

Section 1. Product and Company Identification

**Product Name** Molybdenum Trioxide  
**CAS Number** 1313-27-5

**Parchem - fine & specialty chemicals**  
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Collect Calls Accepted

Section 2. Hazards Identification

**Classification of the substance or mixture**

**GHS Classification**

**Acute Toxicity, Inhalation:** (Category 4)

**Acute Toxicity, Oral:** (Category 4)

**Respiratory Irritation:** (Category 3)

**Eye Irritation:** (Category 2A)

**Carcinogenicity:** (Category 2)

**Pictograms:**



**Signal word:** WARNING

**Hazard and precautionary statements**

**Hazard Statements**

**H333:** May be harmful if inhaled

**H303:** May be harmful if swallowed

**H305:** May be harmful if swallowed and enters airways

**H319:** Causes serious eye irritation

**H335:** May cause respiratory irritation

**H351:** Suspected of causing cancer

**Precautionary Statements:**

**P261:** Avoid breathing dust/fume/gas/mist/vapors/spray

**P264:** Wash contact area thoroughly after handling

**P271:** Use only outdoors or in a well-ventilated area

**P280:** Wear protective gloves/protective clothing/eye protection/face protection.



- P281:** Use personal protective equipment as required  
**P305 + P351 + P338:** IF IN EYES: rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  
**P301 + P330 + P331 +P311:** IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. Call a POISON Center or doctor/ physician.  
**P304 + P340:** IF INHALED: Remove person to fresh air and keep in position comfortable for breathing  
**P337 + P313:** If eye irritation persists: Get medical advice/attention  
**P312:** Call a POISON CENTER or doctor/physician if you feel unwell  
**P403 + P235:** Store in a well-ventilated place. Keep cool.  
**P501:** Dispose of contents/container in accordance with local/state/federal regulations.

### Section 3. Composition / Information on Ingredients

<b>Common Name</b>	Molybdenum Trioxide
<b>Synonym(s)</b>	Pure oxide, sublimed oxide, POS
<b>Formula</b>	MoO <sub>3</sub>
<b>CAS Number</b>	1313-27-5

COMPONENT	CAS NUMBER	CONCENTRATION
Molybdenum Trioxide	1313-27-5	? 98%

### Section 4. First Aid Measures

- Eyes:** Flush eyes with running water for at least fifteen minutes. Remove any contact lenses. If irritation persists, get medical aid.  
**Skin:** Flush skin with running water for fifteen minutes. If irritation persists, get medical attention.  
**Ingestion:** Seek medical advice/attention. If vomiting occurs, keep head lower than hips to prevent aspiration  
**Inhalation:** If safe to do so, remove individual from further exposure. Supply fresh air. If cough or other symptoms develop, call doctor/poison center immediately.  
**PPE first responders:** Wear suitable personal protective equipment in case of insufficient ventilation or possible inhalation or eye contact.

### Section 5. Firefighting Measures

- Fire/Explosion Hazard:** Negligible fire hazard when exposed to flame.  
**Extinguishing Media:** Use any extinguishing media suitable for type of surrounding fire. Molybdenum Trioxide is not considered flammable or combustible.  
**General Hazard:** Evacuate personnel downwind in-order to avoid inhalation of irritating and/or harmful fumes and smoke.  
**Fire Fighting Procedures:** This product is a non-flammable substance. No acute hazard.  
**Fire Fighting Equipment:** Full protective equipment (bunker gear) and self-contained breathing apparatus (SCBA) should be used for all indoor fires and any significant outdoor fires. If possible,



firefighters should control run-off water to prevent environmental contamination.

**Special Hazards Arising from the Substance or Mixture:** Above ca. 700°C sublimation starts to take place and fumes of MoO<sub>3</sub> can become airborne, which should not be inhaled and which can contaminate the surroundings.

Section 6. Accidental Release Measures

**For non-emergency personnel:** Avoid formation and inhalation of dust. Seek to ensure ventilation that maintains airborne concentrations below Occupational Exposure Limits. Keep unprotected persons away. Although the substance has no acute toxicity, it is advised to avoid contact with skin, eyes, and clothing- wear suitable protective equipment.

**For emergency responders:** Avoid formation and inhalation of dust. Seek to ensure ventilation that maintains airborne concentrations below Occupational Exposure Limits. Keep unprotected persons away. Although the substance has no acute toxicity, it is advised to avoid contact with skin, eyes, and clothing- wear suitable protective equipment.

**Environmental Precautions:** Although the substance is not classified as dangerous to the environment, it is advised that in the event of an accidental release, the product should be prevented from reaching the sewage system or any water course, and from penetrating the ground/soil. Dispose of spilled material in accordance with the relevant local regulations.

**Methods and Material for Containment and Cleaning up:** Avoid formation and inhalation of dust. Use an appropriate industrial vacuum cleaner equipped with ULPA or HEPA filters. Collect spilled material in suitable containers or bags for recovery or disposal. In the case of disposal, spilled material or contaminated material should be disposed of as waste as described in Section 13.

Section 7. Handling and Storage

**Conditions for Safe Storage, Including any Incompatibilities:** Store in a well-ventilated area. Do not store in open inadequate mislabeled packaging. Molybdenum Trioxide should not be stored together with highly reactive substances and strong reducing agents.

Section 8. Exposure Controls / Personal Protection

Exposure Pattern	Route	Descriptor	DNEL/PNEC
Long Term - Local Effects	Inhalation	DNEL (derived no effect level)	3 mg MoO <sub>3</sub> /m <sup>3</sup>
Long Term - Systemic Effects	Inhalation	DNEL (derived no effect level)	11.17 mg Mo/m <sup>3</sup> (included for formal reason only, covered by compliance with DNEL for long-term local effects above)
Long Term - Chronic	Freshwater	PNEC (predicted no	12.7 mg Mo/L;



Effects		effect concentration)	equivalent to 19.05 mg MoO <sub>3</sub> /L
Long Term - Chronic Effects	Marine	PNEC (predicted no effect concentration)	1.9 mg Mo/L; equivalent to 2.85 mg MoO <sub>3</sub> /L
Long Term - Chronic Effects	Freshwater Sediment	PNEC (predicted no effect concentration)	22.6 g Mo/kg dw; equivalent to 33.9 g MoO <sub>3</sub> /kg dw
Long Term - Chronic Effects	Marine Sediment	PNEC (predicted no effect concentration)	1.98 g Mo/kg dw; equivalent to 2.97 g MoO <sub>3</sub> /kg dw
Long Term - Chronic Effects	Soil	PNEC (predicted no effect concentration)	11.8-188 mg Mo/kg dw; equivalent to 17.7-282 mg MoO <sub>3</sub> /kg dw (dependent upon soil type)
Long Term - Chronic Effects	STP (Sewage Treatment Plant)	PNEC (predicted no effect concentration)	27.1 mg Mo/L; equivalent to 40.65 mg MoO <sub>3</sub> /L

**Exposure Controls:** Molybdenum Trioxide is not classified as a hazardous substance. High airborne dust concentrations require mechanical ventilation or a respirator mask.

**Engineering Controls:** Use appropriate engineering controls to minimize exposure to dust generated via routine use. Maintain adequate ventilation of workplace and storage areas.

**Personal Protective Equipment**

**Eyes and face:** Wear safety glasses with side shields or goggles when handling this material.

**Skin:** Wear protective clothing when handling this product to prevent prolonged skin contact.

**Respiratory:** Avoid breathing dust or mist. Use NIOSH approved respiratory protection equipment when air borne exposure is excessive.

**Work Hygienic Practices:** Facilities storing or using this material should be equipped with emergency eyewash, and a safety shower. Good personal hygiene practices should always be followed.

Section 9. Physical and Chemical Properties

**Appearance/Color:** Solid, powder, white-yellowish to bluish

**Odor:** Odorless

**Odor threshold:** Not applicable

**pH:** Not applicable

**Melting Point:** 802 °C at 1013 hPa  
**Initial Boiling Point and boiling range:** 1155 °C at 1013 hPa [23]  
**Flash Point:** Not applicable  
**Evaporation Rate:** Negligible at ambient temperatures (At >700°C MoO<sub>3</sub> starts to sublime)  
**Flammability:** Not Flammable  
**Lower Explosive Limit:** Not explosive  
**Upper Explosive Limit:** Not explosive  
**Vapor Pressure:** Low to negligible  
**Vapor Density:** At >700°C MoO<sub>3</sub> starts to sublime  
**Relative Density:** 4.66 at 20°C  
**Solubility:** 1.0 g/l at 20°C  
**Partition coefficient n-octanol/water:** Not applicable for inorganic substances  
**Auto-ignition Temp:** Not applicable (MoO<sub>3</sub> is not combustible/flammable and thus does not auto-ignite)  
**Decomposition Temp:** At 700°C MoO<sub>3</sub> starts to sublime  
**Viscosity:** Not applicable (solid)  
**Explosive Properties:** Non explosive  
**Oxidizing Properties:** Not oxidizing

#### Section 10. Stability and Reactivity

**Reactivity:** Under certain conditions (e.g., heat, large quantities), molybdenum trioxide has been found to react violently (fire/incandescence/explosion) with bromine pentafluoride (BrF<sub>5</sub>), chlorine trifluoride (ClF<sub>3</sub>) and reducing agents, e.g., carbon/graphite, sodium, potassium, magnesium, and lithium [22]. Hazardous polymerization will not occur.

**Chemical Stability:** Under normal conditions of use and storage, molybdenum trioxide is stable.

**Possibility of Hazardous Reactions:** Under certain conditions (e.g., heat, large quantities), molybdenum trioxide has been found to react violently (fire/incandescence/explosion) with bromine pentafluoride (BrF<sub>5</sub>), chlorine trifluoride (ClF<sub>3</sub>) and reducing agents, e.g., carbon/graphite, sodium, potassium, magnesium, and lithium [22]. Hazardous polymerization will not occur.

**Conditions to Avoid:** Avoid dust formation. Avoid conditions under which hazardous reactions may occur (See above)

**Hazardous Decomposition Products:** Above 700°C: sublimation of molybdenum trioxide can result in molybdenum trioxide vapors. Avoid inhalation.

#### Section 11. Toxicological Information

##### Toxicokinetics

**Absorption, Distribution, Metabolism and Excretion:** Molybdenum is an essential element. Uptaken molybdenum trioxide dissolves and exists predominantly in the form of the molybdate ion (MoO<sub>4</sub><sup>2-</sup>).

**Oral Absorption:** Rapid and almost complete absorption through GI tract.



**Inhalation Absorption:** Well Absorbed based on animal data. Absorption in humans dependent on particle size, deposition/clearance.

**Dermal Absorption:** Low to negligible

**Metabolism:** No metabolism. Molybdenum compounds transform quickly to molybdate anions ( $\text{MoO}_4^{2-}$ ) upon dissolution

**Excretion:** Rapidly eliminated from plasma predominantly via renal excretion (>80%) and feces (<10%).

#### Low Acute Toxicity

**LD50, Oral Rat:** 2689/3830 mg/kg bw (male/female)

**LD50, Dermal Rat:** > 2000 mg/kg bw (male/female)

**LD50, Inhalation Rat 4(H):** > 5.84 mg/L (male/female)

**Skin Corrosion/Irritation:** Not irritating/not corrosive to the skin.

**Serious Eye Damage/Irritation:** Classified eye irritant 2; H319 - annex VI commission regulation (EC) No 1272/2008 (1<sup>st</sup> ATP) (However, basis for classification appears unwarranted as mean scores of data in OECD 405 study are below the cut off values for eye irritant classification, i.e. not an eye irritant. Despite this, the classification shown above must be adhered to)

**Respiratory or Skin Sensitization:** Not a skin sensitizer. No data indicated respiratory sensitization.

**Germ-cell Mutagenicity:** Not a germ cell mutagen. Negative test results in bacterial reverse mutation assay with molybdenum trioxide. Read across from negative test results on sodium molybdate for bacterial reverse mutation assay, in vitro micronucleus assay in human lymphocytes, and in vitro gene mutation assay in mouse lymphoma cells

**Carcinogenicity:** Classified carcinogen category 2; H351 suspected of causing cancer via inhalation. Commission regulation (EC) No 1272/2008 (1<sup>st</sup> ATP). Some evidence of carcinogenic activity of molybdenum trioxide in female mice based on increased incidences of alveolar/bronchiolar adenoma and adenoma or carcinoma (Combined). Effects restricted to local effects in respiratory tract.

**Reproductive Toxicity:** There are currently no reliable scientific data available indicating adverse effects on reproduction or fertility.

**STOT-Single Exposure:** Classified STOT single exposure 3; H335. May cause respiratory irritation H319 Annex VI commission regulation (EC) No 1272/2008 (1<sup>st</sup> ATP). Basis for classification is unclear. (However, new data in extended OECD 403/EU B.2 study, with extended histopathology or respiratory tract, indicated no respiratory irritation. Despite this, the classification above must be adhered to)

**STOT-Repeated Exposure:** No reliable scientific data available indicating adverse systemic effects after repeated exposure to molybdenum substances.

**Aspiration Hazard:** Not applicable (not an aerosol/mist)

#### Section 12. Ecological Information

**Toxicity:** Reliable acute aquatic toxicity test results (tests conducted with molybdenum trioxide unless indicated otherwise)

Test Organisms	End Point	Range of Values
Freshwater Fish: Pimephales Promelos	96h-LC <sub>50</sub>	577 mg Mo/L (= 865.5 MoO <sub>3</sub> /L)
Invertebrates: Daphnia Magna	48h-LC <sub>50</sub>	203.2 mg Mo/L (= 304.8 mg MoO <sub>3</sub> /L)
Algae: Pseudokirchneriella Subcapitata	72h-ErC <sub>50</sub> (growth rate)	295.0 - 390.9 mg Mo/L; 298.2 - 369.6 mg Mo/L; Geom. Mean 331.1 mg Mo/L (=4.997 mg MoO <sub>3</sub> /L) <sup>(a)</sup>

<sup>(a)</sup>Test conducted with sodium molybdate; UV-spectra of aqueous solutions of molybdenum trioxide demonstrated that the only dissolved molybdenum species, originating directly from molybdenum trioxide is molybdate.

**Aquatic Freshwater Toxicity Data:** Oncorhynchus mykiss, Pimephales promelas, Pseudokirchneriella subcapitata, Ceriodaphnia dubia, Daphnia magna, Chironomus riparius, Brachionus calyciflorus, Lymnaea stagnalis, Xenopus laevis, Lemna minor; 43.3 - 241.5 mg Mo/L = 64.8 - 362.3 mg MoO<sub>3</sub>/L. Most sensitive species were the fish *O. mykiss* (43.3 mg Mo/L) and *P. promelas* (60.2 mg Mo/L). Symptoms of toxicity were effects on biomass growth, reproduction, (population) growth rate and malformation during development.

**Aquatic Marine Toxicity Data:** Mytilus edulis, Acatia tonsa, Phaeodactylus tricornutum, Cyprinodon variegatus, Americamysis bahia, Crassostrea gigas, Dendraster excentricus, Dundiella tertiolecta, Ceramium tenuicorne, Strongylocentrotus purpuratus; 4.4 - 1,174 mg Mo/L = 6.6 - 1761 mg MoO<sub>3</sub>/L. Most sensitive species were the mussel *M. edulis* (4.4 mg Mo/L) and the copepod *A. tonsa* (7.96 mg Mo/L). Symptoms of toxicity include effects on biomass growth, growth rate, reproduction and malformation during development.

**Chronic Sediment Toxicity:** No reliable acute/chronic sediment data for molybdenum available. PNEC derivation was based on the equilibrium partitioning method, taking into account the PNEC<sub>freshwater</sub> and the sediment K<sub>d</sub>.

#### Chronic Terrestrial Toxicity Test Results (values were determined in different top soils with contrasting properties and spiked with sodium molybdate)

**Annelid Worms:** Enchytraeus crypticus and Eisenia andrei; 7.88 - 1661 mg Mo/kg dw (n=11) = 11.82 - 2,492 mg MoO<sub>3</sub>/kg dw.

**Arthropod:** Folsomia candida; 37.9 - 3,395 mg Mo/kg dw and 56.9 - 5,093 mg MoO<sub>3</sub>/kg dw.

**Plants:** Hordeum vulgare, Brassica napus, Trifolium pratense, Lolium perenne, Lycopersicon esculentum; 4 - 3,476 mg Mo/kg dw = 6 - 5,244 mg MoO<sub>3</sub>/L.

**Soil microorganisms (nitrification, glucose induced respiration, plant residue mineralization):** 10 - 3,840 mg Mo/kg dw = 15 - 5,760 mg MoO<sub>3</sub>/L

Plants are the most sensitive, with reduced shoot yield being the first symptoms of toxicity, followed by reduced reproduction of invertebrates. Toxicity of molybdenum trioxide in soils is dependent on the soil type. Sandy soils (e.g. 5% clay) with low organic carbon content (e.g. 1%), low iron oxide content (e.g. 0.5 g/kg) and high pH (e.g. 7) are most sensitive, with clay soils (e.g. 30% clay) with

high organic carbon content (e.g. 12%), High iron oxide content (e.g. 10 g/kg) and low pH (e.g. 4.5) are least sensitive

Test Organisms	End Point	Range of Values
Domestic Activated Sludge Population	3h - EC <sub>50</sub> (respiration inhibition)	1,926 mg/Mo/L (=2,889 mg MoO <sub>3</sub> /L)
Domestic Activated Sludge Population	3h - EC <sub>50</sub> (respiration inhibition)	216.5 mg Mo/L (=324.8 mg MoO <sub>3</sub> /L)
Domestic Activated Sludge Population	30-min-NOEC (O <sub>2</sub> utilization)	> 950 mg Mo/L (= > 1,425 mg MoO <sub>3</sub> /L)

**Molybdenum trioxide is not hazardous to the aquatic environment as:** The lowest acute reference values for fish, invertebrates and algae are > 100 mg Mo/L. The lowest aquatic NOEC for these three trophic levels is > 1 mg Mo/L (i.e., 43.2 mg Mo/L for the rainbow trout). No evidence for bioaccumulation or bio magnification in the environment.

**Persistence and Degradability:** Molybdenum disulfide is ubiquitous in the environment and is the naturally-occurring base mineral from which molybdenum trioxide is produced. Molybdenum trioxide, in turn, transforms to the non-toxic molybdate species under normal environmental conditions.

**Bio accumulative Potential:** Available BCF/BAF data for the aquatic environment show a distinct inverse relationship with the exposure concentration. This finding demonstrates that molybdenum is homeostatically controlled by these organisms, and this is up to the milligram range of exposure. Available information on transfer of molybdenum through the food chain indicates that it does not bio magnify in aquatic food chains. Although not homeostatically controlled in terrestrial plants and invertebrates, molybdenum is not largely concentrated from soil into plants or soil to invertebrates. There is no significant concentration increase from diet to mammals or birds. It is concluded that bio magnification is not significant in the terrestrial food chain.

**Mobility and Sediment in Soil:** Molybdenum trioxide is soluble in water and with its relatively low K<sub>d</sub> value, the resulting molybdate ions are leachable through normal soil and are mobile in sediment. Typical log K<sub>d</sub>-values of 3.25 and 2.94 have been determined for sediment and soil, respectively.

**Results of PBT and vPvB Assessment:** The PBT and vPvB of Annex XIII to the regulation do not apply to inorganic substances, such as molybdenum trioxide. Therefore, a PBT and vPvB is not required.

**Other Adverse Effects:** Molybdate originating from molybdenum trioxide can contribute to the onset of molybdenosis (a molybdenum -induced copper deficiency) in ruminants such as cattle, deer, and sheep. The level and bioavailability of copper in the animal diet are critical factors in the onset of molybdenosis. The recommended minimum dietary Cu: Mo ratio threshold to prevent molybdenosis is 1.30, i.e. there should be 30% more copper than molybdenum in the diet. Cu & Mo in the diet can be monitored, and if the ratio is < 1.3, then provide Cu supplements such as copper sulfate enriched feeds or copper sulphate enriched salt blocks for ruminants to use ad libitum. If there are ruminants in the vicinity of the minimization measures. Have an animal health check program in place (e.g., blood tests for copper) to verify that the measures are effective. Molybdenum trioxide is





not expected to contribute to ozone depletion, ozone formation, global warming or acidification.

Section 13. Disposal Considerations

**Waste Treatment Methods:** Dispose of product and contaminated packaging in accordance with all local, state, and federal environmental control regulations.

Section 14. Transport Information

**ADR:** None

**RID:** None

**ADN:** None

**IMDG:** None

**IATA:** None

**USDOT:** None

**UN Number:** Not applicable

**UN Proper Shipping Name:** Not applicable

**Transport Hazard Class:** Not applicable

**Packing Group:** Not applicable

**Environmental Hazards:** Not applicable

**Special Precautions for User:** Not Applicable

**Transport in Bulk according to Annex II of MARPOL 73/78 and IBC Code:** Not applicable

Section 15. Regulatory Information

**Safety, Health, and Environmental Regulations/Legislation Specific for the Substance**

**Worldwide chemical inventories**

**Molybdenum trioxide is listed in the following international chemical inventories**

**EC inventory (EU):** 215-204-7

**ENCS (Japan):** Listed

**TSCA (USA):** Listed

**ECL (Korea):** Listed

**DSL (Canada):** Listed

**PICCS (Philippines):** Listed

**AICS (Australia):** Listed

**IECSC (China):** Listed



**NZIoC (New Zealand):** Listed

Molybdenum trioxide is not a SEVESO substance, not an ozone-depleting substance and not an organic pollutant.

**Other regulatory information**

**TSCA Status:** Yes

**Other Regulatory Information Available**

**CERCLA Section 103 (40 CFR 302.4):** No

**SARA Section 302 (40 CFR 355.30):** No

**SARA Section 304 (40 CFR 355.40):** No

**SARA Section 313 (40 CFR 372.65):** Yes

**OSHA Process Safety (29 CFR 1910.119):** No

**CALIFORNIA PROPOSITION 65:** No

**SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)**

**ACUTE HAZARD:** Yes

**CHRONIC HAZARD:** No

**FIRE HAZARD:** No

**REACTIVITY HAZARD:** No

**SUDDEN RELEASE HAZARD:** No

Section 16. Other Information

**Disclaimer:** The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product.

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