Briefing Paper on Ethylene Glycol

Frequently Asked Questions for Airport Operators, Airline Personnel and Other Interested Parties

What is ethylene glycol and how is it used?

Ethylene glycol is an organic chemical used in the production of consumer and industrial goods. Ethylene glycol is most commonly recognized as a major component of automobile antifreeze. It is also a component in heat transfer fluids for ventilation and air-conditioning systems and in deicing fluids used on aircraft, runways and taxiways to fly and land planes safely in winter weather conditions.

The majority of ethylene glycol is used in the production of polyester materials—such as polyester resins and polyester fibers—that are used in a wide variety of industrial and consumer goods.

How much is produced annually?

In 1998, on a volume basis, ethylene glycol was the 29th largest chemical produced in the United States. In that same year, the U.S. chemical industry produced approximately 5.8 billion pounds of ethylene glycol.

What can happen to ethylene glycol in the environment?

Ethylene glycol can readily biodegrade - or break down into carbon dioxide and water - in both water and soil.[1] In addition, the U.S. Environmental Protection Agency (EPA) determined that the relative potential for harm to the environment or the public from ethylene glycol decreases over time through degradative processes.[2]

Laboratory studies have shown that:

- In water, ethylene glycol is not persistent and biodegrades aerobically (in the presence of oxygen) and anaerobically (in the absence of oxygen).[3]
- In the air, ethylene glycol is not readily volatile and undergoes photochemical oxidation; its atmospheric half-life[4] is approximately one day.[5]
- In soil, ethylene glycol is not persistent and biodegrades with or without oxygen present; its half-life in soil is approximately one day.[6]

Similarly, producers of ethylene glycol-based fluids have found that these fluids readily biodegrade in surface waters and in conventional wastewater treatment plants.

What are the human health effects of ethylene glycol?

Ethylene glycol has been used safely for decades when handled properly. This use indicates that incidental exposures, such as skin exposure to antifreeze, do not cause harm. Recent studies support this history. In addition, internationally recognized expert organizations such as the American Council of Governmental Industrial Hygienists have concluded that ethylene glycol in the workplace does not present an inhalation hazard when exposures do not exceed 100 mg/m3.

It is well known that if an adult drinks enough ethylene glycol (reported to be approximately 100 ml or 3 ounces), serious toxic effects or death could occur. Drinking ethylene glycol allows for its rapid absorption into the body, which may overwhelm the body's ability to metabolize and eliminate it. This can lead to the buildup of large concentrations of potentially toxic metabolites.

Why is industry examining the health effects of ethylene glycol?

Under the Responsible Care® program of the American Chemistry Council, each member company has an ongoing product stewardship program that integrates health, safety and envi-

ronmental protection into the design, development, manufacture, use and disposal of a product.

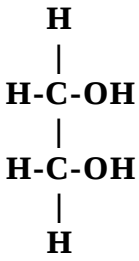
Decades of consumer use demonstrate that ethylene glycol can be used safely if handled properly. Nevertheless, the American Chemistry Council's Ethylene Glycol Panel is funding research to understand better the complex mechanisms of ethylene glycol in the body. Recent studies demonstrate that certain toxic effects of ethylene glycol are directly related to the amount of glycolic acid produced in the body. Other research demonstrates that potential toxic effects depend upon the route, amount and rate of ethylene glycol entering the body. These factors determine how the body absorbs, distributes, breaks down and eliminates ethylene glycol and other compounds produced by the body. The American Chemistry Council-funded research examines all of these factors, as they may relate to possible human exposures.

Why is ethylene glycol a good aircraft deicing fluid?

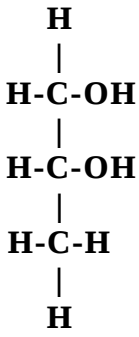
Ethylene glycol's chemical structure (see below) makes it an extremely efficient freeze point depressant, so that after it is applied to the aircraft, it inhibits the reformation of ice. When hot deicing fluid is sprayed on an aircraft, the fluid melts the ice and breaks the bond between the ice and the aircraft. The two "-OH" or hydroxyl groups of ethylene glycol are responsible for the interaction of ethylene glycol and water. The ethylene glycol/water mixture remaining on the aircraft absorbs any new precipitation to help prevent, for a limited time, the ice from re-accumulating on, and adhering to, the aircraft.

Are there substitutes?

Currently, ethylene glycol- and propylene glycol-based deicing fluids are the most commonly used deicing products. The U.S. Federal Aviation Administration (FAA) requires any fluid used for aircraft deicing to pass strict Society of Automotive Engineers (SAE) performance specifications. Many other chemicals also have hydroxyl groups, but cannot be used as aircraft deicers because of explosivity concerns or other safety and efficacy limitations.



Ethylene Glycol



Propylene Glycol

Both ethylene glycol and propylene glycol have two “-OH” or hydroxyl groups, which as noted above, are responsible for breaking the bond between water and the aircraft surface. Ethylene glycol has one less carbon atom than propylene glycol, however, and it is a more economical freeze point depressant on a molecular level, because it takes less ethylene glycol to achieve a desired freeze point than propylene glycol.

[1]Toxicological Profile for Ethylene Glycol and Propylene Glycol,Agency for Toxic Substance and Disease Registry (ATSDR),1997
[2]58 FR 54837,10/22/93.
[3]Dwyer, D.F. et al.,1983,Kameya et.al.,1995,McGahey, C. et al.,1992, Waggy et al.1994.
[4]Half-life refers to the time it takes for a compound to dissipate or degrade by 50%.
[5]Howard,1991.
[6]Klecka, G.M.1993,Hovious, J.C.,1973