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 28, 2004.

Query: The chemical name dichlorobenzene was identified. The following terms were added from ChemIDplus: rotamott
dilatin dbi
CAS Registry Number: 25321-22-6
The chemical name dichlorobenzene was identified. The following terms were added from ChemIDplus: paradow
paradichlorobenzol
paradichlorobenzene
evola
CAS Registry Number: 106-46-7

3
NAME: 1,2-DICHLOROBENZENE
HSN: 521
RN: 95-50-1

HUMAN HEALTH EFFECTS:

EVIDENCE FOR CARCINOGENICITY:
Evaluation: There is inadequate evidence in humans for the carcinogenicity of dichlorobenzenes. There is evidence suggesting a lack of carcinogenicity in experimental animals of ortho-dichlorobenzene. ...

CLASSIFICATION: D; not classifiable as to human carcinogenicity. BASIS FOR CLASSIFICATION: Based on no human data and evidence of both negative and positive trends for carcinogenic responses in rats and mice. HUMAN CARCINOGENICITY DATA: None. ANIMAL CARCINOGENICITY DATA: Inadequate. [U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on 1,2-Dichlorobenzene (95-50-1) Available from: http://www.epa.gov/ngispgm3/iris on the Substance File List as of March 15, 2000]**PEER REVIEWED**

A4. Not classifiable as a human carcinogen. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.30]**QC REVIEWED**

HUMAN TOXICITY EXCERPTS:
TOXICOLOGICAL EFFECT OF O-DICHLOROBENZENE IS PRIMARILY INJURY TO LIVER & SECONDAIRLY TO KIDNEYS. SHORT EXPOSURES AT HIGH CONCN MAY RESULT IN
DEPRESSION OF CNS ALTHOUGH THIS MATERIAL IS BUT WEAKLY ANESTHETIC.

Karyotype analysis of leukocytes in laboratory workers exposed to 1,2-dichlorobenzene during pest control revealed that a significant number of altered cells, identified as having clastogenic chromosomal alterations, were present. [Zapata-Gayon C et al; Arch Environ Health 37: 231 (1982)]**PEER REVIEWED**


Seventeen chemicals (solvents, insecticides and intermediates used in the production of textiles and resins) were tested in a short-term in vitro system with human lymphocytes to determine their action. The parameters studied were tritiated thymidine uptake and cell viability in cultures grown with or without a rat liver metabolizing system (S-9 mix).
1,3-Dichlorobenzene, 1,2-dichlorobenzene, hexane, 1,2-diiodoethane, 1,4-dichlorobenzene, tetrachloroethylene, 2,3-dibromopropanol, chloromethyl methyl ether, 1,2- and 1,3-dibromopropane, in order, exerted the more toxic effects. ... The chemicals were non-toxic in the presence of the metabolizing system with the exception of 1,2- and 1,3-dichlorobenzene which maintained to ... some degree, their toxicity even in the presence of the S-9 mix. [Perocco P et al; Toxicol Lett 16 (1-2): 69-75 (1983)]**PEER REVIEWED**


Ribonucleic acid (RNA) and protein synthesis was found to be strongly inhibited in HeLa cells exposed for 30 minutes to 350 µg/ml concn of o-dichlorobenzene. A possible mechanism leading to such inhibition is the uncoupling of oxidative phosphorylation. [National Research Council. Drinking Water & Health. Volume 5. Washington, D.C.: National Academy Press, 1983.24]**PEER REVIEWED**

Inhalation of dichlorobenzene vapors was primarily responsible for most ... of a series of clinical cases of poisoning. ... 1,2-Dichlorobenzene was the principal or a significant ingredient in ... these case reports. [USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-12 (1980) EPA 440/5-80-039]**PEER REVIEWED**

Analyses of workroom air associated with 1,2-dichlorobenzene manufacture and handling operations at the Dow Chemical Company ... revealed no
evidence of organic injury or adverse hematologic effects attributable to 1,2-dichlorobenzene exposure [USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-27 (1980) EPA 440/5-80-039]**PEER REVIEWED**

VAPORS AND SPRAYS ARE IRRITATING TO EYES, NOSE & THROAT BUT EFFECT SEEMS TO DISAPPEAR QUICKLY. WHEN SWALLOWED ... /THEY/ CAUSE BURNING PAIN IN STOMACH, NAUSEA, VOMITING & DIARRHEA. HEMOGLOBIN MAY CHANGE TO METHEMOGLOBIN WITH RESULTING DUSTY COLOR OF SKIN; LIVER & KIDNEY MAY BE DAMAGED. /DICHLOROBENZENES/ [Thienes, C., and T.J. Haley. Clinical Toxicology. 5th ed. Philadelphia: Lea and Febiger, 1972.176]**PEER REVIEWED**


SKIN, EYE AND RESPIRATORY IRRITATIONS:

MEDICAL SURVEILLANCE:

POPULATIONS AT SPECIAL RISK:
Persons with existing pathology (hepatic, renal, central nervous system, blood), or metabolic disorders, who are taking certain drugs (hormones, or otherwise metabolically active) or who are otherwise exposed to dichlorobenzenes or to related (chemically or biologically) chemicals, by such means as occupation or domestic use or abuse ... might well be considered at increased risk from exposure to dichlorobenzenes. /Dichlorobenzenes/ [Sittig, M. Handbook of Toxic And Hazardous Chemicals. Park Ridge, NJ: Noyes Data Corporation, 1981.228]**PEER REVIEWED**

/Individuals who suffer from/ skin, liver, kidney, or chronic respiratory disease, will be at an increased risk if they are exposed to chlorobenzenes. /Chlorobenzenes/ [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) Publication No. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981.1]**PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:
NIOSH (NOES Survey 1981-1983) has statistically estimated that 76,818 workers (12,654 of these are female) are potentially exposed to 1,2-dichlorobenzene in the US(1). Occupational exposure to 1,2-dichlorobenzene may be through inhalation and dermal contact with this
compound at workplaces where 1,2-dichlorobenzene is produced or used\(\text{SRC}\). 1,2-Dichlorobenzene levels up to 8.5 ppm (51 mg/cu m) were detected in the breathing zones of a chlorobenzene factory\(\text{SRC}\). The general population may be exposed to 1,2-dichlorobenzene via inhalation of ambient air, ingestion of food and drinking water\(\text{SRC}\). \[(1)\text{ NIOSH; National Occupational Exposure Survey (NOES) (1983)} \ (2)\text{ IARC; Some Industrial Chemicals and Dyestuffs 29: 214 (1982)}\] **PEER REVIEWED**

BODY BURDEN:
Dichlorobenzene was detected in whole blood (3.12 ng/g) and adipose tissue (2.28 ng/g) from the general population of Canada\(\text{1}\). 1,2-Dichlorobenzene was detected in the personal air of Los Angeles, CA residents at concns of 0.3-0.4 ug/cu m and residents of Contra Costa, CA at concns of 0.6 ug/cu m\(\text{2}\). 1,2-Dichlorobenzene was detected in the breath of Los Angeles, CA residents at concns of 0.04-0.1 ug/cu m and residents of Contra Costa, CA at concns of 0.08 ug/cu m\(\text{2}\). \[(1)\text{ Mes J; Bull Environ Contam Toxicol 48: 815-20 (1992)} \ (2)\text{ Wallace LA; The Total Exposure Assessment Methodology Study. USEPA/600/S6-87/002 (1987)}\] **PEER REVIEWED**

AVERAGE DAILY INTAKE:
Based on monitoring data at three USA urban sites (Los Angeles, Phoenix, Oakland), the AVDI for 1,2-dichlorobenzene has been estimated to be 0.5-2.8 ng/day\(\text{1}\). The AVDI of 1,2-\(\text{1}\), 1,3-\(\text{1}\), and 1,4-dichlorobenzene isomers in the Netherlands is 7.0 ug/day\(\text{2}\). \[(1)\text{ Singh HB et al; Atmos Environ 15: 601 (1981)} \ (2)\text{ Guichert R, Schulting; Sci Total Environ 43: 193-219 (1985)}\] **PEER REVIEWED**

EMERGENCY MEDICAL TREATMENT:

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LIFE SUPPORT:
- 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) Various drugs and chemicals are capable of inducing
methemoglobinemia. Some chemicals that produce methemoglobinemia can produce toxicity after inhalation, skin absorption or ingestion. Signs and symptoms of methemoglobinemia may be delayed several hours, as some chemicals do not directly produce methemoglobinemia, but require biochemical transformation to toxic metabolites that cause methemoglobinemia. Some methemoglobinemia-producing agents rarely produce sulfhemoglobinemia.

B) SIGNS/SYMPTOMS reflect the quantity of methemoglobin present and are referable to the decreased oxygen-carrying capacity of the blood.

1) Signs and symptoms include central cyanosis, headache, lethargy, dizziness, fatigue, syncope, dyspnea, CNS depression, seizures, dysrhythmia and shock. Symptoms may be delayed several hours after exposure.

2) RISK FACTORS - Patients with underlying medical conditions such as chronic obstructive pulmonary disease (COPD), anemia or coronary artery disease are more susceptible to developing symptoms. Very young (less than 3 months old) and the elderly are at greater risk of developing methemoglobinemia. In addition, individuals with a genetic deficiency of G-6-PD or nicotinamide adenine dinucleotide methemoglobin reductase, or excessive doses or absorption of an oxidant, are at greater risk of developing methemoglobinemia.

3) Nitrites and related compounds are potent peripheral vasodilators. Hypotension associated with a reflex tachycardia may be noted.

4) Death is rare but usually occurs when the methemoglobin level exceeds 70 percent, especially in infants and young children.

0.2.3 VITAL SIGNS

0.2.5 CARDIOVASCULAR

0.2.5.1 ACUTE EXPOSURE

A) Tachycardia is common. Dysrhythmias and hypotension may occur in severe cases. Myocardial infarction and abrupt cardiac arrest have been reported rarely.

0.2.6 RESPIRATORY

0.2.6.1 ACUTE EXPOSURE

A) Dyspnea and tachypnea may occur.

0.2.7 NEUROLOGIC

0.2.7.1 ACUTE EXPOSURE

A) CNS effects include headache, dizziness, altered mental status, confusion, lethargy progressing to coma, seizures and syncope; these occur secondary to CNS hypoxia, usually with levels > 20 percent.

0.2.8 GASTROINTESTINAL

0.2.8.1 ACUTE EXPOSURE

A) Nausea and vomiting may occur.

0.2.11 ACID-BASE

0.2.11.1 ACUTE EXPOSURE

A) Metabolic acidosis may develop secondary to tissue hypoxia.

0.2.13 HEMATOLOGIC

0.2.13.1 ACUTE EXPOSURE
A) Chocolate brown blood is classic. Hemolytic anemia may develop with some agents that cause methemoglobinemia.

0.2.14 DERMATOLOGIC
0.2.14.1 ACUTE EXPOSURE
A) Central cyanosis unresponsive to oxygen therapy is classic.

0.2.18 PSYCHIATRIC
0.2.18.1 ACUTE EXPOSURE
A) Repeated episodes of drug-induced methemoglobinemia were reported in an adult with probable Munchausen syndrome.

0.2.20 REPRODUCTIVE HAZARDS
A) Case reports suggest that fetal outcome is unaffected by mild degrees of maternal methemoglobinemia.

LABORATORY:
A) If patient is cyanotic or symptomatic, obtain hemoglobin level, electrolytes, arterial blood gases, chest x-ray, ECG, and methemoglobin level. Methemoglobin levels will be artificially low if blood is not analyzed within a few hours.
B) Obtain a measured O2 saturation on blood gases. Calculated saturation and pulse oximetry are inaccurate in the setting of methemoglobinemia.
C) If patient is not cyanotic but has ingested or been exposed to a methemoglobin producing substance, methemoglobin level may be drawn as a baseline.
D) If chronic cyanosis not due to pulmonary disease especially if family history of cyanosis is present, hemoglobin electrophoresis, methemoglobin reductase level, and/or G-6-PD activity may be indicated.
E) Qualitative bedside determination can be made by placing a drop of blood on filter paper with a control drop of blood nearby. With greater than 15% methemoglobinemia, the affected blood will have a chocolate brown color in comparison with the control blood.

TREATMENT OVERVIEW:
0.4.2 ORAL EXPOSURE
A) EMESIS: Ipecac-induced emesis is not recommended because of the potential for CNS depression and seizures.
B) 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.
C) 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.
D) OXYGEN - Administer oxygen to all cyanotic or symptomatic patients.
E) METHEMOGLOBINEMIA: Administer 1 to 2 mg/kg of 1% methylene blue slowly IV in symptomatic patients. Additional doses may be required.

F) SHOCK AND CARDIAC ARREST - Treat routinely.

G) ADJUNCTIVE THERAPY - Exchange transfusions and hyperbaric oxygen may be useful in severe cases.

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) Some methemoglobinemia-producing chemicals are readily absorbed through the skin to produce adverse systemic effects. Aniline and related compounds may be rapidly absorbed by all routes. Skin contact with contaminated clothing or shoes may result in adverse systemic effects.

   a) Skin should be thoroughly washed with soap and water. Contaminated clothing and shoes should be discarded. Seek medical attention. Administer 100 percent humidified supplemental oxygen with assisted ventilation as required. Treat for methemoglobinemia and sequelae. Signs and symptoms of methemoglobinemia may be delayed.

2) METHEMOGLOBINEMIA: Administer 1 to 2 mg/kg of 1% methylene blue slowly IV in symptomatic patients. Additional doses may be required.

RANGE OF TOXICITY:
A) Methemoglobin levels (percentage of total hemoglobin) correlate well with symptoms in most cases. Patients with anemia, underlying pulmonary or cardiac disease may develop symptoms at lower methemoglobin concentrations.

B) General symptoms observed in most individuals for a given methemoglobin level:
   15%-20% Clinical cyanosis and chocolate-brown blood evident, patient usually asymptomatic
   20%-45% Headache, lethargy, dizziness, fatigue, syncope, dyspnea
   45%-55% Increasing CNS depression
   55%-70% Coma, seizures, arrhythmias, shock
   > 70% High incidence of mortality, if untreated

/ORELLINE

EMERGENCY MEDICAL TREATMENT:

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**LIFE SUPPORT:**
- 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**
- Whether a substance is labeled a "corrosive" or "irritant" depends on several factors: the nature of the substance, concentration, viscosity, pH, molarity, oxidation-reduction potential, complexing affinity toward bivalent ions etc. It is difficult to determine if a substance is a corrosive or irritant at a particular concentration.
- Irritants are substances that cause inflammation and swelling, but not cellular death and tissue damage; a corrosive causes cellular damage and death.
- Exposure via inhalation may result in headache, rhinorrhea, cough, shortness of breath, chest pain, bronchospasm and rarely, upper airway swelling or acute lung injury.
- Ingestion may cause irritation of the oral mucous membranes and esophagus.

**0.2.4 HEENT**

**0.2.4.1 ACUTE EXPOSURE**
- Irritants may cause swelling, redness and pain at any site, especially at mucous membranes. The mouth, nose, and eyes are susceptible to these effects.

**0.2.6 RESPIRATORY**

**0.2.6.1 ACUTE EXPOSURE**
- Cough, tachypnea, and wheezing are common after inhalation.

**0.2.8 GASTROINTESTINAL**

**0.2.8.1 ACUTE EXPOSURE**
- Nausea, vomiting and diarrhea are possible if ingested.

**0.2.14 DERMATOLOGIC**

**0.2.14.1 ACUTE EXPOSURE**
- Redness, swelling and pain may occur.

**0.2.20 REPRODUCTIVE HAZARDS**
- Pregnant female rats were exposed to N-methylpyrrolidone. Exposed offspring had normal motor function, activity levels, and low-level learning abilities. On higher-level learning tests, their
performance was impaired compared to unexposed offspring.

0.2.21 CARCINOGENICITY

0.2.21.2 HUMAN OVERVIEW
A) Development of sinonasal neoplasms has been associated with exposure to wood dust and other irritants.

LABORATORY:
A) No specific laboratory tests are necessary with the possible exception of testing the pH of the irritant substance and the pH of the ocular cul de sac with wide range pH paper.

TREATMENT OVERVIEW:

0.4.2 ORAL EXPOSURE
A) EMESIS - Not indicated due to the irritant nature of these agents.
B) Charcoal - Not recommended; it may promote vomiting and make endoscopic evaluation difficult.
C) DILUTION: Immediately dilute with 4 to 8 ounces (120 to 240 mL) of water or milk (not to exceed 4 ounces/120 mL in a child).
D) NEUTRALIZATION - Neutralization is not indicated.
E) Although these agents are irritants, and therefore should not produce tissue damage, it is almost impossible to assure that a particular substance under a particular set of circumstances would not cause damage. Therefore, each patient should be examined with the idea that mucous membrane damage might have occurred.

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.
B) If in a medical facility, sterile saline should be used to irrigate the eyes until the cul de sac is returned to neutrality. Some alkali exposures may require prolonged irrigation.

RANGE OF TOXICITY:
A) The extent of damage will depend on a number of factors including concentration, mechanism of action, pH, free acidity and alkalinity, molarity and oxidation-reduction potential. In most cases these factors are more important than volume. Besides its irritant effect, a substance may also have some type of systemic effect. Observe for any potential systemic effects as is appropriate for each compound.

(KHAT)

ANTIDOTE AND EMERGENCY TREATMENT:
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 ... . Monitor for shock 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 ... . /Lindane and related compounds/ [Bronstein, A.C., Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994.284-5]**PEER REVIEWED**

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or in respiratory arrest. Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial. Monitor cardiac rhythm and treat 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. Consider drug therapy for pulmonary edema ... . Treat seizures with diazepam (Valium) ... . Use proparacaine hydrochloride to assist eye irrigation ... . /Lindane and related compounds/ [Bronstein, A.C., Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994.285]**PEER REVIEWED**

ANIMAL TOXICITY STUDIES:

EVIDENCE FOR CARCINOGENICITY:
Evaluation: There is inadequate evidence in humans for the carcinogenicity of dichlorobenzenes. There is evidence suggesting a lack of carcinogenicity in experimental animals of ortho-dichlorobenzene. ...

CLASSIFICATION: D; not classifiable as to human carcinogenicity. BASIS FOR CLASSIFICATION: Based on no human data and evidence of both negative and positive trends for carcinogenic responses in rats and mice. HUMAN CARCINOGENICITY DATA: None. ANIMAL CARCINOGENICITY DATA: Inadequate. [U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on 1,2-Dichlorobenzene (95-50-1) Available from: http://www.epa.gov/iris on the Substance File List as of March 15, 2000]**PEER REVIEWED**

A4. Not classifiable as a human carcinogen. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.30]**QC REVIEWED**

NON-HUMAN TOXICITY EXCERPTS:
... /RATS WERE/ FED O-DICHLOROBENZENE BY STOMACH TUBE, 5 DAYS/WK FOR ... 138 DOSES IN 192 DAYS. ... AT DOSE OF 376 MG/KG OF BODY WT/DAY ... MODERATE INCR IN AVG LIVER WT &amp; SLIGHT INCR IN AVG KIDNEY WT. THERE WERE SLIGHT HISTOPATHOLOGICAL CHANGES IN LIVER. AT ... 188 MG/KG/DAY ...


... GUINEA PIGS /WERE FED/ O-DICHLOROBENZENE IN SOLN IN OLIVE OIL. ALL GUINEA PIGS SURVIVED 0.8 G/KG OF BODY WT BUT THEY ALL SUCCumbed TO 2.0 G/KG OF BODY WT. [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., 1993-1994.1455]**PEER REVIEWED**


1,2-DICHLOROBENZENE AT DOSE OF 5.0 MMOL/ KG, IP TO RATS, INCRBILE DUCT-PANCREATIC FLUID (BDPF) FLOW & DECR ITS PROTEIN CONCN 24 HR AFTER TREATMENT. [YANG KH ET AL, TOXICOL APPL PHARMACOL 47: 505 (1979)]**PEER REVIEWED**

O-DICHLOROBENZENE AS IDENTIFIED BY 96 HR LC50 OF 500 MG/L WAS HAZARDOUS TO FRESHWATER MINNOWS & TO SALWATER SHRIMP. [CURTIS MW ET AL; WATER RES 13: 137 (1979)]**PEER REVIEWED**

o-Dichlorobenzene (o-DCB), and p-dichlorobenzene (p-DCB), were evaluated
for teratogenic potential in rats (o-DCB only) and rabbits. Groups of bred rats and inseminated rabbits were exposed to 0, 100, 200, or 400 ppm of o-dichlorobenzene /while/ groups of inseminated rabbits were exposed to 0, 100, 300, or 800 ppm p-dichlorobenzene. Animals were exposed for 6 hr/day on days 6 through 15 (rats) or days 6 through 18 (rabbits) of gestation. Maternal toxicity, as evidenced by a significant decrease in body weight gain, was observed in all groups of o-dichlorobenzene exposed rats and liver weight was significantly increased in the 400 ppm o-dichlorobenzene exposed group. Slight maternal toxicity was observed in groups of rabbits exposed to 400 ppm o-dichlorobenzene or 800 ppm p-dichlorobenzene as indicated by significantly decreased body weight gain during the first three days of exposure. Inhalation of up to 400 ppm of o-dichlorobenzene was /neither/ teratogenic nor fetotoxic in rats and neither o-dichlorobenzene or p-dichlorobenzene was teratogenic nor fetotoxic in rabbits at exposure levels up to 400 or 800 ppm, respectively. [Hayes WC et al; Fundam Appl Toxicol 1: 190-202 (1985)]**PEER REVIEWED**

Acute toxicity tests with six chlorobenzenes (monochlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, and hexachlorobenzene) were performed on several aquatic organisms at different trophic levels. Fertility impairment on Daphnia and photosynthesis inhibition on Selenastrum were also studied. Results were discussed together with physicochemical properties of the molecules to identify structure-activity relationships, and to predict environmental distribution. [Calamari D et al; Chemosphere 12 (2): 253-62 (1983)]**PEER REVIEWED**

o-Dichlorobenzene injected ip into male Sprague-Dawley rats produced centrilobular necrosis that was enhanced by prior administration of phenobarbital, which was also found to enhance the excretion of metabolites of o-dichlorobenzene. [National Research Council. Drinking Water & Health. Volume 5. Washington, D.C.: National Academy Press, 1983.23]**PEER REVIEWED**


o-Dichlorobenzene was tested for carcinogenicity in both sexes of the B6C3F1 mice and the Fischer 344 rats. Dosages of 60 or 120 mg/kg were administered by gavage to both sexes of the mice, and the rat. o-Dichlorobenzene was administered in corn oil to groups of 50 rats and 50 mice of each sex 5 days/wk for 2 yr. There were corresponding vehicle and untreated control groups of 50 rats and 50 mice of each sex. No compound-related carcinogenic effect was detected in either sex of the mice or rats; however, the maximum tolerated dose was probably not used in this study. No other effects were reported. [National Research Council. Drinking Water & Health. Volume 5. Washington, D.C.: National Academy Press, 1983.24]**PEER REVIEWED**

Mutagenicity was assayed with Salmonella typhimurium strains TA100, TA98, UTH8414, and UTH8413. None of the three dichlorobenzenes (1,2-, 1,3- and 1,4-) was mutagenic in any strain with or without S9 /SRP: rat liver metabolizing system/ from Aroclor treated rats. [Connor TH et al; Toxicol Lett 25: 33-40 (1985)]**PEER REVIEWED**
Liver damage in the rat was investigated by measurements of serum enzyme activities at 24 hr after single or repeated inhalation exposure to one of 6 toxicants including o-dichlorobenzene. o-Dichlorobenzene at 305 ppm (but not at 204 ppm) for 4 hr markedly increased (greater than 3-fold) serum glutamate dehydrogenase (GLDH) and sorbitol dehydrogenase (SODH) activities. Repeated exposure (6 hr/day, 2 or 4 days) to o-dichlorobenzene at 309 ppm caused lesser increases in the enzyme activities at 24 hr after last treatment. Serum glutamate dehydrogenase and sorbitol dehydrogenase are more sensitive indicators of toxicity than glutamic oxaloacetic transaminase or glutamic pyruvic transaminase. [Brondeau MT et al; Toxicol Lett 19: 139-46 (1983)] **PEER REVIEWED**

o-Dichlorobenzene given orally to rats for 60 to 120 days increased liver weights and triglyceride levels of rats more than the controls. The level of hepatic ATP was lower than that in the liver of control rats. o-Dichlorobenzene decreased state 3 respiration, while increasing state 4 respiration. [Mori T; Okayama Igakkai Zasshi 94 (11/12): 967-72 (1983)] **PEER REVIEWED**

A test was developed using Tetrahymena pyriformis in order to determine the toxicity of various chemicals. Precultured Tetrahymena pyriformis was exposed for 24 hr at 30 deg C to various concentrations of chemicals. The concentration of the chemical, at which the proliferation of Tetrahymena pyriformis was restricted to one-half of the blank test (EC50), was determined. The method, applied to 57 chemicals, demonstrated that it could be used to detect the chemicals at low concentrations rapidly and with ease. The EC50 values showed a good relationship with 48 hr LC50 values for Himedaka (Oryzias latipes), and could be explained on the basis of the partition coefficient between water and n-octanol. EC50 for o-dichlorobenzene was 51 mg/l (350 umol/l). [Yoshioka Y et al; Sci Total Environ 43 (1,2): 149-58 (1985)] **PEER REVIEWED**

... Acute and chronic toxicity to fresh water aquatic life occur at concentrations as low as 1,120 and 763 ug/l, respectively. ... ... Acute toxicity to saltwater aquatic life occurs at concentrations as low as 1,970 ug/l ... [USEPA/OWRS; Quality Criteria for Water 1986 1,2-Dichlorobenzene (1986) EPA 440/5-86-001] **PEER REVIEWED**

RATS WERE TREATED WITH EACH ISOMER OF DICHLOROBENZENE (DCB) IN AN ORAL DOSE OF 250 MG/KG ONCE DAILY FOR 3 DAYS. ACTIVITIES OF AMINOPYRINE DEMETHYLASE AND ANILINE HYDROXYLASE WERE ENHANCED MARKEDLY BY TREATMENT WITH M-DICHLOROBENZENE, WHEREAS CYTOCHROME CONTENT WAS NOT ALTERED SIGNIFICANTLY BY TREATMENT WITH ANY ISOMERS OF DICHLOROBENZENE. DELTA-AMINO LEVULINIC ACID SYNTHETASE ACTIVITY WAS ENHANCED 63, 32 AND 42% BY TREATMENT WITH O-, M-, P-DCB RESPECTIVELY, BUT THESE ENHANCEMENTS WERE NOT PARALLELED BY CYTOCHROME P450 CHANGE. [ARIYOSHI ET AL, CHEM PHARM BULL 23 (4): 824-830 (1975)] **PEER REVIEWED**

Eight halogenated benzenes, including bromobenzene (BB), chlorobenzene (CB), three isomers of dichlorobenzene (DCB) and three isomers of trichlorobenzene (TCB) were tested for acute toxicity (LD50) and clastogenicity in 8 week old NMRI mice by ip administration. Four doses of each chemical (up to 70% of LD50) were tested for clastogenic activity. Each compound was administered in two equal doses, 24 hr apart. Increased formation of micronucleated polychromatic erythrocytes, observed in femoral bone marrow, 30 hr after the first injection, was considered to be
due to the clastogenic activity of the test compound. All the halogenated benzenes tested were found to be clastogenic. The highest clastogenic activities were induced by m-DCB and BB. Among three isomers of DCB, m-DCB significantly induced more micronuclei than o-DCB or p-DCB. No significant differences were found between the clastogenic activities of TCB isomers. [Mohtashamipur E et al; Mutagenesis 2 (2): 111-14 (1987)]**PEER REVIEWED**

A dynamic liver culture system, using short term viable tissue culture of rat liver slices, is described. Following initial recovery periods of 2 to 6 hr; potassium ion and adenosine triphosphate (ATP) content were maintained for 16 to 20 hr, and protein synthesis increased linearly for 16 hr. The order of decreasing toxicity of dichlorobenzenes, measured by potassium ion content, protein synthesis, and release of lactic dehydrogenase, was 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene, in agreement with a similar order obtained in vivo. The dichlorobenzenes were less toxic in slices from Sprague-Dawley rats than in Fischer rats. This finding was confirmed by studies in vivo. [Sipes IG et al; Arch Toxicol (Suppl 11): 20-33 (1987)]**PEER REVIEWED**

Linear free energy-related (LFER) and de novo models are applied to the study of quantitative relations between structure and acute toxicity of chlorinated organic compounds. The chemicals studied include chlorophenols, chlorobenzenes, and acyclic chlorocarbons and the properties regressed were median lethal concn for guppy (Poecilia reticulata) and inhibition of phenol degradation. The correlations reveal that toxicity tends to incr as the contaminants have more chloro substituents. Chlorophenols are less toxic than chlorobenzenes. [Gombar VK; QSAR Environ Toxicol Proc Int Workshop 2nd 125-33 (1987)]**PEER REVIEWED**

The acute toxicities of chlorophenols, chlorobenzenes, and p-substituted phenols to rainbow trout (Salmo gairdneri) as ip injection lethality, serum sorbitol dehydrogenase activity, and 96 hr lethal concn were investigated in terms of quantitative structure-activity correlations (QSARs). The effects of chlorophenols and chlorobenzenes were primarily related to their octanol/water partition coefficients (log P). The slopes of the QSARs of chlorophenols for rainbow trout were nearly parallel to those of acute and semichronic chlorophenols toxicities to bluegill (Lepomis macrochirus), guppy (Poecilia reticulata), waterflea (Daphnia magna), and the marine organism Photobacterium phosphateum, indicating similar mechanisms of toxic effect. [Kaiser KLE et al; QSAR Environ Toxicol Proc Workshop Quant Struct Act Relat (QSAR) Environ Toxicol 189-206 (1984)]**PEER REVIEWED**

For chlorobenzenes (n= 0-5) experimental 48 hr median effective concn (EC50) data are reported for Daphnia magna in a closed system and relations established between EC50, solubility, and otanol/water partition coefficient. ... [Bobra a et al; Environ Toxicol Chem 4 (3): 297-305 (1985)]**PEER REVIEWED**

Toxicities of 68 chloro derivatives of phenol, aniline, nitrobenzene, pyridine, and benzene varied substantially with their log P values (octanol/water partition coefficients). The Microtox toxicity values (with bioluminescent Photobacterium phosphateum) correlated with the log P values. The toxicity of these compounds is positive dependent on the number of Cl atoms and the nature of functional group. [Kaiser KLE, Ribo JM; Pharmacochem Libr 8 (ISS QSAR Toxicol Xenobiochem): 27-38
Liver damage resulting from 4 hr exposure to bromobenzene (146-957 ppm) and 1,2-dichlorobenzene (245-739 ppm) as model toxicants was evaluated in rats. The modifications considered were the increases in serum glutamate dehydrogenase (GLDH) and sorbitol dehydrogenase (SDH) activities and the decreases in centrolobular liver cell glucose-6-phosphatase staining intensity. A linear inverse relationship was established between the logarithmic values of blood enzyme activities and liver glucose-6-phosphatase staining intensity. In addition, the levels of exposure to each test chemical were found to be linearly related to liver glucose-6-phosphatase staining intensity and to the logarithmic values of blood enzyme activities. [Brondeau MT et al; Toxicol Lett 31 (2): 159-66 (1986)]

Developmental, genetic, and reproductive toxicities of benzene, chlorobenzene, and o-, m-, and p-dichlorobenzenes were investigated in sea urchin, Paracentrotus lividus. Toxicity order depended on whether the target organ was embryo or sperm. Benzene was active in sea urchin sperm causing developmental and mitotic abnormalities in offspring. Benzene also showed a significant increase in developmental defects following embryo exposure. For chlorobenzene, developmental defects were seen when the concn was increased to 10(-4) M. m-Dichlorobenzene caused a strong increase in developmental defects and also in mitotic abnormalities. [Pagano G et al; Bull Environ Contam Toxicol 40 (4): 481-8 (1988)]

... Under the conditions of these 2 yr gavage studies, there was no evidence of carcinogenicity of 1,2-dichlorobenzene for male or female F344/N rats or B6C3F1 mice receiving 60 or 120 mg/kg/day. ?evels of Evidence of Carcinogenicity: Male Rats: Negative; Female Rats: Negative; Male Mice: Negative; Female Mice: Negative. [Toxicology &amp; Carcinogenesis Studies of 1,2-Dichlorobenzene (o-Dichlorobenzene) in F344/N Rats and B6C3F1 Mice. Technical Report Series No. 255 (1985) NIH Publication No. 86-2511 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709]

Rats survived inhalation exposure for 2 hr at a concentration of 977 ppm but died after a 7-hr exposure. Rats that survived a 7-hr exposure at 539 ppm o-DCB showed liver necrosis and kidney tubule damage. Liver damage in rats was produced in another study at concentrations of from 50 to 800 ppm and exposures lasting between 0.5 and 1 hr at 390 ppm produced liver necrosis in three of six rats. Mice exposed for 1 hr to saturated o-DCB vapor (calculated between 2000 and 3000 ppm) showed prompt narcosis followed by central depression and cyanosis (and death in 24 hr). [American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991.406]

In rats and guinea pigs exposed at 93 ppm, 7 hr/day for 6 to 7 months, the male guinea pigs had a decrease in spleen weight without any histopathologic changes. [American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991.406]
In separate 13-week studies in mice and rats, oral doses of 500 mg o-DCB/kg caused decreased survival (except in male rats). This dose produced necrosis and hepatocellular degeneration and depletion of lymphocytes in both the spleen and thymus and renal tubular degeneration in male rats. Multifocal mineralization of the myocardial fibers of the heart and skeletal muscle were seen in mice. At a dose of 250 mg/kg, necrosis of individual hepatocytes was evident except in the female mice. At a dose of 125 mg/kg, minimal hepatocellular necrosis was observed in a few rats. [American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991.407]**PEER REVIEWED**

Rats and rabbits were exposed by inhalation at either 100, 200, or 400 ppm o-DCB, 6 hr/day, from gestation days 6 through 15 (rats) and days 6 through 18 (rabbits). Maternal toxicity was reflected by a reduced rate of bodyweight gain in all groups of the treated rats. Liver weights were increased at 400 ppm. No evidence of a fetal response was seen at any concentration. Female rabbits exposed at 400 ppm showed a decreased rate of weight gain over the first 3 exposure days without signs of a fetal response. [American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991.407]**PEER REVIEWED**

Male rats given single intraperitoneal injections of either 50, 100, 250, 300, or 800 mg o-DCB/kg showed dose-related, morphologic alterations in sperm consisting of misshapen head, acrosomal defects, and tail abnormalities. [American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991.407]**PEER REVIEWED**

Fischer 344 (F344) rats are reportedly 75-fold more sensitive than Sprague Dawley (S-D) rats to 1,2-dichlorobenzene (o-DCB) hepatotoxicity. Lethality studies were conducted since no information was available regarding the ultimate consequence of this sensitivity in terms of animal survival in the two strains. LD50S for o-DCB (1.66 ml/kg and 1.76 ml/kg in male F344 and S-D rats, respectively) did not differ. Several studies have shown the importance of tissue repair on animal survival following exposure to toxic chemicals. The objective of this study was to investigate if differential rates of cell division and tissue repair might explain the lack of difference in LD50 dose between the two strains despite higher hepatotoxic injury in F344 rats. Age-matched male S-D and F344 rats were administered o-DCB (0.2, 0.6, 1.2 ml/kg, i.p.); injury and tissue repair occurring as two dynamic but opposing events were measured over time. Liver injury was assessed by measuring plasma alanine aminotransferase (ALT) and sorbitol dehydrogenase (SDH) activities and by liver histopathology. Higher plasma ALT elevations were observed in F344 rats following administration of 0.2 and 0.6 ml o-DCB/kg. Using SDH as a marker of liver injury, the strain difference was evident only at 0.2 ml o-DCB/kg. Liver regeneration was estimated by 3H-thymidine incorporation into hepatonuclear DNA and via proliferating cell nuclear antigen (PCNA) assay. Prompt and significantly higher hepatocellular regeneration beginning at 36 h was evident in F344 rats following administration of 0.2 and 0.6 ml o-DCB/kg. The significantly higher depletion of hepatic glycogen observed in F344 rats
following administration of 0.2 and 0.6 ml o-DCB/kg occurred without significant changes in plasma glucose and is consistent with highly stimulated tissue repair seen in these rats at the corresponding doses. However, increasing the dose further to 1.2 ml o-DCB/kg results in a delayed (S-phase synthesis begins at 48 h) and diminished response to o-DCB. These findings suggest that a significantly higher rate of tissue repair in F344 rats helps them overcome higher liver injury inflicted by o-DCB. This differential in tissue repair in the two strains may play a vital role in equalizing the ultimate outcome of toxicity in the two strains. [Kulkarni SG et al; Archives of Toxicology 70 (11): 714-23 (1996)]**PEER REVIEWED**

NATIONAL TOXICOLOGY PROGRAM STUDIES:

... Two yr toxicity and carcinogenesis studies of 1,2-dichlorobenzene (> 99% pure) were conducted by administering the test cmpd in corn oil by gavage 5 days/wk for 103 wk to groups of 50 male and 50 female F344/N rats and B6C3F1 mice at doses of 60 and 120 mg/kg. Groups of 50 rats and 5 mice of each sex received corn oil by gavage on the same schedule and served as vehicle controls. ... Under the conditions of these 2 yr gavage studies, there was no evidence of carcinogenicity of 1,2-dichlorobenzene for male or female F344/N rats or B6C3F1 mice receiving 60 or 120 mg/kg/day. Levels of Evidence of Carcinogenicity: Male Rats: Negative; Female Rats: Negative; Male Mice: Negative; Female Mice: Negative. [Toxicology & Carcinogenesis Studies of 1,2-Dichlorobenzene (o-Dichlorobenzene) in F344/N Rats and B6C3F1 Mice. Technical Report Series No. 255 (1985) NIH Publication No. 86-2511 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709]**PEER REVIEWED**

NON-HUMAN TOXICITY VALUES:


TSCA TEST SUBMISSIONS:

The effects of o-dichlorobenzene were examined in the rat hepatocyte primary culture/DNA repair assay. Based on preliminary toxicity determinations, o-dichlorobenzene was tested at concentrations of 0%, and 5 different concentrations ranging from 1x10(-7)% to 1x10(-3)% (v/v). None of the concentrations tested caused a significant increase in the unscheduled DNA synthesis over the solvent control (DMSO), and these concentrations were not genotoxic to the hepatocytes. [Naylor Dana Institute for Disease Prevention; Study of the Cultured Liver Cells of Three Chlorinated Benzenes, Final Report. (1983), EPA Document No. FYI-AX-0284-0291, Fiche No. 0291-0]**PEER REVIEWED**

An inhalation teratology study was conducted with pregnant Fischer 344 rats and inseminated New Zealand white rabbits receiving whole body exposure to ortho-dichlorobenzene at nominal concentrations of 0, 100, 200 or 400ppm. At each concentration, 30 or 32 bred rats and 28 or 30 inseminated rabbits were exposed for 6hrs/day on days 6-15 of gestation (rats) and on days 6-18 of gestation (rabbits). Maternal toxicity was
evident by depressed body weight gain in both test species and significantly elevated liver weights in 400ppm treated rats. The incidence of major malformations among the fetuses of either test species was not significantly increased over the controls.[Dow Chemical U.S.A.; Orthodichlorobenzene -- Inhalation Teratology Study in Rats and Rabbits, (1982), EPA Document No. FYI-AX-0782-0198, Fiche No. OTS000198-0 ]**PEER REVIEWED**

The mutagenicity of ortho-dichlorobenzene was evaluated in Salmonella tester strain TA100 (Ames Test), both in the presence and absence of added metabolic activation by Aroclor-induced rat liver S9 fraction. Ortho-dichlorobenzene, diluted with DMSO, was tested at concentrations up to 5.0ul/plate using the plate incorporation technique. Ortho-dichlorobenzene did not cause a positive response in tester strain TA100 with or without metabolic activation.[Rohm & Haas Toxicology Department; Genetic Toxicology Report, (1979), EPA Document No. 878212181, Fiche No. OTS0205181 ]**PEER REVIEWED**

The mutagenicity of ortho-dichlorobenzene was evaluated in Salmonella tester strains TA1535, TA1537, TA1538, TA98 and TA100 (Ames Test) and in Saccharomyces cerevisiae strain D4, both in the presence and absence of added metabolic activation by Aroclor-induced rat liver S9 fraction. Based on preliminary toxicity determinations, ortho-dichlorobenzene, diluted in culture medium, was tested at concentrations up 100ul/plate using the plate incorporation technique. Ortho-dichlorobenzene caused a positive response the tester strain TA100 with metabolic activation, but a dose response was not observed. All other tester strains did not produce a positive result with or without metabolic activation.[Litton Bionetics Inc.; Mutagenicity Evaluation of Ortho-Dichlorobenzene, Final Report, (1976), EPA Document No. 878212180, Fiche No. OTS0205976 ]**PEER REVIEWED**

The mutagenic potential of ortho-dichlorobenzene was evaluated in the germ cells (Sex-Linked Recessive Lethal Mutations) of Drosophila males exposed by inhalation. Based on preliminary toxicity determinations, groups of males files received nominal concentrations of 11,000, 14,000, 16,000 or 17,000ppm in sealed hypovials, resulting in a range of 34 - 0% mortality during exposure and pre-mating. None of the treatments produced mutant frequencies significantly greater than the negative control (air only). [Zoology Department of the University of Wisconsin; Drosophila Sex Linked Recessive Lethal Test on Ortho-Dichlorobenzene, Draft Report, EPA Document No. 40-8320545, Fiche No. OTS0511274 ]**PEER REVIEWED**

The ability of ortho-dichlorobenzene to cause chromosome aberration was evaluated in bone marrow cells of male Charles River rats (30/group) receiving subcutaneous doses of 0.04, 0.2 and 1g/kg/day for 16 days. Six animals per dose were sacrificed after 1, 2, 4, 8 and 16 days of treatment. Toxicity was indicated in the high dose animals by increased mortality and decreased body weight gain compared with control animals. No differences were observed between treatment groups and controls for mean red blood cell counts, mean hemoglobin concentrations and mean hematocrit values. Ortho-dichlorobenzene did not induce an statistically significant (t-test) increase in the number of chromosome aberrations observed relative to the control at any dose level regardless of sacrifice time.[Rohm & Haas Toxicology Department; Ortho-Dichlorobenzene: Myelotoxicity and Cytogenetic Study in Rats, (1979), EPA Document No. 878212182, Fiche No. OTS0205976 ]**PEER REVIEWED**
The ability of ortho-dichlorobenzene to cause chromosome aberrations was evaluated in bone marrow cells of Sprague-Dawley rats (3/sex/treatment) sacrificed at 6, 12 and 24 hours following a single intraperitoneal injection at 150, 300 or 600mg/kg. Due to an error in calculating the stock solution, the 12 and 24 hour assays were performed at concentrations of 135, 270 and 540mg/kg. 100 metaphases per animal were analyzed. Ortho-dichlorobenzene did not cause a statistically significant increase in the frequency of chromosomal breaks or aberrations at any of the dose levels regardless of sacrifice time relative to the controls (DMSO).[Bio assay Systems Corporation; Effects of Ortho-Dichlorobenzene on the In-Vivo Induction of Chromosomal Aberrations in Rat Bone Marrow Cells, Draft Report, (1983), EPA Document No. 40-8320545, Fiche No. OTS0511274 ]**PEER REVIEWED**

The ability of ortho-dichlorobenzene to induce chromosome aberrations in cultured Chinese Hamster ovary (CHO) cells was evaluated in the presence and absence of added metabolic activation by Aroclor-induced rat liver S9 fraction. The maximum dose selected for both nonactivated and activated cultures was the solubility of ortho-dichlorobenzene in water, 140ug/ml (literature value). Although isolated test points with ortho-dichlorobenzene cause a statistically significant (Chi-Square Test) increase in the frequency of the chromosomal aberrations with and without metabolic activation compared to the negative control (DMSO), the assays were considered negative due to lower than average frequency of chromosomal breaks in the negative control.[Bioassay Systems Corporation; Effects of Ortho-Dichlorobenzene on the Induction of Chromosomal Aberrations in Chinese Hamster Ovary Cells, Draft Report, (1982), EPA Document No. 40-8320545, Fiche No. OTS0511274 ]**PEER REVIEWED**

The effect of ortho-dichlorobenzene (DCB) was examined in the rat hepatocyte primary culture/DNA repair assay. Based on preliminary toxicity tests, DCB, diluted with DMSO, was tested at 8 concentrations ranging from 1.0 to 1x10\(^{-7}\)% (v/v). Cultures were exposed to DCB for 18 hrs and 20 nuclei were randomly counted due to no obviously positive cells being observed upon scanning of the slides. Concentration of 0.01% and above were cytotoxic. None of the non-cytotoxic concentrations tested caused a significant increase in unscheduled DNA synthesis over the solvent control.[Naylor Dana Institute; Study of the Effects on Cultured Liver Cells of Three Chlorinated Benzenes, Final Report. (1983), EPA Document No. 40-8420666, Fiche No. OTS0511367 ]**PEER REVIEWED**

METABOLISM/PHARMACOKINETICS:

METABOLISM/METABOLITES:


THE EFFECT OF INDUCERS AND INHIBITORS OF MICROSOMAL MIXED-FUNCTION OXIDASES ON THE FATE OF METABOLISM AND THE EXTENT OF BINDING OF ORTHO- AND


Metabolism of ... 1,2-dichlorobenzene (1,2-DCB), was studied ... in chinchilla rabbits. Single doses of 500 mg compound/kg body weight were given by stomach tube .... Results showed 1,2-DCB to be primarily metabolized by oxidation to 3,4-dichlorophenol, and excreted (primarily in urine) as conjugates of glucuronic and sulfuric acids. Peak excretion of these conjugates occurred on the first day after dosing. Minor metabolites also formed and excreted as conjugates included 2,3-dichlorophenol ... 4,5-dichlorocatechol, 3,4-dichlorocatechol, and 3,4-dichlorophenylmercapturic acid. Metabolism and urinary excretion of 1,2-DCB was considered relatively slow, being essentially complete 5 to 6 days after dosing. [USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-15-16 (1980) EPA 440/5-80-039]**PEER REVIEWED**

The excretion of o-dichlorobenzene by rabbits given a single oral dose of 500 mg/kg /was measured/. Virtually all of the cmpd was excreted in 6 days, predominately in urinary conjugates as glucuronide (48%), ethereal sulfate (21%), and mercapturic acid (5%). The remainder was excreted as mono-phenols. [National Research Council. Drinking Water & Health. Volume 5. Washington, D.C.: National Academy Press, 1983.23]**PEER REVIEWED**

1,2,4-Trichlorobenzene (TCB) was reductively converted into monochlorobenzene (MCB) via dichlorobenzenes (DCBs) on incubation with intestinal contents of rats. When the amounts of MCB produced from o-DCB, m-DCB, or p-DCB as substrates were compared, the amount was the least in the case of o-DCB. This was consistent with the finding that o-DCB tended to accumulate more than the other isomers. The mechanism of the reductive dechlorination of aromatic compounds is not well understood. [Tsuchiya T, Yamaha T; Agric Biol Chem 47 (5): 1163-5 (1983)]**PEER REVIEWED**

A Pseudomonas species that was capable of growth on 1,2-dichlorobenzene (o-DCB) or chlorobenzene as a sole source of carbon and energy was isolated by selective enrichment from activated sludge. Extracts of o-DCB-grown cells converted radiolabeled o-DCB to 3,4-dichloro-cis-1,2-dihydroxycyclohexa-3,5-diene (o-DCB dihydrodiol). 3,4-Dichlorocatechol and o-DCB dihydrodiol accumulated in culture fluids of cells exposed to o-DCB. The results suggest that o-DCB is initially converted by a dioxygenase to a dihydrodiol, which is converted to 3,4-dichlorocatechol by an NAD+ dependent dehydrognase. Ring cleavage of 3,4-dichlorocatechol is by a catechol 1,2-oxygenase to form 2,3-dichloro-cis,cis-muconate. Preliminary results indicate that chloride is eliminated during subsequent lactonization of the 2,3-dichloro-cis,cis-muconate, followed by hydrolysis to form 5-chloromaleylacetic acid. [Haigler BE et al; Appl Environ Microbiol 54 (2): 294-301 (1988)]**PEER REVIEWED**

1,2,4-Trichlorobenzene (TCB) labeled with (14)C was given orally to rats
at a dosage of 50 mg/kg. ... Trapped radioactivity in the expired air amounted to 2.1% of the dose, but production of labeled CO₂ was negligible. Dichlorobenzenes and unchanged TCB were confirmed in the expired air. Reductive dechlorination seems to be catalyzed by intestinal microflora enzymes. [Tanaka A et al; Arch Toxicol 59 (2): 82-8 (1986)]**PEER REVIEWED**

ABSORPTION, DISTRIBUTION & EXCRETION:

The dichlorobenzenes may be absorbed through the lung, gastrointestinal tract, and intact skin. Relatively low water solubility and high lipid solubility favor their penetration of most membranes by diffusion, including pulmonary and GI epithelia, the brain, hepatic parenchyma, renal tubules, and the placenta. /Dichlorobenzenes/ [USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-14 (1980) EPA 440/5-80-039]**PEER REVIEWED**

MECHANISM OF ACTION:

PHARMACOLOGY:

ENVIRONMENTAL FATE & EXPOSURE:

ENVIRONMENTAL FATE/EXPOSURE SUMMARY:
1,2-Dichlorobenzene's production and use as a solvent, as a starting material in the manufacture of 3,4-dichloroaniline, and its application as an insecticide will result in its release to the environment through various waste streams. Based on a vapor pressure of 1.4 mm Hg at 25 deg C, 1,2-dichlorobenzene is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase 1,2-dichlorobenzene is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with an estimated atmospheric half-life of 38 days. 1,2-Dichlorobenzene is expected to have moderate to low mobility in soils based upon log Koc values in the range of 2.5-4.3 measured in soils and sediment. Volatilization of 1,2-dichlorobenzene from dry soil surfaces is expected to be an important fate process based upon the vapor pressure of this compound and a volatilization half-life of about 4 days measured in silt loams. Volatilization from moist soil surfaces is expected based on the Henry's Law constant of 1.5X10⁻³ atm-cu m/mole at 20 deg C. A 0% theoretical BOD in sludge over a 4 week incubation period suggests that biodegradation is expected to be slow in soil and water. In water,
1,2-dichlorobenzene is expected to adsorb to sediment or particulate matter based on its measured Koc values. This compound is expected to volatilize from water surfaces given its Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 4 and 120 hours, respectively. The potential for bioconcentration in aquatic organisms is considered moderate to high based on BCF values in the range of 90 to 560 measured in fish. Occupational exposure may be through inhalation and dermal contact with this compound at workplaces where 1,2-dichlorobenzene is produced or used. The general population may be exposed to 1,2-dichlorobenzene via inhalation of ambient air, ingestion of food and drinking water. (SRC) **PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:
NIOSH (NOES Survey 1981-1983) has statistically estimated that 76,818 workers (12,654 of these are female) are potentially exposed to 1,2-dichlorobenzene in the US(1). Occupational exposure to 1,2-dichlorobenzene may be through inhalation and dermal contact with this compound at workplaces where 1,2-dichlorobenzene is produced or used(SRC). 1,2-Dichlorobenzene levels up to 8.5 ppm (51 mg/cu m) were detected in the breathing zones of a chlorobenzene factory(2). The general population may be exposed to 1,2-dichlorobenzene via inhalation of ambient air, ingestion of food and drinking water(SRC). [(1) NIOSH; National Occupational Exposure Survey (NOES) (1983) (2) IARC; Some Industrial Chemicals and Dyestuffs 29: 214 (1982)]**PEER REVIEWED**

BODY BURDEN:
Dichlorobenzene was detected in whole blood (3.12 ng/g) and adipose tissue (2.28 ng/g) from the general population of Canada(1). 1,2-Dichlorobenzene was detected in the personal air of Los Angeles, CA residents at concns of 0.3-0.4 ug/cu m and residents of Contra Costa, CA at concns of 0.6 ug/cu m(2). 1,2-Dichlorobenzene was detected in the breath of Los Angeles, CA residents at concns of 0.04-0.1 ug/cu m and residents of Contra Costa, CA at concns of 0.08 ug/cu m(2). [(1) Mes J; Bull Environ Contam Toxicol 48: 815-20 (1992) (2) Wallace LA; The Total Exposure Assessment Methodology Study. USEPA/600/S6-87/002 (1987)]**PEER REVIEWED**

AVERAGE DAILY INTAKE:
Based on monitoring data at three USA urban sites (Los Angeles, Phoenix, Oakland), the AVDI for 1,2-dichlorobenzene has been estimated to be 0.5-2.8 ng/day(1). The AVDI of 1,2-, 1,3- and 1,4-dichlorobenzene isomers in the Netherlands is 7.0 ug/day(2). [(1) Singh HB et al; Atmos Environ 15: 601 (1981) (2) Guichert R, Schulting; Sci Total Environ 43: 193-219 (1985)]**PEER REVIEWED**

NATURAL POLLUTION SOURCES:

ARTIFICIAL POLLUTION SOURCES:
Dichlorobenzenes have been detected or quantified in rivers, groundwater, municipal and industrial discharges, and drinking water. Dichlorobenzenes enter the water systems (raw and contaminated water) from the use of 1,2-DCB as a deodorant in industrial wastewater treatment. [USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-1 (1980) EPA 440/5-80-039]**PEER REVIEWED**
1,2-Dichlorobenzene's production and use as a solvent, as a starting reagent in the manufacture of 3,4-dichloroaniline, and its application as an insecticide will result in its release to the environment through various waste streams(1,2,SRC). [(1) Lewis RJ; Hawley's Condensed Chemical Dictionary. 12th ed. NY, NY: Van Nostrand Reinhold Co., p. 377 (1993) (2) Budvari S; Merck Index, 12th ed, Whitehouse Station, NJ Merck & Co. p 517 (1996)]**PEER REVIEWED**

ENVIRONMENTAL FATE:


ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), 1,2-dichlorobenzene,
which has a vapor pressure of 1.4 mm Hg at 25 deg C (2), is expected to exist in the vapor phase in the ambient atmosphere. Vapor-phase 1,2-dichlorobenzene 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 about 38 days (3, SRC). [(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988) (2) Daubert TE, Danner RP; Physical and Thermodynamic Properties of Pure Chemicals Data Compilation Washington, DC: Taylor and Francis (1989) (3) Atkinson R; J Phys Chem Ref Data Monograph No 1 (1989)] **PEER REVIEWED**

ENVIRONMENTAL BIODEGRADATION:
A 0% theoretical BOD in sludge over a 4 week incubation period (1) suggests that biodegradation is expected to be slow in soil and water (SRC). 1,2-Dichlorobenzene is resistant to biodegradation using the Japanese MITI test (2). Dichlorobenzene isomers were slowly biodegraded (6.3% of theoretical CO2 evolution in 10 weeks) in an alkaline soil sample (3). 1,2-Dichlorobenzene was biodegraded by an acclimated anaerobic sediment slurry obtained from the Tsurumi River, Japan (4). The first-order biodegradation rate constant was 0.0188 days⁻¹, corresponding to a half-life of about 37 days (4). The first-order biodegradation rate constant of 1,2-dichlorobenzene in pure culture laboratory batch microcosms was 0.06 days⁻¹, corresponding to a half-life of about 12 days following a 13 day lag period (5). The rate constant for 1,2-dichlorobenzene in a heterogeneous aquifer at the Columbus Air Force Base, Mississippi was 0.0059 days⁻¹, corresponding to a biodegradation half-life of about 117 days (6). 1,2-Dichlorobenzene is resistant to biodegradation in soils, with half-lives expected to be greater than 9 months (7). [(1) Chemicals Inspection and Testing Institute. Japan Chemical Industry Ecology - Toxicology and Information Center. ISBN 4-89074-101-1 (1992) (2) Kitano M; Biodegradation and Bioaccumulation Test on Chem Sub OECD Tokyo Meeting Reference Book TSU-No.3 (1978) (3) Haider K et al; Arch Microbiol 9: 183 (1974) (4) Masunga S et al; Wat Sci Technol 33: 173-80 (1996) (5) Nielsen PH et al; Environ Sci Technol 30: 31-37 (1996) (6) Stauffer TB et al; A Natural Gradient Tracer Experiment in a Heterogeneous Aquifer With Measured In Situ Biodegradation Rates: A Case For Natural Attenuation EPA/540/R-94 515 (1994) (7) Roy WR; pp. 411-46 in Contam Groundwaters. Adriano DC et al; Eds. Northwood, UK: Sci Rev (1994)] **PEER REVIEWED**

ENVIRONMENTAL ABIOTIC DEGRADATION:
The rate constant for the vapor-phase reaction of 1,2-dichlorobenzene with photochemically-produced hydroxyl radicals has been measured as 4.2X10⁻¹³ cu cm/molecule-sec at 25 deg C (1). This corresponds to an atmospheric half-life of about 38 days at an atmospheric concentration of 5X10⁻⁵ hydroxyl radicals per cu cm (1, SRC). 1,2-Dichlorobenzene is not expected to undergo hydrolysis in the environment due to the lack of functional groups to hydrolyze (SRC). [(1) Atkinson R; J Phys Chem Ref Data Monograph No 1 (1989)] **PEER REVIEWED**

ENVIRONMENTAL BIOCONCENTRATION:
The sorption of 8 organic compounds by a representative green alga, Selenastrum capricornutum, was determined by GLC by a series of linear model experiments. The log10 bioconcentration factors (BCF), defined as the ratio of the concentration on/in the algae to the concentration in the aqueous medium, were as follows: benzene 3.32, toluene 3.18, chlorobenzene 3.69, 1,2-dichlorobenzene 4.17. The relation of log10 BCF correlation with log10 octanol-water partition coefficient (P) was determined to be log10
BCF = 0.46 log₁₀ P + 2.36. [Casserly DM et al; Water Res 17 (11): 1591-4 (1983)]**PEER REVIEWED**

BCF values of 150 to 230 were measured in carp exposed to 0.1 mg/l of 1,2-dichlorobenzene during an 8 week incubation period and BCF values of 90 to 260 were measured in carp exposed to 0.01 mg/l of 1,2-dichlorobenzene during an 8 week incubation period(1). 1,2-Dichlorobenzene BCF values of 270 to 560 were experimentally determined for rainbow trout exposed up to 119 days in laboratory aquariums(2). A whole body BCF of 66 was determined for bluegill sunfish exposed to 1,2-dichlorobenzene over a 28-day period in a continuous flow system(3). According to a classification scheme(4), these BCF values suggest that bioconcentration in aquatic organisms is moderate to high. [(1) Chemicals Inspection and Testing Institute. Japan Chemical Industry Ecology - Toxicology and Information Center. ISBN 4-89074-101-1 (1992) (2) Oliver BG, Niimi AJ; Environ Sci Technol 17: 287-91 (1983) (3) Barrows ME et al; pp. 379-92 in Dyn Exposure Hazard Assess Toxic Chem Ann Arbor,MI: Ann Arbor Sci (1980)(4) Franke C et al; Chemosphere 29: 1501-14 (1994)]**PEER REVIEWED**

SOIL ADSORPTION/MOBILITY:
Experimental Koc values of 280(1) and 320(2) were determined for 1,2-dichlorobenzene in silt loam soils. A log Koc value of 3.7 was reported for 1,2-dichlorobenzene in sediment obtained from the Ise Bay, Japan(3) and a log Koc value of 4.3 was measured from sediment of Lake Ketelmeer, Netherlands(4). According to a recommended classification scheme(5), these Koc values suggest that 1,2-dichlorobenzene has moderate to low mobility in soil. [(1) Chiou CT et al; Sci 206: 831-32 (1979) (2) Chiou CT et al; Environ Sci Technol 17: 227-31 (1983) (3) Masunga S et al; J Environ Sci Health A31: 887-903 (1996) (4) Tenhulscher TEM et al; Chemosphere 35: 2331-44 (1997) (5) Swann RL et al; Res Rev 85: 23 (1983)]**PEER REVIEWED**

VOLATILIZATION FROM WATER/SOIL:
The Henry's Law constant for 1,2-dichlorobenzene is 1.5X10⁻³ atm-cu m/mole at 20 deg C(1). This value indicates that 1,2-dichlorobenzene will volatilize from water(2,SRC). 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) is estimated as approximately 4 hours(2,SRC). 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 approximately 120 hours(2,SRC). 1,2-Dichlorobenzene's Henry's Law constant(1) indicates that volatilization from moist soil surfaces is expected. 1,2-Dichlorobenzene is expected to volatilize from dry soil surfaces based on a vapor pressure of 1.4 mm Hg at 25 deg C(3). The volatilization half-life of 1,2-dichlorobenzene from Captina and McLaurin sandy loam soils was measured as about 4 days(4). [(1) Staudinger J, Roberts PV; Crit Rev Environ Sci Technol 26: 205-97 (1996) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington,DC: Amer Chem Soc pp. 15-1 to 15-29 (1990) (3)Daubert TE, Danner RP; Physical and Thermodynamic Properties of Pure Chemicals Data Compilation Washington,DC: Taylor and Francis (1989) (4) Anderson TA et al; J Environ Qual 20: 420-24 (1991)]**PEER REVIEWED**

ENVIRONMENTAL WATER CONCENTRATIONS:
DRINKING WATER: A mean 1,2-dichlorobenzene concn of 0.003 ppb was detected in drinking water samples from 3 cities near Lake Ontario in 1980(1). A
concn of 1 ppb was detected in Miami, FL drinking water and qualitative detections were reported for Philadelphia, PA and Cincinnati, OH(2). 1,2-Dichlorobenzene was found in 2 of 945 finished water supplies throughout the US that use groundwater sources at concns of 2.2 and 2.7 ppb(3). 1,2-Dichlorobenzene was identified, not quantified in Cleveland, OH tap water(4) and two drinking water supply sources in the United Kingdom(5). 1,2-Dichlorobenzene was identified, not quantified, in the drinking water of Alexandria, Egypt(6). [(1) Oliver BG, Nicol KD; Environ Sci Technol 16: 532 (1982) (2) USEPA; Preliminary Assessment of Suspected Carcinogens in Drinking Water An Interim Report to Congress (1975) (3) Westrick JJ et al; J Amer Water Works Assoc 76: 52 (1984) (4) Sanjivamurthy VA; Water Res 12: 31 (1978) (5) Fielding M et al; Organic Micropollut in Drinking Water Medmenham, Eng Water Res Cent TR-159 (1981) (6) Hassan AAM et al; Bull Environ Contam Toxicol 56: 397-404 (1996)]**PEER REVIEWED**

GROUNDWATER: 1,2-Dichlorobenzene was positively detected in 20 of 685 groundwaters analyzed in NJ during 1977-1979 with 6,800 ppb the highest concn found(1). 1,2-Dichlorobenzene was detected at concns of less than 4 ng/l in groundwater from the Edwards Aquifer, TX(2). 1,2-Dichlorobenzene was detected at max concns of 2.7 and 13 ug/l in groundwater near landfills at unspecified locations in Finland/Sweden and Germany/USA/Canada(3). [(1) Page GW; Environ Sci Technol 15: 1475 (1981) (2) Buszka PM et al; Anal Chem 67: 3659-67 (1995) (3) Assmuth TW, Strandberg T; Wat Air Soil Pollut 69: 179-99 (1993)]**PEER REVIEWED**

SURFACE WATERS: 1,2-Dichlorobenzene was detected in 15 of 463 surface waters analyzed in NJ during 1977-1979 with 8.2 ppb the highest concn found(1). Mean concs of 5 and 6 parts per trillion were detected in Lake Ontario and Grand River water, respectively, during 1980 near Niagara Falls; concns of 0-56 parts per trillion were found in the Niagara River(2). 1,2-Dichlorobenzene was detected at concns of 4-240 parts per trillion (mean concn of 23 parts per trillion) in the Niagara River at Niagara-On-The-Lake between 1981 and 1983(3) and concns of 5.6-190 parts per trillion (mean concn of 18 parts per trillion) were detected in the Niagara River between 1981 and 1983(4). An avg concn of 20 parts per trillion was found in the Niagara River near Niagara-On-The-Lake between Sept and Oct 1982(5). Positive detection of 1,2-dichlorobenzene was reported by 0.6% of 1077 USEPA STORET stations(6). 1,2-Dichlorobenzene was identified, not quantified, in the Delaware and Raritan Canal in NJ(7). 1,2-Dichlorobenzene was detected at concns below 0.5 ppb in the Rhine River between 1978-1982(8). An avg 1,2-dichlorobenzene concn of 0.32 ppb was found in the Rhine River near Dusseldorf in 1984(9).

RAIN/SNOW: A mean 1,2-dichlorobenzene concn of 0.49 parts per trillion was detected in Portland, OR rainwater during March-April 1982(1); Concns of not detected to 0.62 parts per trillion found in Portland, OR rainwater during 1984(2). [(1) Pankow JF et al; Environ Sci Technol 18: 310-17 (1984) (2) Ligocki MP et al; Atmos Environ 19: 1609 (1985)]**PEER REVIEWED**

**EFLUENT CONCENTRATIONS:**

1,2-Dichlorobenzene was detected in the leachate of municipal landfills in the US at concns of 3-32 g/l(1) and 21-33 ug/kg in the ash of municipal waste incinerators in the US(2). 1,2-Dichlorobenzene was detected at a concn of 0.02 ug/cu m in the effluent of a hazardous waste incinerator in Germany(3). The annual US emission of 1,2-dichlorobenzene was 160 tons in 1990(4). 1,2-Dichlorobenzene was detected at mean concns of 0.03 to 0.20 mg/cu m in the air of municipal landfills in Finland(5).


**SEDIMENT/SOIL CONCENTRATIONS:**

1,2-Dichlorobenzene was detected in the sediment of Lake Ketelmeer, Netherlands at concns of 350 and 220 ng/kg(1). 1,2-Dichlorobenzene was detected in sediment off the coast of Taiwan at concns of 2-5 ng/kg(2). Mean 1,2-dichlorobenzene concns of 1,8,2 and 11 ppb were detected in the superficial sediments from Lakes Superior, Huron, Erie, and Ontario, respectively(3). 1,2-Dichlorobenzene was detected at concns of 0-516 ng/g in sediment from Ise Bay, Japan(4). 1,2-Dichlorobenzene was detected in the sediment of 7 rivers and 1 port in Niigata, Japan at concns of less than 0.03 to 1.4 ng/g(5). [(1) Beurskens JEM et al; Water Sci Technol 29: 77-85 (1994) (2) Lee CL, Fang MD; Chemosphere 35: 2039-50 (1997) (3) Oliver BG, Nicola K; Environ Sci Technol 16: 532-36 (1982) (4) Masunga S et al; Wat Res 25: 289-97 (1991) (5) Kawata K et al; Bull Environ Contam Toxicol 58: 893-900 (1997)]**PEER REVIEWED**

**ATMOSPHERIC CONCENTRATIONS:**

1,2-Dichlorobenzene ... measured in aerial fallout and high volume samples taken at various locations in the Los Angeles area yielded the following concentrations; Catalina Island < 8 ng/sq m; San Clemente < 27 ng/sq m; Santa Barbara < 53 ng/sq m. [USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes p.C-5 (1980) EPA 440/5-80-039]**PEER REVIEWED**

Concentrations (mean) of o-dichlorobenzene were: 0.03 ppb (detected in 29 of 38 samples) in Newark NJ; 0.02 ppb (24 of 37 samples) in Elizabeth NJ; and 0.01 ppb (27 of 35 samples) in Camden NJ during July-August 1981.
URBAN/SUBURBAN: The mean 1,2-dichlorobenzene concentrations from 226 source-dominant points and 674 urban/suburban points in the US have been reported to be 200 and 56 parts per trillion, respectively(1). An avg concn of 0.61 ppb was reported for 1,2-dichlorobenzene near industrial areas in NJ(2). Mean concns of 12.5, 22.6 and 4.0 parts per trillion were detected for 1,2-dichlorobenzene in the ambient air of Los Angeles, CA, Phoenix, A2 and Oakland, CA, respectively, during Apr-May 1979(3). Mean concns of 0.01-0.03 ppb were detected in the ambient air of three NJ cities during July-Aug 1981(4). A mean concn of 5.8 ng/cu m was reported for 1,2-dichlorobenzene in the ambient air of Portland, OR during 1984(5). 1,2-Dichlorobenzene was detected at mean concns of 130 ppb (Los Angeles, CA), 40 ppb(Oakland, CA), 10 ppb(Riverside, CA), 1 ppb(Portland, OR) and unspecified urban locations in the US)(6). [(1) Brodzinsky R, Singh HB; Volatile Org Chem in the Atmosphere: An Assess of Available Data Menlo Park, CA Atmospheric Sci Cntr, SRI Internatl pp. 198 (1982) (2) Bozzilli JW, Kebbekus BB; J Environ Sci Health 17: 693 (1982) (3) Singh HB et al; Atmos Environ 15: 601-12 (1981) (4) Harkov R et al; J Air Pollut Control Assoc 33: 1177 (1983) (5) Ligocki MP et al; Atmos Environ 19: 1609 (1985) (6) Grosjean D; Sci Total Environ 100: 367-414 (1991)]**PEER REVIEWED**

RURAL/REMOTE: The mean 1,2-dichlorobenzene concentrations from 9 rural sources in the US was 1.8 parts per trillion(1). 1,2-Dichlorobenzene was detected at an avg concn of 0.06 ppb in rural residential areas of NJ(2). [(1) Brodzinsky R, Singh HB; Volatile Org Chem in the Atmosphere: An Assess of Available Data Menlo Park, CA Atmospheric Sci Cntr, SRI Internatl pp. 198 (1982) (2) Bozzilli JW, Kebbekus BB; J Environ Sci Health 17: 693 (1982)]**PEER REVIEWED**

INDOOR AIR: 1,2-Dichlorobenzene was detected at median concns of 0.1-2.2 ug/cu m in US homes(1). The mean 3-day concn of dichlorobenzene isomers was 0-7 ug/cu m in 7 buildings in the US(2). The combined isomers of dichlorobenzene were identified, not quantified, in 10 of 14 indoor air samples from 4 buildings in the US(2). 1,2-Dichlorobenzene was identified, not quantified, in the indoor air from 24 of 26 buildings in Finland(3). The mean concn of 1,2-dichlorobenzene measured in houses in Kuwait from Dec 1994 to Jan 1995 was 1,679 ug/cu m(4). [(1) Wallace LA et al; Environ Res 50: 37-55 (1989) (2) Wallace LA et al; Volatile Organic Chemicals in 10 Public Access Buildings. USEPA/600/D-87/152 (1987) (3) Kostiainen K; Atmos Environ 29: 693-702 (1995) (4) Bouhamra WS et al; Environ Intl 23: 197-204 (1997)]**PEER REVIEWED**

FOOD SURVEY VALUES:
1,2-Dichlorobenzene was detected at a concn of 1.0 ng/g in market meat samples in Yugoslavia(1) and in 45 of 234 table ready foods in the US at an avg concn of 9.47 ppb(2). 1,2-Dichlorobenzene was detected in high-fat foods at concns of 49-113 ng/g and in low-fat foods at 11-78 ng/g(3). 1,2-Dichlorobenzene was detected in potato core at a concn of 0.328 ug/kg and pea seeds at a concn of 0.112 ug/kg(4). [(1) Jan J; Mitt Geb Lebensmittelunters Hyg 74: 420-6 (1983) (2) Heikes DL et al; J Agric Food Chem 43: 2869-75 (1995) (3) Daft JL; J Agric Food Chem 37: 560-64 (1989) (4) Wang MJ, Jones KC;J Agric food Chem 42: 2322-28 (1994) ]**PEER REVIEWED**

PLANT CONCENTRATIONS:
1,2-Dichlorobenzene has been detected at unspecified concns in the roots of wheat plants grown from lindane-treated seeds(1). 1,2-Dichlorobenzene was identified, not quantified, in plant material grown in an Illinois coal refuse reclamation site(2). [(1) IARC; Some Industrial Chemicals and Dyestuffs 29: 213 (1982) (2) Webber MD et al; J Environ Qual 23: 1019-26 (1994)]**PEER REVIEWED**

FISH/SEAFOOD CONCENTRATIONS:
1,2-Dichlorobenzene was detected at concns of 0.3, 1, 1 and 1 ppb in trout taken from Lake Superior, Lake Huron, Lake Erie and Lake Ontario, respectively, during 1980(1). Concns of 0-4.0 ug/kg were found in Flatfish off the California coast near Los Angeles(2) and a mean concn of less than 0.031 mg/kg was found in the muscle tissue of 8 seafood species caught off the California coast(2). Fish and mussels taken from rivers in Slovenia and the Gulf of Trieste (Yugoslavia) were found to contain trace levels to 1.2 ug/g of 1,2-dichlorobenzene (on a fat basis)(3). [(1) Oliver BG, Nicol KD; Environ Sci Technol 16: 532-6 (1982) (2) Young DR et al; Water Chlorination Environ Impact Health Eff 3: 471-86 (1980) (3) Jan J, Malnersic S; Bull Environ Contam Toxicol 24: 824 (1980)]**PEER REVIEWED**

MILK CONCENTRATIONS:
Mean 1,2-dichlorobenzene of 13 ug/kg (fat basis) detected in Yugoslavian human adipose tissue and 9 ug/kg (as is basis) or 230 ug/kg (fat basis) in human milk. [Jan J; Bull Environ Contam Toxicol 30: 595 (1983)]**PEER REVIEWED**

A survey of human milk from the general population of Canada found 1,2-dichlorobenzene residues in 17 percent of the samples at an avg concn of 2 ppb(1). 1,2-Dichlorobenzene was detected in human milk at 9 ug/kg(2). [(1) Davies D, Mes J; Bull Environ Contam Toxicol 39: 743-50 (1987) (2) Jan J; Bull Environ Contam Toxicol 30: 595-99 (1983)]**PEER REVIEWED**

ENVIRONMENTAL STANDARDS & REGULATIONS:

FIFRA REQUIREMENTS:
As the federal pesticide law FIFRA directs, EPA is conducting a comprehensive review of older pesticides to consider their health and environmental effects and make decisions about their future use. Under this pesticide reregistration program, EPA examines health and safety data for pesticide active ingredients initially registered before November 1, 1984, and determines whether they are eligible for reregistration. In addition, all pesticides must meet the new safety standard of the Food Quality Protection Act of 1996. Pesticides for which EPA had not issued Registration Standards prior to the effective date of FIFRA, as amended in 1988, were divided into three lists based upon their potential for human exposure and other factors, with List B containing pesticides of greater concern and List D pesticides of less concern. 1,2-Dichlorobenzene is found on List C. Case No: 3057; Pesticide type: Antimicrobial; Case Status: No products containing the pesticide are actively registered ... The case /is characterized/ as "cancelled." Under FIFRA, pesticide producers may voluntarily cancel their registered products. EPA also may cancel pesticide registrations if registrants fail to pay required fees or make/meet certain reregistration commitments, or if EPA reaches findings of unreasonable adverse effects.; Active ingredient (AI):
1,2-Dichlorobenzene; AI Status: The active ingredient is no longer
contained in any registered pesticide products ... "cancelled."
[USEPA/OPP; Status of Pesticides in Registration, Reregistration and Special Review p.249 (Spring, 1998) EPA 738-R-98-002]**QC REVIEWED**

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. 1,2-Dichlorobenzene is included on this list. [40 CFR 716.120 (7/1/97)]**PEER REVIEWED**

Section 8(a) of TSCA requires manufacturers of this chemical substance to report preliminary assessment information concerned with production, use, and exposure to EPA. [40 CFR 712.30 (7/1/97)]**PEER REVIEWED**

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 45.5 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 (7/1/97)]**PEER REVIEWED**

RCRA REQUIREMENTS:
F002; When 1,2-dichlorobenzene is a spent solvent, it is classified as a hazardous waste from a nonspecific source (F002), as stated in 40 CFR 261.31, and must be managed according to state and/or federal hazardous waste regulations. [40 CFR 261.31 (7/1/97)]**PEER REVIEWED**

U070; As stipulated in 40 CFR 261.33, when 1,2-dichlorobenzene, 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 (7/1/96)]**PEER REVIEWED**

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. o-Dichlorobenzene is produced, as an intermediate or a final product, by process units covered under this subpart. [40 CFR 60.489 (7/1/97)]**PEER REVIEWED**

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 (7/1/87)]**QC REVIEWED**

Toxic pollutant designated pursuant to section 307(a)(1) of the Clean Water Act and is subject to effluent limitations. [40 CFR 401.15 (7/1/87)]**QC REVIEWED**

FEDERAL DRINKING WATER GUIDELINES:

STATE DRINKING WATER STANDARDS:
(NJ) NEW JERSEY 600 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**

STATE DRINKING WATER GUIDELINES:
(AZ) ARIZONA 620 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**

(CA) CALIFORNIA 130 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**

(ME) MAINE 85 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**

(MN) MINNESOTA 600 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**

CHEMICAL/PHYSICAL PROPERTIES:

MOLECULAR FORMULA:
C6-H4-Cl2 [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983.444]**PEER REVIEWED**

MOLECULAR WEIGHT:

COLOR/FORM:


ODOR:
PLEASANT ODOR [Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical


BOILING POINT:

MELTING POINT:

CRITICAL TEMPERATURE & PRESSURE:
Critical temperature: 417.2 deg C; Critical pressure: 4031 kPa

DENSITY/SPECIFIC GRAVITY:

HEAT OF COMBUSTION:

HEAT OF VAPORIZATION:

OCTANOL/WATER PARTITION COEFFICIENT:

SOLUBILITIES:


In water, 156 mg/l at 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:
Intense mass spectral peaks: 146 m/z (100%), 148 m/z (64%), 111 m/z (38%), 75 m/z (23%) [Hites, R.A. Handbook of Mass Spectra of Environmental Contaminants. Boca Raton, FL: CRC Press Inc., 1985.69]**PEER REVIEWED**


SURFACE TENSION:

VAPOR DENSITY:

VAPOR PRESSURE:

VISCOSITY:

OTHER CHEMICAL/PHYSICAL PROPERTIES:
PERCENT IN SATURATED AIR: 0.2 (25 DEG C) [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982.3612]**PEER REVIEWED**


Partition coefficients at 37 deg C for 1,2-dichlorobenzene into blood= 423; into oil= 39,900. [Sato A, Nakajima T; Scand J Work Environ Health 13: 81-93 (1987)]**PEER REVIEWED**


Saturated vapor pressure= 0.025 lb/sq in @ 70 deg F [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.]**PEER REVIEWED**

Saturated vapor density= 0.00065 lb/cu ft @ 70 deg F [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.]**PEER REVIEWED**

Ideal gas heat capacity= 0.184 Btu/lb ft @ 75 deg F [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.]**PEER REVIEWED**


Henry's Law constant = 0.0015 atm-cu m/mol at 20 deg C [Staudinger J, Roberts PV; Crit Rev Environ Sci Technol 26: 205-297 (1996)]**PEER REVIEWED**

Hydroxyl radical rate constant = 4.2X10-13 cu-cm/molc sec @ 25 deg C [Atkinson R; Journal of Physical And Chemical Reference Data. Monograph No 1 (1989)]**PEER REVIEWED**


CHEMICAL SAFETY & HANDLING:

DOT EMERGENCY GUIDELINES:
Health: Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Contact with molten substance may cause severe burns to skin and eyes. Avoid any skin contact. Effects of contact or inhalation may be delayed. Fire may produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may be corrosive and/or toxic and 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-152]**QC REVIEWED**


Protective clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations. [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-152]**QC REVIEWED**


Fire: Small fires: Dry chemical, CO2 or water spray. Large fires: Water spray, fog or regular 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; 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. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks 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-152]**QC REVIEWED**

Spill or leak: Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined

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. For minor skin contact, avoid spreading material on unaffected skin. 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-152]**QC REVIEWED**

**ODOR THRESHOLD:**

Odor threshold low= 12.0 mg/cu-m, Odor threshold high= 300.0 mg/cu-m, Irritating concentration= 150.0 mg/cu-m (From table). [Ruth JH; Am Ind Hyg Assoc J 47: A-142-51 (1986)]**PEER REVIEWED**

**SKIN, EYE AND RESPIRATORY IRRITATIONS:**

**FIRE POTENTIAL:**

**NFPA HAZARD CLASSIFICATION:**
Health: 2. 2= Materials that, on intense or continued (but not chronic) exposure, could cause temporary incapacitation or possible residual injury, including those requiring the use of respiratory protective equipment that has an independent air supply. These materials are hazardous to health, but areas may be entered freely if personnel are provided with full-face mask self-contained breathing apparatus that provides complete eye protection. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997. 325-34]**QC REVIEWED**
Flammability 2, 2= Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors. Water spray may be used to extinguish the fire because the material can be cooled to below its flash point. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997. 325-34]**QC REVIEWED**

Reactivity 0, 0= Materials which are normally stable even under fire exposure conditions, and which are not reactive with water. Normal fire fighting procedures may be used. [Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997. 325-34]**QC REVIEWED**

**FLAMMABLE LIMITS:**

**FLASH POINT:**
155 deg F (Open Cup); 151 deg F (Closed Cup) [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., 1993-1994.1455]**PEER REVIEWED**

**AUTOIGNITION TEMPERATURE:**

**FIRE FIGHTING PROCEDURES:**


**FIREFIGHTING HAZARDS:**

**EXPLOSIVE LIMITS & POTENTIAL:**
HAZARDOUS REACTIVITIES & INCOMPATIBILITIES:


HAZARDOUS DECOMPOSITION:

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

PROTECTIVE EQUIPMENT & CLOTHING:
USUAL PRECAUTIONS MUST BE TAKEN IN FACTORY; AVOIDANCE OF CONTACT WITH SKIN & EYES, USE OF GOGGLES & RUBBER GLOVES WHILE HANDLING PRODUCT. [Lefaux, R. Practical Toxicology of Plastics. Cleveland: CRC Press Inc., 1968.149]**PEER REVIEWED**


The American Society for Testing and Materials cell was utilized to study permeation of chlorobenzene, o-dichlorobenzene, and m-dichlorobenzene, and o- and p-chlorotoluenes through Viton (unsupported) and nitrile (supported and unsupported) glove materials using isopropanol as collecting solvent, and FID (flame ionization detector)/gas chromatography for quantitation. Adequate mixing in the collection chamber was accomplished by externally agitating the ASTM cell at the required speed in a moving-tray water bath at 25 deg C. The Viton glove did not show permeation even after 4 hr. The nitrile gloves showed breakthrough times of < 1 hr. The steady state molar flux rates for unsupported or supported nitrile gloves, or for the different challenge solvents were not statistically different. Breakthrough times were better indicators of permeation than steady state molar flux rates. A mixed permeation mechanism was proposed, depending on swelling of the glove material. [Mikatavage M et al; Am Ind Hyg Assoc J 45 (9): 617-621 (1984)]**PEER REVIEWED**


Recommendations for respirator selection. Condition: Emergency or planned entry into unknown concn or IDLH conditions: 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 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, 1997.97]**QC REVIEWED**


PREVENTIVE MEASURES:


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**


SRP: Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants. **PEER REVIEWED**


Work clothing that becomes wet or significantly contaminated should be removed and replaced. [NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997.97]**QC REVIEWED**

SRP: Contaminated protective clothing should be segregated in such a manner so that there is no direct personal contact by personnel who handle, dispose, or clean the clothing. Quality assurance to ascertain the completeness of the cleaning procedures should be implemented before the decontaminated protective clothing is returned for reuse by the workers. Contaminated clothing should not be taken home at end of shift, but should remain at employee's place of work for cleaning. **PEER REVIEWED**

**SHIPEMENT 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 (7/1/96)]**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. 39th Ed. Montreal, Canada and Geneva, Switzerland : International Air Transport Association, Dangerous Goods Regulations, 1998. 127]**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.616 (1988)]**PEER REVIEWED**
STORAGE CONDITIONS:

CLEANUP METHODS:
Land spill: Dig a pit, pond, lagoon, or holding area to contain liquid or solid material. /SRP: If time permits, pits, ponds, lagoons, soak holes or holding areas should be sealed with an impermeable flexible membrane liner./ Dike surface flow using soil, sand bags, foamed polyurethane, or concrete. Absorb bulk liquid with fly ash, or cement power. Apply "universal" gelling agent to immobilize spill. [Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, DC: Association of American Railroads, Bureau of Explosives, 1994.347]**PEER REVIEWED**


1. Remove all ignition sources. 2. Ventilate area of spill or leak. 3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. [Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) Publication No. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981.3]**PEER REVIEWED**

DISPOSAL METHODS:
Generators of waste (equal to or greater than 100 kg/mo) containing this contaminant, EPA hazardous waste numbers U070, F002, must conform with USEPA regulations in storage, transportation, treatment and disposal of waste. [40 CFR 240-280, 300-306, 702-799 (7/1/97)]**PEER REVIEWED**

... Halogenated compounds may be disposed of by incineration provided they are blended with other compatible wastes or fuels so that the composite contains less than 30% halogens and the heating value is from 7000 to 9000 BTU/lb. Liquid injection, rotary kiln, and fluidized bed incinerators are typically used to destroy liquid halogenated wastes. ... Temperatures of at least 2000 - 2200 deg F and residence times /of more than 2 sec/ ... are required for the destruction of halogenated aromatic hydrocarbons. [40 CFR 260.340 - 260.351 (1985)]**PEER REVIEWED**

Potential candidate for rotary kiln incineration, with a temperature range of 820 to 1,600 deg C, and a residence time of seconds. Also a potential candidate for liquid injection incineration, with a temperature range of 650 to 1,600 deg C, and a residence time of 0.1 to 2 seconds. [USEPA;
Chemical Treatability of 1,2-Dichlorobenzene; Concentration Process: Stripping; Chemical Classification: Aromatic; Scale of Study: Full Scale, Continuous Flow; Type of Wastewater Used: Domestic Wastewater; Results of Study: 70% reduction by air stripping. [USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-96 (1982)]**PEER REVIEWED**

OCCUPATIONAL EXPOSURE STANDARDS:

OSHA STANDARDS:
Permissible Exposure Limit: Table Z-l Ceiling value: 50 ppm (300 mg/cu m). [29 CFR 1910.1000 (7/1/98)]**QC REVIEWED**

THRESHOLD LIMIT VALUES:
8 hr Time Weighted Avg (TWA) 25 ppm; 15 min Short Term Exposure Limit (STEL) 50 ppm [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.30]**QC REVIEWED**

A4. A4= Not classifiable as a human carcinogen. [American Conference of Governmental Industrial Hygienists. TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH. 2000.30]**QC REVIEWED**

NIOSH RECOMMENDATIONS:

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

OTHER OCCUPATIONAL PERMISSIBLE LEVELS:

MANUFACTURING/USE INFORMATION:

MAJOR USES:
The active ingredient is no longer contained in any registered pesticide products ... "cancelled." [USEPA/OPP; Status of Pesticides in Registration, Reregistration and Special Review p.249 (Spring, 1998) EPA 738-R-98-002]**QC REVIEWED**
SOLVENT FOR WAXES, GUMS, RESINS, TARS, RUBBERS, OILS, ASPHALTS,


ORG SYNTH ESP OF PESTICIDES & SOLVENT IN CHEM PROCESSES [SRI]**PEER REVIEWED**


Hydrolysis of 1,2-dichlorobenzene with KOH and NaOH gives ortho-chlorophenol /an intermediate for dyestuffs and initiator for higher chlorinated phenols/ [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd


MANUFACTURERS:


METHODS OF MANUFACTURING:
CHLORINATION OF BENZENE OR MONOCHLOROBENZENE IN THE PRESENCE OF A CATALYST [SRI]**PEER REVIEWED**


GENERAL MANUFACTURING INFORMATION:


FORMULATIONS/PREPARATIONS:
... AVAIL IN USA AS TECHNICAL GRADE TYPICALLY CONTAINING 98.7% BY WT OF ORTHO-ISOMER & 1.3% OF META- & PARA-ISOMERS COMBINED. IT HAS ... MOISTURE CONTENT OF 80 PPM. ... ALSO AVAIL IN USA IN GRADE WHICH ... CONTAINS 83% OF ORTHO-ISOMER, 17% OF META- & PARA-ISOMERS ... AN EMULSIFIABLE FORM OF ... LATTER PRODUCT CAN ... /BE OBTAINED/. [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).V7 233 (1974)]**PEER REVIEWED**

High purity grade: 98.0% minimum active ingredient; technical grade: 80-90% active ingredient [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization,
IMPURITIES:
High purity grade: less than 0.2% 1,2,4-trichlorobenzene and less than
0.005% monochlorobenzene. Technical grade: less than 19.0% other
dichlorobenzenes isomers, less than 1.0% trichlorobenzenes & less than
0.05% monochlorobenzene. [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).V29 214 (1982)]**PEER REVIEWED**

CONSUMPTION PATTERNS:
53% FOR ORGANIC SYNTHESIS (CHIEFLY FOR PESTICIDES); 20% FOR SOLVENT IN
TOLUENE DI-ISOCYANATE PROCESS; 15% FOR MISC SOLVENT USES; 8% FOR DYESTUFFS
MFR, 4% FOR MISC USES (1973) [SRI]**PEER REVIEWED**

Organic synthesis (mainly for production of 3,4-dichloroaniline), 70%;
solvents for toluene diisocyanate production, 15%; miscellaneous solvent
usage, 8%; dye manufacture 4%; and other application, 3% (1978) [IARC.
Geneva: World Health Organization, International Agency for Research on

million lb; 2000 /projected/: 36 million lb. [Kavaler AR; Chemical
Marketing Reporter Sept 9 (1996)]**PEER REVIEWED**

U. S. PRODUCTION:
(1972) 2.83X10+10 GRAMS [SRI]**PEER REVIEWED**

(1975) 2.48X10+10 GRAMS [SRI]**PEER REVIEWED**

6.4 to 40.9X10+9 g [USITC (1977)]**PEER REVIEWED**

2.2X10+9 g [USITC (1981)]**PEER REVIEWED**

(1979) 2.60X10+10 g [IARC MONOGRAPHS 1972-PRESENT V29 p.217]**PEER
REVIEWED**

U. S. IMPORTS:
(1972) 6.30X10+06 GRAMS [SRI]**PEER REVIEWED**

(1975) 1.23X10+09 GRAMS (PRINCPL CUSTMS DISTS) [SRI]**PEER REVIEWED**

U. S. EXPORTS:
(1972) ESTIMATED TO BE NEGLIGIBLE [SRI]**PEER REVIEWED**

LABORATORY METHODS:

CLINICAL LABORATORY METHODS:
DETERMINATION OF CHLOROBENZENES (INDUSTRIAL PRODUCTS) MONOCHLOROBENZENE
THROUGH HEXACHLOROBENZENE @ PPB LEVELS IN HUMAN URINE &amp; BLOOD SAMPLES
BY GAS CHROMATOGRAPHY WITH PHOTOIONIZATION DETECTION. [LANGHORST ML ET AL;
ANAL CHEM 51 (12): 2018 (1979)]**PEER REVIEWED**
A method was developed to analyze rat tissue, fat and blood for some chlorinated compounds found in an extract of soil from an industrial waste site. Extraction with hexane and ethyl ether-hexane (1 + 1) was followed by concentration over steam, and gas chromatographic analysis with an electron capture detector. Volatile compounds were analyzed in a glass column coated with 6% SP-2100 plus 4% OV-11 on Chromosorb W Semivolatile compounds, chlorinated compounds and pesticides were analyzed in a 70 m glass capillary column coated with 5% OV-101. Phenols were analyzed in a glass column packed with 1% SP-1240 DA on Supelcoport. The most efficient means of separation was to use the same glass column for volatile compounds, a DB-5 fused silica capillary column for semivolatile compounds, pesticides and phenols, and the same 1% SP-1240 DA glass column for separation of beta-BHC and pentachlorophenol. Recoveries ranged from 86.3 + or - 9.1% (mean + or - SD) to 105 + or - 10.4%. Sensitivities for semivolatile chlorinated compounds, pesticides and phenols were 4 ng/g for fat, 1 ng/g for tissue, and 0.2 ng/ml for blood. Sensitivities for volatile compounds were 4 fold higher (16, 4, 0.8, respectively). Sensitivities for dichlorobenzenes and dichlorotoluenes were 8 ng/g for fat, 2 ng/g for tissue and 0.4 ng/ml for blood. /Chlorinated cmpd/ [Stein VB, Narang RS; J Assoc Off Anal Chem 67 (1): 111-16 (1984)]**PEER REVIEWED**

ANALYTIC LABORATORY METHODS:

Air Sample: ... Ambient air is drawn through a 1.5X6.0 cm bed of Tenax-GC ... so that vapors were collected completely on the resin. The sample was then thermally desorbed and the vapors passed through a cryogenically cooled trap and subsequently introduced into a gas chromatograph-mass spectrometer (GC-MS). Estimated detection limits for monochlorobenzene is 2.1 ng/cu m; 1,2-dichlorobenzene 1.0 ng/cu m; and 1,3-dichlorobenzene 0.7 ng/cu m. [Krost KJ et al; Anal Chem 54 (4): 810-7 (1985) as cited in USEPA; Health Assessment Document: Chlorinated Benezenes p.3-16 EPA 600/8-84-015F]**PEER REVIEWED**


Chlorinated benzenes have been found as contaminants in foods and water. Because of differences in the electron capture response of the isomers at
each chlorination level, residue quantitation requires the separation of all 12 chlorobenzenes. Resolution studies were made on packed and capillary columns coated with Kovats' Ca87H176 hydrocarbon, OV-101, OV-210, OV-17 and Carbowax 20M. Satisfactory resolution of all 12 chlorobenzenes was obtained with a Carbowax 20M-coated column operated isothermally at 120 deg C. /Chlorinated benzenes/ [Miller LJ et al; J Assoc Off Anal Chem 66 (3): 677-83 (1983)]**PEER REVIEWED**

Air Samples: ... An air sampling tube packed with two sections of Amberlite XAD-2 resin separated by a silanized glass wool plug, to collect the chlorobenzenes /is used/. The adsorbent is desorbed with carbon tetrachloride and analyzed by GC using a photoionization detector. When using this method the minimum detection limits for mono-, di-, tri-, tetra-, and pentachlorobenzenes are 15, 20, 30, 35, and 45 ppb (v/v), respectively. /Chlorobenzenes/ [Langhorst ML, Nestrick TJ; Anal Chem 51 (12): 2018-25 (1979) as cited in USEPA; Health Assessment Document: Chlorinated Benzenes p.3-17 (1985) EPA 600/8-84-015F]**PEER REVIEWED**

An integrated analytical procedure for determining chlorinated benzene contaminants that enables quantitation of individual isomers as low as 0.4 ug/kg in sediment samples was developed. Preparation of the sample can be performed by using 1 of 3 techniques, namely, Soxhlet extraction, ultrasonic extraction, or steam distillation. Although all 3 methods are quantitative, the steam distillation method was found to be the most efficient for the determination, insofar as time and simplicity are concerned. Chlorinated benzenes were then characterized and quantified by open tubular column gas chromatography with electron capture detection. Detection limits of this method were 0.4-1.0 ug/kg of individual chlorobenzene isomers. Chlorobenzene recovery from bottom sediment samples at concentration levels between 1 and 100 ug/kg was 86 +/- 14 %. /Chlorobenzene/ [Onuska FI, Terry KA; Anal Chem 57 (4): 801-5 (1985)]**PEER REVIEWED**

**SAMPLING PROCEDURES:**
Analyte: 1,2-Dichlorobenzene; Matrix: Air; Sampler: Solid sorbent tube (coconut shell charcoal, 100 mg/50 mg); Flow rate: 0.01-0.2 l/min; Vol: min: 1 @ 50 ppm, max: 60; Stability: Not determined [U.S. Department of Health and Human Services, Public Health Service. Centers for Disease Control, National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods, 3rd ed. Volumes 1 and 2 with 1985 supplement, and revisions. Washington, DC: U.S. Government Printing Office, February 1984.V2 1003-1]**PEER REVIEWED**

Air Sample: ... Ambient air was drawn through a 1.5X6.0 cm bed of Tenax-GC ... so that vapors were collected completely on the resin. ... [Krost KJ et al; Anal Chem 54 (4): 810-7 (1982) as cited in USEPA; Health Assessment Document: Chlorinated Benzenes p.3-16 (1985) EPA 600/8-84-015]**PEER REVIEWED**

Air Samples: ... An air sampling tube packed with two sections of Amberlite XAD-2 resin separated by a silanized glass wool plug, to collect the chlorobenzenes /is used/. /Chlorobenzenes/ [Langhorst ML, Nestrick TJ; Anal Chem 51 (12): 2018-25 as cited in USEPA; Health Assessment Document: Chlorinated Benzenes p.3-17 (1985) EPA-600/8-84-015]**PEER REVIEWED**

**SPECIAL REFERENCES:**
SPECIAL REPORTS:
USEPA; Ambient Water Quality Criteria Doc: Dichlorobenzenes (1980) EPA 440/5-80-039

USEPA; Ambient Water Quality Criteria Doc: Chlorinated Benzenes (1980) EPA 440/5-80-028

USEPA; Health Assessment Document: Chlorinated Benzenes (1985) EPA-600/8-84-015F

USEPA/OWRS: Quality Criteria for Water 1986 1,2-Dichlorobenzene (1986) EPA 440/5-83-001

Canton JH et al; Resol Toxicol Pharmacol 5 (2): 123-31 (1985). Sixteen chlorine/nitrogen containing compounds were classified into black (ie substances which should be terminated as water pollutants) or gray (ie substances which should be decreased as water pollutants) list substances on the basis of acute toxicity, biodegradability, and accumulation.


DHHS/NTP; Toxicology & Carcinogenesis Studies of 1,2-Dichlorobenzene in F344/N Rats and B6C3F1 Mice (Gavage Studies) Technical Report Series No. 255 (1985) NIH Publication No. 86-2511

USEPA; Drinking Water Criteria Doc: ortho-Dichlorobenzene, meta-Dichlorobenzene, para-Dichlorobenzene (Draft) 174p (1986)

SYNONYMS AND IDENTIFIERS:

RELATED HSDB RECORDS:
6372 [DICHLOROBENZENE] (Mixture)

SYNONYMS:
AI3-00053 **PEER REVIEWED**
BENZENE, O-DICHLORO- **PEER REVIEWED**
BENZENE, 1,2-DICHLORO- **PEER REVIEWED**
CHLOROBEN **PEER REVIEWED**
CLOROBEN **PEER REVIEWED**
O-DICHLOR BENZOL **PEER REVIEWED**
O-DICHLOROBENZENE **PEER REVIEWED**
DICHLOROBENZENE, ORTHO, LIQUID **PEER REVIEWED**


Dilatin DB **PEER REVIEWED**

Dowtherm E **PEER REVIEWED**

NCI-C54944 **PEER REVIEWED**

Caswell No 301 [USEPA/OPP; Catalog of Pesticide Chemical Names and Their Synonyms p.79 (1986)]**PEER REVIEWED**

ORTHODICHLOROBENZENE **PEER REVIEWED**

ORTHODICHLOROBENZOL **PEER REVIEWED**

EPA Pesticide Chemical Code 059401 [USEPA/OPP; Catalog of Pesticide Chemical Names and Their Synonyms p.79 (1986)]**PEER REVIEWED**

FORMULATIONS/PREPARATIONS:
... AVAILABLE IN USA AS TECHNICAL GRADE TYPICALLY CONTAINING 98.7% BY WT OF ORTHO-ISOMER & 1.3% OF META- & PARA-ISOMERS COMBINED. IT HAS ... MOISTURE CONTENT OF 80 PPM. ... ALSO AVAILABLE IN USA IN GRADE WHICH ... CONTAINS 83% OF ORTHO-ISOMER, 17% OF META- & PARA-ISOMERS ... AN EMULSIFIABLE FORM OF ... LATTER PRODUCT CAN ... /BE OBTAINED/. [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).V7 233 (1974)]**PEER REVIEWED**


SHIPPING NAME/ NUMBER DOT/UN/NA/IMO:

UN 1591; Dichlorobenzene, ortho

IMO 6.1; Dichlorobenzene, ortho

STANDARD TRANSPORTATION NUMBER:

49 411 27; Dichlorobenzene, ortho, liquid

EPA HAZARDOUS WASTE NUMBER:

U070; A toxic waste when a discarded commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate.

F002; A hazardous waste from nonspecific sources when a spent solvent.

ADMINISTRATIVE INFORMATION:
HAZARDOUS SUBSTANCES DATABANK NUMBER: 521

LAST REVISION DATE: 20041203

LAST REVIEW DATE: Reviewed by SRP on 9/18/1998

UPDATE HISTORY:
  Complete Update on 2004-12-03, 2 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 10/16/2002, 1 field added/edited/deleted.
  Complete Update on 08/06/2002, 1 field added/edited/deleted.
  Complete Update on 02/13/2002, 1 field added/edited/deleted.
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  Field 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 05/15/2001, 1 field added/edited/deleted.
  Complete Update on 02/20/2001, 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 03/22/2000, 1 field added/edited/deleted.
  Complete Update on 03/13/2000, 2 fields added/edited/deleted.
  Complete Update on 02/08/2000, 1 field added/edited/deleted.
  Complete Update on 02/02/2000, 1 field added/edited/deleted.
  Complete Update on 11/18/1999, 1 field added/edited/deleted.
  Complete Update on 09/21/1999, 1 field added/edited/deleted.
  Complete Update on 08/26/1999, 1 field added/edited/deleted.
  Complete Update on 07/20/1999, 8 fields added/edited/deleted.
  Field Update on 05/24/1999, 2 fields added/edited/deleted.
  Complete Update on 02/23/1999, 80 fields added/edited/deleted.
Field Update on 01/29/1999, 1 field added/edited/deleted.
Field Update on 11/17/1998, 1 field added/edited/deleted.
Field Update on 06/02/1998, 1 field added/edited/deleted.
Field Update on 02/25/1998, 1 field added/edited/deleted.
Field Update on 10/17/1997, 1 field added/edited/deleted.
Field Update on 05/01/1997, 2 fields added/edited/deleted.
Complete Update on 02/26/1997, 1 field added/edited/deleted.
Complete Update on 05/09/1996, 1 field added/edited/deleted.
Complete Update on 04/09/1996, 8 fields added/edited/deleted.
Field Update on 01/19/1996, 1 field added/edited/deleted.
Complete Update on 09/29/1995, 1 field added/edited/deleted.
Complete Update on 04/20/1995, 1 field added/edited/deleted.
Complete Update on 04/20/1995, 1 field added/edited/deleted.
Complete Update on 01/18/1995, 1 field added/edited/deleted.
Complete Update on 12/21/1994, 1 field added/edited/deleted.
Complete Update on 11/09/1994, 1 field added/edited/deleted.
Complete Update on 07/22/1994, 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 09/02/1993, 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.
Field update on 12/13/1992, 1 field added/edited/deleted.
Complete Update on 09/03/1992, 1 field added/edited/deleted.
Complete Update on 04/27/1992, 1 field added/edited/deleted.
Complete Update on 01/23/1992, 1 field added/edited/deleted.
Complete Update on 09/26/1991, 2 fields added/edited/deleted.
Complete Update on 10/10/1990, 1 field added/edited/deleted.
Complete Update on 04/16/1990, 2 fields added/edited/deleted.
Complete Update on 03/06/1990, 4 fields added/edited/deleted.
Field Update on 01/15/1990, 1 field added/edited/deleted.
Complete Update on 01/11/1990, 3 fields added/edited/deleted.
Field update on 12/29/1989, 1 field added/edited/deleted.
Complete Update on 05/05/1989, 1 field added/edited/deleted.
Complete Update on 04/03/1989, 94 fields added/edited/deleted.
Complete Update on 09/03/1987

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