Michigan Department of Natural Resources and the Environment

Interoffice Communication

TO: File for 1,3-Propane sultone (CAS #1120-71-4)

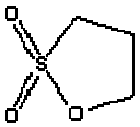
FROM: Doreen Lehner, Toxics Unit, Air Quality Division

SUBJECT: Correction of Screening Level for 1,3-Propane sultone (CAS #1120-71-4)

DATE: March 10, 2011

The initial threshold screening level (ITSL) for 1,3-propane sultone (CAS # 1120-71-4) is 2 µg/m^3 annual averaging time. There is no change from the previous ITSL of 2 µg/m^3 even though there is a correction of a mathematical algorithm (I_A) in the ITSL calculation. The correction was due to an error where a value in m^3/kg was used instead of the correct value in m^3/day. According to the Department of Health and Human Services National Toxicology Program, 1,3-propane sultone is reasonably anticipated to be a human carcinogen based on sufficient evidence in experimental animals. Unfortunately, an appropriate study for determining an initial risk screening level (IRSL) is not available at this time.

1,3-Propane sultone occurs as a colorless liquid or as a white crystalline solid. It releases a foul odor as it melts. It is readily soluble in water and in many organic solvents such as ketones, esters, and aromatic hydrocarbons. It hydrolyzes to 3-hydroxy-1-propanesulfonic acid. When heated to decomposition, 1,3-propane sultone emits toxic fumes of sulfur oxides (NTP, 2005). 1,3-Propane sultone is used as a chemical intermediate to introduce the sulfopropyl group into molecules and to confer water solubility and an anionic character to the molecules. It is also a chemical intermediate in the production of fungicides, insecticides, cation-exchange resins, dyes, vulcanization accelerators, detergents, lathering agents, and bacteriostats, and as a corrosion inhibitor for mild (untempered) steel (NTP, 2005).



A literature review was conducted to determine an initial threshold screening level (ITSL) for 1,3-propane sultone. The following references and databases were searched to derive the above screening level: EPBCCD, United States Environmental Protection Agency (US EPA) Integrated Risk Information System (IRIS), National Institute for Occupational Safety and Health (NIOSH), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values and Biological Exposure Indices (TLV/BEI) 2008 guide, National Toxicology Program (NTP) Study Database, International Agency for Research on Cancer (IARC), Acute Database, Chemical Abstract Service (CAS) Online, National Library of Medicine (NLM)-online, EPA Aggregated Computational Toxicology Resource (ACToR) Database, US EPA TSCATS database, and Hazardous Substances Data Bank (HSDB).

There were several studies on 1,3-propane sultone in animals. One study by Weisburger et al., 1981, involved a two dosage groups of rats with each dosage level having 26 female and 26 male weanling Sprague-Dawley rats, which were orally administered by gavage 28 and 56 mg/kg body weight twice a week for 60 weeks or 32 weeks. There were two groups of rats, one of 16 males and 16 females and one of 26 males and 26 females, were used as matched and pooled controls respectively. Survival at 52 weeks among male and female rats, respectively, was 62% and 39%, in the 28 mg/kg dosage group and 15% and 23% respectively in the 56 mg/kg dosage group. Administration of the high dose was stopped at week 32 in the 56 mg/kg dose group because of numerous mammary tumors developing in the females at the 18th week and high mortality in males. At the 45th week, animals on the 28 mg/kg dose group began showing signs of central nervous system disturbances, therefore, the experiment was terminated at the 60th week. Significant increases in the incidence of certain tumors were found. The incidences in the matched control, low-dose and high-dose groups, respectively, were: male rats – malignant glioma (cerebrum), 0/16, 10/26, and 11/26; malignant glioma (cerebellum), 0/16, 6/26, 11/26; and female rats – malignant glioma (cerebrum), 1/16, 12/26, 12/26; malignant glioma (cerebellum) 0/16, 8/26, 4/26; mammary adenocarcinoma, 0/16, 6/26, and 13/26. Unfortunately, since the high dose was discontinued at 32 weeks (halfway through the study), by the end of the study all rats essentially were given an equivalent of the low dose group. In order to perform an appropriate risk assessment using the benchmark dose software for a long term oral study, there needs to be 2 dosing levels along with the control group. This study is suitable to use the low dose group as a lowest-observed-adverse-effect level (LOAEL) would be 28 mg/kg for males and females.

Determination of the ITSL

The LOAEL of 28 mg/kg/day will be used to calculate the ITSL for 1,3-propane sultone. The study only dosed animals 2 days a week. In order to adjust the dose to 7 days, an average daily dose needs to be calculated.

$$Adjusted\ldots average\ldots daily\ldots dose = LOAEL \times \frac{2days}{7days} = 28\,{}^{mg}\!/_{kg/day} \times \frac{2days}{7days} = 8\,{}^{mg}\!/_{kg/day}$$

Based on Rule 232 (1) (e) the ITSL is determined as follows:

$$ITSL = \frac{LOAEL\,{}^{mg}\!/_{kg/day}}{35 \times 100 \times UF} \times \frac{W_A}{I_A} \times \frac{b}{a}$$

Where:

W_A = Body weight of experimental animal in kilograms (kg).
I_A = Daily inhalation rate of experimental animal in cubic meters/day.
b = Absorption efficiency by the oral route of exposure.
a = Absorption efficiency by the inhalation route of exposure.
UF = A value from 1 to 10 determined on a case-by-case basis, considering type and severity of effect.

Since the value b/a is not known, the default for this value is 1.

The W_A is the default value for a non-gender rat is 0.395 kg. The I_A is determined by the following equation taken from EPA 1988 determined below:

$$I_A = 0.80 \times W^{0.8206}$$

Where:
I = Inhalation rates in m3/day
W = Body weight (kg)

$$I_A = 0.80 \times 0.395^{0.8206} = 0.373 \, {}^{m^3}\!/_{day}$$

Adding the values to the above ITSL equation gives.

$$ITSL = \frac{8 \, {}^{mg}\!/_{kg/day}}{35 \times 100 \times 1} \times \frac{0.395 kg}{0.373 \, {}^{m^3}\!/_{day}} \times 1 = 0.002420 \, {}^{mg}\!/_{m^3} = 2 \, {}^{\mu g}\!/_{m^3}$$

According to Rule 232 (2) (c), the averaging time is annual.

Based on the above data, the ITSL for 1,3-propane sultone (CAS # 1120-71-4) is 2 µg/m^3 annual averaging time.

References:

Act 451 of 1994, Natural Resources and Environmental Protection Act and Air Pollution Control Rules, Michigan Department of Environmental Quality.

Department of Health and Human Services National Toxicology Program. 2005. Report on Carcinogens, Eleventh Edition
http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s153prop.pdf

EPA. 1988. Recommendation for and documentation of biological values for use in risk assessment. PB 88-179874.

Weisburger E.K., Ulland B.M., Nam J.m., Gart J.J., and Weisburger J.H. 1981. Carcinogenicity Tests of Certain Environmental and Industrial Chemicals. J Natl Cancer Inst. 67(1):75-88.

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