ENVIRONMENTAL CONTAMINANTS ENCYCLOPEDIA

DICHLOROETHANE-1,2 (EDC, 1,2-DICHLOROETHANE) ENTRY

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Like a library or most large databases (such as EPA's national STORET water quality database), this document contains information of variable quality from very diverse sources. In compiling this document, mistakes were found in peer reviewed journal articles, as well as in databases with relatively elaborate quality control mechanisms [366,649,940]. A few of these were caught and marked with a "[sic]" notation, but undoubtedly others slipped through. The [sic] notation was inserted by the editors to indicate information or spelling that seemed wrong or misleading, but which was nevertheless cited verbatim rather than arbitrarily changing what the author said.

Most likely additional transcription errors and typos have been added in some of our efforts. Furthermore, with such complex subject matter, it is not always easy to determine what is correct and what is incorrect, especially with the "experts" often disagreeing. It is not uncommon in scientific research for two different researchers to come up with different results which lead them to different conclusions. In compiling the Encyclopedia, the editors did not try to resolve such conflicts, but rather simply reported it all.

It should be kept in mind that data comparability is a major problem in environmental toxicology since laboratory and field methods are constantly changing and since there are so many different "standard methods" published by EPA, other federal agencies, state agencies, and various private groups. What some laboratory and field investigators actually do for standard operating practice is often a unique combination of various standard protocols and impromptu "improvements." In fact, the interagency task force on water methods concluded that [1014]:

> It is the exception rather than the rule that water-quality monitoring data from different programs or time periods can be compared on a scientifically sound basis, and that...
>
> No nationally accepted standard definitions exist for water quality parameters. The different organizations may collect data using identical or standard methods, but identify them by different names, or use the same names for data collected by different methods [1014].

Differences in field and laboratory methods are also major issues related to (the lack of) data comparability from media other than water: soil, sediments, tissues, and air.

In spite of numerous problems and complexities, knowledge is often power in decisions related to chemical contamination. It is therefore often helpful to be aware of a broad universe of conflicting results or conflicting expert opinions rather than having a portion of this information arbitrarily censored by someone else. Frequently one wants to know of the existence of information, even if one later decides not to use it for a particular application. Many would like to see a high percentage of the information available and decide for themselves what to throw out, partly because they don't want to seem uniformed or be caught by surprise by potentially important information. They are in a better position if they can say: "I knew about that data, assessed it based on the following quality assurance criteria, and decided not to use it for this application." This is especially true for users near the end of long decision processes, such as hazardous site cleanups, lengthy ecological risk assessments, or complex natural resource damage assessments.

For some categories, the editors found no information and inserted the phrase "no information found." This does not necessarily mean that no information exists; it

simply means that during our efforts, the editors found none. For many topics, there is probably information "out there" that is not in the Encyclopedia. The more time that passes without encyclopedia updates (none are planned at the moment), the more true this statement will become. Still, the Encyclopedia is unique in that it contains broad ecotoxicology information from more sources than many other reference documents. No updates of this document are currently planned. However, it is hoped that most of the information in the encyclopedia will be useful for some time to come even with out updates, just as one can still find information in the 1972 EPA Blue Book [12] that does not seem well summarized anywhere else.

Although the editors of this document have done their best in the limited time available to insure accuracy of quotes or summaries as being "what the original author said," the proposed interagency funding of a bigger project with more elaborate peer review and quality control steps never materialized.

> The bottom line: The editors hope users find this document useful, but don't expect or depend on perfection herein. Neither the U.S. Government nor the National Park Service make any claims that this document is free of mistakes.

The following is one chemical topic entry (one file among 118). Before utilizing this entry, the reader is strongly encouraged to read the README file (in this subdirectory) for an introduction, an explanation of how to use this document in general, an explanation of how to search for power key section headings, an explanation of the organization of each entry, an information quality discussion, a discussion of copyright issues, and a listing of other entries (other topics) covered.

See the separate file entitled REFERENC for the identity of numbered references in brackets.

HOW TO CITE THIS DOCUMENT: As mentioned above, for critical applications it is better to obtain and cite the original publication after first verifying various data quality assurance concerns. For more routine applications, this document may be cited as:

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on the internet or NTIS: 1998).

Dichloroethane-1,2 (EDC, 1,2-Dichloroethane, CAS number 107-06-2)

Brief Introduction:

Br.Class: General Introduction and Classification Information:

This compound is a volatile organic compound (VOC) [868,903]. It is also one of the 1,2-dihaloalkanes [940]. This compound is considered a purgeable halocarbon [1010] and a chlorinated hydrocarbon [656].

1,2-Dichloroethane is a clear, man-made liquid that is not found naturally in the environment. It evaporates at room temperature and has a pleasant smell and a sweet taste. Its most common use today is to make vinyl chloride and several substances that dissolve grease, glue, and dirt. 1,2-Dichloroethane is also added to leaded gasoline to remove lead. In the past, it was also found in trace amounts in products that industry used to clean cloth, remove grease from metal, and to break down oils, fats, waxes, resins, and rubber. In the household, 1,2-dichloroethane was formerly a component of some cleaning solutions and pesticides; some adhesives, such as those used to glue wallpaper or carpeting; and some paint, varnish, and finish removers. Although large amounts of 1,2-dichloroethane are produced today, most is used to make other chemical products [931].

1,2-Dichloroethane can enter the environment when it is made, packaged, shipped, or used. Most 1,2-dichloroethane is released to the air, although some is released to rivers or lakes. 1,2-dichloroethane could also enter soil, water, or air in large amounts in an accidental spill [931].

1,2-Dichloroethane is a carcinogenic priority pollutant [446]. This contaminant is listed by EPA as a class B2 carcinogen, sufficient evidence to be classed as an animal carcinogen. This compound has been found in the leachate of municipal landfills [85].

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, 7/1/88) [940].

Toxic pollutant designated pursuant to section 307(a)(1) of the Clean Water Act and is subject to effluent limitations (40 CFR 401.15, 7/1/88) [940].

Br.Haz: General Hazard/Toxicity Summary:

Potential Hazards to Fish, Wildlife, Invertebrates, Plants, and other Non-Human Biota:

There has been more publicity and attention given to this VOC as a potential hazard to humans than to fish or wildlife; thus there is more literature related to humans and the information found on other species is comparatively sparse compared to the more detailed human health literature. The imbalance in favor of human effects information (and information on human surrogates: rats and mice), as reflected in the sections below, will hopefully be corrected in the future as more ecological effects information becomes available. For now, a good deal of the information below has been summarized from the HSDB [940] and ATSDR [931], both sources slanted towards human health.

Effects of this volatile solvent to non-human biota would often result from high concentrations immediately after a spill (before the compound has volatilized into the atmosphere) or be the indirect result of contamination of groundwater. For example, if highly polluted groundwater water comes into surface waters from springs or seeps, local effects may occur in the mixing zone where the groundwater enters surface water.

Studies in experimental animals found that breathing or swallowing large amounts of 1,2-dichloroethane produced nervous system disorders and kidney disease [931]. Reduced ability to fight infection was also seen in experimental animals who breathed or swallowed 1,2-dichloroethane, but no evidence of this has been reported in humans [931]. Longer-term exposure to lower doses also caused kidney disease in animals [931].

Potential Hazards to Humans:

Humans are primarily exposed to 1,2-dichloroethane from ambient air, especially in urban and industrial areas. Only about 4-5% of the population are exposed from drinking water but where drinking water comes from contaminated ground water sources, exposure can be considerable. Data on food is sparse but it has been found in a variety of foods and spices, the latter being connected with its use as an extractant, grain fumigant and pesticide diluent [940].

Humans are most likely to be exposed in and outside the workplace by drinking water containing 1,2-dichloroethane or by breathing 1,2-dichloroethane

that has escaped from contaminated water and soil into the air [931]. Humans may also be exposed to 1,2-dichloroethane through its use as a gasoline additive to reduce lead content, but these small levels are not expected to affect human health [931]. As the use of leaded gasoline declines, fewer people will be exposed to 1,2-dichloroethane this way [931]. Besides these environmental exposures, occupational exposures may occur for workers involved in the manufacture or use of chemicals containing 1,2-dichloroethane [931]. Occupational groups with the largest number of workers exposed to 1,2-dichloroethane include automobile mechanics, registered nurses, heavy equipment mechanics, janitors, and machinists [931]. Additional information on levels in the environment and potential for human exposure is presented in the ATSDR profile [931].

Ethylene dichloride is a central nervous system depressant that produces symptoms ranging from nausea, vomiting, headache, lightheadedness, & weakness to stupor, disequilibrium, coma, & respiratory arrest. Typically, in severe cases, central nervous system signs appear first within several hr of exposure & are followed by a quiescent period. On the second day, oliguria & hepatic transaminasemia may develop. Subsequently, over the next several days, hepatorenal failure can occur. Severe ingestions produce widespread organ damage (especially kidney, liver, & adrenal gland) as well as gastrointestinal bleeding. Hepatic & renal dysfunction has been complicated by fatal massive midzonal hepatic necrosis, acute tubular necrosis, hypoglycemia, hypercalcemia, hypoprothombinemia, reduced clotting factors, adrenal necrosis, & gastrointestinal hemorrhage. Heavy exposure produces a bluish purple discoloration of the skin, dermatitis, & corneal abrasions (Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. 976) [940].

Nursing mothers should not be exposed to 1,2-dichloroethane (NIOSH. Criteria Document: Ethylene Dichloride p.2, 1976, DHEW Pub NIOSH 76-139) [940].

People who were accidentally exposed to large amounts of 1,2-dichloroethane in air or who accidentally or intentionally swallowed 1,2-dichloroethane often developed nervous system disorders and liver and kidney disease [931]. They often died from heart failure [931]. We do not know

what levels of 1,2-dichloroethane caused these effects [931].

Chronic poisoning: (From inhalation or skin absorption.) Wt loss, low blood pressure, jaundice, oliguria, or anemia may occur after repeated minimal exposure. (Dreisbach, R.H. Handbook of Poisoning. 12th ed. Norwalk, CT: Appleton and Lange, 1987. 1581) [940].

Several comprehensive reports on the hazards of 1,2-dichloroethane are available. EPA has a free, several page, health advisory on this compound, available through the Office of Drinking Water, EPA, Washington, D.C. or through NTIS. A toxicological profile for 1,2-dichloroethane, especially as it relates to human health, is available from ATSDR [931]. Also, Environment Canada has prepared the Priority Substances List Assessment Report for 1,2-dichloroethane [939]. Due to lack of time, information highlights from these documents have not yet been completely incorporated into this entry.

Br.Car: Brief Summary of Carcinogenicity/Cancer Information:

EPA 1996 IRIS database information [893]:

Evidence for classification as to human carcinogenicity; weight-of-evidence classification

Classification: B2; probable human carcinogen [893].

BASIS: Based on the induction of several tumor types in rats and mice treated by gavage and lung papillomas in mice after topical application [893].

HUMAN CARCINOGENICITY DATA: None [893].

ANIMAL CARCINOGENICITY DATA

In a 1,2-Dichloroethane gavage study ... male rats had significantly increased incidence of forestomach squamous-cell carcinomas and circulatory system hemangiosarcomas. Female rats and mice were observed to have significant increases in mammary adenocarcinoma incidence. Mice of both sexes developed alveolar/bronchiolar adenomas, females developed endometrial stromal polyps and sarcomas, and males developed

hepatocellular carcinomas [893].

One epidemiological study revealed a relationship between cancer incidence and exposure to environmental pollutants in groundwater, including 1,2-dichloroethane; however, subjects were probably exposed to numerous other chemicals at the same time [931]. Cancer was seen in laboratory animals who were fed large doses of the chemical [931]. When 1,2-dichloroethane was put on the skin of laboratory animals, they developed lung tumors [931]. Breathing 1,2-dichloroethane may also cause cancer in animals [931].

No data are available in humans. Sufficient evidence of carcinogenicity in animals. OVERALL EVALUATION: Group 2B: The agent is possibly carcinogenic to humans (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).,p. S7 62, 1987) [940].

Br.Dev: Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information:

The compound 1,2-Dichloroethane was mutagenic for Salmonella in assays wherein excessive evaporation was prevented; exogenous metabolism by mammalian systems enhanced the response [893].

Evidence from animal studies suggests that 1,2-dichloroethane probably does not produce birth defects or affect reproduction [931]. Overall, the data show that 1,2-dichloroethane is not a developmental toxicant in animals. By analogy, 1,2-dichloroethane would not be expected to produce developmental effects in humans [931].

Although some evidence suggests that 1,2-dichloroethane might produce reproductive effects, the overall indication of the data is that this chemical does not produce reproductive effects in animals. Based on the available evidence, 1,2-dichloroethane would not be expected to produce reproductive effects in humans [931].

At a concentration of 250 or 500 ppm of 1,2-dichloroethane was given in feed mash to rats for 2 yr period, no significant decrease in fertility, litter size or fetal weight was observed (Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins University Press, 1986. 191) [940].

Male and female icr swiss mice given 1,2-dichloroethane in water revealed no dose-dependent effects on fertility,

gestation, viability, or lactation indices. The survival of pups & wt gain were not adversely affected (Lane RW et al; Toxicol Appl Pharmacol 63: 409-21 ,1982) [940]. For details, see W.Wildlife Section far below.

Harmful to plants, retarding growth and development along with seedling development. Induces morphological and chlorophyll mutations, resulting in necrosis and atrophy, in some cases (Kirichek YF; Rast Khim Kantserogeny (1979) as cited in Environment Canada; Tech Info for Problem Spills: Ethylene Dichloride (Draft) p.80, 1982) [940].

1,2-Dichloroethane (EDC) and 1,2-dibromoethane (DBE) were tested for the ability to induce gene mutations in 2 human lymphoblastoid cell lines, designated AHH-1 and TK6. Both chemicals were direct-acting mutagens in both cell lines. EDC was 25-fold more mutagenic in the AHH-1 cell line than in the TK6 cell line. This differential sensitivity between AHH-1 cells and TK6 cells was related to the levels of glutathione S-transferase activity in these 2 cell lines (Crespi CL et al; Mutat Res 142 (3): 133-40, 1985) [940].

1,2-Dichloroethane produced single-stranded breaks in DNA of hamster cells and chromosomal aberrations in barley kernels (Ehrenberg LS et al; Radiat Biol 14: 185-94, 1974, as cited in USEPA; Drinking Water Criteria Document (Draft): 1,2-Dichloroethane p.95, 1982) [940].

In a study of 1,2-dichloroethane, a hepatocarcinogen, a significant inhibition of RNA synthesis was observed when transcription was carried out in vitro using nuclei of 1,2-dichloroethane treated animal. The inhibition in RNA synthesis persisted even when 50% of DNA damage was removed. Similarly, nuclear DNA synthesis in vitro was also significantly inhibited during DNA damage. However, DNA synthesis was recovered rapidly even though 50% of DNA damage persisted (Banerjee S; Cancer Biochem Biophys 10, 2: 165-73, 1988) [940].

Some information seems to suggest that the 1,2-dihaloalkanes are genotoxic through modification at ring nitrogens in DNA primarily at the N7 of guanine and, lesser extent, at the N1 of adenine. These N-adducts could be directly miscoding. However, more important for the mutagenic action of chemicals seems to be the formation of non-coding lesions and/or misrepair. [Ballering LA et al; Carcinogenesis 15, 5: 869-75, 1994) [940].

Br.Fate: Brief Summary of Key Bioconcentration, Fate, Transport, Persistence, Pathway, and Chemical/Physical Information:

1,2-Dichloroethane evaporates into the air very fast from soil and water [931]. In water, it breaks down very slowly and most of it will evaporate to the air. Only very small amounts are taken up by plants, fish, and birds. It is not known exactly how long 1,2-dichloroethane stays in water, but it stays longer in lakes than in rivers [931].

In soil, 1,2-dichloroethane either evaporates into the air or travels down through soil and enters underground water. Small living organisms in soil and groundwater may transform it into other less harmful compounds, although this happens slowly. If a large amount of 1,2-dichloroethane enters soil from an accident, hazardous waste site, or landfill, it may travel a long way underground and contaminate drinking water wells [931].

The majority of 1,2-dichloroethane released into the environment will enter the atmosphere from its production and use as a chemical intermediate, solvent, and use as a lead scavenger in gasoline. Once in the atmosphere, it may be transported long distances and is primarily lost by photooxidation (half-life approx 1 month). Releases to water will primarily be removed by evaporation (half-life several hours to 10 days). Releases on land will dissipate by volatilization to air and by percolation into groundwater where it is likely to persist for a very long time. 1,2-Dichloroethane is not expected to bioconcentrate in the food chain; its presence in some food products is probably due to its use as an extractant. Major human exposure is from urban air, drinking water from contaminated aquifers and occupational atmospheres [940].

Synonyms/Substance Identification:

1,2-BICHLOROETHANE [940]
1,2-DICHLOORETHAAN (DUTCH) [940]
1,2-DICHLOR-AETHAN (GERMAN) [940]
1,2-DICHLORETHANE [940]
1,2-DICLOROETANO (ITALIAN) [940]
1,2-ETHYLENE DICHLORIDE [940]
AETHYLENCHLORID (GERMAN) [940]
ALPHA,BETA-DICHLOROETHANE [940]
BICHLORURE D'ETHYLENE (FRENCH) [940]
CHLORURE D'ETHYLENE (FRENCH) [940]
CLORURO DI ETHENE (ITALIAN) [940]
RY DICHLORO-1,2-ETHANE [940]
ENT 1,656 [940]
ETHANE DICHLORIDE [940]
ETHANE, 1,2-DICHLORO- [940]
ETHYLEENDICHLORIDE (DUTCH) [940]
ETHYLENE CHLORIDE [940]

ETHYLENE DICHLORIDE [940]
GLYCOL DICHLORIDE [940]
NCI-C00511 [940]
SYM-DICHLOROETHANE [940]
FREON 150 [940]
BORER SOL [940]
BROCIDE [940]
DESTRUXOL BORER-SOL [940]
DI-CHLOR-MULSION [940]
DICHLOR-MULSION [940]
DICHLOREMULSION [940]
DUTCH LIQUID [940]
DUTCH OIL [940]
beta-Dichloroethane [940]

Associated Chemicals or Topics (Includes Transformation Products):

In the atmosphere, 1,2-dichloroethane is photooxidized by reaction with photochemically produced hydroxyl radicals, generating nitrogen dioxide, ozone, and free chlorine radicals [931].

Related Chemicals [940]:

(Isomer) 1,1-DICHLOROETHANE
(Metabolite) CHLOROACETALDEHYDE
(Metabolite) 2-CHLOROETHANOL
(Metabolite) OXALIC ACID
(Isomer) DICHLOROETHANE

Metabolites [940]:

Metabolites (mammalian) of 1,2-dichloroethane include: glycolic acid, oxalic acid, carbon dioxide, and S,S-ethylene-bis-cysteine. [USEPA; Drinking Water Criteria Document (Draft): 1,2-Dichloroethane p.51 (1982)].

Following IP injection of 50-170 mg/kg body wt (14)c-1,2-dichloroethane to mice, 10-42% was expired unchanged and 12-15% as carbon dioxide, depending on dose; most of remainder was excreted in urine, primarily as chloroacetic acid, s-carboxymethylcysteine and thiodiacetic acid. The metabolism of 1,2-dichloroethane to chloroacetic acid proceeds possibly via chloroacetaldehyde to 2-chloroethanol. [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).,p. V20 440 (1979)].

The metabolite, chloroethanol, was detected in blood & liver of rats during the 1st 2 days after ingestion of 750 mg/kg of 1,2-dichloroethane. [KOKAROVTSEVA MG,

KISELEVA NI; FARMAKOL TOKSIKOL (MOSCOW) 41 (1): 118-20 (1978)].

Ethylene dichloride (14)C- was administered to male osborne-mendel rats by gavage (150 mg/kg in corn oil) or inhalation (150 ppm, 6 hr). ... The major urinary metabolites, thiodiacetic acid and thiodiacetic acid sulfoxide were identified, suggesting a role for glutathione in biotransformation of ethylene dichloride. [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. 3496].

1,2-(14)C-Dichloroethane was metabolized by rat hepatic microsomes to products that irreversibly bound polynucleotides. The polynucleotides were enzymatically hydrolyzed and the products separated by a high-performance liquid chromatography (HPLC) equipped with an ODS or a SCX column. The products of microsome-mediated binding were identified in the high performance liquid chromatography eluate as 1-N6-ethanoadenosine to polyadenylic acid, 3,N4-ethanocytidine to polycytidylic acid, and 2 cyclic derivatives to polyguanylic acid, 1,2-(14)C-dichloroethane was also metabolized in the presence of a glutathione (GSH)-cytosolic fraction and a polynucleotide. After enzymatic hydrolysis of the polynucleotide, the major peak of radioactivity was eluted from a Sephadex G-25 column in the salt volume which excluded the presence of a product containing glutathione and a nucleoside. Chromatography by ODS-High performance liquid chromatography of the major peak from Sephadex G-25 indicated the presence of a glutathione metabolite of 1,2-dichloroethane that did not contain a nucleoside. A similar hydrophilic peak was obtained for the hydrolysis products of polynucleotides from a glutathione plus cytosol incubation in which the polynucleotide instead of being added prior to the incubation was added after the incubation. The products of the glutathione-cytosol metabolism of 1,2-(14)C-dichloroethane appeared to be glutathione metabolites that coisolated with the polynucleotides rather than covalently bound adducts. Covalently bound adducts were identified for microsome-mediated binding of 1,2-dichloroethane to polynucleotides. ... [Lin E LC et al; Toxicol Appl Pharmacol 78 (3): 428-35 (1985)].

Male mice were pretreated with piperonyl butoxide (PIB), an inhibitor of microsomal oxidative metabolism, and the effect of this pretreatment on the extent of hepatic DNA damage produced by 1,2-dichloroethane (EDC) was determined 4 hr after EDC administration. The in vivo genotoxicity of 2-chloroethanol a product of the microsomal oxidative metabolism of EDC, was also

investigated. Hepatic DNA damage was measured with a sensitive, alkaline DNA unwinding assay for the presence of single-strand breaks and alkali-labile lesions in DNA. Pretreatment of mice with piperonyl butoxide to inhibit microsomal oxidative metabolism significantly potentiated the hepatic DNA damage observed 4 hr after a single, 200 mg/kg, IP dose of EDC. Treatment of mice with single, IP doses of 2-chloroethanol as high as 1.2 mmol/kg failed to produce any evidence of single-strand breaks and(or) alkali-labile lesions in hepatic DNA. When 6-di-ethyl maleate (DEM) was used to deplete hepatic glutathione levels prior to administration of 2-chloroethanol, the acute hepatotoxicity of 2-chloroethanol was potentiated. ... [Storer RD, Conolly RB; Toxicol Appl Pharmacol 77 (1): 36-46 (1985)].

Aryl halides were bound mainly to liver DNA whereas interaction of alkyl halides with DNA of liver, kidney, and lung gave rise to similar binding extent. In vitro activation of all chemicals was mediated by microsomal p450-dependent mixed function oxidase system which is present in rat and mouse liver and, in smaller amount, in mouse lung. Activation of alkyl halides by liver cytosolic glutathione transferases also occurred. The relative reactivity of chemicals in vivo, expressed as Covalent Binding Index (CBI) to rat liver DNA, was: 1,2-dibromoethane > bromobenzene > 1,2-dichloroethane > chlorobenzene > epichlorohydrin > benzene. ... [Prodi G et al; Toxicol Pathol 14 (4): 438-44 (1986)].

Prior to exposure to ethylene dichloride (EDC) groups of male mice were pretreated with phenobarbital or 3-methylcholanthrene to induce metabolism. Other mice were administered SKF525A before ethylene dichloride exposure to inhibit cytochrome p450 metabolism. Following the different pretreatments, mice were exposed to ethylene dichloride at selected concentrations (1000, 1250, or 1500 ppm). Exposure to ethylene dichloride, without pretreatment, produced a dose-dependent increase in mortality at 24 and 48 hr postexposure. This response was enhanced at all concentrations of EDC by phenobarbital pretreatment and attenuated by the administration of SKF 525A. Pretreatment with 3-methylcholanthrene prior to ethylene dichloride exposure at 1000 ppm also produced an increase in mortality as compared to ethylene dichloride exposure without pretreatment. Exposure to ethylene dichloride was associated with an increased kidney wt/body wt ratio. SKF 525A pretreatment prevented the increase in the kidney wt/body wt ratio at an ethylene dichloride exposure concentration of 1000 ppm. Pathological changes produced in the kidneys of mice exposed to ethylene dichloride were decreased by SKF 525A pretreatment. [Francovitch RJ et al; J Am Coll Toxicol 5 (2): 117-26 (1986)].

1,2-Dichloroethane is carcinogenic to both B6C3F1 mice and Osborne-Mendel rats. ... Studies were conducted after chronic oral dosing of adult mice and rats with the maximum tolerated dose (MTD) and 1/4 maximum tolerated dose of each cmpd. The extent to which the cmpd were metabolized in 48 hr, hepatic protein binding, and urinary metabolite patterns were exam. Metabolism of the compounds (mmoles/kg) was 1.7-10 times greater in mice than in rats. Hepatic protein binding (nm equiv bound to 1 mg of liver protein) was 1.2-8.3 times higher in rats than in mice for 1,2-dichloroethane. ... Urinary metabolite patterns were similar in both species. ... [Mitoma C et al; Drug Chem Toxicol 8 (3): 183-94 (1985)].

Stimulation of hepatic microsomal carbon monoxide-inhibitable nadph oxidn by 1,2-dichloroethane was enhanced by induction with phenobarbital but not with beta-naphthoflavone. Incubation of dichloroethanes with hepatic microsomes from phenobarbital-treated rats, nadph-generating system, and edta resulted in the conversion of 1,2-dichloroethane to chloroacetaldehyde and to a lesser extent to chloroacetic acid and probably 2-chloroethanol. The omission of dichloroethane or the nadph-generating system from incubation mixtures eliminated these effects. Skf-525a or carbon monoxide diminished or eliminated effects. [MCCALL SN ET AL; BIOCHEM PHARMACOL 32 (2): 207-13 (1983)].

Ethylene dichloride is metabolized by two competing pathways both of which consume glutathione. Ethylene dichloride undergoes oxidation to form chloroacetaldehyde which is detoxified by glutathione and also reacts directly with glutathione to form 2-(s-chloroethyl)-glutathione. A mathematical model for describing tissue glutathione depletion and resynthesis after ethylene dichloride exposure was developed. The reaction of glutathione with ethylene dichloride and chloroacetaldehyde was simulated. Predicted values for the glutathione content of the liver, lung, forestomach, or glandular stomach were compared with experimental data obtained in male Fischer 344 rats and B6C3F1 mice dosed with 25 or 150 mg/kg ethylene dichloride. The predicted values agreed with the experimental data. Of the tissues modeled, the liver showed the greatest capacity for rapidly resynthesizing glutathione after it was depleted by ethylene dichloride. In rats, liver glutathione synthesis increased rapidly and rebounded past the preexposure concentration 12 hr after exposure. The other tissue showed a much slower rate of glutathione resynthesis. Similar results were seen for mouse liver ad lung glutathione concentrations. [D'Souza RW et al; J Pharmacol Exp Ther 245 (2): 563-68 (1988)].

Microbial consortia capable of aerobically degrading more

than 99% of exogenous trichloroethylene were collected from trichloroethylene-contaminated subsurface sediments and grown in enrichment cultures. The major end products recovered were hydrochloric acid and carbon dioxide. Minor products included dichloroethylene, vinylidine chloride, and possibly chloroform. [Fliermans CB et al; Appl Environ Microbiol 54 97): 1709-14 (1988)].

The metabolism of 1,2-dichloroethane is mediated by enzymes located in the microsomal and cytosolic fraction of the liver. The microsomal pathway is mediated by cytochrome p450 and quantitatively more important in terms of both total metabolism and irreversible binding of 1,2-(14)C-dichloroethane to proteins. The cytosolic pathway is mediated by glutathione transferase and is responsible for the mutagenicity of 1,2-(14)C-dichloroethane and for its binding DNA. The absorption and metabolism of inhaled 1,2-dichloroethane was enhanced in rats pretreated with phenobarbital, a classical inducer of cytochrome p450 and of drug metabolism. [Hayes, W.J., Jr., E.R. Laws, Jr., (eds.). Handbook of Pesticide Toxicology. Volume 2. Classes of Pesticides. New York, NY: Academic Press, Inc., 1991. 685].

1992 A study was conducted of the use of freshly isolated hepatocytes to investigate the utilization of glutathione (GSH) in 1,2-dihaloethane metabolism. 1,2-Dichloroethane, 1,2-dibromoethane, and 1-bromo-2-chloroethane were metabolized to S-(2-hydroxyethyl)glutathione), S-(carboxymethyl)glutathione, and S,S -(1,2-ethanediyl)bis(glutathione). 1,2-Dihaloethane induced glutathione depletion was characterized and found to be concomitant with the formation of at least three glutathione containing 1,2-dihaloethane derived metabolites and extensive protein covalent binding. The formation of these glutathione containing metabolites accounted for 58%, 84%, and 71% of the 1,2-dichloroethane, 1-bromo-2-chloroethane, and 1,2-dibromoethane induced loss of intracellular glutathione, respectively. Within 2.0 hours of incubation, the covalent binding of 1,2-dibromoethane to hepatocyte protein reached 18.7 umol/ml of cell suspension. Half of this covalent binding occurred within 0.5 hours of incubation in the presence of high levels of intracellular glutathione. ... [Jean PA et al; Chem Res Toxicol 5 (3): 386-91 (1992)].

Water Data Interpretation, Concentrations and Toxicity (All Water Data Subsections Start with "W."):

W.Low (Water Concentrations Considered Low):

Trace amounts to 4.8 ppb found in half of U.S. surface

waters sampled in 1977 [931].

W.High (Water Concentrations Considered High):

Highest in U.S. groundwater: 9.8 ppb [931].

An average amount of 175 ppb has been found in 12% of the surface water and groundwater samples taken at 2,783 hazardous wastes sites [931].

W.Typical (Water Concentrations Considered Typical):

1,2-Dichloroethane has been found in U.S.drinking water at levels ranging from 0.05 to 19 parts of 1,2-dichloroethane per billion (ppb) parts of water [931].

Found in urban runoff in Oregon at 4 ug/L [931].

1,2-Dichloroethane has also been found in the air near urban areas at levels of 0.1-1.5 ppb and near hazardous waste sites at levels of 0.01-0.003 ppb [931].

Information from HSDB [940]:

SURFACE WATER: USA - 6 river basins 1-90 ppb, 53 of 204 sites pos, only 1 site above 15 ppb(1); Ohio R basin (1977-1978) 0.1-29 ppb, 39 of 243 samples pos(2); Ohio R basin (1980-1981, 4972 samples) 7% pos, 44 samples 1-10 ppb(3); 105 USA cities - raw drinking water 1-4 ppb, 0.55 ppb median, 9.5% pos(4); 80 USA municipal water systems - raw water 0-0.3 ppb, 14% pos(5); Lake Erie - 2 sites, 4 ppb, 1 site pos(6). [(1) Ewing B et al; Monitoring to detect previously unrecognized pollutants in surface water. EPA-560/6-77-015 75 p (1977) (2) Ohio R Valley Water Sanit Comm; Assessment of water quality conditions, Ohio River Mainstream 1978-79 Cincinnati, OH p T-45 (1980) (3) Ohio R Valley Water Sanit Comm; Assessment of water quality conditions, Ohio River Mainstream 1980-81 Cincinnati, OH Table 13 (1982) (4) Coniglio WA et al; Occurrence of volatile organics in drinking water. EPA exposure assessment project draft 47 p (1980) (5) Symons JM et al; J Amer Water Works Assoc 67: 634-47 (1975) (6) Konasewich D et al; Status report on organic and heavy metal contaminants in lakes Erie, Michigan, Huron, Superior Basins. Great Lakes Water Qual Board 373 p (1978)].

SEAWATER: Gulf of Mexico 0-210 parts/trillion (anthropogenic influence) and not detected (unpolluted areas)(1). [(1) Sauer TC Jr; Org

Geochem 3: 91-101 (1981)].

GROUNDWATER: 13 USA cities - raw groundwater 0.2 ppb, 7.7% pos(1); State groundwater survey - 2 states 400 ppb max, 7% pos(2), Aerojet General Rocket Plant - well water, Sacramento - up to 52 ppm(3). [(1) Coniglio WA et al; Occurrence of Volatile Organics in Drinking Water. EPA Exposure Assessment Project Draft 47 p (1980) (2) Dyksen JE, Hess AF III; J Amer Water Works Assoc 1982: 394-403 (1982) (3) USEPA; An Exposure Risk Assessment for Dichloroethanes. Draft Final Report page A-18 (1980)].

DRINKING WATER: 133 USA Cities - finished surface water 0.8-4.8 ppb, 1.8 ppb median, 4.5% pos(1); 25 USA cities - finished groundwater - 0.2 ppb avg, 4.0% pos(1). National Organic Monitoring Survey (1976-77) - 3 of 218 samples pos, limits of detection <0.2 ppb(2). Detected in 7 wells in the Central Sands area of Wisconsin 2 of which exceeded the recommended health advisory of 7 ppb (detection limit= 0.1-3.0 ppb)(3). [(1) Coniglio WA et al; Occurrence of Volatile Organics in Drinking Water. EPA Exposure Assessment Project Draft 47 p (1980) (2) Drury JS, Hammons AS; Investigation of Selected Environmental Pollutants 1,2-Dichloroethanes. EPA-560/78-006 p 63 (1979) (3) Krill RM, Sonzogni WC; J Amer Water Works Assoc 78: 70-5 (1986)].

Effluents Concentrations [940]:

Industries whose wastewater may exceed a mean of 1000 ppb include: photographic equipment/supplies, pharmaceutical mfg and organic chemicals/plastics mfg; max concentration in wastewater was 14 ppm (pharmaceutical mfg)(1). [(1) Treatability Manual. EPA-600/2-82-001a page I.12.7-1 to I.12.7-4 (1981)].

W.Concern Levels, Water Quality Criteria, LC50 Values, Water Quality Standards, Screening Levels, Dose/Response Data, and Other Water Benchmarks:

W.General (General Water Quality Standards, Criteria, and Benchmarks Related to Protection of Aquatic Biota in General; Includes Water Concentrations Versus Mixed or General Aquatic Biota):

EPA 1996 IRIS information [893]:

Ambient Water Quality Criteria for Aquatic Organisms:

Acute Freshwater: 1.8E+4 ug/L LEC [893].

Older reference: Freshwater Acute Criteria: Insufficient data to develop criteria. Lowest Observed Effect Level: 118,000 ug/L [446].

Chronic Freshwater: 2.0E+4 ug/L LEC [893].

Older reference: Freshwater Chronic Criteria: Insufficient data to develop criteria. Lowest Observed Effect Level: 20,000 ug/L [446].

Acute Marine: 1.13E+5 ug/L LEC [893].

Older reference: Marine Acute Criteria: Insufficient data to develop criteria. Lowest Observed Effect Level: 113,000 ug/L [446].

Chronic Marine: None Given [446,893].

Reference: 45 FR 79318 (11/28/80) [893].

Contact: Criteria and Standards Division / OWRS / (202)260-1315 [893].

Discussion: The values that are indicated as "LEC" are not criteria, but are the lowest effect levels found in the literature. LECs are given when the minimum data required to derive water quality criteria are not available [893].

Oak Ridge National Lab, 1994: Ecological Risk Assessment Freshwater Screening Benchmarks for concentrations of contaminants in water [649]. To be considered unlikely to represent an ecological risk, field concentrations should be below all of the following benchmarks [649]:

CAS 107-06-2 DICHLOROETHANE, 1,2- (ug/L)

NATIONAL AMBIENT WATER QUALITY CRITERION - ACUTE: No information found.

NATIONAL AMBIENT WATER QUALITY CRITERION - CHRONIC: No information found.

SECONDARY ACUTE VALUE: 13,500

SECONDARY CHRONIC VALUE: 1100

LOWEST CHRONIC VALUE - FISH: 41,364

LOWEST CHRONIC VALUE - DAPHNIDS: 15,200

LOWEST CHRONIC VALUE - NON-DAPHNID INVERTEBRATES: No information found.

LOWEST CHRONIC VALUE - AQUATIC PLANTS: No information found.

LOWEST TEST EC20 - FISH: 29,000

LOWEST TEST EC20 - DAPHNIDS: < 11,000

SENSITIVE SPECIES TEST EC20: No information found

POPULATION EC2O: 1259

The Netherlands' Harmonized (between media) Maximum Permissible Concentration (MPC) for this compound in water is 700 ug/L [655].

Note: Harmonization takes into account whether or not the MPC in one media (such as soil) would lead to exceeding the MPC in another media (such as air, water, or sediment) [655].

The Netherlands' Harmonized (between media) Negligible Concentration (NC) for this compound in water is 1% of the MPC, or 7 ug/L [655].

Canadian remediation criteria for freshwater aquatic life: 100 ug/L [656].

W.Plants (Water Concentrations vs. Plants):

Algae (Microcystis aeruginosa): 105 mg/l. Green algae (Scenedesmus quadricuda): 719 mg/l (Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 644) [940].

W.Invertebrates (Water Concentrations vs. Invertebrates):

Information from HSDB [940]:

Toxicity threshold (cell multiplication inhibition test): bacteria (Pseudomonas putida): 135 mg/l. Protozoa (Entosiphon sulcatum): 1127 mg/l. [Verschueren, K. Handbook of Environmental Data of

Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 644].

LC50 Daphnia magna (water flea) 218,000 ug/l 48 hr. /Conditions of bioassay not specified/ [Kayser, R., D. Sterling, D. Viviani (eds.). Intermedia Priority Pollutant Guidance Documents. Washington, DC: U.S.Environmental Protection Agency, July 1982.,p. 2-2].

LC50s for Daphnia magna (water flea) were 250 and 1350 mg/L for 24-hr exposure, and ranged from 220 to 1430 mg/L, with most values around 270 mg/L, for 48-hr exposures [998].

LC50 Mysid shrimp 113,000 ug/l/96 hr in salt water. /Conditions of bioassay not specified/ [Kayser, R., D. Sterling, D. Viviani (eds.). Intermedia Priority Pollutant Guidance Documents. Washington, DC: U.S. Environmental Protection Agency, July 1982.,p. 2-2].

LC50 GAMMARUS FASCIATUS (SCUD) GREATER THAN 100 MG/L/96 HR @ 21 DEG C, AGE MATURE, STATIC BIOASSAY. [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government Printing Office, 1980. 83].

LC50 PTERONARCYS (STONEFLY) GREATER THAN 100 MG/L/96 HR @ 15 DEG C, SECOND YEAR CLASS, STATIC BIOASSAY. [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government Printing Office, 1980. 83].

LC50 Crangon crangon (brown shrimp) 75 mg/l/24 hr, 65 mg/l/48 hr, 65 mg/l/96 hr, + or - 2000 mg/l @ 3 min, + or - 630 mg/l/9 min, 345 mg/l/1 hr in sea water @ 15 deg C. /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 644].

W.Fish (Water Concentrations vs. Fish):

LC50s for Pimephales promelas (fathead minnow) were 141, 118 and 120 mg/L for 24-hr, 48-hr and 72-hr exposures, respectively [998].

LC50s for Oryzias latipes (Medaka, high-eyes) were 1150, 1110 and 1200 mg/L for both 24-hr and 48-hr exposures [998].

Information from HSDB [940]:

LC50 SALMO GAIRDNERI (RAINBOW TROUT) 225 MG/L/96 HR @ 13 DEG C, WT 1.8 G, STATIC BIOASSAY. [U.S. Department of Interior, Fish and Wildlife Service. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137. Washington, DC: U.S. Government Printing Office, 1980. 83].

LC50 Lepomis macrochirus (bluegill) 430 mg/l/96 hr (95% confidence limit 230-710 mg/l), static bioassay, temp 21-23 deg C, PH 7.9-6.5. [BUCCAFUSCO RJ ET AL; BULL ENVIRON CONTAM TOXICOL 26: 446-52 (1981)].

LC50 Lepomis macrochirus (bluegill) > 600 mg/l/24 hr, static bioassay, temp 21-23 deg C, PH 7.9-6.5. [BUCCAFUSCO RJ ET AL; BULL ENVIRON CONTAM TOXICOL 26: 446-52 (1981)].

LC50 Cyprinodon variegatus (sheepshead minnows) > 130 ppm but < 230 ppm @ 24 hr, 48 hr, 72 hr & 96 hr, static tests, temp 25-31 deg C. [HEITMULLER PT ET AL; BULL ENVIRONM CONTAM TOXICOL 27: 596-604 (1981)].

LC50 Pimephales promelas (fathead minnow) 136 mg/l/96 hr (95% confidence limit: 129-144 mg/l), temp 25 deg C, dissolved oxygen 7.8 mg/l, water hardness 44.8 mg/l calcium carbonate (CaCO3), alkalinity 41.4 mg/l CaCO3, pH 7.41, static bioassay. (Test 1) [Geiger D.L., Poirier S.H., Brooke L.T., Call D.J., (eds). Acute Toxicities of Organic Chemicals to Fathead Minnows (Pimephales Promelas). Vol. II. Superior,Wisconsin: University of Wisconsin-Superior, 1985. 42].

LC50 Gobius minutus (gobi) 185 mg/l/60 min, 3 hr & up to 96 hr in sea water @ 15 deg C. /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 645].

LC50 Poecilia reticulata (guppy) 106 ppm/7 days. /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 645].

W.Wildlife (Water Concentrations vs. Wildlife or Domestic Animals):

Oak Ridge National Lab, 1994: Risk Assessment Screening Benchmarks for Wildlife derived from No-Observed-Adverse-Effect (NOAEL) levels (see Tis.Wildlife, B) for these). To be considered unlikely to represent an ecological risk, water concentrations should be below the following benchmarks for each species present at the site [650]:

CAS 107-06-2, 1,2-DICHLOROETHANE

SPECIES	WATER CONCENTRATION (ppm)
Mouse (test species)	0.00000
Short-tailed Shrew	300.59300
Little Brown Bat	519.54400
White-footed Mouse	194.26300
Meadow Vole	339.99500
Cottontail Rabbit	161.10500
Mink	167.06100
Red Fox	119.22600
Whitetail Deer	66.7080
Chicken (test species)	0.0000
American Robin	340.04100
American Woodcock	339.33100
Wild Turkey	343.26900
Belted Kingfisher	349.01500
Great Blue Heron	340.35300
Barred Owl	341.97000
Barn Owl	344.06300
Cooper's Hawk	340.29900
Red-tailed Hawk	339.81300

Comment: Actually, the number of significant figures for a benchmark value should never be more than one; even if these values have been taken directly from another report, they should be rounded; otherwise the impression is given of a level of accuracy that is simply unwarranted. The uncertainties are too large to justify such a fine distinction (Owen Hoffman, SENES Oak Ridge, Personal Communication, 1997).

LC50s for Ambystoma gracile (salamander) for a 5.5 day and a 9.5 day exposure periods are 6.53 and 2.54 mg/L (ppm), respectively [998].

LC50s for Rana pipiens (Leopard frog) were 4.52 and 4.40 mg/L for 5- and 9-day exposures, respectively [998].

Information from HSDB [940]:

> Male & female icr swiss mice received 1,2-dichloroethane @ 0, 0.03, 0.09, Or 0.29 Mg/ml in water. No dose-dependent effects on fertility, gestation, viability, or lactation indices were observed & the survival of pups & wt gain were not adversely affected. [Lane RW ET AL; TOXICOL APPL PHARMACOL 63: 409-21 (1982)].
>
> Thirteen week studies were conducted to investigate potential differences in rat strain susceptibility to 1,2-dichloroethane toxicity. F344/N rats, Sprague-Dawley rats, Osborne-Mendel rats and B6C3F1 mice (10 animals of each sex) were exposed to 1,2-dichloroethane in drinking water at 0, 500, 1,000, 2,000, 4,000 or 8,000 ppm for 13 weeks. No compound related deaths occurred in any of the rat strains exposed to 1,2-dichloroethane in drinking water. Weight gain depression was common in each sex of all three rat strains in the 4,000 and 8,000 ppm groups throughout the studies. Water consumption was decreased by 50%-60% with increasing dose for all exposed male and female rats regardless of strain. Kidney and liver weights were increased in dosed rats of all three strains. No chemical-related lesions were observed except for a dose related incidence of renal tubular regeneration in female F344/N rats. Nine of 10 female mice exposed to 8,000 ppm 1,2-dichloroethane in drinking water died before the end of the study. Mean body weights of males at 500 ppm or more and females at 1,000 ppm or more were lower than those of controls throughout most of the studies. Kidney weights were significantly increased for dosed males and females. 1,2-Dichloroethane admin in drinking water resulted in less toxicity to F344/N rats than admin of similar doses by gavage. [DHHS/NTP; Toxicity Studies of 1, 2-Dichloroethane (Ethylene Dichloride CAS No. 107-06-2) in F344/N Rats, Sprague-Dawley Rats, Osborne-Mendel Rats and B6C3Fl Mice (Drinking Water and Gavage Studies) NTP Tox Rpt 4 NIH/PUB-91-3123 (1991)].

W.Human (Drinking Water and Other Human Concern Levels):

EPA 1998 IRIS information [893]:

Maximum Contaminant Level Goal:

Value: 0 mg/L Status/Year: Final 1985 Reference: 50 FR 46880 (11/13/85) [893].

Contact: Health and Ecological Criteria Division / (202)260-7571 Safe Drinking Water Hotline / (800)426-4791 [893].

Discussion: An MCLG of 0 mg/L for 1,2-dichloroethane is proposed based on carcinogenic effects. Dichloroethane (1,2-) caused an increase in the incidence of several tumor types in rats and mice following oral exposure (gavage). EPA has classified 1,2-dichloroethane in Group B2: sufficient evidence in animals and inadequate evidence in humans [893].

Maximum Contaminant Level (MCL):

Value: 0.005 mg/L [893,952].

Status/Year: Final 1987 Econ/Tech?: Yes, does consider economic or technical feasibility Reference: 52 FR 25690 (07/08/87); 56 FR 30266 (07/01/91) [893].

Older reference: EPA Primary Drinking Water Standard is 0.005 mg/L [658].

Contact: Drinking Water Standards Division / OGWDW / (202)260-7575 Safe Drinking Water Hotline / (800)426-4791 [893].

Discussion: EPA has set an MCL based on detection limits [893].

Editor's note: Modern detection limits are even lower, 0.05 ug/L (see Laboratory section below).

Ambient Water Quality Criteria for Human Health:

Water & Fish: 9.4E-1 ug/liter [893].

Older references: Human Health (10-6 Risk Level for Carcinogens):

Published Criteria for Water and Organisms: 0.94 ug/L [446].

IRIS Recalculated (9/90) Criteria for Water and Organisms: None Published [446].

Fish Only: 2.43E+2 ug/liter [893].

Older references: Published Criteria for Organisms Only: 2,600 ug/L [446]. IRIS Recalculated (9/90) Criteria for Organisms Only: None Published [446].

Econ/Tech?: No, does not consider economic or technical feasibility Reference: 45 FR 79318 (11/28/80) [893].

Contact: Criteria and Standards Division / OWRS / (202)260-1315 [893].

Discussion: The WQC represents a cancer risk level of 1E-6 based on consumption of contaminated water and aquatic organisms, or aquatic organisms alone. [893].

Note: Before citing a concentration as EPA's water quality criteria, it is prudent to make sure you have the latest one. Work on the replacement for the Gold Book [302] was underway in March of 1996, and IRIS is updated monthly [893].

Cancer Slope Factor: 9.1E-2 per mg/(kg/day) [893,952].

Unit Risk: 2.6E-6 per ug/liter [893,952].

Extrapolation Method: Linearized multistage procedure with time-to-death analysis, extra risk [893].

Drinking Water Concentrations at Specified Risk Levels [893]:

Risk Level Concentration E-4 (1 in 10,000) 4E+1 ug/liter E-5 (1 in 100,000) 4E+0 ug/liter E-6 (1 in 1,000,000) 4E-1 ug/liter

EPA 1995 Region 9 Preliminary Remediation Goal for Tap Water: 1.2E-01 ug/L [868].

State Drinking Water Standards:

New Mexico 1993, Drinking Water Standards: 0.38 ug/L [931].

Connecticut 1993, Drinking Water Standards: 1 ug/L [931].

(AL) ALABAMA 5 ug/l (USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee, FSTRAC. Summary of State and Federal Drinking Water Standards and Guidelines, 11/93) [940].

(AZ) ARIZONA 5 ug/l (USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee, FSTRAC. Summary of State and Federal Drinking Water Standards and Guidelines, 11/93) [940].

(CA) CALIFORNIA 0.5 ug/l (USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee, FSTRAC. Summary of State and Federal Drinking Water Standards and Guidelines, 11/93) [940].

(FL) FLORIDA 3 ug/l (USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee, FSTRAC. Summary of State and Federal Drinking Water Standards and Guidelines, 11/93) [940].

(NJ) NEW JERSEY 2 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) [940].

State Drinking Water Guidelines:

(AZ) ARIZONA 0.38 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) [940].

(CT) CONNECTICUT 1 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) [940].

(ME) MAINE 5 ug/l (USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee, FSTRAC. Summary of State and Federal Drinking Water Standards and Guidelines, 11/93) [940].

(MN) MINNESOTA 4 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) [940].

W.Misc. (Other Non-concentration Water Information):

1,2- Dichloroethane that remains in soil from a spill or improper disposal can travel through the ground into water [931]. The chemical may remain in water or soil for more than 40 days [931]. 1,2-dichloroethane dissolves in water where it breaks down very slowly, most of it evaporating into the air [931]. Small living organisms in soil and groundwater may transform it into other primarily less harmful compounds, although this happens slowly [931].

Sediment Data Interpretation, Concentrations and Toxicity (All Sediment Data Subsections Start with "Sed."):

Sed.Low (Sediment Concentrations Considered Low):

Not detected in sediment from lower Mississippi (1 sample) and Western Gulf (14 samples, STORET data base) [940]

Sed.High (Sediment Concentrations Considered High):

Southhampton estuary, England, 0.07 to 11 ppb [931].

Sed.Typical (Sediment Concentrations Considered Typical):

Sediment from Pacific Northwest (20 samples) - 5 ug/g avg and max (STORET data base) [940]

Sed.Concern Levels, Sediment Quality Criteria, LC50 Values, Sediment Quality Standards, Screening Levels, Dose/Response Data and Other Sediment Benchmarks:

Sed.General (General Sediment Quality Standards,

Criteria, and Benchmarks Related to Protection of Aquatic Biota in General; Includes Sediment Concentrations Versus Mixed or General Aquatic Biota):

Oak Ridge National Lab, 1994: Risk Assessment Screening Benchmarks for Sediment Concentrations. To be considered unlikely to represent an ecological risk, field concentrations should be below all of the following benchmark [652]:

CAS 107-06-2, DICHLOROETHANE, 1,2-

Estimated equivalent sediment quality criterion at 1% Organic Carbon is 0.325 mg/kg (ppm) dry weight.

Comment: Actually, the number of significant figures for a benchmark value should never be more than one; even if these values have been taken directly from another report, they should be rounded; otherwise the impression is given of a level of accuracy that is simply unwarranted. The uncertainties are too large to justify such a fine distinction (Owen Hoffman, SENES Oak Ridge, Personal Communication, 1997).

The Netherlands' Harmonized (between media) Maximum Permissible Concentration (MPC) for this compound in sediments is 1.5 mg/kg [655].

Note: Harmonization takes into account whether or not the MPC in one media (such as soil) would lead to exceeding the MPC in another media (such as air, water, or sediment) [655].

The Netherlands' Harmonized (between media) Negligible Concentration (NC) for this compound in sediments is 1% of the MPC, or 0.015 mg/kg [655].

Sed.Plants (Sediment Concentrations vs. Plants):

No information found.

Sed.Invertebrates (Sediment Concentrations vs. Invertebrates):

No information found.

Sed.Fish (Sediment Concentrations vs. Fish):

No information found.

Sed.Wildlife (Sediment Concentrations vs. Wildlife or Domestic Animals):

No information found.

Sed.Human (Sediment Concentrations vs. Human):

No information found.

Sed.Misc. (Other Non-concentration Sediment Information):

No information found.

Soil Data Interpretation, Concentrations and Toxicity (All Soil Data Subsections Start with "Soil."):

Soil.Low (Soil Concentrations Considered Low):

No information found.

Soil.High (Soil Concentrations Considered High):

No information found.

Soil.Typical (Soil Concentrations Considered Typical):

No information found.

Soil.Concern Levels, Soil Quality Criteria, LC50 Values, Soil Quality Standards, Screening Levels, Dose/Response Data and Other Soil Benchmarks:

Soil.General (General Soil Quality Standards, Criteria, and Benchmarks Related to Protection of Soil-dwelling Biota in General; Includes Soil Concentrations Versus Mixed or General Soil-dwelling Biota):

The Netherlands' Harmonized (between media) Maximum Permissible Concentration (MPC) for this compound in soil is 1.5 mg/kg [655].

Note: Harmonization takes into account whether or not the MPC in one media (such as soil) would lead to exceeding the MPC in another media (such as air, water, or sediment) [655].

The Netherlands' Harmonized (between media) Negligible Concentration (NC) for this compound in soil is 1% of the MPC, or 0.015 mg/kg [655].

Soil.Plants (Soil Concentrations vs. Plants):

No information found.

Soil.Invertebrates (Soil Concentrations vs. Invertebrates):

No information found.

Soil.Wildlife (Soil Concentrations vs. Wildlife or Domestic Animals):

No information found.

Soil.Human (Soil Concentrations vs. Human):

EPA 1996 National Generic Soil Screening Level (SSL) designed to be conservative and protective at the majority of sites in the U.S. but not necessarily protective of all known human exposure pathways, land uses, or ecological threats [952]:

SSL = 7 mg/kg for ingestion pathway [952].

SSL = 0.4 mg/kg for inhalation pathway [952].

SSL = 0.001 to 0.02 mg/kg for protection from migration to groundwater at 1 to 20 Dilution-Attenuation Factor (DAF) [952].

EPA 1995 Region 9 Preliminary remediation goals (PRGs), 1995 [868]:

Residential Soil: 0.44 mg/kg wet wt.
Industrial Soil: 0.98 mg/kg wet wt.

NOTE:
1) PRGs focus on the human exposure pathways of ingestion, inhalation of particulates and volatiles, and dermal absorption. Values do not consider impact to groundwater or ecological receptors.
2) Values are based on a non-carcinogenic hazard quotient of one.
3) PRGs for residential and industrial landuses are slightly lower concentrations than EPA Region III RBCs, which consider fewer aspects [903].

EPA 1995 Region 3 Risk based concentration (RBC) to protect from transfers to groundwater:

0.01 mg/Kg dry weight [903].

Soil.Misc. (Other Non-concentration Soil Information):

Soil near hazardous waste sites probably does not have high amounts of 1,2-dichloroethane because it evaporates quickly into the air [931]. So exposure near a hazardous waste site most likely occurs more often by breathing contaminated air rather than by touching contaminated soil [931].

1,2-Dichloroethane has not been detected in soil samples collected at hazardous waste sites [931].

Volatilization losses of 1,2-dichloroethane that has migrated through the upper layer of soils occur more slowly [931]. Jury et al modeled the rate of volatilization of 1,2-dichloroethane from soil at a depth of 1 m to mimic the type of contamination that may occur from landfill leachate [931]. When water evaporation was not taken into account, the yearly loss of 1,2-dichloroethane amounted to 7.1% from a sandy soil [931]. Yearly volatilization losses increased to 30% when water evaporation was considered [931]. The 1,2-dichloroethane remaining on soil surfaces should be available for transport into groundwater since the compound does not adsorb to soil particulates unless the organic content of the soil is high [931].

Tissue and Food Concentrations (All Tissue Data Interpretation Subsections Start with "Tis."):

Tis.Plants:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Plants:

No information found.

B) Body Burden Residues in Plants: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found.

Tis.Invertebrates:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Invertebrates:

No information found.

B) Concentrations or Doses of Concern in Food Items Eaten by Invertebrates:

No information found.

C) Body Burden Residues in Invertebrates: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

See Tis.Fish, C) below.

Tis.Fish:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Fish (Includes FDA Action Levels for Fish and Similar Benchmark Levels From Other Countries):

No information found.

B) Concentrations or Doses of Concern in Food Items Eaten by Fish:

No information found.

C) Body Burden Residues in Fish: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

Fish/Seafood Concentrations [940]:

Fish tissue: Lower Mississippi (2 samples) and Western Gulf (3 samples) - not detected; Pacific Northwest (37 samples) 0.05-20 ppm, 0.7 ppm avg; Alaska (6 samples) 0.05 ppm avg and max (Note: data are listed under dichloroethanes, however 1,2-dichloroethane is the most commonly used isomer)(1). Liverpool Bay, England not detected in marine invertebrates and fish(2). [(1) STORET data base (2) Pearson CR, McConnell G; Proc Roy Soc London B 189: 305-32 (1975)].

Tis.Wildlife: Terrestrial and Aquatic Wildlife, Domestic Animals and all Birds Whether Aquatic or not:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Wildlife, Domestic Animals, or Birds:

No information found.

B) Concentrations or Doses of Concern in Food Items Eaten by Wildlife, Birds, or Domestic Animals (Includes LD50 Values Which do not Fit Well into Other Categories, Includes Oral Doses Administered in Laboratory Experiments):

Oak Ridge National Lab, 1994: Risk Assessment Screening Benchmarks for Wildlife derived from No-Observed-Adverse-Effect (NOAEL) levels (mg contaminant per kg body weight per day). To be

considered unlikely to represent an ecological risk, wet-weight field concentrations should be below the following (right column) benchmarks for each species present at the site [650]:

CAS 107-06-2, 1,2-DICHLOROETHANE

SPECIES	NOAEL (mg/kg/day)	FOOD CONCENTRATION (ppm)
Mouse (test species)	50.00000	0.00000
Short-tailed Shrew	66.13100	110.21800
Little Brown Bat	83.12700	249.38100
White-footed Mouse	58.27900	377.09900
Meadow Vole	46.36300	407.99400
Cottontail Rabbit	15.57400	78.85300
Mink	16.53900	120.72300
Red Fox	10.06800	100.68000
Whitetail Deer	4.36900	141.85100
Chicken (test species)	17.20000	0.00000
American Robin	46.81100	38.75700
American Woodcock	34.27600	45.24400
Wild Turkey	11.24500	374.83400
Belted Kingfisher	37.73100	74.45600
Great Blue Heron	15.06700	85.73700
Barred Owl	22.41600	343.43100
Barn Owl	25.84200	192.67500
Cooper's Hawk	26.35600	340.29900
Red-tailed Hawk	19.31400	23.89900

> Comment: Actually, the number of significant figures for a benchmark value should never be more than one; even if these values have been taken directly from another report, they should be rounded; otherwise the impression is given of a level of accuracy that is simply unwarranted. The uncertainties are too large to justify such a fine distinction (Owen Hoffman, SENES Oak Ridge, Personal Communication, 1997).

Information from HSDB [940]:

> LD50 Mouse oral 870-950 mg/kg [Larson, L.L., Kenaga, E.E., Morgan, R.W. Commercial and Experimental Organic Insecticides. 1985 Revision. College Park, MD: Entomological Society of America, 1985. 26].
>
> LD50 Rabbit oral 860-970 mg/kg [Larson, L.L., Kenaga, E.E., Morgan, R.W. Commercial and Experimental Organic Insecticides. 1985

Revision. College Park, MD: Entomological Society of America, 1985. 26].

LD50 Rat oral 670-890 mg/kg [Worthing, C.R. and S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 8th ed. Thornton Heath, UK: The British Crop Protection Council, 1987. 358].

Groups of 50 male & 50 female 5 wk-old b6c3f1 mice were admin technical-grade 1,2-dichloroethane in corn oil by gavage on 5 consecutive days/wk for 78 wk. ... The time-weighted avg doses were 195 and 299 mg/kg body wt/day for high-dose males and females and 97 and 149 mg/kg body wt/day for low-dose males and females. A group of 20 male and 20 female mice that received corn oil alone served as matched vehicle controls. Another group of 60 male and 60 female mice that received the same vehicle served as pooled vehicle controls. Of the high-dose males, 50% survived at least 84 wk, & 42% survived until end of study; 72% (36/50) of high-dose female mice died between wk 60 & 80. In low-dose groups, 52% (26/50) of males survived < 74 wk, & 68% (34/50) of females survived until end of study. In vehicle control groups, 55% (11/20) of males & 80% (16/20) of females survived until end of study. Almost all organs & any tissue containing visible lesions were exam histologically. The numbers of animals with tumors & total number of tumors were significantly greater in male & female mice treated with the higher dose level, and in female mice treated with the low dose, than in controls. Incr incidence of the following neoplasms were observed: mammary adenocarcinomas, uterine adenocarcinomas endometrial stromal neoplasms of uterus & squamous-cell carcinomas of forestomach in females; lung adenomas & malignant histiocytic lymphomas in males & females; and hepatocellular carcinomas in male mice. [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).,p. V20 437 (1979)].

C) Body Burden Residues in Wildlife, Birds, or Domestic Animals: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found.

Tis.Human:

A) Typical Concentrations in Human Food Survey Items:

Food Survey Results:

Found in wheat grain at up to 180 ppb, in a whiskey sample at 30 ppb [931].

Meat, oil and fats, tea, fruits and vegetables 1-10 ppb, largest amount found in olive oil(1). Not detected in wheat, flour, bran, middlings, and bread(1). Spice oleoresins 2-23 ppm, 11 of 17 spices pos(1,2). [(1) USEPA; Ambient Water Quality Criteria for Chlorinated Ethanes. EPA-440/5-80-029 page C-1 to C12 (1980) (2) USEPA; An Exposure and Risk Assessment for Dichloroethanes. Final Draft Report p. 5-23 (1980) [940].

B) Concentrations or Doses of Concern in Food Items Eaten by Humans (Includes Allowable Tolerances in Human Food, FDA, State and Standards of Other Countries):

Oral RfD: None given [893].

Cancer Slope Factor: 9.1E-2 per mg/(kg/day) [868,893].

In man, death has resulted from the ingestion of 20 to 50 ml [940].

FDA Requirements [940]:

FDA regulation for FPC /fish protein concentrates/ require a minimum protein content of 75% & max moisture & fat contents of 10 & 0.5 wt %, respectively. Hake & hakelike fish, herring of the genera Clupea, menhaden, & anchovy of the genus Engraulis mordax, are permitted. Residues of isopropyl alcohol or ethylene dichloride cannot exceed 250 & 5 ppm, respectively ... . [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 11(80) 201]

Ethylene dichloride is an indirect food additive for use as a component of adhesives. [21 CFR 175.105 (4/1/93)].

Annatto extract shall contain no more ethylene dichloride residue than is permitted of the corresponding solvents in spice oleoresins under applicable food additive regulations in Parts 170 through 189 of this chapter. [21 CFR 73.30 (4/1/93)].

The food additive ethylene dichloride may be safely used in the manufacture of animal feeds in accordance with the following prescribed conditions: (a) It is used as a solvent in the extraction processing of animal byproducts for use in animal feeds. (b) The maximum quantity of the additive permitted to remain in or on the extracted byproducts shall not exceed 300 ppm. (c) The extracted animal byproduct is added as a source of protein to a total ration at levels consistent with good feeding practices, but in no event exceeding 13 percent of the total ration. [21 CFR 573.440 (4/1/93)].

Accidental oral ingestion of a single dose of 0.5-1.0 G/kg has been reported to result in death; autopsy revealed liver necrosis and focal adrenal degeneration and necrosis. [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977. 724

Average Daily Intake [940]:

Air Intake (assume 83-1500 parts/trillion) 7-133 ug; Water Intake (assume 0 ppb) 0 ug; Food Intake - insufficient data.(SRC)

C) Body Burden Residues in Humans: Typical, Elevated, or of Concern Related to the Well-being of Humans:

Human Breath (Old Love Canal, Niagara Falls, NY) 0-54 parts/trillion, 4 of 9 pos; Urine (Old Love Canal, Niagara Falls, NY) 0-140 parts/trillion, 3 of 9 pos(1). Mothers' Milk (women had occupational exposure of up to 14 ppm) 5.4-6.4 ppm immediately after exposure(2). [(1) Barkley J et al; Biomed Mass Spectrom 7: 139-47 (1980) (2) USEPA; An Exposure and Risk Assessment for Dichloroethanes. Final Draft Report p 5-24 (1980)] [940]

Tis.Misc. (Other Tissue Information):

No information found.

Bio.Detail: Detailed Information on Bioconcentration, Biomagnification, or Bioavailability:

An experimental bioconcentration factor of 2 for 1,2-dichloroethane indicates that it will not bioconcentrate in fish and aquatic organisms or bioaccumulate in the food chain [931].

1,2-Dichloroethane is not expected to bioconcentrate in fish due to its low octanol/water partition coefficient(1.48)(1). The measured log BCF in bluegill sunfish is 0.30(2). [(1) Hansch C, Leo AJ; Substituent constants for correlation analysis in chemistry and biology. NY NY, John Wiley and Sons 339 pp (1979) (2) Barrows ME et al; Dyn Exposure Hazard Asses Toxic Chem, Ann Arbor, MI, Ann Arbor Sci. p 379-92, 1980)] [940].

Interactions:

Information from HSDB [940]:

The synergistic hepatotoxicity of dietary disulfiram (DSF) with 1,2-dichloroethane (EDC) subchronically administered by inhalation at three concentration levels (150, 300, and 450 ppm) was studied. The criteria for hepatotoxicity were treatment related increases in serum activities of sorbitol dehydrogenase, 5'-nucleotidase, and alkaline phosphatase, and in liver-to-body weight ratios. Dietary disulfiram alone did not elicit these responses while 1,2-dichloroethane at the highest concentration level increased liver-to-body weight ratios and the activity of 5'-nucleotidase. Exposure to dietary disulfiram alone decreased cytochrome p450 levels, but in combination with 1,2-dichloroethane, the decrement of cytochrome p450 was additive in a 1,2-dichloroethane concentration dependent manner. However, depression of cytochrome p450 by 1,2-dichloroethane alone was not concentration dependent. Although dietary disulfiram and dietary disulfiram/1,2-dichloroethane combination increased the activity of glutathione S-transferases (GSTs), both dietary disulfiram and 1,2-dichloroethane singly and in combination increased the tissue levels of reduced glutathione (GSH). [Igwe OJ et al; Toxicol Appl Pharmacol 86 (2): 286-97 (1986)].

The interaction of 1,2-dichloroethane with disulfiram or ethanol was investigated in rats. Sprague-Dawley rats were exposed for 24 months to 50 ppm concentrations of 1,2-dichloroethane in an inhalation study while at the same time being exposed to 0.05% disulfiram in the diet and/or 5% ethanol in the drinking water. A high incidence of intrahepatic bile duct cholangioma were reported in both sexes receiving 1,2-dichloroethane and disulfiram, 18% incidence among males and 34% among females. Male rats also registered 12% incidence of hepatocellular adenomas, 22% incidence for interstitial cell tumors in the testes, 20% subcutis fibroma, and 25% mammary adenocarcinomas in females. The expected rates

for these disorders would have been 0, 4, 4, and 8%, respectively. A slight increase in neoplastic nodules occurred in males receiving 1,2-dichloroethane and ethanol, 8% versus 0% expected. The DNA binding by 1,2-dichloroethane was not altered by disulfiram treatment, and the metabolism of 1,2-dichloroethane was qualitatively the same as in corresponding controls. However, the combined treatment of 1,2-dichloroethane and disulfiram did reduce the rate of elimination of 1,2-dichloroethane, and sustained the blood concentration levels of unchanged 1,2-dichloroethane, which may be related to the increased carcinogenic effect of the combination. [Cheever KL et al; Fourth NCI/EPA/NIOSH Collaborative Workshop: Progress on Joint Environmental and Occupational Cancer Studies p.51-115 (1988)].

Uses/Sources:

Major Uses [940]:

Solvent for fats, oils, waxes, gums, resins, and particularly for rubber; manuf acetyl cellulose, tobacco extract, etc. Also used as fumigant. [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989. 598].

In paint, varnish and finish removers; soaps & scouring compounds; wetting and penetrating agents; ore flotation; lead scavenger in antiknock gasoline; prodn of vinyl chloride, trichloroethylene, vinylidene chloride & trichloroethane. [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 487].

Fumigant for grain, upholstery & carpets; /formerly/ registered for agric use in the usa for postharvest fumigation of grain & for use in orchards, agric premises and mushroom houses. [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).,p. V20 432 (1979)].

In leather cleaning, rubber goods fabrication, drum filling, and metal cleaning industries. [NIOSH; Criteria Document: Ethylene Dichloride (1,2-Dichloroethane) p.20 (1976) DHEW Pub NIOSH 76-139].

In degreaser compounds, rubber cement, and acrylic adhesives. [NIOSH; Criteria Document: Ethylene Dichloride (1,2-Dichloroethane) p.17 (1976) DHEW Pub NIOSH 76-139].

Catalyst in production of hexachlorophene. [NIOSH; Criteria Document: Ethylene Dichloride (1,2-Dichloroethane) p.158 (1976) DHEW Pub. NIOSH 76-139].

Solvent for processing pharmaceutical products. [USEPA; Drinking Water Criteria Document (Draft): 1,2-Dichloroethane p.1 (1982)].

Manufacture of ethylenediamine, succinonitrile, glycol ethers & esters. [Van, H. (ed.). OPD Chemical Buyer's Directory 1990. 77th ed. New York, NY: Schnell Publishing Co., Inc., 1990. 82].

Manufacture of ethylene glycol, diaminoethylene, polyvinyl chloride, nylon, viscose rayon, styrene-butadiene rubber, and various plastics; solvent for resins, asphalt, bitumen, rubber; used as pickling agent and a dry clean agent; in photography, xerography, water softening & in production of cosmetics. [Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985. 425].

Use in extracting spices such as annatto, paprika & turmeric. [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 643].

Used as a solvent for fats, oils, waxes, gums resins, and particularly rubber. [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989. 598].

Most commonly used in the production of vinyl chloride monomer [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 15].

Starting material for chlorinated solvents such as 1,1,1-trichloroethane, vinylidene chloride, trichloroethylene, and perchloroethylene. [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 16].

Natural Occurring Sources [940]:

1,2-Dichloroethane is not known to occur as a natural product(1). [(1) Johns R; Air Pollution Assessment. 1,2-Dichloroethane. MTR-7164 The Mitre Corp, McLean, VA 34 pp (1976)].

Artificial Sources [940]:

Atmospheric release from its production and use as a chemical intermediate, lead scavenger, extraction and cleaning solvent, diluent for pesticides, grain fumigant and in paint, coatings and adhesives(1-5); waste water, spills, and/or improper disposal primarily from its use as a cleaning solvent and

chemical intermediates(1-5). Land release primarily from its production and use as a cleaning solvent and diluent for pesticides(1-5). Chlorination of water does not appear to contribute to 1,2-dichloroethane in drinking water(2). [(1) Khan ZS, Hughes TW; Source Assessment: Chlorinated Hydrocarbon Manufacture. EPA-600/2-79-019g. p 48-66 (1979) (2) Drury JS, Hammons AS; Investigations of Selected Environmental Pollutants 1,2-Dichloroethane. EPA-560/2-78-006. p 20-72 (1979) (3) Verschueren K; Handbook of Environmental Data on Organic Chemicals. 2nd ed NY, NY Van Nostrand Reinhold Co, Inc. (4) Johns R; Air Pollution Assessment of 1,2-Dichloroethane. MTR-7164 The Mitre Corp, McLean, VA 34 pp (1976) (5) USEPA; An Exposure and Risk Assessment for Dichloroethanes Final Draft Report p 3-1 to 3-10, A-10 to D-3 (1980)].

One source of chloroethanes in the environment may be from "EDC-tars" (ethylene dichloride tars), which are by-products of vinyl chloride synthesis. The total by-products are about 4% of the vinyl chloride synthesis. In 1974 this amounted to 800 million pounds of ethylene dichloride tars. /Chloroethanes/ [Jensen S et al; Proc R Soc Lond B 189: 333-46 (1975)].

Forms/Preparations/Formulations:

Information from HSDB [940]:

Granosan: disinfectant composed of 30% carbon tetrachloride and 70% ethylene dichloride. [Domenici F; Rass Clin-Sci 31: 70-3 (1955) as cited in NIOSH; Criteria Document: Ethylene Dichloride (1,2-Dichloroethane) p.28 (1976) DHEW Pub. NIOSH 76-139].

Grades: Technical, spectrophotometric. [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 486

Ethylene dichloride - carbon tetrachloride (Dowfume 75). Principal ingredient: 1,2-Dichloroethane, commercial formulation, 70% active ingredient; & tetrachloromethane, commercial formulation, 30% active ingredient ... . [Hill, E.F. and Camardese, M.B. Lethal Dietary Toxicities of Environmental Contaminants and Pesticides to Coturnix. Fish and Wildlife Technical Report 2.Washington, DC: United States Department of Interior Fish and Wildlife Service, 1986. 758].

Chem.Detail: Detailed Information on Chemical/Physical Properties:

Solubilities [940]:

0.869 G/100 ML WATER @ 20 DEG C [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).,p. V20 430 (1979)].

Miscible with alcohol, chloroform, ether [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989. 598].

Sol in ordinary org solvents [Lide, D.R. (ed.). CRC Handbook of Chemistry and Physics. 75th ed. Boca Raton, Fl: CRC Press Inc., 1994-1995.,p. 3-154].

> 10% in acetone [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 603].

> 10% in benzene [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 603].

> 10% in ether [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 603].

> 10% in ethanol [Weast, R.C. and M.J. Astle. CRC Handbook of Data on Organic Compounds. Volumes I and II. Boca Raton, FL: CRC Press Inc. 1985.,p. V1 603].

Miscible with alcohol [Hayes, W.J., Jr., E.R. Laws, Jr., (eds.). Handbook of Pesticide Toxicology. Volume 2. Classes of Pesticides. New York, NY: Academic Press, Inc., 1991. 685].

Solubility in water @ 20 deg C - 0.86% wt [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA6 263].

Vapor Pressure [940]:

87 torr at 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. 3491].

Octanol/Water Partition Coefficient [940]:

Log Kow = 1.48 [Hansch, C. and A. Leo. The Log P Database. Claremont, CA: Pomona College, 1987.].

Molecular Weight [940]:

98.96 [Lide, D.R. (ed.). CRC Handbook of Chemistry and Physics. 75th ed. Boca Raton, Fl: CRC Press Inc., 1994-1995.,p. 3-154].

Density/Specific Gravity [940]:

1.2351 AT 20 DEG C [Lide, D.R. (ed.). CRC Handbook of Chemistry and Physics. 75th ed. Boca Raton, Fl: CRC Press Inc., 1994-1995.,p. 3-154].

Vapor Density [940]:

3.54 g/L @ boiling point, 760 mm /cis-/; 3.67 g/L @ boiling point, 760 mm /trans-/ [Flick EW; Industrial Solvents Handbook 4th ed. NJ: Noyes Data Corp. p 143 (1991)].

Viscosity [940]:

0.84 cP @ 20 deg C [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Surface Tension [940]:

32.2 dynes/cm = 0.0322 N/m at 20 deg C [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.].

Boiling Point [940]:

83.7 deg C [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Melting Point [940]:

-35.3 deg C [Lide, D.R. (ed.). CRC Handbook of Chemistry and Physics. 75th ed. Boca Raton, Fl: CRC Press Inc., 1994-1995.,p. 3-154].

Color/Form [940]:

CLEAR, COLORLESS, OILY LIQUID [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).,p. V20 429 (1979)].

Clear liquid at ambient temperatures [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA6 263].

Odor [940]:

PLEASANT ODOR [Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ:

Merck and Co., Inc., 1989. 598].

CHLOROFORM-LIKE ODOR [Worthing, C.R. and S.B. Walker (eds.). The Pesticide Manual - A World Compendium. 8th ed. Thornton Heath, UK: The British Crop Protection Council, 1987. 358].

Sweet [Ruth JH; Am Ind Hyg Assoc J 47: A-142-51 (1986)].

Pleasant [Gerhartz, W. (exec ed.). Ullmann's Encyclopedia of Industrial Chemistry. 5th ed.Vol A1: Deerfield Beach, FL: VCH Publishers, 1985 to Present.,p. VA6 263].

Taste [940]:

SWEET TASTE [Hayes, W.J., Jr., E.R. Laws, Jr., (eds.). Handbook of Pesticide Toxicology. Volume 2. Classes of Pesticides. New York, NY: Academic Press, Inc., 1991. 685].

Other Chemical/Physical Properties [940]:

1 PPM IN AIR= 4 MG/CU M [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).,p. V20 430 (1979)].

Resistant to oxidation [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 486].

Gibbs (free) energy of formation @ 25 deg C: -19.03 kcal/mole (liq), -17.65 kcal/mole (gas); entropy @ 25 deg C: 49.84 cal/deg/mole (liq), 73.66 cal/deg/mole (gas) [Dean, J.A. Handbook of Organic Chemistry. New York, NY: McGraw-Hill Book Co., 1987.,p. 5-13].

Liquid-water interfacial tension: (est) 30 dynes/cm @ 25 deg c; ratio of specific heat of vapor: 1.118 [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.].

Thermal conductivity: 0.143 W/(MK) @ 20 deg C (liq) [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Dielectric constant: 10.45 @ 20 deg C (liq), 1.0048 @ 120 deg C (vapor) [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Dipole moment: 1.57 debye [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Coefficient of cubical expansion: 0.00116 ml/g @ 0-30 deg C [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Heat of formation: 157.3 kJ/gmole (liq) 122.6 kJ/gmole (vapor) [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Specific heat: 1.288 @ 20 deg C, liq; 1.066 @ 20 deg C, gas [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Latent heat of fusion: 88.36 J/g [Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present.,p. V6 14].

Saturation concentration 350 g/cu m (20 deg C), 537 g/cu m (30 deg C). [Environment Canada; Tech Info for Problem Spills: Ethylene Dichloride (Draft) p.5 (1982)].

Latent heat of sublimation= 35.4 kJ/mole @ 25 deg C. [Environment Canada; Tech Info for Problem Spills: Ethylene Dichloride (Draft) p.4 (1982)].

Ionization potential= 11.04 eV. [Environment Canada; Tech Info for Problem Spills: Ethylene Dichloride (Draft) p.4 (1982)].

Heat capacity at constant pressure= 135 J/mole 0 deg C @ 25 deg C, at constant volume= 121 J/mole 0 deg C (25 deg C). [Environment Canada; Tech Info for Problem Spills: Ethylene Dichloride (Draft) p.4 (1982)].

Liquid interfacial tension with air 24.15 m N/m @ 20 deg C. [Environment Canada; Tech Info for Problem Spills: Ethylene Dichloride (Draft) p.4 (1982)].

IN PRESENCE OF AIR, MOISTURE & LIGHT, @ ORDINARY TEMP, DARKENS IN COLOR. [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).,p. V20 430 (1979)].

Ethylene dichloride forms azeotropes with: 18% allyl alcohol, bp 79.9 deg C; 6% tert-amyl alcohol, bp 83 deg C; 79% carbon tetrachloride, bp 75.6 deg C; 19.5% 1,1-dichloroethane, bp 72 deg C; 17% ethanol, bp 70.3 deg C; 38% formic acid, bp 77.4 deg C; 6.5% isobutanol, bp 83.5 deg C; 43.5% isopropyl alcohol, bp 74.7 deg C; 19% propanol, bp 80.7 deg C; 10% n-propyl formate 84.1, bp deg C; 18% trichloroethylene, bp 82.9 deg C; 12% methanol, bp 61 deg C; 8.2% water, bp 70.5 deg C [Flick, E.W. Industrial Solvents Handbook. 3rd ed. Park Ridge,

NJ: Noyes Publications, 1985. 125].

Specific resistivity: 9.0x10+6 ohms/cm. [Flick, E.W. Industrial Solvents Handbook. 3rd ed. Park Ridge, NJ: Noyes Publications, 1985. 125].

Fate.Detail: Detailed Information on Fate, Transport, Persistence, and/or Pathways:

Environmental surveys conducted by EPA have detected 1,2-dichloroethane in groundwater sources in the vicinity of contaminated sites [931]. Large spills of 1,2-dichloroethane may contaminate groundwater because the high density of this compound enables it to sink into the aquifer in a vertical gravity-driven process [931]. Experimentally derived log K oc values (ranging from 1.4 to 1.51) for a silt loam soil also indicate that little sorption of 1,2-dichloroethane to low organic content soil is expected [931]. Koc values are adsorption coefficients that reflect the tendency of a chemical to partition from water and become adsorbed by organic carbon in soil or sediment.) In addition, structural analogs of the compound (i.e., dichloromethane, trichloromethane, and 1,1,1-trichloroethane) do not concentrate selectively in sediments [931].

Detailed information about the biocatlysis/biodegradation fate of this compound is included on the University of Minnesota Biocatlysis/Biodegradation Database (Available on the interet in July, 1997, www.nmsr.labmesd.umn.edu).

Information from HSDB [940]:

TERRESTRIAL FATE: Smaller releases on land will evaporate fairly rapidly because of 1,2-dichlorethane's moderately high vapor pressure. Larger releases may leach rapidly through sandy soil into groundwater. (SRC)].

AQUATIC FATE: When 1,2-dichloroethane is released to surface water, its primary loss will be by evaporation. The half-life for evaporation will depend on wind and mixing conditions and was of the order of hours in the laboratory. However a modeling study using the EXAMS model for a eutrophic lake gave a half-life of 10 days(1). The half-life for evaporation would be much less in a river or stream(SRC). Chemical and biological degradation is expected to be very slow. Adsorption to sediment is not expected(SRC). [(1) US EPA; An Exposure and Risk Assessment for Dichloroethanes. Draft Final Report p 4-14 to 4-24 (1980)].

ATMOSPHERIC FATE: When released to the atmosphere, 1,2-dichloroethane will degrade by reaction with hydroxyl radicals which are formed photochemically in the atmosphere with a half-life of a little over a month. One would expect the chemical to be transported long

distances and be washed out in rain. (SRC)].

Aquatic and Atmospheric Fate: Chloroethanes are expected to be present in industrial air and water emissions. They volatilize rapidly from surface water and persist in urban atmospheres. Hydrolysis and biodegradation are expected to be slow. /Chloroethanes/ [ITC/USEPA; Information Review #209 (Draft) Chloroethanes p.IV (1980)].

Biodegradation [940]:

Biodegradability tests with 1,2-dichloroethane resulted in little or no biodegradation in aerobic systems using sewage seed or activated sludge(1-5). The one river die-away test reported no degradation(1). The percent BOD produced in 5-10 days was 0-7%(2,3,4). Another investigator reported slow to moderate biodegradation activity(5). The extent of biodegradation is difficult to assess due to compounds' susceptibility to volatilization(SRC). No degradation occurred in an acclimated anaerobic system after 4 months incubation(6). [(1) Mudder TI; Amer Chem Soc Div Environ Chem Present. Kansas City Mo. Sept (1982) (2) Price KS et al; J Water Pollut Control Fed 46: 63-77 (1974) (3) Heukelekian H, Rand MC; Water Pollut Control Assoc 29: 1040-53 (1955) (4) Stover EL, Kincannon DF; J Water Pollut Control Fed 55: 97-109 (1983) (5) Tabak HH et al; J Water Pollut Control Fed 53: 1503-18 (1981) (6) Bouwer EJ, McCarty PL; App Environ Microbiol 45: 1286-94 (1983)].

Abiotic Degradation [940]:

The direct photolysis of 1,2-dichlorethane is not a significant loss process(1). It is primarily degraded in the atmosphere by reaction with hydroxyl radicals, having a half-life of a little over a month with a 1.9% loss for a 12 hour sunlit day(2,3). Indirect evidence for photooxidation of 1,2-dichloroethane comes from the observation that monitoring levels are highest during the night and early morning(6). The products of photooxidation are CO2 and HCl(4). Although firm experimental data are lacking, the photooxidation of 1,2-dichloroethane in water is expected to be slow(5). The rate of hydrolysis is not significant, being much slower than other pertinent environmental processes such as volatilization and photooxidation(5). [(1) Yates WF, Hughes LJ; J Phys Chem 64: 672-3 (1960) (2) Howard CJ, Evenson KM; J Chem Phys 64: 4303-6 (1976) (3) Singh HB et al; Atmos Environ 15: 601-12 (1981) (4) Pearson CR, McConnell G; Proc Roy Soc London B 189: 305-32 (1975) (5) Drury JS, Hammons AS; Investigations of Selected Environmental Pollutants 1,2-Dichloroethane. p 73-8 EPA-560/2-78-006 (1979) (6) Singh HB et al; Environ Sci

Technol 16: 872-80 (1982)].

Soil Adsorption/Mobility [940]:

Little adsorption to soil is expected based upon an experimental Koc of 33 for silt loam(1) which is in agreement with values calculated from the water solubility(2). 1,2-Dichloroethane rapidly percolates through sandy soil(3). [(1) Chiou CT et al; Science 206: 831-2 (1979) (2) Kenaga EE; Ecotox Environ Safety 4: 26-38 (1980) (3) Wilson JT et al; J Environ Qual 10: 501-6 (1981)].

Volatilization from Water/Soil [940]:

1,2-Dichloroethane rapidly evaporates from water in laboratory experiments (half-life 1/2-4 hours)(1,2,3). It would be expected to evaporate rapidly from spills on land due to its high vapor pressure(SRC). [(1) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. p. 15-25, McGraw Hill, NY (1982) (2) Dilling WL; Environ Sci Technol 11: 405-9 (1977) (3) Scherb K; Muench Beitr Abwasser-Fisch-Flussbiol 30: 234-48 (1978)].

Absorption, Distribution and Excretion [940]:

Ethylene dichloride is readily absorbed via the lung when breathed or via the gastrointestinal tract when taken by mouth. To a lesser extent, it is absorbed through the skin. [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. 3495].

The effect of the pretreatment of male Sprague-Dawley rats with phenobarbital, butylated hydroxyanisole and disulfiram on the inhalation kinetics of 1,2-dichloroethane was studied by the gas uptake method. ... The rate curves in all the pretreatment regimens showed saturable dependence on 1,2-dichloroethane concentration. These saturable dependencies (Michaelis-Menten) appeared to be associated with enzymatic metabolism. In general, a two-compartment, steady-state pharmacokinetic model described the uptake data. Data were transformed by Hanes plots to calculate the inhalational Km, the ambient 1,2-dichloroethane concentration at which uptake proceeded at half maximum rate, and Vmax, the maximum rate of uptake (ie, maximum rate of metabolism). Although phenobarbital and butylated hydroxyanisole pretreatments did not affect the Km of 1,2-dichloroethane, phenobarbital pretreatment increased the Vmax while disulfiram pretreatment decreased both the Km and Vmax. [Igwe OJ et al; Arch Toxicol 59 (3): 127-34 (1986)].

The levels of 1,2-dichloroethane (1,2-EDC), and its metabolites 2-chloroethanol, monochloroacetic acid, and 2-chloroacetaldehyde were determined by gas chromatography in the organs of human cadavers in cases of acute poisoning. The highest 1,2-dichloroethane levels were observed in the stomach and omentum; lower levels in the kidney, spleen, brain, heart, large and small intestines, and blood, and no detectable amounts in the liver. 2-Chloroethanol and monochloroacetic acid, minor metabolites of 1,2-dichloroethane, were detected in small amounts in the myocardium, brain, stomach, and small intestine. 2-Chloroacetaldehyde, because it is a reactive intermediate in the biotransformation of 1,2-dichloroethane was not detectable in the organs. The administration of acetylcysteine to acutely intoxicated humans showed no positive clinical effect. ... [Luzhnikov EA et al; Sud Med Ekspert 28 (2): 47-9 (1985)].

Carbon 14 Ethylene dichloride /was admin/ to male osborne-mendel rats by gavage (150 mg/kg in corn oil) or inhalation (150 ppm, 6 hr) ... Approximately 85 percent of the total metabolites appear in the urine, with 7 to 8 percent, 4 percent, and 2 percent found in the carbon dioxide, carcass, and feces, respectively, following each route of administration. [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. 3496].

Urinary excretion of thiodiglycolic acid and thioethers after 1 2-dichloroethane dosing was studied in rats. Male Sprague-Dawley rats were admin 0, 0.12, 0.25, 0.50, 1.01, 2.02, 4.04 or 8.08 uM/kg (14)C labeled 1,2-dichloroethane orally. Urine samples were collected for 24 hours and analyzed for thiodiglycolic acid and thioethers before and after alkaline hydrolysis by gas chromatography and the Ellman reagent/absorption spectrophotometry (thioether assay), respectively. The amounts of 1,2-dichloroethane derived radioactivity excreted decreased as a logarithmic function of increasing 1,2-dichloroethane dose ranging from 62.1% of the dose for 0.12 and 0.25 umol/kg 1,2-dichloroethane to 7.4% of the 8.08 umol/kg dose. The concentrations of urinary thiodiglycolic acid were well correlated with 1,2-dichloroethane dose up to 2.02 umol/kg. When expressed as a percentage of the dose urinary excretion of thiodiglycolic acid was not dependent on the dose over the range 0.12 to l.0l umol/kg 1,2-dichloroethane and amounted to 21.8% of the dose. Before alkaline hydrolysis no thioethers could be detected. After alkaline hydrolysis, urinary excretion of thioethers by rats dosed with 0.12 and 0.25 umol/kg did not differ significantly from the control value. Between 0.25 and 4.04 umol/kg 1,2-dichloroethane, thioether excretion increased

linearly with dose. The highest thioether/thiodiglycolic ratio 0.17 occurred ln rats given 8.08 umol/kg 1,2-dichloroethane. Urinary thiodiglycolic acid concentrations were not altered by alkaline hydrolysis. The /results suggest/ that urinary thiodiglycolic acid excretion correlates well with the oral dose of 1,2-dichloroethane in rats. Urinary thiodiglycolic acid excretion may be a useful marker of 1,2-dichloroethane exposure. Thiodiglycolic acid is hydrolyzed under alkaline conditions. The thioether assay is not appropriate for estimating urinary thiodiglycolic acid excretion. [Payan JP et al J Appl Toxicol 13 (6): 417-22 (1993)].

Laboratory and/or Field Analyses:

Detection Limits: For optimum risk or hazard assessment work, lab methods with very low detection limits should be used. In concert with need to compare values with low benchmark concentrations and to avoid false negatives, detection limits should be as low as possible and in all cases no higher than comparison benchmarks or standards. Ideally, the detection limit should be at least 10 times higher than the comparison benchmark or criteria [676].

Water Detection Limits:

For NPDES permit applications using EPA method 601 for purgeable halocarbons, EPA specifies a water detection limit of 0.03 ug/L for this compound (40 CFR, Part 136, Appendix A, Table 1) [1010]. This should be the routine default detection limit unless there is logical reason to go higher or lower. Other notes on water detection limits:

Some state drinking water standards are below 1 ug/L (see W.Human section above). If no one is drinking the water and no other low benchmarks apply, higher detection limits might be considered.

The better lab methods for water can achieve detection levels as low as 5 ppt to 0.03 ppb [931].

Wisconsin requires a water detection limit of 0.5 ug/L for all VOCs [923]. The water detection limit needs to be this low for 1,2 dichloroethane since the Ambient Water Quality Criteria for Human Health for exposure to Water & Fish is 0.94 ug/liter [893].

The routine detection limit used for this compound by the USGS and some better labs is 0.05 ug/L or even lower (Brooke Connor, USGS Water Quality Lab,

Denver, Personal Communication, 1996, also previously distributed on the internet).

The EPA recommends GC/MS for the determination of 1,2-dichloroethane in water and waste water; this method can detect 1,2-dichloroethane levels of less than or equal to 0.03 ug/L (EPA 1982b, 1984a) [931].

Under EPA's Contract Laboratory Program, all contract laboratories are required to maintain certain levels of performance to meet specific quantitation levels [931]. For volatiles such as 1,2-dichloroethane, the EPA Superfund/CERCLA Contract Required Quantitation Level (CRQL) for water is 1 ug/L (AOC/Contract Laboratory Program -- CLP, Routine Analytical Services, Summary on EPA Home Page under Superfund Subdirectory, EPA Office of Remedial and Emergency Response, 1997, Internet).

Detection limits in solids:

Under EPA's Contract Laboratory Program, all contract laboratories are required to maintain certain levels of performance to meet specific quantitation levels [931]. For volatiles such as 1,2-dichloroethane, the EPA Superfund/CERCLA Contract Required Quantitation Level (CRQL) for soil is 10 ug/kg (AOC/Contract Laboratory Program --CLP, Routine Analytical Services, Summary on EPA Home Page under Superfund Subdirectory, EPA Office of Remedial and Emergency Response, 1997, Internet).

Fish tissue detection levels (presumably as well as sediment and soil) can be as low as 10 ug/kg (ppb) using GC/MS [931]. GC/MS is adequate for measuring 1,2-dichloroethane in fish samples with sensitivities in the low-ppb range [931].

In the past, many methods have been used to analyze for this compound [861,1010,1011,1013]. EPA methods for NPDES permits are specified in 40 CFR Part 136 [1010]. EPA methods for drinking water are specified in 40 CFR Part 141 [1011].

EPA (RCRA Group) publishes requirements for solid waste methods in 40 CFR Part 261, Appendix III, with details in the following periodically updated publication [1013]:

Environmental Protection Agency. 1995. Test methods for evaluating solid waste, physical/chemical methods, SW-846, EPA Office of Solid Waste and Emergency Response, EPA, Washington, D.C. Available from NTIS [1013].

RCRA (SW-846) methods tend to include provisions for using the specified method or something better, whereas the CERCLA CLP methods tend to require things done exactly per contract specifications. RCRA SW-846 methods typically require instrument calibration before analyses, but some labs don't do it, and many labs actually use some kind of hybrid between RCRA, CERCLA, or other "standard protocols" (Roy Irwin, Park Service, Personal Communication, 1997, based on conversations with various EPA and private lab staff members). The guidance in SW-846 must be used in some states, but is considered "guidance of acceptable but not required methods" in most federal applications.

In the past, EPA has also published separate (not SW-846) guidance documents with suggestions on field sampling and data quality assurance related to sampling of sediments [1016] and soils [1017,1018,1019].

Since they are designed for highly contaminated superfund sites, the CERCLA (CLP) methods typically have higher detection limits than many other EPA standard methods and are thus less appropriate for use in baseline assessments of very clean areas or for use in analyzing environmental concentrations for comparison with low-concentration criteria or benchmarks. EPA (CERCLA) publishes various Contract Laboratory Program (CLP) methods documents periodically, with information available from EPA, NTIS, and the internet. A few past examples (this list is not complete) [861]:

User's Guide CLP CERCLA User's Guide to the Contract Laboratory Program. USEPA - Office of Emergency and Remedial Response. Dec 1988

9240_0-0XFS Multi-Media/Conc Superfund OSWER CERCLA Multi-Media, Multi-Concentration Organic/Inorganic Analytical Service for Superfund, Quick Reference Fact Sheets, 9240.0-08FS (organic) and 9240-0-09FS (inorganic), August 1991. The organic/inorganic analytical service provides a technical and contractual framework for laboratories to apply EPA/Contract Laboratory Program (CLP) analytical methods for the isolation, detection and quantitative measurement of 33 volatile, 64 semi-volatile, 28 pesticide/Aroclor, and 24 inorganic target analytes in water and soil/ sediment environmental samples.

Holding Times for water samples: According to EPA protocols for NPDES permits [1010] and for RCRA [1013], the maximum holding time for all volatile organics is 14 days; samples should be kept at 4 degrees C, with no headspace or bubbles in the container [1010,1013].

Holding Times for samples of solids: The same as for water. EPA RCRA methods for volatiles in solids in SW-846 call for holding times of 14 days; samples should be kept at 4 degrees C, with no headspace or bubbles in the container [1013].

Containers:

Both EPA and APHA (Standards Methods Book) recommend

glass containers for the collection of organic compounds [141,1010]. Guidance from other federal agencies (USGS, FWS, NOAA) also recommends glass containers for organics, and discourages the use of plastic containers for a variety of reasons (Roy Irwin, National Park Service, Personal Communication, 1997, based on a glance through recent internal guidance of several agencies). EPA specifies the use of teflon lined caps and teflon lined cap septums in glass vial containers for water samples of volatiles (VOCs and purgeable halocarbons such as the common organic solvents) [1010]. No headspace is allowed [1010,1013]. Actually, vials are not the best choice for avoiding false negatives in soil samples through volatilization losses, since the use of brass liners for collection resulted in 19 fold higher VOCs than when 40 mL vials were used [798] (see Wisconsin protocol discussion below). The third update of EPA's SW-846 RCRA guidance authorizes the storage of soil samples of volatiles in EnCore TM (or equivalent, no government endorsement implied) samplers as long the sample is analyzed within 48 hours after collection [1013]. Several states also authorize the use of EnCore TM or equivalent containers (Donalea Dinsmore, State of Wisconsin DNR, personal communication, 1997).

Some federal agency quality control procedures call for voiding or red-flagging the results of organic analyses if the lab receives the sample in plastic containers (Roy Irwin, National Park Service, Personal Communication, 1997). The APHA pointed out some the potential hazards of the use of certain plastic containers for storing organic samples [141]:

> A) Potential contamination of the sample via leaching of compounds from the plastic, and/or
>
> B) The plastic container walls can sometimes be attacked by certain organics and fail, and/or
>
> C) The possibility that some of organic compound will dissolve into the walls of the plastic container, reducing the concentration of the compound in the container [141].

Certain plastic polymers present less of a problem related to potential losses of volatiles than others. Some plastic is found in the latest approved EnCore TM samplers. Some states also give the reader the option of using plastic in collecting devices. For example, related to methods for gasoline range petroleum hydrocarbons, Wisconsin states that organics can be collected using a 30 ml plastic syringe with the end sliced off, a brass tube, an EnCore TM sampler or other appropriate devices (Donalea Dinsmore, State of Wisconsin

DNR, personal communication, 1997). A plastic syringe is also mentioned as an option in SW-846 [1013]. The thinking appears to be that plastic is less of a threat in a collecting device, with momentary contact, than in a storage container where contact times are longer.

Typical "standard method" protocols recommend proper cleaning of glass containers before use. Some collectors simply use pre-cleaned jars from I-Chem or Eagle Pitcher (no government endorsement implied) or equivalent suppliers. EPA [1010], USGS, and most other federal agencies recommend cleaning procedures for the glass containers, usually involving detergent rinsing, baking, and sometimes HCL rinses (Roy Irwin, National Park Service, Personal Communication, 1997).

Field Protocols:

Standard field collection method protocols are published by various parts of EPA, and by groups such as ASTM, for public use. Different protocols are distributed for internal use by the Fish and Wildlife Service, the USGS, NOAA, DOE, and various other agencies. These recommendations change over time, with the newest recommendations sometimes being quite different than the old, thereby producing different results. The Fish and Wildlife Service methods are similar in many ways to NOAA field protocols [676].

Many recommended EPA field methods for organics are not very detailed, and some EPA methods refer the user to ASTM methods. Thus the EPA-recommended field methods are scattered through various EPA and ASTM publications. The 3rd update of SW-846 for RCRA solid waste applications has more detail than some previous versions [1013].

The various EPA methods for organics are different from each other, with the selection of the appropriate method depending upon the specific application (RCRA vs. CERCLA vs. NPDES permits, vs. Drinking Water, etc.) [861,1010,1013].

EPA methods typically include recommendations that grab samples rather than composites be utilized for organics, and require the proper cleaning of collection bottles and collecting gear for both volatile and semi-volatile organics [1010,1013]. In other publications, EPA recommends caution in the use of composite soil samples whether organic or inorganic, citing statistical complications and stating that the compositing of samples cannot, in general, be justified unless for a stated specific purpose and unless a justification is provided [1017]. ASTM publishes standard method guidance for numerous very specific applications, like sampling from

pipes (D 3370-95a) and sampling for VOCs in soils (ASTM method D 4547] [1018].

Regardless of what lab methods are used, the investigator must take special precautions to prevent the escape of volatiles during sample shipment, storage, extraction, and cleanup [798]. This is especially true for soil and sediment sampling. The results of analyses of volatiles can be dramatically effected by small details such as how the samples are collected, stored, held, and analyzed in the lab, since volatile compounds can readily volatilize from samples in both field and lab procedures.

The realization that better methods were needed began when the lab results of EPA methods 8020 and 8240 were negative even when contamination by volatiles was obvious in the field, in other words, when investigators began seeing clearly false negative results [798]. In one study, the use of brass liners for collection of soil samples resulted in 19 fold higher VOCs than when 40 mL vials were used [798].

National guidance for minimizing loss of volatiles in field sampling is found in EPA RCRA method 5035 as described in update 3 of SW-846 [1013,1018]. Several states (WI,MN,NJ, and MI) have developed their own detailed guidance, often including the use of methanol as a preservative.

After researching various papers which documented volatile losses of 9 to 99% during sampling and then finding 100% losses in samples held over 14 days in their own facilities, the Wisconsin DNR requires the following for soil sampling of volatiles [913]:

1) Concentrated (1:1 by weight of preservative vs soil) methanol preservation be used for all samples [913], and

2) samples stored in brass tubes must be preserved in methanol within 2 hours and samples stored in EnCore TM samplers must be preserved in 48 hours [913].

3) Detection limits should be no higher than 25 ug/Kg (ppb) dry weight for VOCs or petroleum volatiles in soil samples [913].

Note: The use of methanol for soil sample preservation can make lower detection limits difficult, but the tradeoff can be worth it since otherwise high percentages of volatiles can be lost in very short periods of time, for example in 2 hours for benzene. In other

words, low detection limits do not help much if you are losing all the volatiles from the soil sample before analysis. A possible alternative to using methanol for soil samples of volatiles would be to use the EnCore TM sampler and to analyze as soon as possible (no later than 48 hours) after collection using the methods that give lower detection limits (Donalea Dinsmore, State of Wisconsin DNR, personal communication, 1997).

The USGS NAWQA program also recognized the problem of potential losses of volatile compounds, and recommends the use of strong (1:1) HCL as preservative material. Some SW-846 methods for volatiles call for the use of sulfuric acid [1013].

Variation in concentrations of organic contaminants may sometimes be due to the typically great differences in how individual investigators treat samples in the field and in the lab rather than true differences in environmental concentrations. This is particularly true for volatiles, which are so easily lost at various steps along the way. Contaminants data from different labs, different states, and different agencies, collected by different people, are often not very comparable. In fact, as mentioned in the disclaimers section at the top of this entry, the interagency task force on water methods concluded that [1014]:

> It is the exception rather than the rule that water-quality monitoring data from different programs or time periods can be compared on a scientifically sound basis, and that...
>
> No nationally accepted standard definitions exist for water quality parameters. The different organizations may collect data using identical or standard methods, but identify them by different names, or use the same names for data collected by different methods [1014].

As of 1997, the problem of lack of data comparability (not only for water methods but also for soil, sediment, and tissue methods) between different "standard methods" recommended by different agencies seemed to be getting worse, if anything, rather than better. The trend in quality assurance seemed to be for various agencies, including the EPA and others, to insist on quality assurance plans for each project. In addition to field and lab quality control steps (blanks, duplicates, spikes, etc.), these quality assurance plans call for a step of insuring data comparability [1015,1017]. However, the data comparability step is often not given sufficient consideration. The tendency of agency guidance (such as EPA SW-846 methods and some other new EPA methods for bio-concentratable substances) to allow more and more flexibility to select options at various points along the way, makes it harder in insure data comparability or method validity.

Even volunteer monitoring programs are now strongly encouraged

to develop and use quality assurance project plans [1015]. The basics of these quality assurance plans for chemical analyses should include the following quality control steps:

> At minimum, before using contaminants data from diverse sources, one should determine that field collection methods, detection limits, and lab quality control techniques were acceptable and comparable. The goal is that the analysis in the concentration range of the comparison benchmark concentration should be very precise and accurate. Typical lab quality control techniques should have included the following considerations (condensed from various EPA recommendations [1015] and from various guidance materials distributed the Fish and Wildlife Service):
>
> > Procedural Blanks should be analyzed to assure that no contaminants are added during the processing of the samples. The standards for adequacy depend on the method and the media being measured. Different federal agencies publish different acceptable limits. For one program, NOAA stated that at least 8% of samples should be blanks, reference or control materials [676]. The basic idea is that neither samples nor blanks should be contaminated. Because the only way to measure the performance of the modified procedures is through the collection and analysis of uncontaminated blank samples in accordance with this guidance and the referenced methods, it is highly recommended that any modifications be thoroughly evaluated and demonstrated to be effective before field samples are collected [1003].
> >
> > Duplicate samples are analyzed to provide a measure of precision of the methods. The standards for adequacy depend on the method and the media being measured. Different federal agencies publish different acceptable limits. There appears to be an inverse relationship between precision and sensitivity [676]. Some EPA methods state that a field duplicate must be collected at each sampling site, or one field duplicate per every ten samples, whichever is more frequent [1003]. Some protocols call for the preparation of one Ongoing precision and recovery (OPR) standard for every ten or fewer field samples. Great care should be taken in preparing ongoing precision and recovery standards [1003].
> >
> > Spiked samples are analyzed to provide a measure of the accuracy of the analysis methods. The standards for adequacy depend on the method and the media being measured. Different federal agencies publish different acceptable limits.

Metabolites of this compound can be involved in binding DNA and other biological effects. Therefore, when 1,2 dichloroethane

is found in the environment, the investigator should also consider analyzing for compounds often found with 1,2 dichloroethane, such as the following metabolites (see Associated Chemicals section far above for details):

chloroacetaldehyde
2-chloroethanol
oxalic acid glycolic acid,
oxalic acid
chloroacetic acid
S,S-ethylene-bis-cysteine
thiodiacetic acid sulfoxide
thiodiacetic acid, and
chloroethanol.

Some of the above-listed metabolites may be suspected of being present but are not typically found on the standard EPA scans.

For drinking water, in the past, EPA has recommended the following less rigorous methods for analyses of certain volatiles: Purge and trap capillary gas chromatography (EPA 502.2); gas chromatographic/mass spectrometry (EPA 524.2); purge and trap gas chromatography (EPA 503.1); gas chromatography/mass spectrometry (EPA 524.1); PQL= 0.005 mg/L [893]. For this particular volatile, EPA has recommended Gas chromatography (EPA 502.1, 502.2, 503.1); gas chromatographic/mass spectrometry (EPA 524.1, 524.2), for drinking water analyses [893]. For drinking water, EPA recommends that all systems be monitored for four consecutive quarters; repeat monitoring dependent upon detection, vulnerability status and system size [893].

In general, gas chromatography/mass spectrophotometry (GC/MS) is the most commonly used analytical method for measuring 1,2-dichloroethane in breath, blood, and urine samples [931]. Sensitivity is in the low- to sub-ppb range [931]. For blood samples, recovery is >74% [931]. Precision is adequate (<30% relative standard deviation [RSD]) [931]. Recovery data were not reported for breath or urine samples [931]. Glutathione-S-transferase (GST) was suggested as a biological marker to detect 1,2-dichloroethane in human erythrocytes [931]. 1,2-Dichloroethane inactivates GST in human erythrocytes [931]. A dose-dependent reduction in GST with levels of 1,2-dichloroethane in human erythrocytes *in situ* was reported [931]. However, because a similar response is also reported for acrolein, propylene oxide, styrene oxide, and ethylene dibromide, it is not possible to use measurement of GST activity in human erythrocytes to monitor exposure to 1,2-dichloroethane alone [931]. The presence of metabolites of 1,2-dichloroethane, such as 2-chloroethanol and monochloroacetic acid, in blood and urine could be used as an indicator of exposure to 1,2-dichloroethane [931]. However, similar metabolites may be found following exposure to other volatile organic compounds [931]. This method is not presently used to determine exposure to 1,2-dichloroethane [931]. Levels of thioethers could be determined analytically in the urine [931]. No analytical measurement for these metabolites are given [931]. A pilot study attempted to show a correlation between the levels of

halogenated compounds found in the environment and levels measured in blood and urine [931]. The results, however, were not statistically significant [931]. 1980) [931]. The lack of correlation was attributed to differences in body metabolism between the individuals and small sample size [931]. However, the applicability of GC/MS towards correlating environmental levels with body burden levels, given a large enough sample size, was demonstrated [931].

ENVIRONMENTAL SAMPLES: GC/MS and GC combined with electron capture detection (ECD) are the most commonly used analytical methods for detecting 1,2-dichloroethane in air [931]. Air samples are generally collected on filters and desorbed or collected in canisters [931]. For measuring 1,2-dichloroethane in air samples, sensitivity is in the sub-ppb to low-ppt range for both GC/MS and GC/ECD [931]. Recovery (>90%) and precision (3% RSD) are good [931].

Purge-and-trap extraction methods are generally used when measuring volatile compounds such as 1,2-dichloroethane in water samples [931]. Sensitivity is in the low-to-sub-ppb and low-ppt range for GC/MS and GC/ECD [931]. High performance gas chromatography (HRGC) MS has also been used to measure the compound in water with similar sensitivity [931]. Recovery and precision data were not reported [931]. HRGC, with dual detection by ECD and flame ionization detectors (FID) or GC/FID can also be used to measure 1,2-dichloroethane in drinking water and tap water [931]. Sensitivity for HRGC/ECD-FID is in the sub-ppb range with excellent recovery (100%) [931]. Sensitivity data were not reported for GC/FID; however, recoveries were adequate (77.5%) [931]. For both methods, precision was good (3.1-21% RSD) [931].

Description of EPA standard methods 8240 and 8260 (8260 is replaceing 8240) from EPA EMMI Database on Lab methods [861]:

EPA Method 8240 for Volatile Organics [861]:

Method 8260 is replacing 8240 [1013].

OSW 8240A S Volatile Organics - Soil, GCMS 73 SW-846 GCMS ug/kg EQL Method 8240A "Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS): Packed Column Technique" The volatile compounds are introduced into the gas chromatograph by the purge and trap method or by direct injection (in limited applications) [861]. The components are separated via the gas chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information [861]. The chromatographic conditions, as well as typical mass spectrometer operating parameters, are given [861]. If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile

organic constituents [861]. A portion of the methanolic solution is combined with organic-free reagent water in a specially designed purging chamber [861]. It is then analyzed by purge and trap GC/MS following the normal water method [861]. The purge and trap process - An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase [861]. The vapor is swept through a sorbent column where the volatile components are trapped [861]. After purging is complete, the sorbent column is heated and backflushed with inert gas to desorb the components, which are detected with a mass spectrometer [861].

OSW 8240A W Volatile Organics - Water, GCMS 73 SW-846 GCMS ug/L EQL Method 8240A "Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS): Packed Column Technique" The volatile compounds are introduced into the gas chromatograph by the purge and trap method or by direct injection (in limited applications) [861]. The components are separated via the gas chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information [861]. The chromatographic conditions, as well as typical mass spectrometer operating parameters, are given [861]. If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile organic constituents [861]. A portion of the methanolic solution is combined with organic-free reagent water in a specially designed purging chamber [861]. It is then analyzed by purge and trap GC/MS following the normal water method [861]. The purge and trap process - An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase [861]. The vapor is swept through a sorbent column where the volatile components are trapped [861]. After purging is complete, the sorbent column is heated and backflushed with inert gas to desorb the components, which are detected with a mass spectrometer [861]. Method 8260 is replacing 8240 [1013].

EPA Method 8260 (for GC/MS Volatile Organics):

Method 8260 is replacing 8240 [1013].

EPA description [861]:

OSW 8260 Volatile Organics - CGCMS 58 SW-846 CGCMS ug/L MDL Method 8260 "Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique" The volatile compounds are introduced into the gas chromatograph by the purge and trap method or by direct injection (in limited applications) [861]. Purged sample components are trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the sorbent tube is heated and backflushed with helium to desorb trapped sample components [861]. The analytes are desorbed directly to a large bore capillary or cryofocussed on a capillary precolumn before being flash evaporated to a narrow bore capillary for analysis [861]. The column is temperature programmed to separate the analytes which are then detected with a mass spectrometer interfaced to the gas chromatograph [861]. Wide capillary columns require a jet separator, whereas narrow bore capillary columns can be directly interfaced to the ion source [861]. If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in solvent to dissolve the volatile organic constituents [861]. A portion of the solution is combined with organic- free reagent water in the purge chamber [861]. It is then analyzed by purge and trap GC/MS following the normal water method [861]. Qualitative identifications are confirmed by analyzing standards under the same conditions used for samples and comparing resultant mass spectra and GC retention times [861]. Each identified component is quantified by relating the MS response for an appropriate selected ion produced by that compound to the MS response for another ion produced by an internal standard [861].

Other Misc. (mostly less rigorous) lab methods which have been used in the past in media such as drinking water for volatiles [893] (lab method description from EPA [861]):

EMSLC 502.2 ELCD VOA's - P&T/CGCELCD/CGCPID 44 DRINKING_WATER CGCELD ug/L MDL "Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series" This method is used for the identification and measurement of purgeable volatile organic compounds in finished drinking

water, raw source water, or drinking water in any treatment stage [861]. The method is applicable to a wide range of organic compounds, including the four trihalomethane disinfection by-products, that have sufficiently high volatility and low water solubility to be efficiently removed from water samples with purge and trap procedures [861]. An inert gas is bubbled through a 5 mL water sample [861]. The volatile compounds with low water solubility are purged from the sample and trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the tube is heated and backflushed with helium to desorb trapped sample components onto a capillary gas chromatography (GC) column [861]. The column is temperature programmed to separate the analytes which are then detected with photoionization detector (PID) and halogen specific detectors in series [861]. Analytes are identified by comparing retention times with authentic standards and by comparing relative responses from the two detectors [861]. A GC/MS may be used for further confirmation [861].

EMSLC 502.2 PID VOA's - P&T/CGCELCD/CGCPID 33 DRINKING_WATER CGCPID ug/L MDL "Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series" This method is used for the identification and measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. The method is applicable to a wide range of organic compounds, including the four trihalomethane disinfection by-products, that have sufficiently high volatility and low water solubility to be efficiently removed from water samples with purge and trap procedures [861]. An inert gas is bubbled through a 5 mL water sample [861]. The volatile compounds with low water solubility are purged from the sample and trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the tube is heated and backflushed with helium to desorb trapped sample components onto a capillary gas chromatography (GC) column [861]. The column is temperature programmed to separate the analytes which are then detected with photoionization detector (PID) and halogen specific detectors in series [861]. Analytes are identified by comparing retention times with authentic standards and by comparing relative responses from the two detectors [861]. A GC/MS may be used for further

confirmation [861].

EMSLC 503.1 Volatile Aromatics in Water 28 DRINKING_WATER GCPID ug/L MDL "Volatile Aromatic and Unsaturated Organic Compounds in Water by Purge and Trap Gas Chromatography" This method is applicable for the determination of various volatile aromatic and unsaturated compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. Highly volatile organic compounds with low water solubility are extracted (purged) from a 5-ml sample by bubbling an inert gas through the aqueous sample [861]. Purged sample components are trapped in a tube containing a suitable sorbent material [861]. When purging is complete, the sorbent tube is heated and backflushed with an inert gas to desorb trapped sample components onto a gas chromatography (GC) column [861]. The gas chromatograph is temperature programmed to separate the method analytes which are then detected with a photoionization detector [861]. A second chromatographic column is described that can be used to help confirm GC identifications or resolve coeluting compounds [861]. Confirmation may be performed by gas chromatography/mass spectrometry (GC/MS) [861].

APHA 6230 D Volatile Halocarbons - CGCELCD STD_METHODS GCELCD "6230 Volatile Halocarbons" GCPID 6230 D [861]. Purge and Trap Capillary-Column Gas Chromatographic Method: This method is similar to Method 6230 C., except it uses a wide-bore capillary column, and requires a high-temperature photoionization detector in series with either an electrolytic conductivity or microcoulometric detector [861]. This method is equivalent to EPA method 502.2; see EMSLC\502.2 [861]. Detection limit data are not presented in this method, but the method is identical to 502.2; therefore, see EMSLC\502.2 for detection limit data [861]. Method 6230 B., 17th edition, corresponds to Method 514, 16th edition [861]. The other methods listed do not have a cross-reference in the 16th edition [861].

EMSLC 524.1 Purgeable Organics - GCMS 48 DRINKING_WATER GCMS ug/L MDL "Measurement of Purgeable Organic Compounds in Water by Packed Column Gas Chromatography/Mass Spectrometry" This is a general purpose method for the identification and simultaneous measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment

stage [861]. Volatile organic compounds and surrogates with low water solubility are extracted (purged) from the sample matrix by bubbling an inert gas through the aqueous sample [861]. Purged sample components are trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the trap is backflushed with helium to desorb the trapped sample components into a packed gas chromatography (GC) column interfaced to a mass spectrometer (MS) [861]. The column is temperature programmed to separate the method analytes which are then detected with the MS [861]. Compounds eluting from the GC column are identified by comparing their measured mass spectra and retention times to reference spectra and retention times in a data base [861]. Reference spectra and retention times for analytes are obtained by the measurement of calibration standards under the same conditions used for samples [861]. The concentration of each identified component is measured by relating the MS response of the quantitation ion produced by that compound to the MS response of the quantitation ion produced by a compound that is used as an internal standard [861]. Surrogate analytes, whose concentrations are known in every sample, are measured with the same internal standard calibration procedure [861].

EMSLC 524.2 Purgeable Organics - CGCMS 60 DRINKING_WATER CGCMS ug/L MDL "Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry" This is a general purpose method for the identification and simultaneous measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. Volatile organic compounds and surrogates with low water solubility are extracted (purged) from the sample matrix by bubbling an inert gas through the aqueous sample [861]. Purged sample components are trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the sorbent tube is heated and backflushed with helium to desorb the trapped sample components into a capillary gas chromatography (GC) column interfaced to a mass spectrometer (MS) [861]. The column is temperature programmed to separate the method analytes which are then detected with the MS [861]. Compounds eluting from the GC column are identified by comparing their measured mass spectra and retention times to reference spectra and retention times in a data base [861]. Reference spectra and retention times for analytes are obtained by the measurement

> of calibration standards under the same conditions used for samples [861]. The concentration of each identified component is measured by relating the MS response of the quantitation ion produced by that compound to the MS response of the quantitation ion produced by a compound that is used as an internal standard [861]. Surrogate analytes, whose concentrations are known in every sample, are measured with the same internal standard calibration procedure [861].

USGS 1996 Method for VOC analyses (Brooke Connor, USGS Water Quality Lab, Denver, Personal Communication, 1996, also previously distributed on the intenet):

> Subject: Custom Method 9090: Basic Description of the Method and more Date: Tue, 14 May 1996 From: "John S Zogorski, Supervisory Hydrologist, Rapid City, SD" Custom Method 9090: Basic Description of the Method, Identification and Quantification Strategy, and Data Transfer The purpose of this memo is to provide additional details on the new VOC method -- Custom Method 9090. Information included in this memo includes: (1) general description of the method; (2) identification and quantitation strategy; and (3) data transfer to study units. A. General Description of the Method Custom method 9090 uses capillary column gas chromatography / mass spectrometry (GC/MS) to identify and quantitate 87 analytes, and to tentatively identify unknowns. The method is intended to identify and measure low concentrations of VOCs that may occur in the environmental settings sampled in the NAWQA program, and which may be associated with either point and non-point sources, especially in urban areas. Fifty-five of the analytes included on 9090 are referred to as NAWQA VOC target analytes and were selected because of their known human health concern (A or B carcinogens), aquatic toxicity, frequency of occurrence, and/or emerging chemicals with a potential for wide-scale use and significance. Custom method 9090 builds on the same VOC analytical technology, GC/MS, that has been used at the NWQL and elsewhere for many years, and which is considered the conventional approach for high-quality analysis of VOCs in water...Persons unfamiliar with the GC/MS method for VOCs may wish to refer to 2 recent reports: Rose, D.L., and M.P. Schroeder, 1995, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory -- Determination of volatile organic compounds in water by purge and trap capillary gas chromatography/mass spectrometry: U.S. Geological Survey Open-File Report 94-708, 26 p. Raese, J.W., D.L Rose, and M.W. Sandstrom, 1995, U.S. Geological Survey Laboratory Method for Methyl tert-Butyl Ether and Other Fuel Oxygenates: U.S. Geological Survey Fact Sheet 219-95, 4 p..... Questions on this EDOC should be directed to Brooke Connor (303-467-8170) at the NWQL or John Zogorski of VOC National Synthesis (605-394-1780 x.214), or both.