Epichlorohydrin (1-Chloro-2,3-Epoxypropane)

106-89-8

Hazard Summary

Epichlorohydrin is mainly used in the production of epoxy resins. Acute (short-term) inhalation exposure to epichlorohydrin in the workplace has caused irritation to the eyes, respiratory tract, and skin of workers. At high levels of exposure, nausea, vomiting, cough, labored breathing, inflammation of the lung, pulmonary edema, and renal lesions may be observed in humans. Chronic (long-term) occupational exposure of humans to epichlorohydrin in air is associated with high levels of respiratory tract illness and hematological effects. Damage to the nasal passages, respiratory tract and kidneys have been observed in rodents exposed to epichlorohydrin by inhalation for acute or chronic duration. An increased incidence of tumors of the nasal cavity has been observed in rats exposed by inhalation. EPA has classified epichlorohydrin as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's IRIS (2), which contains information on inhalation chronic toxicity and carcinogenic effects of epichlorohydrin and the RfC, and unit cancer risk estimate for inhalation exposure, and the Health and Environmental Effects Profile for Epichlorohydrin. (1)

Uses

- The primary use of epichlorohydrin is in the production of epoxy resins used in coatings, adhesives, and plastics. (1,5)
- Epichlorohydrin is also used in the manufacture of synthetic glycerine, textiles, paper, inks and dyes, solvents, surfactants, and pharmaceuticals. (1)
- Epichlorohydrin is also listed as an inert ingredient in commercial pesticides. (1)

Sources and Potential Exposure

- Individuals are most likely to be exposed to epichlorohydrin in the workplace. (1)
- Epichlorohydrin may be released to the ambient air during its production and use. (1)
- Accidental releases to waterways may expose the general public to epichlorohydrin. (1)

Assessing Personal Exposure

- No information was located concerning the measurement of personal exposure to epichlorohydrin.

Health Hazard Information

Acute Effects:

- Acute inhalation exposure to epichlorohydrin in the workplace has caused irritation to the eyes, respiratory tract, and skin of workers. At high levels of exposure, nausea, vomiting, cough, labored breathing, chemical pneumonitis (inflammation of the lung), pulmonary edema, and renal lesions may be observed in humans. (1,2)
- Dermal contact with epichlorohydrin may result in irritation and burns of the skin in humans and animals.

(1)

- In rats and mice acutely exposed to epichlorohydrin by inhalation, nasal and lower respiratory tract irritation and lesions, hemorrhage, and severe edema have been observed. Renal degeneration and CNS depression with paralysis of respiration and cardiac arrest have also resulted from acute inhalation exposure in animals. (1-3)
- Tests involving acute exposure of rats, mice and rabbits have demonstrated epichlorohydrin to have high acute toxicity from inhalation, oral, and dermal exposure. (4)

Chronic Effects (Noncancer):

- Chronic occupational exposure of humans to epichlorohydrin in air is associated with high levels of respiratory tract illness and hematological effects (decreased hemoglobin concentration and decreased erythrocyte and leukocyte counts). (1,5)
- Chronic inhalation exposure has been observed to cause pulmonary effects including inflammation and degenerative changes in the nasal epithelia, severe lung congestion, and pneumonia in rats and mice. Effects to the kidneys were also observed. (1,2)
- Hepatic damage, hematological effects, myocardial changes, and damage to the CNS have been reported in chronically exposed rats. (1,5)
- The Reference Concentration (RfC) for epichlorohydrin is 0.001 milligrams per cubic meter (mg/m^3) based on changes in the nasal turbinates in rats and mice. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation 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 RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (2)
- EPA has medium confidence in the study on which the RfC was based because of the inflammation in the respiratory tract of control and exposed animals although it was well conducted and contained detailed histopathological examinations of numerous tissues including the respiratory tract; medium confidence in the database because chronic studies that adequately address the respiratory system and a two-generation reproductive study are lacking and the only chronic inhalation study is confounded by severe nasal inflammation in the controls; and, consequently, medium confidence in the RfC. (2)
- The provisional Reference Dose (RfD) for epichlorohydrin is 0.002 milligrams per kilogram body weight per day (mg/kg/d) based on kidney effects in rats. The provisional RfD is a value that has had some form of Agency review, but it does not appear on IRIS (6)

Reproductive/Developmental Effects:

- In humans occupationally exposed to epichlorohydrin, effects on sperm counts, hormone levels, and fertility have been not detected. (1,2)
- Epichlorohydrin has been demonstrated to reduce fertility in male rats when inhaled or administered orally. (1-3)
- Teratogenic effects (birth defects) have not been observed in studies of rodents exposed by inhalation or ingestion. (1,2,5)

Cancer Risk:

- An increased incidence of lung cancer mortality (not statistically significant) was reported in one study of workers exposed to epichlorohydrin. (1,2)
- An increased incidence of tumors of the nasal cavity has been observed in rats exposed to epichlorohydrin by inhalation. (1,2,5)
- An increased incidence of forestomach tumors has been reported in rats exposed via gavage (experimentally placing the chemical in the stomach) and in drinking water. Mice have exhibited local tumors when exposed by subcutaneous injection. (1-3,5)
- EPA has classified epichlorohydrin as a Group B2, probable human carcinogen. (2)

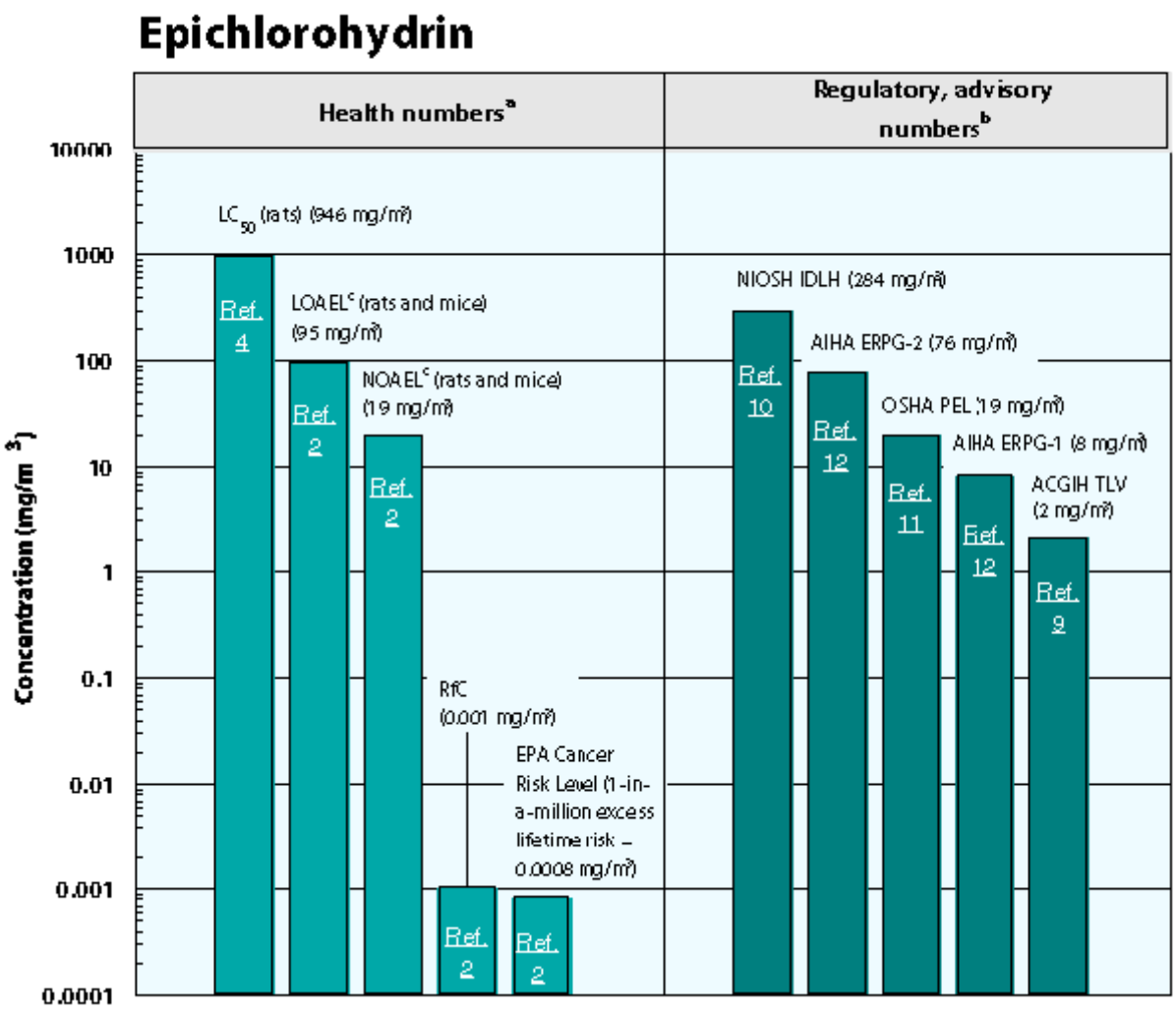
- EPA uses mathematical models, based on human and animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA calculated an inhalation unit risk estimate of 1.2×10^{-6} $(\mu g/m^3)^{-1}$. EPA estimates that, if an individual were to continuously breathe air containing epichlorohydrin at an average of 0.8 $\mu g/m^3$ (0.0008 mg/m^3) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of breathing air containing this chemical. Similarly, EPA estimates that breathing air containing 8.0 $\mu g/m^3$ (0.008 mg/m^3) would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and air containing 80.0 $\mu g/m^3$ (0.08 mg/m^3) would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency estimates, please see IRIS. (2)
- EPA has calculated an oral cancer slope factor of 9.9×10^{-3} $(mg/kg/d)^{-1}$. (2)

Physical Properties

- The chemical formula for epichlorohydrin is C_3H_5OCl, and its molecular weight is 92.53 g/mol. (1,7)
- Epichlorohydrin is a volatile and flammable clear liquid at room temperature and is insoluble in water. (1,2,7)
- The threshold for odor perception of epichlorohydrin is 0.93 parts per million (ppm). Epichlorohydrin has a pungent, garlicky, sweet odor. (2,8)
- The vapor pressure for epichlorohydrin is 22 mm Hg at 30 °C. (1)

Conversion Factors:
To convert concentrations in air (at 25 °C) from ppm to mg/m^3: $mg/m^3 = (ppm) \times (\text{molecular weight of the compound})/(24.45)$. For epichlorohydrin: 1 ppm = 3.78 mg/m^3.

Health Data from Inhalation Exposure



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.

AIHA ERPG--American Industrial Hygiene Association's emergency response planning guidelines. ERPG 1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor; ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.

LC_{50} (Lethal Concentration$_{50}$)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

LOAEL--Lowest-observed-adverse-effect level.

NIOSH IDLH--National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; 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.

NOAEL--No-observed-adverse-effect level.

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, ACGIH, and AIHA numbers are advisory.

[c] This NOAEL and LOAEL are from the critical study used as the basis for the RfC.

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