8	CAS No.: 7440-42-8 (Boron)	Substance: Boron and its compounds

Chemical Substances Control Law Reference No.:
PRTR Law Cabinet Order No.: 1-304 (Boron and its compounds)

Atomic Symbol: B
Atomic Weight: 10.81

1. General Information

Boron is insoluble in water and the water solubility of boric acid and sodium tetraborate is 4.72×10^4 to 5.48×10^4 mg/1000 g (25°C) and 3.07×10^4 to 3.13×10^4 mg/1000 g (25°C), respectively. The vapor pressure of boron is 0.0119 mmHg (= 1.58 Pa) (2140°C). Boric acid is determinate to be persistent but not highly bioaccumulative.

Boron is controlled under the Environmental Standards (quality of water, soil, groundwater). Boron is established as items of drinking water quality standards. Boron and its compounds are designated as Class I Designated Chemical Substance under the Law concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (PRTR Law). Boron is most commonly used for raw materials of building insulation and glass fibers for reinforced plastics, and it is also used in manufacturing of special glass such as that used in liquid-crystal displays and for ceramic glazes. It is also used in lower amounts for chemical reaction catalysts, adhesives of cardboard, eye drops, pesticides, insect repellents, and reactor control rods. Boric acid is used for boric acid cake for cockroach extermination, glass, pharmaceutical products (antiseptic and disinfectant agents and compress treatments), enamel, nickel plating additives, capacitors, fireproofing agents, preservatives, dye manufacturing, pesticides, pigments, fusing agents, catalysts, manufacturing of borates, artificial jewels, cosmetics, photographic chemicals, finishing agents in the leather industry, ceramic glazes, high grade cement, candlewicks, fire protecting materials, paints, hair dressing (pomade), soap, and in the textile industry. Sodium tetraborate is mainly used for enameled ironware, glass, ceramics, metal brazing, tannage, textile printing, preservatives, pharmaceutical products, cosmetics, heat treatment agents, photographs, guignet's green pigment, increased production of rapeseed, desiccants (lead borate and manganese borate), perborate materials, soft water hardeners, preservatives, antifreeze materials, and chemical conversion materials for capacitors.

The total production (shipment) and imports of boric acid for FY2001 was 10,000 to less than 100,000 tons/yr, and the figures for boron and sodium tetraborate were both 1,000 to less than 10,000 tons/yr. The totals of production (shipment) and imports in FY2004 were 10,000 to less than 100,000 tons/yr for boric acid and sodium borate and 1,000 to less than 10,000 tons/yr for boron. Boron and its compounds were categorized as within the 10,000-ton class of production and imports under the Law concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (PRTR Law).

Boron compounds are generally present as boron ions or borate ions in water. The primary component of inorganic boron is undissociated boric acid in nearly neutral ambient water. In addition, boron compounds are absorbed in sediment and soil. Their abilities to be absorbed depend on pH and they are most absorbed at around pH 7.5 to 9.0.

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2. Exposure assessment

Total release to the environment in FY2005 under the PRTR Law came to approximately 4,900 tons. Of this quantity, the amount reported came to approximately 3,100 tons (64% of the total). Release to public water bodies accounted for a large part of the reported release. The landfill disposal was 2.7 tons and transfers to waste and sewage were approximately 2,000 and 33 tons, respectively. Large releases to the air were reported by ceramic and soil and stone products manufacturing industries. Large releases to public water bodies were reported by the sewerage, nonferrous metal manufacturing, and crude oil and natural gas mining industries. It should be noted, however, that the releases from the sewerage industry might be overestimated because they are sometimes calculated based on the lower

limit of quantitation.

When estimated releases are included, releases to water bodies accounted for the greatest quantity of releases to the environment.

Because chemical forms of boron and its compounds are changed in the environment, the ratio of distribution to each media should not be predicted. Thus, the ratio of distribution to each medium of boron and its compounds was not estimated.

The predicted environment concentration (PEC), which indicates exposure to aquatic organisms, was determined to be 2,700 μg/L for public freshwater bodies based on the data on possibly artificial releases. The average concentration in seawater bodies of approximately 2,000 to 4,000 μg/L is higher than that in freshwater bodies. There have been insufficient ecological toxicity studies on aquatic organisms, and therefore, no immediate exposure assessments for seawater bodies will be conducted.

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3. Initial assessment of ecological risk

The initial assessment of ecological risk for aquatic organisms was conducted independently for trivalent boron and pentavalent boron.

With regard to acute toxicity of trivalent boron, reliable information of a 48-hour median lethal concentration (LC_{50}) value of 133,000 μg B/L was found for the crustacea *Daphnia magna* (water flea), a 96-hour LC_{50} value of 125,000 μg B/L was found for the fish Catostomidae *Catostomus latipinnis*, and a 48-hour LC_{50} value of 1,380,000 μg B/L was found for another organism, the Chironomidae *Chironomus decorus*. Accordingly, an assessment factor of 1,000 was used, and a predicted no effect concentration (PNEC) of 125 μg B/L was obtained based on the acute toxicity values. As for chronic toxicity, a 21-day no observed effect concentration (NOEC) for reproduction of the crustacea *D. magna* was 6,000 μg B/L and a 87-day NOEC for growth inhibition and mortality of the rainbow trout *Oncorhynchus mykiss* was above 2,100 μg B/L. From these reliable values, a PNEC based on chronic toxicity was determined to be 60 μg B/L with an assessment factor of 100. As the PNEC for trivalent boron, a value of 60 μg B/L obtained from the chronic toxicity for the crustacea was used.

With regard to acute toxicity of pentavalent boron, reliable information of a 48-hour median effective concentration (EC_{50}) immobilization value of 923 μg B/L was found for the crustacea *Ceriodaphnia* cf. *dubia* (water flea). Accordingly, an assessment factor of 1,000 was used, and a PNEC value 0.92 μg B/L was obtained based on the acute toxicity values. As no reliable information regarding chronic toxicity could be obtained, as the PNEC for pentavalent boron, a value of 0.92 μg B/L obtained from the acute toxicity for the crustacea was used.

The PEC/PNEC ratio of trivalent boron present in water is 45 for freshwater bodies and the substance is considered to be a candidate for further work. It would be advisable to further work this substance after some toxicity studies for algae. Data collection of hazard information on marine organisms should be considered.

Hazard assessment (basis for PNEC)			Assessment factor	Predicted no effect concentration PNEC (μg/L)	Exposure assessment		PEC/ PNEC ratio	Result of assessment
Species	Acute / chronic	Endpoint			Water body	Predicted environmental concentration PEC (μg/L)		
Crustacea (water flea)	Chronic	NOEC reproduction	100	60 (B(III))	Freshwater	2,700	45	■
					Seawater	—	—	

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4. Conclusion

	Conclusions	Judgment
Ecological risk	The PEC/PENC ratio of trivalent boron present in water is 45 for freshwater bodies, and the substance is considered to be a candidate for further work. It would be advisable to further work this substance after some toxicity studies for algae. Data collection of hazard information on marine organisms should be considered.	■

[Risk judgments] ○: No need for further work ▲: Requiring information collection

■: Candidates for further work ×: Impossibility of risk characterization

（○）: Though a risk characterization cannot be determined, there would be little necessity of collecting information.

（▲）: Further information collection would be required for risk characterization.