The following information was generated from the Hazardous Substances Data Bank (HSDB), a database of the National Library of Medicine's TOXNET system (http://toxnet.nlm.nih.gov) on December 29, 2004.

Query: The chemical name was identified.
The following terms were added from ChemIDplus:
skekhg
glycerol epichlorhydrin
epicloridrina
epichlorophydrin
epichlorohydryna
epichlorhydrine
epichlorhydrin
epichloorhydrine
chloropropylene oxide
chloromethylxirane
CAS Registry Number: 106-89-8

1
NAME: EPICHLOROHYDRIN

HSN: 39
RN: 106-89-8

HUMAN HEALTH EFFECTS:

EVIDENCE FOR CARCINOGENICITY:

CLASSIFICATION: B2; probable human carcinogen. BASIS FOR CLASSIFICATION: Human data are inadequate. Multiple studies in rats and mice administered epichlorohydrin by various routes were positive. As epichlorohydrin is a strong alkylating agent, tumors are produced at the site of application. HUMAN CARCINOGENICITY DATA: Inadequate. ANIMAL CARCINOGENICITY DATA: Sufficient. [U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on epichlorohydrin (106-89-8) Available from: http://www.epa.gov/ngispgm3/iris on the Substance File List as of March 15, 2000]**PEER REVIEWED**


A3. A3= Confirmed animal carcinogen with unknown relevance to humans. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.36]**QC REVIEWED**
HUMAN TOXICITY EXCERPTS:

... CASES OF SENSITIZATION WITH RESULTING INTOXERANCE TO TRIVIAL EXPOSURES

... SEVERAL CASES OF SKIN BURNS ... FROM PROLONGED CONTACT ... CONCN OF

... 25 PPM ARE REPORTED TO PRODUCE NO SERIOUS DEGREE OF EXTERNAL
IRRITATION, ALTHOUGH VAPOR IS READILY DETECTABLE @ THESE LEVELS. [American
Conference of Governmental Industrial Hygienists. Documentation of the
Threshold Limit Values for Substances in Workroom Air. Third Edition,
1971. Cincinnati, Ohio: American Conference of Governmental Industrial
Hygienists, 1971. (Plus supplements to 1979)]**PEER REVIEWED**

VAPORS PRODUCE LACRIMATION & CORYZA IN MAN @ SUBLETHAL CONCN. ... A
SINGLE HUMAN RESP EXPOSURE ... RESULT IN CHRONIC ASTHMATIC BRONCHITIS

& SEVERE DIFFUSE FATTY INFILTRATION OF THE LIVER. [U.S. Department of
the Interior, Fish and Wildlife Service. Handbook of Toxicity of

IN ACUTE POISONING, DEATH MAY BE CAUSED BY RESPIRATORY PARALYSIS. IN
CHRONIC POISONING THERE IS KIDNEY DAMAGE. INFLAMMATORY CHANGES IN THE EYES

& LUNG HAVE BEEN OBSERVED. PRIMARY IRRITATION & SENSITIZATION OF
SKIN HAS BEEN DESCRIBED. [Sax, N.I. Dangerous Properties of Industrial
REVIEWED**

MUCH LOWER CONCN / THAN 20 PPM/ CAUSE CHRONIC POISONING ... SYMPTOMS ...

FATIGUE, GASTROINTESTINAL PAINS, CHRONIC CONJUNCTIVITIS ... THE LIQ IS
CAUSTIC, & INSTILLED INTO THE EYE IT CAN GIVE RISE TO OPACITY &
NECROSIS OF CORNEA. [Lefaux, R. Practical Toxicology of Plastics.
Cleveland: CRC Press Inc., 1968.108]**PEER REVIEWED**

... PROSPECTIVE CYTOGENIC STUDY ON 35 WORKERS ... OCCUPATIONALLY EXPOSED
TO EPICHLOROHYDRIN. BLOODSAMPLES WERE OBTAINED ... AFTER 1ST &
2ND YEAR OF EXPOSURE & CULTIVATED FOR 56-58 HR. % CELLS WITH CHROMOSOMAL
ABERRATIONS ... 1.37 BEFORE EXPOSURE, 1.91 AFTER 1ST YR, & 2.69 AFTER
2ND YR.... FREQUENT ... CHROMATID & CHROMOSOMAL BREAKS. [National
National Academy Press, 1980.120]**PEER REVIEWED**

HUMAN PERIPHERAL LYMPHOCYTES ... WERE EXPOSED TO 1X10-11 TO 1X10-4 MOLAR
EPICHLOROHYDRIN IN VITRO FOR 24 HR ... CHROMOSOMAL CHANGES WERE
DOSE-DEPENDENT, & THE MOST COMMON TYPE OF ABBERRATION PRODUCED BY EACH
WERE CHROMATID BREAKS, FOLLOWED BY CHROMOSOMAL BREAKS. CHROMATID EXCHANGES
WERE RARE, CHROMOSOMAL CHANGES EXTREMELY RARE. [National Research Council.
Press, 1980.120]**PEER REVIEWED**

SCEs are observed in human lymphocytes exposed to epichlorohydrin in
vitro. The compound produces chromosomal abnormalities in bone marrow
cells and in human lymphocytes in vitro and in vivo. [De Serres FJ,
Hollaender A; Chemical Mutagens Vol 8 p.302 (1983)]**PEER REVIEWED**

Male employees engaged in the manufacture of glycerine, who were exposed
to epichlorohydrin, allyl chloride, and 1,3-dichloropropane were studied
for their fertility status. The results showed no detrimental effect on
fertility from exposure to the chlorinated three-carbon compounds
including epichlorohydrin. [USEPA; Health Assessment Document:
Human Reflex Response: no response: 0.2 mg/cu m; adverse response: 0.3 mg/cu m [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983.612] **PEER REVIEWED**

... NIOSH concluded that risks from exposure to epichlorohydrin may include carcinogenesis, mutagenesis, and sterility, as well as damage to the kidneys, liver, respiratory tract and skin. [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983.613] **PEER REVIEWED**


A case of toxic allergic skin reaction, secondary to accidental contact with methylenedianiline, in a cleaner at a chemical factory was reported. An extensive red, itchy, papular and vesicular rash developed on the face, neck, and wrists of a 32 year old cleaner several hours after cleaning a shallow gutter in a chemical facility with a high pressure water hose. The cleaner was wearing protective clothing including gloves, apron, safety goggles, and a cap during the cleaning operation. Among the chemicals present in the gutter, two were suspected as the causative agent, epichlorohydrin and methylenedianiline. Patch testing revealed a strong positive reaction to methylenedianiline and epoxy resin, and a broad spectrum of reactions apparently due to cross sensitization to para groups. The patch test with epichlorohydrin was negative. The authors conclude that occupational exposure to methylenedianiline, used as a catalyst in the production of polyurethanes, as a hardener or curing agent for epoxy resins, and as an antioxidant in the manufacture of synthetic fibers, should be avoided because of its manufacture of synthetic fibers, should be avoided because of its sensitization capability and possible cross sensitization with azo dyes. [Van Joost T et al; Contact Dermatitis 16 (5): 246-8 (1987)] **PEER REVIEWED**

The mortality experience of 863 workers identified as having probable exposures to epichlorohydrin at two Shell Chemical facilities was examined. One of the facilities was located at Deer Park, Texas where production of epichlorohydrin started in May of 1948. The other location was at Norco, Louisiana, where production of epichlorohydrin started in April of 1955. The cohorts were followed up for the period 1948 through 1983; only two workers were lost to follow up. The standard mortality ratio for all cancer at 20 or more years after the first exposure was 112.2 and the standard mortality ratio for leukemia was 500.0 which was statistically significant. A relation to estimated levels of exposure to epichlorohydrin was noted for all cancer, leukemia, and most other causes of death except death to violence. The relationship between exposure level and heart disease was the most consistent and occurred at both facilities. The standard mortality ratio for heart disease 20 or more years after the first exposure was 39.2 for low exposures and 105.4 for high exposures. [Enterline PE et al; Br
The cytogenetic effects of epichlorohydrin exposure was evaluated among epoxy resin and glycerin production workers. Samples of blood from 76 epoxy resin workers and 93 glycerin workers were evaluated. Blood from newly hired subjects undergoing preemployment medical examinations was used for comparison. Two different culture media were used to maximize chances for sufficient lymphocytes. After incubation at 37 deg C for 69 to 71 hours, lymphocytes were harvested. Chromosomes were spread and slides were fixed. Chromosomal aberrations were scored by five technologists. Alterations in chromosomes were totaled. Repeat samples were collected from subjects with an abnormally high number of aberrations. Groups were divided by intensity and duration of exposure based on job histories. The estimated exposure to epichlorohydrin did not exceed 5 ppm. There was a significant elevation in the number of chromosome aberrations in epoxy resin workers relative to comparisons. In the repeat cultures, the number of aberrations was only slightly more than that of the comparisons. The initial differences were attributed to the differences between culture media used. No significant differences were found between glycerine workers and their comparisons. 

In an epoxy resin manufacturing plant, 26 of 228 (11.4%) workers had work-related eruptions; 19 were patch tested. The test series consisted of chemicals used in the manufacturing process, a standard battery and some other sensitisers. The prevalence of sensitisation to epichlorohydrin and/or epoxy resins in the whole group was 6.1%. A relatively high prevalence (3.5%) of epichlorohydrin sensitisation was found. 10 cases of sensitisation to liquid epoxy resin (MW about 385) were observed, in 7 cases combined with allergy to solid epoxy resin (MW 980). Sensitisation to Bisphenol A was not seen.

A study of mortality in dye and resin manufacturing workers was conducted. The cohort consisted of 2642 males employed at a dye and resin manufacturing facility in New Jersey for at least 6 months between January 1, 1952 and January 1, 1985. A subcohort was formed of 89 subjects who had previously worked at Cincinnati Chemical Works, Cincinnati, Ohio. Cincinnati Chemical Works produced or used benzidine and beta-naphthylamine. The vital status of cohort was determining as of December 31, 1985. Death certificates were examined. Standardized mortality ratios were calculated using the United States white male population as the reference. The data were also examined according to payroll classification (hourly, weekly, or monthly) and job area. Total mortality in the cohort was significantly decreased, standardized mortality ratios 81. The decrease was due to deficits in mortality from circulatory, respiratory, and digestive diseases, and external causes. Mortality from all cancers of specific sites was not significantly increased. The former Cincinnati Chemical Works employees had a slight excess of deaths from all causes and a significant excess of cancer deaths. The excess cancer mortality was due to increased numbers of deaths from bladder, kidney, and central nervous system (CNS) cancer. By work area, maintenance workers had significantly elevated mortality from lung and liver cancer, azo dye workers an excess of CNS cancer, and
epichlorohydrin workers an excess of lung cancer. The excess risk, however, were usually based on a small number of observed cases. The excess lung cancer mortality in maintenance workers increased with length of employment. Mortality generally did not vary significantly across payroll category except for an excess of esophageal cancer mortality in monthly employees. The authors note that because the study did not assess workplace exposures it is not possible to link the increases in specific cancer mortalities in some work areas with any specific chemical. Further observation of this cohort and independent evaluations of workers with similar exposures at other facilities are warranted. [Delzell E et al; J Occup Med 31 (3): 273-8 (1989)]**PEER REVIEWED**

Squamous cell carcinomas of the forestomach have been observed in many carcinogenicity studies in rodents, especially after oral or gavage exposure. The histopathologial diagnosis of forestomach lesions and the relevance of the data for human risk estimation can be controversial. The pathological classification may be troublesome because of the low-grade malignancy and the pseudoepitheliomatous hyperplasia that may develop after ulceration and inflammation. For human risk estimation it is important to understand the mechanism of actions; this is illustrated by examples using butylated hydroxyanisole, methyl bromide, and epichlorohydrin. Another feature that complicates risk estimation is the absence of a homolog for the forestomach in man. The potential risk from non-genotoxic forestomach carcinogens in man involves exposure of the mouth, pharynx, and esophagus at dose levels that exert irritating action. It is assumed that exposure to non-genotoxic chemicals at concentrations far below those having irritating potential is not hazardous to humans. [Wester PW, Kroes R; Toxicol Pathol 16 (2): 165-71 (1988)]**PEER REVIEWED**

Morbidity experience in two cohorts of workers with potential exposure to epichlorohydrin was examined. The first population (Shell cohort) contained 713 workers with industrial hygiene confirmed potential exposure to epichlorohydrin at the same two Shell manufacturing locations studied in an earlier report by Enterline. The morbidity experience of this group was examined from 1981 through 1988. Heart disease morbidity for workers who had potential exposure to both epichlorohydrin and allyl-chloride was examined. The second population consisted of a subset (Enterline cohort) of the original Enterline cohort members for whom mortality data were available from 1981 to 1988. For both cohorts, the standarized morbidity ratios for all causes and all neoplasms were similar to an internal comparison group. No increases were noted in heart disease morbidity for the Shell cohort or the Enterline cohort. The standardized morbidity ratios for heart disease in the lower exposure group of the Shell cohort were 101 and 93 for the corresponding Enterline cohort. They were 92 and 87, respectively, in the higher exposure group. Morbidity from skin and subcutaneous tissue disorders, however, was increased significantly in the Shell cohort. The standardized morbidity ratios was 98 for the lower exposure group and 195 for the higher exposure group. A review of the original morbidity reports for each case suggested that factors unrelated to exposure to epichlorohydrin such as the physical demands of a particular job, amount of time outside, and other underlying medical conditions may be of greater importance than exposure to epichlorohydrin. [Tsai SP et al; Br J Ind Med 47 (6): 392-9 (1990)]**PEER REVIEWED**

EPICHLOROHYDRIN CAN AFFECT THE BODY IF IT IS INHALED, IF IT COMES IN CONTACT WITH THE EYES OR SKIN, OR IF IT IS SWALLOWED. [Mackison, F. W., R.
SKIN, EYE AND RESPIRATORY IRRITATIONS:

Epichlorohydrin effect on the skin, eyes, and respiratory tract may be delayed for several hours. Epichlorohydrin causes dermatitis. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1988.209]**PEER REVIEWED**

Inhalation of epichlorohydrin causes irritation of the eyes and throat. ... [USEPA; Health Assessment Document: Epichlorohydrin p.5-10 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

MEDICAL SURVEILLANCE:

PRECAUTIONS FOR "CARCINOGENS": Whenever medical surveillance is indicated, in particular when exposure to a carcinogen has occurred, ad hoc decisions should be taken concerning ... /cytogenetic and/or other/ tests that might become useful or mandatory. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boylan, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.23]**PEER REVIEWED**

The health effects of photoactive chemicals present in photoresistant materials and processes used in the microelectronics industry to produce increasingly dense microcircuits were reviewed. ... Photoresist materials should be handled carefully and the workers who handle such materials should be under attentive medical monitoring. [Teitelbaum DT; State of the Art Reviews: Occup Med 1 (1): 59-68 (1986)]**PEER REVIEWED**

The usefulness of cytogenetic surveillance of persons exposed to genotoxic chemicals was discussed with attention toward both chromosomal aberrations and sister chromatid exchanges. Chromosomal aberrations were noted to consist of overt breakage and rearrangements of chromosomes visualized in the metaphase plate. Chromosomal aberrations were most sensitive to agents that directly break the DNA duplex, such as ionizing radiation and radiomimetic chemicals. Sister chromatid exchanges involved breakage of double stranded DNA in both chromatids followed by an exchange of whole DNA duplexes. Usually, less than 7 to 8% values of chromosomally damaged lymphocytes have no significance as such to the health of the individual. Exposure to carcinogenic genotoxic chemicals and induced cytogenetic damage correlated with cancer risk. In a Finnish cohort, a statistically significant positive trend for cancer risk and chromosome aberrations,
whereas no such trend was noted for sister chromatid exchanges. Increased frequencies of chromosomal damage serves as an indicator of exposure to genotoxic agents and signals the potential of cancer risk at the group level. Cytogenetic surveillance of people exposed to ionizing radiation has been carried out for many years. Experience has also been gained with agents such as benzene, ethylene oxide, vinyl chloride, styrene, epichlorohydrin, and some alkylating anticancer drugs. The available cytogenetic test systems are still too insensitive and tedious for use as a routine surveillance procedure. [Sorsa M et al; Teratogenesis Carcinogenesis Mutagenesis 10 (3): 315-21 (1990)]**PEER REVIEWED**

Respiratory Symptom Questionnaires: Questionnaires have been published by the American Thoracic Society (ATS) and the British Medical Research Council). These questionnaires have been found to be useful in identification of people with chronic bronchitis, however certain pulmonary function tests such as FEV 1 (see pulmonary function test section) have been found to be better predictors of chronic airflow obstruction. [Ryan, R.P., C.E. Terry (eds.). Toxicology Desk Reference 4th ed. Volumes 1-3. Taylor & Francis, washington, D.C. 1997.1247]**PEER REVIEWED**

Chest Radiography: This test is widely used for assessing pulmonary disease. Chest radiographs have been found to be useful for detection of early lung cancer in asymptomatic people, especially for detection of peripheral tumors such as adenocarcinomas. However, even though OSHA mandates this test for exposure to some toxicants such as asbestos, there are conflicting views on its efficacy in detection of pulmonary disease. [Ryan, R.P., C.E. Terry (eds.). Toxicology Desk Reference 4th ed. Volumes 1-3. Taylor & Francis, washington, D.C. 1997.1247]**PEER REVIEWED**

Pulmonary Function Tests: The tests that have been found to be practical for population monitoring include: Spirometry and expiratory-flow volume curves; Determination of lung volumes; Diffusing capacity for carbon monoxide; Single breath nitrogen washout; Inhalation challenge tests; Serial measurements of peak expiratory flow; Exercise testing. [Ryan, R.P., C.E. Terry (eds.). Toxicology Desk Reference 4th ed. Volumes 1-3. Taylor & Francis, washington, D.C. 1997.1247]**PEER REVIEWED**

Sputum Cytology: Sputum cytology along with chest radiographs have been the standard procedures for detecting early lung cancer in asymptomatic patients. Sputum cytology has been found to be useful for detection of central tumors, especially squamous carcinomas. For this test to be effective, exfoliated respiratory mucosal cells must be present in the expectorated specimen. Pooling of sputum collected over 2-3 days may enhance the sensitivity of this test by increasing the yield of exfoliated cells in the specimen. [Ryan, R.P., C.E. Terry (eds.). Toxicology Desk Reference 4th ed. Volumes 1-3. Taylor & Francis, washington, D.C. 1997.1248]**PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:
NIOSH (NOES Survey 1981-1983) has statistically estimated that 8,032 workers (655 of these are female) are potentially exposed to epichlorohydrin in the US(1). Occupational exposure to epichlorohydrin may occur through inhalation and dermal contact with this compound at workplaces where epichlorohydrin is produced or used(SRC). In a 1989 Danish survey on chemical exposures(2), the number of worker exposure events for epichlorohydrin were documented: manufacturing of metals, 40;
manufacturing of metal fabricated products 17,500; electrical machinery
and apparatus, 2,100; manufacture of transport equipment 260; painters and
 carpenters 1,500; construction workers, 5,000; publishing and printing,
610; wholesale trades, 1,400; textile and leather manufacturing, 450; wood
and furniture manufacturing, 510; manufacture of paints and petroleum, 38;
manufacture of non-metallic mineral products, 2,100; manufacture of
optical instruments, 1,800; manufacture of plastic and boat building, 150;
health services, 44. The total number of work related exposure events was
33,000(2). [(1) NIOSH; National Occupational Exposure Survey (NOES) (1983)
(2) Brandorff NP et al; Occup Environ Med 52: 454-63 (1995)]**PEER
REVIEWED**

EMERGENCY MEDICAL TREATMENT:

EMT COPYRIGHT DISCLAIMER:
Portions of the POISINDEX(R) and MEDITEXT(R) database have been provided here
for general reference. THE COMPLETE POISINDEX(R) DATABASE OR MEDITEXT(R)
DATABASE SHOULD BE CONSULTED FOR ASSISTANCE IN THE DIAGNOSIS OR TREATMENT OF
SPECIFIC CASES. The use of the POISINDEX(R) and MEDITEXT(R) databases is at your
sole risk. The POISINDEX(R) and MEDITEXT(R) databases are provided "AS IS" and
"as available" for use, without warranties of any kind, either expressed or
implied. Micromedex makes no representation or warranty as to the accuracy,
reliability, timeliness, usefulness or completeness of any of the information
contained in the POISINDEX(R) and MEDITEXT(R) databases. ALL IMPLIED WARRANTIES
OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR USE ARE HEREBY
EXCLUDED. Micromedex does not assume any responsibility or risk for your use of
the POISINDEX(R) or MEDITEXT(R) databases. Copyright 1974-2004 Thomson
MICROMEDEX. All Rights Reserved. Any duplication, replication, "downloading,
sale, redistribution or other use for commercial purposes is a violation of
Micromedex' rights and is strictly prohibited.<p>The following Overview, ***
EPICHLOOROHYDRIN ***, is relevant for this HSDB record chemical.

LIFE SUPPORT:
   o This overview assumes that basic life support measures
have been instituted.

CLINICAL EFFECTS:
   0.2.1 SUMMARY OF EXPOSURE
   0.2.1.1 ACUTE EXPOSURE
   A) Inhalation of vapors, the major route of exposure,
causes systemic effects; it is also toxic by ingestion
and skin absorption. Epichlorohydrin is a strong
irritant to skin, producing burning, itching, deep
pain, redness, swelling, burns and blisters, and to the
eyes and respiratory system. Exposure may result in
nausea, vomiting, abdominal pain, shortness of breath,
cyanosis, dizziness and suffocation. Effects may be
delayed for several hours.
B) Epichlorohydrin is toxic to kidneys. Central nervous
system and respiratory depression are possible.
C) There have been few serious reactions to
epichlorohydrin following industrial exposures.
Repeated, chronic exposure may damage lung, liver and
kidney, with symptoms of enervation, dermatitis and
disturbances in the stomach and kidneys.
0.2.3 VITAL SIGNS

0.2.3.1 ACUTE EXPOSURE
   A) Hypotension and apnea have been reported in animal studies.

0.2.4 HEENT

0.2.4.1 ACUTE EXPOSURE
   A) Facial swelling and eye and nasal mucosal irritation may be seen after exposure.

0.2.6 RESPIRATORY

0.2.6.1 ACUTE EXPOSURE
   A) Irritation of the respiratory tract, bronchitis, and dyspnea are possible, but have not been seen in industrial exposures.

0.2.7 NEUROLOGIC

0.2.7.1 ACUTE EXPOSURE
   A) CNS depression has been the primary cause of death in poisoned laboratory animals.

0.2.8 GASTROINTESTINAL

0.2.8.1 ACUTE EXPOSURE
   A) Vomiting, nausea, and abdominal pain have been seen in exposed workers.

0.2.9 HEPATIC

0.2.9.1 ACUTE EXPOSURE
   A) Hepatomegaly has been seen in both animal studies and human exposures. Liver function abnormalities have been reported in humans up to 2 years after exposure to an unknown concentration.

0.2.10 GENITOURINARY

0.2.10.1 ACUTE EXPOSURE
   A) Kidney lesions were seen in humans briefly exposed to 100 ppm.

0.2.14 DERMATOLOGIC

0.2.14.1 ACUTE EXPOSURE
   A) ECH is irritating on contact. Burns may result. Vesiculation has occurred several hours after direct contact with the skin.
   B) Sensitization may occur.

0.2.20 REPRODUCTIVE HAZARDS

   A) Fetotoxicity was seen in mice.

0.2.21 CARCINOGENICITY

0.2.21.1 IARC CATEGORY
   A) IARC Carcinogenicity Ratings for CAS106-89-8 (IARC, 2004):
      1) IARC Classification
         a) Listed as: Epichlorohydrin
         b) Carcinogen Rating: 2A
      1) The agent (mixture) is probably carcinogenic to humans. The exposure circumstance entails exposures that are probably carcinogenic to humans. This category is used when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals. In some cases, an agent (mixture) may be classified in this category when there is inadequate evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals and strong evidence that the carcinogenesis is mediated by a
mechanism that also operates in humans. Exceptionally, an agent, mixture or exposure circumstance may be classified in this category solely on the basis of limited evidence of carcinogenicity in humans.

0.2.21.3 ANIMAL OVERVIEW
A) There is sufficient evidence to classify ECH as an animal carcinogen by IARC criteria.

0.2.22 GENOTOXICITY
A) ECH has induced DNA damage or repair, unscheduled DNA synthesis, DNA inhibition, mutations, chromosome aberrations, sex chromosome loss and nondisjunction, gene conversion and mitotic recombination.
   1) Sister chromatid exchanges, micronuclei, abnormal sperm morphology, and oncogenic transformation in a variety of cells and species have been reported.

LABORATORY:
A) No toxic serum levels have been established.
B) Liver and kidney function should be monitored.
C) Monitor for CNS and/or respiratory depression in symptomatic patients following a massive acute exposure.

TREATMENT OVERVIEW:

0.4.2 ORAL EXPOSURE
A) EMESIS: Ipecac-induced emesis is not recommended because there is so little information about the effects of overdose in humans.
B) GASTRIC LAVAGE: Consider after ingestion of a potentially life-threatening amount of poison if it can be performed soon after ingestion (generally within 1 hour). Protect airway by placement in Trendelenburg and left lateral decubitus position or by endotracheal intubation. Control any seizures first.
   1) CONTRAINDICATIONS: Loss of airway protective reflexes or decreased level of consciousness in unintubated patients; following ingestion of corrosives; hydrocarbons (high aspiration potential); patients at risk of hemorrhage or gastrointestinal perforation; and trivial or non-toxic ingestion.
C) ACTIVATED CHARCOAL: Administer charcoal as a slurry (240 mL water/30 g charcoal). Usual dose: 25 to 100 g in adults/adolescents, 25 to 50 g in children (1 to 12 years), and 1 g/kg in infants less than 1 year old.
D) ACUTE LUNG INJURY: Maintain ventilation and oxygenation and evaluate with frequent arterial blood gas or pulse oximetry monitoring. Early use of PEEP and mechanical ventilation may be needed.
E) HYPOTENSION: Infuse 10 to 20 mL/kg isotonic fluid. If hypotension persists, administer dopamine (5 to 20 mcg/kg/min) or norepinephrine (ADULT: begin infusion at 0.5 to 1 mcg/min; CHILD: begin infusion at 0.1 mcg/kg/min); titrate to desired response.

0.4.3 INHALATION EXPOSURE
A) INHALATION: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer oxygen and assist ventilation as required. Treat bronchospasm with inhaled
beta2 agonist and oral or parenteral corticosteroids.

0.4.4 EYE EXPOSURE
A) DECONTAMINATION: Irrigate exposed eyes with copious amounts of room temperature water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.

0.4.5 DERMAL EXPOSURE
A) OVERVIEW
1) DECONTAMINATION: Remove contaminated clothing and wash exposed area thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.

RANGE OF TOXICITY:
A) Toxic levels have not been established in humans.
B) The no-effect air level in humans is estimated at 9 ppm.

ANTIDOTE AND EMERGENCY TREATMENT:
ACETYL Cysteine was useful in treating the toxic symptoms in rats resulting from inhalation of Epichlorhydrin. /SRP: CLINICAL EFFECTIVENESS NOT PROVEN/ [LUK'YANCHUK VD & AG KOZLOV, DEPOSITED DOC ISS VINITI 4096 (1979)]**PEER REVIEWED**

Irrigate eyes with water. Wash contaminated areas of skin with abundant soap and water. Administer oxygen or artificial respiration, if needed. If swallowed, prescribe the patient with an antidote (active carbon, magnesia, tannic acid= 2: 1: 1) 10 to 20 g in hot water. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1980.208]**PEER REVIEWED**

Basic treatment: Establish a patent airway. Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if necessary. Administer oxygen by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary .... For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport .... Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Administer activated charcoal .... Cover skin bums with dry sterile dressings after decontamination .... /Dichloropropane, dichloropropene, and related compounds/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994.297]**PEER REVIEWED**

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the unconscious or severe respiratory distress patient. Positive pressure ventilation techniques with a bag valve mask device may be beneficial. Monitor and treat cardiac arrhythmias if necessary .... Start an IV with D5W TKO /SRP: "To keep open", minimal flow rate/. Use lactated Ringer's if signs of hypovolemia are present. Watch for signs of fluid overload and signs of pulmonary edema. Consider drug therapy for pulmonary edema .... Use proparacaine hydrochloride to assist eye irrigation .... /Dichloropropane, dichloropropene, and related compounds/ [Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994.298]**PEER REVIEWED**
ANIMAL TOXICITY STUDIES:

EVIDENCE FOR CARCINOGENICITY:
CLASSIFICATION: B2; probable human carcinogen. BASIS FOR CLASSIFICATION: Human data are inadequate. Multiple studies in rats and mice administered epichlorohydrin by various routes were positive. As epichlorohydrin is a strong alkylating agent, tumors are produced at the site of application. HUMAN CARCINOGENICITY DATA: Inadequate. ANIMAL CARCINOGENICITY DATA: Sufficient. [U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on epichlorohydrin (106-89-8) Available from: http://www.epa.gov/iris on the Substance File List as of March 15, 2000]**PEER REVIEWED**


A3. A3= Confirmed animal carcinogen with unknown relevance to humans. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.36]**QC REVIEWED**

NON-HUMAN TOXICITY EXCERPTS:
... POISONED ANIMALS SHOW CYANOSIS, MUSCULAR RELAXATION OR PARALYSIS, TREMOR, CONVULSIONS & DEATH IN RESPIRATORY ARREST. DEATH MAY BE DELAYED AS LONG AS 2 HR EVEN AFTER PARENTERAL ADMIN ... NO CHARACTERISTIC ORGAN PATHOLOGY ... [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984.II-168]**PEER REVIEWED**

Rats failed to gain weight at a normal rate when exposed at a level of 32 ppm of the vapor for 91 days on a 7 hr/day, 5 day/wk schedule, and similar exposures at 16 ppm resulted in significant increase in kidney size. Trace amt of urinary coproporphyrins were noted at this level. ... Repeated 6 hr exposures at 120 ppm caused lung, liver and kidney injury in rats. Some respiratory distress was observed at 56 ppm, mild irritation at 27 ppm, and vague adverse effects at 17 ppm after 19 exposures. No effects were noted at 9 ppm. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986.233]**PEER REVIEWED**

DEATH IS ATTRIBUTABLE TO EFFECTS ON CNS & RESP TRACT FROM HIGH DOSAGES. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986.233]**PEER REVIEWED**
EPICHLOROHYDRIN MANIFESTS CUMULATIVE ACTION AS A RESULT OF ITS NEPHROTOXICITY. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986.233]**PEER REVIEWED**

MARKEDLY IRRITATING TO EYE ON LOCAL CONTACT. VAPORS OF ABOUT 100 PPM ALSO GIVE RISE TO EYE IRRITATION. ... UNDILUTED ... IS INTENSELY IRRITATING TO THE DEPILATED SKIN OF LAB ANIMALS. REPEATED APPLICATIONS LEAD TO WIDESPREAD NECROSIS. [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley &amp; Sons Inc., 1993-1994.418]**PEER REVIEWED**

OF 50 ... MICE GIVEN 1/WK SC INJECTIONS OF 1 MG EPICHLOROHYDRIN IN 0.05 ML TRICAPRYLIN ... (580 DAYS), 6 DEVELOPED LOCAL SARCOMAS &amp; 1 HAD LOCAL ADENOCARCINOMA. ... ONE LOCAL SARCOMA ... IN 50 TRICAPRYLIN-INJECTED CONTROLS. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work).V11 134 (1976)]**PEER REVIEWED**

IN 12 WK....TEST IN RATS INJECTED IP WITH EPICHLOROHYDRIN ... DOSE-RELATED DECR IN HEMOGLOBIN VALUES; WITH DOSES OF 0.056 G/KG BODY WT AN INCR IN SEGMENTED NEUTROPHILS...REDN IN PROPORTION OF LYMPHOCYTES OCCURED AT DOSES ... @ ... 0.022 &amp; 0.056 G/KG BODY WT ... INCR LEUKOCYTE COUNT WAS OBSERVED AFTER CHRONIC EXPOSURE ... CHRONICALLY TO VAPORS ... AT ... 2 MG/CU M. THE MAXIMUM TOLERATED DOSE IN A 13 WEEK SUBACUTE STUDY IN RATS FOLLOWING ORAL ADMIN OF EPICHLOROHYDRIN WAS 45 MG/KG BODY WEIGHT/DAY. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work).V11 135 (1976)]**PEER REVIEWED**


TEST BY APPLICATION OF A DROP TO RABBIT EYES HAS CAUSED MILD &amp; PRESUMABLY REVERSIBLE INJURY, GRADED 4 ON A SCALE OF 1-10 AFTER 24 HR. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986.394]**PEER REVIEWED**


... 140 /RATS/ ... EXPOSED 30 DAYS (6 HR/DAY) TO VAPOR CONCN 100 PPM &amp;... UNEXPOSED FOR REST OF THEIR LIFE-SPAN, @ LEAST 15 ... DEVELOPED SQUAMOUS CELL CARCINOMA OF NASAL CAVITY &amp; 1 ... A NASAL CAVITY PAPILLOMA. IN LIFETIME STUDY ... 30 PPM (6 HR/DAY, 5 DAY/WK) 2/100 RATS HAVE DEVELOPED TUMORS ... NASAL ... &amp; ... LARYNX ... [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley &amp;
Epichlorohydrin (without metabolic activation) at concn of 50 mM for an hr induced reverse mutations in Salmonella typhimurium G46 and TA100 tester strains. The mutagenic activity with TA1535 tester strain was markedly reduced in the presence of liver homogenates. Epichlorohydrin produced reverse mutations in Escherichia coli and in Neurospora crassa, recessive lethal mutations in Drosophila melanogaster, and was mutagenic in Klebsiella pneumoniae. [Fishbein L; Potential Indust Carcins & Mutagens p.45 (1977) EPA 560/5-77-005]**PEER REVIEWED**

Doses of 50 and 100 mg/kg of epichlorohydrin after 3 hr increased the frequency of reverse mutations using Salmonella typhimurium strains G46, TA100, and TA1950 in ICR female mice in a host-mediated assay. [Fishbein L; Potential Indust Carcins & Mutagens p.46 (1977) EPA 560/5-77-005]**PEER REVIEWED**

Mutagenic activity (as determined with the TA 1535 strain of Salmonella typhimurium) was detected in the urine of mice after oral administration of 200-400 mg/kg epichlorohydrin. Although an initial evaluation of 2 industrial workers exposed to a concentration in excess of 25 ppm was regarded as borderline, additional mutagenic testing revealed more definitive evidence of activity, with the active compound appearing as a conjugate. [Fishbein L; Potential Indust Carcins & Mutagens p.46 (1977) EPA 560/5-77-005]**PEER REVIEWED**

Epichlorohydrin induced dose-dependent chromosome abnormalities in bone marrow of ICR mice injected ip to a single dose of 1-50 mg/kg or repeated doses of five times at 5-20 mg/kg, or given po in a single dose of 5-100 mg/kg or repeated doses of five times at 20 mg/kg. Epichlorohydrin did not induce any dominant lethal mutation in ICR mice when given ip in a single dose of 5-40 mg/kg, 150 mg/kg, repeated doses of five times at 1-10 mg/kg, po in a single dose of 20 or 40 mg/kg or by repeated doses at five times at 4-20 mg/kg. [Fishbein L; Potential Indust Carcins & Mutagens p.46 (1977) EPA 560/5-77-005]**PEER REVIEWED**

Human peripheral lymphocytes exposed to 10-5 to 10-7 M epichlorohydrin in vitro during the last 24 hr of cultivation showed chromosomal aberrations. ... The epichlorohydrin induced changes were mainly classified as chromatid and isochromatid breaks and exchanges. [Fishbein L; Potential Indust Carcins & Mutagens p.46 (1977) USEPA 560/5-77-005]**PEER REVIEWED**

Epichlorohydrin has resulted in very low mutagenic activity. [De Serres FJ, Hollaender A; Chemical Mutagens Vol 5 p.31 (1978)]**PEER REVIEWED**

Epichlorohydrin induces reverse mutation presumably through base-pair substitution in Salmonella strains TA1535 and TA100 without addition of S-9. The urine of exposed humans and mice also gives positive results in Salmonella without further metabolic activation. [De Serres FJ, Hollaender A; Chemical Mutagens Vol 8 p.302 (1983)]**PEER REVIEWED**

Forward mutations are produced in Neurospora in the absence of exogenous activation. [De Serres FJ, Hollaender A; Chemical Mutagens Vol 8 p.302 (1983)]**PEER REVIEWED**

Primary DNA damage tests using repair-proficient and deficient bacteria
show largely positive results in the presence of activation. [De Serres FJ, Hollaender A; Chemical Mutagens Vol 8 p.302 (1983)]**PEER REVIEWED**

The 14 day LC50 value of epichlorohydrin to the guppy (Poecilia reticulata) was determined. These data were investigated through the construction of a quantitative structure-activity relationship (QSAR). Both hydrophobicity and alkylating potency of the compound were found to be necessary parameters for the satisfactory description of the LC50 data. The log LC50 experimental data for epichlorohydrin was 0.85 umol/l as compared to the calculated QSAR value of 1.08 umol/l. [Deneer JW et al; Aquatic Toxicol 13 (3): 195-204 (1988)]**PEER REVIEWED**

The Drosophila wing somatic mutation and recombination test was applied to a series of chemicals to determine its suitability in genotoxicity screening. Epichlorohydrin was weakly positive in the sex linked recessive lethal test, but only after injection. Inhalation testing of 3 day old larvae for 1 hour showed inconclusive results for the lowest exposure (1 ul liquid injected into 1150 ml air), positive for small and large single spots and inconclusive for twin spots at the intermediate exposure (2 ul), and positive for all three mutations at the highest exposure (4 ul). [Graf U et al; Mutat Res 222 (4): 359-73 (1989)]**PEER REVIEWED**

A study was conducted using a combined testing protocol, to determine whether short-term biological end-points, singly or in combination, are sufficiently sensitive to identify damage induced by exposure to ambient levels of industrial chemicals. A small-scale inhalation set-up which is both economical and easy to assemble was designed. Mice were exposed to 4 concentrations of a custom-blend mixture of benzene, chloroprene, epichlorohydrin and xylene in a ratio of 2:2:1:2, respectively. The concentrations for benzene, chloroprene and xylene 0, 0.1, 1.0 and 10 ppm each. Concentrations for epichlorohydrin were half those for the other components. Groups of 22 males and 22 female mice were exposed to each concentration of the mixture for 3 and 6 weeks. Selected biological end-points including urine mutagenesis, bone marrow cell aberrations and micronuclei, spleen lymphocyte aberrations and liver and enzyme induction were monitored. The spleen lymphocyte aberrations and liver and enzyme induction were the most sensitive end-points. The lymphocytes showed a significant induction of chromosome aberrations from exposure for 3 weeks to all 3 concentrations of the mixtures. After 6 weeks of exposure, significant induction of aberrations was observed after exposure to low and medium concentrations but not to the high concentration. This lack of response at the high concentration after 6 weeks exposure, appeared to correlate with a significant induction of glutathione S-transferase in the liver. Since this enzyme is known to detoxify 3 of the 4 chemicals in our mixture, it may indicate a detoxification mechanism after enzyme induction. The present study indicates that the combined testing protocol is sufficiently sensitive to identify toxicological effects after exposure to ambient levels of a gas mixture. [Au WW et al; Mutat Res 203 (2): 103-15 (1988)]**PEER REVIEWED**

A multiple end-point approach to assessing genetic toxicity (the combined testing protocol) was evaluated in male and female CD-1 mice exposed subacutely (3 and 6 weeks) to low levels of a custom blended gas mixture (epichlorohydrin, benzene, chloroprene and xylene, at 50, 100, 100, and 100 ppb, respectively, as the low dose, with concentration levels 10 fold and 100 fold higher as the intermediate and high doses, or 0.1, 1 and 10 ppm of benzene). Urine mutagenicity was tested in the Salmonella/microsome
assay, chromosome aberrations were examined in bone marrow and spleen lymphocytes, micronuclei were measure in bone marrow and peripheral erythrocytes, and cytochrome p450 and glutathione S-transferases were measured in the liver. Structural aberrations in alveolar macrophages and spermatocytes, and thioguanine resistance in spleen lymphocytes were examined for their suitability for incorporation into the overall protocol. Spleen lymphocytes were the most sensitive indicator cells, and showed a dose-related increase (P < 0.01) in structural chromosome aberrations and in cytotoxicity after 6 weeks of exposure. Analysis of micronucleus formation and metaphase aberrations in the bone marrow, and micronucleus in peripheral erythrocytes showed an overall statistically non-significant but positive trend at the high dose. No mutagenicity was detected in pooled urine samples. Liver microsomal cytochrome p450 was not increased, but cytosolic glutathione S-transferases were significantly increased in a dose-related manner. Since the probability of detecting a genotoxic effect increases with the number of endpoints and tissues examined, this approach should be applicable to many situations without having to perform separate experiments for each tissue examined. [Harper BL et al; J Appl Toxicol 9 (2): 97-102 (1989)]**PEER REVIEWED**

The use of cytogenetic assays in genotoxic investigations was discussed and in vivo cytogenetic investigations conducted in mice and rats were reviewed. An inhalation investigation of the effects of a 1:1:0.5:1 mixture of benzene, chloroprene, epichlorohydrin, and xylene in CD-1 mice at concentrations up to 10 ppm, using induction of chromosome aberrations in splenic lymphocytes as the endpoint, revealed that low and medium doses increased the frequency of chromosome aberrations, whereas high doses decreased it. [Au WW et al; Teratogenesis, Carcinogenesis, & Mutagenesis 10 (2): 125-34 (1990)]**PEER REVIEWED**

The genotoxicity of monofunctional alkylating agents and their carcinogenicity potency in rodents were examined. Epichlorohydrin, was one several compounds which was tested for its genotoxic potential in a specially designed Escherichia coli assay system (Escherichia coli multitest). The multitest consisted of a set of Escherichia coli mutants created by fusing the cI and cro region and gal operon of two strains, MT103 and MT119. The endpoints were increases in mutation and recombination frequency and RecA-dependent protease activity (SOS induction). Increases in mutation and recombination frequency and numbers of SOS induction colonies induced by the alkylating agents were compared with previously published data obtained in carcinogenesis studies in rats. When analyzed separately, increases in mutant and recombinant frequencies and SOS induction colonies induced by the compounds did not correlate well with their carcinogenic potencies. When product of the mutant and recombinant frequencies were analyzed, it correlated well the in vivo carcinogenic potencies, correlation coefficient 0.95. Escherichia coli multitest is a rapid, simple test for assessing the correlation between carcinogenicity and genotoxicity of DNA damaging agents. [Quinto I et al; Mutat Res 228 (2): 177-85 (1990)]**PEER REVIEWED**

Measurements were taken of fertility rates, litter sizes, and pup weights during development for female Long-Evans hooded rats exposed to epichlorohydrin prior to ovulation through fertilization and gestation. Epichlorohydrin treatment prior to fertilization and gestation was initiated for the purpose of studying possible effects on the hormonal regulation of the estrous cycle and to study changes in copulatory behavior as a manifestation of an adverse effect on the central nervous
system. Male rats were dosed with 12.5, 25, or 50 mg/kg/day orally for 21 days. Females were treated similarly with 25, 50, or 100 mg/kg/day. The animals were paired with untreated mates. Fertility at the high dose male group was totally impaired. Female reproduction was unchanged. Treated males showed normal copulatory behavior. No statistical differences were noted for either sperm morphology or percentage motile sperm in both ejaculated and cauda epididymal samples from treated males. At the 50 mg/kg dose level, the number of sperm in ejaculates was normal while cauda epididymal sperm count was slightly decreased. At 12.5 mg/kg/day dose levels and above the man curvilinear velocity, straight line velocity, and amplitude of lateral head displacement or cauda epididymal sperm were significantly reduced. A reduction was also noted in sperm track linearity, but only at the 50 mg/kg/day dose level. A significant increase was noted in beat/cross frequency of sperm at 12.5 mg/kg/day and above. Dose dependent trends were noted in all of the above sperm motion parameters. [Toth GP et al; Fund and Appl Toxicol 13 (1): 16-25 (1989)]**PEER REVIEWED**  

Trichloroethylene is a high production volume chemical frequently stabilized with oxiranes. These oxiranes may be responsible for the mutagenic activity of trichloroethylene in Salmonella, which has been occasionally, but not consistently, reported. High purity and oxirane-stabilized trichloroethylene samples were tested for their mutagenic potential in Salmonella typhimurium strains TA 1535, TA 98, and TA 100. Stabilized trichloroethylene was tested using a preincubation protocol up to a dose level of 10,000 ug per plate, but no mutagenic response was observed in either the presence or absence of a supplementary metabolic activation system (S9 mix) derived from Aroclor 1254-induced male rat liver. Trichloroethylene without oxirane stabilizers also was nonmutagenic when tested in a vapor delivery system at nominal concentrations of up to 20% and using S9 mix derived from either rat or hamster. Trichloroethylene containing 0.5-0.6% 1,2-epoxybutane did induce mutagenic responses from strains TA 1535 and TA 100 in the presence and absence of S9 mix. The lowest effective dose was about 0.63% in TA 1535 in the absence of S9 mix. Vapor-phase tests with 1,2-epoxybutane showed that an atmospheric concentration of 0.009% could induce 12-fold and 3-fold increases, respectively, in strains TA 1535 and TA 100. These increases would account for the mutagenic activity of the stabilized trichloroethylene sample. Epichlorohydrin (another commonly used stabilizer) induced similar increases in mutant numbers at an atmospheric concentration of 0.0009%. The absence of a significant response caused by unstabilized trichloroethylene in the presence of S9 mix is probably due to a lack of assay sensitivity, since chloral, a metabolite of trichloroethylene, is a mutagen in TA 100. [McGregor DB et al; Environ Mol Mutagen 13 (3): 197-202 (1989)]**PEER REVIEWED**  

Deuterated and non-deuterated N-nitrosodimethylamine, epichlorohydrin and dimethyl sulfate were evaluated for the ability to induce DNA single-strand breaks in rat hepatocytes as measured by alkaline elution. Non-deuterated nitrosodimethylamine induced twice the amount of DNA-strand breaks as the deuterated form. No evidence of a deuterium isotope effect was seen for the direct-acting alkylating agents epichlorohydrin and dimethyl sulfate. [Sargent EV et al; Mutat Res 263 (1): 9-12 (1991)]**PEER REVIEWED**  

The effect of inhaled epichlorohydrin on rat sperm motility characteristics was evaluated. Male F-344 rats were exposed to 100 ppm epichlorohydrin via inhalation for 4 hrs on the morning of day 0 and
killed immediately and on day 1, 2, 6 and 14 postexposure. Videotapes of cauda epididymal sperm were analyzed (300-350 sperm/sample) with a Hamilton Thorn Motility Analyzer. Epichlorohydrin did not affect the percentage of motile sperm at any time. However, transient changes in sperm velocity were found. On day 1 postexposure mean progressive (straight-line) and mean path (smoothed curvilinear) velocity were significantly decreased to 80% and 85% of control, respectively. The progressive velocities of sperm from both control and treated rats were normally distributed, indicating a general effect of epichlorohydrin on all sperm as opposed to a more severe effect on a specific sperm subpopulation. Both velocities remained slightly but significantly decreased on day 2 (92% and 93% of control for progressive and path velocity, respectively), and were unaffected at later timepoints. Other endpoints (testis and epididymis weights, testicular spermatid counts adn cauda epididymal sperm reserves) were unaltered by epichlorohydrin. Thus, inhaled epichlorohydrin produced specific, transient decreases in rat sperm velocity. (Slott VL et al; Govt Reports Announcements & Index (GRA&I) Issue 9, NTIS/PB91-149732 (1991))**PEER REVIEWED**


NON-HUMAN TOXICITY VALUES:


LD50 Mouse oral 0.238 g/kg [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information
Institute, 1988.208]**PEER REVIEWED**


ECOTOXICITY VALUES:

LC50 Goldfish 23 mg/l 24 hr /Conditions of bioassay not specified/ [Birdie AL al et; Water Research (BG) 13: 633 (1979)]**PEER REVIEWED**

LC50 Bluegills 35 mg/l 96 hr /Conditions of bioassay not specified/ [Dawson GW et al; Jour Hazard Materials 1: 303 (1977)]**PEER REVIEWED**


**TSCA TEST SUBMISSIONS:**

The effects of acute oral exposure to epichlorohydrin (ECH) by gavage in male Wistar rats (20 in control group (water), 5/treated group, number of treated groups not reported) were determined. ECH (single doses of 0, 25 and 50 mg/kg) was administered and the rats were necropsied on the 11th day following dosing. There were differences between treated and control animals in the following: increase in incidence of abnormal sperm (high-dose level group), and decreased total sperm head counts (low-dose group). There were no significant differences between treated and control animals in the following: clinical observations, histopathology of the testes, and testes weights.[Shell Oil Co.; The Effects of Acute Exposure of Dimethoxyethyl Phthalate, Glycerol Alpha-monochlorohydrin, Epichlorohydrin, Formaldehyde and Methylmethanesulfonate Upon Testicular Sperm in the Rat. (1982), EPA Document No. 878210077, Fiche No. OTS0206200]**QC REVIEWED**

The effects of exposure to epichlorohydrin by inhalation on the fertility of male New Zealand white rabbits (10/group) exposed at nominal concentrations of 0, 5, 25 or 50 ppm for 6 hrs/day, 5 days/week for 10 weeks and held for a recovery period of 10 weeks were evaluated. Semen from male rabbits was examined during the exposure and recovery periods.
The exposed male rabbits were mated with unexposed females. There were significant differences observed between treated and control F0 males in the following: excessive nasal exudation (50 ppm group), decreased body weight and weight gain (50 ppm), numbers of non-motile sperm (increased in 25 ppm males at 10th week of exposure), low sperm motility (decreased at 25 pm during 18th week, increased at 25 and 50 ppm during 16th week (recovery period)), increased pre-implantation losses (50 and 5 ppm groups), decreased absolute brain weight, nasal turbinate inflammation (50 and 25 ppm, at 10th week interim sacrifice), and increased rhinitis and sinusitis (50 and 25 ppm group, final sacrifice). One male in each treatment group died prematurely with observed pathology including suppurative rhinitis (50 and 5 ppm), a pulmonary abscess extensively filling the thoracic cavity (25 ppm), or external otitis and mucoid enteritis (5 ppm). There were no significant differences observed between treated and control males in the following: sperm concentration or volume per ejaculate, viability or number of live sperm, percentages of intact sperm, average number of implantations, corpora lutea in non-exposed females mated with exposed males, fertility index, hematology or clinical chemistry values, relative or absolute weights of heart, liver, kidney, testes or epididymides, final sacrifice relative or absolute organ weights.

The effects of exposure to epichlorohydrin by inhalation on the fertility of male and female Sprague Dawley rats (30/sex/group) exposed at nominal concentrations of 0, 5, 25 or 50 ppm for 6 hrs/day, 5 days/week for 10 weeks and held for a recovery period of 10 weeks were evaluated. The male rats were mated with unexposed females and the exposed females were mated with unexposed males. There were significant differences observed between treated and control F0 animals in the following: decreased body weight and weight gain (50 ppm females and males), increased white blood counts (all exposed rats), decreased red blood cell count (males at 50 ppm), and at interim sacrifice (10th week), increased relative and absolute weight of kidney and degenerative change in nasal turbinates (both sexes at 50 ppm and 25 and 50 ppm, respectively). There were significant differences observed in the following exposed male reproductive parameters: marked decreased in number of fertile males (50 ppm group, all 4 exposure mating periods; recovery of fertility was observed as early as 1st recovery mating in 2nd week of recovery), decreased number of implantations in unexposed females (mated to 25 and 50 ppm males during exposure period), decreased number of corpora lutea (exposure period, all matings at 50 ppm, 2nd mating at 25 ppm), decreased number of resorptions (1st recovery mating at 50 ppm), increase in preimplantation losses (exposure matings at 25 and 50 ppm, recovery mating at 50 ppm), and resorption rate (50 ppm, increased for last exposure mating and decreased for 1st recovery mating). There were no significant differences observed in the following exposed female reproductive parameters: percentage of impregnated females, length of gestation period, litter size or survivability and sex ratio of neonates. There were no significant differences observed between treated and control animals in the following: maternal or paternal mortality, final sacrifice relative or absolute organ weights, and final sacrifice histopathology.

Teratogenicity was evaluated in pregnant female Sprague Dawley rats...
(43-46/group) exposed by inhalation to epichlorohydrin at nominal concentrations of 0, 2.5 or 25 ppm for 7 hrs/day during gestation days (GD) 6-15. There were significant differences observed between treated and control animals in the following: decreased maternal body weights and food consumption (25 ppm group). There were no significant differences observed between treated and control animals in the following: absolute or relative liver weight, gravid uterus weights, maternal survival, percentage of pregnant dams, number of implantation sites/dam, live fetuses/litter, fetal sex ratio, fetal body measurements, number of resorptions, total or particular external and soft tissue alterations, or skeletal variations.[Dow Chemical USA; Epichlorohydrin - Subchronic Studies, IV. The Effects of Maternally Inhaled Epichlorohydrin on Rat and Rabbit Embryonal and Fetal Development. (1979), EPA Document No. FYI-AX-0280-0061, Fiche No. 0000061-0 ]**QC REVIEWED**

Teratogenicity was evaluated in pregnant female New Zealand white rabbits (20/treated group, 25/control group) exposed by inhalation to epichlorohydrin at nominal concentrations of 0, 2.5 or 25 ppm for 7 hrs/day during gestation days (GD) 6-18. There were significant differences observed between treated and control animals in the following: decreased incidence of foramen of the skull and incidence of extra ribs in fetuses (25 ppm group). There were no significant differences observed between treated and control animals in the following: maternal body weights, weight gain, absolute or relative liver weights, gravid uterus weights, maternal survival, percentage of pregnant dams, number of implantation sites/dam, live fetuses/litter, fetal sex ratio, fetal body measurements, number of resorptions, total or particular external and soft tissue alterations.[Dow Chemical USA; Epichlorohydrin - Subchronic Studies, IV. The Effects of Maternally Inhaled Epichlorohydrin on Rat and Rabbit Embryonal and Fetal Development. (1979), EPA Document No. FYI-AX-0280-0061, Fiche No. 0000061-0 ]**QC REVIEWED**

The ability of epichlorohydrin to cause chromosome aberrations was evaluated in the bone marrow cells of male and female Fischer 344 rats (10/sex/group) exposed by inhalation to epichlorohydrin at concentrations of 0, 5, 25 or 50 ppm for the males and 0 or 50 ppm for the females for 6 hrs/day, 5 days/week for 4 weeks. The rats were sacrificed on the day following the last exposure and 200 cells/animal were scored for chromosome aberrations. The frequency of aberrations found in all groups was quite low. Male rats exposed to 25 and 50 ppm exhibited a doubling of the frequency over the controls (0.3% to 0.15%), but there was no consistent dose-response effect observed. Statistical analysis by Fischer's exact test indicated the differences in the males was not significant. There were no differences observed between treated and control females with respect to the frequency of chromosome aberrations in bone marrow cells.[Dow Chemical U.S.A.; III. Cytogenic Evaluation of Bone Marrow Cells From Rats Exposed by Inhalation to Epichlorohydrin for Four Weeks. (1979), EPA Document No. 878210084, Fiche No. OTS0206200 ]**QC REVIEWED**

The mutagenicity of epichlorohydrin was evaluated in Salmonella tester strains TA98, TA100, TA1535 and TA1537 (Ames Test), both in the presence and absence of added metabolic activation by Aroclor-induced rat liver S9 fraction. Based on the results of preliminary bacterial toxicity determinations, epichlorohydrin, diluted with DMSO, was tested for mutagenicity at concentrations of 0.001, 0.01, 0.1, 1.0, and 5.0 micromoles/plate using the plate incorporation method. Epichlorohydrin
caused a reproducible positive response at 1.0 and 5.0 micromoles/plate in tester strains TA1535 and TA100, both in the presence and absence of metabolic activation, and at 5.0 micromoles/plate in tester strain TA98 in the absence of activation. [Rohm and Haas Co.; Epichlorohydrin Microbial Mutagen Test. (1978), EPA Document No. 878212036, Fiche No. OTS0205978]**QC REVIEWED**

The fate of 2-14C-epichlorohydrin (ECH) was studied in five male Fischer 344 rats exposed by gavage to an aqueous solution of ECH (approximately 6 mg/kg, 25 uCi/animal). Urine, feces and exhaled air were monitored for radioactivity. The animals were sacrificed 3 days after dosing and selected tissues were analyzed for radioactivity. Within 3 days, 50% of the administered radioactivity was recovered in the urine, 3% in the feces, and 38% as exhaled CO2. Total radioactivity recovered in the muscle (4.83% of dose), liver (2.82%), kidney (0.41%), and fatty tissue (0.47%). Activity (as radioactivity/g of tissue) was high in liver, kidney, and forestomach, but was below blood levels in other tissues. Unextractable radioactivity was highest in the kidney, while the level in the testis was approximately the same as that in the blood. [Shell Westhollow Research Center; Biochemistry of Three-Carbon Halogenated Compounds: Disposition of (2-14C)- Epichlorohydrin After Oral Administration to Rats. (1982), EPA Document No. 878210087, Fiche No. OTS0206200]**QC REVIEWED**

The fate of 1,3-14C-epichlorohydrin (1,3-14C-Epi) was studied using male Fischer 344 rats exposed either by inhalation in a head-only chamber to nominal doses of 1 (3 rats) or 100 ppm (4 rats) for 6 hrs or by gavage to a single dose of 1 or 100 mg/kg. The rats were immediately transferred to Both-type glass metabolism cages following exposure, and samples of plasma, urine, feces, and expired air were collected at 8 hr intervals for 72 hrs. By 72 hrs, 79-89% of the dose had been recovered from urine (46-54%) and as 14CO2 in expired breath (25-42%) regardless of the dose level or route. At 72 hrs, 1-4% of the dose was found in the skin and 4-5% in the carcass. Very little of the excreted 14C was parent Epi. Urinary metabolites showed 9 peaks (gavage) and 8 peaks (inhalation) by ion-exclusion chromatography. Separate experiments in which rats were exposed by gavage to 100 mg 3-14C-Epi indicate that if any C-C bond is broken the molecule is metabolized completely to CO2. A 4 to 5 times greater concentration was seen in the target organ for toxicity (nasal turbinates) than in the lung immediately following inhalation. Similar results were not observed at any time after oral exposure. [Dow Chemical USA; Pharmacokinetics of Epichlorohydrin (EPI) Administered to Rats by Gavage or Inhalation. (1979), EPA Document No. FYI-AX-0185-0022, Fiche No. OTS0000022-1]**QC REVIEWED**

METABOLISM/PHARMACOKINETICS:

... WISTAR RATS DOSED ORALLY OR IP WITH ... EPICHLOROHYDRIN YIELD ... URINARY METABOLITES ... 2,3-DIHYDROXYPROPYL-S-CYSTEINE &amp; ITS N-ACETATE. SINCE EPICHLOROHYDRIN IS A STRONG ELECTROPHILE THAT IS CAPABLE OF REACTING WITH CELLULAR NUCLEOPHILES, IT IS PROBABLE THAT SOME EPICHLOROHYDRIN METABOLITES ARE ALSO COVALENTLY BOUND TO VARIOUS TISSUE MACROMOLECULES. [National Research Council. Drinking Water and Health. Volume 3, Washington, DC: National Academy Press, 1980.113]**PEER REVIEWED**
Rats given oral (14)C labeled epichlorhydrin and sacrificed after 3 days: 38% exhaled as carbon dioxide; 50% excreted as metabolites in urine; 3% excreted in the feces; and the remainder was found in the tissues - liver, kidney, and forestomach. [Gingell R et al; Drug Metb Dispos 13 (3): 333-41 (1985)]**PEER REVIEWED**

The major urinary metabolite of (14)C-epichlorohydrin, after oral administration to rats, was identified previously to be N-acetyl-S-(3-chloro-2-hydroxypropyl)-L-cysteine at 36% of the administered dose. In a similar study reported here, 1,2-dibromo-3-chloropropane was metabolized to at least 20 radioactive urinary metabolites. N-acetyl-S-(3-chloro-2-hydroxypropyl)-L-cysteine was only a minor metabolite (4%) of 1,2-dibromo-3-chloropropane. Epichlorohydrin was metabolized in vitro by rat liver microsomes to alpha-chlorohydrin, but 1,2-dibromo-3-chloropropane was not metabolized to epichlorohydrin or alpha-chlorohydrin under similar conditions. Covalent binding of radioactivity to liver microsomal proteins occurred for both substrates, but was less for (14)C-epichlorohydrin than for (14)C-1,2-dibromo-3-chloropropane. Addition of 3,3,3-trichloropropylene oxide, an inhibitor of epoxide hydrolase, increased the extent of protein binding of epichlorohydrin, but decreased the amount of (14)C-1,2-dibromo-3-chloropropane which was bound. The data indicate the epichlorohydrin is not a significant in vivo nor in vitro metabolite of 1,2-dibromo-3-chloropropane in the rat, and is unlikely to be responsible for the toxicity of 1,2-dibromo-3-chloropropane. [Gingell R et al; Xenobiotica 17 (2): 229-40 (1987)]**PEER REVIEWED**

ABSORPTION, DISTRIBUTION & EXCRETION:
RATS SHOWED RAPID ABSORPTION FROM GI TRACT WITH PEAK TISSUE LEVELS @ 2 HR IN MALES & 4 HR IN FEMALES. KIDNEYS, LIVER, PANCREAS, ADRENALS, & SPLEEN CONTAINED HIGHEST AMT. [WEIGEL, WW ET AL, RES COMMUN CHEM PATHOL PHARMACOL 20 (2): 275 (1978)]**PEER REVIEWED**

WITH EXCEPTION OF PANCREAS, A CORRELATION OBSERVED BETWEEN TISSUE DISTRIBUTION & TARGET ORGAN TOXICITY. EXCRETION MAINLY IN URINE. 21% & 18% OF DOSE EXCRETED AS CO2 IN MALE & FEMALE RATS. PEAK TISSUE LEVELS IN FEMALES LOWER. [WEIGEL WW ET AL, RES COMMUN CHEM PATHOL PHARMACOL 20 (2): 275 (1978)]**PEER REVIEWED**


The absorption of chemical vapors by the upper respiratory tract was studied in rats. The upper respiratory tarcts of male Fischer F344 rats were surgically isolated and connected to a specially designed flow system. The tracheal connection of the upper respiratory tract and the lower respiratory tract was interrupted. The upper respiratory tract was exposed to propylene-glycol- monomethyl ether, propylene glycol monomethyl ether acetate, epichlorohydrin, cmpd which include vapors while the rat spontaneously breathed from a stream of air. Intact rats were exposed nose only to the same compound and the percentages of vapor absorbed were determined for comparison purposes. Attempts were made to correlate the results with the water solubility of the compounds. The data were compared
to predictions of two compartment mathematical models. More than 50 to 70% of the epichlorohydrin, vapors passing through the isolated upper respiratory tracts were absorbed. With the exception of styrene and methylene chloride, the percentage of vapors absorbed by the upper respiratory tract approximated that observed in the lower respiratory tract and nose only exposed animals. There was no correlation between absorption in the URT and water solubility. The mathematical models generally predicted the absorption of vapors by the lower respiratory tract and intact animals accurately. The models seriously underestimated absorption of epichlorohydrin, by the upper respiratory tract. /Results indicate/ that blood air partitioning can account for absorption of chemicals by the upper respiratory tract, but only if other metabolic and physiological parameters are considered. [Stott Wt et al; Toxicology of the Nasal Passages p.191-210 (1986)]**PEER REVIEWED**

**BIOLOGICAL HALF-LIFE:**
... Male mice were given a single ip injection of epichlorohydrin dissolved in corn oil. Groups of ten mice were killed by decapitation at 1, 3, 5, 7, 10, 15, 20 and 30 minutes after injection and blood samples were collected. The in vivo half-life of epichlorohydrin is extremely short, being only just detectable after 15 minutes. [USEPA; Health Assessment Document: Epichlorohydrin p.4-2 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

**MECHANISM OF ACTION:**
The two reactive electrophilic sites, the C-1 carbon in the epoxide ring and C-3, the chlorine-bearing carbon, behave as alkylating agents and can react nonenzymatically with glutathione or protein sulfhydryl groups. [USEPA; Health Assessment Document: Epichlorohydrin p.4-6 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

3-Chloro-1,2-propanediol /to which epichlorohydrin may be enzymatically converted/ oxidized to chlorolactic acid. Conversion of beta-chlorolactic acid to oxalic acid may occur and could result in renal toxicity in rats due to deposition of oxalic acid crystals in the kidneys. [USEPA; Health Assessment Document: Epichlorohydrin p.4-6 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

3-Chloroglycerophosphate inhibited rat sperm enzyme activities (glyceraldehyde-3-phosphate dehydrogenase and triosephosphate isomerase) and hence glycolysis. Only the S(-) isomer and not the R(+) isomer of 3-chloro-1,2-propanediol produced antifertility or antiglycolytic effects. Since epichlorohydrin has not been shown to have enzyme inhibitory effects, it may be that it is metabolized in vivo to S(-) alpha-chlorohydrin phosphate, to exert its antifertility effect. [USEPA; Health Assessment Document: Epichlorohydrin p.4-8 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

**INTERACTIONS:**
PHARMACOLOGY:

INTERACTIONS:


ENVIRONMENTAL FATE & EXPOSURE:

ENVIRONMENTAL FATE/EXPOSURE SUMMARY:

Epichlorohydrin's production and use as a solvent and chemical intermediate may result in its release to the environment through various waste streams. If released to air, a vapor pressure of 16.4 mm Hg at 25 deg C indicates epichlorohydrin will exist solely as a vapor in the ambient atmosphere. Vapor-phase epichlorohydrin will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 36 days. If released to soil, epichlorohydrin is expected to have very high mobility based upon an estimated Koc of 40. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 3.0X10^-5 atm-cu m/mole. Epichlorohydrin may volatilize from dry soil surfaces based upon its vapor pressure. Epichlorohydrin is expected to undergo hydrolysis in moist soil surfaces. Limited data suggest that epichlorohydrin may undergo biodegradation in acclimated soil and surface waters. If released into water, epichlorohydrin is not expected to adsorb to suspended solids and sediment in water based upon the estimated Koc. Volatilization from water surfaces is expected to be an important fate process based upon this compound's estimated Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 19 hours and 12 days, respectively. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is expected to be an important environmental fate process based upon hydrolysis half-lives of 8.2 days and 5.3 days in distilled water and simulated seawater, respectively. Occupational exposure to epichlorohydrin may occur through inhalation and dermal contact with this compound at workplaces where epichlorohydrin is produced or used. (SRC) **PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:

NIOSH (NOES Survey 1981-1983) has statistically estimated that 8,032 workers (655 of these are female) are potentially exposed to epichlorohydrin in the US(1). Occupational exposure to epichlorohydrin may occur through inhalation and dermal contact with this compound at workplaces where epichlorohydrin is produced or used (SRC). In a 1989 Danish survey on chemical exposures(2), the number of worker exposure events for epichlorohydrin were documented: manufacturing of metals, 40; manufacturing of metal fabricated products 17,500; electrical machinery and apparatus, 2,100; manufacture of transport equipment 260; painters and carpenters 1,500; construction workers, 5,000; publishing and printing, 610; wholesale trades, 1,400; textile and leather manufacturing, 450; wood and furniture manufacturing, 510; manufacture of paints and petroleum, 38;
manufacture of non-metallic mineral products, 2,100; manufacture of optical instruments, 1,800; manufacture of plastic and boat building, 150; health services, 44. The total number of work related exposure events was 33,000(2). [(1) NIOSH; National Occupational Exposure Survey (NOES) (1983) (2) Brandorff NP et al; Occup Environ Med 52: 454-63 (1995)]**PEER REVIEWED**

ARTIFICIAL POLLUTION SOURCES:
Epichlorohydrin's production and use as a solvent and chemical intermediate(1) may result in its release to the environment through various waste streams(SRC). Emissions from its production (estimated 6.7X10+4 kg from 3 facilities in 1978) and use in epoxy resins (estimated 1.1X10+5 kg from 11 facilities in 1978) and as a chemical intermediate (estimated 3.7X10+4 kg in production of chemicals other than glycerine in 1978); wastewater, and spills(2). Other uses which may lead to its release include textile treatment, coatings, solvent, surface active agent, stabilizer in insecticide, and elastomer manufacture(2,3). Atmospheric emissions of epichlorohydrin were reported as 479,000 lbs/yr in the US in a 1983 study(3). [(1) Budvari S; Merck Index, 12th ed, Whitehouse Station, NJ: Merck and Co. p. 612 (1996) (2) Keneklis T et al; Health Assessment Document for Epichlorohydrin. External review draft; p.1.1-3.4 USEPA 600/8-93-032a (1983) (3) Verscheuren K; Handbook of environmental data on organic chemicals; Van Nostrand Reinhold New York p.611-2 (1983) (4) Anderson GE; Human Exposure to Atmospheric Concentrations of Selected chemicals. Vol 1. NTIS PB84-102540. USEPA Triangle Park, NC Off Air Qual Planning and Standards (1983)]**PEER REVIEWED**

ENVIRONMENTAL FATE:

AQUATIC FATE: Based on a classification scheme(1), an estimated Koc value of 40(SRC), determined from a log Kow of 0.45(2) and a regression-derived equation(3), indicates that epichlorohydrin is not expected to adsorb to suspended solids and sediment in water(SRC). Volatilization from water
surfaces is expected(3) based upon an estimated Henry's Law constant of
3.0X10-5 atm-cu m/mole (SRC), calculated from its vapor pressure of 16.4 mm
Hg(4) and water solubility of 65,900 mg/l(5). Using this estimated Henry's
Law constant and an estimation method(3), volatilization half-lives for a
model river and model lake are 19 hours and 12 days, respectively (SRC).
According to a classification scheme(6), an estimated BCF of 3 (SRC), from
its log Kow(2) and a regression-derived equation(7), suggests the
potential for bioconcentration in aquatic organisms is low. The hydrolysis
half-life of epichlorohydrin is 8.2 days in distilled water and 5.3 days
in simulated seawater(8). Epichlorohydrin achieved 3% of the theoretical
BOD in a sewage sludge over a 5 day incubation period, but achieved 14% of
the theoretical BOD following acclimation(9); thus biodegradation in
acclimated water may be important (SRC). [(1) Swann RL et al; Res Rev 85:
Lyman WJ et al; Handbook of Chemical Property Estimation Methods.
TE, Danner RF; Physical and Thermodynamic Properties of Pure Chemicals
SH, Dannenfelser RM; Aquasol Database of Aqueous Solubility. Version 5.
College of Pharmacy, University of Arizona - Tucson, AZ (1992) (6) Franke
C et al; Chemosphere 29: 1501-14 (1994) (7) Meylan WM et al; Environ
(1986)]**PEER REVIEWED**

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of
semivolatile organic compounds in the atmosphere(1), epichlorohydrin,
which has a vapor pressure of 16.4 mm Hg at 25 deg C(2), is expected to
exist solely as a vapor in the ambient atmosphere. Vapor-phase
epichlorohydrin is degraded in the atmosphere by reaction with
photochemically-produced hydroxyl radicals (SRC); the half-life for this
reaction in air is estimated to be 36 days (SRC), calculated from its rate
constant of 4.4X10-13 cu cm/molecule-sec at 25 deg C(3). [(1) Bidleman TF;
and Thermodynamic Properties of Pure Chemicals Data Compilation
Data Monograph 1 (1989)]**PEER REVIEWED**

ENVIRONMENTAL BIODEGRADATION:
An unspecified amount of epichlorohydrin reached 18% of its theoretical
BOD in 1 week using an activated sludge inoculum and the Japanese MITI
test(1). Pure cultures were able to rapidly biodegrade epichlorohydrin to
3-chloro-1,2-propanediol(2). Epichlorohydrin achieved 3% of the
theoretical BOD in a sewage sludge over a 5 day incubation period, but
achieved 14% of the theoretical BOD following acclimation(3).
Epichlorohydrin was 67% biodegraded in an activated sludge degradability
test following a 1 day acclimation period(4). [(1) Chemicals Inspection
and Testing Institute; Japan Chemical Industry Ecology - Toxicology and
(1988)]**PEER REVIEWED**

ENVIRONMENTAL ABIOTIC DEGRADATION:
The rate constant for the vapor-phase reaction of epichlorohydrin with
photochemically-produced hydroxyl radicals has been measured as 4.4X10-13
cu cm/molecule-sec at 25 deg C(1). This corresponds to an atmospheric
half-life of about 36 days at an atmospheric concentration of 5\times 10^5 hydroxyl radicals per cu cm\(^{-1}\). Anions such as chloride attack the epoxide ring producing 1,3-dichloro-2-propanol\(^4\). Epichlorohydrin reacts with photochemically produced hydroxyl radicals with an estimated atmospheric half-life of 4 days\(^5\). When irradiated in the presence of 5 ppm nitric oxide to simulate photochemical smog conditions, the half-life was 16 hrs\(^6\). Epichlorohydrin hydrolyzes in distilled water to yield 1-chloro-2,3-propanediol, with a half-life of 8.2 days\(^2\). Acid catalysis contributes less than 10\% to the rate of hydrolysis and base catalysis is not detectable at pH < 10\(^2\). The half-life in 3\% sodium chloride (simulated seawater) is 5.3 days\(^2\). The reported hydrolysis half-life of epichlorohydrin in acidic waters (pH = 2.5) was reported as 3.3 days and in basic waters (pH = 12) 2.6 days\(^3\). [(1) Atkinson R; J Phys Chem Ref Data Monograph 1 (1989) (2) Mabey W, Mill T; J Phys Chem Ref Data 7: 383-415 (1978) (3) Krijghsheld KR, van der Gen A; Chemosphere 15: 881-93 (1986) (4) Santodonato J et al; Investigation of selected potential environmental contaminants: epichlorohydrin and epibromohydrin; p.73-5 USEPA 560/11-80-006 (1980) (5) Cupitt LT; Fate of toxic and hazardous materials in the air environment; USEPA-600/3-80-084 (1980) (6) Dilling WL et al; Environ Sci Technol 10: 351-6 (1976)]**PEER REVIEWED**

ENVIRONMENTAL BIOCONCENTRATION:
An estimated BCF of 3 was calculated for epichlorohydrin(SRC), using a log Kow of 0.45\(^1\) and a regression-derived equation\(^2\). According to a classification scheme\(^3\), this BCF suggests the potential for bioconcentration in aquatic organisms is low. [(1) Deneer JW et al; Aquatic Toxicol 13: 195-204 (1988) (2) Meylan WM et al; Environ Toxicol Chem 18: 664-72 (1999) (3) Franke C et al; Chemosphere 29: 1501-14 (1994)]**PEER REVIEWED**

SOIL ADSORPTION/MOBILITY:
The Koc for epichlorohydrin calculated from its water solubility (6.58\%\(^1\)) is 123\(^2\) which indicates that it is not appreciably adsorbed(SRC). After a spill of 20,000 gal following a train accident, water in wells closest to the spill were highly contaminated\(^1\). [(1) Keneklis T et al; Health assessment documents for epichlorohydrin. External review draft; p.1-1-3.24 USEPA 600/8-83-032a (1983) (2) Lyman WJ et al; Handbook of chemical property estimation methods. Environmental behavior of organic compounds; McGraw Hill New York p.4-1 to 4-33 (1982)]**PEER REVIEWED**

The Koc of epichlorohydrin is estimated as 40(SRC), using a log Kow of 0.45\(^1\) and a regression-derived equation\(^2\). According to a classification scheme\(^3\), this estimated Koc value suggests that epichlorohydrin is expected to have very high mobility in soil. [(1) Deneer JW et al; Aquatic Toxicol 13: 195-204 (1988) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9 (1990) (3) Swann RL et al; Res Rev 85: 17-28 (1983)]**PEER REVIEWED**

VOLATILIZATION FROM WATER/SOIL:
The Henry's Law constant for epichlorohydrin is estimated as 3.0\times 10^{-5} atm-cu m/mole(SRC) from its vapor pressure, 16.4 mm Hg\(^1\), and water solubility, 65,900 mg/l\(^2\). This Henry's Law constant indicates that epichlorohydrin is expected to volatilize from water surfaces\(^3\). Based on this Henry's Law constant, the volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 3 m/sec)\(^3\) is estimated as
The volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec) is estimated as 12 days. Epichlorohydrin's estimated Henry's Law constant indicates that volatilization from moist soil surfaces is expected to be an important fate process. Epichlorohydrin is expected to volatilize from dry soil surfaces based upon its vapor pressure.

Epichlorohydrin's estimated Henry's Law constant indicates that volatilization from moist soil surfaces is expected to be an important fate process. Epichlorohydrin is expected to volatilize from dry soil surfaces based upon its vapor pressure.

ENVIRONMENTAL WATER CONCENTRATIONS:
SURFACE WATER: Detected, not quantified in unspecified surface water.
GROUND WATER: Point Pleasant, WV (1/78) - Closest well to 20,000 gal spill resulting from train accident - 75 ppm.

ENVIRONMENTAL STANDARDS & REGULATIONS:
FIFRA REQUIREMENTS:
Epichlorohydrin (not more than 20% of pesticide formulation) is exempted from the requirement of a tolerance when used as a stabilizer for all pesticides used before crop emerges from soil or in soil fumigants before or after crop emerges in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only. [40 CFR 180.1001(d) (7/1/99)]

ACCEPTABLE DAILY INTAKES:
Assuming a human body wt of 70 kg, the acceptable daily intake for epichlorohydrin is 0.15 mg/day. [USEPA; Drinking Water Criteria Doc: Epichlorohydrin p.VIII (1985)]

TSCA REQUIREMENTS:
Pursuant to section 8(d) of TSCA, EPA promulgated a model Health and Safety Data Reporting Rule. The section 8(d) model rule requires manufacturers, importers, and processors of listed chemical substances and mixtures to submit to EPA copies and lists of unpublished health and safety studies. Oxirane, (chloromethyl) - is included on this list. [40 CFR
CERCLA REPORTABLE QUANTITIES:
Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 100 lb or 45.4 kg. The toll free number of the NRC is (800) 424-8802; In the Washington D.C. metropolitan area (202) 426-2675. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b). [40 CFR 302.4 (7/1/99)]

Releases of CERCLA hazardous substances are subject to the release reporting requirement of CERCLA section 103, codified at 40 CFR part 302, in addition to the requirements of 40 CFR part 355. Epichlorohydrin is an extremely hazardous substance (EHS) subject to reporting requirements when stored in amounts in excess of its threshold planning quantity (TPQ) of 1000 lbs. [40 CFR 355 (7/1/99)]

RCRA REQUIREMENTS:
U041; As stipulated in 40 CFR 261.33, when epichlorohydrin, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to Federal and/or State hazardous waste regulations. Also defined as a hazardous waste is any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5). [40 CFR 261.33 (7/1/99)]

ATMOSPHERIC STANDARDS:
This action promulgates standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The intended effect of these standards is to require all newly constructed, modified, and reconstructed SOCMI process units to use the best demonstrated system of continuous emission reduction for equipment leaks of VOC, considering costs, non air quality health and environmental impact and energy requirements. Epichlorohydrin is produced, as an intermediate or a final product, by process units covered under this subpart. [40 CFR 60.489 (7/1/99)]

Listed as a hazardous air pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. Epichlorohydrin is included on this list. [Clean Air Act as amended in 1990, Sect. 112 (b) (1) Public Law 101-549 Nov. 15, 1990]

CLEAN WATER ACT REQUIREMENTS:
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. [40 CFR 116.4 (7/1/99)]
FEDERAL DRINKING WATER STANDARDS:
EPA Treatment Technique in lieu of MCL. [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**

STATE DRINKING WATER GUIDELINES:
(FL) FLORIDA 3 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**

(AZ) ARIZONA 3.5 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**


(NC) NORTH CAROLINA 3.54 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93)]**QC REVIEWED**

ALLOWABLE TOLERANCES:
Epichlorohydrin (not more than 20% of pesticide formulation) is exempted from the requirement of a tolerance when used as a stabilizer for all pesticides used before crop emerges from soil or in soil fumigants before or after crop emerges in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only. [40 CFR 180.1001(d) (7/1/99)]**PEER REVIEWED**

CHEMICAL/PHYSICAL PROPERTIES:

MOLECULAR FORMULA:
C3-H5-Cl-O **PEER REVIEWED**

MOLECULAR WEIGHT:

COLOR/FORM:

ODOR:

Slightly irritating, chloroform-like odor. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C.
BOILING POINT:
117.9 deg C [Budavari, S. (ed.). The Merck Index - An Encyclopedia of
Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co.,
Inc., 1996.612]**PEER REVIEWED**

MELTING POINT:
-25.6 deg C [Budavari, S. (ed.). The Merck Index - An Encyclopedia of
Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co.,
Inc., 1996.612]**PEER REVIEWED**

DENSITY/SPECIFIC GRAVITY:
1.1750 @ 25 deg C/4 deg C [Budavari, S. (ed.). The Merck Index - An
Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ:
Merck and Co., Inc., 1996.612]**PEER REVIEWED**

HEAT OF COMBUSTION:
-8143 Btu/lb; -4524 Cal/g; -189.4 E+5 J/kg [U.S. Coast Guard, Department
of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington,

HEAT OF VAPORIZATION:
Latent heat of vaporization: 176 Btu/lb; 97.9 Cal/g; 4.10X10+5 J/kg [U.S.
Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical
1984-5.]**PEER REVIEWED**

OCTANOL/WATER PARTITION COEFFICIENT:
log Kow= 0.45 [Deneer JW et al; Aquat Toxicol 13: 195-204 (1988)]**PEER
REVIEWED**

SOLUBILITIES:
Miscible with most organic solvents; slightly soluble in water [Lewis,
York, NY: John Wiley &amp; Sons, Inc. 1997. 449]**PEER REVIEWED**

Miscible with alcohol, ether, chloroform, trichloroethylene, carbon
tetrachloride; immiscible with petroleum hydrocarbons. [Budavari, S.
(ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and
REVIEWED**

SOL IN ALCOHOL, ETHER AND BENZENE [Lide, D.R. (ed). CRC Handbook of
Chemistry and Physics. 72nd ed. Boca Raton, FL: CRC Press,
1991-1992.3-412]**PEER REVIEWED**

In water, 6.59X10+4 mg/l @ 25 deg C [Yalkowsky SH, Dannenfelser RM; The
AQUASOL dATAbASE of Aqueous Solubility. Fifth ed, Tucson, AZ: Univ AZ,
College of Pharmacy (1992)]**PEER REVIEWED**

SPECTRAL PROPERTIES:
Index of refraction: 1.44195 @ 11.6 deg C/D; 1.43969 @ 16 deg C/D; 1.43585
@ 25 deg C/D [Budavari, S. (ed.). The Merck Index - An Encyclopedia of
Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co.,
Inc., 1996.612]**PEER REVIEWED**
Characterized by two potentially reactive sites: the epoxide ring and the chlorine atom. Presence of the highly strained 3-membered ring makes epichlorohydrin a relatively reactive compound.

Coefficient of expansion at 68 deg F: 0.000577 [USEPA; Health Assessment Document: Epichlorohydrin p.3-2 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

Elemental composition: C=38.94%, H=5.45%, Cl=38.32%, O=17.29%. [USEPA; Health Assessment Document: Epichlorohydrin p.3-2 (1983) EPA 600/8-83-032A]**PEER REVIEWED**


Hydroxyl radical rate constant= 4.40X10-13 cu cm/molecule-sec @ 25 deg C [Atkinson R; J Phys Chem Ref Data Monograph No. 2 (1994)]**PEER REVIEWED**

CHEMICAL SAFETY & HANDLING:

DOT EMERGENCY GUIDELINES:
Health: Toxic; may be fatal if inhaled, ingested or absorbed through skin. Inhalation or contact with some of these materials will irritate or burn skin and eyes. Fire will produce irritating, corrosive and/or toxic gases. Vapors may cause dizziness or suffocation. Runoff from fire control or dilution water may cause pollution. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-131P]**QC REVIEWED**

Fire or explosion: Highly flammable: Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapor explosion and poison hazard indoors, outdoors or in sewers. Those substances designated with a "P" may polymerize explosively when heated or involved in a fire. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated. Many liquids are lighter than water. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-131P]**QC REVIEWED**


Fire: CAUTION: All these products have a very low flash point. Use of water spray when fighting fire may be inefficient. Small fires: Dry chemical, CO₂, water spray or alcohol-resistant foam. Large fires: Water spray, fog or alcohol-resistant foam. Move containers from fire area if you can do it without risk. Dike fire control water for later disposal; do not scatter the material. Use water spray or fog; do not use straight streams. Fire involving tanks or car/trailer loads: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. 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 engulfed in fire. For massive fire use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131P]**QC REVIEWED**

Spill or leak: Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Small spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Use clean non-sparking tools to collect absorbed material. Large spills: Dike far ahead of liquid spill for later disposal. Water spray may reduce vapor; but may not prevent ignition in closed spaces. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-131P]**QC REVIEWED**

First aid: Move victim to fresh air. Call 911 or emergency medical service. Apply artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. Wash skin with soap and water. Keep victim warm and quiet. Effects of exposure (inhalation,
Ingestion or skin contact to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000, p. G-131P]**QC REVIEWED**

**ODOR THRESHOLD:**
Sensory perception studies indicate that mean threshold for odor recognition is approximately 10 ppm. @ 25 ppm it is recognized by majority of persons. [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 1993-1994.422]**PEER REVIEWED**

Human Odor Perception: non perception 0.2 mg/cu m; perception 0.3 mg/cu m [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983.612]**PEER REVIEWED**

**SKIN, EYE AND RESPIRATORY IRRITATIONS:**

Epichlorohydrin effect on the skin, eyes, and respiratory tract may be delayed for several hours. Epichlorohydrin causes dermatitis. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1988.209]**PEER REVIEWED**

Inhalation of epichlorohydrin causes irritation of the eyes and throat. [USEPA; Health Assessment Document: Epichlorohydrin p.5-10 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

**NFPA HAZARD CLASSIFICATION:**
Health: 3. 3= Materials that, on short exposure, could cause serious temporary or residual injury, including those requiring protection from all bodily contact. Fire fighters may enter the area only if they are protected from all contact with the material. Full protective clothing, including self-contained breathing apparatus, coat, pants, gloves, boots, and bands around legs, arms, and waist, should be provided. No skin surface should be exposed. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997. 325-46]**PEER REVIEWED**

Flammability: 3. 3= This degree includes Class IB and IC flammable liquids and materials that can be easily ignited under almost all normal temperature conditions. Water may be ineffective in controlling or extinguishing fires in such materials. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997. 325-46]**PEER REVIEWED**

Reactivity: 2. 2= This degree includes materials that are normally unstable and readily undergo violent chemical change, but are not capable of detonation. This includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures and materials that can undergo violent chemical changes at elevated temperatures and pressures. This also includes materials that may react...
violently with water or that may form potentially explosive mixtures with water. In advanced or massive fires involving these materials, fire fighting should be done from a safe distance or from a protected location. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997. 325-46]**PEER REVIEWED**

**FLAMMABLE LIMITS:**

**FLASH POINT:**

**AUTOIGNITION TEMPERATURE:**

**FIRE FIGHTING PROCEDURES:**


If material on fire or involved in fire Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use "alcohol" foam, dry chemical or carbon dioxide. [Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, DC: Association of American Railroads, Bureau of Explosives, 1994.432]**PEER REVIEWED**


**TOXIC COMBUSTION PRODUCTS:**

**FIREFIGHTING HAZARDS:**

EXPLOSIVE LIMITS & POTENTIAL:
Epichlorohydrin LEL: 3.8%, UEL: 21.0% for volume percent in air. [USEPA; Health Assessment Document: Epichlorohydrin p.3-2 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

HAZARDOUS REACTIVITIES & INCOMPATIBILITIES:
Epichlorohydrin can violently react with compounds carrying an active hydrogen atom, including water. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1988.208]**PEER REVIEWED**
Epichlorohydrin liberates heat in the presence of ... alkalis, and certain salts ... [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1988.208]**PEER REVIEWED**


INTERACTION /BETWEEN EPICHLOROHYDRIN & AN N-SUBSTITUTED ANILINE/ IS EXOTHERMIC & MIXT WAS NORMALLY MAINTAINED @ 60 DEG C BY STIRRING & COOLING. MALFUNCTION CAUSED TEMP INCR TO 70 DEG C & COOLING CAPACITY WAS INSUFFICIENT TO REGAIN CONTROL. TEMP ... INCR TO 120 DEG C, WHEN EXPLOSIVE DECOMP OCCURRED. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990364]**PEER REVIEWED**

HAZARDOUS DECOMPOSITION:

HAZARDOUS POLYMERIZATION:

OTHER HAZARDOUS REACTION:
The heat evolved by the reaction of epichlorohydrin with acids, alkalis, active hydrogen, including water, and certain salts may cause overflow from the container or explosion. [ITII. Toxic and Hazardous Industrial
PRIOR HISTORY OF ACCIDENTS:
In a train accident in January 1963, about 5000 gal of epichlorohydrin was spilled into the New River at South Fayette, West Virginia. [Gillenwater LE; J Am Water Work Assoc 57: 201-207 (1965) as cited in USEPA; Health Assessment Document: Epichlorohydrin p.3-19 (1983) EPA 60/8-83-032A]**PEER REVIEWED**

In a train accident in January 1978 in West Virginia more than 20,000 gal of epichlorohydrin were spilled about 150 feet from the Ohio River near the center of the town of Point Pleasant. Although the chemical was reported not to have contaminated the Ohio River, local officials ordered the removal of about 1 acre of soil (several feet deep). The level of epichlorohydrin in water from wells closest to the spill area at the time was 75 ppm. The city's wells were closed, after an estimation of subsurface movement. Since the closing of the wells, water has been obtained from a radial collector several miles from the city. [USEPA; Health Assessment Document: Epichlorohydrine p.3-19(1983) EPA 600/8-83-032A]**PEER REVIEWED**

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

PROTECTIVE EQUIPMENT & CLOTHING:
Skin, eye, and respiratory contact must be avoided & protective clothing including PVC suits, plastic gloves, goggles or face shield, hat, & neoprene or PVC boots should be worn. Air concn should not exceed recommended limits of exposure. Where more exposure ... expected, positive pressure respirator ... worn. [Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 1993-1994.422]**PEER REVIEWED**

Gloves made of butyl rubber, when exposed to epichlorhydrin, protected the hands better than surgical rubber, polyethylene, polyvinyl alcohol, saranex-lamnated tyvek, neoprene and others. [Stampfer JF et al; Am Ind Hyg Assoc J 45 (9): 642-54 (1984)]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": ... Dispensers of liq detergent /should be available./ ... Safety pipettes should be used for all pipetting. ... In animal laboratory, personnel should ... wear protective suits (preferably disposable, one-piece & close-fitting at ankles & wrists), gloves, hair covering & overshoes. ... In chemical laboratory, gloves & new disposable plastic aprons might provide addnl protection. ... Gowns ... /should be/ of distinctive color, this is a reminder that they are not to be worn outside the laboratory. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boylan, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon,


Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.128]**PEER REVIEWED**

Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from any body areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily available, whereas in others, the availability of water from a sink or hose could be considered adequate.][NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.128]**PEER REVIEWED**

Recommendations for respirator selection. Condition: At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration. Respirator Class(es): Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.128]**PEER REVIEWED**


**PREVENTIVE MEASURES:**

PRECAUTIONS FOR "CARCINOGENS": Smoking, drinking, eating, storage of food or of food & beverage containers or utensils, & the application of cosmetics should be prohibited in any laboratory. All personnel should remove gloves, if worn, after completion of procedures in which carcinogens have been used. They should wash hands, preferably using dispensers of liq detergent, & rinse thoroughly. Consideration should be given to appropriate methods for cleaning the skin, depending on nature of the contaminant. No standard procedure can be recommended, but the use of organic solvents should be avoided. Safety pipettes should be used for all pipetting. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.8]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": In animal laboratory, personnel should remove their outdoor clothes & wear protective suits (preferably disposable, one-piece & close-fitting at ankles & wrists), gloves, hair covering & overshoes. ... Clothing should be changed daily but discarded immediately if obvious contamination occurs ... workers should shower immediately. In chemical laboratory, gloves & gowns should always be worn ... however, gloves should not be assumed to provide full protection. Carefully fitted masks or respirators may be necessary when working with particulates or gases, & disposable plastic aprons might provide addnl protection. If gowns are of distinctive color, this is a reminder that they should not be worn outside of lab. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.8]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": Operations connected with synth & purification should be carried out under well-ventilated hood. Analytical procedures should be carried out with care & vapors evolved during procedures should be removed. ... Expert advice should be obtained before existing fume cupboards are used & when new fume cupboards are installed. It is desirable that there be means for decreasing the rate of air extraction, so that carcinogenic powders can be handled without powder being blown around the hood. Glove boxes should be kept under negative air pressure. Air changes should be adequate, so that concn of vapors of volatile carcinogens will not occur. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.8]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": Vertical laminar-flow biological safety cabinets may be used for containment of in vitro procedures ... provided that the exhaust air flow is sufficient to provide an inward air flow at the face opening of the cabinet, & contaminated air plenums that are under positive pressure are leak-tight. Horizontal laminar-flow hoods or safety cabinets, where filtered air is blown across the working area towards the operator, should never be used ... Each cabinet or fume
cupboard to be used ... should be tested before work is begun (eg, with fume bomb) & label fixed to it, giving date of test & avg air-flow measured. This test should be repeated periodically & after any structural changes. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.9]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": Principles that apply to chem or biochem lab also apply to microbiological & cell-culture labs ... Special consideration should be given to route of admin. ... Safest method of administering volatile carcinogen is by injection of a soln. Admin by topical application, gavage, or intratracheal instillation should be performed under hood. If chem will be exhaled, animals should be kept under hood during this period. Inhalation exposure requires special equipment. ... unless specifically required, routes of admin other than in the diet should be used. Mixing of carcinogen in diet should be carried out in sealed mixers under fume hood, from which the exhaust is fitted with an efficient particulate filter. Techniques for cleaning mixer & hood should be devised before expt begun. When mixing diets, special protective clothing & possibly, respirators may be required. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.9]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": When ... admin in diet or applied to skin, animals should be kept in cages with solid bottoms & sides & fitted with a filter top. When volatile carcinogens are given, filter tops should not be used. Cages which have been used to house animals that received carcinogens should be decontaminated. Cage-cleaning facilities should be installed in area in which carcinogens are being used, to avoid moving of ... contaminated /cages/. It is difficult to ensure that cages are decontaminated, & monitoring methods are necessary. Situations may exist in which the use of disposable cages should be recommended, depending on type & amount of carcinogen & efficiency with which it can be removed. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.10]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": To eliminate risk that ... contamination in lab could build up during conduct of expt, periodic checks should be carried out on lab atmospheres, surfaces, such as walls, floors & benches, & the interior of fume hoods & air ducts. As well as regular monitoring, check must be carried out after cleaning-up of spillage. Sensitive methods are required when testing lab atmospheres. ... Methods should where possible, be simple & sensitive. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International
PRECAUTIONS FOR "CARCINOGENS": Rooms in which obvious contamination has occurred, such as spillage, should be decontaminated by lab personnel engaged in expt. Design of expt should ... avoid contamination of permanent equipment. ... Procedures should ensure that maintenance workers are not exposed to carcinogens. ... Particular care should be taken to avoid contamination of drains or ventilation ducts. In cleaning labs, procedures should be used which do not produce aerosols or dispersal of dust, ie, wet mop or vacuum cleaner equipped with high-efficiency particulate filter on exhaust, which are avail commercially, should be used. Sweeping, brushing & use of dry dusters or mops should be prohibited. Grossly contaminated cleaning materials should not be re-used ... If gowns or towels are contaminated, they should not be sent to laundry, but ... decontaminated or burnt, to avoid any hazard to laundry personnel. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.10]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": Doors leading into areas where carcinogens are used ... should be marked distinctively with appropriate labels. Access ... limited to persons involved in expt. ... A prominently displayed notice should give the name of the Scientific Investigator or other person who can advise in an emergency & who can inform others (such as firemen) on the handling of carcinogenic substances. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.11]**PEER REVIEWED**

SRP: The scientific literature for the use of contact lenses in industry is conflicting. The benefit or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place. **PEER REVIEWED**


Personnel protection: Avoid breathing vapors. Keep upwind. ... Avoid bodily contact with the material. Do not handle broken packages unless wearing appropriate personal protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap.


STABILITY/SHELF LIFE:
Epichlorohydrin can be oxidized by free radical process in liquid or gas phases; these reactions may occur as photochemically initiated atmospheric reactions. [USEPA; Health Assessment Document: Epichlorohydrin p.3-10 (1984) EPA 600/8-83-032A]**PEER REVIEWED**

SHIPMENT METHODS AND REGULATIONS:
No person may /transport,/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)./ [49 CFR 171.2 (7/1/99)]**PEER REVIEWED**

The International Air Transport Association (IATA) Dangerous Goods Regulations are published by the IATA Dangerous Goods Board pursuant to IATA Resolutions 618 and 619 and constitute a manual of industry carrier regulations to be followed by all IATA Member airlines when transporting hazardous materials. [IATA. Dangerous Goods Regulations. 40th Ed. Montreal, Canada and Geneva, Switzerland: International Air Transport Association, Dangerous Goods Regulations, 1999. 148]**PEER REVIEWED**

The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article. [IMDG; International Maritime Dangerous Goods Code; International Maritime Organization p.6143 (1998)]**PEER REVIEWED**

STORAGE CONDITIONS:
Separate from acids, alkalies, salts, water, and oxidizers. Store in a cool, dry, well-ventilated location. Inside storage should be in a


PRECAUTIONS FOR "CARCINOGENS": Storage site should be as close as practical to lab in which carcinogens are to be used, so that only small quantities required for ... ext need to be carried. Carcinogens should be kept in only one section of cupboard, an explosion-proof refrigerator or freezer (depending on chemico-physical properties ...) that bears appropriate label. An inventory ... should be kept, showing quantity of carcinogen & date it was acquired ... Facilities for dispensing ... should be contiguous to storage area. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.13]**PEER REVIEWED**

CLEANUP METHODS:


PRECAUTIONS FOR "CARCINOGENS": A high-efficiency particulate arrestor (HEPA) or charcoal filters can be used to minimize amt of carcinogen in exhausted air ventilated safety cabinets, lab hoods, glove boxes or animal rooms ... Filter housing that is designed so that used filters can be transferred into plastic bag without contaminating maintenance staff is avail commercially. Filters should be placed in plastic bags immediately after removal ... The plastic bag should be sealed immediately ... The sealed bag should be labelled properly ... Waste liquids ... should be placed or collected in proper containers for disposal. The lid should be secured &amp; the bottles properly labelled. Once filled, bottles should be placed in plastic bag, so that outer surface ... is not contaminated ... The plastic bag should also be sealed &amp; labelled. ... Broken
glassware ... should be decontaminated by solvent extraction, by chemical
destruction, or in specially designed incinerators. /Chemical Carcinogens/
[Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A.
Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical
Carcinogens in the Laboratory: Problems of Safety. IARC Scientific
Publications No. 33. Lyon, France: International Agency for Research on
Cancer, 1979.15]**PEER REVIEWED**

Eliminate all ignition sources. Approach release from upwind. Releases may
require isolation or evacuation. Use appropriate foam to blanket release
and suppress vapors. Use water spray to cool and disperse vapors, protect
personnel, and dilute spills to form nonflammable mixtures. Do not use
clay absorbents in cleanup. Control runoff and isolate discharged material
REVIEWED**

DISPOSAL METHODS:

Generators of waste (equal to or greater than 100 kg/mo) containing this
contaminant, EPA hazardous waste number U041, must conform with USEPA
regulations in storage, transportation, treatment and disposal of waste.
[40 CFR 240-280, 300-306, 702-799 (7/1/96)]**PEER REVIEWED**

Epichlorohydrin is a waste chemical stream constituent which may be
subjected to ultimate disposal by controlled incineration. Incineration,
preferably after mixing with another combustible fuel. Care must be
exercised to assure complete combustion to prevent the formation of
phosgene. An acid scrubber is necessary to remove the halo acids produced.
EPA 68-03-3025]**PEER REVIEWED**

A potential candidate for liquid injection incineration at a temperature
range of 650 to 1,600 deg C and a residence time of 0.1 to 2 seconds. A
potential candidate for rotary kiln incineration at a temperature range of
820 to 1,600 deg C and residence times of seconds for liquids and gases,
and hours for solids. A potential candidate for fluidized bed incineration
at a temperature range of 450 to 980 deg C and residence times of seconds
for liquids and gases, and longer for solids. [USEPA; Engineering Handbook
for Hazardous Waste Incineration p.3-11 (1981) EPA 68-03-3025]**PEER
REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": There is no universal method of disposal
that has been proved satisfactory for all carcinogenic compounds &amp;
specific methods of chem destruction ... published have not been tested on
all kinds of carcinogen-containing waste. ... summary of avail methods
&amp; recommendations ... /given/ must be treated as guide only. /Chemical
Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L.
Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.).
Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC
Scientific Publications No. 33. Lyon, France: International Agency for
Research on Cancer, 1979.14]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": ... Incineration may be only feasible
method for disposal of contaminated laboratory waste from biological expt.
However, not all incinerators are suitable for this purpose. The most
efficient type ... is probably the gas-fired type, in which a first-stage
combustion with a less than stoichiometric air:fuel ratio is followed by a
second stage with excess air. Some ... are designed to accept ... aqueous & organic-solvent solutions, otherwise it is necessary ... to absorb soln onto suitable combustible material, such as sawdust. Alternatively, chem destruction may be used, esp when small quantities ... are to be destroyed in laboratory. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.15]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": HEPA (high-efficiency particulate arrestor) filters ... can be disposed of by incineration. For spent charcoal filters, the adsorbed material can be stripped off at high temp & burned in an incinerator. ... LIQUID WASTE: ... Disposal should be carried out by incineration at temp that ... ensure complete combustion. SOLID WASTE: Carcasses of lab animals, cage litter & misc solid wastes ... should be disposed of by incineration at temp high enough to ensure destruction of chem carcinogens or their metabolites. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.15]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": ... Small quantities of ... some carcinogens can be destroyed using chem reactions ... but no general rules can be given. ... As a general technique ... treatment with sodium dichromate in strong sulfuric acid can be used. The time necessary for destruction ... is seldom known ... but 1-2 days is generally considered sufficient when freshly prepd reagent is used. ... Carcinogens that are easily oxidizable can be destroyed with milder oxidative agents, such as saturated soln of potassium permanganate in acetone, which appears to be a suitable agent for destruction of hydrazines or of compounds containing isolated carbon-carbon double bonds. Conc or 50% aqueous sodium hypochlorite can also be used as an oxidizing agent. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979.16]**PEER REVIEWED**

PRECAUTIONS FOR "CARCINOGENS": Carcinogens that are alkylating, arylating or acylating agents per se can be destroyed by reaction with appropriate nucleophiles, such as water, hydroxyl ions, ammonia, thiols & thiosulfate. The reactivity of various alkylating agents varies greatly ... & is also influenced by sol of agent in the reaction medium. To facilitate the complete reaction, it is suggested that the agents be dissolved in ethanol or similar solvents. ... No method should be applied ... until it has been thoroughly tested for its effectiveness & safety on material to be inactivated. For example, in case of destruction of alkylating agents, it is possible to detect residual compounds by reaction with 4(4-nitrobenzyl)-pyridine. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A. B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33.
OCCUPATIONAL EXPOSURE STANDARDS:

OSHA STANDARDS:
Permissible Exposure Limit: Table Z-1 8-hr Time-Weighted Avg: 5 ppm (19 mg/cu m). Skin Designation. [29 CFR 1910.1000 (7/1/99)]**PEER REVIEWED**


THRESHOLD LIMIT VALUES:
8 hr Time Weighted Avg (TWA) 0.5 ppm, skin [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.36]**QC REVIEWED**

Excursion Limit Recommendation: Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.6]**QC REVIEWED**

A3. A3= Confirmed animal carcinogen with unknown relevance to humans. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.36]**QC REVIEWED**

NIOSH RECOMMENDATIONS:


IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:
OTHER OCCUPATIONAL PERMISSIBLE LEVELS:
USSR: 0.25 ppm; Poland: 0.25 ppm; East Germany: 1 ppm; Romania: 1 ppm.
[American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986.233]**PEER REVIEWED**

Emergency Response Planning Guidelines (ERPG): ERPG(1) 2 ppm (no more than mild, transient effects) for up to 1 hr exposure; ERPG(2) 20 ppm (without serious, adverse effects) for up to 1 hr exposure; ERPG(3) 100 ppm (not life threatening) up to 1 hr exposure. [American Industrial Hygiene Association. The AIHA 1999 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook. American Industrial Hygiene Association. Fairfax, VA 1999.25]**PEER REVIEWED**

MANUFACTURING/USE INFORMATION:

MAJOR USES:


COMONOMER FOR UNMODIFIED EPOXY RESINS [SRI]**PEER REVIEWED**

COMONOMER FOR POLYAMIDE-EPICHLOROHYDRIN RESINS [SRI]**PEER REVIEWED**

CHEM INT FOR ALKYL GLYCERYL ETHER SULFONATE SURFACTANTS [SRI]**PEER REVIEWED**

CROSS-LINKING AGENT IN STARCH [SRI]**PEER REVIEWED**

CROSS-LINKING AGENT IN MICROENCAPSULATION [SRI]**PEER REVIEWED**

HEAT STABILIZER FOR PLASTICS [SRI]**PEER REVIEWED**

SCAVERGING ADDITIVE TO TRICHLOROETHYLENE [SRI]**PEER REVIEWED**

SPORICIDE [SRI]**PEER REVIEWED**
REACTIVE PLASTICIZER [SRI]**PEER REVIEWED**

CHEM INT FOR POLYTHIOLS [SRI]**PEER REVIEWED**

Cross-linking agent for cyclodextrins [Aldrich; Catalog Hdbk Fine Chem p.496 (1984)]**PEER REVIEWED**


Used in polymer coating materials in water supply systems. [Yakovleva LE, Pashkina EN; Gig Sanit 7: 74 (1984)]**PEER REVIEWED**


Used in preparation of ion exchange resins, elastomers, solvents, and plasticizers. [CHEMICAL PRODUCTS SYNOPSIS: Epichlorohydrin, 1984]**PEER REVIEWED**


Flexible membrane liners. [Bellen G et al; Govt Reports Announcements & Index (GRA&amp;I) Issue 24 (NTIS/PB87-227319) (1087)]**PEER REVIEWED**


MANUFACTURERS:


METHODS OF MANUFACTURING:
Epichlorohydrin is commercially prepared by high temperature chlorination of propylene to allyl chloride, followed by chlorohydration with hypochlorous acid to form isomeric glycerol dichlorohydrins. The mixture is subsequently dehydrochlorinated with alkali to yield epichlorohydrin. [USEPA; Health Assessment Document: Epichlorohydrin p.1-1 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

Made by chlorohydration of allyl chloride ... which is obtained by high-temperature chlorination of propylene. Byproducts of chlorination are cis- and trans-1,3-dichloropropene and 1,2-dichloropropane. Glycerol dichlorohydrins are made from allyl chloride, with 1,2,3-trichloropropane being obtained as a byproduct. Finally, epichlorohydrin is produced from the glycerol-dichlorohydrin mixture by treatment with base. [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed. Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present. VA9 539]**PEER REVIEWED**

GENERAL MANUFACTURING INFORMATION:
DIETHYLAMINOETHYL DEXTRAN GEL CAN BE USED AS A TEMPORARY WOUND COVERING TO PROMOTE THE WOUND HEALING PROCESS BY FUNCTIONING AS A SUBSTRATE AND PROVIDING A DIRECTIONAL INFLUENCE FOR CELL PROPAGATION. THE HYDROGEL SHEET WAS PREPARED USING EPICHLORHYDRIN AS THE CROSSLINKING AGENT. [MA AYC, WANG PY; POLYM WATER SCI ENG 53: 212-5 (1985)]**PEER REVIEWED**


FORMULATIONS/PREPARATIONS:

IMPURITIES:

CONSUMPTION PATTERNS:
Epoxy resins, 65%; glycerine, 25%; epichlorohydrin elastomers, 5%; miscellaneous, 5% (1984) [CHEMICAL PRODUCTS SYNOPSIS: Epichlorohydrin, 1984]**PEER REVIEWED**

U. S. PRODUCTION:
(1977) 1.32X10+11 G [SRI]**PEER REVIEWED**  
(1982) 1.52X10+11 G [SRI]**PEER REVIEWED**  
(1984) 2.00X10+11 g [CHEMICAL PRODUCTS SYNOPSIS: Epichlorohydrin, 1984]**PEER REVIEWED**

U. S. IMPORTS:
(1978) 1.5X10+9 G [SRI]**PEER REVIEWED**
Materials:

(1983) $1.5 \times 10^9$ G [SRI]**PEER REVIEWED**

(1985) $1.34 \times 10^{10}$ g [BUREAU OF THE CENSUS. U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1985 p.1-583]**PEER REVIEWED**

U.S. EXPORTS:

(1978) $9.90 \times 10^9$ G [SRI]**PEER REVIEWED**

(1983) $8.22 \times 10^9$ G [SRI]**PEER REVIEWED**

(1985) $3.21 \times 10^{10}$ g [BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, 1985 p.2-76]**PEER REVIEWED**

LABORATORY METHODS:

CLINICAL LABORATORY METHODS:


Levels of epichlorohydrin in male mice blood samples were determined by a gas chromatograph with a flame ionization detector (extraction method not given). [De Petrocellis L et al; J Chromatogr 240 (1): 218-223 (1983) as cited in USEPA; Health Assessment Document: Epichlorohydrin p.4-2 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

ANALYTIC LABORATORY METHODS:

A HIGHLY SENSITIVE FLUOROMETRIC PROCEDURE BASED ON ALKYLATION OF NICOTINAMIDE IS DESCRIBED FOR DETECTION OF ALIPHATIC EPOXIDES. SUBSEQUENT REACTION OF THE RESULTING N-ALKYL NICOTINAMIDES WITH A KETONE YIELDS STRONGLY FLUORESCENT PRODUCTS AFTER FINAL ACIDIFICATION. [NELIS HJ C &amp; JE SINSHEIMER, ANAL BIOCHEM 115 (1): 151 (1981)]**PEER REVIEWED**

Epichlorohydrin in water can be analyzed by direct injection of an aqueous sample into a gas chromatograph. The potential sensitivity range is 1-10 ppm. The determination of epichlorohydrin in water at the level of a few parts per billion has been performed by extraction of aqueous samples with ether and analysis of the extract by gas chromatography-mass spectrometry. This method provides the highest sensitivity and high specificity. [Van Lierop J BH; J Chromatogr 166 (2): 609-610 (1978) (Response to Public Comments on Draft Health Assessment Document for Epichlorohydrin) as cited in USEPA; Health Assessment Document: Epichlorohydrin p.3-11 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

Epichlorohydrin was determined in water samples by extracting the water samples with carbon tetrachloride and spectrophotometric determination of absorbance at 1,274 1/cm (wavelength not given). [Adamek P, Peterka V; Analyst 96: 807-809 (1971) as cited in USEPA; Health Assessment Document: Epichlorohydrin p.3-13 (1983) EPA 600/8-83-032A]**PEER REVIEWED**

Epichlorohydrin has been determined by volumetric or titrimetric analysis.

Epichlorohydrin can be determined volumetrically. A method for its colorimetric determination in air samples with chromotropic acid after periodate oxidation was described. It has also been determined with a limit of detection of 0.3% in aqueous solutions after extraction with carbon tetrachloride by measurement of the absorbance at 1273 per cm. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work).V11 131 (1976)]**PEER REVIEWED**


SAMPLING PROCEDURES:
ACTIVATED CHARCOAL, AMBERLITE XAD-2, AND AMBERLITE XAD-7 WERE EVALUATED FOR ADSORPTION OF EPICHLOROHYDRIN FROM WORKROOM AIR. XAD-7 WAS MOST EFFECTIVE SORBENT. [ANDERSSON ET AL, CHEMOSPHERE 10 (2): 143 (1981)]**PEER REVIEWED**


SPECIAL REFERENCES:

SPECIAL REPORTS:
USEPA; Response To Public Comments On Draft Health Assessment Document for Epichlorohydrin (1983) EPA 600/8-83-032A Contract 68-02-4030

USEPA; Health Assessment Document: Epichlorohydrin (1983) EPA-600/8-83-032A

U.S. Department of Health & Human Services/National Toxicology Program; Tenth Report on Carcinogens. National Institutes of Environmental Health Sciences. The Report on Carcinogens is an informational scientific and public health document that identifies and discusses substances (including agents, mixtures, or exposure circumstances) that may pose a carcinogenic hazard to human health. Epichlorohydrin (106-89-8) was first listed in the Fourth Annual Report on Carcinogens (1985) as reasonably anticipated to be a human carcinogen. [ ]

SYNONYMS AND IDENTIFIERS:

SYNONYM:


3-CHLORO-1,2-EPOXYPROPANE **PEER REVIEWED**

(CHLOROMETHYL)ETHYLENE OXIDE **PEER REVIEWED**


CHLOROPROPYLENE OXIDE **PEER REVIEWED**

GAMMA-CHLOROPROPYLENE OXIDE **PEER REVIEWED**

3-CHLORO-1,2-PROPYLENE OXIDE **PEER REVIEWED**


EPICHLORHYDRIN **PEER REVIEWED**


Substances (RTECS). National Library of Medicine's current MEDLARS file.82/8110]**PEER REVIEWED**


1,2-EPOXY-3-CHLOROPROPANE **PEER REVIEWED**

2,3-EPOXYPROPYL CHLORIDE **PEER REVIEWED**


GLYCEROL EPICHLOROHYDRIN **PEER REVIEWED**

GLYCIDYL CHLORIDE **PEER REVIEWED**


OXIRANE, (CHLOROMETHYL)- **PEER REVIEWED**

OXIRANE, 2-(CHLOROMETHYL) [U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for

SHIPPING NAME/ NUMBER DOT/UN/NA/IMO:
UN 2023; Epichlorohydrin
IMO 6.1; Epichlorohydrin

STANDARD TRANSPORTATION NUMBER:
49 074 20; Epichlorohydrin

EPA HAZARDOUS WASTE NUMBER:
U014; A toxic waste when a discarded commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or manufacturing chemical intermediate.

ADMINISTRATIVE INFORMATION:

HAZARDOUS SUBSTANCES DATABANK NUMBER: 39
LAST REVISION DATE: 20030829
LAST REVIEW DATE: Reviewed by SRP on 1/29/2000

UPDATE HISTORY:
Complete Update on 2003-08-29, 1 fields added/edited/deleted
Complete Update on 02/14/2003, 1 field added/edited/deleted.
Complete Update on 11/08/2002, 1 field added/edited/deleted.
Complete Update on 10/31/2002, 1 field added/edited/deleted.
Complete Update on 05/31/2002, 1 field added/edited/deleted.
Complete Update on 05/13/2002, 1 field added/edited/deleted.
Complete Update on 02/13/2002, 1 field added/edited/deleted.
Complete Update on 01/14/2002, 1 field added/edited/deleted.
Complete Update on 08/09/2001, 1 field added/edited/deleted.
Complete Update on 05/16/2001, 1 field added/edited/deleted.
Complete Update on 01/31/2001, 2 fields added/edited/deleted.
Complete Update on 09/12/2000, 1 field added/edited/deleted.
Complete Update on 06/12/2000, 1 field added/edited/deleted.
Complete Update on 06/08/2000, 73 fields added/edited/deleted.
Field Update on 02/08/2000, 1 field added/edited/deleted.
Field Update on 02/02/2000, 1 field added/edited/deleted.
Field Update on 11/18/1999, 1 field added/edited/deleted.
Field Update on 09/21/1999, 1 field added/edited/deleted.
Field Update on 08/26/1999, 1 field added/edited/deleted.
Complete Update on 07/20/1999, 5 fields added/edited/deleted.
Complete Update on 05/04/1999, 1 field added/edited/deleted.
Complete Update on 03/29/1999, 2 fields added/edited/deleted.
Field Update on 03/17/1999, 1 field added/edited/deleted.
Complete Update on 01/20/1999, 1 field added/edited/deleted.
Complete Update on 11/12/1998, 1 field added/edited/deleted.
Complete Update on 10/07/1998, 1 field added/edited/deleted.
Complete Update on 06/02/1998, 1 field added/edited/deleted.
Complete Update on 08/11/1997, 1 field added/edited/deleted.
Complete Update on 03/27/1997, 2 fields added/edited/deleted.
Complete Update on 02/26/1997, 1 field added/edited/deleted.
Complete Update on 02/04/1997, 1 field added/edited/deleted.
Complete Update on 05/14/1996, 2 fields added/edited/deleted.
Complete Update on 05/10/1996, 1 field added/edited/deleted.
Complete Update on 04/16/1996, 7 fields added/edited/deleted.
Complete Update on 01/18/1996, 1 field added/edited/deleted.
Complete Update on 05/04/1995, 1 field added/edited/deleted.
Complete Update on 02/13/1995, 1 field added/edited/deleted.
Complete Update on 01/20/1995, 1 field added/edited/deleted.
Complete Update on 12/19/1994, 1 field added/edited/deleted.
Complete Update on 09/26/1994, 1 field added/edited/deleted.
Complete Update on 08/31/1994, 1 field added/edited/deleted.
Complete Update on 07/25/1994, 1 field added/edited/deleted.
Complete Update on 05/05/1994, 1 field added/edited/deleted.
Complete Update on 03/25/1994, 1 field added/edited/deleted.
Complete Update on 08/07/1993, 1 field added/edited/deleted.
Complete Update on 08/04/1993, 1 field added/edited/deleted.
Complete Update on 05/28/1993, 1 field added/edited/deleted.
Complete Update on 05/25/1993, 1 field added/edited/deleted.
Field update on 12/10/1992, 1 field added/edited/deleted.
Complete Update on 12/02/1992, 1 field added/edited/deleted.
Complete Update on 11/25/1992, 1 field added/edited/deleted.
Complete Update on 08/26/1992, 1 field added/edited/deleted.
Complete Update on 07/02/1992, 82 fields added/edited/deleted.
Field Update on 04/16/1992, 1 field added/edited/deleted.
Field Update on 04/01/1992, 1 field added/edited/deleted.
Field Update on 01/13/1992, 1 field added/edited/deleted.
Complete Update on 10/23/1990, 6 fields added/edited/deleted.
Field Update on 08/23/1990, 1 field added/edited/deleted.
Field Update on 05/14/1990, 1 field added/edited/deleted.
Complete Update on 01/11/1990, 12 fields added/edited/deleted.
Field Update on 11/09/1988, 1 field added/edited/deleted.
Field Update on 07/06/1988, 1 fields added/edited/deleted.
Field Update on 07/06/1988, 1 fields added/edited/deleted.

Complete Update on 09/03/1987

Created 19830401 by DS