Material Safety Data Sheet

Titanium(IV) oxysulfate - sulfuric acid hydrate

sc-237122

Hazard Alert Code Key:
- EXTREME
- HIGH
- MODERATE
- LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Titanium(IV) oxysulfate - sulfuric acid hydrate

STATEMENT OF HAZARDOUS NATURE

NFPA
- HEALTH: 3
- FLAMMABILITY: 0
- INSTABILITY: 1

SUPPLIER
Company: Santa Cruz Biotechnology, Inc.
Address: 2145 Delaware Ave
Santa Cruz, CA 95060
Telephone: 800.457.3801 or 831.457.3800
Emergency Tel: CHEMWATCH: From within the US and Canada: 877-715-9305
Emergency Tel: From outside the US and Canada: +800 2436 2255 (1-800-CHEMCALL) or call +613 9573 3112

PRODUCT USE
Treatment of chrome yellow and other colours, production of titanous sulfate (titanium sesquisulfate) used as a reducing agent or stripper for dyes, laundry chemicals. NOTE: The name "titanyl sulfate" is a synonym for products with compositions varying from Ti(SO4)2.9H2O to TiSO4.H2SO4.8H2O

SYNONYMS

Section 2 - HAZARDS IDENTIFICATION

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW
RISK
Causes severe burns.
Risk of serious damage to eyes.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS
HAZARD RATINGS

- Respiratory irritants may result in disease involving difficult breathing and related systemic problems.
- Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.
- Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lungs. Prime symptom is breathlessness; lung shadows show on X-ray. Long term exposure to titanium and several of its compounds produces lung scarring and chronic bronchitis. Breathing is impaired and cardiac changes with right heart enlargements occur. There is an increased chance of developing cancers of the respiratory tract.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

HAZARD RATINGS

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</thead>
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<tr>
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<tr>
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<tr>
<td>Reactivity:</td>
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<td>2</td>
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<tr>
<td>Chronic:</td>
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<td>1</td>
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</table>

Name: titanium sulfate (basic)
CAS RN: 13825-74-6
%: >98
reacts with water or moist air to produce
sulfuric acid 7664-93-9

Section 4 - FIRST AID MEASURES

SWALLOWED

■ For advice, contact a Poisons Information Center or a doctor at once.
■ Urgent hospital treatment is likely to be needed.
■ If swallowed do NOT induce vomiting.
■ If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
■ Observe the patient carefully.
■ Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
■ Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
■ Transport to hospital or doctor without delay.

EYE

■ If this product comes in contact with the eyes:
■ Immediately hold eyelids apart and flush the eye continuously with running water.
■ Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
■ Continue flushing until advised to stop by the Poisons Information Center or a doctor, or for at least 15 minutes.
■ Transport to hospital or doctor without delay.
■ Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

■ If skin or hair contact occurs:
■ Immediately flush body and clothes with large amounts of water, using safety shower if available.
■ Quickly remove all contaminated clothing, including footwear.
■ Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Center.
■ Transport to hospital, or doctor.

INHALED

■ If fumes or combustion products are inhaled remove from contaminated area.
■ Lay patient down. Keep warm and rested.
■ Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
■ Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
■ Transport to hospital, or doctor, without delay.

Inhalation of vapors or aerosols (mists, fumes) may cause lung edema. Corrosive substances may cause lung damage (e.g. lung edema, fluid in the lungs). As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested. Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered. This must definitely be left to a doctor or person authorized by him/her. (ICSC13719).

NOTES TO PHYSICIAN

■ For acute or short term repeated exposures to strong acids:
■ Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.
■ Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling
■ Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
■ Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the dessicating action of the acid on proteins in specific tissues.

INGESTION:

■ Immediate dilution (milk or water) within 30 minutes post ingestion is recommended.
■ DO NOT attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
■ Be careful to avoid further vomit since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
■ Charcoal has no place in acid management.
■ Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

■ Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
■ Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

■ Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. DO NOT use neutralizing agents or any other additives. Several liters of saline are required.
■ Cycloplegic drops, (1% cyclopentolate for short-term use or 5% homatropine for longer term use) antibiotic drops, vasoconstrictive agents or artificial tears may be indicated dependent on the severity of the injury.
■ Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

(Copper, magnesium, aluminum, antimony, iron, manganese, nickel, zinc (and their compounds) in welding, galvanizing or smelting operations all give rise to thermally produced particulates of smaller dimension than might be produced if the metals are divided mechanically. Where insufficient ventilation or respiratory protection is available these particulates may produce "metal fume fever" in workers from an acute or long term exposure.

■ Onset occurs in 4-6 hours generally on the evening following exposure. Tolerance develops in workers but may be lost over the weekend. (Monday Morning Fever)
Pulmonary function tests may indicate reduced lung volumes, small airway obstruction and decreased carbon monoxide diffusing capacity but these abnormalities resolve after several months. Although mildly elevated urinary levels of heavy metal may occur they do not correlate with clinical effects. The general approach to treatment is recognition of the disease, supportive care and prevention of exposure. Seriously symptomatic patients should receive chest x-rays, have arterial blood gases determined and be observed for the development of tracheobronchitis and pulmonary edema.

[Ellenhorn and Barceloux: Medical Toxicology].

* Consider preplacement screening with emphasis on chronic respiratory problems. Afflicted workers are at an increased risk from severe, prolonged exposure.

### Section 5 - FIRE FIGHTING MEASURES

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<th>Property</th>
<th>Value</th>
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<tr>
<td>Upper Explosive Limit (%)</td>
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<tr>
<td>Specific Gravity (water=1):</td>
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<tr>
<td>Lower Explosive Limit (%):</td>
<td>Not Available</td>
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</table>

**EXTINGUISHING MEDIA**

- Metal dust fires need to be smothered with sand, inert dry powders.
- DO NOT USE WATER, CO2 or FOAM.
- Use DRY sand, graphite powder, dry sodium chloride based extinguishers, G-1 or Met L-X to smother fire.
- Confining or smothering material is preferable to applying water as chemical reaction may produce flammable and explosive hydrogen gas.
- Chemical reaction with CO2 may produce flammable and explosive methane.
- If impossible to extinguish, withdraw, protect surroundings and allow fire to burn itself out.
- DO NOT use halogenated fire extinguishing agents.

**FIRE FIGHTING**

- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use fire fighting procedures suitable for surrounding area.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

**GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS**

- Non combustible.
- Not considered to be a significant fire risk.
- Acids may react with metals to produce hydrogen, a highly flammable and explosive gas.
- Heating may cause expansion or decomposition leading to violent rupture of rigid containers.
- May emit corrosive, poisonous fumes. May emit acrid smoke.
- Decomposition may produce toxic fumes of: sulfur oxides (SOx), metal oxides.

**FIRE INCOMPATIBILITY**

- None known.

**PERSONAL PROTECTION**

**Glasses:** Safety Glasses.

**Respirator:** Type E-P Filter of sufficient capacity

### Section 6 - ACCIDENTAL RELEASE MEASURES

**MINOR SPILLS**

- Drains for storage or use areas should have retention basins for pH adjustments and dilution of spills before discharge or disposal of material.
- Check regularly for spills and leaks.
- Clean up all spills immediately.
- No smoking, naked lights, ignition sources.
- Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials; as ignition may result.
- Avoid breathing dust or vapors and all contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb spill with dry sand, earth, inert material or vermiculite
- DO NOT use sawdust as fire may result.
- Scoop up solid residues and seal in labeled drums for disposal.
- Neutralize/decontaminate area.

**MAJOR SPILLS**

- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Consider evacuation.
- Stop leak if safe to do so.
- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Neutralize/decontaminate residue.
- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.
- If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL

PROTECTIVE ACTION ZONE

Isolation Distance 25 meters
Downwind Protection Distance 250 meters
Evacuation Direction

FOOTNOTES
1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all people without appropriate protective equipment to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)
AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING
- Avoid personal contact and inhalation of dust, mist or vapors.
- Provide adequate ventilation.
- Always wear protective equipment and wash off any spillage from clothing.
- Keep material away from light, heat, flammables or combustibles.
- Keep cool, dry and away from incompatible materials.
- Avoid physical damage to containers.
- DO NOT repack or return unused portions to original containers.
- Withdraw only sufficient amounts for immediate use.
- Contamination can lead to decomposition leading to possible intense heat and fire.
- When handling NEVER smoke, eat or drink.
- Always wash hands with soap and water after handling.
- Use only good occupational work practice.
- Observe manufacturer's storing and handling directions.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.

- Avoid smoking, naked lights or ignition sources.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately.
- Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer’s storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

RECOMMENDED STORAGE METHODS
- DO NOT use aluminum or galvanized containers.

Check regularly for spills and leaks.

Glass container:
- Lined metal can, Lined metal pail/drum
- Plastic pail
- Polyliner drum
- Packing as recommended by manufacturer.

Check all containers are clearly labeled and free from leaks.

For low viscosity materials:
- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.

For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.):
- Removable head packaging;
- Cans with friction closures and
- low pressure tubes and cartridges may be used.

For materials with a viscosity of at least 1500 cSt. (23 deg. C):
- Where combination packages are used, and the inner packages are of glass, porcelain or stoneware, there must be sufficient inert cushioning material in contact with inner and outer packages unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic.

STORAGE REQUIREMENTS
- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer’s storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

X: Must not be stored together
O: May be stored together with specific preventions
+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

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<thead>
<tr>
<th>Source</th>
<th>Material</th>
<th>TWA ppm</th>
<th>TWA ppm</th>
<th>STEL ppm</th>
<th>STEL ppm</th>
<th>Peak ppm</th>
<th>Peak ppm</th>
<th>TWA F/CC</th>
<th>Notes</th>
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<td>US - Oregon Permissible Exposure Limits (Z3)</td>
<td>titanium sulfate (basic) (Inert or Nuisance Dust: (d) Total dust)</td>
<td>10</td>
<td>*</td>
<td>50</td>
<td>150</td>
<td>500</td>
<td>1500</td>
<td>5000</td>
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<td>US OSHA Permissible Exposure Levels (PELs) - Table Z3</td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- T20, strong acid mists only
- TLV Basis: pulmonary function. A2 = as contained in strong inorganic acid mists
Canada - Prince Edward Island
Occupational Exposure Limits
sulfuric acid (Sulfuric acid) 0.2

US - Oregon Permissible Exposure Limits (Z1)
sulfuric acid (Sulfuric acid) 1

Canada - Northwest Territories
Occupational Exposure Limits (English)
sulfuric acid (Sulphuric acid) 1 3

Canada - Nova Scotia
Occupational Exposure Limits
sulfuric acid (Sulfuric acid) 0.2

**TLV**
Basis: pulmonary function.
A2 = as contained in strong inorganic acid mists

**EMERGENCY EXPOSURE LIMITS**

<table>
<thead>
<tr>
<th>Material</th>
<th>Revised IDLH Value (mg/m3)</th>
<th>Revised IDLH Value (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sulfuric acid</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

**MATERIAL DATA**

**SULFURIC ACID:**
TITANIUM SULFATE (BASIC):

- NOTE: Detector tubes for sulfuric acid, measuring in excess of 1 mg/m3, are commercially available.

Based on controlled inhalation studies the TLV-TWA is thought to be protective against the significant risk of pulmonary irritation and incorporates a margin of safety so as to prevent injury to the skin and teeth seen in battery workers acclimatised to workplace concentrations of 16 mg/m3. Experimental evidence in normal unacclimated humans indicates the recognition, by all subjects, of odour, taste or irritation at 3 mg/m3 or 5 mg/m3. All subjects reported these levels to be objectionable but to varying degrees.

**SULFURIC ACID:**

- Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

**PERSONAL PROTECTION**

Consult your EHS staff for recommendations

**EYE**

- Chemical goggles.
- Full face shield.
- Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

**HANDS/FEET**

- Elbow length PVC gloves.
  
  Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:
  - frequency and duration of contact,
  - chemical resistance of glove material,
  - glove thickness and
  - dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).
- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

- Protective gloves eg. Leather gloves or gloves with Leather facing

OTHER

- Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

- Respirators may be necessary when engineering and administrative controls do not adequately prevent exposures.
- The decision to use respiratory protection should be based on professional judgment that takes into account toxicity information, exposure measurement data, and frequency and likelihood of the worker's exposure - ensure users are not subject to high thermal loads which may result in heat stress or distress due to personal protective equipment (powered, positive flow, full face apparatus may be an option).
- Published occupational exposure limits, where they exist, will assist in determining the adequacy of the selected respiratory protections. These may be government mandated or vendor recommended.
- Certified respirators will be useful for protecting workers from inhalation of particulates when properly selected and fit tested as part of a complete respiratory protection program.
- Use approved positive flow mask if significant quantities of dust becomes airborne.
- Try to avoid creating dust conditions.

RESPIRATOR

- Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important. Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

- Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection and an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

<table>
<thead>
<tr>
<th>Breathing Zone Level ppm (volume)</th>
<th>Maximum Protection Factor</th>
<th>Half-face Respirator</th>
<th>Full-Face Respirator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>10</td>
<td>Airline*</td>
<td>-</td>
</tr>
<tr>
<td>1000</td>
<td>50</td>
<td>-</td>
<td>E-1 P</td>
</tr>
<tr>
<td>5000</td>
<td>50</td>
<td>Airline*</td>
<td>-</td>
</tr>
<tr>
<td>5000</td>
<td>100</td>
<td>-</td>
<td>E-2 P</td>
</tr>
<tr>
<td>10000</td>
<td>100</td>
<td>-</td>
<td>E-3 P</td>
</tr>
<tr>
<td>100+</td>
<td></td>
<td>Airline* **</td>
<td></td>
</tr>
</tbody>
</table>

* - Continuous Flow ** - Continuous-flow or positive pressure demand.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.

- Contaminated gloves should be replaced.
- PVC Apron.
- Overalls.
- Protective gloves eg. Leather gloves or gloves with Leather facing

When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.

When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.

Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

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OTHER

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- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

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- The decision to use respiratory protection should be based on professional judgment that takes into account toxicity information, exposure measurement data, and frequency and likelihood of the worker's exposure - ensure users are not subject to high thermal loads which may result in heat stress or distress due to personal protective equipment (powered, positive flow, full face apparatus may be an option).
- Published occupational exposure limits, where they exist, will assist in determining the adequacy of the selected respiratory protections. These may be government mandated or vendor recommended.
- Certified respirators will be useful for protecting workers from inhalation of particulates when properly selected and fit tested as part of a complete respiratory protection program.
- Use approved positive flow mask if significant quantities of dust becomes airborne.
- Try to avoid creating dust conditions.

RESPIRATOR

- Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important. Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

- Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection and an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

<table>
<thead>
<tr>
<th>Type of Contaminant:</th>
<th>Air Speed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>solvent, vapors, degreasing etc., evaporating from tank (in still air).</td>
<td>0.25-0.5 m/s (50-100 f/min.)</td>
</tr>
<tr>
<td>aerosols, fumes from pouring operations, intermittent container filling, low speed conveyor transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)</td>
<td>0.5-1 m/s (100-200 f/min.)</td>
</tr>
<tr>
<td>direct spray, spray painting in shallow booths, drum filling, conveyor loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)</td>
<td>1-2.5 m/s (200-500 f/min.)</td>
</tr>
<tr>
<td>grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).</td>
<td>2.5-10 m/s (500-2000 f/min.)</td>
</tr>
</tbody>
</table>

Within each range the appropriate value depends on:

<table>
<thead>
<tr>
<th>Lower end of the range</th>
<th>Upper end of the range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Room air currents minimal or favorable to capture</td>
<td>1: Disturbing room air currents</td>
</tr>
<tr>
<td>2: Contaminants of low toxicity or of nuisance value only.</td>
<td>2: Contaminants of high toxicity</td>
</tr>
<tr>
<td>3: Intermittent, low production.</td>
<td>3: High production, heavy use</td>
</tr>
<tr>
<td>4: Large hood or large air mass in motion</td>
<td>4: Small hood-local control only</td>
</tr>
</tbody>
</table>

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank
2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

### Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

**PHYSICAL PROPERTIES**

**Corrosive. Acid.**

<table>
<thead>
<tr>
<th>State</th>
<th>DIVIDED SOLID</th>
<th>Molecular Weight</th>
<th>159.94</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting Range (°F)</td>
<td>Not available.</td>
<td>Viscosity</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Boiling Range (°F)</td>
<td>Not available.</td>
<td>Solubility in water (g/L)</td>
<td>Reacts</td>
</tr>
<tr>
<td>Flash Point (°F)</td>
<td>Not Applicable</td>
<td>pH (1% solution)</td>
<td>Not available.</td>
</tr>
<tr>
<td>Decomposition Temp (°F)</td>
<td>Not Available.</td>
<td>pH (as supplied)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Autoignition Temp (°F)</td>
<td>Not available.</td>
<td>Vapour Pressure (mmHG)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Upper Explosive Limit (%)</td>
<td>Not Available.</td>
<td>Specific Gravity (water=1)</td>
<td>3.22 @ 20 deg.C.</td>
</tr>
<tr>
<td>Lower Explosive Limit (%)</td>
<td>Not Available.</td>
<td>Relative Vapor Density (air=1)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Volatile Component (%vol)</td>
<td>Not applicable</td>
<td>Evaporation Rate</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**APPEARANCE**

White or slightly yellow, hygroscopic cake-like solid; decomposes in water. The commercial product may consist of a mixture of closely related forms with a pH similar to 50% sulfuric acid.

### Section 10 - CHEMICAL STABILITY

**CONDITIONS CONTRIBUTING TO INSTABILITY**

- Contact with alkaline material liberates heat
- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerization will not occur.

**STORAGE INCOMPATIBILITY**

- Inorganic acids are generally soluble in water with the release of hydrogen ions. The resulting solutions have pH's of less than 7.0.
- Inorganic acids neutralize chemical bases (for example: amines and inorganic hydroxides) to form salts.
- Neutralization can generate dangerously large amounts of heat in small spaces.
- The dissolution of inorganic acids in water or the dilution of their concentrated solutions with additional water may generate significant heat.
- The addition of water to inorganic acids often generates sufficient heat in the small region of mixing to cause some of the water to boil explosively. The resulting "bumping" can spatter the acid.
- Inorganic acids react with active metals, including such structural metals as aluminum and iron, to release hydrogen, a flammable gas.
- Inorganic acids can initiate the polymerization of certain classes of organic compounds.
- Inorganic acids react with cyanide compounds to release gaseous hydrogen cyanide.
- Inorganic acids generate flammable and/or toxic gases in contact with dithiocarbamates, isocyanates, mercaptans, nitriles, nitriles, sulfides, and strong reducing agents. Additional gas-generating reactions occur with sulfites, nitrates, thiosulfates (to give H2S and SO3), dithionites (SO2), and even carbonates.
- Acids often catalyze (increase the rate of) chemical reactions.
- **WARNING:** Avoid or control reaction with peroxides. All transition metal peroxides should be considered as potentially explosive. For example transition metal complexes of alkyl hydroperoxides may decompose explosively.
- The pi-complexes formed between chromium(0), vanadium(0) and other transition metals (haloarene-metal complexes) and mono- or poly-fluorobenzene show extreme sensitivity to heat and are explosive.
- Avoid reaction with borohydrides or cyanoborohydrides

**Metals and their oxides or salts may react violently with chlorine trifluoride. Chlorine trifluoride is a hypergolic oxidizer. It ignites on contact (without external source of heat or ignition) with recognized fuels - contact with these materials, following an ambient or slightly elevated temperature, is often violent and may produce ignition. The state of subdivision may affect the results.

**NOTE:** May develop pressure in containers; open carefully. Vent periodically.

For incompatible materials - refer to Section 7 - Handling and Storage.

### Section 11 - TOXICOLOGICAL INFORMATION

**titanium sulfate (basic)**

**TOXICITY AND IRRITATION**

- unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.
- Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a
documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.

No significant acute toxicological data identified in literature search.

The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

### CARCINOGEN

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>US ACGIH Threshold Limit Values (TLV) - Carcinogens</th>
<th>Carcinogen Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric acid</td>
<td></td>
<td>A2</td>
</tr>
</tbody>
</table>

### Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

**SULFURIC ACID:**
- **TITANIUM SULFATE (BASIC):**
  - DO NOT discharge into sewer or waterways.
  - Prevent, by any means available, spillage from entering drains or watercourses.
- **TITANIUM SULFATE (BASIC):**
- **Ecotoxicity:**
  The tolerance of water organisms towards pH margin and variation is diverse. Recommended pH values for test species listed in OECD guidelines are between 6.0 and almost 9. Acute testing with fish showed 96h-LC50 at about pH 3.5.
- Data from tap water studies with human volunteers indicate that sulfates produce a laxative effect at concentrations of 1000 - 1200 mg/litre, but no increase in diarrhoea, dehydration or weight loss. The presence of sulfate in drinking-water can also result in a noticeable taste; the lowest taste threshold concentration for sulfate is approximately 250 mg/litre as the sodium salt. Sulfate may also contribute to the corrosion of distribution systems. No health-based guideline value for sulfate in drinking water is proposed. However, there is an increasing likelihood of complaints arising from a noticeable taste as concentrations in water increase above 800 mg/litre.
  Sulfates are removed from the air by both dry and wet deposition processes. Wet deposition processes including rain-out (a process that occurs within the clouds) and washout (removal by precipitation below the clouds) contribute to the removal of sulfate from the atmosphere.
  In soil, the inorganic sulfates can adsorb to soil particles or leach into surface water and groundwater. Sulfates can be taken up by plants and be incorporated into the parenchyma of the plant.
  Sulfate in water can also be reduced by sulfate bacteria (Thiobacilli) which use them as a source of energy.

**SULFURIC ACID:**
- Sulfuric acid is soluble in water and remains indefinitely in the environment as sulfate.
  Large discharges may contribute to the acidification of water and be fatal to aquatic life and soil micro-organisms. Large discharges may also contribute to the acidification of effluent treatment systems and injure sewage treatment organisms.
  In water, sulfuric acid dissociates, and the sulfate anion may combine with other cations. In soil, the ions from sulfuric acid can adsorb to soil particles or leach into surface water and groundwater. Sulfates can be taken up by plants and be incorporated into the parenchyma of the plant.
  The ions (sulfate, hydrogen) can adsorb to soil particles or be converted to gases. Anaerobic bacteria in sediments and soil can reduce sulfate to sulfur and hydrogen sulfide.
  Sulfates, including sulfuric acid, can be removed from the air by both dry and wet deposition processes. Wet deposition processes including rain-out (a process that occurs within the clouds) and washout (removal by precipitation below the clouds) contribute to the removal of sulfate from the atmosphere.
  In the stratosphere, sulfuric acid aerosols have lifetimes of about 14 and 2.4 days at altitudes of 15 and 20 km, respectively. At cloud level, the residence time is about 6 days, with shorter residence times in surface air.
  Sulfuric acid is soluble in water and remains indefinitely in the environment as sulfate.
  Large discharges may contribute to the acidification of water and be fatal to aquatic life and soil micro-organisms.
  Large discharges may contribute to the acidification of effluent treatment systems and injure sewage treatment organisms. [ICI UK]

**Ecotoxicity**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Persistence: Water/Soil</th>
<th>Persistence: Air</th>
<th>Bioaccumulation</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric acid</td>
<td></td>
<td></td>
<td></td>
<td>LOW</td>
</tr>
</tbody>
</table>

### Section 13 - DISPOSAL CONSIDERATIONS

**US EPA Waste Number & Descriptions**

A. General Product Information

Corrosivity characteristic: use EPA hazardous waste number D002 (waste code C)

**Disposal Instructions**

All waste must be handled in accordance with local, state and federal regulations.

Legislation addressing waste disposal requirements may differ by country, state and / or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.

A Hierarchy of Controls seems to be common - the user should investigate:
- Reduction
- Reuse
- Recycling
Disposal (if all else fails)
This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

Recycle wherever possible.
Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.
Treat and neutralize at an approved treatment plant.

Treatment should involve: Mixing or slurrying in water Neutralization with soda-lime or soda-ash followed by: Burial in a licensed land-fill or Incineration in a licensed apparatus (after admixture with suitable combustible material)
Decontaminate empty containers with 5% aqueous sodium hydroxide or soda ash, followed by water. Observe all label safeguards until containers are cleaned and destroyed.

Section 14 - TRANSPORTATION INFORMATION

DOT:

<table>
<thead>
<tr>
<th>Symbols:</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard class or Division:</td>
<td>8</td>
</tr>
<tr>
<td>Identification Numbers:</td>
<td>UN3260</td>
</tr>
<tr>
<td>PG:</td>
<td>II</td>
</tr>
<tr>
<td>Label Codes:</td>
<td>8</td>
</tr>
<tr>
<td>Special provisions:</td>
<td>IB8, IP2, IP4, T3, TP33</td>
</tr>
<tr>
<td>Packaging: Exceptions:</td>
<td>154</td>
</tr>
<tr>
<td>Packaging: Non-bulk:</td>
<td>212</td>
</tr>
<tr>
<td>Packaging: Exceptions:</td>
<td>154</td>
</tr>
<tr>
<td>Quantity limitations:</td>
<td>Passenger aircraft/rail: 15 kg</td>
</tr>
<tr>
<td>Quantity Limitations: Cargo aircraft only:</td>
<td>50 kg</td>
</tr>
<tr>
<td>Vessel stowage:</td>
<td>Other</td>
</tr>
<tr>
<td>Vessel stowage: Location:</td>
<td>B</td>
</tr>
</tbody>
</table>

Hazardous materials descriptions and proper shipping names:
Corrosive solid, acidic, inorganic, n.o.s.

Air Transport IATA:

| ICAO/IATA Class: | 8 |
| ICAO/IATA Subrisk: | None |
| UN/ID Number: | 3260 |
| Packing Group: | II |
| Special provisions: | A3 |

Shipping Name: CORROSIVE SOLID, ACIDIC, INORGANIC, N.O.S. *(CONTAINS TITANIUM SULFATE (BASIC))

Maritime Transport IMDG:

| IMDG Class: | 8 |
| IMDG Subrisk: | None |
| UN Number: | 3260 |
| Packing Group: | II |
| EMS Number: | F-A,S-B |
| Special provisions: | 274 944 |
| Limited Quantities: | 1 kg |

Shipping Name: CORROSIVE SOLID, ACIDIC, INORGANIC, N.O.S.(contains titanium sulfate (basic))

Section 15 - REGULATORY INFORMATION

titanium sulfate (basic) (CAS: 13825-74-6,123334-00-9,1314-58-5,15550-72-8,126165-81-9,742005-85-2) is found on the following regulatory lists;
*Cana||

sulfuric acid (CAS: 7664-93-9) is found on the following regulatory lists;
*Canada Domestic Substances List (DSL)*;*Canada Ingredient Disclosure List (SOR/88-64)*;*OECD Representative List of High Production Volume (HPV) Chemicals*;*US - New Jersey Right to Know Hazardous Substances*;*US Toxic Substances Control Act (TSCA) - Inventory* Regulations for ingredients

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Inhalation may produce health damage*.
■ Cumulative effects may result following exposure*.
* (limited evidence).

Ingredients with multiple CAS Nos

Ingredient Name        CAS

Titanium sulfate (basic)  13825-74-6, 123334-00-9, 1314-58-5, 15550-72-8, 126165-81-9, 742005-85-2

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■ Classification of the mixture and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references. A list of reference resources used to assist the committee may be found at: www.chemwatch.net/references.
■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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