

1. Material Identification

Product Name : Maleic acid

Catalog Number : io-2580

CAS Number : 110-16-7

Identified uses : Laboratory chemicals, manufacture of chemical compounds

Company : IonZ

>> R&D Use only

2. Hazards Identification

GHS Classification:

Flammable liquid (category 2)

Acute toxicity, oral (Category 3)

Acute toxicity, dermal (Category 3)

Acute toxicity, inhalation (Category 3)

Specific target organ toxicity, single exposure (Category 1)

Pictogram(s)



GHS Hazard Statements

>> H290 (47.4%): May be corrosive to metals [Warning Corrosive to Metals]

>> H314 (48.7%): Causes severe skin burns and eye damage [Danger Skin corrosion/irritation]

>> H318 (40.4%): Causes serious eye damage [Danger Serious eye damage/eye irritation]

>> H319 (50%): Causes serious eye irritation [Warning Serious eye damage/eye irritation]

Precautionary Statement Codes

>> P234, P260, P264, P264+P265, P280, P301+P330+P331, P302+P361+P354, P304+P340, P305+P351+P338, P305+P354+P338, P316, P317, P321, P337+P317, P363, P390, P405, P406, and P501

Note

>> Pictograms displayed are for 99.8% (1954 of 1957) of reports that indicate hazard statements. This chemical does not meet GHS hazard criteria for 0.2% (3 of 1957) of reports.

EPA Safer Chemical:

EPA labels products so that consumers can easily choose ones that are safer for people and the environment. When consumers see the Safer Choice label on a product, they can be confident that the ingredients have been through a rigorous EPA review. The label means that EPA scientists have evaluated every ingredient in the product to ensure it meets Safer Choice's stringent criteria. When people use Safer Choice products, they are protecting their families and the environment by making safer chemical choices.

EPA Safer Chemical

>> Chemical: Polymaleic acid

>> Green circle – The chemical has been verified to be of low concern based on experimental and modeled data.



Health Hazards:

- >> Inhalation causes irritation of nose and throat. Contact with eyes or skin causes irritation. (USCG, 1999)
- >> Special Hazards of Combustion Products: Irritating smoke containing maleic anhydride may form in fire. (USCG, 1999)
- >> Combustible. Gives off irritating or toxic fumes (or gases) in a fire.

3. Composition/Information On Ingredients

Chemical name : Maleic acid
CAS Number : 110-16-7
Molecular Formula : C₄H₄O₄
Molecular Weight : 116.0700 g/mol

4. First Aid Measures

First Aid:

- >> EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.
- >> SKIN: IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. If symptoms such as redness or irritation develop, IMMEDIATELY call a physician and be prepared to transport the victim to a hospital for treatment.
- >> INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.
- >> INGESTION: DO NOT INDUCE VOMITING. Corrosive chemicals will destroy the membranes of the mouth, throat, and esophagus and, in addition, have a high risk of being aspirated into the victim's lungs during vomiting which increases the medical problems. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. Transport the victim IMMEDIATELY to a hospital. (NTP, 1992)

First Aid Measures

Inhalation First Aid

- >> Fresh air, rest. Refer for medical attention.

Skin First Aid

- >> Wear protective gloves when administering first aid. Remove contaminated clothes. Rinse skin with plenty of water or shower.

Eye First Aid

- >> First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.

Ingestion First Aid

- >> Rinse mouth. Give one or two glasses of water to drink. Refer for medical attention .

5. Fire Fighting Measures

- >> Irritating smoke containing maleic anhydride may form in fire.
- >> Excerpt from ERG Guide 156 [Substances – Toxic and/or Corrosive (Combustible / Water-Sensitive)]:
- >> Note: Most foams will react with the material and release corrosive/toxic gases. CAUTION: For Acetyl bromide (UN1716), use CO2 or dry chemical only.
- >> SMALL FIRE: CO2, dry chemical, dry sand, alcohol-resistant foam.
- >> LARGE FIRE: Water spray, fog or alcohol-resistant foam. FOR CHLOROSILANES, DO NOT USE WATER; use alcohol-resistant foam. If it can be done safely, move undamaged containers away from the area around the fire. Avoid aiming straight or solid streams directly onto the product.
- >> FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)
- >> Use water spray, powder, foam, carbon dioxide.

6. Accidental Release Measures

Isolation and Evacuation:

Isolation and evacuation measures to take when a large amount of this chemical is accidentally released in an emergency.

- >> Excerpt from ERG Guide 156 [Substances – Toxic and/or Corrosive (Combustible / Water-Sensitive)]:
- >> IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.
- >> SPILL: Increase the immediate precautionary measure distance, in the downwind direction, as necessary.
- >> FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Spillage Disposal:

Methods for containment and safety measures to protect workers dealing with a spillage of this chemical.

- >> Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting. Wash away remainder with plenty of water.

7. Handling And Storage

Safe Storage:

- >> Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs. Dry. Store only in original packaging.

Storage Conditions:

- >> Keep container tightly closed in a dry and well-ventilated place. Keep in a dry place. Storage class (TRGS 510): Non Combustible Solids

8. Exposure Control/ Personal Protection

Inhalation Risk:

- >> Evaporation at 20 °C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed, especially if powdered.

Effects of Short Term Exposure:

>> The substance is severely irritating to the eyes. The substance is irritating to the skin and respiratory tract.

Effects of Long Term Exposure:

>> Repeated or prolonged contact with skin may cause dermatitis. Repeated or prolonged contact may cause skin sensitization.

Fire Prevention

>> NO open flames.

Exposure Prevention

>> PREVENT DISPERSION OF DUST! STRICT HYGIENE!

Inhalation Prevention

>> Use local exhaust or breathing protection.

Skin Prevention

>> Protective gloves. Protective clothing.

Eye Prevention

>> Wear safety goggles or eye protection in combination with breathing protection.

Ingestion Prevention

>> Do not eat, drink, or smoke during work.

9. Physical And Chemical Properties

Molecular Weight:

>> 116.07

Exact Mass:

>> 116.01095860

Physical Description:

>> Maleic acid is a colorless crystalline solid having a faint odor. It is combustible though it may take some effort to ignite. It is soluble in water. It is used to make other chemicals and for dyeing and finishing naturally occurring fibers.

>> WHITE CRYSTALS.

Color/Form:

>> Monoclinic prisms from water

Odor:

>> Faint acidulous odor

Taste:

The sensation of flavor perceived in the mouth and throat on contact with a substance.

>> Characteristic repulsive, astringent taste

Boiling Point:

>> 275 °F at 760 mmHg (decomposes) (NTP, 1992)

Melting Point:

>> 266 to 268 °F (NTP, 1992)

>> 131 °C

Flash Point:

>> 127 °C

Solubility:

>> greater than or equal to 100 mg/mL at 66 °F (NTP, 1992)

>> Solubility in water, g/100ml at 25 °C: 78 (soluble)

Density:

>> 1.59 at 68 °F (USCG, 1999) – Denser than water; will sink

>> Relative density (water = 1): 1.59

Vapor Density:

>> 4 (NTP, 1992) – Heavier than air; will sink (Relative to Air)

Vapor Pressure:

>> Negligible (NTP, 1992)

>> Vapor pressure, Pa at 25 °C: 0.0048

LogP:

>> -0.5

Stability/Shelf Life:

>> Stable under recommended storage conditions.

Decomposition:

>> When heated to decomp it emits acrid smoke and irritating fumes.

>> 135 °C

Corrosivity:

The ability of a chemical to damage or destroy other substances when it comes into contact.

>> May corrode metals when wet.

Heat of Combustion:

>> -1355.2 kJ/mol

Dissociation Constants:

pKa

>> 1.83

>> pKa1 = 1.94, pKa2 = 6.22 at 25 °C (OECD Guideline 105)

Collision Cross Section:

Collision cross section (CCS) represents the effective area for the interaction between an individual ion and the neutral gas through which it is traveling (e.g., in ion mobility spectrometry (IMS) experiments). It quantifies the probability of a collision taking place between two or more particles.

>> 112.5 Å² [M-H]–

10. Stability And Reactivity

>> Soluble in water.

11. Toxicological Information

Toxicity Summary:

>> IDENTIFICATION AND USE: Maleic acid forms colorless or white crystals. It is used for manufacturing of artificial resins, dyeing and finishing wool, and for preparing the maleate salts of antihistamines and similar drugs. HUMAN EXPOSURE AND TOXICITY: A 20% aqueous solution produced a mild and reversible skin irritation in humans. Lower concentrations (< 5%) are sufficient to produce serious ocular irritation in human subjects. Neat maleic acid is reported to be a severe irritant to the mucous membranes of humans. In vitro, maleic acid produced highly significant alterations in the physical state of human erythrocyte membrane proteins. ANIMAL STUDIES: Single intravenous application of 400 or 200 mg/kg bw maleic acid to male rats via jugular venous catheter caused immediate injury in the kidneys which progressed to extensive necrosis by 24 hr after administration. In dogs the intravenous administration of maleic acid (50 mg/kg)

increased sodium, potassium, and phosphate excretion. Maleic acid may enhance anaphylactic histamine release from guinea pig lung by its metabolic utilization in the tricarboxylic acid cycle. Kidney damage has been observed as a systemic toxic action of maleic acid. Morphological-functional changes in the kidneys were produced by intraperitoneal injection (100–350 mg/kg; rats, dogs) and also by inhalation exposure to ca. 720 mg/mc (rats). The damage to distal and proximal tubular resorption produced by maleic acid is reminiscent of the known (congenital or acquired) Fanconi syndrome in humans. This damage seems to be caused by the interaction of maleic acid with glutathione in tubular renal cells, leading to intolerable concentration of free radicals and peroxides. In addition to the resultant cellular damage, maleic acid appears to affect Na⁺ and H⁺ ion transport in the proximal tubes. After chronic exposure of male rats (250, 500, 750 mg/kg /per/ day for up to two years), an increased mortality as well as kidney damage and delayed growth was observed in all dosage groups. Liver and testicular damage has also been found in highest dosage group. No signs of carcinogenic activity of maleic acid were discovered with long-term dosage, which however was not designed as a carcinogenicity study. Maleic acid given to mice has some inhibitory action on the growth of spontaneous carcinomata and grafted sarcomata. When tested using Salmonella typhimurium TA100, maleic acid was not mutagenic when reacted with chlorine in aqueous solution. In a 50/50 by vol methanol/water solution it was substantially mutagenic, and reacted with chlorine with a peak at 3 equivalents per mole.

Carcinogen Classification:

This section provides the International Agency for Research on Cancer (IARC) Carcinogenic Classification and related monograph links. In the IARC Carcinogenic classification, chemicals are categorized into four groups: Group 1 (carcinogenic to humans), Group 2A (probably carcinogenic to humans), Group 2B (possibly carcinogenic to humans), and Group 3 (not classifiable as to its carcinogenicity to humans).

>> No indication of carcinogenicity to humans (not listed by IARC).

Exposure Routes:

>> The substance can be absorbed into the body by inhalation and by ingestion.

Inhalation Exposure

>> Cough. Laboured breathing.

Skin Exposure

>> Redness. Pain.

Eye Exposure

>> Redness. Pain. Blurred vision.

Ingestion Exposure

>> Burning sensation. Further see Inhalation.

Adverse Effects:

An adverse effect is an undesired harmful effect resulting from a medical treatment or other intervention.

>> Dermatotoxin – Skin burns.

Toxicity Data:

>> LC50 (rat) > 720 mg/m3/1h

Interactions:

>> Maleic acid was administered iv both alone and after initiating iv administered neutral sodium phosphate, sodium sulfate, or sodium chloride to 10 unanesthetized trained female dogs undergoing water diuresis. /The following observations were noted:/ 1) Administration of maleic acid alone predictably induced dose-dependent increments in urine flow and in renal clearance of HCO₃⁻, Na⁺, K⁺, and alpha-aminonitrogen and a pronounced increase in the renal clearance and excretion of citrate. 2) Prior phosphate loading, which increased the plasma concentration of phosphate from 2.5 +/- 0.20 to 11.3 +/- 2 mg/dL: a) attenuated the increment in renal clearance of HCO₃ by one-half even though the filtered load of bicarbonate was higher by 37%, owing to the higher values of both GFR and plasma bicarbonate concentration that obtained with phosphate loading; b) prevented the increment in renal clearance and excretion of alpha-aminonitrogen; c) significantly attenuated the increments in urine flow and renal clearance of K⁺; but d) did not affect the increment in renal clearance and excretion of citrate.

Antidote and Emergency Treatment:

>> Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing water. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Organic acids and related compounds/

Human Toxicity Excerpts:

>> /SIGNS AND SYMPTOMS/ A 20% aqueous solution produced a mild and reversible skin irritation in humans.

Non-Human Toxicity Excerpts:

>> /LABORATORY ANIMALS: Acute Exposure/ On rabbit eyes 10% maleic acid in water at pH 1 applied for thirty seconds causes permanent opacity & vascularization. A 1% soln applied for 2 minutes causes cloudiness of cornea, but no injury remains the next day. A 5% soln has similar but more intense effect, with recovery delayed 6-7 days.

Non-Human Toxicity Values:

>> LD50 Rat oral 708 mg/kg

12. Ecological Information

ICSC Environmental Data:

>> The substance is toxic to aquatic organisms.

Sediment/Soil Concentrations:

Concentrations of this compound in sediment/soil.

>> Two soil samples taken at the University of California, Los Angeles campus contained ND (not detected) and 2.33 nmol/g of maleic acid, whereas bog sediment samples from the Sierra Nevada foothills contained 8 nmol/g(1). Maleic acid was qualitatively detected in German soil samples(2).

13. Disposal Considerations

Spillage Disposal

>> Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting. Wash away remainder with plenty of water.

Disposal Methods

>> SRP: Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in air, soil or water; effects on animal, aquatic and plant life; and conformance with environmental and public health regulations. If it is possible or reasonable use an alternative chemical product with less inherent propensity for occupational harm/injury/toxicity or environmental contamination.

>> /Product/ Offer surplus and non-recyclable solutions to a licensed disposal company. /Contaminated packaging/ Dispose of as unused product.

14. Transport Information

DOT

Maleic acid

8

UN Pack Group: III

Reportable Quantity of 5000 lb or 2270 kg

IATA

Maleic acid

8,

UN Pack Group: III

15. Regulatory Information

Clean Water Act Requirements:

The Clean Water Act (CWA) of 1972 establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under CWA, the U.S. Environmental Protection Agency (EPA) developed the Toxic Pollutant List (40 CFR Part 401.15) and the Priority Pollutant List (40 CFR Part 423, Appendix A). These lists are to be used by EPA and States to develop the Effluent Guidelines regulations and ensure water quality criteria and standards.

- >> Maleic acid is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

Regulatory Information

The Australian Inventory of Industrial Chemicals

- >> Chemical: 2-Butenedioic acid (2Z)-, homopolymer

The Australian Inventory of Industrial Chemicals

- >> Chemical: 2-Butenedioic acid, (Z)-

The Australian Inventory of Industrial Chemicals

- >> Chemical: 2-Butenedioic acid, (Z)-, potassium salt

REACH Registered Substance

- >> Status: Active Update: 05-08-2022 <https://echa.europa.eu/registration-dossier/-/registered-dossier/15769>
- >> Status: Cease Manufacture Update: 16-09-2010 <https://echa.europa.eu/registration-dossier/-/registered-dossier/1550>
- >> Status: Active Update: 30-05-2012 <https://echa.europa.eu/registration-dossier/-/registered-dossier/1412>
- >> Status: Active Update: 10-08-2010 <https://echa.europa.eu/registration-dossier/-/registered-dossier/1548>

New Zealand EPA Inventory of Chemical Status

- >> Maleic acid: Does not have an individual approval but may be used under an appropriate group standard

New Zealand EPA Inventory of Chemical Status

- >> 2-Butenedioic acid (2Z)-, homopolymer: Does not have an individual approval but may be used under an appropriate group standard

16. Other Information

Toxic Combustion Products:

Toxic products (e.g., gases and vapors) produced from the combustion of this chemical.

- >> Carbon oxides

Other Safety Information

Chemical Assessment

- >> Evaluation – Chemicals that are unlikely to require further regulation to manage risks to environment
- >> Evaluation – Maleic acid salts

Chemical Assessment

- >> Evaluation – Chemicals that are unlikely to require further regulation to manage risks to environment
- >> Evaluation – Maleic acid

Chemical Assessment

- >> IMAP assessments – 2-Butenedioic acid, (Z)-, homopolymer: Human health tier I assessment

"The information provided is believed to be accurate but is not comprehensive and should be used as a reference. It reflects our current knowledge and is intended for safety guidance related to the product. This document does not constitute a warranty of the product's properties. Ionz is not responsible for any damages resulting from handling or contact with the product incorrectly."