ENVIRONMENTAL FATE AND EFFECTS OF ETHYLENE GLYCOL USED AT AIRPORTS

The American Chemistry Council's Ethylene Glycol Panel has prepared this document to educate interested parties on the specific fate and effects of ethylene glycol in the environment.

BACKGROUND

Ethylene glycol and water are the principal components of ethylene glycol-based fluids used at airports to protect the flying public from accidents related to solid precipitation on aircraft and runways. Specifically, ethylene glycol-based fluids are applied to aircraft and runways both to remove snow and ice (deicing) and to prevent snow and ice from reforming (anti-icing).

Deicing and anti-icing fluids are applied to aircraft before take-off and on runways. After application and during take-off, these fluids come off aircraft and mix with precipitation and other liquids on the ground. They then are either collected or leave the airport facilities as runoff. Collected fluids may be sent to a publicly owned treatment facility, treated on- or off-site, or recycled for other uses. Diluted runoff enters the surrounding soil or aquatic environment, where the ethylene glycol biodegrades.

The Ethylene Glycol Panel has reviewed information on the fate of ethylene glycol in the environment and its effect on aquatic environments in particular. Federal agencies have also studied the environmental effects of ethylene glycol exposure. Both the Ethylene Glycol Panel and the U.S. Environmental Protection Agency (EPA) agree that ethylene glycol biodegrades in the environment and that studies show it is relatively non-toxic to aquatic life.

ENVIRONMENTAL FATE

An EPA evaluation found that ethylene glycol does not collect in living tissues or sediments—does not bioaccumulate—and therefore poses little cumulative hazard to the environment. EPA also found that ethylene glycol biodegrades readily in the air, in water and in soil. This EPA evaluation occurred as part of the Agency's effort to adjust the threshold for reporting releases of certain chemicals, including ethylene glycol. This threshold is known as the reportable quantity or RQ. The Agency decided to adjust the RQ for ethylene glycol upwards to the most lenient threshold (5,000 pounds) based on its analysis of ethylene glycol's "susceptibility to biodegradation in the environment."

In its 1997 review of ethylene glycol, the U.S. Agency for Toxic Substances and Disease Registry also concluded that ethylene glycol "can break down relatively quickly" in surface water and in soil.

Ethylene glycol is made up of hydrogen, oxygen and carbon molecules. When exposed to oxygen in the presence of bacteria, ethylene glycol biodegrades into carbon dioxide and water.

Additional 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).
- In the air, ethylene glycol is not readily volatile and undergoes photochemical oxidation; its atmospheric half-life is approximately one day.
- In soil, ethylene glycol is not persistent and biodegrades with or without oxygen present; its half-life in soil is approximately one day.
- Ethylene glycol can be disposed of and treated in conventional wastewater treatment plants.

Environmental Effects

In a January 2000 report titled "Preliminary Data Summary – Airport Deicing Operations," EPA reviewed the available data on ethylene glycol and concluded that ethylene glycol is "fairly non-toxic to the aquatic environment." The EPA report explains:

> Although EPA does not use such a system, the U.S. Fish and Wildlife Service Classification System for Acute Exposures defines 'relatively harmless' as any chemical with an LC50 above 1,000 mg/L. The test results … indicate that ethylene glycol and propylene glycol may be classified as 'relatively harmless,' as defined by the U.S. Fish and Wildlife Service.

In fact, the LC50 values for ethylene glycol are at concentrations above 10,000 mg/L.

The normal process of ethylene glycol biodegradation requires oxygen. Ethylene glycol requires less dissolved oxygen from the receiving waters to biodegrade than do other glycol-based chemicals used in deicing fluids. Nonetheless, large discharges of ethylene glycol and other glycols can result in a rapid reduction or depletion of dissolved oxygen (DO) levels in the receiving waterway. In some cases, a significant reduction in DO may result in levels too low to support aquatic life. Airport operators take measures to reduce the risk of such discharges. In addition, the dilution that results from increased stormwater flow during most periods of deicing fluid use and the reduced activity of aquatic life during low winter temperatures tend to minimize oxygen consumption and the environmental impact of ethylene glycol.

Conclusion

The ethylene glycol in deicing and anti-icing fluids does not bioaccumulate, biodegrades quickly, and is relatively non-toxic in aquatic environments. While significant discharges can have adverse effects on the environment, ethylene glycol generally poses little threat to the environment if managed appropriately.

EPA Memorandum "Evaluation of the RQ to be Proposed for Ethylene Glycol," Gerain Perry, Response Regulations Development Section, U.S. Environmental Protection Agency, May 5,1993.

June 12,1995 Federal Register, page 30932.

Toxicological Profile for Ethylene Glycol and Propylene Glycol,Agency for Toxic Substances and Disease Registry (ATSDR),1997.

Dwyer, D.F. et al.,1983,Kameya et.al.,1995,McGahey, C. et al.,1992,Waggy et al.1994.

Half-life refers to the time it takes for a compound to dissipate or degrade by 50%.

Howard,1991.

Klecka, G.M.1993,Hovious, J.C.,1973

US EPA,Office of Water, "Preliminary Data Summary – Airport Deicing Operations," EPA 821-R-00-001, January 2000.