IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Potassium permanganate

Identification | Characterisation | Formula | Physical and chemical properties | Toxicology / Ecotoxicology | Occupational health and first aid | Safe handling | Regulations | Links | Literature register

IDENTIFICATION

Potassium permanganate
Permanganic acid potassium salt
Permanganate of potassium

ZVG No:	4070
CAS No:	7722-64-7
EC No:	231-760-3
INDEX No:	025-002-00-9

CHARACTERISATION

SUBSTANCE GROUP CODE

122300 Potassium compounds
136700 Manganese compounds

STATE OF AGGREGATION

The substance is solid.

PROPERTIES

crystalline
violet
odourless

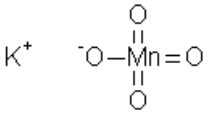
CHEMICAL CHARACTERISATION

Oxidizing solid.
The substance itself does not burn, but in contact with combustible substances it increases the risk of fire and can fuel any existing fire substantially.
Soluble in water.
Acute or chronic health hazards result from the substance.
The substance is hazardous to the aquatic environment.
(see: chapter REGULATIONS).

Substance information in Wikipedia

FORMULA

$KMnO_4$



Molar mass: 158,03 g/mol

PHYSICAL AND CHEMICAL PROPERTIES

Melting point | Density | Solubility | pH-value |
Hazardous reactions

MELTING POINT

The substance decomposes when heated (see decomposition temperature).
Reference: 00300

DENSITY

DENSITY
Value: 2,70 g/cm³
Temperature: 20 °C
Reference: 01211

SOLUBILITY IN WATER

Concentration: 28,3 g/l
Temperature: 0 °C
Reference: 00220

Concentration: 44 g/l
Temperature: 10 °C
Reference: 00500

Concentration: 64 g/l
Temperature: 20 °C
Reference: 00220 01211

Concentration: 91 g/l
Temperature: 30 °C
Reference: 00500

Concentration: 125 g/l
Temperature: 40 °C
Reference: 00220

Concentration: 224 g/l

Temperature: 60 °C

Reference: 00220

Concentration: 324 g/l
Temperature: 75 °C
Reference: 00500

pH-VALUE

pH-value: ca. 7 ... 9
Temperature: 20 °C
Concentration: 20 g/l
Reference: 01211

HAZARDOUS REACTIONS

Decomposition temperature: › 240 °C

Decompositon products
Oxygen

Hazardous chemical reactions

Risk of explosion in contact with:
ammonia
substances which can be oxidized
concentrated acid
organic substances
strong reducing agents
alcohols/sulfuric acid
aluminium powder/impact
ammonium nitrate
ammonium perchlorate
ammonium compounds
arsenic (powder)
combustible liquids
hydrogen chloride (rare)
dimethyl formamide
acetic acid/friction
acetic anhydride (rare)
formaldehyde
glycerine nitrate + cellulose nitrate
potassium chloride/sulfuric acid
mineral wool/slag wool
cellulose nitrate/impact
phosphorus/friction
pyridine
hydrochloric acid, conc.
sulfur/heat
sulfuric acid/manganese heptoxide
titanium powder (heat)
trifluoroacetic acid
trifluoroacetic anhydride
sugar (rare)

The substance can react dangerously with:
alcohols
reducing agents
nitric acid
hydrogen peroxide
acetaldehyde
acetylacetone
aluminium carbide (heat)
antimony (powder)
benzaldehyde
dichloromethylsilane
dimethyl sulfoxide
ethylene glycol
ethylene glycol ester
hydrogen fluoride
organic liquids
glycerin (anhydrous)
glycerin/sulfuric acid
wood + humidity or friction
hydroxylamine
coal (heat)
mannitol
lactic acid
organic oxygen compounds
oxalic acid
polypropylene
sulfuric acid + organic compounds
hydrogen sulfide
triethanolamine

TOXICOLOGY / ECOTOXICOLOGY

TOXICOLOGICAL DATA

LD50 oral rat

Value: 1090 mg/kg

American Industrial Hygiene Association Journal. Vol. 30, Pg. 470, 1969.

LD50 dermal

Species: Rat

Value: › 2000 mg/kg

Reference: 02071 07520

ECOTOXICOLOGICAL DATA

LC50 Fish (96 hours)

Minimum: 0,348 mg/l

Maximum: 7,52 mg/l

Median: 1,72 mg/l

Study number: 69

Reference for median:

Marking, L.L., and T.D. Bills 1975. Toxicity of Potassium Permanganate to Fish and its Effectiveness for Detoxifying Antimycin. Trans.Am.Fish.Soc. 104(3):579-583

EC50 Crustaceans (48 hours)

Minimum: 0,08 mg/l

Maximum: 0,08 mg/l

Median: 0,08 mg/l

Study number: 1

Reference for median:

Office of Pesticide Programs 2000. Pesticide Ecotoxicity Database (Formerly: Environmental Effects Database (EEDB)). Environmental Fate and Effects Division, U.S.EPA, Washington, D.C.

EC50 Algae (72 or 96 hours)

Test duration: 72 hours

Minimum: 0,45 mg/l

Maximum: 0,45 mg/l

Median: 0,45 mg/l

Study number: 1

Reference for median:

Paixao, S.M., L. Silva, A. Fernandez, K. O'Rourke, E. Mendonca, and A. Picado 2008. Performance of a Miniaturized Algal Bioassay in Phytotoxicity Screening. Ecotoxicology 17(3):165-171

Reference: 02072

OCCUPATIONAL HEALTH AND FIRST AID

Routes of exposure | Toxic effects |
First Aid

ROUTES OF EXPOSURE

Main routes of exposure

In the workplace, the most likely route of exposure to potassium permanganate (K.) is via inhalation. [83]

Respiratory tract

The most common route of exposure to K. is via inhalation of dusts or aerosols of the substance in solution. Water-soluble manganese compounds such as K. are readily absorbed in the lungs, provided the inhaled particles can reach the alveoli. In addition, manganese ions absorbed in the nose can directly pass into the brain via the olfactory nerve. [7520, 10534, 7619] Substance-specific quantitative data on K. are not available. [99998]

Skin

Absorption via the skin of inorganic manganese compounds is not considered to be toxicologically relevant. It should also be noted that when permanganate ions come into contact with the skin, they are immediately reduced in the upper layers of the skin to manganese dioxide, which is slightly soluble. [7619]
A simulation of a one-hour exposure of both hands and forearms (approx. 2000 cm^2) has suggested that a 0.5 % aqueous solution of K., dilute enough it can be assumed to no longer cause skin irritation, will likely result in a total dermal uptake of 0.36 mg of K., corresponding to 0.12 mg of Mn. [7619]

Gastrointestinal tract

Substance-specific data are not available. [99998]
Contact of the mucosa of the gastrointestinal tract with dilute solutions of K., which are likely to cause only moderate irritation, is, due to reduction of permanganate ions (manganese(VII)) in the acidic environment of the stomach, which is likely to cause soluble manganese(II) chloride and slightly soluble manganese(IV) oxide to form. The latter reaction prevails in the alkaline environment of the small intestine. [7520]
Manganese(IV) oxide is slightly soluble and not readily absorbed. In contrast, manganese(II) compounds are soluble and approximately 5 % (range: 3 - 13 %) of the manganese in a given dose is likely to be absorbed. Gastrointestinal absorption of manganese is dependent on homeostatic mechanisms; if manganese and iron levels are low in the body, manganese will be absorbed more readily. [8093, 7520]
In the event that undissolved K. or highly concentrated solutions have been swallowed, it should be anticipated that the more of the substance will be absorbed due to associated tissue damage. [99999]

TOXIC EFFECTS

Main toxic effects

Acute:
Skin and mucous membranes corrosion, risk of severe eye damage [7520, 7836, 7934]
Chronic:
In animal experiments, changes in clinical chemistry and blood count (due to liver and kidney damage), evidence of neurotoxic effects [7520]
General systemic effects of manganese ions: Central nervous system damage [10534, 7619]

Acute toxicity

In the event of contact with the crystalline substance or with a concentrated solution, there is a risk of severe chemical burns and possibly irreversible eye damage. [220] Even highly dilute solutions of K. can cause violet to black discolouration of the eye, which is reversible after several days. [7836] The skin corrosion caused by K. observed in animal experiments (see below) suggests that a similar effect is likely to occur in the eye, with a risk of severe eye damage. [7520]
Patches of skin that have come into contact with K. turn brown due to formation of slightly soluble manganese(IV) oxide. Solutions of K. with a concentration of 5 % or higher may cause skin corrosion/ulceration along with scab formation, depending on the concentration, temperature and duration of exposure. [7934] In a patch test on the skin of volunteers, a 2.5 % suspension of K. in Vaseline (approx. 20 mg K., 48 h occlusive) caused irritation in only a minority of subjects (2 of 58 subjects) in the first 96 hours following the cessation of exposure. In this case, the effects of K. were markedly different from those of manganese(II) chloride, which caused irritation in 41 % of the test subjects. [10539]
In experiments involving rabbits conducted as per EU Method B.4, brief dermal contact with K. (0.5 g moistened with water, semi-occlusive, three-minute or one-hour exposure) did not damage the skin. Four hours of contact, however, resulted in deep destruction of the skin. Such damage persisted unchanged for 72 hours, but subsided almost completely within 14 days. Based on these findings, K. has been assessed as corrosive. [7520]
A patch test involving 58 subjects revealed no evidence of that K. (2.5 % in petroleum jelly) could cause allergenic reactions of the skin. [10539] A maximization test in guinea pigs conducted as per OECD Guideline 406 found no evidence that K. might cause sensitization. [7520]
In a limit test conducted as per EU Method B.3, no deaths or clinical symptoms occurred after the skin of rats was exposed to 2000 mg K./kg bw (moistened with water, occlusive, 24 h exposure). However, unspecified macroscopic changes in the liver and kidney and decreased weight gain were observed during the 14-day follow-up period. [7520]
In general, dermal exposure is not considered to be a typical exposure pathway for inorganic manganese compounds, as manganese ions do not readily penetrate the skin. [10534]
If dusts or aerosols of the substance in solution have been inhaled, severe irritation of the respiratory tract (burning of the mucous membranes, severe coughing, sensation of suffocation) is likely to occur. [305] Headache, nausea and vomiting may occur. There is an acute risk of glottic spasm, glottic oedema or lung damage. [7656]
When ingested orally, the powerful oxidizing effect of K. causes local irritation or chemical burns, depending on the concentration and quantity of the substance. Ingestion of 1 % solutions usually causes only stomach pain, while 5 % solutions cause stomach cramps, vomiting and diarrhoea. Glottic oedema and circulatory collapse are likely following exposure to solutions that are even higher in concentration, high enough to cause skin erosions and ulcerations with scabbing. The chemical burns are manifested as oedematous swelling of the lips, tongue, mouth and pharyngeal mucosa. Later stages of poisoning may include gastritis phlegmonosa, oesophageal strictures and symptoms reminiscent of Parkinson’s disease. The lethal dose in humans is reported to be approximately 10 g of K. [220]
In the absence of further details, oral LD50s of 750 and 1090 mg/kg bw have been reported for rats, 750 and 2157 mg/kg bw for mice and 810 and 1151 mg/kg bw for guinea pigs. [10570, 220] In a test performed on rats as per EU method B.1 (acute toxic class method), 2000 mg K./kg bw caused some animals to perish. All animals manifested clinical signs (respiratory problems, pale skin and mucosa) and, as the poisoning progressed, reduced weight gain or weight loss, as well as damage to the mucosa of the stomach and small intestine (hyperaemia, inflammation) and the liver (dystrophy). [7520]

Chronic toxicity

No reports of injuries in the workplace exist due to exposure solely to K. [99998] In one instance, cases of pneumonia among workers in a permanganate factory were primarily attributed to exposure to manganese oxide containing dusts, which were apparently present in the ambient air at much higher levels than permanganate dusts (no further details available). [83]
K., i.e. the permanganate ion (manganese(VII)), is reduced to soluble manganese(II) ions and slightly soluble manganese(IV) oxide on contact with bodily tissues. [8131, 99999] Expert panels consider data from studies involving these manganese compounds to be generally informative for inorganic manganese compounds. [7619, 99999]
Epidemiological studies have yielded the following pattern of toxic effects for systemically available inorganic manganese(II), manganese(III), and manganese(IV) compounds.
The organ most predominantly affected by manganese is the central nervous system; only at higher concentrations do local effects also occur in the lungs. Numerous studies on workers exposed to a variety of manganese compounds have shown that prolonged inhalative exposure to high concentrations of manganese, cause, in addition to pneumonia, chronic manganism, a disease similar to Parkinson's disease characterised by tremor, rigidity, slowed voluntary motor activity and gait disturbances. [7619]
Exposure to lower concentrations has been observed to cause preclinical neurological symptoms such as headache, memory impairment, dizziness, weakness and fatigue. These represent early signs of potential structural or functional damage of the central nervous system, which persists even after exposure has ended and which, in principle, should be regarded as irreversible. Such preclinical effects constitute the most sensitive endpoint for assessing inhalative exposure to manganese in the workplace. [7619]
Such effects (motor coordination of the hands, finger tremor, fatigability, tinnitus, irritability) were also found when 141 workers were examined in a factory at which various water- or acid-soluble manganese(II) salts (carbonate, sulfate, nitrate) and manganese oxides were produced or processed. In this study, the mean period of employment was 7.1 years (range 1 - 19 years), and the arithmetic mean manganese concentration in dust overall (inhalable fraction) was 1.33 mg Mn/m³ (geometric mean: 0.94 mg Mn/m³, median: 0.97 mg Mn/m³). [7619] Based on the observed neurological changes a LOAEC of 0.97 mg manganese/m³ was derived (human equivalent concentration (HEC): 0.34 mg/m³). [640]
Other studies involving long-term exposure mainly to manganese oxides, which are slightly soluble, reported impairments of motor and cognitive abilities even at concentrations around 0.3 mg Mn/m³ (geometric mean, arithmetic mean: 0.75 mg Mn/m³, in each case inhalable fraction) (LOAEC). The stated concentration causing no adverse effects was 0.2 mg Mn/m³ (inhalable fraction). [7619]
The observed neurological changes are attributed to neurotoxic processes triggered by increased concentrations of manganese in the brain. In rats, 13 weeks of inhalation (6 h/d, 5 d/week) of soluble manganese(II) salts increased the manganese content in the olfactory bulb at concentrations as low as 0.01 mg Mn/m³ and in the basal ganglia of the cerebrum at concentrations as low as 0.1 mg Mn/m³, while at a concentration of 0.5 mg Mn/m³ mild inflammatory reactions of the nasal mucosa were observed. [7619]
Repeated contact with the skin with dilute K. solutions (‹ 5 %) at normal temperature did not lead to irreversible dermal changes in employees of a permanganate factory. [220]
In animal studies conducted as per OECD Guideline 410 in rats, dermal exposure to 150 mg K./kg bw per day for 28 days did not result in any substance-related changes (NOAEL). At dosages of 300 mg/kg bw per day and above, changes in clinical-chemical (increased sodium levels), haematological parameters (altered leukocyte differential blood count) and urinary parameters (decreased volume, increased pH) were observed. Locally, brown discolouration of the exposed skin area was observed at this dosage, and at 600 mg/kg bw per day dry reddish skin areas, partly with scabbing, were observed as a sign of local irritation. [7520]
Following oral exposure of rats to K. per gastric tube for 28 days (as per EU method B.7), no adverse effects occurred at 40 mg K./kg bw per day (NOAEL). The next higher dosage of 100 mg/kg bw per day resulted in urinary changes, while 250 mg/kg bw per day resulted in a variety of effects such as reduced weight gain, metabolic disturbances with raised levels of creatine and lowered levels of protein in the blood and increased excretion of protein, urobilin and ketone bodies in the urine with reduced urine volume, as well as blood count and blood coagulation changes. Such changes indicate that K. damages the liver and kidneys. In addition, changes in the brain were observed with proliferation of glial cells and oedema, indicating a potential neurotoxic effect. [7520]

Reproductive toxicity, mutagenicity, carcinogenicity

For classifying the reproductive toxicity and mutagenic and carcinogenic potential see list in Annex VI of the CLP regulation / TRGS 905 / List of MAK values (see section REGULATIONS).

Reproductive toxicity
According to the information material available a risk of reproductive-toxic action is suspected. For classification of damage to the developing embryo or fetus / impairment of reproductive capability see section REGULATIONS.
In a developmental toxicity study in rats conducted per EU method B.31, even the lowest oral dose of 20 mg K./kg bw per day, administered on days 5 - 19 of gestation, resulted in minor effects on the offspring (slightly reduced foetal weight, delayed vertebral ossification, while with regards to LOAEL, a no adverse effect level (NOAEL) was not determined). The feed intake of the dams was reduced. At 100 mg K./kg bw per day and above, more pronounced maternal toxic effects occurred (clinical symptoms such as apathy, cachexia, difficulty breathing, local damage to the gastric mucosa), as well as intrauterine lethal effects and thus a reduced number of viable foetuses, and these effects were even more pronounced at 500 mg K./kg bw per day. [7520]
In a single-generation study conducted as per EU method B.34, male rats were exposed to K. in aqueous solution via gastric tube (concentration of solution max. 3.2 %) for 10 weeks before and three weeks during mating. The females were exposed in the same manner two weeks prior to mating, for at least one day until mating was completed, throughout pregnancy and during the three-week lactation period.
At dosages in the offspring starting at 80 mg K./kg bw per day, developmental delays (delayed opening of the eyes) and changes in the brain (pronounced formation of vacuoles in the nuclei of neurons, to a lesser extent also at 20 mg/kg bw per day) were observed, and, at the highest dosage of 320 mg K./kg bw per day, swelling of the brain tissue and changes in the reproductive organs (testes and epididymis reduced or absent) and in the stomach (blocked mucous membrane, bloody chyme) were observed. [7520]
With regard to exposure at the workplace, the following assessment was made:
There is no reason to fear a risk of damage to the developing embryo or foetus when MAK and BAT values are observed.
[7619]
In the above-mentioned single-generation study, at the highest dosage the number of pregnant females was reduced in the parent animals due to injury of the reproductive organs of the males (impaired spermatogenesis in the testis, reduced prostate weight). The highest dosage also caused severe local damage in both sexes (haemorrhagic erosions and ulcers in the stomach and small intestine; NOAEL = 80 mg/kg bw per day). [7520] Based on these findings, an expert panel did not propose a classification for effects on fertility due to insufficient reliability of the available studies. [10569, 10570]

Mutagenicity
In vitro, K. in the presence and absence of an exogenous metabolising system (S9 mix) was not found to be mutagenic in bacteria in the Ames test and in the thymidine kinase assay on mammalian cells (murine L5178Y cells). [7520]
In vivo, no induction of micronuclei in bone marrow cells was observed in the micronucleus test conducted as per EU guideline B.12 in mice after a single oral administration of K. (up to 1500 mg/kg bw per gastric tube). [2077, 7520, 2140]

Carcinogenicity
Substance-specific data are not available. [99998]
Water-soluble manganese(II) sulfate was found not to be carcinogenic in rats when administered chronically in their diet over a period of two years. In mice, increased follicular cell hyperplasia was seen in the thyroid gland, and the incidence of adenomas but not of carcinomas of the follicular cells was found to be slightly increased at the highest dosage (731 mg Mn/kg bw per day). On the basis of these data, no clear conclusions can be drawn on the carcinogenic potential of manganese compounds. [2077, 7985, 10534, 7619]

Biotransformation and excretion

Substance-specific data are not available for K. [99998]
K., i.e. the permanganate ion (manganese(VII)), is reduced to soluble manganese(II) ions and slightly soluble manganese(IV) oxide on contact with bodily tissues. This is also evidenced by the brown colouration caused by manganese(IV) oxide (manganese dioxide) on contact with the skin and mucous membranes. [99999]
Distribution and metabolism of manganese ions are dependent on the relevant physiological pathways. Oral absorption of manganese is dependent on homeostatic control, both with regard to its absorption from the digestive tract and with regard to its excretion via the gall. In the case of inhalative exposure, this control mechanism can be partially bypassed, as manganese ions can enter the brain tissue directly via the olfactory nerve (see below). [10534]
The rate of transport of inhaled manganese compounds out of the respiratory tract has been shown to correlate with their solubility. Following inhalative exposure to manganese compounds, manganese has been found to be both absorbed via the epithelium of the respiratory tract and transported from the nose to the brain along the olfactory nerve, a process that is saturable. It is assumed that, despite anatomical differences between rats and humans, the uptake pathway via the olfactory nerve into the central nervous system is relevant in humans. [7619, 10534]
Adults are estimated to have a total of 10 - 20 mg of manganese in their bodies. Manganese is an essential trace element, a cofactor of various enzymes and is found in all tissues of the body. The highest levels are found in the liver, pancreas, kidneys and brain. [7619]
Manganese ions undergo redox reactions in the body. In the blood, manganese is present both as manganese(II) ions bound to albumin and globulins and as manganese(III) ions bound to transferrin following oxidation. [7619]
Animal studies have shown that manganese can cross the placental barrier and pass into breast milk. [10543]
The elimination half-life of manganese from the brain has been determined to be 53 days in humans following prior intravenous administration of radiolabelled manganese. Studies in rhesus monkeys have shown that manganese is eliminated from different regions of the brain with different half-lives following inhalative exposure: most rapidly from the olfactory bulb (5 days) and most slowly from the cerebellum (32 days). In another study in rhesus monkeys, significantly longer elimination half-lives for manganese in the range of 250 days were found following a single inhalative exposure to manganese(II) chloride. [7619]
Manganese is primarily eliminated from the blood in the liver, where it is transferred into the bile. This is then released into the small intestine and the manganese it contains excreted in the faeces. Studies in humans showed that following inhalation, 40 - 70 % of the manganese ions absorbed in the form of inhaled manganese(II) chloride were eliminated via the faeces within four days. Only a small percentage (0.01 %) is eliminated with the urine. Only traces of manganese are excreted via sweat, tears, hair and nails. [8093, 10202, 7637, 7619, 10543]
Occupational exposure to manganese and manganese compounds can be assessed by measuring the concentration of manganese in whole blood. Such assessment should also take into account the background exposure of individuals not occupationally exposed to manganese. In adults not occupationally exposed to manganese, the background exposure of individuals in the 95th percentile has been reported to be 15 µg/l. [7620]

Annotation

This occupationla health information was compiled on 05.04.2022.
It will be updated if necessary.

FIRST AID

Eyes

As soon as possible:
Rinse the affected eye with widely spread lids for 10 minutes under running water whilst protecting the unimpaired eye.
Then, immediately transport the casualty to an eye doctor / to hospital.
Continue rinsing during the transport with isotonic saline solution, alternatively with water.
[305, 2001, 7798, 7978, 7906, 10339]

Skin

Whilst protecting yourself, relocate the casualty away from the source of danger.
Remove contaminated clothing while protecting yourself.
Rinse the affected skin areas for at least 10 to 20 minutes under running water.
Under no circumstances should alcohol, gasoline or other solvents be used.
Arrange for medical treatment.
[305, 2001, 7798, 7978, 7906, 10339]

Respiratory tract

Whilst protecting yourself remove the casualty from the hazardous area and take him to the fresh air.
In the case of breathing difficulties have the casualty inhale oxygen.
As soon as possible repeatedly have the casualty deeply breath a glucocorticoid inhalation spray in.
Poisoning symptoms can appear after a period of delay.
If the casualty is unconscious but breathing lay him in a stable manner on his side.
Arrange medical treatment.
[305, 2001, 7798, 7978, 7906, 10339]

Swallowing

Rinse the mouth and spit the fluids out.
If the casualty is conscious have him drink 1 glass of water (ca 200 ml).
If available, drink milk immediately
Do not make the casualty vomit.
Do not administer activated charcoal.
In case of spontaneous vomiting, keep the patient in a prone position with the head lower than the chest to prevent the vomit from penetrating the respiratory tract.
Arrange medical treatment.
[305, 2001, 7798, 7978, 7906, 10339]

Information for physicians

A significant number of acute poisonings with potassium permanganate in humans have been described, including fatal cases. Irrespective of the route of exposure, the most prominent effect is the substance's severe corrosivity [10534]. Ingestion can result in obstruction of the gastrointestinal tract due to scarring (strictures). [7798, 7978, 10603] In contrast, acute poisoning is unlikely to trigger late-onset neurotoxic effects due to accumulation of manganese in the central nervous system. [8101, 10339, 10534]

- Symptoms of acute poisoning
Eyes: brown discolouration, pain, chemosis, conjunctivitis, corneal damage (ulceration), possibly deposition of crystals under the eyelids resulting in mechanical irritation/damage [10339].
Skin: brown discolouration, induration, oedema, ulceration, necrosis, haemorrhage [7978].
Inhalation: cough, dyspnoea, stridor (glottic oedema), tachypnoea; pulmonary oedema, acute respiratory distress syndrome (ARDS) [7606, 7798, 7978, 10339], while in extreme cases mediastinitis possible [99999].
Ingestion: a 0.01 - 0.05 % solution causes brown discolouration, a 1 % solution causes swallowing disorders (dysphagia, odynophagia), nausea, vomiting, severe abdominal pain; a 2 - 3 % solution and crystals may cause ulceration and necrosis, a 4 - 5 % solution causes bleeding (haematemesis, haematochezia) and perforation of lesions [7606, 7798, 8101, 10339].
Absorption: systemic effects following ingestion:
Blood: hypoxaemia, leucocytosis, disseminated intravascular coagulation (DIC), methaemoglobinaemia [7798, 7978, 10603]
Metabolism: hyperglycaemia, hyperkalaemia, metabolic acidosis [7978, 10339]
Cardiovascular: tachycardia, hypotension; in extreme cases hypoxaemic and/or hypovolaemic shock [7978, 8101, 10339]
Severe organ damage possible (acute liver and kidney failure, pancreatitis) [7798, 7978, 10339, 10603].

- First medical assistance
Following eye contact: Check rinsing by first-aid responder, and, if required, repeat using 5 % ascorbic acid (vitamin C) solution [10339]. In the event of blepharospasm, rinse after application of a local anaesthetic (e.g. lidocaine 2 %). Due to the potential for severe damage, an ophthalmologist should be consulted. Following exposure to the crystals, the upper and lower eyelids should also be rinsed following lid eversion. If symptoms are severe, refer patient to ophthalmic specialist clinic after initial treatment.
Following skin contact: check and, if required, repeat decontamination by first aid responder (see above). Rinsing with lemon juice or 5 % ascorbic acid (vitamin C) solution is more effective than water. [10339]
After inhalation: provide oxygen (10 - 15 l/min), intubate and ventilate if necessary. If aspiration has occurred, immediately perform bronchoscopy and bronchoalveolar lavage to rapidly remove aspirated fluid and crystals from the airways. In the event of dyspnoea due to airway constriction (glottic oedema) or if toxic pulmonary oedema is suspected, a glucocorticoid should be administered by inhalation and/or intravenously, and the patient should be monitored in hospital [7978]. In the event of ARDS with refractory hypoxaemia, a decision should be made on the application of extracorporeal membrane oxygenation (ECMO). [10571]
Following ingestion: do not induce vomiting; instead encourage the patient to drink some fluid (100 - 200 ml still water, tea, juice, milk, 5 % ascorbic acid (vitamin C) solution). Do not administer activated charcoal, laxatives or gastric lavage. Suctioning of gastric contents via a nasogastric tube with intubation protection should be considered, if this is feasible within 60 min [10339]. The extent of corrosion should be immediately clarified and fluid and crystals removed by means oesophagogastroduodenoscopy [7978, 8101].
All complications are to be treated in a symptom-oriented manner.
In the event of › 30 % methaemoglobinaemia, administer IV tolonium chloride 2 - 4 mg/kg bw gradually – a single repetition is possible. This will cause blue discolouration of the patient, and if injection is too rapidly, a drop in blood pressure, while overdosage will cause haemolysis. [10095]
No known specific antidote exists. Treatment with calcium disodium ethylenediaminetetraacetate (CaNa2EDTA) improves excretion of manganese in the urine and reduces the concentration of manganese in the blood without having an effect on clinical symptoms [8115, 10375, 10598].

Recommendations

Provide the physician information about the substance/product and treatment already administered.
Only in the event of persistent neurological symptoms (manganism) should manganese levels (blood, serum, urine) be determined and radiological diagnostics (cMRI) be performed [8115, 10375].

Annotation
This first aid information was compiled on 30.09.2022.
It will be updated if necessary.
This information was translated from German into English by Übersetzungsdienst Proverb.

SAFE HANDLING

Handling | Storage | Fire and explosion protection | Organisational measures | Personal protection | Disposal considerations | Accidental release measures | Fire fighting measures

TECHNICAL MEASURES - HANDLING

Workplace
Provision of good ventilation in the working area.
The floor should not have a floor drain.
Washing facility at the workplace required.
Eye bath required. These locations must be signposted
clearly.
When handling excessive amounts of the substance an emergency shower is required.

Equipment
Use closed apparatus if possible.
If release of the substance cannot be prevented, then it should be suctioned off at the point of exit.
Consider emission limit values, a purification of waste gases if necessary.
Label containers and pipelines clearly.

Unsuitable materials:
Copper
Zinc
Plastics have to be proven for their resistibility.
Potassium permanganate can also ignite various plastics (e.g. polypropylene) on intensive contact.

Advice on safer handling
Take care to maintain clean working place.
The substance must not be present at workplaces in quantities above that required for work to be progressed.
Do not leave container open.
Sufficient ventilation must be guaranteed for refilling, transfer, or open use.
Avoid spillage.
Fill only into labelled container.
Avoid rising dust.
Avoid any contact when handling the substance.
Do not transport together with incompatible substances.
Use an appropriate exterior vessel when transporting in fragile containers.

Cleaning and maintenance
Use protective equipment while cleaning if necessary.
Avoid dust formation. Dust formation that cannot be avoided must be collected regularly.
Use a tested industrial vacuum cleaner or suction device.
Do not raise dust while cleaning.
Use of a blower for cleaning is not permitted.
Alternative: clean damp.
Only conduct maintenance and other work on or in the vessel or closed spaces after obtaining written permission.

TECHNICAL MEASURES - STORAGE

Storage

Do not use any food containers - risk of mistake.
Containers have to be labelled clearly and permanently.
Store in the original container as much as possible.
Preferably use unbreakable containers rather than glass containers.
Place fragile vessels in break-proof outer vessels.
Keep container tightly closed in a cool, dry and well-ventilated place.

Conditions of collocated storage

Storage class 5.1 B (Oxidizing substances)
Only substances of the same storage class should be stored together.
Collocated storage with the following substances is prohibited:
- Pharmaceuticals, foods, and animal feeds including additives.
- Infectious, radioactive und explosive substances.
- Gases.
- Aerosols (spray bottles).
- Other explosive substances of storage class 4.1A.
- Pyrophoric substances.
- Substances liberating flammable gases in contact with water.
- Organic peroxides and self reactive substances.

Under certain conditions the collocated storage with the following sub-stances is permitted (For more details see TRGS 510):
- Flammable liquids of storage class 3.
- Flammable solid substances or desensitized substances of storage class 4.1B.
- Ammonium nitrate and preparations containing ammonium nitrate.
- Combustible and non combustible acutely toxic substances of stora-ge classes 6.1A and 6.1B.
- Combustible toxic or chronically acting substances of storage class 6.1C.
- Noncombustible toxic or chronically acting substances of storage class 6.1D.
- Combustible corrosive substances of storage class 8A.
- Combustible liquids of storage class 10.
- Combustible solids of storage class 11.

The substance should not be stored with substances with which ha-zardous chemical reactions are possible.

TECHNICAL MEASURES - FIRE AND EXPLOSION PROTECTION

Technical, constructive measures

Substance has an oxidizing effect.
Fire fighting equipment must be available.
Inspect the electrical fittings regularly against the higher risk of corrosion.

Precaution on handling

Keep away from open flames.
Observe the smoking prohibition!
Absolutely no welding in the working area.
Only work with vessels and lines after these have been thoroughly rinsed and inerting.
Work done with fire or open flame should only be carried out with written permission if the risk of fire or explosion cannot be completely eliminated.
Keep away from combustible materials.
Filter the solutions only with glass wool, glass chips, or ceramic filters. Do not use any filtration materials made of paper which risks ignition after drying. Do not leave any cleaning rags lying in the open.

ORGANISATIONAL MEASURES

Instruction on the hazards and the protective measures using instruction manual (TRGS 555) are required with signature if just more than one minor hazard was detected.

Instruction must be provided before employment and then at a minimum of once per annum thereafter.

An escape and rescue plan must be prepared when the location, scale, and use of the work-site so demand.

It must be assured that the workplace limit values are being maintained. If the limit values are exceeded, additional protection measures are necessary.

The measurements must be recorded and kept on file.

Observe the restrictions on juvenile employment as defined in the "Jugendarbeitsschutzgesetz".

PERSONAL PROTECTION

Body protection

Depending on the risk, wear a sufficiently long apron and boots or a suitable chemical protection suit.

Respiratory protection

In an emergency (e.g.: unintentional release of the substance, exceeding the occupational exposure limit value) respiratory protection must be worn. Consider the maximum period for wear.

Respiratory protection: Particle filter P3, colour code white.

Use insulating device for concentrations above the usage limits for filter devices, for oxygen concentrations below 17% volume, or in circumstances which are unclear.

Eye protection

Sufficient eye protection must be worn.

Wear chemical safety goggles.

If the face is at risk a protective shield must also be worn.

Hand protection

Use protective gloves. The glove material must be sufficiently impermeable and resistant to the substance. Check the tightness before wear. Gloves should be well cleaned before being removed, then stored in a well ventilated location. Pay attention to skin care.

Skin protection cremes do not protect sufficiently against the substance.

The following information is valid for aqueous, saturated solutions of the salt.

Also for a potassium permanganate solution (6%) :

The following materials are suitable for protective gloves (Permeation time >= 8 hours):

Natural rubber/Natural latex - NR (0,5 mm) (use non-powdered and allergen free products)

Polychloroprene - CR (0,5 mm)

Nitrile rubber/Nitrile latex - NBR (0,35 mm)

Fluoro carbon rubber - FKM (0,4 mm)

Polyvinyl chloride - PVC (0,5 mm)

The times listed are suggested by measurements taken at 22 °C and constant contact. Temperatures raised by warmed substances, body heat, etc. and a weakening of the effective layer thickness caused by expansion can lead to a significantly shorter breakthrough time. In case of doubt contact the gloves' manufacturer. A 1.5-times increase / decrease in the layer thickness doubles / halves the breakthrough time. This data only applies to the pure substance. Transferred to mixtures of substances, these figures should only be taken as an aid to orientation.

Occupational hygiene

Foods, beverages and other articles of consumption must not be consumed at the work areas. Suitable areas are to be designated for these purposes.

Avoid contact with skin. In case of contact wash skin.

Avoid contact with eyes. In case of contact rinse the affected eye(s).

Avoid inhalation of dust.

Avoid contact with clothing. Contaminated clothes must be exchanged and cleaned carefully.

Provide washrooms with showers and if possible rooms with separate storage for street clothing and work clothing.
The skin must be washed with soap and water before breaks and at the end of work. Apply fatty skin-care products after washing.

DISPOSAL CONSIDERATIONS

Hazardous waste according to Waste Catalogue Ordinance (AVV).
If there is no way of recycling it must be disposed of in compliance with the respective national and local regulations.

Collection of small amounts of substance:
Do not put/place waste into sink or dust bin.
Convert into a less harmful reduction product by introducing in a sodium thiosulfat solution, if necessary under acidification.
Place in collecting containers for salt solutions, adjust for a pH value of 6 - 8, or
place in collecting containers for toxic anorganic residues as well as heavy-metal salts and their solutions.
Collection vessels must be clearly labelled with a systematic description of their contents. Store the vessels in a well-ventilated location. Entrust them to the appropriate authorities for disposal.

ACCIDENTAL RELEASE MEASURES

Evacuate area. Warn affected surroundings.
The hazardous area may only be entered once suitable protective measures are implemented. Only then can the hazardous situation be removed (see chapter Personal Protection).
Pick up without creating dust.
Afterwards ventilate area and wash spill site.

Endangerment of watert:
Severe hazard to waters. Avoid penetration into water, drainage, sewer, or the ground. Inform the responsible authorities about penetration of even small quantities.

FIRE FIGHTING MEASURES

Instructions

Substance is non-combustible, but has an oxidizing effect.
Cool surrounding containers with water spray.
If possible, take container out of dangerous zone.
Rise in pressure and risk of bursting when heating.
Do not allow runoff to get into the sewage system.

Special protective equipment

In the case of inclusion in an ambient fire hazardous substances can be released.
Metal oxide fume
Wear self-contained breathing apparatus and special tightly sealed suit.

REGULATIONS

GHS Classification/Labelling | Workplace labelling | Water hazard class | Air quality control | Transport Regulations | Threshold limit values | EC-Threshold limit values | MAK recommendations | Biological exposure indeces | SevesoIII | Restriction of use | Technical rules | Regulations of accident insurers

EUROPEAN GHS CLASSIFICATION AND LABELLING

Classification

Oxidising solids, Category 2; H272
Acute toxicity, Category 4, oral; H302
Skin corrosion, Category 1C; H314
Serious eye damage, Category 1; H318
Reproductive toxicity, Category 2; H361d
Specific Target Organ Toxicity (repeated exposure), Category 2; H373
Hazardous to the aquatic environment, Acute Category 1; H400
Hazardous to the aquatic environment, Chronic Category 1; H410

Signal Word "Danger"

Hazard Statement - H-phrases

H272: May intensify fire; oxidiser.
H302: Harmful if swallowed.
H314: Causes severe skin burns and eye damage.
H361d: Suspected of damaging the unborn child.
H373: May cause damage to organs through prolonged or repeated exposure.
H410: Very toxic to aquatic life with long lasting effects.

Precautionary Statement - P-phrases

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P220: Keep away from clothing and other combustible materials.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water or shower.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a POISON CENTER or doctor.

Manufacturer's specification by Thermo Fisher Scientific

Reference: 01231
State: 2019
Checked: 2019

The substance is listed in appendix VI, table 3 of CLP regulation.
The given classification can deviate from the listed classification, since this classification is to be complemented concerning missing or divergent danger classes and categories for the respective substance.

Reference: 99999

GHS-CLASSIFICATION OF MIXTURES

The classification of mixtures containing this substance results from Annex 1 of Regulation (EC) 1272/2008.

Reference: 99999

WORKPLACE LABELLING ACCORDING TO GERMAN ASR A1.3

Prohibition label

No open flame; fire, open ignition sources and smoking prohibited

Warning label

Caution - corrosive material

Caution - oxidizing material

Precept label

Use safety goggles

Wear safety gloves

GERMAN WATER HAZARD CLASS

Substance No: 1936

WGK 3 - severe hazard to waters

Classification according to the announcement of the list of substances hazardous to water in the Federal Register of 10.08.2017, last update 24.11.2023

TECHNICAL INSTRUCTIONS ON AIR QUALITY CONTROL (TA LUFT)

Chapter 5.2.2 Inorganic dusts
Class III
Also with the presence of several substances of the same class, the following values are in all not allowed to be exceeded in the exhaust gas:

Mass flow: 5 g/hr

or

Mass conc.: 1 mg/m³

Specified as Mn.

TRANSPORT REGULATIONS

UN Number: 1490
Shipping name: Potassium permanganate, solid
Hazard Identification Number: 50
Class: 5.1 (Oxidizing Agents)
Packing Group: II (medium danger)
Danger Label: 5.1

Special labelling: Symbol (fish and tree)

Classification code: O2

Tunnel restrictions:
Passage forbidden through tunnels of category E.

Reference: 07902

TRGS 900 - GERMAN OCCUPATIONAL EXPOSURE LIMIT VALUES

0,02 mg/m³
with reference to the respirable fraction

0,2 mg/m³
with reference to the inhalable fraction

Peak limitation: Excursion factor 1

Duration 15 min, mean; 4 times per shift; interval 1 hour
Category II - Substances with systemic effects

There is no reason to fear a risk of damage to the developing embryo or foetus when AGW and BGW are adhered to.

Source: DFG

Scope:
Manganese compounds, inorganic

The occupational exposure limit value refers to the element content of the corresponding Metal.

EC OCCUPATIONAL EXPOSURE LIMIT VALUES

Directive 2017/164/EU
Recommended indicative occupational exposure limit value for the European Union
A national occupational exposure limit value has to be set.
8 hours limit value: 0,2 mg/m³ (inhalable fraction)
8 hours limit value: 0,05 mg/m³ (alveolar fraction)
(as manganese)

RECOMMENDATIONS OF MAK-COMMISSION

This data is recommended by scientific experience and is not established law.

0,02 mg/m³
with reference to the respirable fraction

Peak limitation: Excursion factor 1
Duration 15 min, mean; 4 times per shift; interval 1 hour
Category II - Substances with systemic effects

inorganic manganese compounds

0,2 mg/m³
with reference to the inhalable fraction

Peak limitation: Excursion factor 1
Duration 15 min, mean; 4 times per shift; interval 1 hour
Category II - Substances with systemic effects

Pregnancy: Group C
There is no reason to fear damage to the embryo or foetus when MAK and BAT values are observed.

GERMAN BIOLOGICAL EXPOSURE INDICES

Parameter:	Manganese
Assay material:	Whole blood
Sampling time:	for long-term exposure: at end of shift after several shifts end of exposure/end of shift
	There is at present insufficient data for the derivation of a BAT value; however, documentation for this substance has been published. Scope: inorganic manganese combounds

Reference: 08112

DIRECTIVE 2012/18/EU (Seveso III)

The substance is subject to the hazard categories of the Hazardous Incident Ordinance:

P8	Oxidising liquids or solids, Category 1, 2 or 3
E1	Hazardous to the aquatic environment, Category Acute 1 or Chronic 1

Quantity thresholds for determination of operation scopes:

Annex I Part 1 Section: P8
Oxidising liquids or solids
Qualifying quantity for the application of
Lower-tier requirements: 50 t

Upper-tier requirements: 200 t

Quantity thresholds for determination of operation scopes:

Annex I Part 1 Section: E1
Hazardous to the aquatic environment
Qualifying quantity for the application of
Lower-tier requirements: 100 t
Upper-tier requirements: 200 t

RESTRICTIONS OF USE / BANS OF USE

REACH Regulation (EC) No 1907/2006 Annex XVII

Annex XVII, Point 75
Mixtures containing certain hazardous substances shall no longer be placed on the market for tattooing purposes. Mixtures containing such substances in specified concentrations shall no longer be used for tattooing purposes after 04.01.2022. Substances falling within one or more of the following points:
- carcinogenic or reproductive toxic substances according to Part 3 of Annex VI to CLP Regulation (excluding the classification due to effects only following exposure by inhalation),
- skin-sensitising, skin-corrosive, skin-irritant, serious eye-damaging or eye-irritant substances according to Annex VI Part 3 of the CLP Regulation,
- substances listed with specified conditions in Annex II or IV to Regulation (EC) No 1223/2009 [Cosmetics Regulation], and
- substances listed in Appendix 13 to Annex XVII (point 75) of the REACH Regulation.
In general, mixtures placed on the market for use for tattooing purposes must be labelled "Mixture for use in tattoos or permanent make-up." from 04.01.2022 on and may not be used for tattooing purposes without this labelling. Further safety information shall be provided on the packaging or in the instructions for use. Before using a mixture for tattooing purposes, the person using the mixture shall provide this information to the person undergoing the procedure.
Further information on the restrictions, concentration limits and exemptions can be taken from the Regulation.

Annex XVII to Regulation (EC) No 1907/2006, consolidated version (BAUA) (only in German)

TECHNICAL RULES FOR HAZARDOUS SUBSTANCES

TRGS 201
Einstufung und Kennzeichnung bei Tätigkeiten mit Gefahrstoffen; Ausgabe Februar 2017, zuletzt geändert und ergänzt April 2018

TRGS 400
Gefährdungsbeurteilung für Tätigkeiten mit Gefahrstoffen; Ausgabe Juli 2017

TRGS 555
Betriebsanweisung und Information der Beschäftigten; Ausgabe Februar 2017

TRGS 600
Substitution; Ausgabe Juli 2020

TRGS 402
Ermitteln und Beurteilen der Gefährdungen bei Tätigkeiten mit Gefahrstoffen: Inhalative Exposition; Ausgabe September 2023

TRGS 401
Gefährdung durch Hautkontakt, Ermittlung - Beurteilung - Maßnahmen; Ausgabe Oktober 2022

TRGS 500
Schutzmaßnahmen; Ausgabe September 2019

TRGS 509
Lagern von flüssigen und festen Gefahrstoffen in ortsfesten Behältern sowie Füll- und Entleerstellen für ortsbewegliche Behälter; Ausgabe Juni 2022

TRGS 510
Lagerung von Gefahrstoffen in ortsbeweglichen Behältern; Ausgabe Januar Dezember 2020

TRGS 800
Brandschutzmaßnahmen; Ausgabe Dezember 2010

REGULATIONS OF GERMAN ACCIDENT INSURERS

DGUV Regel 112-190
Benutzung von Atemschutzgeräten, Ausgabe November 2021
(in German only)

LINKS

International Limit Values
The MAK Collection for Occupational Health and Safety
DGUV Information 213-098: List of substances - lesson in schools (in German only)

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GHS-Sicherheitsdatenblatt, Sigma-Aldrich
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Quelle: 01231
GHS-Sicherheitsdatenblatt, Thermo Fisher Scientific
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Angabe des Bearbeiters
Indication of the editor

Identification | Characterisation | Formula | Physical and chemical properties | Toxicology / Ecotoxikology | Occupational health and first aid | Safe handling | Regulations | Links | Literature register