

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

May 12, 1997

TO: File for boron trifluoride (CAS # 7637-07-2)

FROM: Marco Bianchi, Toxics Unit, Air Quality Division

SUBJECT: Initial Threshold Screening Level

The Initial Threshold Screening Level (ITSL) for boron trifluoride is $0.7 \mu\text{g}/\text{m}^3$ based on a 24 hr. averaging time.

The following references or databases were searched to identify data to determine the ITSL/IRSL: IRIS, HEAST, NTP Management Status Report, RTECS, EPB-CCD, EPB library, CAS-online, NLM-online, IARC, NIOSH Pocket Guide, and ACGIH Guide.

Boron trifluoride fumes in moist air and reacts to form boric acid, hydrogen fluoride, fluorboric acid, and other hydrolysis products. Boron trifluoride is used as a catalyst in organic synthesis, and is used in soldering fluxes. It is also used for neutron measurement, as a fumigant, and to protect molten magnesium and its alloys from oxidation.

Two major literature sources for boron were reviewed for this evaluation; an ATSDR Toxicologic Profile for Boron, and an EPA Health and Environmental Effects Document for Boron and Boron Compounds. However, these sources did not provide animal studies specifically for boron trifluoride and consequently, could not be used to establish an ITSL.

RTECS listed a number of Russian LC_{50} studies involving different species, two of which were a 4 hr. guinea pig and a rat inhalation study. The LC_{50} for each of the test species was $109 \text{ mg}/\text{m}^3$ for guinea pigs, and $1180 \text{ mg}/\text{m}^3$ for rats. Adverse effects in the rat study included gasping, excessive oral and nasal discharge, and lacrimation. In a two-week study reported by the ACGIH, rats exposed at 67 ppm ($187.6 \text{ mg}/\text{m}^3$) for 6 hrs/day died before the sixth daily exposure. Histopathology showed kidney damage (necrosis and pyknosis of the proximal tubular epithelium). Rats exposed 6 hrs/day at 24 ppm ($67.2 \text{ mg}/\text{m}^3$) or 9 ppm ($25.2 \text{ mg}/\text{m}^3$) for 2 weeks showed signs of respiratory irritation, depression of body weight, increased lung weights, and depressed liver weights.

Pharmacokinetics data in mammalian species showed that boron trifluoride is absorbed from the respiratory tract of laboratory animals as indicated by urinary excretion, organ distribution, or systemic toxicity. Evidence that boron compounds are also absorbed from the gastrointestinal tract of humans

and laboratory animals has been shown by their distribution to blood and tissues, systemic toxicity, and urinary excretion levels.

According to ACGIH documentation, Stokinger and Spiegel found that boron trifluoride is a severe pulmonary irritant leading to pneumonia in animals upon repeated exposure. Exposures at concentrations of 100 ppm (280 mg/m³) resulted in a uniformly high mortality rate in six laboratory species, and 15 ppm was occasionally fatal in 30-day studies.

Toxicologic studies of boron trifluoride by Torkelson showed that rats, rabbits, and guinea pigs exposed 5 days/wk for up to 6 months at concentrations of 1.5 to 4 ppm (4.2 to 11.2 mg/m³), caused pneumonitis and dental fluorosis (probably enhanced by licking the fur). At the lowest value, there was only marginal evidence of pneumonitis.

The U.S. EPA established a chronic HEAST RfC for boron trifluoride of 0.0007 mg/m³. This value is based on a 13-week rat inhalation study by Rusch et al., which used a NOAEL of 6 mg/m³ based on kidney necrosis. The EPA document didn't provide an explanation of why it selected this study rather than the Torkelson 6 month study. They did note however, that Rusch was the only study of sufficient quality for RfC derivation. Rusch et al. did explain in his study introduction that the Torkelson study along with earlier studies were limited due to uncertainties and variations in the exposure concentrations, health status of the test animals and the limited use of control groups.

In the study by Rusch et al., Fischer 344 rats were exposed 6 hr/day, 5 days/wk for 13 weeks to a respirable, liquid aerosol of boron trifluoride at concentrations of 0, 2, 6, and 17 mg/m³. One rat in the high exposure group died. The most significant finding in this group was necrosis of the proximal tubular epithelium of the kidneys. Other observations noted during the study included dried material around the nose and mouth, rales and excessive lacrimation, reversible depression of serum total protein and globulin concentrations, and increasing urinary, serum, and bone fluoride amounts. In the lower exposure groups, findings of respiratory irritation were minimal. All observations occurred in a dose-related pattern. Based on this study, exposure to boron trifluoride at 17 mg/m³ resulted in renal toxicity, while exposure at 6 mg/m³, although showing elevations of fluoride amounts, did not result in a toxic response.

According to Air Toxics Rule 232 (1) (a); if an inhalation reference concentration (RfC) can be determined from the best available information sources, the initial threshold screening level equals the inhalation RfC. AQD evaluation of the Rusch et al., study concurs with EPA's assessment that this study was appropriate to establish an RfC.

The ITSL was determined as follows:

$$HEAST\ RfC = 0.0007 \frac{mg}{m^3} (ITSL)$$

$$0.0007 \frac{mg}{m^3} \times \frac{1000 \mu g}{1 mg} = 0.7 \frac{\mu g}{m^3}$$

The ITSL for boron trifluoride = 0.7 $\mu\text{g}/\text{m}^3$ based on 24 hr. averaging time.

References:

ACGIH, 1991. Documentation of TLVs and BETs, boron trifluoride.

ATSDR Toxicologic Profile for Boron, 1992. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. TP-91/05.

U.S. EPA, 1991. Health and Environmental Effects Document for Boron and Boron Compounds. Environmental Criteria and Assessment Office, Office of Research and Development, 'U.S. Environmental Protection Agency, Cincinnati, OH; EPA/600/8-9 1/015; PB91-233635.

Rusch, G. M. et al., 1986. Inhalation toxicity studies with boron trifluoride, Toxicology and Pharmacology, 83: 69-78.

MB:slb