MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: File for Dimethylethanolamine (CAS #108-01-0)

FROM: Doreen Lehner, Toxics Unit, Air Quality Division

DATE: January 18, 2013

SUBJECT: Screening Level for Dimethylethanolamine

The initial threshold screening level (ITSL) for dimethylethanolamine (CAS #108-01-0) is 5.2 µg/m^3 with an annual averaging time and a second ITSL for dimethylethanolamine is 220 µg/m^3 with an 8-hour averaging time.

Dimethylethanolamine (DMEA) has a molecular weight of 89.14 g/mol is a primary alcohol and is a transparent, pale yellow liquid. DMEA is an industrial chemical used: as a curing agent for polyurethanes and epoxy resins; as a sweetening agent in the treatment of natural gases; in water treatment; in coatings; in the synthesis of dyestuffs, textile auxiliaries, pharmaceuticals, emulsifiers, and corrosion inhibitors; an additive in paint removers, boiler water, and amino resins; as a corrosion inhibitor in boiler systems; and when formed in salts is used as alternatives to conventional solvents (Wikipedia, 2012; Leung, 1996).

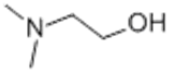

Fig 1. Structure of Dimethylethanolamine

A literature review was conducted to determine an initial threshold screening level (ITSL) for DMEA. The following references and databases were searched to derive the above screening levels: CCD, 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) 2012 guide, National Toxicology Program (NTP) Study Database, International Agency for Research on Cancer (IARC), Acute Database, Chemical Abstract Service (CAS) Online (searched 11/19/12), National Library of Medicine (NLM)-online, EPA Aggregated Computational Toxicology Resource (ACToR) Database, US EPA TSCATS database, and Hazardous Substances Data Bank (HSDB).

DMEA is a normal substrate in the biosynthesis of choline and phosphatidylethanolamine, however endogenous levels in tissues are very low. DMEA may by indirectly involved with nerve impulse propagation and membrane phospholipid biosynthesis. In humans, DMEA vapors have produced “irritation of the eyes, mouth, throat, and skin. Systemic effects following inhalation include: headache, nausea, fainting, and anxiety” (Klonne et al., 1987).

Animal Studies

The original ITSL for DMEA was derived from a study by Klonne et al. (1987). This wan an inhalation study on male and female F344 rats (20/sex/group) exposed to 0, 8, 24, or 76 ppm DMEA whole body for 6 hours/day, 5 days/week for 13 weeks. Corneal opacity occurred in medium and high dose rats at the end of the daily exposures beginning approximately 2 weeks after initiation of exposure. The opacity regressed during non-exposure periods. However, the authors regarded the 24 ppm exposure group as a NOAEL, and the original ITSL derivation followed that interpretation. A review document by NIEHS (2002) identified 24 ppm as a LOAEL. The current staff evaluation concurs that 24 ppm was a LOAEL. The NOAEL for corneal opacity is 8 ppm.

After reviewing the available data, another key study was identified (Leung et al., 1996). Pregnant F344 rats (25/group) were exposed via inhalation to 0, 10.4, 29.8, or 100 ppm DMEA whole body for 6 hours/day during gestation days 6 – 15. Ocular effects (darkened, cloudy and hazy eyes, slight corneal vascularization and fixed, dilated pupils) were seen in all exposure groups, but were minimal and transient in the 10.4 ppm group. The LOAEL for ocular effects is 10.4 ppm.

Derivation of the ITSL

Using Rule 229(2)(b), both long-term and short-term ITSLs can be calculated using the best available science. The studies above have two of the same authors in both articles and the studies support each other in the effects seen after whole body and inhalation exposure to low concentrations of DMEA. The NOAEL can be used to calculate a RfC using EPA (1990) guidelines. Before adjustment to the daily dose the NOAEL of 8 ppm must be converted to mg/m^3.

$$^{mg}/_{m^3} = \frac{ppm \times molecular\ weight\ of\ DMEA}{24.45} = \frac{8\ ppm \times 89.14\ ^{g}/_{mol}}{24.45}$$
$$= 29.16646\ ^{mg}/_{m^3}$$

$$Daily\ Dose\ Adjustment = 29.1664\ ^{mg}/_{m^3} \times \frac{6\ hours}{24\ hours} \times \frac{5\ days}{7\ days} = 5.2083\ ^{mg}/_{m^3/day}$$

The human equivalent concentration is assumed to be equal to the adjusted daily dose of 5.2083 mg/m^3. The ITSL is calculated below:

$$ITSL = \frac{HEC}{10 \times 10 \times 10} = \frac{5.2083\ ^{mg}/_{m^3}}{1{,}000} = 0.005208\ ^{mg}/_{m^3} = 5.2\ ^{\mu g}/_{m^3}$$

The 1,000 fold uncertainty factor consists of: 10 for animal to human; 10 for interhuman sensitivity; and 10 to adjust for subchronic to chronic exposure.

The ITSL is equivalent to an RfC and Rule 232(2)(b) states that it would have a 24-hour averaging time. This averaging time can be changed to an annual averaging time if coupled with a second shorter term ITSL.

Derivation of a Second ITSL

Using the same NOAEL from the Klonne et al. (1987) study, a second ITSL can be derived. The rats were exposed for 6 hours/day which is 2 hours shorter than a standard dispersion modeling averaging time of 8 hours for an occupational exposure. An ITSL with an 8-hour averaging time can be derived using the NOAEL of 8 ppm from this study.

$$second\ ITSL = \frac{NOAEL}{10 \times 10} \times \frac{6\ hours}{8\ hours} = \frac{29.1665\ {}^{mg}/_{m^3}}{100} \times \frac{6\ hours}{8\ hours} = 0.2187\ {}^{mg}/_{m^3}$$
$$= 220\ {}^{\mu g}/_{m^3}$$

The uncertainty factor of 100 consists of: 10 for animal to human; and 10 for interhuman sensitivity.

The initial threshold screening level (ITSL) for dimethylethanolamine (CAS #108-01-0) is 5.2 µg/m^3 with an annual averaging time and a second ITSL for dimethylethanolamine is 220 µg/m^3 with an 8-hour averaging time.

References

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