United States
Environmental
Protection Agency

Office of Enforcement and
Compliance Assurance
Washington, DC 20460

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EPA

Federal Facilities Toxic Release and Reduction Initiatives Fact Sheet

CHROMIUM COMPOUNDS

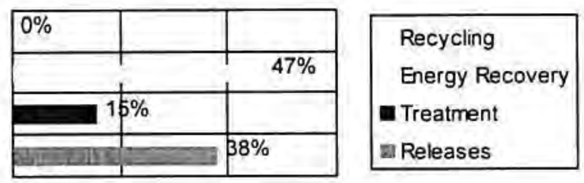
Background

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.

1995 Waste Management Distribution



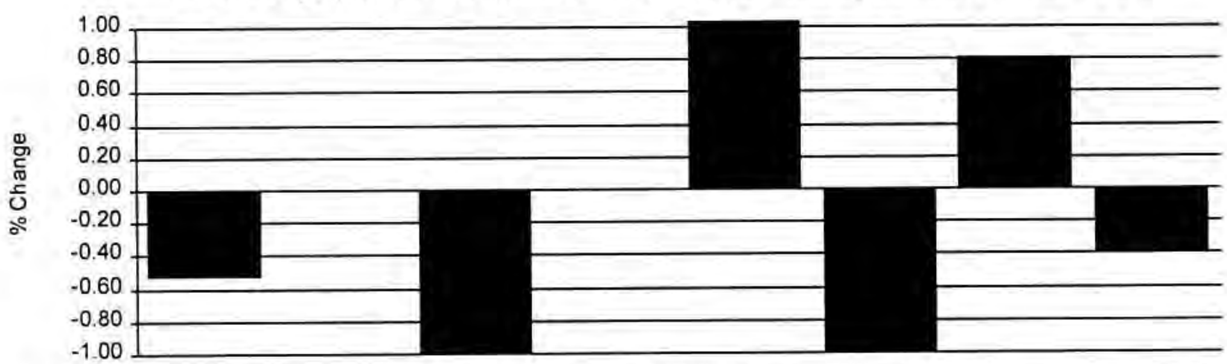
Approach

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)	176,633	0	6,000	30,000	24,570	10,552	18,816	195,449
1995 (lbs)	83,357	0	0	30,000	72,430	0	34,078	117,435
% Change	-53%	0%	-100%	0%	195%	-100%	81%	-40%

SYNONYMS NONE

COMMON USES IN THE U.S.

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

- Eleven federal facilities reported TRI chromium releases in either 1994 or 1995. The largest reported releases were from Air Force Plant 04, Air Force Plant 06, Anniston Army Depot, and Watervliet Arsenal. The chromium releases resulted from depot-level maintenance and manufacturing operations involving chrome plating. The decreases in releases between 1994 and 1995 may be attributed to fluctuations in workloads, plating tank change-outs, and other factors.
- The primary use for chromium compounds is in electroplating and other metal finishing operations. The main ingredient in all hexavalent chromium plating solutions is chromium trioxide, a compound that contains approximately 25% hexavalent chromium. Other uses are: leather tanning, stainless steel welding, chromate or chrome pigment production.

ACUTE HEALTH HAZARDS

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

- Breathing very high levels of chromium (VI) in air can damage and irritate your nose, lungs, stomach, and intestines. People who are allergic to chromium can also have asthma attacks after breathing high levels of either chromium (VI) or (III). Long term exposure to high or moderate levels of chromium (VI) can cause damage to the nose and lungs and can increase the risk of non-cancer lung diseases. Ingesting very large amounts of chromium can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and death.

CHRONIC HEALTH HAZARDS

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

- Certain chromium (VI) compounds are known carcinogens. Not enough data are available to determine if chromium (0) or chromium (III) are carcinogens.

COMMON P2 INITIATIVES

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

- Recycling. Facilities have installed closed loop recycling systems for rinsewaters and advanced bath maintenance equipment to extend bath life.
- Process efficiency improvements. Many facilities have also replaced their conventional plating bath lines with physical or chemical vapor deposition processes.
- Material substitution. Many DOD facilities have replaced chromium (IV) with chromium (III) and other substitutes.

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: CHROMIUM COMPOUNDS

Federal Facililties Reporting in both 1994 and 1995	6	PLATING
Federal Facililties Reporting Only in 1994	4	
Federal Facililties Reporting Only in 1995	1	

POLLUTION PREVENTION APPROACHES CURRENTLY IN USE

PLATING

- Best management practices for reducing chrome plating wastes include: operator training, routine tank testing, strict inventory control, written procedures for bath make-up and additions, use process baths to the maximum extent possible, and establishing a preventive maintenance program.
- Bath maintenance technologies to extend the life of chrome plating baths include: fluorosurfactant fume suppressant, tank chemistry monitors, alternate anodes, drag-out reduction, rinse water reduction, ion exchange, microfiltration, acid sorption.
- High Velocity Oxy-Fuel (HVOF) -- HVOF is a dry process that uses a fuel/oxygen mixture in a combustion chamber to produce a dense metallic coating. HVOF is recommended by Boeing as a replacement for chrome plating. HVOF is under implementation at: Hill AFB, Cherry Point, Corpus Christi Army Depot, and Sacramento ALC. Hill AFB (OO-ALC) has already implemented HVOF for landing gear components. (POC at General Atomics, San Diego, CA A. Gattuso 619-455-2910). Coating is much harder and wear resistant than electroplate chrome. Process window is wide. Additional research is being performed by: BIRL, Northwestern U., Keith Legg, George Nichols; T 708-467-1572, F 708-467-1022; MITRE, Neil Sylvestre; T 703-883-5708,F 703-883-1951; Concurrent Technologies Corp., David S. Viszlay; T 814-269-2593, F 814-269-2798; Some work is conducted from SM-ALC, (McClellan AFB), NDCEE and commercial clients.

ON-GOING POLLUTION PREVENTION RESEARCH AND DEVELOPMENT

PLATING

PSII

Coating is much harder than electroplate chrome when used on chrome and steel. Los Alamos National Laboratory, Jay T. Scheur; T 505-665-6525, F 505-665-3552; For US Dept. of Energy and US Dept. of Commerce.

AMPLATE Ni-W-B Cemkote NiB Electroplating

Coating is as hard as electroplate chrome. NiB applied for automotive and plastic molding tools and some aerospace approvals. U. of California, Davis, Prof. Ahmet N. Palazoglu; T 916-752-8774, F 916-752-1031. Lawrence Livermore National Laboratory, Sandia National Laboratory; National Chemical Corporation, Edward McComas; T 407-22-3-4058.

Manganese Silicate for Aluminum

Coating is as resistant to corrosion as chrome electroplate (on bulk aluminum). McDonald-Douglas, Inc.; Sanchem, Inc., Dr. John W. Bibber; T 312-733-6100; F 312-733-7432.

Laser cladding

Wright Laboratory (Jay Tiley, 513-255-3054). EB-PVD and Laser cladding = High deposition rate of EB-PVD and Laser cladding. Applied Research Laboratory, Penn State Prof. Jogender Singh; T 814-863-9898, F 814-863-1183; Concurrent Technologies Corp., David S. Viszlay; T 814-269-2593, F 814-269-2798.

Chemical vapor deposition

MicroCoating Technologies, Inc. for the Office of Naval Research. CAPVD and CCAD; Coating is almost as hard as chrome and wears as well or almost as well as chrome. Implant Sciences Corp., A.J. Armini; T 617-246-0700, F 617-246-1167; For US EPA.

Carbon based coatings

Developed by Diamonex, Inc. (Patricia Kendall, 888-234-5978).

Russian hard chrome coating

Under development by Faraday Technology, Inc.

Nickel-tungsten-silicon-carbide

SM-ALC, NDCEE, Delta Pollution Control and Boeing Aircraft. "Takada" Ni-W-SiC electroplate - Coating is as hard as electroplate chrome. MITRE, Neil Sylvestre; T 703-883-5708, F 703-883-1951.

High hardness electroless nickel

Electroless plating is similar to electroplating, but deposition is accomplished without the use of electrodes or external electrical energy. A high hardness NiClad 797 4% phosphorus electroless Ni plating process is available from MacDermid, Inc. - Waterbury, CT (POC - M. Malik 810-437-8161). This process is currently being developed for chromium replacement for ALC applications at SA-ALC by L. Galarza 210-925-3190 and is being tested at Cherry Point Naval Aviation Depot (Steve Hartle, NAWCAD Patuxent River, 301-342-8006). Very Hard Electroless Nickel - coating is close in hardness to electroplate chrome. Wear tests show less wear resistance than chrome electroplate. McGean-Rohco, Inc., OH D. Kent Dickie; T 216-441-4900 X-3010, F 216-441-1377.

Physical vapor deposition (PVD)

PVD processes are performed under a high vacuum, in their simplest form, a vapor of coating material is generated either by evaporation or sputtering from a solid target. The most advanced types of PVD coatings use energetic ion bombardment to enhance coating properties. PVD is currently being tested under separate initiatives by the EPA's Environmental Technology Initiative, Boeing, SM-ALC/TIEL, the Hard Chrome Alternatives Team, Wright Laboratory (Jay Tiley, 513-255-3054), and SERDP (Dr. John Beatty, 410-516-4748). The Army has proposed three R&D projects for chrome plating substitutes but has not yet funded them. IBAD - Coating (after nitride implantation) is much harder than chrome electroplate. Low deposition rate. Only thin coating and nitride are energy efficient. Use in combination with CAPVD/CCAD. Implant Sciences Corp., A.J. Armini; T 617-246-0700, F 617-246-1167

For US EPA (Cr), US Army (diamond), US Air Force (SiC) (N+ impregnation); Southwestern Research Institute; T 210-522-6588, F 210-522-6965 and Oak Ridge National Laboratory, J.M. Williams; T 423-574-6265, F 423-576-8135. Thermal deposition - High hardness (Cr_2O_3 in particular), wear reduced by 1/3 (for tungsten carbide). Corrosion resistance is much improved with WC-Cr and Cr_2O_3- (no pitting) and resistance to 50% HCl. Sicorsky Aircraft, Robert Guillemette; T 203-386-7559, F 203-386-7523 For US Army.

Spray Casting

Spray casting is another form of thermal spray process in which an inert gas is heated and enter a supersonic convergent, divergent nozzle. The nozzle injects molten metal/alloy into the gas stream where it is broken into tiny droplets, accelerated by the supersonic flow, then sprayed out of the nozzle toward the part to be coated. Testing is underway at the National Defense Center for Environmental Excellence. The Air Force POCs for this project are: Lt Ray Smith (210-724-6506); and Maj Albert Rhodes (904-283-6239). Spray Casting Ni Alloy - Coating parameters can be used to control hardness and corrosion resistance. MSE Technology Applications, Ronald J. Glovan; T 31-2733-6100, F 312-733-7432.

POLLUTION PREVENTION RESEARCH AND DEVELOPMENT / TRANSITION NEEDS

PLATING

- 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. MARINE CORPS LOGISTICS, ALBANY, GA	3,260	0	-100%
U.S. MARINE CORPS, BARSTOW, CA	0	11,749	100%
U.S. ARMY WATERVLIET ARSENAL, WATERVLIET, NY	37,433	20,516	-45%
U.S. ARMY, SCRANTON, PA	284	0	-100%
U.S. ARMY, ANNISTON, AL	29,696	28,480	-4%
U.S. AIR FORCE PLANT 06 GA, MARIETTA, GA	66,389	3,371	-95%
U.S. AIR FORCE PLANT 04 TX, FORT WORTH, TX	28,600	12,100	-58%
U.S. AIR FORCE PLANT 03 OK, TULSA, OK	9,583	0	-100%
U.S. AIR FORCE OGDEN AIR, HILL A F B, UT	6,930	7,100	2%
U.S. AIR FORCE, TINKER AFB, OK	5,509	34,119	519%
U.S. AIR FORCE, KELLY AFB, TX	7,765	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.