

Maleic Anhydride

108-31-6

Hazard Summary

Maleic anhydride is used in the formulation of resins. Exposure to maleic anhydride may occur from accidental releases to the environment or in workplaces where it is produced or used. Acute (short-term) inhalation exposure of humans to maleic anhydride has been observed to cause irritation of the respiratory tract and eye irritation. Chronic (long-term) exposure to maleic anhydride has been observed to cause chronic bronchitis, asthma-like attacks, and upper respiratory tract and eye irritation in workers. In some people, allergies have developed so that lower concentrations can no longer be tolerated. Kidney effects were observed in rats chronically exposed to maleic anhydride via gavage (experimentally placing the chemical in the stomach). EPA has not classified maleic anhydride for carcinogenicity.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (6), which contains information on oral chronic toxicity and the RfD, and EPA's Health and Environmental Effects Profile for Maleic Anhydride. (2) Other secondary sources include Hazardous Substances Data Bank (HSDB) (1), a database of summaries of peer-reviewed literature, and the Registry of Toxic Effects of Chemical Substances (RTECS) (3), a database of toxic effects that are not peer reviewed.

Uses

- Maleic anhydride is used primarily in the formation of unsaturated polyester resins for use in boats, autos, trucks, buildings, piping, and electrical goods. Lube oil adhesives synthesized from maleic anhydride are used to prolong oil-change intervals and improve engine efficiency. (2,9)
- Maleic anhydride is also used to make copolymers, pesticides, and other organic compounds, and in Diels-Alder syntheses. (2,9)

Sources and Potential Exposure

- Exposure to maleic anhydride would primarily be occupational from contact with spills, fugitive emissions, or vent gases. (1)
- Maleic anhydride may be spilled or emitted into the atmosphere during its manufacture, transport, or use. (1)

Assessing Personal Exposure

- No information is available on the measurement of personal exposure to maleic anhydride.

Health Hazard Information

Acute Effects:

- Acute inhalation exposure of humans to maleic anhydride has been observed to cause irritation of the respiratory tract, burning in the larynx, reflex cough, lacrimation, headaches, eye irritation, and corneal burns (that healed within 48 hours). (1,2)
- Bronchial asthma was observed in guinea pigs acutely exposed to maleic anhydride. (2)

- Acute animal tests in rats, mice, rabbits, and guinea pigs have demonstrated maleic anhydride to have moderate to high acute toxicity by ingestion and moderate acute toxicity from dermal exposure. (3)

Chronic Effects (Noncancer):

- Chronic exposure to maleic anhydride has been observed to cause chronic bronchitis, asthma-like attacks, pulmonary edema, upper respiratory tract irritation, eye irritation, and dermatitis in workers. In some people, allergies have developed so that lower concentrations can no longer be tolerated. (2,4,5,7)
- Nose and eye irritation, upper respiratory lesions, nasal discharge, dyspnea (shortness of breath), and sneezing have been observed in rats, hamsters, and monkeys chronically exposed to maleic anhydride by inhalation. (2,7)
- Renal lesions were observed in rats chronically exposed to maleic anhydride via gavage (experimentally placing the chemical in the stomach). Decreased body weight and increased kidney weight have also been observed in orally exposed rats. (2,6)
- EPA has not established a Reference Concentration (RfC) for maleic anhydride. (6)
- The Reference Dose (RfD) for maleic anhydride is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on renal lesions in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (6)
- EPA has medium confidence in the study on which the RfD was based because the study was conducted by a relevant route of administration at several dose levels and several endpoints of toxicity were examined; medium confidence in the database because adequately defined no-observed-adverse-effect levels (NOAELs) and lowest-observed-adverse-effect levels (LOAELs) and reproductive and teratogenic effects data were available; and, consequently, medium confidence in the RfD. (6)
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of 2×10^{-4} milligrams per cubic meter (mg/m^3). The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. (7)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of maleic anhydride in humans.
- No teratogenic or fetotoxic effects were observed in the offspring of rats exposed via gavage or diet. (2,7)

Cancer Risk:

- No information is available on the carcinogenic effects of maleic anhydride in humans.
- A study reported no treatment-related increased tumor incidence in rats exposed in their diet. (2)
- EPA has not classified maleic anhydride for carcinogenicity because it has not been adequately tested regarding potential carcinogenicity. (2)

Physical Properties

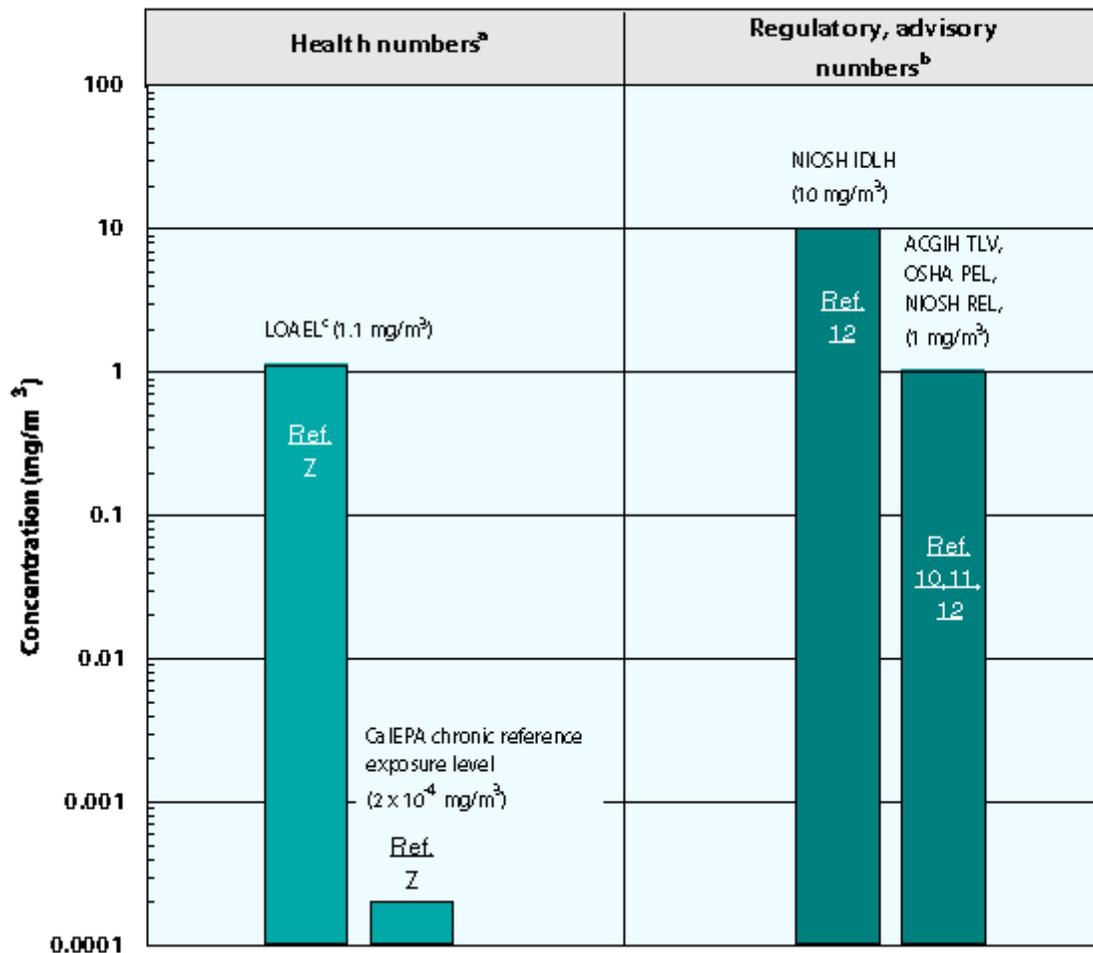
- The chemical formula for maleic anhydride is $\text{C}_4\text{H}_2\text{O}_3$, and its molecular weight is 98.06 g/mol. (2)
- Maleic anhydride is a colorless to white solid that forms orthorhombic crystals and decomposes in water. (2)
- Maleic anhydride has an acrid odor, with an odor threshold of 0.32 parts per million (ppm). (5,8)
- The vapor pressure for maleic anhydride is 0.1 to 0.2 mm Hg at 25 °C. (2)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m³: $\text{mg/m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For maleic anhydride: 1 ppm = 4.0 mg/m³.

Health Data from Inhalation Exposure

Maleic Anhydride



ACGIH TLV --American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

NIOSH REL --National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH--recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

NIOSH IDLH -- NIOSH's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

OSHA PEL --Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

^c The LOAEL is from the critical study used as the basis for the CalEPA inhalation reference exposure level.

References

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