

10	CAS No.: 7439-96-5 (Manganese)	Substance: Manganese and its compounds
<p>Chemical Substances Control Law Reference No.:</p> <p>PRTR Law Cabinet Order No.: 1-311 (manganese and its compounds)</p> <p>Atomic Symbol : Mn</p> <p>Atomic Weight : 54.94</p>		
<p><b>1. General Information</b></p> <p>Manganese is slowly degraded in cold water. Manganese dioxide is insoluble in water and the water solubility of potassium permanganate is <math>7.06 \times 10^5</math> mg/1000 g at 25°C. The vapor pressure of manganese is <math>4.16 \times 10^{-7}</math> mmHg (= <math>5.55 \times 10^{-7}</math> Pa) (527°C). Potassium permanganate is determined to be persistent but not highly bioaccumulative. Manganese is established as items of drinking water quality standards. Manganese 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). Manganese is mainly used for raw materials for alloy of machine parts requiring strength, and for additives to remove the effect of iron sulfur and deoxidizing agents in manufacturing processes of iron and steel products. Potassium permanganate is mainly used for oxidants to remove organic compounds and odor from drinking water and analytical reagents for measuring of COD (chemical oxygen demand), and it is also used for removing manganese and iron and textile and grease bleaching. Manganese dioxide is mainly used for manganese battery electrodes, oxidants in the manufacturing process of organic solvents due to its strong oxidizing properties, raw materials for magnetic ferrite materials, raw materials for fireworks and matches, and glass coloring. Manganese in slag is used for manganese calcium silicate fertilizers, and manganese compounds (maneb and manzeb) are used for pesticides (fungicides).</p> <p>The anthropogenic sources are city sewage, sewage sludge, combustion of fossil fuels, waste landfills containing manganese, and combustion of small amounts of fuel additives. The primarily natural sources of manganese in air are crust rocks, ocean spray, forest fire, plants, and volcanoes. The natural sources in water are direct reduction of particulate manganese, weathered minerals containing divalent manganese, acidic environments, and reduction of particulate manganese oxide under anaerobic conditions. The natural sources in soil are deposition from air, leaching from plant tissues, deciduous leaves, and animal stools.</p> <p>In FY2001, the totals of production and imports of manganese and manganese dioxide were both 10,000 to less than 100,000, and 100 to less than 1,000 tons/yr for potassium permanganate. The totals of manganese, manganese oxide and potassium permanganate in FY2004 were 100,000 to less than 1,000,000 tons/yr, 10,000 to 100,000 tons/yr, and 100 to less than 1,000 tons/yr, respectively. Production and import quantities of manganese and its compounds under the Law concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (PRTR Law) came to 100,000 tons.</p> <p>Manganese compounds are considered to be present in the states of dissociated ions, complex ions, and insoluble salts, and divalent ions are most stable in water. Manganese other than divalent manganese is considered not to be important in solution.</p> <p>-----</p> <p><b>2. Exposure assessment</b></p> <p>Total release to the environment in FY2005 under the PRTR Law came to approximately 7,600 tons, of which approximately 7,100 tons (93% of the total) was reported. Release to public water bodies accounted for a large part of the reported release. In addition, landfill disposal was approximately 6,200 tons, and transfer to waste and sewage were approximately 25,000 and 6.2 tons, respectively. Large releases to air were reported by steel, nonferrous metal manufacturing, machinery, and apparatuses manufacturing industries, and to public water bodies by sewerage and</p>		

chemical 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.

The ratio of distribution to each media of manganese and its compounds should not be predicted because their chemical forms are changed in the environment. Therefore, the ratio of distribution to each media of manganese and its compounds was not predicted.

The predicted environment concentration (PEC), which indicates exposure to aquatic organisms, was determined to be 330 µg/L for soluble manganese for public freshwater bodies and 140 µg/L for soluble manganese for public seawater bodies.

### 3. Initial assessment of ecological risk

The initial assessment of ecological risk for aquatic organisms was conducted independently for divalent manganese and heptavalent manganese. With regard to acute toxicity of divalent manganese, reliable information of a 72-hour median effective concentration (EC<sub>50</sub>) growth inhibition value of 4,850 µg Mn/L was found for the diatom *Asterionella japonica*, a 48-hour EC<sub>50</sub> immobilization value of 4,700 µg Mn/L was found for the crustacea *Daphnia magna* (water flea), a 96-hour median lethal concentration (LC<sub>50</sub>) value of 130,000 µg Mn/L was found for the cyprinid *Agosia chrysogaster*, and a 48-hour EC<sub>50</sub> value of 30,000 µg Mn/L was found for another organism, *Mytilus edulis*. Accordingly, an assessment factor of 100 was used, and a predicted no effect concentration (PNEC) of 47 µg Mn/L was obtained based on the acute toxicity values. With regard to chronic toxicity, reliable information of a 62-day no observed effect concentration (NOEC) growth inhibition value of 2,840 µg Mn/L was found for the brown trout *Salmo trutta*. Accordingly, an assessment factor of 100 was used, and a PNEC value of 28 µg Mn/L was obtained based on the chronic toxicity values. As the PNEC for divalent manganese, a value of 28 µg Mn/L obtained from the chronic toxicity for the fish was used.

As for acute toxicity for heptavalent manganese, a 96-hour LC<sub>50</sub> for the crustacea *Diatomus forbesi* (Diatomidae), a 48-hour LC<sub>50</sub> for the fish *Ictalurus punctatus* (channel catfish), and a 48-hour LC<sub>50</sub> for the *Dreissena polymorpha* (zebra mussel) were 76.5, 553, and above 13,900 µg Mn/L, respectively. From these reliable values, a PNEC based on acute toxicity was determined to be 0.077 µg Mn/L with an assessment factor of 1,000. As no reliable information regarding chronic toxicity could be obtained, as the PNEC for heptavalent manganese, a value of 0.077 µg Mn/L obtained from the acute toxicity for the crustacea was used.

The PEC/PNEC ratio of divalent manganese, which is the most stable form in water, was 12 for freshwater bodies, and 5 for seawater bodies, and therefore, the substance is considered to be a candidate for further work. It would be advisable to further work this substance, collecting findings of chronic toxicity data for algae and crustacea.

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)		
Fish (brown trout)	Chronic	NOEC growth Inhibition	100	28 (Mn(II))	Freshwater	330	12	■
					Seawater	140	5	

### 4. Conclusions

	Conclusions	Judgment
Ecological risk	This substance is a candidate for further work. It would be advisable to further work this substance, collecting findings of chronic toxicity data for algae and crustacea.	■

[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.