis Report Requirements:

- 2.5.3 Eliminate Indoor Firing Range Lead Contamination
- 3.1.c Heavy Metals Reduction/Elimination from Surface Protection
- 3.1.g Develop Alternative Sealants Materials and Technologies
- 3.3.b Reduce Hazardous Components in Ordnance
- 3.3.c Reduce VOCs in Ordnance Manufacture and Analysis
- 3.3.g Eliminate Lead in Ordnance

3.1.6.c Energetics Production Pollution Prevention (Navy)

95-2502 Remediate Lead at Outdoor Ranges (Air Force)

ACCOMPLISHMENTS AND RESULTS

During Phase I, USAEC and ARDEC demonstrated the viability of seven non-developmental item (NDI) formulations to replace lead in the 5.56 mm projectiles. Composite materials tested during Phase I consisted of tungsten bonded with light metals (i.e., tin, zinc) or synthetics (i.e., nylon). Composites were subjected to a high-speed assembly and loading process to produce net shape cores with physical properties similar to lead. Projectiles underwent ballistics performance testing for dispersion, penetration, electronic pressure, velocity, and action time. Phase I successfully isolated two candidates suitable for replacing the current 5.56 mm service round. Toxicity studies on tungsten are being analyzed at Oak Ridge National Laboratory.

The final report of the demonstration of lead-free alternatives for 5.56 mm ammunition was submitted to USAEC in February 1997. Both configurations will advance through Phase II to production unless one proves unfeasible.

FOLLOW-ON PROGRAM REQUIREMENTS

- Complete Phase II (select final candidates).
- Complete Phase III (transition the technology to other calibers).

POINT OF CONTACT

Lisa Miller

PROGRAM PARTNERS

U.S. Army Environmental Center
U.S. Army Armament Research Development and Engineering Center
Lake City Army Ammunition Plant, Missouri
Oak Ridge National Laboratory

Joint Small Arms Range Remediation Demonstration

Soils on many Department of Defense (DoD) small arms ranges contain lead, a RCRA listed toxic material. Conventional cleanup technologies are limited to stabilization and landfilling. Physical separation and acid leaching are cost-effective technologies that can remediate soil to an appropriate level, reduce waste volume, minimize range downtime and eliminate future liability to DoD.

Purpose

To demonstrate and evaluate physical separation and soil washing technologies for removing lead from soils on small arms firing ranges.

Benefits

A cost-effective technology for the cleanup and maintenance of small arms firing ranges will be available throughout the Army.

Technology Users

Department of Defense (DoD) small arms ranges.

Background

Soils on numerous DoD sites contain lead or other heavy metals from small arms test and practice activities. Small arms projectiles consist primarily of lead, a RCRA listed toxic material. Recent DoD facility closures have focused attention on the toxic lead buildup at small arms facilities, resulting in the classification of abandoned small arms ranges as solid waste management units. In addition, future regulatory focus may restrict test and training activities and force the closure of valuable small arms range facilities. As a result, the Army user community has prioritized "soil inorganic" as the seventh-highest requirement for environmental restoration research and development.

Conventional cleanup technologies for soil that contains lead are limited to landfilling and solidification-stabilization. These technologies are expensive and neither destroy nor remove the toxic metals. As disposal restrictions tighten, these methods will become increasingly more difficult and expensive. Costs for treatment are in the range of $400 per ton, and one-way mileage from remediation sites to disposal facilities typically exceeds 600 miles. Excessive waste transportation increases both the disposal costs and the potential for accidents.

DoD's long-term liability for these wastes remains because current technologies do not remove metal contaminants. The need for an alternative technology is particularly urgent at Base Realignment and Closure sites with small arms ranges.

Description

The mining industry developed physical separation and soil washing technologies to concentrate metallic ores. These technologies have been modified for use in removing metals from soil. The typical metals found on small arms ranges are lead, copper, antimony and zinc — lead being the greatest concern. Physical separation causes larger and heavier particles of metal and sand to settle out of the soil for collection and recycling. The remaining clay fraction is "washed" in an acid solution to remove the residual metals.

With funding from the Defense Department's Environmental Security Technology Certification Program, The U.S. Army Environmental Center (USAEC) and the Naval Facilities Engineering Service Center (NFESC) tested two commercially available physical separation and acid leaching processes at Fort Polk, Louisiana. USAEC prepared the site and conducted the demonstration; NFESC evaluated the technologies and documented the results. The U.S. Army Waterways Experiment Station (USAWES) supported the demonstration by providing treatability study results and technical guidance throughout the demonstration.

The acid leaching processes demonstrated at Fort Polk used hydrochloric and acetic acids. The technical and cost-performance aspects of the processes for removing heavy metals from small arms range soils were demonstrated. Many site-specific parameters can affect the cost and applicability of soil washing technology, but generally, the technology applies to sites with low clay-content soils (less than 25% clay) and larger amounts of material requiring treatment (more than 2,600 tons). Before a site employs this technology, it should conduct a bench-scale test for the site-specific soil and target metals to be removed and recycled.

Applicability

Andrulis Report Requirements:

- 1.3.e Soil Inorganic
- 1.4.c Heavy Metals

Resource Conservation and Recovery Act (RCRA)

Clean Water Act (CWA)

National Pollution Discharge Elimination System (NPDES)

Accomplishments and Results

The data indicate that for a 10,000-ton site with soils similar to Fort Polk's (25% clay), the hydrochloric acid process will cost approximately $170 per ton. The acetic acid process was not effective at Fort Polk, but it may work at sites with different soil parameters. Physical separation alone is expected to satisfy most requirements for range maintenance and, in certain cases, meet cleanup goals. Data indicate the physical separation process costs about $40 per ton.

The Fort Polk demonstration ended in December 1996. Final reports, implementation guides, pamphlets and a video will be available in January 1998.

Limitations

The processes may not be cost effective in treating soils high in clay content or that contain mercury or certain organic compounds.

Resource Support

Environmental Security Technology Certification Program (ESTCP)

Follow-On Program Requirements

USAEC sponsored a bench-scale study for the application of soil washing on four ranges at Fort Benjamin Harrison, Indiana, and on a known distance range at the U.S. Military Academy (USMA), West Point, New York. The Fort Benjamin Harrison test is complete and the final report has been delivered. The USMA study is complete and the final report will be delivered in February 1998.

Once the final report is delivered, additional funds may be provided for a full-scale soil washing operation.

Point of Contact

Lisa Miller

Program Partners

Environmental Security Technology Certification Program

U.S. Army Environmental Center

Naval Facilities Engineering Service Center

Army Training Support Center

U.S Army Waterways Experiment Station

Fort Polk, Louisiana

Publications

Implementation Guidance Manual, video and brochures.

Technology Application Report, Vols. 1 and 2.

Technology Application Analysis Report.

Worldwide Vendor Search Report.

Final Technical Report.

Shock Absorbing Concrete Performance and Recycling Demonstration

Recovery of lead and other bullet fragments from conventional soil berms is often difficult. As a result, lead and other heavy metals may leach into groundwater, potentially resulting in a remediation effort. Impact berms constructed from a special type of concrete will retain bullets while providing an easy-to-recycle berm material.

Purpose

To use Shock Absorbing Concrete (SACON) to reduce the potential of off-site migration of lead and other heavy metals.

Benefits

SACON may provide a means to recycle projectiles and prevent buildup of heavy metals in range soils. SACON would also mitigate the excessive soil erosion experienced on outdoor ranges caused by bullet impacts. Erosion control and soil stabilization would help prevent migration of heavy metals off-range, and would alleviate the recurring costs of land rehabilitation on the ranges. In addition, SACON may reduce or eliminate safety problems caused by ricochets off natural or other materials.

Technology Users

The Army — primarily Forces Command (FORSCOM) and Training and Doctrine Command (TRADOC) installations — as well as the National Guard, Navy, Coast Guard, Marines, and Air Force.

Background

Numerous Department of Defense (DoD) small arms ranges contain lead and other metals in soils. In some cases, those inorganics may “migrate” to surface or groundwater. The Army operates approximately 1,400 outdoor small arms ranges in the continental United States (CONUS); the Navy operates approximately 270 outdoor small arms ranges (including Marine ranges) and the Air Force operates approximately 200 outdoor small arms ranges. The U.S. Army Environmental Center (USAEC), Army Training Support Center (ATSC) and U.S. Army Waterways Experiment Station (USAWES) seeks ways to reduce the potential of off-site migration of lead and other heavy metals.

SACON has been used as a bullet-stopping material since the 1980s. It has been extensively field tested with a wide variety of small arms, including most common military and civilian automatic and semi-automatic weapons. The Army and a number of federal and state agencies have fabricated “training villages” from SACON. However, SACON has not been demonstrated as a berm material on conventional small arms ranges.

Description

SACON can be used to build safe, durable, low-maintenance barriers that can hold spent bullets in a low-permeability, alkaline matrix that will minimize escape of potentially harmful metals into surrounding soil or groundwater. After use, the SACON bullet traps will be recycled. The SACON will be crushed and the bullet fragments will be separated from the crushed material. The aggregate developed from the crushed SACON will be used to recast blocks in a new foamed concrete mixture. The bullet fragments will be available for recycling.

Two sites have been selected for demonstration of SACON: the U.S. Military Academy (USMA) at West Point, New York; and Fort Knox, Kentucky. Initially, SACON will be tested on 25-meter zero ranges at both sites. Additional tests will be performed on automated record fire (ARF) ranges at both sites and on an automated field fire (AFF) range and a combat pistol qualification course (CPQC) at Fort Knox.

Applicability

Andrulis Report Requirements:

- 2.3.c Develop Recycle/Reuse Technologies
- 2.3.d Develop Alternative Technologies to Mitigate Contaminated Soil
- 4.2.i Land Rehabilitation
- 4.3.a Mitigating Army-Unique Impacts
- 4.3.d Erosion Control Technologies

Accomplishments and Results

Preliminary field trials were conducted on the 25-meter ranges at Fort Knox and West Point in November 1996. The SACON blocks were redesigned based on performance data and discussions with range personnel; new blocks were installed on the 25-meter ranges at Fort Knox and USMA in March 1997.

An initial briefing of the data collection requirements was given to the range managers at West Point and Fort Knox in November 1996.

The Cooperative Research and Development Agreement between USAWES and Ballistics Technology International has been signed.

A manuscript for the American Defense Preparedness Association (ADPA) 1997 Waste Management Conference was published in the Proceedings of the Meeting. The paper was presented in January 1997; the presentation is titled “Management of Spent Bullets and Bullet Debris on Training Ranges.”

A paper titled “Chemical Containment of Heavy Metals from Bullet Debris in Shock-Absorbing Concrete (SACON) Bullet Barriers” was presented at the ADPA 23rd Environmental Symposium in April 1997.

A paper titled “Design of Modular Bullet Trapping Units Using Shock-Absorbing Concrete (SACON)” was presented at the Tri-Service Environmental Workshop in St. Louis in June 1997.

SACON was installed on the ARF range at USMA in April 1997. SACON was installed on the ARF, AFF and CPQC at Fort Knox in June 97.

A recycling demonstration has been conducted at USAWES.

Follow-On Program Requirements

- Complete field demonstrations on ranges.
- Complete final reports.

Points of Contact

Gene Fabian

Program Partners

U.S. Army Environmental Center
Combat Training Support Directorate, Deputy Chief of Staff-Training, Training and Doctrine Command
U.S. Army Waterways Experiment Station
U.S. Army Military Academy, New York
Fort Knox, Kentucky

Publications

"Management of Spent Bullets and Bullet Debris on Training Ranges, " presentation for the the American Defense Preparedness Association 1997 Waste Management Conference.

"Chemical Containment of Heavy Metals from Bullet Debris in Shock-Absorbing Concrete (SACON) Bullet Barriers," paper presented at the 23rd ADPA Environmental Symposium.

"Design of Modular Bullet Trapping Units Using Shock-Absorbing Concrete (SACON)," paper presented at the 1997 Tri-Service Environmental Workshop.

Small Arms Range Bullet Trap Feasibility Assessment and Implementation Plan

Lead from bullets fired on small arms ranges may contaminate groundwater and soil. Such lead contamination results in long-term cleanup costs and range closure. Capturing the bullets will prevent the lead from entering the environment. The use of bullet traps on small arms ranges will prevent pollution and result in greater range availability for training, long-term savings, and environmental protection.

Purpose

To reduce the potential of off-site migration of lead and other heavy metals; to reduce the impacts on the environment; and to promote training readiness through pollution prevention methods that reduce environmental compliance impacts.

Benefits

Bullet traps may provide a means to recycle the projectile material and prevent the contamination of the range and the environment. The bullet traps would also mitigate the excessive soil erosion experienced in outdoor ranges caused by the impact of the projectiles. Erosion control and soil stabilization on the ranges would help prevent the migration of existing heavy metals contaminants off range and it would help alleviate the recurring costs of land rehabilitation on the ranges.

Technology Users

All Army and Department of Defense (DoD) installations with small arms ranges will benefit from this technology. In addition, there may be civilian applications.

Background

The Army operates approximately 1,400 outdoor small arms ranges in the continental United States (CONUS); the Navy operates approximately 270 outdoor small arms ranges (including Marine ranges) and the Air Force operates approximately 200 outdoor small arms ranges.

Future regulatory focus may restrict test and training activities and force the closure of valuable small arms range facilities unless methods are implemented to capture and recycle all the projectile material and prevent contamination of the range facility and the surrounding environment. Bullets from small arms are primarily lead, which is listed as a toxic material by the federal Resource Conservation and Recovery Act (RCRA). Once fired, bullets may corrode and the lead may enter ground or surface water. This may result in a violation of RCRA or other laws. Cleanup of water contaminated with lead is costly, and contamination may result in range closures or restricted use.

Description

Bullet traps can reduce the amount of lead and other metal compounds that presently end up in the soils of military installations. Present use of bullet traps is limited to only a handful of military installations and primarily confined to indoor ranges. This project will identify the best available configurations of bullet traps to be considered for use at outdoor military ranges.

Techniques that limit the volume of soil containing heavy metals at small arms ranges also will limit cleanup costs and prevent regulatory restrictions of test and training activities at active sites. Bullet traps at training sites that capture and contain the projectiles for recycling will limit or possibly prevent soil contamination. Demonstrations of commercially available bullet traps are being initiated.

APPLICABILITY

Andrulis Report Requirements:

- 2.3.c Develop Recycle and Reuse Technologies
- 2.3.d Develop Alternative Technologies to Mitigate Contaminated Soil
- 4.2.i Land Rehabilitation
- 4.3.a Mitigating Army-Unique Impacts
- 4.3.d Erosion Control Technologies

ACCOMPLISHMENTS AND RESULTS

- An evaluation of outdoor small arms range designs has been completed to develop criteria for bullet trap implementation on the ranges.
- A technology identification search also has identified commercially available bullet traps.
- The bullet trap feasibility assessment report and user's manual completed.
- Demonstration of commercial bullet traps on a 25-meter range are being initiated.

LIMITATIONS

- Use of bullet traps to capture lead may result in:
- Increased maintenance costs for traps
- Increased construction costs for new or refurbished ranges
- Reduced training realism in some cases
- Reduced range use flexibility for the user as some bullets or weapons might damage the traps

RESOURCE SUPPORT

This program was supported by the U.S. Army Environmental Center (USAEC).

FOLLOW-ON PROGRAM REQUIREMENTS

Complete demonstration of commercial bullet traps on the 25-meter range. Issue assessment report and revise user's manual to reflect lessons learned.

POINT OF CONTACT

Gene Fabian

PROGRAM PARTNERS

U.S. Army Environmental Center
Army Training Support Center

PUBLICATIONS

Final Report, Bullet Trap Feasibility Assessment and Implementation Plan, Technology Identification Report, March 1996, Report Number SFIM-AEC-ET-CR-96005.

Final Report, Bullet Trap Feasibility Assessment and Implementation Plan, Evaluation Criteria Report, April 1996, Report Number SFIM-AEC-ET-CR-96142.

Final Report, Bullet Trap Feasibility Assessment, December 1996, Report Number SFIM-AEC-ET-CR-96195.

Final Report, Bullet Trap User's Guide, December 1996, Report Number SFIM-AEC-ET-CR-96201.

Small Arms Range Management Manual

Maintenance of small arms ranges must be conducted in ways that protect the environment and comply with environmental regulations. Currently, no standard procedures exist for range managers to conduct environmentally proactive maintenance activities. The Small Arms Range Management Manual will provide a reference and planning tool for training range management, and present techniques that will help minimize downtime for ranges and maximize training opportunities for soldiers.

Purpose

To develop an operation and maintenance manual for small arms range management to reduce the impact of environmental regulations on training

Benefits

Successful standard operating procedures — combined with technologies being developed by the Department of Defense (DoD) — will provide range managers with the necessary tools to maintain compliance without impact to readiness.

Technology Users

Range managers.

Background

Numerous DoD installations contain small arms ranges that may be at risk of heavy metal migration and accelerated erosion rates. A Worldwide Environmental Range Strategy has been devised through the combined efforts of the Army Training Support Center and the U.S. Army Environmental Center (USAEC) in an attempt to minimize environmental impacts from range activities while reducing the impacts on the training mission. Information to be included in the manual is based on USAEC research and demonstration projects, scientific literature and studies from the Army, Navy, Department of Agriculture and private institutions.

Description

Army ranges are sited according to Chapter 4 of Training Circular (TC) 25-8, Training Ranges. Certain site characteristics (physical, geochemical, hydrogeological, climatological, etc.) may increase the risk of heavy metal migration into groundwater, surface water, and vegetation. In addition, the buildup of rounds and fragments result in accelerated erosion rates. Such buildup in berms or backstops could contribute to migration of heavy metals into surrounding soil, groundwater, and surface water resources. Preventive measures are being sought to maintain compliance with the Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Clean Water Act (CWA), and to reduce the need for costly cleanup operations in the future.

All relevant information regarding the operation and maintenance of small arms ranges will be compiled and organized for incorporation into the manual. The information will assist in the ranges' operation and maintenance in a manner that reduces the spreading of heavy metals, is in compliance with all laws and regulations, and demonstrates a proactive approach to environmental stewardship.

APPLICABILITY

Andrulis Report Requirements:

- 1.2.e Inorganics in Groundwater
- 1.4.c Heavy Metals
- 4.2.1 Develop and Perform Maintenance on Lands
- 4.3.d Erosion Control

ACCOMPLISHMENTS AND RESULTS

The Combat Training Support Directorate, DCS-T, Training and Doctrine Command and USAEC are working to complete the first draft of the manual by February 1998. The draft manual will undergo review until March 1998. The Small Arms Range Management Manual will be ready for Armywide distribution in April 1998.

RESOURCE SUPPORT

VENC

FOLLOW-ON PROGRAM REQUIREMENTS

The manual may be modified and incorporated into Chapter 4 of TC 25-8. Updates to the manual will be available via the World Wide Web.

POINT OF CONTACT

Lisa Miller

PROGRAM PARTNERS

U.S. Army Environmental Center
Army Training Support Center
U.S. Army Waterways Experiment Station
U.S. Army Engineering and Support Center, Huntsville
Major command and installation range managers

Project Focus: SCAPS

TRI-SERVICE SITE CHARACTERIZATION AND ANALYSIS PENETROMETER SYSTEM (SCAPS)

The purpose of the Tri-Service Site Characterization and Analysis Penetrometer System (SCAPS) program is to develop, demonstrate, and transition a rapid means of characterizing subsurface contamination and to reduce the number of monitoring wells and soil borings at a site, thus reducing site characterization costs.

SCAPS is a 20-ton truck-mounted cone penetrometer system. Attached to the penetrometer is one of several sensor probes. The sensor relays information on subsurface contaminants to the surface for analysis and interpretation. SCAPS provides the ability to collect and analyze field data faster than traditional methods. Because SCAPS costs less than conventional sampling techniques, more samples can be taken on a site in a shorter period of time, providing the definition of the contamination boundaries faster. An additional benefit of SCAPS is the reduced quantity of investigation-derived wastes generated as part of the site characterization. SCAPS is fielded and has been used on Army, Navy, Air Force, Department of Energy (DOE) and Environmental Protection Agency (EPA) sites. The Army, Navy, DOE and EPA have SCAPS equipment.

Application of innovative SCAPS field-screening technologies will result in faster, more detailed site characterization at considerably lower costs than current methods. A cost/benefit analysis conducted by DOE (DOE report #LAUR-91-4016) indicates that, in a site investigation alone, 25% to 35% cost avoidance can be realized with SCAPS Laser-Induced Fluorescence (LIF) technology. In addition, because SCAPS can delineate the extent of the subsurface contamination more accurately than with widely spaced monitoring wells, the remediation costs will also be significantly reduced.

The U.S. Army Environmental Center (USAEC) leads a tri-service effort to enhance existing cone penetrometry with chemical sensors to detect and delineate site contamination. Current capabilities include petroleum, oil, and lubricant (POL) screening, identification of stratigraphy, soil resistivity measurements, and micro-well installation. These capabilities have successfully been evaluated by the EPA Superfund Innovative Technologies Evaluation (SITE) program and the EPA Consortium for Site Characterization Technologies (CSCT).

The POL sensor technology, the LIF probe, was patented and licensed for commercial production and marketing and has completed field demonstrations successfully at many Department of Defense (DoD) and DOE sites, and is currently characterizing sites throughout Europe. SCAPS can be used at all DoD installations, Formerly Used Defense Sites (FUDS), Department of Interior (DOI), DOE, and EPA-EMSL sites.

Additional SCAPS probes to detect heavy metals, volatile organic compounds (VOCs), and explosives are available. A brief description of each follows.

Metals are detected using one of two methods: X-ray Fluorescence and Laser-Induced Breakdown Spectroscopy. The X-ray Fluorescence sensor causes metals, above or below the water table, to emit a unique fluorescent signature which is analyzed above ground. Laser-Induced Breakdown Spectroscopy quantifies metal concentrations by causing laser-induced plasma emissions. Spectrographic analysis is conducted above ground.

VOCs are identified using two different methods, the HydroSparge VOC Sensor Probe and the Thermal Desorption VOC Probe. The HydroSparge VOC Sensor Probe creates a temporary monitoring well for an in-situ sampler to strip the VOCs from groundwater and return them to the surface for real-time analysis by an ion trap mass spectrometer (ITMS). The Thermal Desorption VOC Probe pushes to a desired depth and collects a known volume of soil. Heat is applied, contaminant vapors are purged and transported to the surface for desorption and analysis using a portable ITMS. The soil plug is ejected and the sample chamber is purged. This process can be repeated at lower depths.

For explosives detection, materials are identified as the probe is pushed into the ground. The chemical and geophysical sensors in the probe are monitored continuously through an umbilical.

Certification of the various probes is executed on a state-by-state basis. The state of California has certified the LIF technology. Reciprocity with other states is being pursued through the Interstate Technology and Regulatory Cooperation (ITRC) Workgroup. Certification with the state of California is currently pending for the VOC sensors, as well as reciprocity with other states through the ITRC. Sensors and samplers are also being developed to detect explosives, metals and radionuclides in a coordinated effort with DOE and the EPA.

Evaluation of Direct Sampling Ion Trap Mass Spectrometry and Cone Penetrometry for the Real-Time Detection of VOCs in Soil

Current methods of evaluating contamination in soil and water are costly and time consuming, usually requiring transportation of samples to an off-site laboratory for analyses. Combining direct sampling ion trap mass spectrometry with special cone penetrometer probes could provide a faster, more efficient, and less expensive means of locating and profiling organic pollutants in soil.

Purpose

To determine if the direct sampling ion trap has the sensitivity, when used with a special sampling probe, to detect environmentally significant levels of organic pollutants during the pushing of the probe through the ground.

Benefits

This technique could provide a much faster, more efficient, and less expensive means of locating and profiling organic pollutants in the vadose zone.

Technology Users

Government facilities and private industry.

Background

Past operations at Army installations involving the manufacturing, handling, and disposal of hazardous materials have resulted in the contamination of soil and water. Current methods of contamination evaluation are costly and time consuming, usually requiring transportation of samples to an off-site laboratory for subsequent analyses.

Description

This project will involve an evaluation of direct sampling ion trap mass spectrometry in conjunction with a special sampling probe designed to be deployed via a cone penetrometer for real-time measurement of volatile organic compounds (VOCs) in soil.

Two field tests will be performed. The first field test has been conducted at the Savannah River Site. The second test site has yet to be determined.

Applicability

Andrulis Report Requirements:

- 1.1.a Develop Improved Field Analytical Techniques
- 2.1.a Volatile Organic Compound (VOC) Emission Control
- 2.1.c Monitoring Air Emissions
- 2.1.g Hazardous Air Pollutant (HAP) Emission Control
- 2.2.h Monitoring of Waste Streams at Industrial Waste Treatment Plants
- 3.7.f Rapid Field Sample Analysis

Accomplishments and Results

- Optimization of air monitor.
- Field study at Savannah River Site.
- Probe modifications based on field study.

Follow-On Program Requirements

- Field study at second Department of Defense (DoD) site.
- Final report.

Point of Contact

George Robitaille

Publications

Comparison of Direct Sampling Ion Trap Mass Spectrometry to GC/MS for Monitoring VOCs in Groundwater, proceedings of the 4th International Field Screening Symposium, Las Vegas, Nevada, February 1995.

Effects of Transfer Line on the MS Sampling and Analysis of VOCs in Air, Proceedings from the 43rd ASMS Conference on Mass Spectrometry, Atlanta, Georgia, May 1995.

Real-Time Continuous Monitoring of VOCs by Direct Sampling Ion Trap Mass Spectrometry, Proceedings of the 3rd International On-Site Analysis Conference, Houston, Texas, January 1995.

Enhanced Sensitivity Real-Time Monitoring of VOCs in Air and Water Using Filtered Noise Field in Conjunction with a Direct Sampling Ion Trap Mass Spectrometer, proceedings from the 42nd ASMS Conference on Mass Spectrometry, Chicago, Illinois, May 1994.

Field Transportable Ion Trap Mass Spectrometer, proceedings of the IFPAC ON-SITE Conference, Houston, Texas, January 1994.

"Direct Sampling Ion Trap Spectrometry," Spectroscopy Magazine, April 1993.

Rapid Environmental Organic Analysis by Direct Sampling Glow Discharge Mass Spectrometry and Ion Trap Mass Spectrometry: Summary of Pilot Studies, USATHAMA Report, CETHA-TE-CR 90029.

Field Deployable Direct Sampling Ion Trap Mass Spectrometer

The time needed to analyze samples collected during site characterization efforts often delays the decision process. Analysis may take several weeks. As a result, a site may be over-sampled to prevent missing a contaminated area. Developing a capability for field analysis of volatile compounds will allow a more focused assessment and characterization, saving time and reducing sampling costs.

Purpose

To create a commercial, affordable, and accurate ion trap mass spectrometer (ITMS) for continuous, in-situ characterization of contaminants in the soil subsurface, surface water, solid waste, as well as liquid and solid phase industrial processes.

Benefits

Reduced cost and time to characterize site contamination compared to traditional methods.

Technology Users

Government facilities and private industry.

Background

Past operations at Army installations involving the manufacturing, handling, and disposal of hazardous materials have resulted in soil and water contamination. Current contamination evaluation methods are costly and time consuming, usually requiring transporting and analyzing samples at an off-site laboratory.

Traditional laboratories use mass spectrometry to analyze water and soil samples with a high degree of certainty. Such analysis usually takes up to five weeks. A portable, direct sampling ion trap mass spectrometer (DSITMS) can provide quicker, accurate analyses, and increase the number of samples analyzed. As a field tool, the system reduces sample collection expenses because it rapidly identifies the extent of site contamination.

Description

The ITMS has been operated in conjunction with the Site Characterization and Analysis Penetrometer System (SCAPS) for the characterization of sites contaminated with volatile organic compounds (VOCs).
This effort is a three-phase program consisting of a base program, phase 1 and phase 2. The 12-month base program evaluated the configured ITMS field deployable system. Based on the experience of the users during the field evaluation, a Preliminary Design Review was held to incorporate the users' recommendations into a prototype design. In the current phase 1, the users are conducting field evaluations of the retrofitted instruments produced as a result of the Preliminary Design Review. At the completion of the 36-month effort, the consortium will carry the project through beta testing and production on its own.

Applicability

Andrulis Report Requirements:

- 1.1.a Develop Improved Field Analytical Techniques
- 2.1.a Volatile Organic Compound (VOC) Emission Control
- 2.1.c Monitoring Air Emissions
- 2.1.g Hazardous Air Pollutant (HAP) Emission Control
- 2.2.h Monitoring at Industrial Water Treatment Plants
- 3.7.f Rapid Field Sample Analysis

Accomplishments and Results

The DSITMS has shown sensitivity below 10 ppb for VOC mixtures in laboratory and field studies, in turnaround times of several minutes. The DSITMS has been successfully field tested at various Department of Defense (DoD) and Department of Energy sites.

The Environmental Protection Agency assigned an SW-846 field method number for the DSITMS VOC analysis methods.

The technology has been used to analyze data from several site characterization efforts, including:

- Soil and groundwater samples for well-siting at Arnold Engineering Center, Tullahoma, Tennessee.
- Soil gas, water, subsurface samplers, and SCAPS at Dover Air Force Base, Dover, Delaware.
- Groundwater and monitoring-well bailing at Oak Ridge National Laboratory WAG-6 Site, Oak Ridge, Tennessee.
- Real-time and collected air monitoring in conjunction with in-situ soil heating demonstration by ITT Research Institute at the K-25 Site, Oak Ridge, Tennessee.
- Multiagency, EPA-directed Consortium for Site Characterization Technology (CSCT) study of field mass spectrometry at the Savannah River Site, Aiken, South Carolina.
- EPA-directed testing of candidate technologies for continuous emission monitoring of incinerator stacks, Jefferson, Alaska.
- Groundwater volatile organics plume characterization in conjunction with SCAPS at Aberdeen, Maryland.
- Field support of EPA SITE program photocatalytic groundwater remediation technology demonstration at the K-25 Site, Oak Ridge, Tennessee.
- Multiagency EPA-directed CSCT study of field mass spectrometry at Wurtsmith Air Force Base, Oscoda, Michigan.

The reprogrammed DSITMS software was very successful. The program was successfully promoted in Taiwan in conjunction with the Asian Environmental Partnership (AEP).

LIMITATIONS

Will be determined during extensive field trials.

RESOURCE SUPPORT

As the lead in this collaborative effort between private industry and the government, USAEC provided funding for the Oak Ridge National Laboratory field deployable ITMS development. The Advanced Research Projects Agency (ARPA) Technology Reinvestment Program is matching funds from the TRP consortium for commercializing and marketing a field-deployable ITMS.

FOLLOW-ON PROGRAM REQUIREMENTS

The program will fabricate eight prototypes. The program will lab- and field-test the prototypes, modify system requirements and specifications, and conduct a final review.

TRP consortium cost and performance data will be generated as part of the "Cal/Cert" program.

POINT OF CONTACT

George Robitaille

PROGRAM PARTNERS

U.S. Army Environmental Center
Advanced Research Projects Agency
Department of Energy
Oak Ridge National Laboratory
Teledyne Inc.

PUBLICATIONS

Comparison of Direct Sampling Ion Trap Mass Spectrometry to GC/MS for Monitoring VOCs in Groundwater, proceedings of the 4th International Field Screening Symposium, Las Vegas, Nevada, February 1995.

Effects of Transfer Line on MS Sampling and Analysis of VOCs in Air, Proceedings from the 43rd ASMS Conference on Mass Spectrometry, Atlanta, Georgia, May 1995.

Real-Time Continuous Monitoring of VOCs by Direct Sampling Ion Trap Mass Spectrometry, Proceedings of the 3rd International On-Site Analysis Conference, Houston, Texas, January 1995.

Enhanced Sensitivity Real-Time Monitoring of VOCs in Air and Water Using Filtered Noise Field in Conjunction with a Direct Sampling Ion Trap Mass Spectrometer, proceedings from the 42nd ASMS Conference on Mass Spectrometry, Chicago, Illinois, May 1994.

Field Transportable Ion Trap Mass Spectrometer, proceedings of the IFPAC ON-SITE Conference, Houston, Texas, January 1994.
"Direct Sampling Ion Trap Spectrometry," Spectroscopy Magazine, April 1993.

Rapid Environmental Organic Analysis by Direct Sampling Glow Discharge Mass Spectrometry and Ion Trap Mass Spectrometry: Summary of Pilot Studies, USATHAMA Report, CETHA-TE-CR 90029.

Oak Ridge National Laboratory Support for Commercialization of Ion Trap Mass Spectrometer (ITMS)

Past operations at Army installations involving the manufacturing, handling, and disposal of hazardous materials have resulted in the contamination of soil and water. Current methods of contamination evaluation are costly and time consuming, usually requiring transportation of samples to an off-site laboratory for analyses. The ion trap mass spectrometer can analyze contaminants immediately and in the field, reducing the costs and time needed to characterize contaminants.

Purpose

To create a commercial, affordable, and accurate ion trap mass spectrometer (ITMS) for continuous, in-situ characterization of contaminants in subsurface soil, groundwater, surface water and solid waste, and for monitoring liquid phase industrial processes.

Benefits

Reduced cost and time to characterize contamination in comparison to traditional methods.

Technology Users

Government facilities and private industry.

Description

This Technology Reinvestment Program (TRP) effort is a three-phase program consisting of a base program, phase 1, and phase 2. Oak Ridge National Laboratory (ORNL) will provide support for DoD interests under the TRP and for transitioning the technology to the Corps of Engineers' SCAPS districts.

Applicability

Andrulis Report Requirements:

- 1.1.a Develop Improved Field Analytical Techniques
- 2.2.h Monitoring of Waste Streams at Industrial Waste Treatment Plants
- 2.1.a Volatile Organic Compound (VOC) Emission Control
- 2.1.c Monitoring Air Emissions
- 2.1.g Hazardous Air Pollutant (HAP) Emission Control
- 3.7.f Rapid Field Sample Analysis

Accomplishments and Results

- Soil and groundwater sampled for well-siting. Arnold Engineering Center, Tullahoma, Tennessee.
- Soil gas, water, subsurface samplers, and SCAPS, Dover Air Force Base, Dover, Delaware.
- Method 8265 (Provisional) submitted to the Environmental Protection Agency
- Groundwater and monitoring well bailing. Oak Ridge National Laboratory WAG-6 Site, Oak Ridge, Tennessee.

- Real-time and collected air monitoring in conjunction with in-situ soil heating demonstration by ITT Research Institute. K-25 Site, Oak Ridge, Tennessee.
- Multiagency EPA-directed Consortium for Site Characterization Technology (CSCT) study of field mass spectrometry. Savannah River Site, Aiken, South Carolina.
- EPA-directed testing of candidate technologies for continuous emission monitoring of incinerator stacks. Jefferson, Alaska.
- Groundwater volatile organics plume characterization in conjunction with the SCAPS. Aberdeen, Maryland.
- Field support of EPA SITE program photocatalytic groundwater remediation technology demonstration. K-25 Site, Oak Ridge, Tennessee.
- Multiagency EPA-directed Consortium for Site Characterization Technology (CSCT) study of field mass spectrometry. Wurtsmith Air Force Base, Oscoda, Michigan.
- Submitted draft Method 8265 to EPA.

Resource Support

The U.S. Army Environmental Center (USAEC) provided the funding for the Oak Ridge National Laboratory (ORNL) to develop a field deployable ITMS. Teledyne Inc. manufactures a laboratory bench-scale ITMS system. The Advanced Research Projects Agency (ARPA) Technology Reinvestment Program is matching the funding provided by a Teledyne-led consortium to commercialize and market a field deployable ITMS. USAEC has the lead in this collaborative effort between private industry and the government.

Follow-On Program Requirements

Support for DoD interests under the TRP.
Support transition of technology to Corps of Engineers' SCAPS districts.

Point of Contact

George Robitaille

Program Partners

U.S. Army Environmental Center
Oak Ridge National Laboratory
Department of Energy
Private industry (Teledyne, Monsanto, Phillips Petroleum)

Publications

Comparison of Direct Sampling Ion Trap Mass Spectrometry to GC/MS for Monitoring VOCs in Groundwater, proceedings of the 4th International Field Screening Symposium, Las Vegas, Nev., February 1995.

Effects of Transfer Line on the MS Sampling and Analysis of VOCs in Air, Proceedings from the 43rd ASMS Conference on Mass Spectrometry, Atlanta, Ga., May 1995.

Real-Time Continuous Monitoring of VOCs by Direct Sampling Ion Trap Mass Spectrometry, Proceedings of the 3rd International On-Site Analysis Conference, Houston, Texas, January 1995.

Enhanced Sensitivity Real-Time Monitoring of VOCs in Air and Water Using Filtered Noise Field in Conjunction with a Direct Sampling Ion Trap Mass Spectrometer, proceedings from the 42nd ASMS Conference on Mass Spectrometry, Chicago, Illinois, May 1994.

Field Transportable Ion Trap Mass Spectrometer, proceedings of the IFPAC ON-SITE Conference, Houston, Texas, January 1994.

"Direct Sampling Ion Trap Spectrometry," Spectroscopy Magazine, April 1993.

Rapid Environmental Organic Analysis by Direct Sampling Glow Discharge Mass Spectrometry and Ion Trap Mass Spectrometry: Summary of Pilot Studies, USATHAMA Report, CETHA-TE-CR 90029.

SCAPS Sensors/Samplers

At the heart of the Site Characterization and Analysis Penetrometer System (SCAPS) are the sensor probes. These provide the capability to identify and quantify contaminants found underground. Sensors exist which can detect and quantify heavy metals, explosives, volatile organic compounds (VOCs), and petroleum, oils and lubricants (POLs).

Purpose

To develop sensor packages that enhance SCAPS capability as an effective Department of Defense (DoD) tool.

Benefits

SCAPS sensors will reduce costs and speed the decision process regarding site cleanup.

Technology Users

Army, Navy, and Air Force restoration organizations, Department of Energy (DOE), Environmental Protection Agency (EPA).

Background

SCAPS is a proven, effective tool for rapid site characterization and assessment. Because it pushes a penetrometer into the soil rather than drilling a hole, it is quicker, less expensive, and generates less waste. SCAPS sensors to detect and quantify four contaminants — heavy metals, VOCs, POLs, and explosives — are available.

Description

Heavy Metals

X-Ray Fluorescence - The SCAPS X-Ray Fluorescence sensor detects and quantifies heavy metals in soils. This proven method uses an x-ray source to cause metals to emit unique fluorescence x-rays, which are then analyzed on the surface. The X-Ray Fluorescence (XRF) sensor can operate above or below the water table. Test results indicate that the XRF probe design can provide in-situ detection of metals in soils down to the parts per million (ppm).

Laser Induced Breakdown Spectroscopy - The Laser Induced Breakdown Spectroscopy (LIBS) quantifies metal concentrations by creating a laser-induced plasma. Emissions from the plasma are carried to the surface for spectrographic analysis.

Volatile Organic Compounds

HydroSparge VOC Sensor Probe - A Hydropunch (is pushed into the ground creating a temporary monitoring well providing access to groundwater. An in-situ sampler (sparger) strips VOCs from the groundwater and returns them to the surface for real-time analysis on-site by an ion trap mass spectrometer (ITMS).

Thermal Desorption VOC Sampler - The SCAPS pushes the sensor to the desired ground depth and a known volume of soil is collected in a sample chamber. Heat is applied and contaminant vapors are purged, transported to the surface, trapped, desorbed, and analyzed in real-time by an onboard ITMS. The sample is expelled, the probe pushed to a new depth, and the process repeated.

The utility of in-situ, direct sparging of VOC analytes from groundwater has been demonstrated with the SCAPS system using the Hydropunch(, a direct sparge device developed by Oak Ridge National Laboratory (ORNL), and an ITMS detector. However, to effectively characterize a site with VOC groundwater contamination, it has been necessary to perform stratigraphic site characterization prior to VOC investigations due to the lack of availability of a SCAPS probe that combines these two functions. In addition, the penetrations performed using the Hydropunch(must be grouted after retraction of the penetrometer push pipe.

The U.S. Army Environmental Center (USAEC) is the lead organization responsible for project management and coordination with the appropriate regulatory agencies and potential commercial and government users. U.S. Army Waterways Experiment Station (USAWES) is responsible for conducting the field demonstrations. USAWES and ORNL cooperate in performing data analysis and laboratory verification, and documenting the results in published reports and technical papers.

Petroleum, Oils and Lubricants

Laser Induced Fluorescence Probe (LIF) -This patented sensor uses ultraviolet laser energy to induce fluorescence in POL contaminants present in subsurface soils. Through a fiber optic cable link, fluorescent energy is returned to the surface for real-time spectral data acquisition and processing.

Explosives

Explosives Sensor - The SCAPS explosives sensor detects explosives contamination by heating soil samples to generate nitric oxides, which are then detected using an electrochemical sensor inside the probe.

A number of detailed field tests and demonstrations will provide direct comparisons between the SCAPS explosives sensor and standard methods that include laboratory and field analyses of physical samples. Test sites will be selected to evaluate the technology under different geological conditions and for different explosive contaminant types. In addition to comparing SCAPS sensor data to standard EPA laboratory and field analysis methods, a detailed analysis of splits from the same samples will be conducted using a lab version of the SCAPS probe.

Applicability

Andrulis Report Requirements:

- 1.1.a Develop Improved Field Analytical Technologies
- 1.1.k Alternative Techniques for Sub-Surface Characterization
- 3.7.f Rapid Field Sample Analysis

Accomplishments and Results

Heavy Metals

- Successful field tests completed for all probe configurations.

Volatile Organic Compounds

Thermal Desorption Sampler and HyrdoSparge Sensor

- Field test at Building 525, Aberdeen Proving Ground (APG), Maryland.
- Field test at Cold Regions Research Engineering Laboratory (CRREL)
- Demonstration at Bush River Area, APG.
- Demonstration at McClellan Air Force Base, California.
- Demonstrations and pursuit of regulatory acceptance funded by the Environmental Security Technology Certification Program (ESTCP).
- A German demonstration may be performed in conjunction with the U.S./Germany data exchange program.
- Completed field effort at CRREL.
- Completed field effort at Fort Dix.

Petroleum, Oils and Lubricants

- The POL sensor technology has been patented and licensed for commercial production and marketing.
- The POL sensor technology has been demonstrated in Germany and is characterizing sites throughout Europe.

Explosives

- Field tests conducted at Volunteer, Longhorn and Joliet Army Ammunition Plants.
- Field test conducted at Pantex (Department of Energy site).

Other results:

- SCAPS has been evaluated under the EPA Superfund Innovative Technology Evaluation (SITE) program. Phase 2 technology validation under the EPA-led CSCT was completed in the first quarter of FY 1996.
- Formalized coordination of SCAPS sensor development efforts among DoD, DOE, and EPA.
- The Army has transitioned three SCAPS trucks to the Corps of Engineers to characterize Army and Air Force sites. The Navy is operating two trucks to characterize Navy sites.
- California has certified the LIF technology. Reciprocity with other states is being pursued through the ITRC.

Follow-On Program Requirements

Heavy Metals

- Second field investigation.
- Letter report of findings.
- Select demonstration and validation sites.
- Complete demonstration plan.
- Complete application to Cal/Cert.
- Complete first field demonstration.
- Complete field demonstration under Cal/Cert.
- Complete second Cal/Cert demonstration.
- Complete Cal/Cert with ITRC.
- Transition to Army/Navy SCAPS.
- Establish CRADA for technology transfer.

Volatile Organic Compounds

- Complete verification analysis.
- Generate final report.
- Certification with California is currently pending for the VOC sensors, as well as reciprocity with other states through the ITRC.

Explosives

- Suggest change of direction to ESTCP.

Point of Contact

George Robitaille

Program Partners

U.S. Army
U.S. Navy
U.S. Air Force
U.S. Department of Energy
U.S. Environmental Protection Agency

Publications

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Adams, J.W., Cespedes, E.R., Cooper, S.S., Davis, W.M., "Development and Testing of Cone Penetrometer Sensor Probe for In-Situ Detection of Explosive Contaminants," Field Screening Methods for Hazardous Waste and Toxic Chemicals, VIP47, Vol. 1., 1995.

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Brown, G.J., "New Sensors Shine in SCAPS Field Tests," Environmental Update, Vol. 8, No. 3, p. 9, Fall 1996.

Industrial Wastewater, “Samplers Detect VOCs in Soil and Groundwater,” p. 23-24, July/August 1996.

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Sonic-CPT Probing

Site Characterization and Analysis Penetrometer System (SCAPS) screening technologies provide faster, more detailed site characterization at considerably lower costs than current methods. Sensor technologies are an important part of SCAPS. Integrating sonic drilling with cone penetrometer technology (CPT) will allow the system's sensors to analyze wider varieties of soil types and depths.

Purpose

To integrate sonic drilling with cone penetrometer technology (CPT) to yield a site characterization and analysis system that will penetrate deeper into stiff soils than conventional CPT.

Benefits

Adding sonic technology will enhance the traditional CPT platform accessibility, allowing it to reach greater depths and push through a greater variety of soil stratigraphy.

Technology Users

Department of Defense (DoD) installations, Formerly Used Defense Sites (FUDS), Department of Energy, Department of Interior, Environmental Protection Agency.

Background

Past operations at Army installations involving the manufacturing, handling, and disposal of hazardous materials have resulted in the contamination of soil and water. Current methods of contamination evaluation are costly and time consuming, usually requiring transportation of samples to an off-site laboratory for analyses.

Application of innovative Site Characterization and Analysis Penetrometer System (SCAPS) field screening technologies will result in faster, more detailed site characterization at considerably lower costs than current methods. In addition, because SCAPS can delineate the extent of the subsurface contamination more accurately than with widely spaced monitoring wells, remediation costs will also be significantly reduced.

Although sensor technology is extremely important, CPT must be able to advance sensor packages to the desired depth. As probe sizes have increased, the ability of CPT to reach desired depths for a given rig weight of 20 tons has been reduced. This limits CPT because a particular site geology prevents a probe from being pushed before the sounding has advanced to the desired depth. Penetration enhancements are needed to increase the likelihood that CPT can penetrate to desired depths.

Description

The Air Force has been funded by the U.S. Army Environmental Center (USAEC) and the Department of Energy (DOE) to develop Sonic-CPT for use at DoD and DOE sites. The project includes the acquisition and fabrication of hardware, the integration of the hardware with a CPT truck, the development of more robust CPT push rods and probes, and demonstration of the technology at an Army-designated site.

Cost and performance data will be determined as part of this task.

APPLICABILITY

Andrulis Report Requirements:

- 1.1.a Develop Improved Field Analytical Techniques
- 1.1.k Alternative Techniques for Sub-Surface Characterization
- 3.7.f Rapid Field Sample Analysis

ACCOMPLISHMENTS AND RESULTS

- Field test at CRREL.
- MMR demonstration and visitors' day.
- Demonstration at two SRS sites.
- SRS visitors' day.

FOLLOW-ON PROGRAM REQUIREMENTS

Enhance the database and acquisition software.

POINT OF CONTACT

Melissa Ruddle

PROGRAM PARTNERS

U.S. Army Environmental Center
Department of Energy
U.S. Air Force

Tri-Service SCAPS Pursuit of Regulatory Acceptance

The Tri-Service Site Characterization and Analysis Penetrometer System (SCAPS) has been proven as an effective tool for rapid site characterization and assessment. Sensors to detect and quantify four contaminants (heavy metals, VOCs, POL, and explosives) are currently available. Several of these sensors have been demonstrated to state and federal regulators as part of a comprehensive validation program.

Purpose

To attain regulatory acceptance at the state and federal levels, and attain commercial acceptance, for new SCAPS sensor technologies.

Benefits

Reduced cost and time needed to characterize contamination of a site in comparison to traditional methods.

Technology Users

All government facilities and private industry.

Background

The pursuit of regulatory acceptance began with the Laser Induced Fluorescence (LIF) sensor in the Environmental Protection Agency (EPA) Superfund Innovative Technology Evaluation (SITE) program. From there, the LIF entered the EPA Consortium for Site Characterization Technology (CSCT) and Interstate Technology Regulatory Cooperation Workgroup (ITRC), which was formerly the WGA-ITRC. A standard practice for the American Society of Testing and Materials (ASTM) for the LIF has been accepted and given the designation D-6187-97. The HydroSparge Sensor (HS) and Thermal Desorption Sampler (TDS) have been initiated into the process of certification with the Cal/Cert program and the ITRC. Both the HS and TDS will follow in the path of the LIF in pursuit of an ASTM method.

Description

Regulatory acceptance for the HS and TDS is being sought on the state and federal levels, as well as in the private sector. The technologies have been submitted for certification with Cal/Cert and ITRC on the state and federal levels. Commercially, the technologies will be submitted as ASTM methods, and a strong interest in licensing has been expressed.

Applicability

Andrulis Report Requirements:

- 1.1.a Develop Improved Field Analytical Techniques
- 1.1.k Alternative Techniques for Sub-Surface Characterization
- 3.7.f Rapid Field Sample Analysis

Accomplishments and Results

ASTM

- Submitted draft document to subcommittee chairman for ballot in September 1996.
- Met with subgroup concerning ballot of method at ASTM conference in January 1997.

- Balloted concurrently at subcommittee level and main committee level.
- Accepted and given designation number D-6187-97.

Cal/Cert — HydroSparge Sensor

- Field test at Building 525, Aberdeen Proving Ground (APG), Maryland.
- Field test at Cold Regions Research Engineering Laboratory (CRREL).
- Demonstration at Bush River Area, APG.
- Demonstration at McClellan Air Force Base, California.
- Demonstration at Fort Dix, New Jersey.
- Accepted by the ITRC subgroup to assist in implementing state reciprocity by endorsing the Cal/Cert process.
- Demonstrations and pursuit of regulatory acceptance funded by Environmental Security Technology Certification Program (ESTCP).
- As with the LIF, a German demonstration may be performed in conjunction with the U.S./Germany data exchange program.
- Evaluation of provisional SW846 method 8265 by Environmental Protection Agency Office of Hazardous Waste.

Cal/Cert — Thermal Desorption Sampler

- Field test at Building 525, APG.
- Field test at CRREL.
- Demonstration at Bush River Area, APG.
- Demonstration at McClellan AFB.
- Demonstration at CRREL.
- Accepted by the ITRC subgroup to assist in implementing state reciprocity by endorsing the Cal/Cert process.
- Demonstrations and pursuit of regulatory acceptance funded by ESTCP.
- As with the LIF, a German demonstration may be performed in conjunction with the U.S./Germany data exchange program.
- Evaluation of provisional SW846 method 8265 by Environmental Protection Agency Office of Hazardous Waste.

ITRC — HydroSparge Sensor

- Accepted by the ITRC subgroup to assist in implementing state reciprocity by endorsing the Cal/Cert process.
- Conducted a Visitors Day at McClellan AFB.
- Distributed McClellan AFB data package.
- Distributed Method 8265 (provisional) for review.
- Invitational orders mailed for Fort Dix demonstration.
- Conducted a workshop at ITRC training meeting.

ITRC — Thermal Desorption Sampler

- Accepted by the ITRC subgroup to assist in implementing state reciprocity by endorsing the Cal/Cert process.
- Conducted a Visitors Day at McClellan AFB.
- Conducted a workshop at ITRC training meeting.

Follow-On Program Requirements

ASTM

- Initiate HS practice.
- LIF guide (coordinate between parties).
- Submit methods to subcommittee chairman.

Cal/Cert — HydroSparge Sensor

- Review Fort Dix data packages.
- Pending certification.

Cal/Cert — Thermal Desorption Sampler

- Review CRREL data packages.
- Must expand database.

ITRC — HydroSparge Sensor

- Attend ITRC meetings.
- Maintain interactions with Cal/Cert activities.
- Pending final report for SCAPS sub-team and acceptance of all members.

ITRC — Thermal Desorption Sampler

- Attend ITRC meetings.
- Maintain interactions with Cal/Cert activities.
- Pending final report for SCAPS sub-team and acceptance of all members.

Points of Contact

George Robitaille
Melissa Ruddle

Publications

D-6187-97, Standard Practice for Cone Penetrometer Technology Characterization of Petroleum Contaminated Sites with Nitrogen Laser-Induced Fluorescence

Brown, G.J., "New Sensors Shine in SCAPS Field Tests," Environmental Update, Vol. 8, No. 3, p. 9, 1996.

Industrial Wastewater, "Samplers Detect VOCs in Soil and Groundwater," p. 23-24, July/August 1996.

Brown, G., Filbert, B., "APG, AEC demonstrate effort that saves money, helps environment," APG News, P. 10, August 28, 1996.

Buckley, M., Robitaille, G., "Newly developed sensors aid in detection of volatile organic compounds," Environmental Update, Vol. 8, No. 1, p. 9, January 1996.

Cooney, C.M., "Twenty states join federal government to facilitate innovative technology use," Environmental Science and Technology, Vol. 30, No. 10, 1996.

Project Focus: UXO

UNEXPLODED ORDNANCE TECHNOLOGY

The U.S. Army Environmental Center (USAEC) provides methods and information on unexploded ordnance (UXO) technology to help those who need UXO technical support. Site managers, site environmental officers, local, state, and federal regulators, and private citizens may all benefit from these technical services.

USAEC has considerable knowledge and expertise in the UXO technology arena. For more than six years, the Center has managed a comprehensive UXO characterization and remediation program. The program is structured to: gather and establish UXO technology requirements; demonstrate, evaluate and enhance technology; and perform education and technology transfer related efforts.

Man-Portable Ordnance Detection System (ManPODS)

Reports have addressed the Defense Department's needs for technologies to detect, locate, access, identify and evaluate, neutralize, recover, and dispose of unexploded ordnance, known as UXO. The ManPODS system provides enhanced UXO detection, location and identification. This latest phase of the ManPODS project has significantly enhanced original ManPODS development efforts.

Purpose

To provide reliable UXO detection and discrimination capabilities; to reduce the overall cost of capital equipment; to produce user-friendly software; and to decrease the manpower and time to conduct UXO surveys.

Benefits

ManPODS provides a cost-effective, accurate and reliable tool for UXO site characterization.

Technology Users

Active ranges and Formerly Used Defense Sites (FUDS) with UXO.

Description

The U.S. Army Environmental Center (USAEC), the Naval Explosive Ordnance Disposal Technology Division (NAVEODTECHDIV) and Vallon GmbH of Germany have partnered to complete the enhancement of ManPODS.

This second phase of the ManPODS program was to prepare a commercially available system consisting of a sensor base, global positioning integration, a data collection unit, and software to produce target analysis.

Accomplishments and Results

USAEC and NAVEODTECHDIV have taken delivery of the ManPODS system. The cost of ManPODS has been reduced by using commercially available computers and multi-sensor towed array components. The system can now be operated by one person and the software reduces data collection and data analysis time.

Follow-On Program Requirements

- Demonstrate ManPODS capabilities.
- Enhance data algorithms and sensor selection criteria to significantly reduce false-alarm rates.
- Continue technology transfer efforts.

Point of Contact

George Robitaille

Program Partners

U.S. Army Environmental Center
Naval Explosive Ordnance Disposal Technology Division
Vallon GmbH

Subsurface Ordnance Characterization System

Finding alternative uses for areas on military installations with subsurface ordnance or unexploded ordnance (UXO) is hard because locating, characterizing and removing ordnance is difficult. Evaluating systems that perform these tasks is difficult as there is often no baseline to measure system performance against.

Purpose

To establish the Subsurface Ordnance Characterization System (SOCS) as a reliable, robust, testbed system for conducting scientific studies during limited site investigations.

Benefits

The identification of safe, effective and economical methods for Unexploded Ordnance (UXO) location and identification.

Technology Users

DoD sites containing areas of UXO.

Background

SOCS is a testbed system being used to evaluate new technologies and conduct scientific field studies to help identify safe, effective and economical methods for UXO location and identification.

Description

The U.S. Army Environmental Center (USAEC) and the U.S. Air Force Wright Laboratories performed a complete system assessment of SOCS. This system assessment report provided the government with information necessary to identify system improvements and upgrades (short and long-term) that will improve the durability and reliability of SOCS when conducting field studies of different sensors and sensor combinations; data acquisition and reduction of techniques; geophysical phenomena; and autonomous surveying methods and parameters.

The second stage is to characterize and evaluate a new antenna design for detecting buried UXO with ground penetrating radar (GPR). The GPR investigation will focus on evaluating and demonstrating a new, lightweight design that has improved performance over the current SOCS GPR subsystem.

Applicability

Andrulis Report Requirements:

- 1.1.d UXO Identification
- 1.3.f Soil UXO
- 1.3.l Establish Cleanup Standard for UXO

Accomplishments and Results

- The system is integrated and functioning.
- ESTCP demos completed at Tyndall Air Force Base, Florida, and Jefferson Proving Ground (JPG), Indiana.
- Successful autonomous surveying.
- Positive results with GPR discrimination.

Limitations

- Poor system reliability and durability.
- Magnetometers limited to existing capabilities.

Resource Support

The Defense Environmental Restoration Account (DERA) program provided support for this project.

Follow-On Program Requirements

- SOCS will be used in conjunction with the phenomena study for UXO detection.
- Field demo at Yuma Proving Ground, Arizona.
- Perform the following studies to improve site characterization:
- Improve existing sensor capabilities.
- Evaluate new sensors and combinations.
- Investigate geophysical effects on performance.
- Evaluate UXO discrimination techniques.
- Characterize system operating parameters.
- Enhance system durability.
- Initiate design and development of second-generation version.
- Shift program focus to demos, technology transfer and UXO program support testing.

Point of Contact

Scott Hill

Program Partners

U.S. Army Environmental Center
U.S. Air Force Wright Laboratories
Jefferson Proving Ground, Indiana
Naval Explosives Ordnance Disposal Technical Division
Tyndall Air Force Base, Florida

UXO Forum

In a concerted effort to bring together the best minds from all corners of the world, the annual UXO Forum addresses technology, policy, and regulatory issues related to unexploded ordnance (UXO). Participants acquire a greater understanding of UXO issues, how they affect our world today, and the implications for the 21st century.

Purpose

To produce, manage and host a conference that addresses UXO technology, policy, and regulatory issues.

Benefits

The conference brings together a diverse audience from around the world to exchange ideas and information on UXO.

Description

The UXO Forum addresses technology, policy, and regulatory issues related to unexploded ordnance.

UXO Forum 1997 was sponsored by the U.S. Department of Defense Explosives Safety Board (DDESB) and hosted by the U.S. Army Environmental Center (USAEC), in cooperation with the U.S. Army Corps of Engineers - Huntsville Center, the U.S. Army Project Manager for Non-Stockpile Chemical Material, the Naval Explosive Ordnance Disposal Technology Division, the U.S. Air Force/Wright Laboratory and the National Association of Ordnance and Explosive Waste Contractors. The DDESB has agreed to sponsor UXO Forum 1998.

Applicability

The report "UXO Clearance — A Coordinate Approach to Requirements & Technology Development" (25 March 1997) addresses Department of Defense (DoD) needs for UXO detection, location, access, identification and evaluation, neutralization, recovery, disposal, training and breaching.

Accomplishments and Results

USAEC produced and hosted UXO Forum 1997 in Nashville, Tennessee, from May 28-30, 1997. More than 550 people attended — an increase of approximately 100 people from the year before — attesting to the popularity and necessity of the conference.

Follow-On Program Requirements

Plan and conduct UXO Forum 1998 at the Anaheim Marriott, Anaheim, California, from May 5-7, 1998.

Point of Contact

Kelly Rigano

Program Partners

U.S. Army Environmental Center
U.S. Department of Defense Explosives Safety Board
Joint UXO Coordination Office
U.S. Army Corps of Engineers - Huntsville Center
U.S. Army Project Manager for Non-Stockpile Chemical Material
Naval Explosive Ordnance Disposal Technology Division

U.S. Air Force Wright Laboratory
U.S. Army Waterways Experiment Station
National Association of Ordnance and Explosive Waste Contractors

Publications

UXO Forum 1996 conference proceedings.

UXO Technology Demonstration Program

The Department of Defense needs advanced methods to detect, locate, identify, neutralize, recover and dispose of unexploded ordnance (UXO). The UXO Technology Demonstration Program, conducted at Jefferson Proving Ground, Indiana, over the past several years, has established a framework to better understand and assess UXO technology.

Purpose

To evaluate, establish and advance UXO technology performance.

Benefits

This program has created a framework for the evaluation of UXO technology. Baseline technology performance has been established and technology capabilities and limitations have been assessed. Technology users are better able to select the optimum technology or system for their needs. Private industry has benefited from the demonstration program feedback and participants are better able to undertake or continue system improvements.

Technology Users

Military installations with sites that contain UXO.

Background

The UXO Technology Demonstration Program was mandated by Congress. More than 60 technology demonstrations of UXO characterization and remediation technologies have been conducted. Phase I, Phase II and Phase III were conducted in 1994, 1995 and 1996 at Jefferson Proving Ground in Madison, Indiana. The demonstrations were performed on a controlled test site containing a known baseline of emplaced, inert ordnance. Additional technology demonstrations were conducted during 1995 at five sites throughout the United States that contained live ordnance.

Description

For each phase of the demonstration program, companies and government agencies have been given the opportunity to demonstrate their system capabilities. Details of the multi-phase demonstration programs can be found in published reports.

Results of the most recent Phase III demonstrations show that overall technology detection rates have improved since the initial Phase I Demonstration Program in 1994. Phase III results show that state-of-the-art technology is capable of detecting a substantial portion of emplaced ordnance (over 95%). However, significant technology limitations still exist. There has been no substantial change in the ability of demonstrators to discriminate UXO from non-UXO material (clutter). This deficiency is major cost driver in UXO characterization due to additional data analysis requirements and subsequent unnecessary excavation. Remote excavation of UXO has been shown to be feasible; the systems were able to locate, excavate, and handle the UXO. However, they were slow and inefficient.

The Phase IV effort, currently under way, will capitalize upon the previous UXO technological investments by focusing upon target discrimination and reduction of false alarm rates. This will provide the government with an economical and effective technology that will significantly reduce the overall cost of UXO clearance (by reducing the number of anomalies which must be excavated).

Accomplishments and Results

Results from this program have been used across the U.S. to aid in the selection and utilization of companies, systems and sensors for UXO characterization and restoration efforts.

Limitations

Technology demonstrators are unable to discriminate UXO from non-UXO material (clutter).

Follow-On Program Requirements

- Technology enhancements.
- Technology demonstrations.
- Evaluation and reporting.

Point of Contact

George Robitaille

Program Partners

U.S. Army Environmental Center
Naval Explosive Ordnance Disposal Technology Division
U.S. Army Corps of Engineers

Publications

Unexploded Ordnance Advanced Technology Demonstration Program at Jefferson Proving Ground (Phase I), December 1994.

Evaluation of Individual Demonstrator Performance at the Unexploded Ordnance Advanced Technology Demonstration Program at Jefferson Proving Ground (Phase I), March 1995.

Unexploded Ordnance Advanced Technology Demonstration Program at Jefferson Proving Ground (Phase II), June 1996.

Live Site Unexploded Ordnance Advanced Technology Demonstration Program, June 1996.

Unexploded Ordnance Technology Demonstration Program at Jefferson Proving Ground (Phase III), April 1997.

Other Technology Programs

QA and Method Assistance

To meet program objectives, demonstration projects often need rapid development or modification of analytical methods. This project provides on-call technical support to demonstration projects.

Purpose

To allow rapid evaluation of methodological options and testing of candidate methods.

Benefits

This project will provide rapid on-call technical support to demonstration projects.

Background

To meet program objectives, demonstration projects often need rapid development or modification of analytical methods. Often these methods impact the project's cost and schedule, and may need to be resolved before awarding a contract. This task will allow rapid evaluation of methodological options and testing of candidate methods.

Description

The final products of this work are the demonstration of applicability, limitations and criteria for evaluation of methods tailored to a specific application. General Quality Assurance functions will be accessed on-call.

Applicability

This project supports all the requirements delineated in the Andrulis Report.

Accomplishments and Results

- Tennessee Valley Authority (TVA) method assistance for hot gas decontamination, phytoremediation, chromatography assistance, and digestion of plant tissue.
- Volunteer/National Environmental Technology Test Site (NETTS) lab method for explosives, transformation products, on-site methods.
- Presented at IRD Atlanta workshop (only Corps lab participant).
- Presented at U.S. Army Environmental Center/Environmental Protection Agency multi-city tour.
- Supported compost demonstration at Umatilla Army Depot, Oregon.
- Assisted most commercial labs, working for USAEC, with explosive methods.
- Provided input to the National Guard on Massachusetts Military Range (MMR).
- Supported Site Characterization and Analysis Penetrometer System (SCAPS) effort with volatiles.
- Prepared American Society for Testing and Materials (ASTM) guide on sampling for volatiles.

Follow-On Program Requirements

Determine specific milestones and completion dates for each request.

Point of Contact

Martin Stutz

Tri-Service Environmental Technology Workshop

In this age of decreasing funds, it is important for the military services to leverage available resources and information. The Tri-Service Environmental Technology Workshop provides such an opportunity. The Workshop is a forum for technical exchange and interaction on environmental technology strategies, initiatives, demonstrations, and products.

Purpose

To provide a forum for technical exchange and interaction on environmental technology strategies, initiatives, demonstrations, and products.

Benefits

By combining efforts with the Navy and Air Force in developing a tri-service workshop, the Army minimizes its funding support to one third of the total cost. The workshop also helps disseminate information across the services, reducing the "reinventing the wheel" syndrome. Combining what could be three conferences into one also reduces personnel travel expenses and time away from the office.

Technology Users

Department of Defense installations.

Background

In 1995, the U.S. Army Environmental Center (USAEC) hosted the Department of Defense Environmental Technology Workshop. Bringing together the three environmental support centers, this venue offered the opportunity for a unified position toward environmental technology. The need to share information was recognized by the services. Since then, the services have supported and USAEC has hosted the Tri-Service Environmental Technology Workshop.

Description

USAEC is the hosting agency for the Workshop and chair of the organizational committee. The organizational committee includes one individual from each of the service environmental support centers and one individual from each service's Environment, Safety and Occupational Health (ESOH) office. The committee's main role is to review and select abstracts for platform presentation; it performs other functions as necessary. The balance of the effort is handled by USAEC and the support contractor, Science and Technology Corporation.

Workshop presentations focus on mature technologies that are of timely interest to participants. Emphasis is placed on technologies that are "field ready," currently being demonstrated, or have been demonstrated. This workshop is supported by the Tri-Service Environmental Support Centers Coordinating Committee.

Applicability

This venue is applicable to implementors and decision makers throughout the services, Department of Defense, and other government agencies.

Accomplishments and Results

The 1997 Tri-Service Environmental Technology Workshop, held June 10-12 in St. Louis, Missouri, was well attended despite an overall reduction in travel funds for government employees and contractors. It included 43 exhibitors (using 50 exhibit spaces) and 66 technical presentations. The plenary session included presentations from Texas Instruments, USAEC, the Air Force Center for Environmental Excellence (AFCEE) and the Naval Facilities Engineering Service Center (NFESC). A tour of the McDonnell Douglas FLASHJET demonstration facility was offered to interested attendees.

A task for the 1998 Workshop has been awarded to the contractor. Supporting funds have been received from the Navy and Air Force.

Follow-On Program Requirements

- Receive camera ready copy of 1997 proceedings from contractor.
- Anticipate proceedings to be ready for general distribution.
- Distribute proceedings. Proceedings to be available through the Technical Information Center (TIC).
- Select a location for the 1998 Workshop.

Resource Support

U.S. Army Environmental Center
Naval Facilities Engineering Service Center
Air Force Center for Environmental Excellence

Point of Contact

Darlene F. Bader

Program Partners

U.S. Army Environmental Center
Office of the Director of Environmental Programs
Office of the Assistant Secretary of the Navy for Installations and Environment
Headquarters, Air Force
Naval Facilities Engineering Service Center
Air Force Center for Environmental Excellence

Publications

Report Number SFIM-AEC-ET-CR-96187 (Proceedings from 1996 Workshop).

Report Number SFIM-AEC-ET-CR-9705 (Proceedings from 1997 Workshop).

U.S. Army Environmental Technology User Requirements Survey

During the first 15 years of Army environmental research (1975-1990), most Research, Development, Test and Evaluation (RDT&E) goals and objectives were established through informal coordination with Army users and technology developers. Given greater emphasis on relevance to the Army, a more rigorous, requirements-based approach was developed in the early 1990s.

Purpose

To help the Army identify opportunities to develop, demonstrate and use improved environmental systems that employ new technologies; to help the Army better identify opportunities to demonstrate and use faster and more cost-effective systems that employ new technologies.

Benefits

In addition to satisfying an annual Department of Defense (DoD) tri-service reporting requirement to the Environmental Security Technology Requirements Group (ESTRG), the study should enhance communication between the "users" of environmental technology and the Army's RDT&E community. The RDT&E community will better understand the Army users' environmental technology requirements and their priorities. Army installations will have better information on the development and availability of faster and more cost-effective environmental technologies. Organizations with technology requirements will be able to use the study to identify and share "lessons learned" in a time of shrinking resources.

Technology Users

All DoD installations that use technologies to satisfy their environmental requirements. The Technology Needs Survey (TNS) documents technology needs from four user communities: (1) users responsible for installation infrastructure; (2) users from major commands (MACOMs) that develop and manage weapons systems; (3) MACOMs that use these weapon systems; and (4) agencies responsible for collecting and tracking needs related to infrastructure and weapons systems.

Background

From 1992 to 1994, a series of meetings was held to facilitate the collection and development of an initial database of approximately 200 environmentally related operational problems throughout the Army. The list of requirements was screened to focus on those requiring long-term research and development, then validated and prioritized through a voting process based on the following six ranking criteria:

- Impact of the unresolved requirement on the environment.
- Impact of the unresolved requirement on the Army's military readiness.
- Impact of the unresolved requirement on an Army installation's quality of life.
- Annual cost of operating with an unresolved requirement.
- Extent of the requirement throughout the Army.

- Urgency for resolution of the requirement based on future regulatory time limits.

The Office of the Assistant Chief of Staff for Installation Management (ACSIM), through the U.S. Army Environmental Center (USAEC), refined and updated these requirements during 1996 and 1997, expanding the scope of the effort into the Technology user Needs Survey (TNS). This was done to refine the qualitative and quantitative data supporting the needs, and also to allow reporting to and compilation in a common format to support the DoD Tri-Service Environmental Quality Requirements Strategy, which is prepared by the ESTRG.

DESCRIPTION

This update was based on a multi-phase approach to the validation and prioritization of the needs. The first step was an analysis of the Army's environmental databases to avoid a data-call and maximize the user's environmental reporting. In addition, several site visits and interviews were made across a cross-section of the Army's installations and MACOMs. The updated requirements were presented at technology team meetings in 1996 and 1997 for review and validation. These meetings and requirement changes were conducted through the cooperation of the Army MACOMS and installations, ultimately reducing the number of currently documented, prioritized, and approved needs to 142. These are prioritized within each primary area of the Army's environmental program.

The TNS is a "living document/database" that is continuously being refined. As the technology teams develop and execute RDT&E programs in response to these needs, the user representatives and stakeholders on each team will adjust the needs statement and identify "close out" criteria that would allow the need to be considered as completely satisfied. Periodically, the team's user representatives will assess the prioritization of that program area's needs to determine needed adjustments. Users will eventually be able to submit on-line suggestions for additional needs candidates for consideration by the technology team, as well as provide additional data relative to existing needs statements. The technology teams are also responsible for screening out needs for which the solutions clearly do not involve technology.

An electronic copy of the Army's current environmental technology needs can be reviewed on the Internet at http://www.lgst.com/tns. This information is being prepared for eventual transfer to the Defense Environmental Network and Information eXchange (DENIX) Web site. To address problems of data management and satisfy the concerns of having certain sensitive information exposed to the public, USAEC will prepare two versions of the Army's environmental technology requirements on the World Wide Web. The first version will contain all the unfiltered information and be maintained on the DENIX Web site. A second version, deleting "sensitive" information not readily needed by the general public, will be on the ESTRG Web site at http://xre22.brooks.af.mil/estrg/estrgtop.htm. The OSD ESTRG site will also identify primary points of contact (1-2 per program area, per service) as a gateway for interested parties external to DoD. The advantage of storing information at the DENIX site is that access will be restricted to DoD employees and contractors with approved accounts and passwords.

APPLICABILITY

This project supports every Army environmental technology requirement by serving to update, expand, and clarify the set of technology requirements created in the 1993 Andrulis Report.

ACCOMPLISHMENTS AND RESULTS

The survey and update efforts are ongoing and can be evaluated as noted above.

POINT OF CONTACT

Edward Engbert

PROGRAM PARTNERS

U.S. Army Environmental Center
Members of the Army RDT&E community
Army technology users

PUBLICATIONS

Army Technology Needs Survey.

Appendix A

Acronyms and Abbreviations

AAP	Army Ammunition Plant
AAR	Application Analysis Report
ACSIM	Assistant Chief of Staff for Installation Management
ADPA	American Defense Preparedness Association
AEP	Asian Environmental Partnership
AFCEE	Air Force Center for Environmental Excellence
AFF	Automated Field Fire
AIVD	Aluminum Ion Vapor Deposition
APG	Aberdeen Proving Ground, Maryland
AR	Army Regulation
ARDEC	U.S. Army Armament Research Development and Engineering Center
ARF	Automated Record Fire
ARL	U.S. Army Research Laboratory
ARPA	Advanced Research Projects Agency
ASTM	American Society of Testing and Materials
ATC	U.S. Army Aberdeen Test Center
ATSC	Army Training Support Center
BRAC	Base Realignment and Closure
CARC	Chemical Agent Resistant Coating
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFC	Chlorofluorocarbon
CFM	Cubic Feet per Minute
CONUS	Continental United States
CPAR	Construction Productivity Advancement Research program (U.S. Army Corps of Engineers)
CPQC	Combat Pistol Qualification Course
CPT	Cone Penetrometer Technology
CRADA	Cooperative Research and Development Agreement
CRREL	Cold Regions Research Engineering Laboratory
CSCT	Consortium for Site Characterization Technologies (EPA)
CTC	Concurrent Technologies Corporation
CWA	Clean Water Act
CWM	Chemical Warfare Material
DDESB	U.S. Department of Defense Explosives Safety Board
DEA	Data Exchange Agreement
DENIX	Defense Environmental Network and Information eXchange
DERA	Defense Environmental Restoration Account
DLA	Defense Logistics Agency
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DOT	Department of Transportation
ECS	Environmental Compliant Solvents

EPA	U. S. Environmental Protection Agency
EPCRA	Emergency Planning Community Right-to-Know Act
ESOH	Environment, Safety and Occupational Health
ESTCP	Environmental Security Technology Certification Program
ESTRG	Environmental Security Technology Requirements Group
ETD	Environmental Technology Division (U.S. Army Environmental Center)
FORSCOM	U.S. Army Forces Command
FRH	Fire Resistant Hydraulic fluid
FRTR	Federal Remediation Technologies Roundtable
FUDS	Formerly Used Defense Sites
GAC	Granular Activated Carbon
GIS	Geographic Information System
GPM	Gallons Per Minute
GPR	Ground Penetrating Radar
HAP	Hazardous Air Pollutant
HAZMIN	Hazardous Waste Minimization
HMX	Cyclotetramethylene-tetranitramine
HQDA	Headquarters, Department of the Army
HS	HydroSparge Sensor
IOC	U.S. Army Industrial Operations Command
IR	Installation Restoration
ITAM	Integrated Training Area Management
ITMS	Ion Trap Mass Spectrometer
ITRC	Interstate Technology and Regulatory Cooperation
JPG	Jefferson Proving Ground, Indiana
LAP	Load, Assemble, and Pack
LBCC	Land Based Carrying Capacity
LCTA	Land Condition Trend Analysis
LIF	Laser-Induced Fluorescence
LRAM	Land Rehabilitation and Maintenance
MACOM	Major Command
ManPODS	Man-Portable Ordnance Detection System
MDW	Military District of Washington
MEEP	Management and Equipment Evaluation Program (Air Force)
MMR	Massachusetts Military Range
MTC	Mobility Technology Center (TARDEC)
NAPL	Non-Aqueous Phase Liquid
NAVEODTECHDIV	Naval Explosive Ordnance Disposal Technology Division
NDCEE	National Defense Center for Environmental Excellence
NETTS	National Environmental Technology Test Sites
NFESC	Naval Facilities Engineering Service Center
NGB	National Guard Bureau
NHPA	National Historic Preservation Act
NPDES	National Pollution Discharge Elimination System
NREL	National Renewable Energy Laboratory (DOE)
NTL	National Test Location
OB/OD	Open Burning /Open Detonation
ORNL	Oak Ridge National Laboratory (DOE)
OSHA	Occupational Safety and Health Administration
PAT	Plasma Arc Technology

PCB	Polychlorinated biphenyl
PEP	Propellants, Explosives, and Pyrotechnic materials
PI	Principal Investigator
POL	Petroleum, Oils and Lubricants
PPM	Parts Per Million
QA/QC	Quality Assurance/Quality Control
R & D	Research and Development
R3M	Range Rule Risk Model
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylene-trinitramine
RI/FS	Remedial Investigation and Feasibility Study
RREL	Risk Reduction Engineering Laboratory (EPA)
RTD&E	Research, Development, Test and Evaluation
SACON	Shock Absorbing Concrete
SAIC	Science Application International Corporation
SCAPS	Site Characterization and Analysis Penetrometer System
SERDP	Strategic Environmental Research and Development Program
SITE	Superfund Innovative Technologies Evaluation (EPA)
SOCS	Subsurface Ordnance Characterization System
SOW	Statement of Work
SVE	Soil Vapor Extraction
TAAR	Technology Application Analysis Report
TARDEC	U.S. Army Tank-Automotive and Armaments Command Research, Development and Engineering Center
TCA	Tactical Concealment Area
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Thermal Desorption Sampler
TECOM	U.S. Army Test and Evaluation Command
TIC	Technical Information Center
TLM	Test Location Manager
TNS	Technology Needs Survey
TNT	Trinitrotoluene
TRADOC	U.S. Army Training and Doctrine Command
TRI	Toxic Release Inventory
TRP	Technology Reinvestment Program
TVA	Tennessee Valley Authority
USACERL	U.S. Army Construction Engineering Research Laboratories
USAEC	U.S. Army Environmental Center
USAIC	U.S. Army Infantry Center
USARPAC	U.S. Army, Pacific
USAWES	U.S. Army Waterways Experiment Station
USDA	Department of Agriculture
USMA	U.S. Military Academy
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WWW	World Wide Web
XRF	X-Ray Fluorescence

Appendix B

Program Partners

Environmental Technology Division specialists often team up with experts from across the Army, Navy, Air Force, Department of Defense, other government agencies, private industry and academia. Our partners include:

88th Regional Support Command, Indiana

Advanced Research Projects Agency
Air Force Center for Environmental Excellence
Alabama Army Ammunition Plant
Anniston Army Depot, Alabama
Armament Research Development and Engineering Center
Army Training Support Center

Badger Army Ammunition Plant, Wisconsin

Camp Bullis, Texas
Camp Dodge, Iowa
Camp Guernsey, Wyoming
Camp Ripley, Minnesota
Cold Regions Research Engineering Laboratory
Concurrent Technologies Corporation
Cornhusker Army Ammunition Plant, Nebraska
Corpus Christi Army Depot, Texas

Defense Evaluation Support Activity
Department of Energy National Renewable Energy Laboratory

Fort Bliss, Texas
Fort Campbell, Kentucky
Fort Carson, Colorado
Fort Drum, New York
Fort Hood, Texas
Fort Knox, Kentucky
Fort Leonard Wood, Missouri
Fort Lewis, Washington
Fort McPherson, Georgia
Fort Polk, Louisiana
Fort Riley, Kansas
Fort Rucker, Alabama
Fort Sill, Oklahoma

Georgia Institute of Technology
Global Environmental Solution (Alliant Techsystem Company)

Indian Head Division, Naval Surface Warfare Center
Iowa Army Ammunition Plant, Iowa

Jefferson Proving Ground, Indiana
Joint UXO Coordination Office
Joliet Army Ammunition Plant, Illinois

Lake City Army Ammunition Plant, Missouri
Landa Incorporated
Letterkenny Army Depot, Pennsylvania

McAlester Army Ammunition Plant, Oklahoma
Monsanto
Milan Army Ammunition Plant, Tennessee

National Association of Ordnance and Explosive Waste Contractors
National Defense Center for Environmental Excellence
National Guard Bureau
Natural Resources Conservation Service
Naval Explosive Ordnance Disposal Technology Division
Naval Facilities Engineering Service Center

Oak Ridge National Laboratory
Office of the Assistant Secretary of the Navy for Installations and Environment
Office of the Director of Environmental Programs

Pall Aerospace
Pennsylvania Department of Environmental Protection
Phillips Petroleum
Point Magu Naval Air Weapons Station, California

Radford Army Ammunition Plant, Virginia
Range Rule Partnering Initiative
Retech Inc.
RGF Environmental Group
Roy F. Weston Inc.

Schofield Barracks, Hawaii.
Science Applications International Corporation
SESCO Inc.

TACOM Fluids and Fuels Group
TACOM Fuels and Lubricants Technology Team
TCI Americas, Inc.
Teledyne Inc.
Tennessee Valley Authority

Tobyhanna Army Depot, Pennsylvania
TransTechnology Inc.
TRW, Inc.
Twin Cities Army Ammunition Plant, Minnesota.
Tyndall Air Force Base, Florida

U.S. Air Force
U.S. Air Force Wright Laboratory
U.S. Army Aberdeen Test Center
U.S. Army Acquisition and Pollution Prevention Support Office
U.S. Army Armament Research, Development and Engineering Center
U.S. Army Aviation and Missile Command
U.S. Army Construction and Engineering Research Laboratories
U.S. Army Corps of Engineers, Omaha District
U.S Army Waterways Experiment Station (Corps of Engineers)
U.S. Army Engineering and Support Center, Huntsville
U.S. Army Forces Command
U.S. Army Industrial Operations Command
U.S. Army Materiel Command
U.S. Army Project Manager for Non-Stockpile Chemical Material
U.S. Army Research Laboratory Coatings Research Team
U.S. Army Tank-Automotive and Armaments Command
U.S. Army Training and Doctrine Command
U.S. Army, Pacific
U.S. Department of Agriculture
U.S. Department of Defense Explosives Safety Board
U.S. Department of Energy
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Environmental Protection Agency (EPA) Risk Reduction
Engineering Laboratory
U.S. Military Academy
U.S. Navy

Vallon GmbH
Volunteer Army Ammunition Plant, Tennessee