United States
Environmental
Protection Agency

Office of Enforcement and
Compliance Assurance
Washington, DC 20460

EPA-300-F-98-002f
February 1998

# Federal Facilities Toxic Release and Reduction Initiatives Fact Sheet

## ETHYLENE GLYCOL

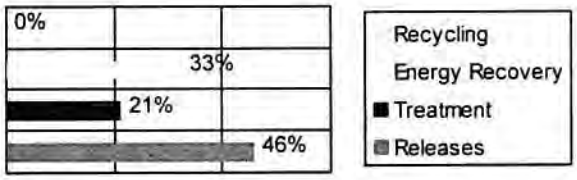
### Background

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**



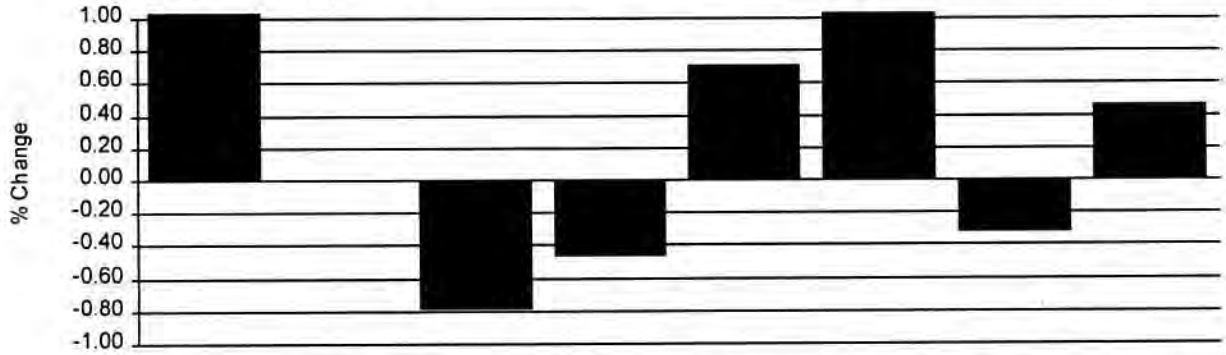

### Approach

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) | 263,183 | 0 | 12,886 | 166,940 | 201,935 | 32,537 | 290,900 | 554,083 |
| 1995 (lbs) | 616,503 | 0 | 2,631 | 89,265 | 347,331 | 86,966 | 198,659 | 815,162 |
| % Change | 134% | 0% | -80% | -47% | 72% | 167% | -32% | 47% |

## CHEMICAL PROFILE: ETHYLENE GLYCOL

**CAS #: 107-21-1**

**SYNONYMS** MONOETHYLENE GLYCOL; GLYCOL ALCOHOL; GLYCOL; 1,2-DIHYDROXYETHANE

### COMMON USES IN THE U.S.

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

- Ethylene glycol is used as antifreeze in cooling and heating systems, in hydraulic brake fluids, as an industrial humectant, as an ingredient of electrolytic condensers, and as a solvent in the paint and plastics industries.
- Miscellaneous uses of ethylene glycol include: deicing aircraft, runways and taxiways; heat transfer solutions for a wide temperature range (-51 to 135 °C). It is also used in adhesive, latex paint, and asphalt-emulsion water-based formulations to provide freeze protection. High purity ethylene glycol is a solvent and suspending medium for ammonium perborate, the conductor used in most eletrolytic capacitors.
- About 27% of the antifreeze market is used in the manufacture of polyester and other packaging materials.
- About 42% of the ethylene glycol produced domestically is used as a nonvolatile antifreeze for liquid-cooled motor vehicles.

### ACUTE HEALTH HAZARDS

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

- The reported probable oral acute lethal dose is between 1 - 2 g/kg.
- Acute exposure of humans to ethylene glycol by ingesting large quantities causes three stages of health effects. Phase I, CNS depression, includes such symptoms as vomiting, drowsiness, coma, respiratory failure, and convulsions. Phase I is followed by Phase II, cardio and pulmonary abnormalities, and Phase III, renal damage.

### CHRONIC HEALTH HAZARDS

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

- No effects were noted in one study of individuals exposed to low levels of ethylene glycol by inhalation for about a month.
- No information is available on the carcinogenic effects of ethylene glycol in humans. EPA has classified ethylene glycol as a Group D, not classifiable as to human carcinogenicity.

### COMMON P2 INITIATIVES

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

- Recycling. Ethylene glycol or propylene glycol is typically recycled either on or off-site using a variety of technologies
- Substitution. Replaced ethylene glycol with propylene glycol for vehicle and equipment maintenance applications. Propylene glycol is less toxic and more biodegradable than ethylene glycol. For de-icing applications, propylene glycol is the only aircraft deicer currently approved for purchase by the Air Force. Ethylene glycol is no longer approved for deicing runways and roadways. For natural gas production, use alternative dehydrating systems.

*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

| | |
|---|---|
| Federal Facililties Reporting in both 1994 and 1995 | 28 |
| Federal Facililties Reporting Only in 1994 | 9 |
| Federal Facililties Reporting Only in 1995 | 3 |

### COMMON USES OF: ETHYLENE GLYCOL

DE-ICING AGENT; ENGINE COOLANT; NATURAL GAS PRODUCTION; PAINT CONSTITUENT

### POLLUTION PREVENTION APPROACHES CURRENTLY IN USE

DE-ICING AGENT

## POLLUTION PREVENTION APPROACHES CURRENTLY IN USE

### DE-ICING AGENT

- According to Air Force Instruction 32-1045, "Snow and Ice Control" (7 March 1994), ethylene glycol is no longer approved for de-icing operations on runways and roadways. The following chemicals are approved and currently available: propylene glycol, potassium acetate, isopropyl alcohol Grade B, urea, calcium chloride. and sodium chloride. Urea, a solid compound, has been used as a de-icer in the past, however, it has come under increasing scrutiny and some states and airports have prohibited its use. Sodium acetate and sodium formate are solid compounds that have been tested at several Air Force bases and found to perform better than urea and to have less of an environmental impact. The Air Force is using sodium formate and sodium acetate for use as pavement and runway deicers because they meet the SAE/AMS 1431A specifications and are listed in FAA Advisory Circular 150\2500-30A, "Aircraft Winter Safety and Operation." The following products still require further testing and have not been fully certified for military applications: combination potassium acetate/propylene glycol, liquid potassium acetate, and potassium formate. Liquid potassium acetate has been approved under Aerospace Material Specification Liquid Pavement De-Icer, and can be used for pavement de-icing operations.
- Equipment for recycling de-icing fluids may differ from those used for recycling automobile or equipment antifreeze because de-icing fluids are more dilute and they contain different types of contaminants. An anaerobic biofilter system can be used to pre-treat de-icing fluid prior to discharge to either a POTW for direct discharge to a stream under a NPDES permit (manufactured by AAA Environmental Services Corporation). ECOLOCorp Inc. manufactures a reprocessor for spent deicing fluid by evaporation and distillation. Glycol Specialists manufactures a system that concentrates (by membrane technology) and purifies (by chemical pretreatment and distillation) spent aircraft deicing fluids.
- Like many of the large commercial airports, Air Force installations have begun investigating the feasibility of installing systems to capture and recycle spent aircraft de-icing fluids. Due to the high cost of retrofitting airports with equipment to capture and recycle the spent antifreeze, recycling may only be feasible for larger facilities (e.g., Denver's airport, Greater Pittsburgh International Airport.) Technical Order 42-C-1 prohibits the reuse of propylene glycol for aircraft deicing (source: Air Force Pro-Act Technical Inquiry 10802, 18 November 1996).
- Propylene glycol (SAE-AMS 1424, "Fluid Deicing/Anti-icing, Aircraft, Newtonian SAE Type I", Mil Spec. MIL-A-8243D, Type I) is the only aircraft deicer approved for purchase by Air Force activities. Several possible substitutes for aircraft de-icing are commercially available but have not yet been fully certified and tested: new Type I and II anti-icing fluid; super Type II; Type I fluid; UCAR AAF ULTRA; New Type II (Type IV). The majority of the alternatives are propylene glycol based. Reported advantages include lower toxicity, more biodegradable, and longer holdover times.

### ENGINE COOLANT

- The Army's Tank and Automotive Command has established an antifreeze hotline which provides technical assistance on antifreeze recycling. Questions can be faxed to 810-574-5413.
- As of 1996, propylene glycol had not been approved as a substitute for use in government owned vehicles. The Mobility Technology Center - Belvoir is in the process of evaluating propylene glycol. Some DOD facilities have already begun using propylene glycol in some vehicles. Two DOD-approved recycling systems work with either ethylene glycol or propylene glycol, but each must be processed separately. Several different technologies are available for engine coolant recycling including: ion exchange, distillation, and several types of filtration systems (chemically assisted mechanical filtration, filtration and dual bed deionization, filtration, precipitation/aeration/filtration, advanced filtration, and micro-filtration/ion exchange). (Source: USEPA "Vehicular Products Containing Recovered Materials" EPA530-B-96-001. July 1996). Fort Bragg, Fort McCoy, the Naval Petroleum and Oil Shale Reserves, Red River Army Depot, US Army Transportation Center - Fort Eustis, and several US Navy facilities are already recycling their ethylene glycol.

### NATURAL GAS PRODUCTION

- No implemented P2 projects were identified.

### PAINT CONSTITUENT

- Some latex paints contain ethylene glycol. Facilities should try to find alternative paints that contain the least amount of ethylene glycol possible.

## ON-GOING POLLUTION PREVENTION RESEARCH AND DEVELOPMENT

### DE-ICING AGENT

Substitutes for Ethylene Glycol for Deicing

SERDP issued a request for proposal in FY98 for research into substitutes for ethylene glycol for deicing.

Improved De-icing Agent Application Systems.

Another alternative to reducing spent de-icing fluids is to improve the equipment used to apply the fluids. One company has developed a double gantry spray system called the "Whisper Wash". High pressure nozzles facing the aircraft blast heated air at 40 - 500 pounds per square inch to remove snow and ice. A small amount of water and glycol may by used with the system.

InfraTek (Infrared) De-icing System.

Process Technologies, Inc. has developed a device called InfraTek which uses infrared heat instead of chemicals to de-ice aircraft. Aircraft are towed through an aluminum deicing structure where they are exposed to electromagnetic wavelengths. The system was tested at Greater Buffalo International Airport in 1995.

## ON-GOING POLLUTION PREVENTION RESEARCH AND DEVELOPMENT

### DE-ICING AGENT

Electromagnetic De-Icing Systsem.

A company called Cirrus Design has completed a Phase I report for a low-cost electromagnetic-type de-icing system that would be affordable for small businesses and personal transportation aircraft. Axiomatics Corporation completed a Phase I project for a dielectric sensor technology to detect, quantify, and characterize ice accretion on aircraft components both in-flight and on the ground. The system would provide a low-cost, low-power, retrofittable ice detection capability that would serve as the primary control for in-flight activation of an ice protection system, minimize deicing required at the ramp, while providing verifiable aircraft protection and maximizing holdover times. Similarly, two companies, Aerazur (France) and Vibro-Meter (Switzerland) have teamed to develop a de-icing boot with a miniature ice detector that indicates when to operate the de-icing system.

Several organizations have initiatives underway to test and or develop de-icing/anti-icing fluids.

NASA Ames Research Center in California is testing a new product that is reported to be non-toxic, biodegradable, and have a lower BOD than other propylene glycol fluids. Wright Laboratory has a project underway to identify, develop, and test drop-in substitutes for deicing fluids for aircraft and runways. Armstrong Laboratory Environics Directorate has completed a Phase I study to determine the technical feasibility of developing aircraft and runway deicers based on ice inhibition compounds. The project looked at the design and synthesis of novel biomimetic deicing/anti-icing agents based on naturally occurring antifreeze proteins.

### ENGINE COOLANT

No research projects were identified.

### PAINT CONSTITUENT

No research projects were identified.

### POWER PRODUCTION

Alternatives to Glycol Dessicants.

Alternatives to the use of glycols as a dessicant in natural gas production include: using solid dessicants (e.g., alumina, silica gel, or molecular sieves), expansion refrigeration using the Joule-Thompson effect, or anhydrous calcium chloride. These techniques are only suitable under certain operating conditions.

## POLLUTION PREVENTION RESEARCH AND DEVELOPMENT / TRANSITION NEEDS

### DE-ICING AGENT

- The Air Force has two initiatives underway to baseline current deicing management practices and develop a management strategy for minimizing de-icer runoff.

### ENGINE COOLANT

- Ethylene glycol recycling has been successfully explored. However, there are no on-going R&D projects seeking an ethylene glycol substitute.

### NATURAL GAS PRODUCTION

- A feasability analysis should be conducted to determine the process impact of substituting to an alternative dessicant for natural gas produciton other than ethylene glycol.

### PAINT CONSTITUENT

- Federal facilities should attempt to use latex paints which do not contain ethylene glycol or lesser quantities of ethylene glycol - these types of paints are currently available.

## 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 FORT MCCOY, CAMP MC COY, WI | 0 | 0 | 0% |
| U.S. ARMY WATERVLIET ARSENAL, WATERVLIET, NY | 33,000 | 14,080 | -57% |
| U.S. ARMY TRANSPORTATION, NEWPORT NEWS, VA | 12,260 | 27,260 | 122% |
| U.S. ARMY TOOELE CHEMICAL, TOOELE, UT | 24,174 | 25,770 | 7% |
| U.S. ARMY SCHOFIELD BARRACKS, WAHIAWA, HI | 1,000 | 1,010 | 1% |
| U.S. ARMY RED RIVER ARMY DEPOT, TEXARKANA, TX | 43,000 | 2,300 | -95% |

## 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 LETTERKENNY ARMY, CHAMBERSBURG, PA | 39,000 | 17,000 | -56% |
| U.S. ARMY HQ USAEC, FORT LEONARD WOOD, MO | 38 | 0 | -100% |
| NASA JOHN F. KENNEDY SPACE, KENNEDY SPACE CENTER, FL | 8,386 | 0 | -100% |
| U.S. ARMY FORT RILEY, FORT RILEY, KS | 4,351 | 99,560 | 2188% |
| U.S. DOE FERMILAB, BATAVIA, IL | 1,070 | 1,441 | 35% |
| U.S. ARMY FORT LEWIS, FORT LEWIS, WA | 1,156 | 4,274 | 270% |
| U.S. ARMY FORT CAMPBELL, FORT CAMPBELL, KY | 2,910 | 894 | -69% |
| U.S. ARMY FORT BENNING, COLUMBUS, GA | 30 | 0 | -100% |
| U.S. ARMY FIELD ARTILLERY, FORT SILL, OK | 0 | 2,000 | 100% |
| U.S. AIR FORCE OGDEN AIR, HILL A F B, UT | 23,000 | 0 | -100% |
| U.S. AIR FORCE ENGINEERING, ARNOLD A F B, TN | 120,996 | 40,916 | -66% |
| U.S. AIR FORCE ELMENDORF, ELMENDORF AFB, AK | 499 | 480,870 | 96267% |
| U.S. AIR FORCE, TINKER AFB, OK | 18,304 | 0 | -100% |
| U.S. ARMY HEADQUARTERS XVIII, FORT BRAGG, NC | 500 | 0 | -100% |
| U.S. MARINE CORPS, JACKSONVILLE, FL | 20,000 | 269 | -99% |
| U.S. NAVY SAN DIEGO, SAN DIEGO, CA | 0 | 239 | 100% |
| U.S. NAVY, WILLOW GROVE, PA | 0 | 0 | 0% |
| U.S. NAVY, SAN DIEGO, CA | 35 | 34 | -3% |
| U.S. NAVY, SAN DIEGO, CA | 0 | 154 | 100% |
| U.S. NAVY, PORTSMOUTH, VA | 4,800 | 0 | -100% |
| U.S. NAVY, NORFOLK, VA | 11,110 | 4,940 | -56% |
| U.S. MARINE CORPS. CAMP, OCEANSIDE, CA | 0 | 4,627 | 100% |
| U.S. MARINE CORPS LOGISTICS, ALBANY, GA | 60,000 | 38,900 | -35% |
| U.S. DEFENSE LOGISTICS AGENCY, OGDEN, UT | 0 | 2,280 | 100% |
| U.S. MARINE CORPS, YUMA, AZ | 1,050 | 1,028 | -2% |
| U.S. DEFENSE LOGISTICS AGENCY, RICHMOND, VA | 0 | 0 | 0% |
| U.S. MARINE CORPS, CHERRY POINT, NC | 0 | 23,000 | 100% |
| U.S. MARINE CORPS, BARSTOW, CA | 101,949 | 18,404 | -82% |
| U.S. ENRICHMENT CORP., PIKETON, OH | 0 | 520 | 100% |
| U.S. DOE PORTSMOUTH GASEOUS, PIKETON, OH | 61 | 3 | -95% |
| U.S. DOE NAVAL PETROLEUM, TUPMAN, CA | 1,299 | 952 | -27% |
| U.S. DOE NAVAL PETROLEUM, CASPER, WY | 67 | 67 | 0% |
| U.S. DOE HANFORD SITE, RICHLAND, WA | 0 | 2,370 | 100% |
| U.S. TVA COLBERT FOSSIL PLANT, TUSCUMBIA, AL | 18,836 | 0 | -100% |
| U.S. MARINE CORPS CAMP LEJEUNE, CAMP LEJEUNE, NC | 1,202 | 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.*