IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Aluminium oxide

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

IDENTIFICATION

Aluminium oxide

ZVG No:	1280	
CAS No:	1344-28-1	
EC No:	215-691-6	
Related		
CAS No:	1302-74-5	Korund

CHARACTERISATION

SUBSTANCE GROUP CODE

121110 Metal oxides
124200 Aluminium compounds

STATE OF AGGREGATION

The substance is solid.

PROPERTIES

white

CHEMICAL CHARACTERISATION

Non-combustible substance.
Practically insoluble in water.

Substance information in Wikipedia

DUST EXPLOSIVENESS

No risk of dust explosion.
Quelle: *99999*

FORMULA

Al_2O_3

O^{2-} Al^{3+} O^{2-} Al^{3+} O^{2-}

Molar mass: 101,96 g/mol

PHYSICAL AND CHEMICAL PROPERTIES

Melting point | Boiling point | Density | Solubility | Hazardous reactions

MELTING POINT

Melting point: 2040 °C

Reference: 01221

BOILING POINT

Boiling Point: 2980 °C

Reference: 01211

DENSITY

DENSITY

Value: 3,94 g/cm³

Temperature: 20 °C

Reference: 01211

SOLUBILITY IN WATER

practically insoluble in water

Temperature: 20 °C

Reference: 01211

HAZARDOUS REACTIONS

Hazardous chemical reactions

Risk of explosion in contact with:
sodium nitrate

The substance polymerize in contact with:
ethylene oxide

The substance can react dangerously with:
fluorine
chlorine trifluoride
vinyl acetate
hydrogen halides (heat)
halogenated hydrocarbons (heat)

OCCUPATIONAL HEALTH AND FIRST AID

Routes of exposure | Toxic effects | First Aid

ROUTES OF EXPOSURE

Main routes of exposure

In occupationally exposed individuals, the major route of exposure for aluminium oxide (A) is by inhalation via the respiratory tract. [7619]
Non-occupational absorption is possible in particular via oral intake, for example, from toothpaste, cosmetics and pharmaceuticals. [7619, 8093, 7639, 10265, 8011]

Respiratory tract

Inhalation of A is possible in the form of dust or fumes (such as those produced during welding). [7619, 10265]
Depending on workplace hygiene conditions, quantities and particle sizes, inhaled A particles are first deposited in the lungs. [7619, 7639, 7620]
It is assumed that very fine particles, which are particularly present in fumes, penetrate the lungs up to the lower lung areas and are preferably absorbed directly into the lungs. [10264, 8093, 610, 630]
Moreover, it must be assumed that particles removed from the respiratory tract via mucociliary clearance mechanisms are transferred to the digestive tract and absorbed to a small extent. (see also “digestive tract”). [10265, 7748, 630] In case of larger particles, the major part is subject to mucociliary lung clearance, which was confirmed after exposure to A particles. [7619]
In test subjects who had inhaled particles of radioactively labelled A with a mean diameter of 1.2 µm, the 26Al excretion in urine measured over 900 days showed that 1.9% of the dust deposited in the lungs was absorbed. [10202, 7619] The absorbed portion for individuals exposed to the inhalation in the aluminium industry ranged in the same order of magnitude (1.5–2%). [7619, 10264, 7620, 10265, 8093, 630]
A modification, alpha-A (mineral name: corundum), differs significantly (regarding physicochemical properties, bioavailability etc.) from the other modifications (e.g. gamma-A). It is insoluble in water and in strong mineral acids and alkalis. Inhalative exposure may occur to dusts and solution aerosols. Inhalation does not entail absorption in the lungs; the absorbed particles are rather evacuated by various clearance mechanisms (e.g. macrophages). [7619]

Skin

Percutaneous absorption of A or alpha-A in the occupational context is considered hardly significant. [7619]

Gastrointestinal tract

A particles removed from the respiratory tract via mucociliary clearance mechanisms or directly swallowed, are partially dissolved in the acidic environment of the stomach and transformed to the ionised condition. However, the subsequent pH-dependent conversions to partly insoluble compounds in the intestines mean that absorption in the small intestine remains low. [630, 10264, 8093]
In the case of A or poorly soluble aluminium compounds, the absorbed proportion is usually about 0.1–0.3%. [8011, 630, 8093, 10265, 10267] A great variety of factors can influence absorption from the digestive tract: The type of A modification, the amount absorbed, the pH value, the iron/calcium status, chelating food components (absorption e.g. increased by citrate, decreased by phosphate). [10265, 10267, 10268, 8011, 630]

TOXIC EFFECTS

Main toxic effects

Acute effects:
information on systemic effects in healthy exposed individuals is not available [8057]
Chronic effects:
particle deposition in the lung tissue (aluminosis) through inhalation of very high dust or fume concentrations [7619, 7639]; impairment of the central nervous system (CNS) [7620]
gastrointestinal disorders and impairment of the bone mineralization after high oral doses [8108, 7619, 10202, 10264].

Acute toxicity

Data on acute effects specifically of alpha-A (corundum), the most stable A modification, are hardly available. [7619, 99998]
The acute potential of A is chiefly determined by particle-related effects and less by systemic ones after intake of aluminium ions, which are more relevant for soluble aluminium compounds. [10266, 7620]
Case studies on eye irritations in humans are lacking. [7619, 99998] In studies on rabbit eyes, A only caused mild, rapidly subsiding reddening of the conjunctiva (probably caused by mechanical impact). A significant eye-irritant effect was not found. [7520]
In the test on rabbits, semi-occlusive exposure of intact or damaged skin to A led to a temporary reddening of the skin. However, it did not prove to be significantly skin-irritant. [7520]
Due to its extreme hardness, alpha-A is often used as an abrasive or polishing agent; a similar abrasive effect can therefore be expected after contact with the skin, the eyes or other tissues. [10264, 7619]
Regarding the widespread use and exposure, a contact-sensitising potential of A is reported only in isolated cases, and partly without clinical relevance. [7619] In an older study performed according to the Landsteiner-Draize method, no skin-sensitising effect of A was observed in guinea pigs. [7520]
Test results on the acute dermal toxicity are not available. [99998] Based on the results of oral tests, it can be assumed to be negligible. [99999]
Reports on health impairments due to single inhalation of A dusts or fumes containing A are lacking. In welders exposed to A particles or A fumes, diseases consistent with metal fume fever were not observed at concentrations of up to 15 mg/m³. [7619, 7639]
In rats, single 4-hour inhalative exposure (whole body) to 2.3 mg A/l air in the form of particles (MMAD: 2.31–2.85 µm) caused no mortality; however, toxicity symptoms (closed eyes, wet nose-mouth area, dark lungs in one doe during exposure) (4-hour LC50 › 2.3 mg/l) were observed. [7520]
Oral acute toxicity of A was low in animal experiments (rats, LD50: › 10000 mg per kg of body weight). [7520] Doses of A nanoparticles (30 and 40 nm) up to 2000 mg per kg of body weight did not lead to higher acute toxicity in rats than the bulk form, but changes in liver enzymes were observed. [10266]

Chronic toxicity

The eye examination of a man who was chronically exposed to the inhalation of A and metallic aluminium powder (n/a, mixed exposures possible) revealed no adverse changes. [630, 600]
Workers complained of allergic lung diseases (including asthmatic complaints, “potroom asthma”, increased bronchial hyperreactivity) after long-term massive inhalative exposure to A or metallic aluminium in melting plants, foundries or during welding; however, there are no substantiated indications that A or metallic aluminium produce sensitising effects on the respiratory tract. [7619, 7639, 7620, 7748]
Due to the poor solubility of the particles, repeated inhalative exposure to A dust may cause an accumulation in the lungs. As a result, the self-cleaning mechanism of the lungs (clearance) may be impaired, inflammatory reactions may occur and fibrotisation may be triggered. Fibrotic lung injuries after exposure to A were confirmed in animal experiments on rats. [7619, 10264]
Long-term exposure to dust containing aluminium from the aluminium powder production in concentrations above 6 mg/m³ (exposure confirmed by simultaneously increased Al concentration in the urine: › 200 µg/l) can cause lung fibrosis or aluminosis. Aluminosis is characterised by a diffuse interstitial lung fibrosis, which is mostly located in the upper and middle pulmonary lobes. The first effects to occur are unspecific symptoms such as dry cough, sputum, dyspnoea on exertion and subsequently at rest and also frequent recurrent bronchitis and an increased susceptibility to infections. Subpleural emphysematous bullae and an increased risk of spontaneous lung collapse (pneumothorax) may occur as the disease progresses. The time to onset of first symptoms is subject to strong variations (months to decades). [7619, 7639] The literature provides only insufficient exposure data; a dose-response relationship for the occurrence of aluminosis can thus not be derived. However, some risk factors could be identified (including work on stamping machines with ungreased or lightly greased, stamped aluminium powder, depending on the level of cumulative exposure, the type of exposure and individual factors). [7619]
Nine workers who had been exposed to abrasives containing alpha-A (corundum) in air concentrations of 0.2 to 44 mg Al/m³ for a mean time of 25 years were found to have abnormal chest x-rays and altered lung functions. Microscopic examinations of the lung tissue in the three most exposed workers revealed interstitial lung fibroses with increased aluminium levels compared to reference values. The partly high alpha-A exposures were considered the reason for the lung fibroses. [7619, 7748, 10202, 10264]
Repeated massive inhalative exposure to alpha-A was found to cause aluminosis. The corundum smelter’s lung ("Shaver's disease”) must be differentiated from this. This is a special type of pulmonary fibrosis, in which the changes in the lung tissue show characteristics of an aluminosis and also of silicosis; the course of the disease deviates from the typical picture of an aluminosis. It

only occurs after mixed exposure to the gases that are generated during the smelting process of aluminium ores (bauxite). [7619]
A final assessment regarding the occurrence of obstructive diseases of the respiratory tract in workers who had been exposed to grinding dusts, welding fumes containing A, or to fumes and dusts generated during aluminium production or processing is presently impossible due to simultaneous mixed exposures. [7619]
Reliable data on the effects of repeated inhalative exposure particularly to ultrafine A particles as those found during welding or in aluminium plants are not available, as there is often mixed exposure, e.g. to quartz and ozone. [7619, 10264]
Numerous epidemiological studies on workers from the aluminium (powder) production and on welders processing aluminium parts provide no consistent picture. However, the overall data situation indicates that many years of inhalative exposure to aluminium are accompanied by frequent incidence of neurological changes. [7748] These changes are early signs of potential structural or functional damage to the central nervous system. The onset of such pre-clinical neurotoxic effects has been shown to be the most sensitive endpoint for the toxicological assessment of chronic aluminium exposure at workplaces. [7620]
In these studies, aluminium elimination with the urine was found to be a suitable parameter for internal exposure. For instance, in the majority of the repeatedly conducted neuropsychological tests, welders who had been exposed to aluminium showed worse cognitive performance (including attention, learning and memory) compared to controls at a median aluminium concentration of approx. 100 ?g/g creatinine in the post-shift urine in the 5-year period under consideration. [7620]
The analysis of several of these neuropsychological tests yielded an NOAEL of 50 µg Al/g creatinine for cognitive deficits. [7619] A connection between occupational exposure to aluminium and the occurrence of Alzheimer's disease and Alzheimer type dementia or amyotrophic lateral sclerosis could not be definitively proven. [7619, 7620]
Due to its biopersistence and the related poor systemic absorption, a neurotoxic effect of alpha-A is not assumed. [7619]
Therapeutic oral administration of antacids containing aluminium, often in the form of A or aluminium hydroxide at doses of 1–5 g per day caused no adverse effects in individuals with normal kidney function. Chronic overdosing can at first entail reduced intestinal motility and severe constipation. [8108, 7619, 10202, 10265] Severe toxicity cases may involve a mineralisation disorder in the bones (osteomalacia). Such osteomalacia was observed in a 39-year old woman with normal kidney functions, who had absorbed a total of 18 kg aluminium in the form of antacids over an 8-year period. [10264]
Individuals with impaired kidney function, particularly newborn children, infants and dialysis patients showed increased susceptibility to aluminium exposures. In these cases, increased exposures to aluminium can cause neurotoxic disorders (dialysis encephalopathy), osteomalacia and microcytic anaemia. [8108, 7619, 8011]

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:
The following shall apply to alpha-A:
There is no reason to fear a risk of damage to the developing embryo or foetus when MAK and BAT values are observed.
[7619]
The following applies to dusts containing A (except ultrafine dusts and A fibres (monocrystalline or polycrystalline)):
The available information was considered to be insufficient for evaluation and hence for classification.
[7619]
Substance-specific test results are not available. [99998]
In developmental toxicity studies performed with poorly soluble aluminium hydroxide on test animals, exposure of pregnant rats and mice entailed no developmental-toxic or maternal-toxic effects up to the highest administered dose (NOAEL, rats: 266 mg Al per kg of body weight per day; mice: 100 mg Al per kg of body weight per day). [7619]
In general, absorbed aluminium can pass the placenta, reach the foetus and enter the breastmilk. However, due to its poor bioavailability, exposure to A provides no relevant contribution in this regard. [610, 10202, 10264]
A fumes were not assessed due to the lack of substance-specific data. [7619, 99998]

Mutagenicity:
Information pertaining to alpha-A is not available. [99998] Based on experiences with other granular bio-resistant dusts, alpha-A is not expected to have a genotoxic potential. [7619]
In vitro, dusts containing A in the form of nanoparticles caused no mutagenic effects in bacteria. [7520] In-vivo studies (micronucleus test, chromosomal aberration test, Comet assay) with A in the form of fine particles (µm range) or of nanoparticles (particle size: 30 nm or 40 nm) showed a positive result in all tests performed with the nanoparticles and a negative result in all tests conducted with fine particles. [7520]
The data are insufficient to permit a final assessment of dust containing A. [99998]
A fumes were not assessed due to the lack of substance-specific data. [7619, 99998]

Carcinogenicity:
The following shall apply to alpha-A:
A significant contribution to a cancer risk for humans is not expected, provided the MAK value is observed.
[7619]
Substance-specific data on dusts containing A are not available. [99998]
Increased incidences of bladder cancer and, to a smaller extent, also of lung cancer in workers involved in the aluminium production was ascribed to the simultaneous exposure to polycyclic aromatic hydrocarbons (PAH). [7980, 7619]
A fumes were not assessed due to the lack of substance-specific data. [7619, 99998]

Biotransformation and excretion

Information on the metabolisation of alpha-A is not available. [7619, 99998]
Aluminium ions absorbed after exposure to A are evenly distributed between plasma and cellular blood components. [7619] Non-essential aluminium always occurs in the human body in ionic form (oxidation state +3). [7942, 99999] In plasma, more than 90% of the aluminium is bound to transferrin, a smaller part (about 8%) is bound to citrate, and less than 1% is bound to phosphate in the form of aluminium complexes. [10264, 7619]
The concentration of bound or complexed aluminium ions in the plasma usually ranges between 1 and 3 µg/l, although values may vary widely (95th percentile in serum, plasma or whole blood in the range of 2.4 to 33.3 µg/l). [10268, 7619]
Aluminium is distributed in almost all organs of the human organism and accumulates in the bones, from which it is only slowly eliminated (half-life of several years). The total aluminium content in the organism of healthy individuals is about 30–50 mg per kg of body weight, of which at least half is found in the bones and a quarter in the lungs. [10202, 8093] The aluminium content in the organism increases with advancing age. Aluminium can pass the blood-brain barrier and accumulate in the brain because of the strong protein binding. [7620]
Elimination of absorbed aluminium primarily (› 95%) occurs with the urine via the kidneys, only a small proportion is excreted via the gall bladder. [10268, 10264] Depending on exposure situation and duration, the biological half-life of renal aluminium elimination after inhalation ranges from a few hours to several weeks and years. In addition to considerable individual differences, aluminium storage in different compartments of the organism with their different elimination behaviour may play a key role in renal elimination kinetics. [7619]
The elimination of aluminium with the urine can be used to determine occupational exposure to aluminium and aluminium compounds. The background exposure of individuals who are not exposed to aluminium at their workplaces should also be considered (95th percentile in the range of 7.5 to 21.4 µg/g creatinine for individuals of working age). [7620]

Annotation

This occupational health information was compiled on 02.04.2020.
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.
[99999]

Skin

Remove contaminated clothing while protecting yourself.
Cleanse the affected skin areas thoroughly with soap under running water.
[99999]

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.
Arrange medical treatment.
[99999]

Swallowing

Rinse the mouth and spit the fluids out.
If the casualty is conscious have him drink 1 glass of water (ca 200 ml).
Do not make the casualty vomit.
Arrange medical treatment.
[99999]

Information for physicians

- Symptoms of acute toxicity:
Eyes: mechanical irritation [99999]
Skin: mechanical irritation is possible [10342]
Inhalation of dusts, fumes: mucosal irritation, coughing, dyspnoea, pneumonia possible [10342, 8101]
Ingestion: metallic taste, mucosal irritation cannot be completely ruled out [99999]
Absorption: ingestion of high doses can result in a reduction of the intestinal motility and constipation. [8121]

- Notes on first aid
Following eye contact: after completed rinsing of the eyes, the casualty must be examined by an ophthalmologist [99999]
Following skin contact: medical measures are usually unnecessary after rinsing with soap and water, except for skin irritations, which requires symptomatic treatment.[7520]. [99999]
Following inhalation: administration of a short-acting ß-2 sympathomimetic spray and inhalation of a muscarinic receptor antagonist such as ipratropium bromide, symptomatic treatment [10014, 99999]
Following ingestion: symptomatic treatment, possibly deferoxamine administration [99999, 8101]

Recommendations

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

Annotation

This first aid information was compiled on 18.10.2020.
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.
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.
Containers are to be marked clearly.

Advice on safer handling

Do not leave container open.
Sufficient ventilation must be guaranteed for refilling, transfer, or open use.
Fill only into clearly marked containers.
Avoid rising dust.

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 marked clearly and permanently.
Keep container tightly closed.
Storage temperature: Without any limitation.
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.
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.

PERSONAL PROTECTION

Body protection

Wear an apron or a lab coat.

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 P1, colour code white.

Eye protection

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.
Avoid inhalation of dust.

DISPOSAL CONSIDERATIONS

Non-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:
Collect in container for inorganic solids.
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:
No hazards to sources of water are to be feared if released into water, drainage, sewer, or the ground.

FIRE FIGHTING MEASURES

Instructions
Substance is incombustible. Select fire fighting measures according to the surrounding conditions.

REGULATIONS

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

EUROPEAN GHS CLASSIFICATION AND LABELLING

Not a dangerous substance according to GHS.
Manufacturer's specification by Sigma-Aldrich

Reference: 01221
State: 2020
Checked: 2022

GERMAN WATER HAZARD CLASS

Substance No: 1346
non-hazardous 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

Not subject to transport regulations.

Reference: 01221

TRGS 900 - GERMAN OCCUPATIONAL EXPOSURE LIMIT VALUES

1,25 mg/m³
with reference to the respirable fraction

Source: AGS, DFG

Scope:
General threshold limit value for dust - respirable fraction

10 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 II - Substances with systemic effects

Source: AGS, DFG

Scope:
General threshold limit value for dust - inhalable fraction

RECOMMENDATIONS OF MAK-COMMISSION

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

1,5 mg/m³
with reference to the respirable fraction

4 mg/m³
with reference to the inhalable fraction

Pregnancy: Group D
Either there are no data for an assesment of damage to the embryo or foetus or the currently available data are not sufficient for classification in one of the groups A-C.

Scope: gamma-Aluminium oxide

0,3 mg/m³
with reference to the respirable fraction

Peak limitation: Excursion factor 8
Duration 15 min, mean; 4 times per shift; interval 1 hour
Category II - Substances with systemic effects

Carcinogenic: Category 4
Substances which are carcinogenic with no or minor genetically toxical effects. If there is a MAK-value for these substances no considerable contribution to the hazard of cancer will be expected.

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

Limit value, multiplied by the material density for respirable fraction.

Scope: alpha-Aluminium oxide

TECHNICAL RULES FOR HAZARDOUS SUBSTANCES

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

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

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

REFERENCES

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Quelle: 00610
Health Council of the Netherlands: Committee on Updating of Occupational Exposure Limits.
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Quelle: 00630
US Department of health and human services, Public health services,
Agency for Toxic Substances and Diseases Registry (ATSDR),
Toxicological Profiles
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Quelle: 01211
GHS-Sicherheitsdatenblatt, Merck
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Quelle: 01221
GHS-Sicherheitsdatenblatt, Sigma-Aldrich
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Quelle: 05300
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Quelle: 07619
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Quelle: 07620
DFG: Arbeitsmedizinisch-toxikologische Begründungen von BAT-Werten; Verlag Chemie

Quelle: 07639
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Angabe des Bearbeiters

Indication of the editor

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

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