8	CAS No.: 7440-32-6 (Titanium)	Substance: Titanium and its compounds

Chemical Substances Control Law Reference No.:

PRTR Law Cabinet Order No.:

Atomic symbol: Ti

Atomic Weight: 47.87

1. General information

Titanium compounds include titanium oxide and barium titanate. Titanium oxide is insoluble in water.

The main uses of microparticulate titanium oxide are in cosmetics, silicone rubber, UV-shielding coatings, plastic fibers, magnetic tape, toner, ceramics, automotive coatings, other chemicals, and ink for inkjet usage. The main uses of titanium tetrachloride are as a raw material for the production of metallic titanium, pigments, coatings, and polyethylene polymerization catalysts. The main use of barium titanate is in electronic components (ceramic capacitors, EL [electroluminescence]). The titanium oxide and barium titanate production (shipments) and import quantities in fiscal 2007 were, respectively, 100,000 to <1,000,000 t/y and 1,000 to <10,000 t/y.

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2. Exposure assessment

Because this substance is not a Class 1 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), release and transfer quantities could not be obtained. Predicting distribution by individual medium was not considered appropriate because the chemical forms adopted by titanium and its compounds in the environment are not fully understood. Accordingly, a prediction of distribution by individual medium for titanium and its compounds was not carried out.

The predicted maximum exposure to humans via inhalation, based on general environmental atmospheric data, was around 0.2 μg/m^3. The predicted maximum oral exposure was estimated to be around 82 μg/kg/day based on calculations from food and soil data.

The predicted environmental concentration (PEC), which indicates exposure to aquatic organisms, could not be set because water quality data could not be obtained.

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3. Initial assessment of health risk

When (TiO_2) is taken into eyes, they turn to red. Titanium tetrachloride ($TiCl_4$) is corrosive to eyes, skin and respiratory tracts. When it is taken orally, it is corrosive. When its vapor is inhaled, it may cause pneumonedema. When it is inhaled, it will cause pharyngalgia, coughing, burning sensation, breath shortness and closeness. When it is taken orally, it will lead to burning sensation, stomachache, shock or collapse. When it is attached to eyes or skin, pains, redness or thermal injury will occur. Toxicity of $TiCl_4$ would be attributed to hydrogen chloride produced by its reaction with water, so it is different from toxicity of titanium itself. $TiCl_4$ is out of scope of the present assessment.

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 oral exposure, NOAEL, or the maximum dose without any effect, of 2,500 mg/kg/day was obtained from mid-term and long-term toxicity tests for rats with TiO_2, and 2,500 mg/kg/day, or 1,500 mg/kg/day as titanium, was identified as the 'non-toxic level*'. As for inhalation exposure, NOAEL of TiO_2, or its maximum concentration without any effect on workers, of 20 mg/m^3 was obtained from findings on its effects on human, and this was adjusted against exposure conditions to produce 4 mg/m^3, or 2.4 mg/m^3 as titanium, as the 'non-toxic level*'.

As for oral exposure, the maximum exposure for titanium was estimated to be around 82 μg/kg/day, when intakes of

food and soil were assumed. Its margin of exposure (MOE) would be 370 when calculated from its 'non-toxic level*' of 1,500 mg/kg/day and its estimated maximum exposure, then divided by 10 due to the fact that 'non-toxic level*' was obtained from animal experiments, and divided again by 5 when its carcinogenicity was considered. No further action would be required at the moment to assess health risk from oral exposure to this substance.

As for inhalation exposure, the maximum exposure concentration for titanium was estimated to be around 0.2 μg/m^3, when its concentrations in the ambient air were considered. Its MOE would be 2,400, when calculated from its 'non-toxic level*' of 2.4 mg/m^3 and its estimated maximum exposure concentration, and divided by 5 after its carcinogenicity was considered. No further action will be required at the moment to assess health risk from inhalation exposure to this substance in the ambient air.

As for nanomaterial made of titanium dioxide, their particles are so small that their metabolism, dynamics and toxicology would be different. Based on the information on exposure to them, separate risk assessment should to be considered for them.

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				
Oral	'Non-toxic level*' 1,500 mg/kg/day	Rats	The maximum dose without any effect	Drinking water	— μg/kg/day	MOE	—	×	○
				Food, Soil	82 μg/kg/day	MOE	370	○	
Inhalation	'Non-toxic level*' 2.4 mg/m^3	Human	The maximum concentration without any effect on workers	Ambient air	0.2 μg/m^3	MOE	2,400	○	○
				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 titanium.

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4. Initial assessment of ecological risk

Judgment on the ecological risk of this substance could not be made because its environmental concentration and toxicity data applicable to initial assessment could not be obtained.

The water solubilities of titanium compounds (excluding nanoparticle substances) for which ecotoxicity data could be obtained are low, and data that could be applied in this initial assessment was unobtainable; however, toxicity was not recognized based on the data that was collected.

On the other hand, assessment methods for nanoparticulate titanium dioxide have not yet been established and assessment has thus not been conducted.

Risk assessment for this substance will be considered once again when toxicity data has been collected and assessment methods have been established.

Hazard assessment (basis for PNEC)			Assessment factor	Predicted no effect concentration PNEC (μg/L)	Exposure assessment		PEC/PNEC ratio	Assessment result
Species	Acute/ chronic	Endpoint			Water body	Predicted environmental concentration PEC (μg/L)		
—	—	—	—	—	Freshwater	—	—	× (▲)
					Seawater	—	—	

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5. Conclusions

	Conclusions		Judgment
Health risk	Oral exposure	No further action required.	○
	Inhalation exposure	No further action required.	○
Ecological risk	Judgment on the ecological risk of this substance could not be made because its environmental concentration and toxicity data applicable to initial assessment could not be obtained. The water solubilities of titanium compounds (excluding nanoparticle substances) for which ecotoxicity data could be obtained are low, and data that could be applied in this initial assessment was unobtainable; however toxicity was not recognized based on the data that was collected. On the other hand, assessment methods for nanoparticulate titanium dioxide have not yet been established and assessment has thus not been conducted. Risk assessment for this substance will be considered once again when toxicity data has been collected and assessment methods have been established.		（▲）

［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.