MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTEROFFICE COMMUNICATION

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TO: File for Propylene (CAS # 115-07-1)

FROM: Doreen Lehner, Toxics Unit, Air Quality Division

DATE: September 19, 2017

SUBJECT: Screening Level for Propylene (CAS # 115-07-1)

The initial threshold screening level (ITSL) for propylene (CAS # 115-07-1) is 8,600 µg/m^3 based on an 8-hour averaging time.

Propylene, also known as propene or methyl ethylene, is an alkene with one double bond with a molecular weight of 42.08 g/mol. Propylene is a colorless gas with a faint petroleum-like odor. It can be found in nature as a byproduct of vegetation and fermentation processes. Propylene is a byproduct of oil refining and natural gas processing and it is used: as a raw material in the production of plastics (films, fibers, containers, packaging, caps, and closures); in the production of chemicals (such as propylene oxide, acrylonitrile, cumene, butyraldehyde, and acrylic acid); as an alternative fuel to acetylene in oxy-fuel welding and cutting, brazing, and heating metal for bending; and it is also used as a MAPP gas substitute (Wikipedia, 2017). Propylene has been found in smoke from forest fires, cigarette smoke, and motor vehicle and aircraft exhaust (Wikipedia, 2017).

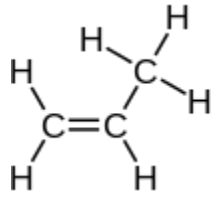

Figure 1. Structure of propylene.

ITSL Derivation:

A study by the National Toxicology Program (NTP, 1985) used groups of 50 male and female F344 rats and groups of 49 or 50 of male and female B6C3F1 mice. Animals were exposed via inhalation to either 0, 5,000, or 10,000 ppm propylene for 6 hours per day, 5 days a week for 103 weeks. NTP found an increased incidence of squamous

metaplasia of the respiratory epithelia in female rats at 5,000 and 10,000 ppm and in male rats at 10,000 ppm. NTP also found an increased incidence of chronic focal inflammation of the kidney in male and female mice at 5,000 ppm and 10,000 ppm. A review of the renal histopathology by Hard (2001) found no evidence of renal tubule injury in either the male and female mice or male and female rats. “There was no evidence of renal tubule injury as indicated by an absence of any apparent increase in cytoplasmic vacuolation, cell degeneration/death, apoptosis or necrosis, mitotic activity, or tubule hyperplasia compared to the controls” (Hard, 2001). A review of the nasal cavity histopathology by Harkema (2002) found “an increased incidence of nasal inflammation (rhinitis) in male and female rats chronically exposed to 5,000 or 10,000 ppm propylene compared to filtered-air control rats (0 ppm propylene),” and “…a slightly higher incidence of rhinitis in female mice exposed to 5,000 or 10,000 ppm propylene compared to control mice” (Harkema, 2002). “There was also a slight increase in the incidence of nasal inflammation in the low-dose exposed, but not the high-dose exposed male mice compared to control male mice” (Harkema, 2002). There were also exposure-related nasal epithelial changes including, “…mucous cell hyperplasia in nasal respiratory epithelium of propylene-exposed male and female rats, and a propylene-related increase in the amount of eosinophilic globules in olfactory epithelium in male and female rats (both low and high doses) and female mice exposed to the low dose” (Harkema, 2002). “These changes in the surface epithelium probably reflect secretory defense mechanisms of the airways to prevent further damage from the inhaled irritant (e.g., mucous cell hyperplasia suggests an increased production, storage, and secretion of airway mucous)” (Harkema, 2002).

ACGIH (2006) also reviewed the above data as well as data from mutagenicity studies in rats and *E. coli*, in addition to a comparative toxicokinetic study in mice, rats, and a human volunteer. The ACGIH determined that there may be a possible threshold effect at the NTP (1985) low dose (5,000 ppm) for most of the observed nasal lesions. “There was also a modest gender effect with female rodents (rats and mice) having a slightly higher incidence of propylene-induced nasal lesions compared to similarly exposed males. In addition, rats had more exposure-related nasal epithelial alterations than did the similarly exposed mice” (Harkema, 2002; ACGIH, 2006). “Though propylene is metabolized to propylene oxide, a known animal carcinogen, only a small amount of propylene is metabolized to the oxide, and the reaction saturates at approximately 50 ppm propylene according to Michaelis-Menten kinetics, unlike propylene oxide metabolism” (ACGIH, 2006). ACGIH adopted a threshold limit value – time weighted average (TLV-TWA) of 500 ppm (860 mg/m^3), “…recommended to prevent changes in nasal mucosa, based on the animal studies and incorporating a suitable uncertainty factor” (ACGIH, 2006).

The ACGIH TLV-TWA of 500 ppm (860 mg/m^3) is intended to protect healthy workers for a conventional 8-hour workday for a duration of employment. Based on Rule 232(1)(c) the ITSL is determined as follows and is intended to ensure protection from all health effects in the general population including sensitive subpopulations for a lifetime of exposure:

$$ITSL = \frac{Occupational\ Exposure\ Level}{100}$$

Where the occupational exposure level is the TLV of 860 mg/m^3. Using the above equation:

$$ITSL = \frac{860\ {}^{mg}/_{m^3}}{100} = 8.6\ {}^{mg}/_{m^3} = 8{,}600\ {}^{\mu g}/_{m^3}$$

Based on Rule 232(2)(a), the averaging time for this ITSL is 8 hours.

The initial threshold screening level (ITSL) for propylene (CAS # 115-07-1) is 8,600 µg/m^3 based on an 8-hour averaging time.

References:

ACGIH. 2006. Propylene. TLVs and BEIs Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices. ACGIH Worldwide Signature Publications.

Hard. 2001. Expert Report on Renal Histopathologic changes in mouse and rat Inhalation Studies with Propylene. Prepared for American Chemistry Council Olefins Panel, 1300 Wilson Boulevard, Arlington, VA 22209.

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NTP. 1985. Toxicology and Carcinogenesis studies of propylene (CAS No. 115-07-1) in F344/N rats and B6C3F1 mice (inhalation studies). National Toxicology Program. U.S. Department of Health and Human Services. Public Health Service. National Institute of Health. NTP TR 272. NIH Publication No. 86-2528.

Part 55, Air Pollution Control of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, Michigan Department of Environmental Quality.

Wikipedia. 2017. Propene. Available online at: https://en.wikipedia.org/wiki/Propene

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