IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Zinc oxide

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

IDENTIFICATION

Zinc oxide

ZVG No:	2090
CAS No:	1314-13-2
EC No:	215-222-5
INDEX No:	030-013-00-7

CHARACTERISATION

SUBSTANCE GROUP CODE

134400 Zinc compounds
121110 Metal oxides

STATE OF AGGREGATION

The substance is solid.

PROPERTIES

powder
white
odourless

CHEMICAL CHARACTERISATION

Non-combustible substance.
Practically insoluble in water.
The substance is hazardous to the aquatic environment.
(see: chapter REGULATIONS).

Substance information in Wikipedia

DUST EXPLOSIVENESS

No risk of dust explosion.
Quelle: 06806

FORMULA

ZnO

Zn^{2+} O^{2-}

Molar mass: 81,39 g/mol

PHYSICAL AND CHEMICAL PROPERTIES

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

MELTING POINT

Melting point: 1975 °C

Reference: 07520

DENSITY

DENSITY

Value: 5,68 g/cm³

Temperature: 22 °C

Reference: 01211

SOLUBILITY IN WATER

Concentration: 1,6 mg/l

Temperature: 29 °C

Reference: 01221

pH-VALUE

pH-value: 7

Temperature: 20 C°

Concentration: 50 g/l

slurry

Reference: 01221

HAZARDOUS REACTIONS

Hazardous chemical reactions

Risk of explosion in contact with:
magnesium (heat)

The substance can react dangerously with:
chlorinated rubber (rare)
linseed oil (rare)

TOXICOLOGY / ECOTOXICOLOGY

ECOTOXICOLOGICAL DATA

LC50 Fish (96 hours)

Minimum:	1,1 mg/l
Maximum:	2250 mg/l
Median:	1120 mg/l
Study number:	2

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.; Gale, N.L., B.G. Wixson, and M. Erten 1992. An Evaluation of the Acute Toxicity of Lead, Zinc, and Cadmium in Missouri Ozark Groundwater. Trace Subst.Environ.Health 25:169-183

LC50 Crustaceans (48 hours)

Minimum:	0,098 mg/l
Maximum:	24,6 mg/l
Median:	12,3 mg/l
Study number:	2

Reference for median:

Gale, N.L., B.G. Wixson, and M. Erten 1992. An Evaluation of the Acute Toxicity of Lead, Zinc, and Cadmium in Missouri Ozark Groundwater. Trace Subst.Environ.Health 25:169-183

Reference: 02072

OCCUPATIONAL HEALTH AND FIRST AID

Routes of exposure | Toxic effects |
First Aid

ROUTES OF EXPOSURE

Main routes of exposure

Inhalation of zinc compounds such as zinc oxide (Z) in the form of aerosols plays the major role at workplaces. [7619, 7655]

Respiratory tract

Quantitative data on the systemic availability of Z and other zinc compounds are neither available for humans nor from animal experiments. [7619]
In one study on probands, approx. 80% of the particles were deposited in the respiratory tract after 2-hour exposure to ultra fine Z particles (0.5 mg/m³, diameter 0.04 µm). The deposition of fine particles (0.29 µm) was 35% of the particle number and was thus lower. [7619]
Increased zinc concentrations found in the blood and the urine of individuals who had been exposed to zinc oxide fumes at their workplaces might point to pulmonary absorption, however, detailed studies are lacking. Even when toxic effects (metal fume fever) were observed, increased zinc concentrations could not be detected in the serum in most case reports. [2050, 7619]
Data from animal experiments pertaining to inhalative Z absorption are not available. However, studies on rats, rabbits and guinea pigs determined a pulmonary retention (deposition of the particles) of 5% to 20% of fine Z particles (particle size 0.17 µm). [2050]
Inhaled zinc oxide dusts were removed from the lungs of rats with a half-life in the region of several hours. [7619]
It must be assumed that particles removed from the respiratory tract via ciliary clearance mechanisms enter the digestive tract, where the zinc is absorbed after dissolution in the gastric acid depending on zinc supply status and nutrition. [2050, 99999].

Skin

Reliable data on the extent of dermal zinc oxide absorption is not available. Exposure of intact skin is assumed to entail minor systemic availability in humans [7748]
However, zinc that is initially bound in the skin can slowly become systemically available at a later point in time. [2050]
Increased zinc absorption from Z was described in the case of injured skin (skin burns). [2050]
In-vitro studies on human skin yielded a comparable 24-hour absorption of approx. 0.35% of the poorly soluble Z and of the easily soluble zinc sulphate from an ointment basis. The indicated flux rate was 0.02–0.09 µg/cm² per hour. [7619]
In an animal experiment with rats, application of Z labelled with radioactive 65Zn on intact skin resulted in dermal absorption of less than 2%, measured via the determination of the radioactivity in the organism. In another trial, 12% of Z that had been applied to skin wounds (section into all skin layers) were displaced into the wound. [2050]

Gastrointestinal tract

Since Z is soluble in diluted mineral acids, it can be assumed that zinc ions dissolved in the acidic environment of the stomach are absorbed in a similar way as the soluble zinc salts (zinc sulphate, zinc chloride). [99999]
In a comparative study on humans, the relative bioavailability of zinc from Z amounted to approx. 60% compared with water-soluble zinc compounds; absolute values were not reported. [7619]
Depending on the diet, absorption of zinc ions from the human digestive tract amounts to 8%–80%. Absorption amounts to 20%–30% in persons with adequate zinc supply. Zinc absorption occurs in the entire small intestines both via passive diffusion and active transportation mechanisms. In experiments, probands rapidly absorbed orally supplied zinc sulphate (half-life of the absorption: 0.4 hours); the maximum serum level was found after 2.3 hours. Moreover, in studies with Z, percentage absorption decreased with increasing supply (up to 5.8 mg zinc: 55%, at 58 mg zinc absorption was limited to 25%). [7619]

TOXIC EFFECTS

Main toxic effects

Acute effects:
Metal fume fever, taste disturbance, irritations of the digestive tract. [7619]
Chronic effects:
Taste disturbance, inflammatory reactions of the respiratory tract, disorders of the copper homoeostasis and effects of a copper deficiency including changes of the haematological and clinical-chemical parameters. [7619, 7520]

Acute toxicity

Experience reports pertaining to eye irritations triggered by Z in humans are not available. In valid trials on rabbit eyes, Z only triggered mild, rapidly subsiding reddening of the conjunctiva and swelling. Corneal changes or injuries of the epithelium did not occur. [7520]
Z is used as ointment ingredient in dermatology. Indications of an irritative potential were not derived from this use. [7619]
In valid trials on test animals, Z showed no skin-irritant potential. [7520]
Like other zinc compounds, Z has been used in cosmetic and pharmaceutical products for decades without yielding indications of an allergic potential. This is also true for the results of patch tests in probands. [7619]
In an animal experiment, Z showed no skin-sensitising potential according to the findings of several maximisation tests on guinea pigs. [7619, 7520]
Data on the toxicity involved in dermal exposure of humans to Z are not available.
In an animal experiment with nanoscale Z, dermal application of 2000 mg per kg of body weight in a valid test caused neither local nor clinical or systemic effects (LD50 › 2000 mg per kg of body weight). [7520]
Processing of materials such as galvanised steel at high temperatures like those generated during welding and flame cutting can result in the formation of ultrafine zinc oxide fume particulates. Exposure to these fumes triggers metal fume fever. This condition involves a sweet metal taste that occurs after 4 to 12 hours, followed by irritations of the throat in the further course, unspecific flu-like symptoms including coughing and shortness of breath. Further organs can be affected; rapidly increasing fever is accompanied by headache, impaired vision, nausea and vomiting, muscle and joint pain and urination disorders. The complaints are reversible, long-term effects are not known, however, extensive studies are pending. Due to mixed exposure, threshold values cannot be derived from workplace studies. [7619]
In experiments, metal fume fever was triggered in all exposed probands after 2-hour exposure to metal fumes with 5 mg Z/m³, after 6-hour exposure the condition occurred at levels as low 2.5 mg/m³. Exposures to 0.5 mg Z/m³ caused no symptoms in healthy subjects. Another, more recent study on probands involving 4-hour inhalation of different concentrations of nanoscale Z particles (particle size ‹ 100 nm) points to a NOEL (no observed effect level) in the range of 0.5 to 10 mg Z/m³. [7619, 10027]
Indications of inflammatory reactions in the lungs were observed in rats and guinea pigs after exposure to values as of 2.5 mg Z/m³ (ultrafine particles, 60 nm) in an animal experiment. [7619]
Data pertaining to the oral toxicity of Z in humans are lacking. Gastrointestinal symptoms were described after oral intake of soluble zinc salts. In one case, intake of 28 g zinc sulphate triggered vomiting, accelerated heart rates and hyperglycaemia, followed by bloody inflammation of the pancreas, kidney failure and finally death in the further course. Less severe cases involved severe diarrhoea, vomiting and abdominal pain after intake of 2.5 to 112 g zinc sulphate. [2077]
Oral administration of 5000 mg Z per kg of body weight caused neither toxicity symptoms nor lethal effects (LD50 › 5000 mg per kg of body weight) in an animal experiment. In mice, LD50 values of › 5000 or › 2000 mg per kg of body weight were determined for nano Z (20 nm-particles) and fine Z particles (120 nm). [7520]

Chronic toxicity

Studies on 234 workers with mean exposure times to the inhalation of zinc oxide dusts (2.5–4.5 mg/m³, chiefly Z, 25% of the particles were ‹ 3 µm) of 5.5 years yielded no indications of pulmonary dysfunctions or asthmatic complaints. [7619]
Repeated exposure to zinc oxide fumes must principally be expected to trigger the symptoms of “metal fume fever” described after acute exposure (see there). Trials on 35 workers who had been exposed to welding fume concentrations containing 30%–70% of approx. 5 mg/m³ Z (with values occasionally exceeding 6 mg/m³) (information on the particle size and further components was not provided) yielded no indications of impaired lung functions or disorders that are typical for metal fume fever, however, an increased metallic taste was reported. One person who participated in another trial on 7 workers reported having experienced zinc fume fever symptoms in the past. Personal measurements revealed mean shift values of 0.27–2.8 mg/m³ zinc oxide fume (information on the particle size was not provided). [7619]
Increased oral intake of zinc compounds for the supplementation of zinc was reported to entail disorders in the balance of the (also essential) trace element copper with reduced activity of the enzymes containing copper (such as the superoxide dismutasis) as well as haematological changes such as anaemia, neutropenia (reduced number of neutrophilic white blood cells), changed cholesterol levels as well as immunological changes and gastrointestinal disorders. [2077]
Copper deficiency and anaemia were observed even after oral long-term dosages of 2.1 mg zinc per kg of body weight per day, these effects present the most sensitive parameter in cases of increased systemic zinc exposure. An oral dose of 0.43 mg zinc per kg of body weight per day was indicated as NOAEL in which changes of the copper balance do not longer occur. [7619]
In an animal experiment with guinea pigs, up to 6-day inhalation of ultrafine Z particles (3 hours per day) caused deterioration of the lung functions as well as inflammatory changes in the lung tissue at 5.5 mg Z/m³, which subsided within 3 days after termination of the exposure (4.4 mg zinc/m³, particle size 0.05 µm). In further studies, no such changes occurred after 5-day exposure to 2.7 mg Z/m³, however, signs of an inflammatory reaction could be found in the BAL (bronchoalveolar lavage) as early as on day 2 after exposure to 2.3 mg Z/m³. Changes in the BAL were also described in rats after exposure to 6.9 mg Z/m³ (other concentrations were not investigated, particle size 1.6 µm) during the 7-day exposure and 1 week thereafter. [7619]
A 13-week subchronic inhalation study conducted in accordance with OECD directive involving the exposure of rats to coated zinc oxide particles (coating: triethoxycaprylylsilane) or uncoated Z (size ‹ 3 µm each) showed no adverse effect (NOAEC) at 1.5 mg/m³. Exposure to 4.5 mg/m³ (LOAEC) coated and uncoated Z trigged mild changes in the nasal epithelium as well as slight signs of inflammatory reactions in the lungs. [7520]
In a trial performed in accordance with OECD directive, dermal exposure of rats to nanoscale Z particles (particle size of the raw material: approx. 20 nm, in aqueous solution: approx. 225 nm) resulted in a prolonged coagulation time and a reduced collagen content of the skin. After termination of the exposure, the effects were reversible within 14 days (LOAEL: 75 mg per kg of body weight per day, no NOAEL). [7520]
After oral treatment of ferrets with Z in the feed for up to 180 days, exposures to the lowest dose of 81.3 mg Z per kg of body weight per day caused no pathological changes apart from increased blood formation in the spleen. The next higher dose of 243.8 mg per kg of body weight per day caused severe toxic effects (fatty liver, enlarged kidneys, nephrosis, intestinal bleeding and anaemia) within 21 days. [7520]
Administration of water-soluble zinc compounds (zinc sulphate heptahydrate, zinc chloride, zinc acetate, zinc glycerinate) with the drinking water or the feed to mice and rats entailed first effects in the form of reduced body weight after 14 to 16 weeks at 1.5 or 3.6 mg zinc per kg of body weight per day. Zinc amounts from 5.3 or 9.7 mg per kg of body weight per day triggered changes in the activity of liver enzymes in the serum. A reduced haemoglobin level as well as a reduced number of red blood cells were observed in rats as early as after 4-week exposure to 12 mg zinc per kg of body weight. Histological changes of internal organs (kidneys, pancreas, bones, gastrointestinal tract, lymph nodes) were found after exposures to values from 50 mg per kg of body weight per day. [7619]

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:
There is no reason to fear a risk of damage to the developing embryo or foetus when MAK and BAT values are observed.
Zinc is an essential trace element. The majority of human studies on zinc supply address the relationship between zinc deficiency and its effects on pregnancy. There are no data pointing to an impairment of the pregnancy due to excessive zinc supply. Several studies on healthy pregnant women yielded no indications of adverse effects up to oral doses of approx. 1.3 mg zinc per kg of body weight per day. In studies on non-pregnant women, oral long-term dosages of 2.1 mg zinc per kg of body weight per day caused deficiencies of copper, which is also an essential trace element, and anaemia in studies on non-pregnant women. [7619]
Increased body temperatures occurring in metal fume fever could constitute a risk for pregnant women, since fever (including an increase of the body temperature by 2°C or more) can trigger embryotoxic effects. 2-hour exposure of probands to 0.5 mg Z/m³ (0.4 mg zinc/m³) caused no temperature increase, exposure to 2.5 mg Z/m³ entailed an average temperature increase of 0.7°C. An increased body temperature must not be expected after 8-hour exposure to 0.1 mg zinc/m³. [7619]
In one animal inhalation experiment on the developmental toxicity performed in accordance with OECD directive with coated zinc oxide particles (see above), exposure of pregnant rats to 7.5 mg/m³ caused mild inflammatory changes of the lungs, which was not the case after exposure to 1.5 mg/m³; developmental-toxic effects were not observed. [7520]
In one study on rats, exposure to up to the highest zinc carbonate dose (50 mg per kg of body weight per day), which is poorly soluble in water like Z, but easily soluble in diluted mineral acids caused neither maternal nor developmental-toxic effects. After administration of Z over the entire duration of the pregnancy, exposure to 300 mg zinc per kg of body weight per day entailed an increased incidence of still births, which was not the case after exposure to 120 mg zinc per kg of body weight per day. [7619]
Only few data are available on the impact on the fertility. After more than 4-week administration of high zinc sulphate doses with the feed (corresponding to 200 mg zinc per kg of body weight per day) in an animal experiment, reduced sperm mobility was observed in male rats; the number of pregnant females and living offspring was also reduced. 58-day oral administration of 303 mg zinc per kg of body weight per day (as zinc gluconate) followed by 6-day application of 266 mg zinc per kg of body weight per day entailed changes of the testicle and prostate tissues of male rats; female rats exhibited changes of the uterus; 54 mg zinc per kg of body weight per day triggered no effect. [7619]
Mutagenicity
Sufficient information is not available in humans.
Micronucleus tests on mice with coated zinc oxide particles (see above) of different sizes conducted according to OECD directive showed no clastogenic potential. [7520]
Most studies performed with different zinc compounds including Z showed no mutagenic potential in-vitro, chromosome damage was described in the range of high, cytotoxic concentrations. Nor can a genotoxic potential of zinc compounds be derived from the overall assessment of the studies on clastogenic effects (chromosome damage and formation of micronuclei). Isolated positive findings observed after exposure to high doses or concentrations of Z and other zinc compounds can be explained by the fact that the capacity of the cells or the total organism to regulate the zinc concentration was exceeded (or, in case of intraperitoneal injection, bypassed). However, comparable zinc concentrations are not reached under workplace conditions. [7619]
The available data on the genotoxicity did not point to a suspected germ cell-mutagenic potential. [7619]
Carcinogenic potential
Sufficient data are not available.
A study on approx. 4800 workers in copper and zinc plants yielded no indication of an increased cancer mortality in connection with the exposure to zinc. [7619]
Valid conclusions on the carcinogenic potential of Z and other zinc compounds cannot be derived from the available animal experiments. [7619].

Biotransformation and excretion

Zinc is an essential trace element that occurs as bivalent cation in all tissues of the organism. It can enter proteins or other molecules or anions via electrostatic interactions with negatively charged groups. More than 300 enzymes containing zinc as cofactor are known. The total content in the human organism is said to amount to 1.5–3 g. Quantitatively, the largest zinc portion can be located in the muscles (approx. 60%), the highest concentrations are found in the bones, the hair and the prostate. In the blood plasma, zinc occurs in a concentration of approx. 1 mg/l, bound to albumin and other proteins. [7619] In the whole blood, the largest zinc proportion is found in the erythrocytes. [7620]
Increased zinc levels in the serum were reported after industrial exposure to zinc compounds. However, the determination of zinc in the whole blood or the serum is not recommended for the assessment of an industrial zinc exposure. [8093]
Half-life of the elimination ranges between 100 and 500 days in humans without strongly increased zinc supply. Exposure to high supplied doses (in the trial: 58 mg) entailed a shorter elimination half-life of 93 days. In experiments, biphasic elimination kinetics with a short biological half-life of 19 days could be determined for approx. 30% of the absorbed zinc quantity after oral administration of radioactive zinc; the half-life for the remaining zinc amount was approx. 380 days. [2050]
Approx. 70%–80% of orally absorbed zinc are eliminated with the faeces. The zinc amount eliminated this way reflects the unabsorbed proportion from the food and from endogenous sources (bile and pancreatic juice). A considerable amount of zinc that was secreted into the intestines is re-absorbed; this is presumably the most important regulation mechanism to control the physiological zinc level in the organism. Besides excretion with the faeces, renal elimination is the second most important elimination path. About 14%–25% of the zinc is eliminated with the urine. [7619]
Moreover, minor zinc amounts can be excreted with the saliva, the hair and the sweat (particularly during heavy perspiration) and via the breastmilk. [7619]
Increased zinc levels in the blood or the urine could be confirmed in workers who had been exposed to zinc inhalation. However, a significant correlation between external and internal zinc loads could not be identified. [7655]

Annotation

This occupational health information was compiled on 26.11.2018.
It will be updated if necessary.
This information was translated from German into English by Übersetzungsbüro Branco.

FIRST AID

Eyes

Rinse the affected eye with widely spread lids for 10 minutes under running water whilst protecting the unimpaired eye.
Arrange medical treatment.
[454, 99999]

Skin

Remove contaminated clothes.
Cleanse the affected skin areas thoroughly with soap under running water.
In case of skin injuries or changes:
Arrange for medical treatment.
[454, 99999]

Respiratory tract

Whilst protecting yourself remove the casualty from the hazardous area and take him to the fresh air.
Lay the casualty down in a quiet place and protect him against hypothermia.
If the casualty is unconscious but breathing lay him in a stable manner on his side.
In any case:
Arrange medical treatment.
[454, 99999]

Swallowing

Rinse the mouth and spit the fluids out.
Have the casualty immediately drink a glass of fluid (water).
Do not make the casualty vomit.
In case of spontaneous vomiting, keep the patient in a prone position with the head lower than the chest to effectively prevent the vomit from penetrating the respiratory tract.
Lay the casualty down in a quiet place and protect him against hypothermia.
In any case:
Arrange medical treatment.
[454, 99999]

Information for physicians

- Symptoms of acute toxicity:
Zinc oxide is poorly soluble in water; it is slightly irritant to the mucosae. Zinc inhibits copper absorption in the intestines.
Eyes: burning sensation, reddening, lacrimation; blepharospasm (spasms of the eyelids), impaired vision; mechanical injuries of the cornea might also occur depending on the type of the particles;
Skin: Zinc oxide is contained in many topical ointments and cosmetic products and is skin-friendly, at most, an erythema (reddening) can be expected after prolonged exposure, exposure under occlusion or exposure of predamaged skin. [99999]
Inhalation: feeling of irritation in the throat, metal taste, coughing; inhalation of zinc fumes that essentially consist of zinc oxide also entails the development of moderate fever with chills, nausea with vomiting, thirst and tachycardia, headache and muscle pain and physical weakness as well as, in rare cases, shortness of breath. [454, 10047] The symptoms of this metal fume fever typically subside with strong perspiration within 24 hours without leaving residual damage. Repeated exposure causes the development of a short-term tolerance (“Monday morning fever“). [10048]
Ingestion: metallic taste; intake of high zinc oxide doses (more than 5000 mg) entails nausea, vomiting, diarrhoea, abdominal pain. [454, 7606] Gastroduodenal irritations were reported in one isolated case after intake of 150 ml of a 10% zinc oxide lotion. [454]
Absorption: systemic effects after dermal exposure or after inhalation have not been described yet (apart from metal fume fever, see under “Inhalation”). Such effects would have to be expected only after very atypical, high exposures (e.g. exposure of large injured skin areas) and could be similar to those occurring after ingestion.
Systemic effects after ingestion of zinc oxide have not been reported to date. Tachycardia, hyperglycaemia, injury of the pancreas, the kidneys and, in rarer cases, of the liver were observed in isolated cases after ingestion of soluble zinc salts in the gastrointestinal tract. [10047, 10048]
Moreover, chronic exposure can be expected to result in physical weakness, susceptibility to infections and coagulation disorders.

- Notes on first aid
Check whether the first aiders have rinsed the eyes after contact with the substance, otherwise this must be performed. [454] Blepharospasm requires rinsing after local application of a local anaesthetic (e.g. lidocaine 2%) In all cases: the casualty must be treated by an ophthalmologist. [99999]
Check whether the first aiders have rinsed the skin after contact with the substance, otherwise this must be performed.
After substance inhalation: severe metal fume fever requires the application of an antipyretic.
Do not induce vomiting, no administration of activated charcoal suspension, no gastric lavage.
Strong abdominal pain requires endoscopic examination of the stomach and the duodenum for the clarification of local changes of the mucosae.
Symptom-oriented treatment: liquid substitution should be considered in cases of prolonged vomiting, shortness of breath might require oxygen supply or artificial respiration. [305]
With severe absorptive symptoms (see above) monitor the cardiovascular functions as well as the blood count and the zinc and copper concentration in the blood.
Inpatient monitoring is also recommended when the casualty has fever without any further symptoms until the fever has subsided.
Laboratory tests or imaging tests are not necessary in cases of mild symptoms after inhalation or skin contact. [454, 10047]
In cases of inhalative exposure capable of triggering metal fume fever, leukocytosis[454, 10048, 10049] as well as increased inflammation parameters, such as the C-reactive protein[10049], amyloid A (SAA)[10049] and interleukine-6 can be detected in the blood. [10039]
Increased pancreas, liver and kidney values should be considered after acute oral or intravenous exposure. [454, 7619, 10047]
Increased zinc and decreased copper concentrations in the blood, [454] particularly after chronic exposure; chronic exposure entails a decrease of the red and white blood cells as well as a reduced number of thrombocytes (pancytopenia). [2077]
Administration of a zinc-binding antidote such as pentetate calcium trisodium (CaDTPA), calcium disodium edetate (CaEDTA) or sodium dimercaptopropane sulfonate (DMPS) [10040, 10041] bears the risk of exacerbating a copper deficiency and is only indicated in rare exceptional cases. [10047, 454] CaDTPA and CaEDTA appear to be the most effective antidotes. [10048, 10041, 10047]
Haemodialysis or haemoperfusion is not indicated. [454] Copper substitution can be considered at reduced copper concentrations in the blood. [454]
Determination of zinc and copper in the blood can be considered to rule out a zinc toxicity.

Recommendations

Provide the physician information about the substance/product and treatment already administered.

Annotation
This first aid information was compiled on 25.03.2019.
It will be updated if necessary.
This information was translated from German into English by Übersetzungsbüro Branco.

SAFE HANDLING

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

TECHNICAL MEASURES - HANDLING

Workplace
Select ventilation measures according to the other used substances.
If there is a chance that dusts may be released, then the work room must provide adequate ventilation.
The floor should not have a floor drain.
Washing facility at the workplace required.

Equipment
Use closed apparatus if possible.
Suction off dust at the point of exit.
Consider emission limit values, a purification of waste gases if necessary.
Label containers and pipelines clearly.

Advice on safer handling
Do not leave container open.
Sufficient ventilation must be guaranteed for refilling, transfer, or open use.
Fill only into labelled container.
Avoid rising dust.
Use an appropriate exterior vessel when transporting in fragile containers.

Cleaning and maintenance
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.

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.
Keep container tightly closed.
Store in a dry place.

Conditions of collocated storage
Storage class 10 - 13 (Other liquids and solids)
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.
- Strongly oxidizing substances of storage class 5.1A.

Under certain conditions the collocated storage with the following sub-stances is permitted (For more details see TRGS 510):

- Gases.
- Flammable liquids of storage class 3.
- Other explosive substances of storage class 4.1A.
- Pyrophoric substances.
- Substances liberating flammable gases in contact with water.
- Oxidizing substances of storage class 5.1B.
- Ammonium nitrate and preparations containing ammonium nitrate.
- Organic peroxides and self reactive substances.
- Combustible and non combustible acutely toxic substances of stora-ge classes 6.1A and 6.1B.

The substance should not be stored with substances with which hazardous chemical reactions are possible.

TECHNICAL MEASURES - FIRE AND EXPLOSION PROTECTION

Technical, constructive measures

Substance is non-combustible. Select fire and explosion prevention measures according to the other used substances.

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.

PERSONAL PROTECTION

Body protection

Wear an apron or a lab coat.

Respiratory protection

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

Respiratory protection: Particle filter P1, colour code white.

Eye protection

Sufficient eye protection should be worn.

Wear glasses with side protection.

Hand protection

Select hand protection according to the other used substances.

Occupational hygiene

Take heed of usual occupational hygiene measures when handling chemical substances, espacially wash the skin with soap and water before breaks and at the end of work and 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.

Collect in container for inorganic solids.
Neutral solutions (pH-control):
Place in a collection container for salt solutions, adjust for a pH value of 6-8.
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

Wear a dust mask.
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 incombustible. Select fire fighting measures according to the surrounding conditions.
In case of ambient fire:
Cool surrounding containers with water spray.
If possible, take container out of dangerous zone.
Do not allow runoff to get into the sewage system.

Special protective equipment
Wear self-contained breathing apparatus.

REGULATIONS

GHS Classification/Labelling | Water hazard class | Air quality control | Transport Regulations | MAK recommendations | SevesoIII | Technical rules | Regulations of accident insurers

EUROPEAN GHS CLASSIFICATION AND LABELLING

Classification
Hazardous to the aquatic environment, Acute Category 1; H400
Hazardous to the aquatic environment, Chronic Category 1; H410

Signal Word "Warning"

Hazard Statement - H-phrases
H410: Very toxic to aquatic life with long lasting effects.

Precautionary Statement - P-phrases
P273: Avoid release to the environment.
P391: Collect spillage.
P501: Dispose of contents/ container to an approved waste disposal plant.

Manufacturer's specification by Merck

Reference: 01211

State: 2023

Checked: 2023

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

GERMAN WATER HAZARD CLASS

Substance No: 2187

WGK 2 - distinct 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 5.2.1 Overall Dust, including fine dust
The emissions of dust in the exhaust gas are not allowed to exceed the following values:

Mass flow: 0,20 kg/hr

or

Mass conc.: 20 mg/m³

The mass per unit volume of 0,15 g/m3 in exhaust gas is not allowed to be exceeded also on observance or lower deviation of a mass flow of 0,20 kg/h.

TRANSPORT REGULATIONS

UN Number: 3077
Shipping name: Environmentally hazardous substances, solid, n.o.s.
Hazard Identification Number: 90
Class: 9 (Miscellaneous items and materials)
Packing Group: III (low danger)
Danger Label: 9

Special labelling: Symbol (fish and tree)

Classification code: M7

Tunnel restrictions:

Passage allowed through all tunnels.

Reference: 01211

RECOMMENDATIONS OF MAK-COMMISSION

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

0,1 mg/m³
with reference to the respirable fraction

Peak limitation: Excursion factor 4
Duration 15 min, mean; 4 times per shift; interval 1 hour
Category I - Substances for which local irritant effects determine the exposure limit value, also respiratory allegens

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

Zinc and inorganic zinc compounds

2 mg/m³
with reference to the inhalable fraction

Peak limitation: Excursion factor 2
Duration 15 min, mean; 4 times per shift; interval 1 hour
Category I - Substances for which local irritant effects determine the exposure limit value, also respiratory allegens

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

Zinc and inorganic zinc compounds

DIRECTIVE 2012/18/EU (Seveso III)

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

E1 Hazardous to the aquatic environment, Category Acute 1 or Chronic 1

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

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 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

REGULATIONS OF GERMAN ACCIDENT INSURERS

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

LINKS

Statement concerning the rating as carcinogenic, mutagenic or toxic for reproduction (in german only, source BAuA)

International Limit Values

OECD Screening Information DataSet (SIDS)

Risk Assessment Report
Risk Assessment Report

The MAK Collection for Occupational Health and Safety

DGUV Information 213-098: List of substances - lesson in schools (in German only)

REFERENCES

Quelle: 00001
IFA: Erfassungs- und Pflegehandbuch der GESTIS-Stoffdatenbank (nicht öffentlich)
Data acquisition and maintenance manual of the GESTIS substance database (non-public)

Quelle: 00305
G. Hommel "Handbuch der gefährlichen Güter" ("Handbook of Dangerous Goods"), CD-ROM "Hommel interaktiv" ab Version 15.0 Springer-Verlag, Berlin Heidelberg

Quelle: 00454
Hazardous Substances Data Bank (HSDB)

Quelle: 01211
GHS-Sicherheitsdatenblatt, Merck
GHS Material Safety Data Sheet, Merck

Quelle: 01221
GHS-Sicherheitsdatenblatt, Sigma-Aldrich
GHS Material Safety Data Sheet, Sigma-Aldrich

Quelle: 02050
European Union "Risk Assessment Report" European Chemicals Bureau

Quelle: 02072
Ecotoxicological Data, compiled by the US Environmental Protection Agency (EPA), selected and distributed by Technical Database Services (TDS), New York, 2009

Quelle: 02077
National Industrial Chemicals Notification and Assessment Scheme (NICNAS), Australia
https://www.nicnas.gov.au/

Quelle: 05200
Kühn-Birett "Merkblätter Gefährliche Arbeitsstoffe" Loseblattsammlung mit Ergänzungslieferungen, ecomed Sicherheit, Landsberg

Quelle: 05300
TRGS 510 "Lagerung von Gefahrstoffen in ortsbeweglichen Behältern" Ausgabe Dezember 2020

Quelle: 06002
L. Roth, U. Weller
"Gefährliche Chemische Reaktionen" Loseblattsammlung mit Ergänzungslieferungen, ecomed-Verlag ("Dangerous chemical reactions" loose-leaf collection with supplement deliveries)

Quelle: 06806
GESTIS-STAUB-EX-Datenbank des IFA www.dguv.de/ifa/gestis-staub-ex

Quelle: 07520
Europäische Chemikalienagentur ECHA: Informationen über registrierte Substanzen
European Chemicals Agency ECHA: Information on registered substances

Quelle: 07580
Bekanntmachung der Liste der wassergefährdenden Stoffe im Bundesanzeiger vom 10.08.2017, zuletzt geändert 24.11.2023

Quelle: 07619
DFG Deutsche Forschungsgemeinschaft: The MAK-Collection for Occupational Health and Safety, nach Veröffentlichungsdatum zu finden unter:
bis 2002 Verlag Chemie
ab 2002 Online: http://onlinelibrary.wiley.com/book/10.1002/3527600418/topics?filter=#
ab 2020 Online:
https://series.publisso.de/en/pgseries/overview/mak/dam/allContents/alphabetical

Quelle: 07620
DFG: Arbeitsmedizinisch-toxikologische Begründungen von BAT-Werten; Verlag Chemie

Quelle: 07655
D. Henschler (Hrsg.) "Analytische Methoden zur Prüfung gesundheitsschädlicher Arbeitsstoffe, Analysen im biologischen Material" Loseblattausgabe mit Ergänzungslieferungen, VCH Verlagsgesellschaft mbH Weinheim

Quelle: 07727
L. Roth "Gefahrstoff-Entsorgung" Loseblattsammlung mit Ergänzungslieferungen, ecomed-Verlag, Landsberg

Quelle: 07748
American Conference of Governmental Industrial Hygienists "Documentation of the threshold limit values and biological exposure indices Loseblattsammlung mit Ergänzungslieferungen

Quelle: 08093
E. Bingham, B. Cohrssen (Edts.) "Patty´s Toxicology" Sixth Edition, John Wiley & Sons, New York 2012

Quelle: 08112
DFG Deutsche Forschungsgemeinschaft: MAK- und BAT-Werte-Liste 2023, Senatskommission zur Prüfung gesundheitsschädlicher Arbeitsstoffe, Mitteilung 59; GMS PUBLISSO

Quelle: 10027
O. Hagemeyer, C. Monsé, C. Eisenhawer, T. Brüning, R. Merget
Gesundheitliche Effekte durch Zinkoxid im Niedrigdosisbereich - Studie zur Dosis-Wirkungsbeziehung
IPA-Journal 01/2018, Institut für Prävention und Arbeitsmedizin der Deutschen Gesetzlichen Unfallversicherung
https://www.ipa-dguv.de/medien/ipa/publikationen/ipa-journale/ipa-journale2018/documents/ipa_journal_1801.pdf

Quelle: 10039
J.M. Fine et al.
Metal fume fever: characterization of clinical and plasma IL-6 responses in controlled human exposures to zinc oxide fume at and below the threshold limit value.
J Occup Environ Med. 1997, 39(8), 722-6

Quelle: 10040
K.M. Bora, B.A. Dolcourt, A. Katiyar, C.K. Aaron
Kinetics of zinc elimination with and without chelation. [Abstract].
Clin Toxicol 2009; 47: 702-765

Quelle: 10041
J. Ruprecht
Dimaval®. Wissenschaftliche Produktmonographie. 7. Aufl., Berlin: Heyl GmbH 2008

Quelle: 10047
P. Hantson: Zinc Toxicity. Clin Toxicol 39(3) (2001) 239-240

Quelle: 10048
D.G. Barceloux, D. Barceloux: Zinc. Clin Toxicol 37(2), (1999) 279-292

Quelle: 10049
O. Hagemeyer, C. Monsé, C. Eisenhawer, T.Brüning, R. Merget: Gesundheitliche Effekte durch Zinkoxid im Niedrigdosisbereich, IPA Journal 1/2018, 11-14

Quelle: 99999
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