MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTEROFFICE COMMUNICATION

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TO: File for Boron oxide [CAS # 1303-86-2]

FROM: Doreen Lehner, Toxics Unit, Air Quality Division

DATE: February 26, 2019

SUBJECT: Initial Threshold Screening Level for Boron Oxide [CAS # 1303-86-2]

The initial threshold screening level (ITSL) for boron oxide [CAS # 1302-86-2] is 520 µg/m^3 based on a 1-hour averaging time. The ITSL is based on the methodology cited in Williams, 2019 memo on boric acid [CAS # 10043-35-3].

Boron oxide, also known as boric anhydride, boron sesquioxide, and boron trioxide, is an inorganic compound with the formula B_2O_3 and has a molecular weight of 69.62 g/mol. It is a colorless glassy solid that rapidly hydrates to boric acid and is corrosive to metals in the presence of air. Boron oxide is used: as a fluxing agent for glass and enamels; in synthesizing other boron compounds; as an additive in optical fibers; as an insecticide; in the production of borosilicate glass; in the production of gallium arsenide crystals; and as an acid catalyst in organic synthesis.

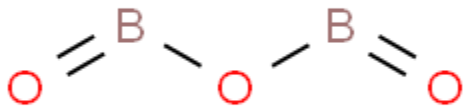

Figure 1. Structure of boron oxide.

A literature review was conducted to determine an initial threshold screening level (ITSL) for boron oxide. The following references and databases were searched: 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) 2017 Guide; National Toxicology Program (NTP) Study Database; International Agency for Research on Cancer (IARC); Chemical Abstract Service (CAS) SciFinder (searched

11/13/2018), National Library of Medicine (NLM) Hazardous Substances Data Bank (HSDB); US EPA Chemview; and Canadian Center for Occupational Health and Safety (RTECS).

Because boron oxide readily hydrates to boric acid (EPA, 2004; EPA 2008). "…[The] exposure to boron oxide, which easily converts to boric acid in humid air or upon entering the mucosal layer of tissues" (ATSDR, 2010). As water vapor will be encountered in the atmosphere, boron oxide should be evaluated as boric acid. In a study by Wilding et al. (1959), three dogs were exposed to 57 mg/m^3 of boron oxide aerosols for 23 weeks. Wilding et al. (1959) also exposed a group of 70 male and female albino rats to an average concentration of 77 mg/m^3 of boron oxide aerosols for 6 hours/day, 5 days/week for 24 weeks. Additional groups of rats were exposed to 175 mg/m^3 for 12 weeks or 470 mg/m^3 for 10 weeks using the same exposure regimen. As the exposure was whole body, boron oxide dust covered the animals and they may have orally ingested the boron oxide. A slight reddish exudate appeared from the nose in the rats exposed to 470 mg/m^3, which the authors attributed to nasal irritation. The 470 mg/m^3 group showed a 9% reduction in growth compared to controls. "There was a significant drop in pH and increase in urine volume in rats exposed to 77 mg/m^3. The researchers hypothesized that this was due to formation of boric acid from boron oxide by hydration in the body and the diuretic properties of boron oxide" (EPA, 2004). As boron oxide reacts with water and irritates mucous membranes, there should be consideration that boric acid is formed on these moist mucous membranes in the nasal and respiratory passages.

The ITSL for boron oxide is based on the borates, which is available in the boric acid [CAS# 10043-35-3] justification (Williams, 2019). The ITSL for boron is 80 µg/m^3 (as boron with a 1-hour averaging time). The molecular weight of boron is 10.8 g/mol. Boron oxide has a molecular formula of B_2O_3 and has a molecular weight of 69.62 g/mol. As the toxicity of boron oxide would be due to the boron portion of the chemical, the ITSL for boron can be adjusted to reflect the level of boron using the equation below:

$$Boron\ oxide\ ITSL = Boron\ ITSL\ \times \frac{Molecular\ weight_{boron\ oxide}}{Molecular\ weight_{boron}}$$

$$80\ {}^{\mu g}/_{m^3} \times \frac{69.62}{10.8} =\ 515.7037\ {}^{\mu g}/_{m^3}\ \approx 520\ {}^{\mu g}/_{m^3}$$

Therefore, based on the above data the initial threshold screening level for boron oxide [CAS # 1302-86-2] is 520 µg/m^3 based on a 1-hour averaging time. Boron oxide also has footnote #40, which should also be referred to.

References:

APCR. 2016. Air Pollution Control Rules, Promulgated pursuant to Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act, Michigan Department of Environmental Quality. 1994. Act 451, as amended (NREPA).

ATSDR. 2010. Toxicological Profile for Boron. Atlanta, GA: U.S. Department of Health and Human Services. Public Health Service. Agency for Toxic Substances and Disease Registry. November 2010.

EPA. 2004. Toxicological Review of Boron and Compounds (CAS No. 7440-42-8), In Support of Summary Information on the Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, DC. EPA Document Number: EPA 635/04/052. June 2004.

EPA. 2008. Chapter 3: Boron. In: Regulatory Determinations Support Document for Selected Contaminants from the Second Drinking Water Contaminant Candidate List (CCL 2), Part II: CCLs Contaminants Undergoing Regulatory Determination. EPA Report 815-R-08-012. June 2008.

Wilding JL, Smith WJ, Yevich P, Sicks ME, Ryan SG, Punte CL. 1959. The toxicity of boron oxide. Am Ind Hyg Assoc J. 20(4):284-289.

Williams. 2019. Memo to the File for Boric acid (CAS # 10043-35-3). Michigan Department of Environmental Quality. Air Quality Division.

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