

2	CAS No.: —	Substance: Trivalent Chromium Compounds
<p>Chemical Substances Control Law Reference No.:</p> <p>PRTR Law Cabinet Order No.*: 1-87 (chromium and trivalent chromium compounds)</p> <p>*Note: No. in Revised Cabinet Order enacted on October 1, 2009</p>		
<p>1. General information</p> <p>The major trivalent chromium compounds are chromium (III) oxide and chromium (III) nitrate. Chromium (III) oxide is insoluble, whereas chromium (III) nitrate is soluble in water.</p> <p>Chromium and trivalent chromium compounds are designated as Class 1 Designated Chemical Substances under the Law Concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (PRTR Law).</p> <p>The main use of chromium (III) oxide is as a green pigment in cement, rubber, roofing materials and ceramics, etc., when heat resistance and durability are required. The main uses of chromium (III) nitrate are dyeing reagents and plating chemicals. In addition, the main uses of other trivalent chromium compounds are dyeing auxiliaries and catalysts in the case of chromium (III) trichloride; dye intermediates, leather processing, and plating for chromium (III) sulfate; and leather tanning agents for basic chromic sulfate.</p> <p>The production and import category under the PRTR Law for chromium and trivalent chromium compounds is more than 100 t. Chromium oxide (Cr₂O₃) production in fiscal 2006 and fiscal 2007 was 3,399 t and 2,796 t, respectively.</p> <hr/> <p>2. Exposure assessment</p> <p>Total release of chromium and trivalent chromium compounds to the environment in fiscal 2007 under the PRTR Law was approximately 120 t, of which approximately 86 t or 72% of overall releases were reported. Among reported release destinations, the amount discharged to landfill was large. In addition, transfer to waste materials was approximately 12,000 t. Industry types with large reported releases were the non-ferrous metal manufacturing industry and the steelmaking industry for landfill, the sewage industry and the steelmaking industry for public water bodies, and the steelmaking industry, transportation equipment manufacturing industry and general machinery manufacturing industry for the atmosphere. However, releases from the sewage sector are sometimes derived on the basis of lower limit of quantitation values; therefore, attention must be paid to the fact that there are cases of overestimation. Of unreported releases (for regulated industry types), 0.99 t (total chromium) is estimated to be released accompanying combustion of coal in coal-fired power stations (substances containing low content).</p> <p>The largest release among releases to the environment including unreported ones was to water bodies.</p> <p>Predicting proportions of distribution by individual medium was not considered appropriate because the chemical forms adopted by trivalent chromium compounds in the environment are not clearly understood. Accordingly, a prediction of distribution by medium for trivalent chromium compounds was not carried out.</p> <p>The predicted maximum exposure to humans via inhalation was 0.092 µg/m³ based on general environmental atmospheric data. The predicted maximum oral exposure was estimated to be around 2.7 µg/kg/day based on calculations from data for public freshwater bodies, food, and soil.</p> <p>The predicted environmental concentration (PEC), which indicates exposure to aquatic organisms, was around 13 µg/L for public freshwater bodies and generally less than 10 µg/L for seawater.</p> <hr/> <p>3. Initial assessment of health risk</p> <p>Particles of trivalent chromium compounds may irritate eyes and respiratory tracts.</p> <p>A woman who died after she took 48 g of basic chromium sulfate contained in leather tanning solution suffered</p>		

diarrhea, stomachache and low body temperature. During her autopsy, hemorrhagic and erosive gastroenteritis, serious hemorrhagic pancreatitis, congestion and edema in lungs, peritonitis, ascites, and diffuse petechial hemorrhage were observed. Another woman who took 5 g of chromium hydroxide vomited and suffered from tenderness in her abdomen and anemia. Mild granulocytopenia was also temporarily observed in her.

Sufficient information could not be obtained on its carcinogenicity, and its initial assessment was conducted on the basis of data on its non-carcinogenic effects.

As for its oral exposure, NOAEL of no less than 2,140 mg/kg/day was obtained for chromium oxide (equivalent to 1,460 mg/kg/day for chromium) since this maximum dose did not cause any effect after its administration in its mid-term and long-term toxicity tests for rats. This was divided by 10, when the fact that reproductive or developmental toxicity tests had been conducted for its effects was considered, to produce 210 mg/kg/day as its ‘non-toxic level*’ (equivalent to 150 mg/kg/day for chromium).

As for its inhalation exposure, LOAEL of 3 mg/m³ (for increased lymph tissue, chronic inflammation in alveoli, and growth of type-II alveolar epithelia) was obtained for chromium by exposure to chromium oxide or basic chromium sulfate in mid-term and long-term toxicity tests for rats. This was adjusted against exposure conditions to provide 0.5 mg/m³, and then divided by 10 as is always the case for LOAEL. This was divided by 10 again, due to their short test periods, to produce 0.005 mg/m³ as a reliable finding for its lowest dose, and this is identified as its ‘non-toxic level*’.

As for its oral exposure, its maximum exposure was estimated to be around 2.7 µg/kg/day, when its intakes through freshwater from public water supply and through food and soils were assumed. Its margin of exposure (MOE) would be 5,600 when calculated from its ‘non-toxic level*’ of 150 mg/kg/day and its estimated maximum exposure, and then divided by 10 due to the fact that ‘non-toxic level*’ was obtained from animal experiments. No further action, therefore, will be required at the moment to assess health risk from oral exposure to this substance.

As for its inhalation exposure, its maximum exposure concentration was estimated to be 0.092 µg/m³, when its concentrations in the ambient air were considered. Its MOE would be 5, when calculated from its ‘non-toxic level*’ of 0.005 mg/m³ and its estimated maximum exposure concentration, and then divided by 10 due to the fact that ‘non-toxic level*’ was obtained from animal experiments. Detailed assessment would be required on health risk from inhalation exposure to this substance in the ambient air.

Information of toxicity				Exposure assessment		Result of risk assessment			Judgment
Exposure Path	Criteria for risk assessment	Animal	Criteria for diagnoses (endpoint)	Exposure medium	Predicted maximum exposure quantity and concentration	MOE			
Oral	‘Non-toxic level’, 150 mg/kg/day	Rats	no effect even at the highest dose	Drinking water	— µg/kg/day	MOE	—	×	
				Freshwater, food, and soils	2.7 µg/kg/day	MOE	5,600	○	
Inhalation	‘Non-toxic level’, 0.005 mg/m ³	Rats	increased lymph tissue, chronic inflammation in alveoli, and growth of type-II alveolar epithelia	Ambient air	0.092 µg/m ³	MOE	5	■	
				Indoor air	— µg/m ³	MOE	—	×	

Non-toxic level *

- When a LOAEL is available, it is divided by 10 to obtain a level equivalent to NOAEL.
- When an adverse effect level for the short-term exposure is available, it is divided by 10 to obtain a level equivalent to an adverse effect level for the long-term exposure.

Note: Estimated maximum exposure (concentration) and ‘non-toxic level’ are presented as those for chromium.

4. Initial assessment of ecological risk

With regard to acute toxicity, the following reliable data were obtained: a 96-h median effective concentration (EC₅₀) of 397 µg-Cr/L for growth inhibition in the green algae *Pseudokirchneriella subcapitata*; a 96-h median lethal concentration (LC₅₀) of 390 µg-Cr/L in the crustacean *Austropotamobius pallipes* (Astacidae); a 48-h median lethal

threshold (TL_m) of 3,850 µg-Cr/L in the fish species *Poecilia reticulata* (guppy); and a 48-h LC₅₀ of 139 µg-Cr/L for the ciliate *Spirostomum ambiguum*. Accordingly, based on these acute toxicity values and an assessment factor of 100, a predicted no effect concentration (PNEC) of 3.9 µg/L was obtained.

With regard to chronic toxicity, the following reliable data were obtained: a 21-d no observed effect concentration (NOEC) of 47 µg-Cr/L for reproductive inhibition in the crustacean *Daphnia magna*; and a 72-d NOEC of 48 µg-Cr/L for mortality in the fish species *Oncorhynchus mykiss* (rainbow trout). Accordingly, based on these chronic toxicity values and an assessment factor of 100, a predicted no effect concentration (PNEC) of 0.47 µg-Cr/L was obtained. The value of 0.47 µg-Cr/L obtained from the chronic toxicity to the crustacean was used as the PNEC for this substance.

The PEC/PNEC ratio was 28 for freshwater bodies and less than 21 for seawater. For this reason, the substances are considered as candidates for detailed assessment.

Hazard assessment (basis for PNEC)			Assessment factor	Predicted no effect concentration PNEC (µg Cr/L)	Exposure assessment		PEC/PNEC ratio	Assessment result
Species	Acute/chronic	Endpoint			Water body	Predicted environmental concentration PEC (µg/L)		
Crustacean	Chronic	NOEC	100	0.47	Freshwater	13	28	■
<i>Daphnia magna</i>		Reproductive inhibition			Seawater	<10	<21	

5. Conclusions

	Conclusions		Judgment
Health risk	Oral exposure	No further action required.	○
	Inhalation exposure	Collection of information required on exposure in the ambient air.	■
Ecological risk	Considered as candidates for detailed assessment.		■

[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.