Summary of Initial Risk Assessment Report

Nickel

This substance is assessed based on the Guideline for Initial Risk Assessment Version 1.0.

>> Introduction <<

Nickel is the subject of this assessment report. Under the Japanese PRTR law, nickel (elemental nickel) and nickel compounds are defined separately. Thus, the assessments of these substances were also conducted separately. Although PRTR data are available for both nickel and nickel compounds, almost all environmental data are reported as concentrations of elemental Ni making it difficult to describe their environmental fates separately. Inorganic compounds exist as diverse chemical species which can change in the environment. These chemical species have different hazardous properties. However, very few measured environmental concentrations are available for each species. Taking that into consideration, risk assessments of inorganic compounds are conducted using slightly different procedures from those of organic compounds. Refer to the Guideline for more detail. In this report, units of concentrations and intake (e.g., mg/L, mg/kg-Bodyweight/day) refer to the concentration or amount of pure Nickel.

1. General Information

1.1 Physico-chemical properties

PRTR No. of Japan	231
Chemical formula	Ni
CAS No.	7440-02-0
Appearance	Silver solid
Melting point	1,455 degC
Boiling point	2,730 degC
Water solubility	Insoluble

1.2 Environmental fate

Bioaccumulation	No information on the bioaccumulation of metal nickel was obtained. However, nickel sulfate heptahydrate is known to be a weakly bioaccumulative substance.
Biodegradation	--
Stability and fate in the environment	(Transport and distribution in soil) Nickel and nickel compounds are distributed mainly in sulfide ore and oxide ore; they are transferred to soil by the weathering of rock. The global content of nickel in soil is estimated to average 50 mg (Ni)/kg. (Transport and distribution in air) Transport and distribution of nickel particles in air are highly dependent on particle size and weather conditions. Smaller particles of nickel can remain airborne for longer periods of time and thus be transported over greater distances. (Transport and distribution in water) In rivers, nickel is adsorbed to particles and transported. Release of nickel from adsorbed matter can occur due to changes in pH, etc. Biochemical methylation is shown only in methanogenic bacteria. Nickel particles are oxidized in the presence of sulfide dioxide and changed to nickel sulfate. Precipitated nickel sulfide in aquatic environments is oxidized by sulfur-oxidizing bacterium and changed to sulfuric acid.

2. Sources of Release to the Environment

2.1 Annual production, import, export and domestic supply of nickel (pure metal), ferronickel and nickel oxide in 2002(ton/year)

Production	Import	Export	Domestic supply	Remarks
157,913	70,007	47,290	180,630	--

2.2 Uses

Stainless steel (74%), special steel (19%), nickel plating (1.8%), batteries, nonferrous alloys

2.3 Release from industries within the scope of the PRTR system (in 2002)

Release sources		Air(ton)	Water(ton)	Soil(ton)	Remarks
Listed industries	Reported release	1	8	<0.5	Release into rivers: 164 tons
	Release outside notification	186	158	<0.5	
Release outside notification from non-listed industry		--	--	--	
Households		--	--	--	
Mobile sources		--	--	--	
Total		187	166	<0.5	

2.4 Releases from other sources

(Natural sources)

Nickel may be released to soil as a result of weathering of rocks. The concentration of nickel in agricultural soil was reported as 3-1,000mg/kg.

(Anthropogenic sources)

Nickel may be released to air through combustion of fossil fuels by power plants and boilers. Nickel occurs in dust contained in the atmosphere near municipal incinerators and industrial incinerators. Water soluble nickel that is contained in domestic waste water and industrial waste water is released into sewage treatment plants.

.

2.5 Main release routes

Nickel is released from both anthropogenic sources and natural sources. From anthropogenic sources, nickel is released to air and to water during the refining process, alloy processes using nickel and powder metallurgy processes using nickel.

3. Exposure Assessment

3.1 Measured environmental concentration

Media	No. of points detected / No. of points measured	No. of samples detected / No. of samples measured	Detection range*	95th percentile	Detection limit	Year of investigation, Institution
Air (microg/m^3)	304/305	-- /3,447	nd-0.320	0.040	0.000007-0.0048	2003, Ministry of the Environment
River water (microg/L)	219/715	-- /1,626	nd-110	10	1-50	2002, Ministry of the Environment
Drinking water (microg/L)	58/353	--	nd-5	--	1	2003, Japan Water Research Center
Food	The dietary intake and the concentration of nickel in foods were surveyed. The 95th percentile of the concentration of Ni in the Japanese diet was reported as 0.14microg/g.		0.10-0.15	0.14	--	1985, Ishimatsu

*nd: Not detected

For calculation of the 95th percentile, data less than the detection limit are replaced with a value equal to 1/2 of the detection limit.

3.2 Estimated environmental concentration

Estimation by mathematical model was not conducted because it was difficult to make assumptions on the effects on environmental concentration considering to natural emissions and dynamism in the environment.

3.3 Estimated environmental concentration in water (EEC)

EEC(microg/L)	10
	The ninety-fifth percentile of measured concentrations in river water was used for the risk assessment because an estimation by model was not conducted.

3.4 Estimated human intake

Intake route		Concentration used for estimation of intake	Estimated intake (microg/ person/ day)	Estimated intake (microg/ kg-Bodyweight (BW)/ day)
Inhalation	Air	0.040(microg/m^3)	0.80	0.016
		The ninety-fifth percentile of the maximum annual concentrations measured at 304 measurement points was used for the risk assessment.		
Oral	Drinking water	5(microg/L)	10	0.20
		The maximum concentration of measured concentration was used for the risk assessment.		
	Food	0.14(microg/g)	280	5.6
		The dietary intake of Ni was derived using the ninety-fifth percentile of Ni concentration in food (0.14microg/g) and the dietary intake of the Japanese population (2000 g/person).		
	Subtotal	--	290	5.8
Total route		--	290	5.8

4. Hazard Assessment

4.1 Effects on organisms in the environment

No adequate data

4.2 Human health toxicity

Epidemiological studies and case reports: Nickel is a dermal sensitizer.					
Toxicity	Exposure routes	Species	Duration / Dose method	Toxic effects (Key study is underlined)	NOAEL or LOAEL (converted)
Repeated dose toxicity	Inhalation	Rat	13 weeks/ inhalation of nickel powder	<u>Increased absolute and relative lung weights, alveolar proteinosis, lung granulomatous inflammation</u>, pulmonary fibrosis, alveolar and bronchiolar hyperplasia, pulmonary monocyte infiltration, reduced body weight gains	LOAEL: 1 mg/m^3 (equivalent to 0.13 mg/kg/day)
	Oral	--	--	--	--
	Dermal	--	--	--	--
Reproductive and developmental toxicity	--	--	--	--	--
Carcinogenicity	Evaluation by IARC :Group 2B (Possibly carcinogenic to humans)				

Genotoxicity	Unable to determine genotoxicity

5. Risk Assessment

5.1 Environmental organisms

Risk characterization	EEC (microg/L)	NOEC	MOE	Product of uncertainty factors	Conclusion
	10	No adequate data	--	--	No immediate concern
	Product of uncertainty factors (UF): --				
Recommendation: As nickel is not water soluble, it is not expected to cause adverse effects to aquatic organisms.					

5.2 Human health

5.2.1 Repeated dose toxicity

Exposure route	Intake (microg/kgBW/day)	NOAEL or LOAEL (mg/kgBW/day)	Risk characterization		
			MOE	Product of uncertainty factors	Conclusion
Inhalation	0.016	LOAEL: 0.13	8,100	5,000	No immediate concern
Oral	5.8	No data	--	--	Could not be assessed
Total	--	--	--	--	--
Product of uncertainty factors (UF): Interspecies (10) * Intraspecies (10) * Use of LOAEL (10) * Duration of test (5) = 5,000					

5.2.2 Reproductive and developmental toxicity

--

5.2.3 Carcinogenicity

A carcinogenic risk characterization of the substance was not conducted in this assessment.

5.2.4. Recommendation for Human Health

In terms of inhalation exposure, the substance is considered to be of no immediate concern for the moment, and a low priority for further work. As for oral exposure, a risk assessment was not conducted due to a lack of toxicity data.

6. Supplement

--