MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTEROFFICE COMMUNICATION

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TO: File for Quinone (CAS # 106-51-4)

FROM: Doreen Lehner, Toxics Unit, Air Quality Division

SUBJECT: Screening Level for Quinone (CAS # 106-51-4)

DATE: September 30, 2014

The initial threshold screening level (ITSL) for quinone is 4.4 µg/m³ based on an 8-hour averaging time.

A literature review was conducted to determine an initial threshold screening level (ITSL) for quinone. The following references and databases were searched to derive the above screening level: 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) 2012 Guide, National Toxicology Program (NTP) Study Database, International Agency for Research on Cancer (IARC), Chemical Abstract Service (CAS) Online (searched 8/20/14), National Library of Medicine (NLM)-online, EPA Aggregated Computational Toxicology Resource (ACToR) Database, and EPA Toxic Substance Control Act Test Submission Database (TSCATS).

Quinone (CAS# 106-51-4) is also known as 2,5-cyclohexadiene-1,4-dione, p-quinone and 1,4-benzoquinone. It is a light-sensitive, water soluble, gold-colored crystalline powder with a pungent, irritating odor resembling that of chlorine, which may decompose spontaneously above 140°F and can sublime even at room temperature. Quinone has a molecular weight of 108.0948 g/mol and an odor threshold of 0.4 mg/m^3 (Toxnet, 2009). Quinone can occur in nature as many insects synthesize simple benzoquinones (Toxnet, 2009). Quinone is used: as a chemical intermediate in the manufacture of hydroquinone; as a photographic chemical; as a rubber accelerator; in the manufacture of unsaturated polyesters as a polymerization inhibitor; in the manufacture of fungicides; as an oxidizing agent; in adhesive mixtures; in the dehydrogenation of coal; in the pharmaceutical industry for production of cortisone and as an intermediate for barbiturates; as a chemical intermediate for dyes, especially yellow dyes; to make gelatin insoluble; and as a tanning agent to strengthen animal fibers. Quinone is also found as a waste product from the coal industry and has been found in tobacco smoke (Toxnet, 2009). With a vapor pressure of 37.5 mm Hg at 25°C, quinone will exist in the vapor phase in the ambient atmosphere and is degraded by hydroxyl radicals and ozone. The half-life of quinone in the atmosphere is estimated to be 33.6 minutes. “Since it absorbs UV radiation in environmentally significant wavelengths, photolysis is also possible” (Toxnet, 2009).

Figure 1. Structure of quinone.

There is not much toxicity information available for quinone. A study by Woodward et al., (1949) found that quinone has a rat oral LD_{50} of 130 mg/kg. There was also a study by Sterner et al., (1947) of workers manufacturing hydroquinone from aniline that reported characteristic ocular injuries in workers. “The injuries developed gradually over a period of years with no serious cases appearing from exposures of durations shorter than five years. No systemic effects were found associated with these injuries. Quinone was believed to be the chief causative agent, although hydroquinone dust was suspected as a contributory cause” (ACGIH, 2001).

The ITSL is based on the ACGIH TLV-TWA of 0.1 ppm (0.44 mg/m^3). ACGIH based their TLV recommendation on a finding of ocular irritancy and fatal oral doses of quinone in animals which “caused respiratory difficulties and paralysis of the medullary centers….quinone has caused mild transient ocular irritation at air concentrations of 0.1 ppm or greater” (ACGIH, 2001).

According to Rule 232(1)(c), an ITSL can be derived from an occupational exposure level (OEL) for a toxic air contaminant using the following equation.

$$ITSL = \frac{OEL}{100} = \frac{0.44\ {}^{mg}/_{m^3}}{100} = 0.0044\ {}^{mg}/_{m^3} = 4.4\ {}^{\mu g}/_{m^3}$$

According to Rule 232(2)(a), an ITSL derived from an OEL is given an averaging time of eight hours. Therefore, the ITSL for quinone is 4.4 µg/m³ based on an 8-hour averaging time.

References:

ACGIH. 2001. Quinone. 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.

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

Sterner JA, Oglesby FL, and Anderson B. 1947. Quinone vapors and their harmful effects to corneal and conjunctival injury. J. Ind. Hyg. Toxicol. 29:60-73.

Toxnet. 2009. 1,4-Benzoquinone CASRN 106-51-4. Health Sciences Database. Available online at: http://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+hsdb:@term+@rn+106-51-4

Woodward G, Hagan EC, and Radomski JL. 1949. Toxicity of hydroquinone for laboratory animals. Fed. Proc. 8:348.

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