MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

<table>
<thead>
<tr>
<th>Product name</th>
<th>Nickel sulfate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical formula</td>
<td>NiSO₄·6H₂O</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>SUMITOMO METAL MINING CO., LTD.</td>
</tr>
<tr>
<td></td>
<td>NON-FERROUS METALS DIV./ADMINISTRATION DEPT.</td>
</tr>
<tr>
<td></td>
<td>3-5-3, NISHIBARA-CHO, NIHAMA, EHIME, 792-8555 JAPAN</td>
</tr>
<tr>
<td></td>
<td>TEL +81- 897-37-4817</td>
</tr>
<tr>
<td></td>
<td>FAX +81- 897-37-4910</td>
</tr>
</tbody>
</table>

Product use: This material is used for Nickel plating, Coloring for aluminum surface, Catalysts, and Electric cells.

2. HAZARDS IDENTIFICATION

GHS classification

**Physical hazards:**
- Explosives: Outside scope of the classification
- Flammable gases: Outside scope of the classification
- Flammable aerosols: Outside scope of the classification
- Oxidizing gases: Outside scope of the classification
- Gases under pressure: Outside scope of the classification
- Flammable liquids: Outside scope of the classification
- Flammable solids: Not classified
- Self-reactive substances and mixtures: Classification not possible
- Pyrophoric liquids: Outside scope of the classification
- Pyrophoric solids: Not classified
- Self-heating substances and mixtures: Not classified
- Substances and mixtures which, in contact with water, emit flammable gases: Not classified
- Oxidizing liquids: Outside scope of the classification
- Oxidizing solids: Classification not possible
- Organic peroxides: Outside scope of the classification
- Corrosive to metals: Classification not possible

**Health hazards:**
- Acute toxicity – oral: Category 4 (see the following index 11.)
- Acute toxicity – dermal: Classification not possible
- Acute toxicity – inhalation (gases): Outside scope of the classification
- Acute toxicity – inhalation (vapors): Classification not possible
- Acute toxicity – inhalation (dust, mist): Classification not possible
- Skin corrosion/irritation: Classification not possible
- Serious eye damage/eye irritation: Classification not possible
- Respiratory sensitization: Category 1
- Skin sensitization: Category 1
- Germ cell mutagenicity: Not classified
- Carcinogenicity: Category 1A

(MSDS No.) SUMITOMO METAL MINING CO., LTD.
Nickel sulfate

Reproductive toxicity
Specific target organ toxicity (single exposure) Category 2
Specific target organ toxicity (repeated exposure) Category 1 (central nervous system, respiratory organ)
Aspiration hazard Classification not possible

Environmental hazards:
Hazardous to the aquatic environment - acute toxicity Category 2
Hazardous to the aquatic environment - chronic toxicity Category 2

HAZARDS EXCLUDED FROM THE GHS CLASSIFICATION CATEGORIES

HEALTH HAZARDS

- Seriously irritate the eyes, membrane of respiratory tract or skin.
- If swallowed large amount, may cause displeasure, nausea, giddiness, fatigue, headache, vomiting, diarrhea, cough, rapid breathing, temporary half-blindness.
- The increased rate of chromosomal aberration was observed in human peripheral lymphocyte who exposed occupationally to nickel chloride or nickel sulfate.
- In the epidemiological studies in the workers occupationally exposed to nickel oxide, nickel sulfate or nickel chloride, it is reported that the exposure may cause lung and nasal cavity cancer.
- The effects on nasal cavity, lung, testis, liver, heart and intestinal tract were observed in the repeatedly dosed animal study.

PICTOGRAM

SIGNAL WORD  DANGER

HAZARD STATEMENT

- Toxic if swallowed.
- May cause allergy or asthma symptoms or breathing difficulties if inhaled.
- May cause an allergic skin reaction.
- May cause cancer.
- Suspected of damaging fertility or the unborn child.
- Causes damage to organs <central nervous system, respiratory organs>
- Causes damage to organs <respiratory organs, kidney, testis> through prolonged or repeated exposure.
- May cause damage to organs <liver> through prolonged or repeated exposure.
- Very toxic to aquatic life.

PRECAUTIONARY STATEMENTS

[Prevention]
- Do not handle until all safety precautions have been read and understood.
4. FIRST AID MEASURES

Eye contact
Rinse cautiously with plenty of water for several minutes. Get medical attention.

Skin contact
Wash with plenty of water and soap. Take off all contaminated clothing and shoes. Wash contaminated clothing before reuse.

Inhalation
Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately get medical attention. Get medical attention if you feel unwell.

Ingestion
Rinse mouth. Get medical attention.

5. FIRE FIGHTING MEASURES

Flammable properties
Flash point
No data available

3. COMPOSITION / INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CAS No.</th>
<th>TSCA</th>
<th>EINECS</th>
<th>%w/w</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel sulfate</td>
<td>10101-97-0</td>
<td>Listed</td>
<td>231-104-9</td>
<td>NiSO₄·6H₂O:98.5&lt; Ni:22.0 &lt;</td>
</tr>
</tbody>
</table>

(Second Issue Jan. 5, 2011)

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**6. ACCIDENTAL RELEASE MEASURES**

**Personal precautions**
Immediately isolate the spilled area with adequate distance for all directions.
Wear adequate protector refer to Section 8 and avoid contact with eyes and skin or inhaling.
Keep unnecessary and unprotected personnel from entering.

**Environmental precautions**
Avoid entering the river or affecting to the environment.
Do not let this substance enter the environment.

**Method for clean-up**
Sweep diffused spillage and place in an empty container.
Residual substances are collected completely with care and moved to a safe place.
Sweep up spillage and place in a sealable empty container for later disposal.
Treat with solution of calcium hydrate or sodium carbonate, and then wash plenty of water.
Prevent the spillage release to the river.

**7. HANDLING AND STORAGE**

**Handling**
Wear protective equipment and set the engineering controls refer to Section 8.
Local exhaust or general ventilation may be necessary. (Refer to Section 8)
Wear protective gloves when handling.
Use only outdoors or in a well-ventilated area.
Avoid breathing dust or fume.
Wash hands thoroughly after handling.
Avoid to contact with strong oxidizers. (refer to Section 10)

**Storage**
Keep away from high temperature, humidity and direct sunlight. Keep container tightly closed and store in a cool, well-ventilated place.
Store keeping away from incompatible materials.
8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure guidelines
ACGIH has established the following exposure limit.
<ACGIH> 0.1mg/m3 (TWA)(as Ni, Soluble inorganic compounds (NOS))(2007)
<JSOH> Not established (2007).
<OSHA> 1mg/m3 (PEL-TWA) (as Ni)

Engineering controls
Indoor use, seal the source or provide local exhaust.
In case of dust or fume may generate, use local ventilation.

Personal protective equipments
Respiratory protection
Wear respiratory protection.
Skin protection
Wear protective gloves.
Eye / face protection
Wear eye protection. (e.g. A pair of goggles)
Wear protective clothing or face protection if necessary.
General hygiene considerations
Do not eat, drink, or smoke during work.
Wash hands thoroughly after handling.

9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Crystal</td>
</tr>
<tr>
<td>Color</td>
<td>Pale blue green</td>
</tr>
<tr>
<td>Odor</td>
<td>Odorless</td>
</tr>
<tr>
<td>Melting point</td>
<td>No data available (Decomposed to nickel oxide and sulfur trioxide at 840°C)</td>
</tr>
<tr>
<td>Boiling point</td>
<td>No data available.</td>
</tr>
<tr>
<td>Flash point</td>
<td>No data available.</td>
</tr>
<tr>
<td>Explosive range</td>
<td>No data available.</td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>No data available.</td>
</tr>
<tr>
<td>Vapor density</td>
<td>No data available.</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>2.07</td>
</tr>
<tr>
<td>Solubility in water</td>
<td>Water 40.8g/100g (25°C Anhydrous salts)</td>
</tr>
<tr>
<td>Partition Coefficient</td>
<td>No data available.</td>
</tr>
<tr>
<td>n-octanol/water</td>
<td>No data available.</td>
</tr>
<tr>
<td>Auto-ignition point</td>
<td>No data available.</td>
</tr>
<tr>
<td>Decomposition temperature</td>
<td>No data available.</td>
</tr>
<tr>
<td>Odor threshold</td>
<td>No data available.</td>
</tr>
<tr>
<td>Evaporation rate</td>
<td>No data available.</td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
<td>No data available.</td>
</tr>
<tr>
<td>Viscosity</td>
<td>No data available.</td>
</tr>
</tbody>
</table>

10. STABILITY AND REACTIVITY
Chemical stability

Stable under normal condition.

Conditions to avoid

Contact with incompatible materials.

Incompatible materials

Strong oxidizers.

Hazardous decomposition products

In case of fire, irritating or toxic fumes or gases may be generated.

Possibility of hazardous reactions

React with base and form hydroxides.

Upon heating, decompose at 848 °C and generate hazardous fumes of sulfur trioxide or Nickel oxide. The solution is a weak acid.

11. TOXICOLOGICAL INFORMATION

Acute toxicity – oral

LD₅₀ 275~500 mg/kg (rat)

Category 4 would be suitable based on ECETOC TR33.

Acute toxicity – dermal

No data available

Acute toxicity–inhalation

No data available

Skin corrosion/irritation

Skin irritation: Negative (rabbits)

Serious eye damage/eye irritation

Eye irritation: Negative (rabbits)

Respiratory sensitization

Respiratory sensitizer. As nickel compounds including this substance are listed as respiratory sensitization substances by DFG and listed as Group 2 by the Japan Society of Occupational Health.

Skin sensitization

Skin sensitizer. (guinea pig; maximization study)

As nickel compounds including this substance are listed as skin sensitization substances by DFG and listed as Group 1 by the Japan Society of Occupational Health.

Germ cell mutagenicity

Germ cell in vivo mutagenicity study of Cytogenetic test and somatic cell in vivo mutagenicity study of Micronuclei test and Cytogenetic Test; Negative.

Carcinogenicity

As nickel compound:

IARC : Group 1 (Carcinogenic to humans)(1990)
ACGIH : A1(Confirmed Human Carcinogen)(2001)
NTP : K(Known to be a Hunan Carcinogen)(2005)
Reproductive toxicity

Effects on male fertility and development of pups are observed.

Specific target organ toxicity (single exposure)

Acute symptoms, such as nausea, an abdominal spasm, diarrhea, vomiting, headache, giddiness, a sense of exhaustion, muscular pain or single-sided visual field defect were observed. In addition, as acute intoxication of a nickel compound, nausea, diarrhea, giddiness, and headache were seen in human.

Specific target organ toxicity (repeated exposure)

The increase of protein, β2-microglobulin, retinol binding protein or NAG concentration in urine was observed in human. Also Chronic allergic rhinitis, nasal-septum erosion, perforation and ulcer were observed in human. Degeneration and atrophy of olfactory epithelium, alveolitis, atrophy of vas deferens, vacuolation or degeneration of liver cell, glomerular degeneration in kidney, deciduation of alveolar and bronchial epithelium and thickening of alveolar cell wall in lung, emphysema were observed in animal experiments. The target organs are respiratory system, kidney, testis and liver. Repeated exposure of nickel or nickel compounds may damage the membrane of respiratory system at the established level. Prolonged exposure at high concentration may cause pulmonary fibrosis.

Aspiration hazard

No data available.

12. ECOLOGICAL INFORMATION

Hazardous to the aquatic environment – acute toxicity

EC₅₀ (72h) 0.75 mg/l (Selenastrum)

An estimate of the molecular weight conversion from anhydride to hexahydrate

EC₅₀ (72h) 1.27 mg/l (Category 2)

Hazardous to the aquatic environment – chronic toxicity

No data available.

This substance is metal. No data is available about the behavior in the water. Toxic to aquatic life through chronic influence (Category 2)

13. DISPOSAL CONSIDERATIONS

- Please consult us in case of recycling.
- Disposal should be in accordance with applicable regional, national and local laws and
regulations.
- When order to dispose the remainder to the private or public waste disposer, inform the physico-chemical and health hazards of this substance.
- Container should be cleaned up prior to recycling or dispose in accordance with applicable regional, national and local standard method.
- Empty container should be cleaned up prior to disposal.

14. TRANSPORT INFORMATION (not meant to be all-inclusive)

<table>
<thead>
<tr>
<th>Proper Shipping Name</th>
<th>ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN Number</td>
<td>3077</td>
</tr>
<tr>
<td>Class</td>
<td>9</td>
</tr>
<tr>
<td>Sub Risk</td>
<td>-</td>
</tr>
<tr>
<td>Packing Group</td>
<td>III</td>
</tr>
</tbody>
</table>

15. REGULATORY INFORMATION (not meant to be all-inclusive)

TSCA Inventory Listed

This product is followed by the competent regulations in an applicable country or region.

16. OTHER INFORMATION

Reference
1 European Center of Ecotoxicology and Toxicology of Chemicals(ECETOC) ; Technical Report No. 33 (1989)
5 USDHHS ; The Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles. (2005)
6 US NTP ; NTP Database Search (2005)
7 ACGIH ; Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices. 7th Ed. (2001)
9 "Biodegradation and Bioaccumulation Data of Existing Chemicals based on the CSCL Japan." ed by Chemicals Inspection & Testing Institute Japan (1992)
10 "Biodegradation and Bioaccumulation Data of Existing Chemicals based on the CSCL Japan." ed by Chemicals Inspection & Testing Institute Japan (1992)

(MSDS No.) SUMITOMO METAL MINING CO., LTD.
This information only concerns the above-mentioned product and does not need to be valid if used with other(s) or in any process. The information is to our best present knowledge correct and complete and is given in good faith but without warranty. It remains the user’s own responsibility to make sure that the information is appropriate and complete for his special use of this product.

(This is the last page of this MSDS.)