

BRIEFING PAPER ON ETHYLENE GLYCOL

RESEARCH SHOWS THAT NORMAL SKIN CONTACT IS NOT EXPECTED TO CAUSE A SIGNIFICANT HEALTH HAZARD

Summary

Recent studies indicate that skin contact with ethylene glycol that may occur during normal uses does not present a significant health hazard to humans.

If an adult of average size drinks approximately 100 ml (or 3 ounces) of ethylene glycol over a short period of time, however, serious toxic effects or even death can result. These toxic effects are believed to be related to breakdown products (metabolites). Small doses of ethylene glycol can be readily broken down and/or eliminated without any adverse effects from the body in urine and expired air, but when large quantities of ethylene glycol are ingested, the ethylene glycol is rapidly absorbed and the body's ability to metabolize and/or excrete ethylene glycol or its metabolites is overwhelmed. In these situations, toxic amounts of metabolites can accumulate.

Acute exposure studies indicate that in cases of skin exposure to ethylene glycol, the rate of penetration is so slow that excretion and metabolism pathways are not overwhelmed. Metabolites do not accumulate, therefore, and toxicity does not occur.

Study Results

Laboratory studies confirm that when ethylene glycol is applied to the healthy skin of experimental animals, it is absorbed so slowly that the body's metabolic systems can easily eliminate it. Normal skin contact does not result in high levels of ethylene glycol in the body and therefore would not likely cause the type of systemic toxic effects that may be seen upon ingestion. This is demonstrated in the following study results:

- When ethylene glycol was tested on samples of mouse skin, the rate of absorption was found to be slow (Sun et al., 1995);
- Human skin has been shown to be a better barrier against ethylene glycol absorption than animal skin. When ethylene glycol was tested on human skin samples, absorption was 30 to 40 times slower than through mouse skin (Sun et al., 1995); and
- When a 50/50 mix of ethylene glycol and water (a common concentration when ethylene glycol is used as an automobile antifreeze) was applied to human skin, the absorption rate was reduced by half compared with undiluted ethylene glycol (Sun et al., 1995). Thus, when ethylene glycol is used in its most common form as antifreeze, skin absorption is even slower than with pure ethylene glycol.

Based on his studies on the absorption of ethylene glycol through human skin samples, Sun calculated the following internal doses of ethylene glycol, which may result from potential skin exposures. For instance:

If a garage mechanic were to spend all day (8 hours) changing automobile antifreeze (50% ethylene glycol in water), with both hands and forearms in constant contact with the antifreeze, he/she would absorb approximately 0.09 ml of ethylene glycol, which is equivalent to a few drops. This is approximately 1,000 times less than the amount that would be expected to cause serious health problems if ethylene glycol were swallowed (based on accounts of human ingestion of antifreeze).

Although research indicates that incidental skin contact is not a hazard to humans, it is always advisable to rinse off any ethylene glycol that comes into contact with human skin as soon as possible to reduce the amount that may be absorbed or accidentally ingested. In addition, prolonged or repeated exposure could result in irritation to the skin.

Conclusions

Laboratory studies have shown that ethylene glycol penetrates animal skin slowly and that absorption through human skin is even slower. This slow rate of absorption prevents high concentrations of ethylene glycol and its toxic breakdown products from accumulating in the blood. The body is able to eliminate effectively the small amount that is absorbed. When mixed with water, as in automobile antifreeze, skin absorption of ethylene glycol is even slower. Ethylene glycol, therefore, does not cause toxic effects in humans through skin absorption under normal use scenarios.

The American Conference of Governmental Industrial Hygienists, a group that develops guidelines to assist in the control of health hazards, reviewed ethylene glycol data in 1995. That group concluded that a "skin notation," a designation referring to the potential of significant contribution to the overall exposure by the dermal route, was not necessary for ethylene glycol, given its negligible absorption through the skin.

Reference List

- Sun, J.D., Frantz, S.W. and Beskitt, J.L., In Vitro Skin Penetration of Ethylene Glycol Using Excised Skin from Mice and Humans, *Journal of Toxicology: Cutaneous and Ocular Toxicology* 14: 273-286 (1995).
- American Conference of Governmental Industrial Hygienists, *Documentation of the Threshold Limit Values and Biological Exposure Indices* (6th edition), 1995-1996.