United States Environmental Protection Agency

Office of Enforcement and Compliance Assurance
Washington, DC 20460

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February 1998

EPA Federal Facilities Toxic Release and Reduction Initiatives Fact Sheet

Background

Executive Order 12856, entitled "Federal Compliance with Right-To-Know Laws and Pollution Prevention Requirements", was signed by President Clinton on August 3, 1993. The primary objectives of EO 12856 are to encourage Federal facilities to:

- Develop pollution prevention plans to reduce toxic releases by 50%;
- Collect and report data on the quantity of hazardous materials stored, used, and released at the facility;
- Ensure public access to use and release information.

Federal facilities are required to submit annual TRI reports starting in 1995 for data collected in 1994.

TOLUENE

1995 Waste Management Distribution

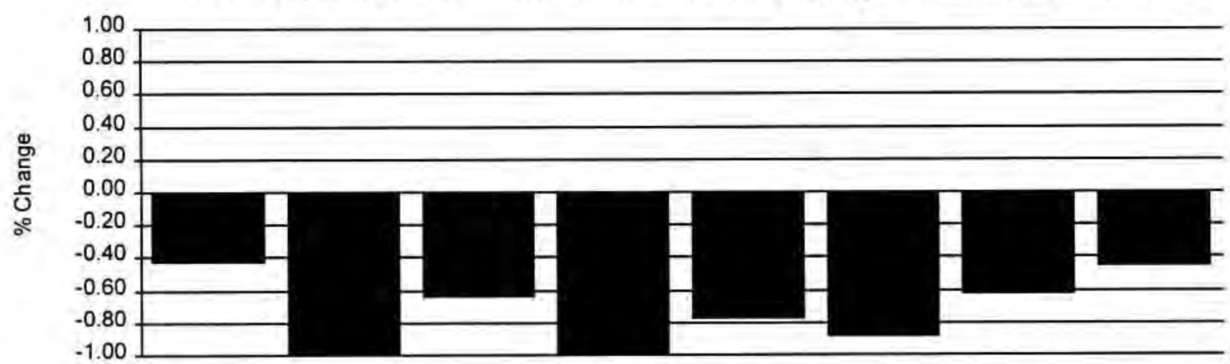
Approach

A study was undertaken to analyze Federal facility TRI data for 1994 and 1995 to: 1) determine the most commonly used and released chemicals; 2) identify currently used pollution prevention (P2) approaches and on-going pollution prevention research and development to lower or substitute the use of a chemical; and 3) identify potential RD/transition needs. As of January 1998, fifteen chemical Fact Sheets have been developed. Please refer to the back page to order Fact Sheets for other chemicals.

This Fact Sheet contains two charts and four main sections:

- The charts represent the waste management distribution and percent change of TRI reported quantities.
- Chemical Profile section.
- Identified and used P2 approaches section.
- On-going P2 research and development section.
- P2 research and development/transition needs section.

TRI Reported Quantities - Percent Change 1994 and 1995



TRI Reporting	Releases	Recycling		Energy Recovery		Treatment		Releases plus Off-site Treatment
		On-Site	Off-Site	On-Site	Off-Site	On-Site	Off-Site	
1994 (lbs)	429,175	30,700	69,375	10,415	255,787	167,068	61,810	490,985
1995 (lbs)	242,598	0	24,694	0	57,145	18,167	22,873	265,471
% Change	-43%	-100%	-64%	-100%	-78%	-89%	-63%	-46%

SYNONYMS METHYLBENZENE TOLUOL PHENYLMETHANE

COMMON USES IN THE U.S.

www.epa.gov/ttn/uatw#http://www.epa.gov/ttn/uatw#

- Forty nine Federal facilities reported releases of toluene in their 1994 or 1995 TRI reports. The majority of the facilities use toluene in painting and depainting operations or cleaning. The single largest releaser is Robins AFB (14% of the total 1994 releases), followed by the Air Force Flight Test Center, Edwards, CA (7%).
- Toluene is used in the manufacture of benzene and styrene, dyes, and explosives. It is commonly used as a solvent for extraction processes. Toluene is a component of paints and paint thinners, degreasers, adhesives and sealants.

ACUTE HEALTH HAZARDS

www.epa.gov/ttn/uatw#http://www.epa.gov/ttn/uatw#

- Exposure can irritate the nose, throat, and eyes. Higher levels can cause dizziness and fainting. Death can occur. Lower levels may cause trouble concentrating, headaches, and slowed reflexes.

CHRONIC HEALTH HAZARDS

www.epa.gov/ttn/uatw#http://www.epa.gov/ttn/uatw#

- Toluene may cause genetic mutations, further study is needed to determine if it is carcinogenic. Toluene may damage the developing fetus. Other long term effects: repeated exposure may cause damage to bone marrow, causing a low blood cell count. Prolonged contact can cause drying and cracking of the skin, and a rash. Repeated exposure can cause headaches, lack of appetite, nausea, and liver and kidney damage, and may cause brain damage.

COMMON P2 INITIATIVES

www.epa.gov/ttn/uatw#http://www.epa.gov/ttn/uatw#

- Process efficiency improvement. Abrasive blast media is used as an alternative method for cleaning metal parts. Aqueous jet washers, vacuum vapor degreasers, and other parts washer systems reduce solvent wastes and fugitive emissions.
- Degreasing.
  Solvent substitution. Switch to cleaning solvents with reduced environmental impact (low toxicity, low VOC, non-HAP, biodegradable).
- Recycling. Toluene based paint thinners can be recycled on-site or off-site in recycling units.
- Process efficiency improvements. Use more efficient paint guns to improve transfer efficiency; use alternative paint stripping equipment.
- Painting and Paint Stripping
  Material substitution. Switch to non-toluene based paints, coatings, and paint thinners.

Additional information regarding chemical hazards and access to Material Safety Data Sheets can be reached through the Agency for Toxic Substances and Disease Registry web page: http://atsdr1.atsdr.cdc.gov.8080/ - refer to ToxFAQs.

FEDERAL FACILITIES REPORTING | **COMMON USES OF: TOLUENE**

Federal Facililties Reporting in both 1994 and 1995	22	HAND-WIPE SOLVENT	HEAVY-DUTY SOLVENT
Federal Facililties Reporting Only in 1994	26	PAINT REMOVER	
Federal Facililties Reporting Only in 1995	1		

POLLUTION PREVENTION APPROACHES CURRENTLY IN USE

HAND-WIPE SOLVENT

- Replaced MEK with a cleaner approved by the KC-135 SPO at Tinker AFB, methyl-n-propyl ketone (MPK). ASC/RAS, Wright Patterson AFB
- KC-135 Systems Program Office, (OC-ALC), switched to cleaners under the MIL-C-87937 specification including DS-108 for wipe-prior-to-paint applications. They are continuing to test and evaluate other commercially available solvents including borothene and hydrofluoroethers. Tinker AFB, Oklahoma City ALC
- Isopropyl alcohol (IPA) is approved as an alternative to MEK. Technical Order 1-1-8 which references T.O. 1-1-691 contains specific procedures for the use of IPA. T.O. 1-1-691 recommends cleaning products qualified to MIL-C-87937, Type II. Cleaners qualified to MIL-C-87937B are the most environmentally friendly cleaners authorized for use on C-141 aircraft and its components. (Reference: PRO-ACT Technical Inquiry 8200)

POLLUTION PREVENTION APPROACHES CURRENTLY IN USE

HAND-WIPE SOLVENT

- Replaced 1,1,1-trichloroethane (TCA) and methyl ethyl ketone (MEK) with a terpene cleaner for hand wiping operations. Martin Marietta Astronautics

HEAVY-DUTY SOLVENT

- Tinker AFB is installing two vacuum vapor degreasers for wax removal. Vacuum vapor degreasers release less solvent to the atmosphere because the work chamber is completely enclosed. The engine parts are placed in an airtight chamber into which solvent vapors are introduced. After cleaning is complete, the solvent vapors in the chamber are evacuated and captured by chilling and carbon adsorption. Once the solvent in the chamber is evacuated, the door of the chamber is opened and the workload is withdrawn. The cleaned workload is also free from any residual solvent, and there are no subsequent emissions. (Reference: USEPA Guide to Cleaner Technologies: Cleaning and Degreasing Process Changes. EPA/625/R-93/017. February 1994).
- Abrasive blasting is an alternative to solvents for cleaning. In the blasting process, particulate media is propelled by compressed gases or a liquid to impinge on the contaminated surface. No toxic or hazardous chemicals are used; however, the blasting media can become contaminated with the material being blasted from the surface. There are several different types of blasting media, some multi-purpose and others single purpose. The various types of blasting media are: Mineral Grit/Sand Blasting, Steel Shot, Plastic Media, Plastic Foam, Dry Ice (CO_2), Wheat Starch, Walnut Shells and Other Food By Products, and Sodium Bicarbonate.
- Nonhalogenated Systems for Cleaning Metal Parts: Production testing demonstrated the viability of spray and immersion cleaning systems for specific cleaning applications. Based on the bench scale testing, NDCEE determined that Brulin formula 815GD is the preferred aqueous chemistry for mechanically and ultrasonically agitated immersion systems and will be used for production testing in the Advanced Ultrasonic Cleaning System. Daraclean 282 was selected for use in the Power Washer Cleaning System, although all of the chemistries downselected for the bench scale testing effectively emulsified the soils and prevented recontamination of the parts. NDCEE, POC: Richard Pirotta 814-269-2810.
- Hill AFB switched to terpenes and an ethyl lactate blend for aircraft cleaning operations. Hill AFB, Ogden ALC
- Steam cabinets or vacuum vapor degreasers will most likely be used at OC-ALC for penetrant removal prior to plating. Steam cleaning is a viable solvent alternative for removing oily or greasy residue. The heat accelerates emulsification break-down, and removal of caked-on dirt and grease. The high temperature of steam is used to heat surfaces long enough for the steam to vaporize or liquefy the oil, grease, or dirt. The residue can then be effectively washed away with the steam condensate. Steam cleaning can also be used with a degreasing agent (often a surfactant) to enhance the solubility of grease in water. Steam cleaners are available to perform medium duty to heavy duty cleaning jobs and are available in a variety of different system configurations. Portable steam cleaners are available through the national stock system. These have been used at DOD facilities for removing oil, grease, sand, rust, carbon, and burnt propellant from weapons. The wastewater generated from the steam cleaning process may be treated at an industrial wastewater treatment plant, depending on the toxicity of the dirt and grease removed.
- Switched to alternative cleaners for MEK and TCA: Pensolv L805 (a terpene-based, four part cleaner); a four part cleaner (containing MEK and toluene); and DS-108. Commodities Directorate, OC-ALC
- Tinker AFB is installing two vacuum vapor degreasers for wax removal. Vacuum vapor degreasers release less solvent to the atmosphere because the work chamber is completely enclosed. The engine parts are placed in an airtight chamber into which solvent vapors are introduced. After cleaning is complete, the solvent vapors in the chamber are evacuated and captured by chilling and carbon adsorption. Once the solvent in the chamber is evacuated, the door of the chamber is opened and the workload is withdrawn. The cleaned workload is also free from any residual solvent, and there are no subsequent emissions. (Reference: USEPA Guide to Cleaner Technologies: Cleaning and Degreasing Process Changes. EPA/625/R-93/017. February 1994).
- Using carbon dioxide blast media system for cleaning KC-135, C-141, B-52, B-1, and F-16 engines. CO_2 is used in conjunction with solvent cleaning methods as an initial cleaning step in the process. Both G.E. and Pratt and Whitney approved the use of CO_2 for cleaning engines. Additional technologies successfully implemented to replace solvent usage in propulsion include: power spray washers, water-based cleaners, and water jet. (Reference: B. Ley "Solvent Substitution in Jet Engine Maintenance at Tinker AFB" Proceedings from the 1996 Tri-Services World-Wide Pollution Prevention Conference"). Tinker AFB
- For heavy soil removal, NAVAIR recommends low vapor pressure (LVP) organic solvents. These solvents are volatile organic compounds, but due to their low vapor pressures and slower evaporation rates, they may be exempt from certain air regulations and produce lower air emissions depending on how they are used, managed, and stored. LVP solvents are generally composed of aliphatic petroleum hydrocarbons, terpenes, esters, or organic blends with vapor pressures below 5 mmHg at 72 degrees F. Normally, these solvents are applied with a solvent soaked cloth, followed by a surface wipe with a clean cloth. In some cases, a second clean cloth wipe may be required to remove residual solvent to speed drying.
- Abrasive blasting is an alternative to solvents for cleaning. In the blasting process, particulate media is propelled by compressed gases or a liquid to impinge on the contaminated surface. No toxic or hazardous chemicals are used; however, the blasting media can become contaminated with the material being blasted from the surface. There are several different types of blasting media, some multi-purpose and others single purpose. The various types of blasting media are: Mineral Grit/Sand Blasting, Steel Shot, Plastic Media, Plastic Foam, Dry Ice (CO_2), Wheat Starch, Walnut Shells and Other Food By Products, and Sodium Bicarbonate.
- Toluene is found in many heavy degreasing and stripping products often as an additive instead of as the primary ingredient. It is a major component in blanket wash cleaners used in lithographic printing. Many Federal facilities have successfully found less toxic alternatives for toluene in cleaning processes. In many cases, facilities have modified both the cleaning agent and the cleaning equipment. Aqueous jet washers, for example, are now commonly found at most DOD facilities.

POLLUTION PREVENTION APPROACHES CURRENTLY IN USE

HEAVY-DUTY SOLVENT

- Steam cabinets or vacuum vapor degreasers will most likely be used at OC-ALC for penetrant removal prior to plating. Steam cleaning is a viable solvent alternative for removing oily or greasy residue. The heat accelerates emulsification break-down, and removal of caked-on dirt and grease. The high temperature of steam is used to heat surfaces long enough for the steam to vaporize or liquefy the oil, grease, or dirt. The residue can then be effectively washed away with the steam condensate. Steam cleaning can also be used with a degreasing agent (often a surfactant) to enhance the solubility of grease in water. Steam cleaners are available to perform medium duty to heavy duty cleaning jobs and are available in a variety of different system configurations. Portable steam cleaners are available through the national stock system. These have been used at DOD facilities for removing oil, grease, sand, rust, carbon, and burnt propellant from weapons. The wastewater generated from the steam cleaning process may be treated at an industrial wastewater treatment plant, depending on the toxicity of the dirt and grease removed.
- Using carbon dioxide blast media system for cleaning KC-135, C-141, B-52, B-1, and F-16 engines. CO2 is used in conjunction with solvent cleaning methods as an initial cleaning step in the process. Both G.E. and Pratt and Whitney approved the use of CO2 for cleaning engines. Additional technologies successfully implemented to replace solvent usage in propulsion include: power spray washers, water-based cleaners, and water jet. (Reference: B. Ley "Solvent Substitution in Jet Engine Maintenance at Tinker AFB" Proceedings from the 1996 Tri-Services World-Wide Pollution Prevention Conference"). Tinker AFB
- Resolved by switching to terpenes and an ethyl lactate blend for aircraft cleaning operations. Hill AFB, Ogden ALC

PAINT REMOVER

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- Mobile Manipulation of a CO2 Turbine Wheel Coatings Removal System: NDCEE tested and demonstrated the use of a centrifugally accelerated carbon dioxide pellet turbine wheel (CO2 TW) device manufactured by Cryogenics, Inc. The device was tested using Navy equipment and compared results with current coatings removal methods. POC: Frederick Lancaster, NDCEE, 814-269-2806.
- Automated Ultra-High Pressure Waterjet System Workcell UHPWJ (N.020): This project will evaluate the automated UHPWJ process for thermal spray coatings removal, aid in transitioning this technology to DOD repair/refurbishment depots, and explore UHPWJ stripping as a possible alternative to other waste-generating coatings removal processes, which utilize acid dip/media blast steps that generate hazardous waste and damage engine components. ARDEC, Corpus Christi Army Depot (CCAD), NDCEE; POC: Frederick Lancaster, NDCEE, 814-269-2806.
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ON-GOING POLLUTION PREVENTION RESEARCH AND DEVELOPMENT

HAND-WIPE SOLVENT

<u>Surface/Solvent Diagnostics for Metal Cleaning Operations:</u>
Army Research Laboratory; POC: Unknown

<u>Alternatives for General Aircraft Maintenance:</u>
CCAD; POC: Unknown

<u>Solvent Substitution for Fuel Tank Cleaning:</u>
Using isopropyl alcohol (IPA) as a temporary substitute for the cleaning compound (NSN 6850-00-611-7993) that contains MEK for spot cleaning fuel tanks. The B-52 program office is working with Morton Aerospace to test a substitute sealant (MC-250) that could be removed with a substitute cleaner that does not contain HAPS. USAF, B-52 Program Office; POC: Unknown.

HAND-WIPE SOLVENT

Substitute Wipe Solvent:

Testing DS-108 as a substitute wipe solvent. DS-108 Solvent was developed and patented by General Dynamics, Fort Worth Division (now Lockheed-Martin Tactical Aircraft Systems) for use in the F-16 program. DS-108 has been qualified to meet a variety of OEM and military specifications and received toxicity clearance from the Surgeon General, Department of the Army. USAF, OC-ALC; POC: Unknown.

Substitute Hand-Wipe Solvents:

Tested 30 commercially available hand-wipe cleaners. Of the 30 cleaners, only four passed all screening tests: SD 1291 (Brulin Corporation); CitraSafe (Inland Technology); Super 140 (LPS Industries); and De-Solv-It E&E (Orange-Sol, Inc.). USAF, Warner Robins ALC (WR-ALC/TI); POC: Unknown.

Substitute Hand-Wipe Solvents:

Evaluated 24 cleaners. Testing three potential substitutes for MEK: ISO-BLAST, MD-516F, and Androx 5564. USAF, F-15 Program Office, Wright Patterson AFB; POC: Unknown.

Substitute for Hand-Wipe Solvents:

Conducted extensive testing on commercially available, environmentally-friendly hand-wipe solvents for use on the B-2 program at the Air Force Plant 42 Palmdale site. Selected two solvents for implementation in manufacturing operations, Dynamold DS-108 and DS-108CA. Northrop Grumman; POC: Unknown.

Solvent Substitution/Low VOC Cleaners:

Navy-Patuxant; POC: Unknown

Non-toxic Small/Medium Caliber Automatic Weapons Cleaning Process:

ARDEC; POC: Unknown

HEAVY-DUTY SOLVENT

Liquefied Gases as Substitutes for Traditional Solvents:

U.S. Army, MICOM; POC: Unknown

High Efficiency, Low-Cost Supercritical Fluid Cleaner:

SWRI developed a natural convection supercritical fluids cleaner as a substitute for 1,1,1-trichloroethane. SWRI also designed and built a pre-production natural convection cleaning system. Under this project, SWRI will establish the cleaning envelope for the natural convection process. As of June 1997, SWRI had begun the background contamination study and the particulate filtering system design. Southwest Research Institute and Air Force Research Laboratory; POC: Mary Marshall, (210) 522-2183.

APMS&E for Aircraft Components:

Field demonstration of laser based facility for component cleaning, coating removal and surface preparation. Wright Lab; POC: Robert Hall, WL/MLPJ, DSN 785-2334.

Supercritical Carbon Dioxide for Solvent Replacement:

LANL conducted a project to develop improved techniques for cleaning with supercritical carbon dioxide. LANL has a Supercritical Fluids Experimental User facility available for exploratory evaluation and long-term R&D. Los Alamos National Laboratory; POC: Dale Spall, Ken Laintz.

Reduce Toxic Pollutant in Ultrasonic Cleaner Discharge Wastewater:

NDCEE/ Tobyhanna Army Depot; POC: Unknown

Plasma Dry Cleaning:

LANL conducted a technology demonstration of plasma dry cleaning on sample components and is developing industrial process techniques. Process uses an oxygen, radio-frequency plasma to remove hydrocarbon surface contamination, such as cutting fluids, oils, and greases from components. Resultant by-products are carbon dioxide and water vapor. Reactive ions generated in a plasma bombard the substrate, releasing contaminants. Los Alamos National Laboratory; POC: Harold Davis.

P2 Technology Maturation:

Ultraviolet Light/Ozone Cleaning. Wright Lab, McDonnell Douglas, SAIC; POC: Harvey Lilenfeld (314) 233-2550.

APEDOM for a Supercritical Fluid Cleaner for Avionics and Mechanical Components:

Alternative Process Design and Operation Manual for a supercritical fluid cleaner with an internal chamber sized to accommodate both avionics and mechanical components. Air Force Research Laboratory; POC: Phil Mykytiuk, WL/MLSE, DSN 785-3953, (513) 255-3953.

Mobile Advanced, Aqueous Solution Recovery Systems:

NDCEE will test advanced separation and filtration technologies for closed loop recovery of aqueous solutions. NDCEE; POC: David Roberts, 814-269-2885.

Alternative Cleaning Processes for Metal and Composite Honeycomb Parts:

Corpus Christi Army Depot and NDCEE will develop an environmentally friendly cleaning process for cleaning the honeycomb core, skins, and structural members prior to bonding. CCAD, NDCEE; POC: Mr. Al Gonzales, 512-939-4073.

HEAVY-DUTY SOLVENT

Laser Cleaning for Semiconductor Manufacturing:

Joint demonstration of a laser cleaning system manufactured by Neuman MicroTechnologies, Inc. for silicon wafers, photomasks, and flat panel display substrates. National Security Agency, Motorola, USEPA, Radiance Services Company; POC: John Robinson, (301) 654-0228, (Radiance Services)

Laser Cleaning and Coatings Removal:

Demonstrate the use of laser cleaning and coating removal on components ranging from turbine engine blades to landing gear and radomes. Prototype laser-based facility will test carbon dioxide and examine laser cleaning and coating removal operations for a variety of aircraft and general equipment cleaning. Wright Lab/MTPN; POC: Mr. Michael Waddell (513) 255-7277.

Evaluation of Alternatives to Chlorinated Solvents and Cleaners for Army Vehicles:

Identify candidate replacement solvents and recovery systems for chlorinated solvents for Army vehicle maintenance and-repair. Test, evaluate and determine environmental and economic benefits. U.S. Army Materiel Command, TACOM; POC: T.C. Ilandsy, TACOM, 810-574-8834.

Environmentally Acceptable Cleaning Processes:

U.S. Army, TARDEC; POC: Unknown

Deploy Lactate Esters as Non-toxic, Non-polluting Solvent:

Explore the use of inexpensive lactate esters, such as ethyl lactate, for paint equipment cleaning, and honeycomb structure cleaning prior to bonding. Test recovery process. Conduct economic analysis. NCMS/ORNL; POC: Mr. Jim Frank, 708-252-7693

Continuous Aqueous Cleaning to Eliminate ODC:

RIA; POC: Unknown

Nonhalogenated Systems for Cleaning Metal Parts:

Production testing demonstrated the viability of spray and immersion cleaning systems for specific cleaning applications. Based on the bench scale testing, NDCEE determined that Brulin formula 815GD is the preferred aqueous chemistry for mechanically and ultrasonically agitated immersion systems and will be used for production testing in the Advanced Ultrasonic Cleaning System. Daraclean 282 was selected for use in the Power Washer Cleaning System, although all of the chemistries downselected for the bench scale testing effectively emulsified the soils and prevented recontamination of the parts. NDCEE and ARDEC; POC: Richard Pirotta NDCEE, 814-269-2810; Ms. D. Demone, ARDEC, 201-724-6773.

Solvent Replacement - Vapor Degreaser:

Allied Signal will demonstrate a replacement for 1,1,1-trichloroethane vapor degreasing. Allied Signal Army Engine Plants; POC: Mr. T. Russell, Mr. J. Morrell, 203-385-3741.

Aqueous-based Degreasing Technology:

The Army's Soldier Systems Command (SSCOM) will develop nonpolluting, nontoxic water-based degreasers for cleaning metal/ glass/plastic surfaces using biopolymer emulsifying materials. Develop microbially produced natural surfactants (emulsans) through fermentation processes and optimize chemical structure of the new materials for specific oil/grease removal needs. Solve production issues for fermentation and purification of new bioemulsifiers. Relate detergency to chemical structure. Tailor chemical structure of bioemulsifiers for specific degreasing applications. Extramural: modify bioemulsifiers by fermentation feeding strategies. Chemically characterize new emulsifiers. Modify other similar biopolymers with fermentation technique. Optimize bioremediation methods for emulsified oil/grease solutions. NRDEC and AMC-IOC; POC: Dr. Fred Allen 508-233-4266

Supercritical Carbon Dioxide Optical Sub-system Cleaning:

ARDEC; POC: Mr. Curtis Anderson, 201-724-4287.

Alternative Bullet Tip Degreasing Agent:

ARDEC/Lake City Army Ammunition Plant; POC: Ms. Bianca Roberts, 816-796-7168

APEDOM for Non-chemical Metal Cleaning of Aircraft Components:

Alternative process, engineering design and operation manual for non-chemical metal cleaning process for aircraft components, including wing skins, fuselage panels and bulkheads, etc., prior to surface preparation, such as anodizing, and subsequent priming in preparation for coating or adhesive bonding. Air Force Research Laboratory; POC: Phil Mykytiuk, WL/MLSE, DSN 785-3953, (513) 255-3953.

PAINT CONSTITUENT

Reduce Or Eliminate VOCs In CARC Paint Formulation, Application, & Removal:

The goals of the Army project are to reduce or eliminate VOCs in CARC paint formulation (MIL-C-53039 and MIL-C-46168), application, and removal. Reformulation will be based on a high performance, water reducible/water dispersible polyurethane binder system. Evaluate electroless metallic dispersion or thermoplastic spray coatings for application techniques. Current stripping technologies will be evaluated against the new coatings and optimized as required. US Army Research Laboratory; POC: 1-800-USA-3845.

KC-135 Integration Testing:

The USAF High Performance Aerospace Coating System (HPACS) program has performed testing of alternative aerospace coating systems (ex: low-VOC) on C-17 aircraft; laboratory data as well as flight test data from the C-17 program is available. Proposed efforts are to transition the application of high performance aerospace coating systems to KC-135 aircraft.

PAINT CONSTITUENT

Advanced Corrosion Resistant Aircraft Coatings (Contractor Support From Boeing Defense and Space):

The objective of this USAF program is to develop, demonstrate and commercialize effective coating materials and processes for aluminum alloys which prevent pollution, reduce or eliminate hazardous waste treatment and disposal costs, and are safe to use. The new processes will be environmentally benign and will meet DOD performance demands. The materials will eliminate the use of heavy metals (chromium) and volatile organic compounds (VOCs). The program employs a two-part parallel effort to develop a near-term coating system that will meet Aerospace NESHAP requirements and a long-term, totally "green" system. The near-term system includes non-chromate conversion coatings, non-chromate and low VOC primers and topcoats. The long-term solution will utilize sol-gel to replace conversion coatings, interface coatings, and low VOC, non-isocyanate topcoats. POC: Unknown.

Environmentally Compliant Protective Coatings:

The goals of this Army project are VOC reduction and removal of hazardous materials from protective coatings. US Army Research Laboratory; POC: 1-800-USA-3845.

Environmentally Compliant, Zero VOC Coatings (Contractor Support From Foster Miller):

The goal of this USAF project is to develop a two component, zero VOC coating that cures at room temperature in less than 24 hours. A no-VOC polyurethane/vinyl dioxolane (PVD) coating was developed in phase 1 that required a 50° C cure for several hours to develop adequate hardness properties. This development program will address room temperature cure capability by evaluating increased catalyst levels, more reactive catalysts, catalyst promoters and accelerators. The C-17 Advanced Performance Coating requirement document will be used to quantify coating performance. POC: Unknown.

High solids primer properties enhancements:

This USAF effort is to define the nature and extent of problems associated with the existing high solids primers. Problems with adhesion and excessive curing times have been reported. Potential solutions will be evaluated utilizing existing material and process options. Interaction with coating manufacturers to reformulate primers to correct problems that cannot be corrected by existing options will be accomplished. Additional pollution minimization may be achieved through reduced need for rework due to improved performance of the primers as well as reduced flow time for aircraft re-coating. POC: Unknown.

High Velocity Thermal Spray Coatings (Contractor Support From Aspen Systems, Weidman Associates, and SAIC):

This program at WR-ALC is to develop the high velocity thermal spray (HVTS) process of applying powder based coatings and systems. It includes development of AF specific HVTS application equipment and the development of powder based coatings. Note: Thermal Spray Coatings contain zero to little solvent borne carriers. POC: Unknown.

Non-Toxic, Low VOC Wash Primer:

Develop a non-toxic, low VOC wash primer as a universal metal pretreatment for Army equipment. Evaluate water-borne polymers that are compatible with moderate levels of mineral and organic acids and test their ability to act as adhesion-promoting primers and surface passivators. Armament Research, Development and Engineering Center (ARDEC); POC: 201-724-6518.

Plastic Laminate As A Replacement For Conventional Topcoats:

This Navy effort involves using plastic laminates developed by 3M as a total-body decal to replace traditional topcoats. The laminates are currently being flight tested on F-3, F-18, and C-130 aircraft. The plastic film is laminated to the aircraft's primer with an acrylic adhesive. Delaminating an aircraft is accomplished by using steam to release and remove the adhesive. The used laminate can then be land-filled. Advantages over traditional coatings include: reduced environmental/OSHA issues associated with traditional paint booth applications, faster installation, elimination of depaint hazardous waste and OSHA issues, lighter weight compared to typical multiple layer coatings, improved corrosion protection due to the impenetrable nature of the plastic film, and improved survivability. In addition to these advantages, commercial airline testing of the laminates have shown a fuel savings due to decreased drag. Navy; POC: Dave Pulley 301/342-8050.

R&M Improvement, Environmentally Compliant Aircraft Paints and Coatings (Contractor Support From Battelle):

Suppliers have been solicited to provide candidate-coating systems with primer and topcoat VOC levels equal to or less than 210 grams per liter as part of this USAF project. The contractor will also do some formulating with low VOC resin systems. POC: Unknown.

Topcoat for SADARM Projectile:

The goals of this Army project are to develop thin CARC paint coat for SADARM Projectile which meets VOC requirements. Armament Research, Development and Engineering Center (ARDEC); POC: 201-724-6518.

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

This project will investigate painting application technologies which reduce VOC emissions and improve coating quality. Identify present processes, research on state-of-the-art techniques. Development of demonstration facility and transition to a DOD facility. NDCEE; POC: Unknown.

Topcoat Reformulation:

JG-APP is currently sponsoring a project with Raytheon TI Systems, Inc. (formerly Texas Instrument Defense Systems and Electronics) to identify reduced VOC topcoat and primer formulations. Specifically, Raytheon is targeting reductions in methyl ethyl ketone (MEK), toluene, and xylene releases associated with conventional, wet-spray coating of primer, ground support equipment topcoat, and airborne topcoat applications. To date, this project has developed test protocols and will shortly be testing individual primer and topcoat formulations. JG-APP; POC: Mr. Luis Garcia-Baco, 703/617-2818.

PAINT CONSTITUENT

Waterborne primer system improvements:

This USAF effort involves assessing existing MIL-C-85582 primer problems that prevent USAF full-scale usage. Baseline laboratory integration and field transition testing of material and process improvements will be conducted. Assistance in transitioning the improved systems will be provided where required. This effort is proactive in solving current waterborne coatings technical issues for the purpose of transitioning from solvent-borne coating systems to low or zero VOC waterborne coating systems. POC: Unknown.

Large Area Powder Coatings Program (Contractor Support From BBM Inc., METTS Inc., Univ. of Southern Mississippi, and Weidman Associates):

The goal of this USAF project is to provide powder materials and technology to improve aircraft coating performance and increase environmental acceptability. The use of polymeric beads (powder) can significantly reduce the VOCs in aircraft coating formulations. Powders are also required for high velocity thermal spray coatings, which promise zero VOCs. This program will develop, optimize and produce powders that will provide the desired improvements in coating systems. In FY97, the processes and equipment developed will be demonstrated at WR-ALC on tactical mobile shelter structures and other applications. POC: Unknown.

Powder Coating Technology For Small Arms Bullet Tip Identification:

Eliminate VOCs associated with painting bullet tips. Demonstrate use of powder coating technologies in bullet tip identification. Armament Research, Development and Engineering Center (ARDEC); POC: 201-724-6518.

PAINT REMOVER

Improved Non-HAPs Chemical Strippers:

Identify/develop environmentally acceptable chemical paint strippers with a maximum dwell time of 1-hour and strip rate comparable to methylene chloride. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Water Jet Paint Stripping:

This effort is to develop a process to strip coatings from military ground vehicles, and small aircraft, contain the wastes, and recycle the water. POC: TACOM; Mr. Carl Handsy (313)-574-8834.

Selective Stripping Process Development:

Identify "smart" stripping processes capable of selectively removing topcoats from long-life foundation layers (primers). Would allow use of permanent foundation layers to achieve "paint for Life" systems. Any required HAPs, e.g. chromate corrosion inhibitors, could be contained within the permanent foundation layer. If this is not stripped, then there is no pollution from stripping process. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Polymedia Lite Evaluation for Composites:

The effort is to evaluate new dry blast media for stripping paint from composite laminates (graphite, glass , Kevlar). Tests will be conducted to determine if acceptable stripping rates can be achieved with insignificant or no damage to the aircraft. This is applicable to C-17 and F-22 aircraft with potential application to other aircraft. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Plastic Laminate As A Replacement For Conventional Topcoats:

This Navy effort involves using plastic laminates developed by 3M as a total-body decal to replace traditional topcoats. The laminates are currently being flight tested on F-3, F-18, and C-130 aircraft. The plastic film is laminated to the aircraft's primer with an acrylic adhesive. Delaminating an aircraft is accomplished by using steam to release and remove the adhesive. The used laminate can then be land-filled. Advantages over traditional coatings include: reduced environmental/OSHA issues associated with traditional paint booth applications, faster installation, elimination of depaint hazardous waste and OSHA issues, lighter weight compared to typical multiple layer coatings, improved corrosion protection due to the impenetrable nature of the plastic film, and improved survivability. In addition to these advantages, commercial airline testing of the laminates have shown a fuel savings due to decreased drag. Navy; POC: Dave Pulley 301/342-8050.

Paint Stripping Methods – Autocrawler:

This program is aimed at developing an autonomous or remotely piloted vehicle prototype designed to remove aircraft coatings. The approach is to take the existing autocrawler prototype and develop end effecter delivery systems capable of stripping coatings. The end effecters being evaluated are 1) medium/high pressure water, 2) wheat starch, and 3) flash lamp. The program includes a prototype built for one system. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Aircraft Depainting Technology:

This program will identify the best alternatives from existing/developmental methods such as non-hazardous chemical paint strippers (i.e., no chrome, MeCL, etc.) and mechanical procedures (PMB, Flash Lamp, dry ice, water jet, etc.). Procedure efficiency, substrate surface effects, hazardous waste generation and A/C applicability will be investigated in order to determine the best procedure for Navy applications. Comparison of the advantages and disadvantages of each technique will also be performed. Mechanical procedures eliminate hazardous chemicals, but can damage substrate surfaces. Since some aircraft skins are very thin, this is not acceptable. However, combinations of some techniques (i.e., flash lamp/dry ice) could eliminate or minimize surface damage to an acceptable level. POC: NAWCAD, Patuxent River; Mr. Steve Hartle; (301)-342-8006.

Medium Pressure Water Stripping:

This effort is to evaluate semi-automation and industrialization of a pressurized water process. This process can replace or enhance methylene chloride chemical applications. It applies to C-130, C-141 and other large aircraft. Recycled water can be used in the water stripping process. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

ON-GOING POLLUTION PREVENTION RESEARCH AND DEVELOPMENT

PAINT REMOVER

Alternate Chemical Paint Strippers:

Environmentally compatible paint strippers provide an alternative to the more hazardous products based on methylene chloride or caustic agents. The products are effective in removing thick layers of paint buildup with minimal damage to the substrate surface. The demonstration/validation (D/V) project confirmed that products effectively remove interior and exterior LBP from wood surfaces. POC: CERL, Susan Drodz (217)-373-6732.

Evaluation of Polymedia-lite Dry Blast Media:

This effort was to evaluate new dry blast media for paint stripping. Tests will be conducted to determine if acceptable stripping rates can be achieved with the same or less damage to the aircraft than conventional dry blast media. This is applicable to the C-5, F-15, A-10 and C-130. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Environmentally Acceptable Chemical Strippers:

This effort is to determine the range of parameters for viable environmentally acceptable processes and to evaluate handling issues. Potential benefits are to reduce or eliminate the use of toxic chemicals (HAPs). POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Dry Media Stripping of Thin Skin Aluminum:

This effort will determine the effects of dry media blasting (DMB) on thinner skin aluminum, .032 and .025 inch 2024 - T3 and bare alloy. Three different DMB will be evaluated: acrylic, polymedia-lite and polymerized wheat starch. Material characterization data for comparison of the three media will be developed from the JPATS airframe. If successful, a follow-on integration project will be started in FY98. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Development of NDE for Selective Stripping:

This effort is to develop non destructive evaluation techniques for determining the health of the primer or "foundation layer" that is to be left on the substrate and to inspect for corrosion under the primer or "foundation layer." POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Biodegradable Plastic Media - Foster Miller (SBIR):

This effort is to develop biodegradable plastic media and an associated biotreatment system, which can be, used in current generation plastic media blasting (PMB) aircraft coatings REMOVER processes. This could significantly reduce the amount of heavy metals contaminated waste from stripping chromate and cadmium containing paints. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

Aqueous Paint Coating & Stripping:

This Army project will design and produce new protein-based coatings for specific substrates (metals) and clean REMOVER strategy based on new aqueous-based systems. Armament Research, Development and Engineering Center (ARDEC); POC: 201-724-6518.

Next Generation Energetic Stripping:

Identify and develop novel ideas using energetic means to REMOVER coating layers, i.e. laser-stripping, flashjet, pinchlamp, etc. , which will allow reduction of hazardous waste, cost and downtime of aircraft. POC: WL/MLSS - CTIO; MAJ W. Kevin Kuhn (937)-255-0943.

POLLUTION PREVENTION RESEARCH AND DEVELOPMENT / TRANSITION NEEDS

HAND-WIPE SOLVENT

- On-going R&D and existing commercial off-the-shelf technology solutions are adequately addressing the pollution prevention needs for this use.

HEAVY-DUTY SOLVENT

- It appears as though these pollution prevention needs can be resolved either through current techniques and commercially available products or on-going R&D. No additional R&D seems necessary to resolve the need.

PAINT REMOVER

- On-going R&D and existing commercial off the shelf technology solutions are adequately addressing the pollution prevention needs for this use.

Federal Facilities Which Reported for Both 1994 and 1995

Facility	1994 Release+ Off-site Treatment	1995 Release+ Off-site Treatment	Percent Change
U.S. AIR FORCE PLANT 04 TX, FORT WORTH, TX	2,025	0	-100%
U.S. BUREAU OF PRISONS FEDERAL, FLORENCE, CO	17,770	0	-100%
U.S. ARMY RED RIVER ARMY DEPOT, TEXARKANA, TX	7,000	1,264	-82%
U.S. ARMY LAKE CITY ARMY, INDEPENDENCE, MO	5,953	2,004	-66%
U.S. ARMY FORT MCCOY, CAMP MC COY, WI	6,334	1,400	-78%
U.S. ARMY FORT HOOD, FORT HOOD, TX	11,335	7,200	-36%
U.S. ARMY FORT CAMPBELL, FORT CAMPBELL, KY	2,100	2,357	12%
U.S. ARMY FITZSIMONS, AURORA, CO	3,200	0	-100%

Federal Facilities Which Reported for Both 1994 and 1995

Facility	1994 Release+ Off-site Treatment	1995 Release+ Off-site Treatment	Percent Change
U.S. ARMY DUGWAY PROVING, DUGWAY, UT	1	0	-100%
U.S. ARMY, FORT MC CLELLAN, AL	150	150	0%
NASA JOHN F. KENNEDY SPACE, KENNEDY SPACE CENTER, FL	12,629	10,811	-14%
U.S. AIR FORCE PLANT 06 GA, MARIETTA, GA	24,000	14,570	-39%
U.S. DEFENSE LOGISTICS AGENCY, CHARLESTON, SC	1,610	0	-100%
U.S. AIR FORCE PLANT 03 OK, TULSA, OK	4,216	0	-100%
U.S. AIR FORCE OGDEN AIR, HILL A F B, UT	18,300	6,210	-66%
U.S. AIR FORCE MCCLELLAN AIR, SACRAMENTO, CA	29,000	8,800	-70%
U.S. AIR FORCE FLIGHT TEST, EDWARDS, CA	34,656	0	-100%
U.S. AIR FORCE ACADEMY, U S A F ACADEMY, CO	4,660	0	-100%
U.S. AIR FORCE, TYNDALL AFB, FL	62	0	-100%
U.S. AIR FORCE, TINKER AFB, OK	17,822	24,782	39%
U.S. AIR FORCE, ROBINS AIR FORCE BASE, GA	66,913	68,080	2%
U.S. AIR FORCE, KELLY AFB, TX	10,885	0	-100%
U.S. AIR FORCE, CANNON A F B, NM	13,086	11,018	-16%
U.S. ARMY, ANNISTON, AL	19,026	19,380	2%
U.S. DOE NAVAL PETROLEUM, TUPMAN, CA	5,988	0	-100%
U.S. NAVY, SAN DIEGO, CA	0	1,432	100%
U.S. NAVY, PORTSMOUTH, VA	26,000	0	-100%
U.S. NAVY, PENSACOLA, FL	10,300	0	-100%
U.S. NAVY, PATUXENT RIVER, MD	19,878	0	-100%
U.S. NAVY, MAYPORT, FL	7,500	0	-100%
U.S. NAVY, JACKSONVILLE, FL	18,400	0	-100%
U.S. MARINE CORPS LOGISTICS, ALBANY, GA	17,001	15,500	-9%
U.S. MARINE CORPS, CHERRY POINT, NC	37,000	31,000	-16%
U.S. MARINE CORPS, BARSTOW, CA	14,053	6,850	-51%
U.S. EPA NATL. VEHICLE &, ANN ARBOR, MI	13	7	-46%
U.S. COAST GUARD YARD, BALTIMORE, MD	10,231	9,660	-6%
U.S. DOE SANDIA NATL. LAB, ALBUQUERQUE, NM	440	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, ANCHORAGE, AK	339	0	-100%
U.S. DOE NAVAL PETROLEUM, CASPER, WY	0	19,746	100%
U.S. DOE IDAHO NATIONAL, SCOVILLE, ID	300	330	10%
U.S. DEFENSE LOGISTICS AGENCY, WHITTIER, AK	79	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, VERONA, NY	2,250	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, SEARSPORT, ME	690	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, MACDILL AFB, FL	430	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, GRAND FORKS, ND	3,900	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, GLADSTONE, MI	1,000	0	-100%
U.S. DEFENSE LOGISTICS AGENCY, CINCINNATI, OH	220	0	-100%
U.S. NAVY INDIAN HEAD DIV., INDIAN HEAD, MD	0	2,920	100%
U.S. DOE SAVANNAH RIVER SITE, AIKEN, SC	2,240	0	-100%

If you have additional information regarding an identified or used P2 approach, on-going P2 research and development, or any P2 research and development/transition needs, please notify Will Garvey, US EPA, 1200 Pennsylvania Avenue, NW, Ariel Rios Building, 3rd Floor, Washington, DC 20004-2403, or fax (202) 501-0069.