MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

INTEROFFICE COMMUNICATION

TO: File for Ethylenediamine (CAS #107-15-3)

FROM: Doreen Lehner, Toxics Unit, Air Quality Division

DATE: January 27, 2022

SUBJECT: Correction for Screening Level Calculation for Ethylenediamine (CAS #107-15-3)

The Department was requested to review the calculations for the ethylenediamine screening level that was developed February 23, 2011. The equation that was used to convert from ppm to μg/m^3 was used incorrectly; this equation should have been a conversion from ppm to mg/m^3. This caused an error in the final calculated screening level. Therefore, the ethylenediamine initial threshold screening level (ITSL) of 0.03 μg/m^3 (annual averaging time) is incorrect. The correct ethylenediamine ITSL is 30 μg/m^3 (annual averaging time).

MICHIGAN DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT

INTEROFFICE COMMUNICATION

TO: File for Ethylenediamine (CAS # 107-15-3)

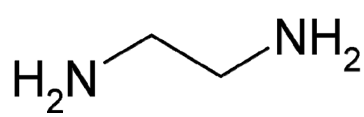
FROM: Doreen Lehner, Toxics Unit, Air Quality Division

SUBJECT: Review of Screening Level for Ethylenediamine (CAS # 107-15-3)

DATE: February 23, 2011

The Initial Threshold Screening Level (ITSL) for ethylenediamine is 0.03 μg/m^3 based on an annual averaging time.

A literature review was conducted to determine an initial threshold screening level (ITSL) for ethylenediamine. The following references and databases were searched to derive the above screening level: EPBCCD, Integrated Risk Information System (IRIS), National Institute for Occupational Safety and Health (NIOSH), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV)/Biological Exposure Indices (BEI) 2004 guide, DEQ library, National Toxicology Program (NTP) Study Database, International Agency for Research on Cancer (IARC), Acute Database, CAS Online (search performed on 10/18/10), National Library of Medicine (NLM)-online, Environmental Protection Agency (EPA) Aggregated Computational Toxicology Resource (ACToR) Database, Agency for Toxic Substances and Disease Registry (ATSDR) database, Kirk-Othmer chemical encyclopedia, and Patty's Industrial Hygiene & Toxicology.



Ethylenediamine (EDA) [CAS # 107-15-3] is the lowest molecular weight ethyleneamine (MW 60.1) and contains two primary nitrogens. It is a clear liquid with an ammonia-like odor and is a strongly basic amine. Ethylenediamine is a widely used building block for chemical synthesis and it is used in the production of many industrial chemicals including: bleach activators (e.g. tetraacetylethylenediamine); chelating agents (e.g. EDTA, Hydroxyethylethylenediamine); corrosion inhibitors in paints and coolants; elastomeric fibers; fungicides (e.g. Maneb, Mancozeb, Zineb, and Metiram); lube oil and fuel additives; mineral processing aids; pharmaceuticals (e.g. aminophylline and some antihistamines); plastic lubricants; polyamide resins; rubber processing additives; textile additives; urethane chemicals; used in electroplating baths; ethylenediamine dihydroiodide (EDDI) is added to animal feeds as a source of iodide; and N,N-ethylenebis(stearamide) (EBS) is a commercially significant mold-release agent and a surfactant in gasoline and motor oil.

RfC or RfD values were unavailable. There is no NIOSH recommended exposure limit data available or a threshold limit value from ACGIH. A 30-day inhalation study of the toxicity of ethylenediamine in rats was performed by Pozzani and Carpenter (1954). Due to the extreme hygroscopicity and chemical reactivity of ethylenediamine with atmospheric carbon dioxide, the actual concentration of the vapors were less than 50% of the calculated concentration. Therefore, the nominal concentrations of 1,000, 500, 250, and 125 ppm exposures were recalibrated to actual concentrations of 484, 225, 132, and 59 ppm respectively. There were fifteen male and fifteen female Sherman rats for each of the four exposure levels. Because these exposure runs were not performed concurrently, each exposure group had its own control group. All animals which survived the 30 day exposure were killed, the liver and kidneys were weighed, and histological examination was performed on the lungs, heart, liver, kidney, adrenal gland, and spleen. Only the liver, kidney, and lung were sampled from the rats exposed to the 125 ppm (59 ppm) level.

All 30 rats at the highest concentration (1,000 ppm [484 ppm]) died within 20 days of initial exposure. Depilation was first noticed on the 6th day of exposure and necropsy revealed damage to the lungs, kidneys, and liver. Cloudy swelling was observed in 23 of 28 livers and was observed in the loop and convoluted tubules of most of the kidneys. Also degeneration of the convoluted tubules occurred in ~ 25% of rats. Congestion of the lungs was observed in 17 of 28 rats, and congestion of the adrenal cortex was observed in 5 of 28 rats. At the next highest exposure level (500 ppm [225 ppm]) only 4 rats survived the 30 day exposure, these rats exhibited significantly lower weight gain and higher liver and kidney weights than controls. Depilation was still apparent, but to a lesser degree than observed at the highest dose level. On necropsy, cloudy swelling of the liver and in the loop and convoluted tubules of the kidneys was found in most rats. Congestion of the lungs was observed in ~ 33% of the rats. However, congestion of the lungs was also observed in ~ 33% of the controls. At the 250 ppm [132 ppm] exposure level, no deaths occurred among the rats exposed for 30 days. The death of 4 rats was attributed to lung infection. There was no significant alteration in liver and kidney weights and no significant tissue damage was found, however there was a slight depilatory effect observed. At the 125 ppm [59 ppm] exposure level, no deaths occurred among the exposed rats, also no effects on mean weight gain or on liver or kidney weights were found. There was no significant damage to the lung, liver, or kidney and no depilation was observed.

Due to a slight depilation observed at the 132 ppm level, this dosage level is considered the LOAEL. A NOAEL of 59 ppm for rat inhalation of ethylenediamine, based on a lack of any effects observed on the rats at this dosage. To determine at ITSL it is necessary to convert ppm to $\mu g/m^3$ using the following equation:

$$\mu g/m^3 = \frac{ppm \times MW}{24.45} = \frac{59\,ppm \times 60.1\,g/mol}{24.45} = 145.0266\,\mu g/m^3$$

Based on the Rule 232(1)(d) the ITSL can be determined using a 7-day inhalation study. Since this study is a 30-day inhalation study, the uncertainty factor of 35 for acute to subchronic was changed to 10, which would allow an uncertainty factor from less than subchronic to subchronic. Also, the study only exposed animals 5 days a week. In order to adjust the dose to 7 days, an average daily duration adjustment needs to be included in the equation. The ITSL equation is listed below:

$$ITSL = \frac{NOAEL}{10 \times 100} \times \frac{hours \ldots \exp osed \ldots per \ldots day}{24 hours \ldots per \ldots day} \times \frac{5 days}{7 days}$$

$$ITSL = \frac{145.0266\, {}^{\mu g}\!/_{m^3}}{10 \times 100} \times \frac{7\, {}^{hours}\!/_{day}}{24\, {}^{hours}\!/_{day}} \times \frac{5 days}{7 days} = 0.0302\, {}^{\mu g}\!/_{m^3} = 0.03\, {}^{\mu g}\!/_{m^3}$$

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

Based on the above data, the ITSL for ethylenediamine is 0.03 μg/m^3 based on an annual averaging time.

References:

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

Pozzani, U.C. and Carpenter, C.P. 1954. Response of rats to repeated inhalation of ethylenediamine vapors. Arch. Ind. Hyg. Occup. Med. 9:223-226.

DL:lh