

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: File for Benzoic acid (CAS# 65-85-0)

FROM: Doreen Lehner, Toxics Unit, Air Quality Division

SUBJECT: Screening Level Determination for Benzoic acid

DATE: July 26, 2012

An initial threshold screening level (ITSL) for benzoic acid will not be set due to a lack of sufficient toxicity data. This compound is a solid with a relatively low oral toxicity and therefore, emissions may be evaluated based on the National Ambient Air Quality Standards (NAAQS) for PM_{2.5}.

Benzoic acid [CAS# 65-85-0] (also known as benzenecarboxylic acid and benzoate) is an aromatic carboxylic acid with a molecular weight of 122.12 g/mol. It is a colorless crystalline solid. Benzoic acid is used as a precursor for the synthesis of many organic substances including: benzoyl chloride; benzoate plasticizers; and phenol. Benzoic acid is also used as a food preservative, a growth inhibitor for mold, yeast, and bacteria, skin antifungal treatment, antiseptic, and in inhalant decongestants (Wikipedia, 2012).

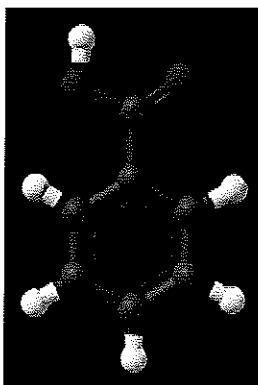


Figure 1. Benzoic acid ball and stick model.

A literature review was conducted to attempt to derive an initial threshold screening level (ITSL) for benzoic acid. The following references and databases were searched: Chemical Criteria Database (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) 2010 guide, National Toxicology Program (NTP) Study Database, International Agency for Research on Cancer (IARC), Acute Database, Chemical Abstract Service (CAS) Online (searched 8/22/11), National Library of Medicine (NLM)-online, EPA Aggregated Computational Toxicology Resource (ACToR) Database, US EPA TSCATS database, and Hazardous Substances Data Bank (HSDB).

No inhalation toxicity data were found which could be used to establish an ITSL. However, benzoic acid is regarded to have a relatively low order of oral toxicity. In 1973 the FDA evaluated the health effects of benzoic acid and determined it to be Generally Recognized as Safe (GRAS) in food based on an estimated average daily intake of 0.1-1.4 mg/kg (0.6 – 34 mg/day) for benzoic acid and 2 – 17 mg/kg (10 – 328 mg/day) for sodium benzoate (FDA, 1973). The EPA has set an oral RfD for benzoic acid at 4 mg/kg/day based on a NOAEL of 34 mg/day benzoic acid and 328 mg/day for sodium benzoate (converted to 312 mg/day benzoic acid). "In the stomach, both benzoic acid and sodium benzoate exist in their ionized form, benzoate, which is absorbed rapidly and completely by the GI tract" (EPA, 1993). Since the molecular weight for sodium benzoate differs from benzoic acid the following conversion factor is needed to determine total exposure of both compounds to calculate the RfD listed below:

$$328 \text{ mg/day sodium benzoate} \times \frac{122.12 \text{ (MW benzoic acid)}}{144.11 \text{ (MW sodium benzoate)}} \\ = 278 \text{ mg/day (benzoic acid from sodium benzoate)}$$

$$278 \text{ mg/day} + 34 \text{ mg/day (benzoic acid)} = 312 \text{ mg/day}$$

Assuming adult human body weight of 70 kg, the EPA (1993) RfD was derived as:

$$\frac{312}{70} = 4.4 \text{ mg/kg/day}$$

According to Rule 232(1)(b), an ITSL can be determined by an oral reference dose

$$ITSL = Oral \text{ RfD} \times \frac{70 \text{ kg}}{20 \text{ m}^3} \\ \text{potential ITSL} = 4 \text{ mg/kg/day} \times \frac{70 \text{ kg}}{20 \text{ m}^3} = 14 \text{ mg/m}^3 = 14,000 \text{ }\mu\text{g/m}^3$$

Rounded to one significant figure the potential ITSL is 10,000 $\mu\text{g/m}^3$. According to Rule 232(2)(b) the averaging time is 24 hours. As benzoic acid is considered a solid, the ITSL determined above exceeds the NAAQS for $\text{PM}_{2.5}$ therefore, an ITSL will not be determined and emissions of benzoic acid will be evaluated using the NAAQS standard for $\text{PM}_{2.5}$.

References:

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

EPA. 1993. Integrated Risk Information System. Benzoic acid. Retrieved data on 7/18/2011 (<http://www.epa.gov/iris/subst/0355.htm>).

EPA. 2006. National Ambient Air Quality Standards (NAAQS) 71FR61144, October 17, 2006. Available online at <http://www.epa.gov/air/criteria.html>

FDA. 1973. Evaluation of the health aspects of benzoic acid and sodium benzoate as food ingredients. Federation of American Societies for Experimental Biology, U.S. Food and Drug Administration. PB-223-837.

Wikipedia, 2012. Benzoic acid. Available online at:
http://en.wikipedia.org/wiki/Benzoic_acid

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