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MISSION:

The Industrial Ecology Center (IEC), formerly the Environmental Technology Office (ETO), located at Picatinny Arsenal, New Jersey manages the Army’s Environmental Quality Pollution Prevention Program. This program includes the Basic Research & Development Program (EQBRD) and the Strategic Environmental Research & Development Program (SERDP) Pollution Prevention (P2) Technology Thrust Area Working Group (TTAWG). IEC is also the program management office for the DOD National Defense Center for Environmental Excellence (NDCEE). The IEC also provides life cycle environmental support to the Army’s armament mission.

TECHNOLOGY BASE PROGRAM:

The EQBRD program, with its heavy reliance on academia, accentuates basic research and is a vehicle to evaluate the feasibility of early technology concepts. The SERDP differs in that it normally represents the next step in the technology maturation process and contains projects which concentrate on the further development and application of selected technologies.

The POC for the EQBRD Program is Mr. J. Frankovic (201-724-5650) and Mr. Tom Sachar (201-724-2364) the POC for SERDP Program.

DEMONSTRATION/VALIDATION PROGRAM:

Once the feasibility and utility of a key environmental technology concept has been proven and completed, the next step in the R&D process is Dem/Val. This step ensures validation prior to transition to field use. The Environmental Security Technology Certification Program (ESTCP) and the National Defense Center for Environmental Excellence (NDCEE) are two separate programs, established to accomplish this objective.

The POC for ESTCP Support is Mr. Gary Kosteck, P.E., D.E.E. (201-724-6755) and the POC for the NDCEE is Mr. Mike Wrazen (201-724-3730).
# STAFF DIRECTORY

## MATRIX SUPPORT

**ACQUISITION CENTER**
- M. O’CONNELL x6630
- M. MOREAU x2016
- L. FRANZ x4894

**LEGAL OFFICE**
- Ft. HENNESSY (ENV LAW) x6584
- M. KANE (NDCEE) x5502
- E. GOLDBERG (PATENT) x6590
- D. SCOTT (CRDAS) x6585

**ENV MATRIX MANAGER**
- R. BLAJDA x5913

**PROGRAM MGT OFFICE**
- A. GROUNARD x2299

## ENVIRONMENTAL ANALYSIS

<table>
<thead>
<tr>
<th>Director</th>
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## NATIONAL DEFENSE CENTER FOR ENVIRONMENTAL EXCELLENCE

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## TECHNOLOGY DEMONSTRATIONS

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## ENVIRONMENTAL TECHNOLOGY

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## THRUST MANAGERS

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Dept. of the Army
Armament Research, Development and Engineering Center
Industrial Ecology Center
Building 172
Picatinny Arsenal, NJ 07806-5000

AUG 95
### Army Pollution Prevention Thrust Managers:

<table>
<thead>
<tr>
<th>Thrust Area</th>
<th>POC/Organization internet:</th>
<th>Telephone No.</th>
<th>FAX No.</th>
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<tbody>
<tr>
<td>Energetic Mfg &amp; Reuse</td>
<td>Mr. R. Goldberg/PBMA <a href="mailto:regold@pia.army.mil">regold@pia.army.mil</a></td>
<td>201-724-4069</td>
<td>20 1-724-4407</td>
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<tr>
<td>Advanced Materials</td>
<td>Mr. Don Yee/PBMA <a href="mailto:donyee@pia.army.mil">donyee@pia.army.mil</a></td>
<td>201724-6286</td>
<td>20 1-724-4407</td>
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<tr>
<td>Fabrication &amp; Packaging Processes</td>
<td>Mr. P. Arienti/ARDEC <a href="mailto:parienti@pica.army.mil">parienti@pica.army.mil</a></td>
<td>201-724-2181</td>
<td>201-724-4187</td>
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<tr>
<td>Surface Protection</td>
<td>Mr. R. Katz/ARDEC <a href="mailto:rkatz@pica.army.mil">rkatz@pica.army.mil</a></td>
<td>201-724-6518</td>
<td>201-724-6503</td>
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<tr>
<td>Ozone Depleting Chemical Elimination</td>
<td>Mr. M. Napolitano/ARDEC <a href="mailto:mnapolit@pica.army.mil">mnapolit@pica.army.mil</a></td>
<td>201-724-6515</td>
<td>20 1-724-6503</td>
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<tr>
<td>Chemical Munitions</td>
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<tr>
<td>Base Operations</td>
<td>Mr. B. Donahue/CERL donahue%epi @aardvark.cecer.army.mil</td>
<td>217-373-6733</td>
<td>217-373-3490</td>
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<td>Electronics</td>
<td>Mr. R. Benjamin/ARDEC <a href="mailto:rbenjam@pica.army.mil">rbenjam@pica.army.mil</a></td>
<td>201-724-7021</td>
<td>201-724-6424</td>
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Cleaning and Deareasina Projects

TITLE: Surface/Solvent Diagnostics for Metal Cleaning Operations

PROJECT NUMBER: E218  PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: Army Research Laboratory, APG, MD

OBJECTIVE: To develop and test a single instrument, based on a low cost Fourier transform infrared (FTIR) spectrometer, for measuring both degree of metal surface cleanliness and degree of solvent contamination.

APPROACH: Modify a small commercial FTIR spectrometer to perform FTIR reflectance spectrometry for both normal and internal cylindrical surfaces measurements. Measure spectroscopy and detection limits and for representative surfaces and solvents. For one or more metal cleaning operations, develop and test software algorithms for FTIR microprocessor for automated computation of surface and solvent contaminant levels.

PROPONENT: IOC

POC: Dr. Robert Fifer
PHONE: 410-278-6149  FAX: 410-278-6150

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TITLE: Aqueous Based Degreasing Technology

PROJECT NUMBER: NATO2  PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: U.S. Army Natick Research, Development & Eng. Center

OBJECTIVE: Develop nonpolluting, nontoxic water-based degreasers for cleaning metal/glass/plastic surfaces using biopolymer emulsifying materials.


PROPONENT: IOC

POC: Dr. Fred Allen
PHONE: 508-651-4266  FAX: 508-651-5104
Plating and Finishing Projects

TITLE: PVD Coatings And Ion Beam Processing

PROJECT NUMBER: A065                PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: Army Research Lab, Watertown, MA

OBJECTIVE: Demonstrate PVD coating techniques and ion beam processing as effective environmentally acceptable alternatives to chromium and cadmium electroplating.

APPROACH: Conduct applied R&D to demonstrate that metal or ceramic coatings deposited by PVD and/or ion-beam-modified surfaces are equivalent in performance and a cost effective alternative to electroplated coatings.

PROPOONENT: ATCOM, IOC, Navy

POC: Dr. John Beatty
PHONE: (410) 516-4748            FAX: (410) 516-5293

TITLE: Replacement of Hazardous Chromium Electroplating with Environmental Compliant Laser Process/Materials Development

PROJECT NUMBER: BAA94-020                PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: Penn State University, State College, PA

OBJECTIVE: To provide an alternative process to the environmentally hazardous electroplating method along with a more precise method for cladding the protective coating on the substrate.

APPROACH: It is proposed to focus on the development of Laser Beam Cladding (LBC) techniques and materials compatible with laser processing, that can be substituted for the chromium plating process. These materials and processes must demonstrate equal or better wear and corrosion resistance, while at the same time, be economical and environmentally acceptable. Phase I of the program will be a combined theoretical and experimental effort. The theoretical effort will be in the development of a model that can predict the dilution/chemistry of a clad based on the LBC parameters. The experimental portion; of the program will examine three types of materials that are candidates to replace chromium electroplating. Phase 2 will provide a laboratory demonstration of the cladding process and materials on specific parts. The materials used will be based on the results of Phase 1 of the program. If possible, actual components will be tested in their normal operating environment to determine performance of the new coatings in “real world” conditions. Phase 3 will be a technology transfer thrust for the program. In this phase efforts will concentrate on developing industrial procedures and standards for the new LBC techniques. Based on the results of Phase 1 and 2, a study will be conducted to select “dual use” applications and end-users that would best be suited for the newly developed materials and processes.

PROPOONENT: Multi-service

POC: Mr. Lewis Watt
PHONE: 8 14-863-3880            FAX: 814-863-1183
TITLE: Advanced Zinc Phosphate Metal Pre-treatment

PROJECT NUMBER: D005/F074 PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: Tank and Automotive Research and Development Command

OBJECTIVE: Eliminate hexavalent chromium rinses on zinc phosphate and to enhance corrosion protection and adhesion of paint films on ferrous and non-ferrous metal surfaces prior to painting or adhesive assembly.

APPROACH: Finish the laboratory studies at Brookhaven National Labs (BNL). Transfer this technology to the shop floor at TRW. Validate the concept under actual production on real parts as encountered by industry. Reformulate and adjust process as dictated by the scale up studies.

PROPOONENT: TACOM.

POC: Mr. I. Carl Handsy
PHONE: (313) 574-8834 FAX: (313) 574-6501

TITLE: Replacement for Cadmium Plated Fasteners

PROJECT NUMBER: D073 PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: U.S. Army Mobility Technology Center, Ft. Belvoir, VA

OBJECTIVE: To identify a conformal compound (replacement for cadmium) providing uniform friction independent of corrosion coating and to modify this compound to meet Army requirements.

APPROACH: Conduct realistic performance testing that relates directly to the eventual in-service performance requirements. These realistic performance tests allow research results to effectively predict actual field performance. All tests include cadmium as an engineering control and are based on a statistical approach. The use of cadmium as an engineering control will allow program results to be economically transition to operational equipment. The program’s statistical approach will allow the development of acquisition documentation that efficiently addresses the normal variations in coating thickness, application parameters, and chemical composition. By effectively addressing these normal variations, the technical approach can ensure that the final coatings meet Army needs.

PROPOONENT: TACOM

POC: Mr. Carl Handsy
PHONE: (313) 574-8834 FAX: (313) 574-6501
**TITLE:** Eliminate Use of Mercurous Nitrate

**PROJECT NUMBER:** F032  
**PROGRAM FUNDING SOURCE:** 6.3

**PERFORMING LAB:** Armament Research and Development Command

**OBJECTIVE:** Develop an alternate test method to replace the currently specified Mercurous Nitrate solution to determine the level of residual stress in small caliber brass cartridge cases since the disposal of the used solution is no longer economical nor feasible because of environmental concerns.

**APPROACH:** A prototype Eddy Current Hardness Measuring System (ECHMS) fabricated during a previous project will be modified, evaluated for this specific use and demonstrated. In addition, alternative non-hazardous chemical solutions to replace the mercurous nitrate solution will be investigated.

**PROPONENT:** AMCCOM

**POC:** Mr. M. Leng  
**PHONE:** 201-724-5688  
**FAX:** (201) 724-7378

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**TITLE:** Ion Beam Processing For Environmentally Acceptable Coatings

**PROJECT NUMBER:** NDCEE N.001  
**PROGRAM FUNDING SOURCE:** DEMIVAL

**PERFORMING LAB:** NDCEE, Johnstown, PA

**OBJECTIVE:** To eliminate heavy metal contaminated wastewaters associated with electroplating.

**APPROACH:** Demonstrate dry coating processes to eliminate electroplating, aqueous cadmium and/or chromium wastes

**PROPONENT:** Army, Navy

**POC:** Mr. B. Manty  
**PHONE:** (814) 269-6425  
**FAX:** (814) 269-2798

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**TITLE:** Identification Of Health Effects And Costs Assoc. With Toxic Substances In DOD Workplace

**PROJECT NUMBER:** NDCEE N.016  
**PROGRAM FUNDING SOURCE:** DEM/VAL

**PERFORMING LAB:** NDCEE, Johnstown, PA

**OBJECTIVE:** To investigate the hazards associated in working in the DOD industrial workplace and to establish risks.

**APPROACH:** Apply state-of-the-art risk assessment methods to existing DOD industrial processes and environmental technologies. Compare results to replacement technologies and incorporate optimal processes.

**PROPONENT:** IOC, TACOM, ATCOM, NAVY

**POC:** Mr. J. Powell  
**PHONE:** (814) 269-28 11  
**FAX:** (814) 269-2798
TITLE: Facility Environmental Management and Monitoring System (FEMMS)

PROJECT NUMBER: N.041 PROGRAM FUNDING SOURCE: DEMIVAL

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: To install a Facility Management and Monitoring System (FEMMS) Test Bed at Tobyhanna Army Depot. This test bed will focus on toxics reduction evaluation, air emissions inventory, real-time monitoring of water usage/flows, monitoring of pollutants and air emissions monitoring.

APPROACH: The environmental management requirements at Tobyhanna AD will be evaluated to determine needed capabilities. The FEMMS testbed will be established which will employ the use of the latest computer, communications, and pollution prevention technologies as well as environmental sensors, meters, monitors, and alarms integrated into a single real-time system capable of supporting the environmental requirements of any Army facility.

PROPOSTENT: Army, Navy, Air Force

POC: Mr. Joseph Maciejewski, Tobyhanna Army Depot, PA
PHONE: (717) 894-7090 FAX: (717) 894-7005
Paint and Coating Reformulation Projects

TITLE: Chemical Agent Resistant Coatings (CARC)

PROJECT NUMBER: B074/E105 PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: Army Research Laboratory, (Ft. Belvoir)/MRDEC

OBJECTIVE:
A. Develop a water reducible/water dispersible (WR/WD) CARC
B. Identify a flame spray coating that does not require solvents.

APPROACH:
A. Reformulation of the polyurethane topcoat system with WR/WD polymers which have the potential for chemical agent resistance.
B. Identify thermoplastic materials and spray equipment, test and evaluate polymer flame spray systems.

PROPOONENT: ARL, MICOM

POC: Mr. Jeff Duncan

TITLE: Self Assembled Monolayers (SAMs) as Primers for Corrosion Protection for Metallic Substrates (ARL, BAA94-014) & Spectroscopic Studies of Primer Alternatives.

PROJECT NUMBER: E222/BAA94-014 PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: Army Research Laboratory, APG, MD

OBJECTIVE: To prepare and characterize SAM coatings on steel and aluminum surfaces; to study the corrosive and oxidative resistance of the SAM coatings, and to identify the optimal coating characteristics with respect to metal protection, durability, ruggedness, ease of application, and longevity.

APPROACH: This project will be a collaborative effort between Aerodyne Research, Inc. (ARI) and the Army Research Laboratory (ARL). ARI will perform the synthesis of appropriate long-chain hydrocarbons for use as SAM coatings on steel and aluminum; the preparation, characterization, and testing of the SAM coatings; and the synthesis of terminal air-interface groups and chain modified materials for cross-linking and multi-layer SAM coatings. ARL will perform the FTIR and Raman characterization of chemical and morphological changes in SAM films due to exposure to common solvents, acidic and alkali solutions, and corrosive gases. In addition, ARL will conduct photochemical cross-linking studies of SAM coatings as well as characterize the structure and chemical resistance of multi-layer coatings.

PROPOONENT: IOC

POC: Dr. Andrew Freedman, Gary N. Robinson, Dr. Andrezej W. Miziolek, ARL
PHONE: (ARI) 508-663-9500 (ARL) 410-278-6157 FAX: (ARL) 410-278-6150
TITLE: Aqueous Based Paint Coating and Stripping

PROJECT NUMBER: NATO1 PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: U.S. Army Natick Research, Development & Engineering Center, Natick, MA

OBJECTIVE: Design and produce new protein based coatings for specific substrates (metals) and clean removal strategy based on new aqueous based systems.

APPROACH: Select suitable protein sequences for substrate and paint functional groups. Design coatings with specific recognition ends for the substrates to be coated and for the final coat chemistry. Optimize structures of proteins for optimal enzymatic stability or thermal susceptibility. Utilize genetic techniques to produce libraries of target protein sequences for screening and characterization. Demonstrate that proteins can be tightly bound to surfaces and then successfully removed using heat or enzymes in water environments.

PROPOSTENT: IOC

POC: Dr. Kevin McGrath
PHONE: 508-651-4562 FAX: 508-651-5521
Painting and Coating Process Projects

TITLE: Unitized Coating Application Facility: E-Coat & Powder Coat

PROJECT NUMBER: NDCEE N.002  PROGRAM FUNDING SOURCE: DEM/VAL

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: To investigate paint application technologies which reduce VOC emissions and improve coating quality.

APPROACH: Identify present processes, research on state-of-the-art techniques. Development of demonstration facility and transition to Letterkenny Army Depot.

PROponent: IOC, Navy

POC: Carl Handsy, TACOM
PHONE: (313) 574-8834  FAX: (313) 574-6501

TITLE: Supercritical CO2/Replacement for Solvent in Spray Applied Coatings

PROJECT NUMBER: NDCEE N.021  PROGRAM FUNDING SOURCE: DEM/VAL

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: Develop UNICARB coatings, using existing Mil Specs., and application equipment for DOD applications which would include antifouling coatings, epoxy primers and urethanes. Implement the UNICARB system into shipyards, maintenance facilities, and depots. Transition the technology into commercial industry.

APPROACH: First, a facility survey of DoD facilities will be conducted to identify and prioritize target applications for the technology. Cost benefit analyses will be performed to help in the prioritization of target applications. Coatings will then be reformulated by coating suppliers. The current equipment that is available will be adapted to meet the requirements of the military and then hardened for harsh outdoor environments. The paints and systems will then go through a performance testing program to verify that the coating system will meet military requirements and specifications. The systems will then be implemented into a minimum of three facilities, one from each service. The technology will then be demonstrated in the real military environment and the technology transferred to commercial industry.

PROponent: Army / Navy

POC: Mr. John Williams, Office of Naval Research
PHONE: (703) 696-0342  FAX: (703) 696-8480
TITLE: Paint Handling & Spraying Equipment Testing, Evaluation and Training

PROJECT NUMBER: NDCEE N.023      PROGRAM FUNDING SOURCE: DEM/VAL

PERFORMING LAB: NDCEE

OBJECTIVE: Evaluate and test advanced paint handling and spray equipment for use in military industrial facilities that will reduce environmental discharges associated with painting operations, comply with EPA regulations, and improving productivity. The NDCEE will act as a non-biased third party to evaluate the various technologies against the DoD requirements using latest industry innovations.

APPROACH: First, a requirements analysis will be undertaken. This will involve DoD specification owners, DoD end users, paint handling and spray equipment vendors, paint manufacturers and commercial users. These groups will be assembled into committees which will then be used for the information survey. Technologies which have the biggest benefit will be identified and demonstrated first. Certification test programs will be developed and carried out to ensure that the technologies meet all DoD and EPA requirements and specifications. A paint handling and spray technology information database will be established and made accessible to the DOD and commercial industry. The NDCEE will establish a training center which will allow for economical training of personnel.

PROPOSER: All services

POC: Mr. John Williams, Office of Naval Research
PHONE: (703) 602-0342 FAX: (703) 602-8480
Paints, Coatings and Chromium Replacement Projects

TITLE: Non-chromated/Non-carcinogenic Etching for Bonding Materials

PROJECT NUMBER: A131     PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Develop environmentally acceptable surface preparation processes for structural adhesive bonding of metals, advanced composites, engineering plastics and elastomers in military hardware.

APPROACH: Low toxicity (LOTOX) processes will be identified and evaluated in iterative fast track bonding studies on titanium alloy. The rheological and chemical effects of various other lotox alternatives for titanium and other materials will be studied. Finally the processes will be evaluated for their effects on the wastestream, health and safety.

PROPOONENT: IGC, ATCOM

POC: Mr. J. Brescia
PHONE: 201-724-4555

____________________________________________________________________________________

TITLE: Non-Chromate Conversion Coatings and Sealers

PROJECT NUMBER: E111     PROGRAM FUNDING SOURCE: 6.2/6.3

PERFORMING LAB: Army Research Laboratory, Watertown, MA

OBJECTIVE: The development and implementation of (1) a non-chromate conversion coating for aluminum alloys and (2) an alternative sealing treatment to the currently used sodium dichromate in the anodizing process for use in combat and tactical vehicles, munitions, and aircraft.

APPROACH: Evaluate by a comprehensive characterization of candidate non-chromate conversion coatings for Aluminum alloys for comparison with the currently used chromate conversion coatings. Several sources of supply for the non-chrome anodize sealer will be identified and evaluated in the laboratory and field tested with respect to corrosion resistance, abrasion resistance adhesion, fatigue life.

PROPOONENT: RRAD, CCAD

POC: Dr. John Beatty
PHONE: (410) 516-4748
FAX: (410) 516-5293

____________________________________________________________________________________

TITLE: Evaluation of Non-Chromate Conversion Coating / Pretreat of Aluminum

PROJECT NUMBER: NDCEE N.008     PROGRAM FUNDING SOURCE: 6.4

PERFORMING LAB: NDCEE

OBJECTIVE: Eliminate discharge of toxic heavy metal wastes associated with chromate-based conversion coatings.

APPROACH: Demonstrate at the NDCEE a non-chromium conversion coating process (modified version of the SAN-CHEM SAFEGUARD-CC process).

PROPOONENT: Navy, Army
POC: Stephen J. Spadafora
PHONE: (215) 441-2704
FAX: (215) 441-1925
Paint Stripping Projects

TITLE: Alternate Chemical Paint Strippers

PROJECT No: A031                      PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: Construction Engineering Research Laboratory, Champaign, IL

OBJECTIVE: Reduce hazardous emissions to water and air caused by use of hazardous/toxic chemical paint strippers.

APPROACH: Reformulate alternate chemical paint strippers which will perform at or near the level of methylene chloride strippers yet will be environmentally acceptable.

PROPOSPONENT: IOC

POC: Dr. Keturah Reinbold

TITLE: Waterjet Paint Stripping

PROJECT No: DO74                      PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: TACOM, Warren MI

OBJECTIVE: To eliminate or significantly lower the generation of hazardous and toxic materials during metal surface pretreatment. Ultimately this will reduce the cost of painting in manufacturing and in Depot repair.

APPROACH: Combine state of art robotics with Waterjet paint stripping and simultaneously apply a waterbased nonhazardous material that will produce a continuous barrier between the metal oxide and primer paint. The effect will be to use all of the above new technologies into a single operation that is environmentally acceptable.

PROPOSPONENT: TACOM

POC: Mr. Carl Handsy
PHONE: (313) 574-8834                FAX: (313) 574-6501
TITLE: Environmentally Acceptable Heat Treating

PROJECT No: E090
PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: APDEC, Picatinny Arsenal, NJ

OBJECTIVE: To eliminate the environmental problems which are associated with standard commercial heat treatment/quench systems which use molten salt/metal, oil, and water base solutions to thermally process DoD materials and components. To establish fluid bed heat treating as an environmentally benign process for paint stripping.

APPROACH: Clarify the principal heat treatment concepts of fluid bed thermal processing, provide guidelines for the selection and use of fluid bed furnaces in the heat treatment of metal armament components, undertake to incorporate fluid bed thermal processing as a integral part of the design and manufacturing process for metal armament components utilizing basic considerations of statistical process control and concurrent engineering. Coordinate with National/International thermal processing associations to develop common processing standards, specifications and quality assurance (ISO) standards.

PROPOSENENT: Amy

POC: Dr. Sheldon Cytron
TELEPHONE: (201) 724-3368

TITLE: Automated Ultra-High Pressure Water Jet System WorkCell

PROJECT No: NDCEE N.002
PROGRAM FUNDING SOURCE: DEM/VAL

PERFORMING LAB: NDCEE, Johnstown, PA

OBJECTIVE: Evaluate ultra-high pressure waterjet using activated surface treatment agents (hydrolyzed silane coupling agents with abrasive) for coatings removal as well as surface priming.

APPROACH: Demonstrate automatic high pressure waterjet to replace chemical and manual paint stripping, rubber removal and pretreatment of metal parts.

PROPOSENENT: DOD

POC: Carl Handsy
PHONE: (313) 574-8834
FAX: (313) 574-6501
**Ordnance-Reuse/Recycling Projects**

**TITLE:** Single Base Propellant Recovery Technology Demonstration

**PROJECT No:** A096  
**PROGRAM FUNDING SOURCE:** 6.3

**PERFORMING LAB:** ARDEC, Picatinny Arsenal, NJ

**OBJECTIVE:** To investigate the recovery of nitrocellulose from single base propellants

**APPROACH:** To demonstrate the technical feasibility for using 2-proponol as an extraction solvent on a pilot scale unit.

**PROPONE NENT:** IOC

**POC:** Steve Rosenberg  
**PHONE:** (201) 724-4224  
**FAX:** (201) 724-3162

**TITLE:** Reutilization of Energetic Materials

**PROJECT No:** CO24  
**PROGRAM FUNDING SOURCE:** 6.1

**PERFORMING LAB:** ARDEC, Picatinny Arsenal, NJ

**OBJECTIVE:** Provide for bioconversion of scrap to precursor compounds for conversion to new energetic compounds.

**APPROACH:** It is planned to use enzymes from plant and animal sources to modify energetic materials. Enzymes are very efficient catalysts that can accomplish a variety of chemical reactions at room temperature with more specificity than that obtainable from conventional chemical reactions. These facts coupled with the recent advances made in genetic engineering, which allows enzymes to be tailored for specific purposes and facilitates their production, makes the use of enzymes a very attractive method for demilitarization of labile energetic materials. Bioconversion will supply the technology for the reutilization of energetic molecules thus eliminating the need for environmentally unfriendly disposal methods such as open burning/open detonation. An example of the bioconversion of energetics involves the enzymatic removal of diphenylamine and 2,4 dinitrotoluene from single base propellant so that it can be reutilized as a nitrocellulose source for ball propellant production. This eliminates the need for the use of toxic VOCs to accomplish this removal and for the destruction of single base propellant. Further, there is no hazardous waste as with the current practice of burning single base propellant and there is a cost reduction for ball propellant manufacture because of the nitrocellulose reutilization.

**PROPO NE NT:** IOC

**POC:** Mr. Bruce Brodman  
**PHONE:** 201-724-5345  
**FAX:** 201-724-4434
TITLE: Extraction & Recycling of LOVA Propellant with Supercritical Fluids

PROJECT No: D009

PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: To identify suitable supercritical fluid solvents for use in extracting and recycling the ingredients of obsolete solid LOVA gun propellants and nitramine explosives.

APPROACH: Experimental investigations of the effectiveness of polar “modifiers” in increasing the solubility of energetic materials in supercritical CO2.

PROPONENT: IOC

POC: Dr Jeffrey B. Morris
PHONE: (410) 278-6148
FAX: (410) 278-6150

TITLE: Recycling Propellants and Non-Polluting Supercritical Fluids

PROJECT No: E316

PROGRAM FUNDING SOURCE: 6.1/6.2

PERFORMING LAB: Army Research Laboratory, APG MD

OBJECTIVE: To determine the optimal physical conditions and chemical makeup of an effective SFCO2/modifier solvent using well established computational chemistry techniques to recover nitramines from obsolete energetic materials.

APPROACH: Use computer modeling/(ARMY) (High Priority).theoretical chemistry to predict solubility of RDX in supercritical CO2 and validate project D009.

PROPONENT: IOC

POC: Dr. Betsy Rice
PHONE: (410) 278-6183
FAX: (410) 278-6150
**Ordnance-Eliminate Toxic Materials Projects**

**TITLE:** Eliminate Lead-Based Compounds in Minimum Smoke Solid Rocket Propellants

**PROJECT No:** A024  
**PROGRAM FUNDING SOURCE:** 6.2

**PERFORMING LAB:** MRDEC, Redstone Arsenal, AL

**OBJECTIVE:** To demonstrate a selected lower-toxicity catalyst for a minimum smoke propellant.

**APPROACH:** The first step will be screening of candidate ballistic modifiers. A selected candidate formulation would be scaled-up and characterized.

**PROPOSENT:** MICOM

**POC:** Ms. Diane Hagler  
**PHONE:** (205) 876-1074  
**FAX:** (205) 842-1359

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**TZ TLE:** Clean Burning Solid Propellants

**PROJECT No:** B037  
**PROGRAM FUNDING SOURCE:** 6.1

**PERFORMING LAB:** Army Research Laboratory, APG, MD

**OBJECTIVE:** Eliminate toxic gases, CO, NO, and HCN due to incomplete combustion of solid gun propellants.

**APPROACH:** Investigate use of “DENOX” agents for elimination of NOx (primarily nitric oxide, NO). For gun propellants the DENOX agents are NHx- (e.g., NH2- or NH3-) containing species that serve as reducing agents by reacting with any NO present to reduce it to N2. Previous attempts to “catalyze” the burning of solid propellants have made use of oxidizing-rather than reducing-agents, typically metal oxides (e.g., lead oxide PbO). If DENOX agents can efficiently eliminate NOx from the combustion products of solid propellants, they may also serve as effective burning rate “catalysts” thereby simultaneously preventing pollution (by both NOx and heavy metals) and enhancing performance. The result would be improved air quality and personnel safety at and near propellant test center, in tanks and other vehicles where incomplete products of combustion enter from gun breaches, near rockets or artillery where combustion of propellant or propellant residue occur, or in situations where either accidental or deliberate combustion of munitions occurs, such as during ignition of stored rounds in tanks, or during combustive disposal.

Work on this project began in February 1993 under the new mission program (AH43) Environmental “plus-up” for WTD/ARL (BRL). It is currently unfunded for FY96 and beyond.

**PROPOSENT:** ARL

**POC:** DR. Rose Pesce Rodriguez  
**PHONE:** 410-278-6183  
**FAX:** 410-278-6150
TITLE: Design/Use Catalysts to Avoid Redwater in TNT Production

PROJECT No: B048  PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Prevention of Red Water and other waste products in TNT manufacturing

APPROACH: Regioselectively nitrate toluene to generate orthonitro toluene (ONT) and further to TNT using small amounts of catalyst in systematic way. Various clay and zeolite based catalysts of appropriate pore size will be designed using modeling studies. These catalysts will be employed in nitration studies of toluene and other aromatic and non aromatic nitration processes. Zeolites with appropriate pore size will lead to selective nitration thus avoid unwanted byproducts in the nitration process.

PROPOONENT: IOC

POC: Dr. Reddy Damavarapu
PHONE: 201-724-5810  FAX: 201-724-5713

TITLE: Develop Non-Polluting Primary Explosives

PROJECT No: B069  PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Eliminate heavy metals (lead and mercury) in the formulation of primary explosives by evaluating poly-nitro-alkyl-ammonium nitrate substitute compounds.

APPROACH: New promising primary explosive compounds, e.g. different polynitro alkyl ammonium nitrate compounds, will be researched, synthesized and down selected. Those new compounds which satisfy the requirements will be further tested in end-items.

PROPOONENT: IOC

POC: Dr. S. Iyer
PHONE: (201) 724-3135  FAX: (201) 724-5713

PROJECT No: CO12 PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Provide more environmentally friendly, safer and more economical manufacturing methods for energetic materials.

APPROACH: It is planned to use enzymes from plant and animal sources to synthesize energetic materials. Enzymes are very efficient catalysts that can accomplish a variety of chemical reactions at room temperature with more specificity than that obtainable from conventional chemical reactions. These facts coupled with the recent advances made in genetic engineering, which allows enzymes to be tailored for specific purposes and facilitates their production, makes the use of enzymes a very attractive method for the synthesis of energetic materials. Enzymatic synthesis of required molecules with a much more environmentally friendly waste stream, contributes to pollution prevention. Further, enzymatic synthesis would result in a safer and less costly manufacturing process as well as holding the potential for the synthesis of new more powerful explosives that are not obtainable from conventional chemical synthetic methods.

PROPOONENT: IOC

POC: Mr. Bruce W. Brodman
PHONE: 201-724-5345 FAX: 201-724-4434

TITLE: Laser Ignition to Replace Chemical Ordnance Igniters for Propulsion

PROJECT No: E209 PROGRAM FUNDING SOURCE: 6.216.3

PERFORMING LAB: Army Research Lab, APG MD

OBJECTIVE: To reduce production of waste and unnecessary energetic material in manufacturing for guns and rockets. To eliminate the use of energetic ignition systems

APPROACH: To set up laboratory scale experiments for propellant ignition using a state of the art laser laboratory with full electro-optics diagnostics capability.

PROPOONENT: TACOM

POC: Dr Brad E. Forth
PHONE: (410) 278-7067 FAX: (410) 278-6150
**VOC Elimination Projects (In Ordnance Manufacturing)**

**TITLE:** Environmentally Acceptable Process, RP Formulation

**PROJECT No:** A053  
**PROGRAM FUNDING SOURCE:** 6.3

**PERFORMING LAB:** ARDEC, Picatinny Arsenal, NJ

**OBJECTIVE:** Develop a replacement for the solvent used in production of the L8A3 Grenade containing red phosphorus (RP) smoke composition in order to meet Arkansas, EPA and OSHA requirement. This proposed project would eliminate approximately 17 tons of methylene chloride per rear based on current production requirements of 155,396 grenades.

**APPROACH:** Evaluate candidate environmentally benign replacement solvents for methylene chloride and develop new red phosphorous (RP)/butyl rubber smoke mix process and test performance of product.

**PROPONENT:** Pine Bluff Arsenal

**POC:** Mr. M. Collins  
PHONE: (201) 724-5610  
FAX: (201) 724-3162

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**TITLE:** The Use of Pollution Free Aqueous Based Adhesion Enhancement of Rubber to Metal Surfaces

**PROJECT No:** A054  
**PROGRAM FUNDING SOURCE:** 6.2

**PERFORMING LAB:** MRDEC, Redstone Arsenal, AL

**RESEARCH CATEGORY:** 6.2

**OBJECTIVE:** Eliminate the use of chlorinated solvents in the preparation of vulcanized bondlines.

**APPROACH:** Identify a representative rubber stock from each family commonly used rubber materials (e.g., natural, SBR, Resin Cured, Mercapto). Investigate surface modification of both the rubber and metal surfaces to enhance the reactivity of the silane coupling agents with the rubber. Select a variety of organofunctional silane compounds that should react with both the metal and rubber surfaces. Optimize most promising bond system and propose scale up for technology transfer.

**PROPONENT:** MICOM

**POC:** Mr. Ronald Hagler  
PHONE: (205) 313-6562  
FAX: (205) 313-6596

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**TITLE:** Elimination of VOCs in Energetic Material Processing

**PROJECT No:** B045  
**PROGRAM FUNDING SOURCE:** 6.2

**PERFORMING LAB:** Army Research Lab, APG, MD & ARDEC, Picatinny Arsenal, NJ
OBJECTIVE: To provide a demonstration of solventless processing of a Thermoplastic Elastomer (TPE) polymeric system for artillery propellant. To develop new energetic materials and processes necessary to eliminate or greatly reduce both VOC production and ancillary waste through enhanced DEMIL and recyclability.

APPROACH: To utilize technology initially developed, in conjunction with ARL, for a LOVA tank propellant and currently being investigated under a follow-on technology-base program to develop a high performance, i.e. TNAZ, RDX or CL20 TPE tank propellant. To provide maximum VOC elimination, artillery propellants will be formulated for Unicharge based on TPE elastomeric binders. These propellants must have characteristics similar to M30 for Unicharge to function properly. Production of the candidate propellants initially will be by batch extrusion. Both molecular modeling and advanced chemical diagnostics will be used to optimize the propellant. The propellant will be tested in Unicharge gun firings to optimize performance. Continuous twin-screw extruder processing will be developed for the most promising candidates.

PROPOSED: IOC

POC: Dr. Lee Harris
PHONE: (201) 724-4535 FAX: (201) 724-2443


PROJECT No: B046 PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: ARDEC, Picatinny Arsenal NJ

OBJECTIVE: Eliminate the generation of hazardous solvent waste, acetonitrile and methanol, resulting from analyses of energetic and related materials at all DOD laboratories. Total quantity of contaminated solvents generated DOD wide and at commercial facilities is estimated to be in excess of 3,000 gallons; with a savings potential of $200,000. per year.

APPROACH: Incorporate the state-of-the-art supercritical fluid extraction (SFE) technique, supercritical fluid chromatography (SFC), high resolution high performance liquid chromatography (HRHPLC), and solvent recovery to eliminate greater than 99% of the hazardous waste solvents and reagents with added advantages of attaining shorter analysis time and more reliable results.

PROPOSED: TACOM, IOC

POC: Dr. Tung-Ho Chen
PHONE: (201) 724-2210 FAX: (201) 724-5713

TITLE: Non-Polluting Propellant Extrusion Process

PROJECT No: E214 PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: Reduce release of volatile organic solvents during drying of solid propellants
**APPROACH:** Use liquid supercritical CO2 to replace conventional solvents.

**PROPONENT:** IOC

**POC:** Dr. Rose Pesce-Rodriquez
**PHONE:** 410-278-6806
**FAX:** 410-278-6150

**TITLE:** Solventless Bond Surface Preparation

**PROJECT No:** E240
**PROGRAM FUNDING SOURCE:** 6.2

**PERFORMING LAB:** MRDEC, Redstone Arsenal, AL

**OBJECTIVE:** Reduce the usage of ozone depleting and hazardous solvents in cleaning of solid rocket motor substrates prior to bonding

**APPROACH:** The approach will involve identifying and/or obtaining candidate solventless substrate preparation processes. Conduct bond tests on prototypical bondlines with substrates prepared with candidate processes and to validate the solventless processes by providing control comparisons with bond specimens prepared by solvent cleaning processes. Lastly, to determine process feasibility of implementation of candidate processes.

**PROPONENT:** MICOM
**POC:** Mr. Ronald Hagler
**PHONE:** (205) 313-6562
**FAX:** (205) 313-6596

**TITLE:** Ultraviolet Curing Coatings and Liners As Replacement for Products With Hazardous Materials or Volatile Organic Compounds (VOCs)

**PROJECT No:** E250JE243JE244
**PROGRAM FUNDING SOURCE:** 6.2J6.3

**PERFORMING LAB:** MRDEC Redstone Arsenal, AL

**OBJECTIVE:** Eliminate coatings which contain VOCs, ozone depleting solvents, or hazardous materials for lining rocket motor parts.

**APPROACH:** The effort would replace such coating processes with non-VOC ultraviolet (UV) curing materials. It is expected that this method would eliminate the health hazard as well as provide increased reliability. Rocket motor liners are currently oven cured before propellant loading. The use of UV cure agents is expected to result in savings in time, energy, and facility costs.

**PROPONENT:** MICOM

**POC:** Mr. Ronald Hagler
**PHONE:** (205) 313-6562
**FAX:** (205) 313-6596
**Other Hazardous Waste Projects**

**TITLE:** Non-Solvent Coat System for Military Clothing

**PROJECT No:** DO32  
**PROGRAM FUNDING SOURCE:** 6.3

**PERFORMING LAB:** NRDEC, Natick, MA

**OBJECTIVE:** To develop new processes to eliminate use of volatile organic chemicals in production of coated fabrics for military use.

**APPROACH:** Conduct market survey of non-solvent coating processes. Evaluate water-based coatings for military coated fabrics.

**PROPONENT:** NRDEC

**POC:** Mr. C. Pentheny  
**PHONE:** 508-651-5476  
**FAX:** 508-651-5496

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**TITLE:** Elimination of Lead, Antimony, and CFC Compounds from MIL-L46147 and MIL-L46010 Solid Film Lubricants.

**PROJECT No:** DO60  
**PROGRAM FUNDING SOURCE:** 6.3

**PERFORMING LAB:** U.S. Army Mobility Technology Center, Ft.Belvoir VA

**OBJECTIVE:** To develop and evaluate reformulated solid film lubricants without hazardous metal components or chlorofluorocarbon (CFC) propellants.

**APPROACH:** Evaluate candidate formulations and assess performance properties. Evaluations will include wear endurance and load capacity testing, corrosion protection, fluid resistance, storage stability, and other performance properties on a variety of metal surfaces. Performance data will be incorporated in draft revised specifications for the two solid film lubricants.

**PROPONENT:** TACOM

**POC:** Ms. Ellen Purdy  
**TELEPHONE:** (703) 704-3722  
**FAX:** (703) 704-1822
Ozone Elimination Solvent Projects

TITLE: Continuous Aqueous Cleaning to Eliminate ODC

PROJECT No: A070  PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: AMCCOM, Rock Island Arsenal, IL

OBJECTIVE: To develop non-ODC metal parts cleaning process for use prior to painting.

APPROACH: Validate an aqueous based cleaning system for degreasing metal parts at Rock Island Arsenal prior to the application of a chemical agent resistant coating (CARC). A three step approach will be followed. First the aqueous based cleaner will be selected to replace 1,1,1-trichloroethane, which is an ODC. Secondly equipment specifications and purchase descriptions including waste water treatment requirements will be developed. Lastly the most feasible alternative will be installed.

PROPOONENT: IOC

POC: Tera Hill
TELEPHONE: (309) 782-7860  FAX: (309) 782-7122

TITLE: Alternates to Halon 1301 for Occupied Compartments in Ground Combat Vehicles

PROJECT No: COO2  PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: TACOM - Warren, MI

OBJECTIVE: To identify and evaluate an acceptable substitute for Halon 1301 for use in occupied compartments of ground combat vehicles.

APPROACH: Through leveraging, existing and ongoing work by the Air Force, Navy, National Institute of Standards and Technology (NIST), Center for Global Environmental Technologies (CGET), NASA, British Petroleum, FAA, and New Mexico Engineering Research Institute (NMERI) will be screened and evaluated for selection of alternatives for the application stated. Technology profiles will be developed for approximately 25 viable agents and submitted to AERA for toxicity evaluation. For each candidate, an agent delivery system will be developed. Agent concentration and performance testing will be conducted in a full/scale ground combat vehicle. Toxicology studies will be performed on the most promising agents. Upon completion of the above, specification will be developed for the extinguishing system components including agents and delivery system that have been successfully screened per above.

PROPOONENT: TACOM

POC: Mr. Steve McCormick
TELEPHONE: (313) 574-5948  FAX: (313) 574-6674
TITLE: Research in CFC Substitutes

PROJECT No: DO09

PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: To research alternative refrigerants for the Microclimate Cooling (MCC) Program, currently in development.

APPROACH: Research environmentally friendly refrigerants, select most promising, determine system needs, performance, sizing, life expectancy and match to overall system needs. Conduct experimental testing and determine performance and technical data specifications for the MCC program.

PROPOINTER: NRDEC

POC: Mr. Mark W. Wolfson
PHONE: (508) 651-5441  FAX(508)651-5441

TITLE: Chemistry of Halon Substitutes

PROJECT No: DO70

PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: Army Research Lab, APG, MD

OBJECTIVE: Identify potential halon replacement agents which are efficient in extinguishing fuel fires without producing excessive amounts of toxic by-products.

APPROACH: Agents will be ranked according to their ability to extinguish JP-8 fires and their production to toxic gases.

PROPOINTER: ATCOM

POC: Dr. Anthony E. Finnerty
PHONE: 410-278-6572  FAX: 410-278-8736

TZ TLE: Non-Ozone Depleting Sealants for Ammunition Applications

PROJECT No: El76

PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: For small caliber ammunition, replace existing case mouth waterproofing sealant, which contains ODC’s with non-ODC material.

APPROACH: Investigate and evaluate non-ODC sealants, test candidate materials and conduct high rate application/feasibility studies.

PROPOINTER: IOC

POC: Primary: Dean Martinelli; Secondary Don Rorabaugh
PHONE: 201-724-4482; DSN: 8804482  FAX: 201-724-4482
**TITLE:** Replacement of HCFC-22 in Military Environmental Control Units  

**PROJECT No:** E201  
**PROGRAM FUNDING SOURCE:** 6.3  

**PERFORMING LAB:** Army Mobility Tech Center, Ft.Belvoir, VA  

**RESEARCH CATEGORY:** 6.3  

**OBJECTIVE:** To evaluate non-ozone-depleting refrigerants and retrofit designs for existing military environmental control units.  

**APPROACH:** Evaluate HCFC-22 (Class 2 ODC) alternative refrigerants in existing military environmental control units based on complete designs and test data and develop optimized retrofit designs using best refrigerant substitutes.  

**PROPOONENT:** TACOM  

**POC:** Mr. Chris Bolton  
**PHONE:** (703)704-1995  
**FAX:** (703)704-2005  

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**TITLE:** Atmospheric Fate of Halon Alternative Compounds  

**PROJECT No:** E2 17  
**PROGRAM FUNDING SOURCE:** 6.1  

**PERFORMING LAB:** Army Research Lab, APG, MD  

**OBJECTIVE:** To determine the environmental acceptability of current and future candidates replacement compounds.  

**APPROACH:** This research project consists of multiple tasks which involves primarily (A) chemical kinetic research of both atmospheric gas phase and surface (heterogeneous) reactions (joint ARL/NIST collaborative effort), (b) spectroscopy and photochemistry (including surface photochemistry) of halocarbon replacement compounds or their reaction products (joint ARL/NIST collaborative effort), and (c) determination of GWP and ODP for the halocarbon replacement compounds or for their reaction products. The actual ODP and GWP calculations will be done at the University of Illinois.  

**PROPOONENT:** TACOM  

**POC:** Dr. Andrzej W. Miziolek  
**PHONE:** 410-278-6157  
**FAX:** 410-278-6150  

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**TITLE:** Chemical and Physical Processes Responsible for Flame Inhibition Using Halon Agents and Their Alternatives.  

**PROJECT No:** E219  
**PROGRAM FUNDING SOURCE:** 6.216.3  

**PERFORMING LAB:** Army Research Lab, APG, MD  

**OBJECTIVE:** The goal of this research project is to develop a detailed flame chemistry computer model which will no only predict the relative flame extinguishment properties of new Halon alternative compounds, but also will identify the possible formation of toxic flame products resulting from the use of the agents(s).
**APPROACH:** The basic approach involves a tightly coordinated research program of flame model development coupled with experimental verification. The flame experiments involve the use of a low pressure burner apparatus which contains a premixed laminar flow flame. We use the Tunable Diode Laser (TDL) absorption technique for flame profile studies. The detailed chemical flame mechanisms are tested on the basis of agreement with the experimental results. The detailed kinetic models are based on accurate knowledge of thermodynamic and kinetic properties of the relevant species and reactions.

**PROPOONENT:** TACOM, ATCOM, Wright Paterson AFB.

**POC:** Dr. Andrzej W. Miziolek, ARL  
**PHONE:** 410-278-6157  
**FAX:** 410-278-6150

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**TITLE:** Elimination of Ozone Depleting Chemical Warfare Agent Test Simulants  
**PROJECT No:** F037  
**PROGRAM FUNDING SOURCE:** 6.2  
**PERFORMING LAB:** NRDEC, Natick, MA  
**RESEARCH CATEGORY:** 6.2  
**OBJECTIVE:** Develop a non-ozone depleting chemical to replace carbon tetrachloride as the simulant used in the chemical adsorptivity testing of chemical protective fabrics for the military.

**PROPOONENT:** Natick Research, Development and Engineering Center  
**POC:** Mr. Martin Katz  
**PHONE:** (508) 651-4730  
**FAX:** (508) 651-4331

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**TITLE:** Elimination of ODS and VOC From the Manufacture of I-136 Igniter Mix  
**PROJECT No:** F066  
**PROGRAM FUNDING SOURCE:** 6.3  
**PERFORMING LAB:** ARDEC, Picatinny Arsenal, NJ  
**OBJECTIVE:** Develop an alternative method of blending I-236 igniter mix as a replacement for the current processes, which utilizes ozone depleting substances and volatile organic compounds (methyl chloroform and ethyl alcohol).

**APPROACH:** The approach will be to develop an alternate method of manufacturing I-136 igniter without the use of any ODC or VOC solvents or the substitution of other fuel/oxidizer materials which do not require the use of ODC or VOC solvents. Liquid nitrogen is under consideration as a possible solvent substitute. Other methods used by the pharmaceutical industry to improve homogeneity and powder flow characteristics are also under consideration for application to resolve this problem. The problem will be investigated under a contract with Lake City Army Ammunition Plant (LCAAP). Once the best alternate solutions are determined, samples will be fabricated and tested. Upon completion of testing, the optimum alternate solution will be manufactured in quantity and subjected to ballistic performance testing, long term storage and compatibility testing and implemented into production upon successful completion of objectives.

**PROPOONENT:** NATICK  
**POC:** Mr. Martin Katz  
**PHONE:** (508) 651-4730  
**FAX:** (508) 651-4331
TZTLE Elimination of ODS Used in Chemical Agent Filter Performance Testing:

**PROJECT No:** F083  
**PROGRAM FUNDING SOURCE:** AMC/ODC

**PERFORMING LAB:** Army Environmental Hygiene Agency (AEHA), APG, MD

**OBJECTIVE:** To develop a new leak test for chemical warfare agent filters such that only environmentally friendly substances are used and increased assurance of adequate filter performance is obtained.

**APPROACH:** A wide range of candidate chemical compounds will be screened for their ability to meet the six major criteria needed to be effective in filter leak testing. The top two or three candidates will be selected for experimental evaluation. Test filters will be modified with leaks of known extent. The test program will be conducted to determine which leak tracer compound best measures the extent of leakage in the test filters. A formal description of the test methodology will be prepared.

**PROONENT:** AEHA

**POC:** Robert W. Morrison  
**PHONE:** (410) 671-5689  
**FAX:** (410) 671-3323

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**TITLE:** Non-Halogenated Systems For Cleaning Metal Parts

**PROJECT No:** NDCEE N.007  
**PROGRAM FUNDING SOURCE:** DEMIVAL

**PERFORMING LAB:** NDCEE

**OBJECTIVE:** Demonstrate non-solvent cleaning and degreasing processes for DOD metal components.

**APPROACH:** Select aqueous cleaning processes to replace halogenated solvent cleaning processes. Define metal surface cleanliness standards.

**PROONENT:** Army, Navy

**POC:** Mr. W. Sharpe  
**PHONE:** (201) 724-7171  
**FAX:** (201) 724-6503
Packaging Projects

TITLE: Biodegradable Packaging - Characterize Starch Based Formulations

PROJECT No: D030A

PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: Develop 100% biodegradable materials for the Army, other military services, and civilian applications

APPROACH: Pursue and characterize starch based formulations.

PROPOINENT: NRDEC/ NAVSUP

POC: Jean Mayer
PHONE: (508) 651-4405
FAX: (508) 651-5521

TITLE: Biodegradable Packaging - Characterize Non-starch Based Formulations

PROJECT No: D030B

PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: To develop biodegradable packaging and food utensils for military use which can be readily disposed in an environmentally acceptable manner.

APPROACH: Pursue and characterize non-starch based formulations.

PROPOINENT: NRDEC / NAVSUP

POC: Jean Mayer
PHONE: (508) 651-4405
FAX: (508) 651-5521

TITLE: Degradation in Soil and Marine Environments

PROJECT No: D030C

PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: To eliminate the negative effects of packaging upon the soil and marine environments.

APPROACH: To examine the effectiveness of new formulations of packaging to the soil and marine environments.

PROPOINENT: NRDEC / NAVSUP

POC: Jean Mayer
PHONE: (508) 651-4405
FAX: (508) 651-5521
TITLE: Solid Waste Composting of Packaging Materials

PROJECT No: D030D  PROGRAM FUNDING SOURCE: 6.2

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: The objective of this effort is to develop 100% biodegradable materials for the Army, other military services, and civilian applications.

APPROACH: To develop accelerated recycling biodegradable materials with the emerging technology of solid waste composting.

PROPOSENT: NRDEC / NAVSUP

POC: Jean Mayer
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NUMBER: D030E

TITLE: Toxicity Studies of Biodegradable Plastics

PROJECT No: D030E  PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: The objective of this project is to develop 100% biodegradable packaging materials for the Army, other military services, and civilian applications.

APPROACH: The approach of this project is to perform soil and marine toxicity studies to determine impact of biodegradable materials on higher organisms if the materials are discarded on land and sea.

PROPOSENT: NRDEC I NAVSUP

POC: Jean Mayer
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TITLE: Field Testing of Biodegradable Products

PROJECT No: D030F  PROGRAM FUNDING SOURCE: 6.3

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: The objective of this project is to develop 100% biodegradable packaging materials for the Army, other military services, and civilian applications.

APPROACH: The approach of this project is to conduct evaluations of products fabricated from biodegradable materials for properties, functions, and acceptability.

PROPOSENT: NRDEC I NAVSUP

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Advanced Materials Processing Projects

**TITLE:** Minimization of Uranium Alloy Waste by Electron Beam Melting

**PROJECT No:** A055B  
**PROGRAM FUNDING SOURCE:** 6.2

**PERFORMING LAB:** ARDEC/Sandia NL/LLNL

**OBJECTIVE:** Reduce disposal costs associated with the manufacturing and demilitarization of depleted uranium by conversion into new products/alloys.

**APPROACH:** Pursue a joint effort with DOE to demonstrate on a small scale the electron beam, cold hearth vacuum furnace technology to convert DU metal waste to billets for production use.

**PROPONEENT:** IOC

**POC:** Mr Kenneth Willison  
**PHONE:** (201) 724-2879  
**FAX:** (201)361-7378

**TITLE:** Alternates to Acid Cleaning of DU Metal Surfaces

**PROJECT No:** A056  
**PROGRAM FUNDING SOURCE:** 6.3

**PERFORMING LAB:** ARDEC/Army Mobility Tech Center, Ft. Belvoir, VA

**OBJECTIVE:** Reduce disposal costs associated with the equipment and vehicles contaminated with depleted uranium.

**APPROACH:** Investigate new technologies for cleaning Depleting Uranium (DU) metal surfaces to eliminate acid cleaning procedures (e.g. spongejet).

**PROPOINENT:** PM-TMAS, IOC, TACOM

**POC:** Dr. R. Bhatt  
**PHONE:** (703)704-1979  
**FAX:** (703)704-1990

**TITLE:** Environmental/Health Effects Evaluation of Alternatives for DU Penetrators.

**PROJECT No:** BAA94-019  
**PROGRAM FUNDING SOURCE:** 6.1

**PERFORMING LAB:** Oak Ridge(DOE)/ARDEC, Picatinny Arsenal, NJ

**OBJECTIVE:** Investigate alternative alloys to depleted uranium for kinetic energy penetrators that do not have the low-level radiation and health effects issues of depleted uranium

**APPROACH:** Investigate tungsten based alloys having improved binder materials to currently available iron-nickel. The alternate binders have initially been identified as hafnium, zirconium, titanium, intermetallic compounds, and precipitation and spinodally-hardned copper alloys.

**PROPOINENT:** TACOM

**POC:** Deepak Kapoor  
**PHONE:** 201-724-2596  
**FAX:** 201-361-7378
TITLE: Light Weight Protective Ceramics

PROJECT No: CO10 PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: Develop new processing systems to reduce environmental burdens (organic solvents) and energy requirements of ceramic manufacturing through new processing approaches in the formation of ceramic powders and composites by mimicking biological methods to control inorganic-organic interfaces.

APPROACH: Identify the proteins involved in natural mineralization. Determine protein function as matrix material for biomineralization. Synthesize modified matrix biopolymers for specific structures. Select and evaluate ceramic and composite systems of military importance for study. Conduct modeling studies to predict structure-function relationships relative to crystal growth studies. Determine conditions necessary for aqueous ambient growth of technologically important ceramic materials.

PROONENT: NRDEC

POC: Mr. Il-Young Kim
PHONE: 508-651-4296 FAX: 508-651-5104

TITLE: Aqueous Processing of Fibers and Composites

PROJECT No: El 96 PROGRAM FUNDING SOURCE: 6.1

PERFORMING LAB: NRDEC, Natick, MA

OBJECTIVE: Demonstrate environmentally compatible, viable technology for aqueous processing of high performance polymers into functional materials. This will be done using aqueous based synthesis and processing and use of materials derived from renewable resources.

APPROACH: Design and optimize biopolymer materials that exhibit key structural properties for specific applications and that can be processed from aqueous systems. Structurally functional protein polymers will be genetically designed. Key polymers will be produced from biological cultures, isolated, purified characterized and scaled up for processing studies. Functional properties of new materials will be evaluated in fiber film, membrane and composite form. Extramural solubilization problems will be solved for biopolymers in aqueous systems. Processing will be optimized to produce high orientation and controlled structure in fibers / films / composites. New biopolymers for high performance, multifunctional applications will be synthesized by recombinant DNA techniques and expressed in bacteria/plant cells and characterized or use in membrane, film and composite applications.

PROONENT: AMC

POC: Mr. Stephen Fossey
PHONE: 508-651-5360 FAX: 508-651-5104
TITLE: Environmentally Safe Sealants for Weapon System Design and Production

PROJECT No: F004

PROGRAM FUNDING SOURCE: 6.2/6.3

PERFORMING LAB: ARDEC, Picatinny Arsenal, NJ

OBJECTIVE: Eliminate and replace the use of toxic, environmentally unsafe solvents in sealants for projectile/cartridge interfaces, primers, fuze threads, mortar fin assemblies, mine/housing interfaces, artillery systems, grenade fuzes and many other munitions/weaponry designs.

APPROACH: Identify 100% solids or safe solvent sealants suitable for various substrates. Validate candidate materials by providing control specimens and compare to specimens sealed with solvent safe/free materials. Determine feasibility of using new materials in high rate production environment.

PROPOSENENT: AMC

POC: Mr. D. Martinelli
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