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**PRINT-OUTS FROM THE INTEGRATED RISK INFORMATION SYSTEM  
(IRIS 1994) - PAGES FROM THE HAZARDOUS SUBSTANCES  
DATABANK ENTRY ON TETRACHLOROETHYLENE - SEARCH WAS  
CONDUCTED ON LINE ON 8-18-94 - (USED AS A REFERENCE IN  
OU 5 RI REPORT)**

00/00/94

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PRINTOUT**

PRINT-OUTS FROM THE INTEGRATED RISK INFORMATION SYSTEM (IRIS 1994)  
THE FOLLOWING PAGES ARE FROM THE HAZARDOUS SUBSTANCES DATABANK  
ENTRY ON TETRACHLOROETHYLENE.

SEARCH WAS CONDUCTED ON-LINE ON 8-18-94

1 - HSDB  
HAZARDOUS SUBSTANCES 124  
DATABANK NUMBER  
LAST REVISION DATE 940802  
REVIEW DATE Reviewed by SRP on 12/1/88  
UPDATE HISTORY 08/02/94, 1 field  
UPDATE HISTORY 06/28/94, 1 field  
UPDATE HISTORY 05/05/94, 1 field  
UPDATE HISTORY 03/25/94, 1 field  
UPDATE HISTORY 01/17/94, 1 field  
UPDATE HISTORY 11/05/93, 1 field  
UPDATE HISTORY 09/15/93, 1 field  
UPDATE HISTORY 08/07/93, 1 field  
UPDATE HISTORY 08/04/93, 1 field  
UPDATE HISTORY 04/28/93, 1 field  
RECORD LENGTH 153601  
NAME OF SUBSTANCE TETRACHLOROETHYLENE  
CAS REGISTRY NUMBER 127-18-4  
SYNONYMS 1,1,2-TETRACHLOROETHYLENE \*\*PEER REVIEWED\*\*  
SYNONYMS CZTEROCHLOROETYLEN (POLISH) \*\*PEER REVIEWED\*\*  
SYNONYMS ETHENE, TETRACHLORO- \*\*PEER REVIEWED\*\*  
SYNONYMS ETHYLENE TETRACHLORIDE \*\*PEER REVIEWED\*\*  
SYNONYMS PERCHLOORETHYLEEN, PER (DUTCH) \*\*PEER REVIEWED\*\*  
SYNONYMS PERCHLORAETHYLEN, PER (GERMAN) \*\*PEER  
REVIEWED\*\*  
SYNONYMS PERCHLORETHYLENE \*\*PEER REVIEWED\*\*  
SYNONYMS PERCHLORETHYLENE, PER (FRENCH) \*\*PEER REVIEWED\*\*  
SYNONYMS PERCHLOROETHYLENE \*\*PEER REVIEWED\*\*  
SYNONYMS PERCLOROETILENE (ITALIAN) \*\*PEER REVIEWED\*\*  
SYNONYMS TETRACHLOORETHEEN (DUTCH) \*\*PEER REVIEWED\*\*  
SYNONYMS TETRACHLORAETHEN (GERMAN) \*\*PEER REVIEWED\*\*  
SYNONYMS TETRACHLORETHYLENE \*\*PEER REVIEWED\*\*  
SYNONYMS TETRACHLOROETHENE \*\*PEER REVIEWED\*\*  
SYNONYMS TETRACLOROETENE (ITALIAN) \*\*PEER REVIEWED\*\*  
SYNONYMS PCE \*\*PEER REVIEWED\*\*  
SYNONYMS AI3-01860 \*\*PEER REVIEWED\*\*  
SYNONYMS Ankilostin \*\*PEER REVIEWED\*\*  
SYNONYMS Caswell no 827 \*\*PEER REVIEWED\*\*  
SYNONYMS Didakene \*\*PEER REVIEWED\*\*  
SYNONYMS ENT 1,860 \*\*PEER REVIEWED\*\*  
SYNONYMS EPA pesticide chemical code 078501 \*\*PEER  
REVIEWED\*\*  
SYNONYMS Ethylene, tetrachloro- \*\*PEER REVIEWED\*\*  
SYNONYMS Fedal-un \*\*PEER REVIEWED\*\*

SYNONYMS NCI-C04580 \*\*PEER REVIEWED\*\*  
 SYNONYMS Nema \*\*PEER REVIEWED\*\*  
 SYNONYMS Perclene \*\*PEER REVIEWED\*\*  
 SYNONYMS Persec \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetlen \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetracap \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetraleno \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetropil \*\*PEER REVIEWED\*\*  
 SYNONYMS Antisal 1 \*\*PEER REVIEWED\*\*  
 SYNONYMS Antisol 1 \*\*PEER REVIEWED\*\*  
 SYNONYMS Dow-Per \*\*PEER REVIEWED\*\*  
 SYNONYMS Fedal-Un \*\*PEER REVIEWED\*\*  
 SYNONYMS Per \*\*PEER REVIEWED\*\*  
 SYNONYMS Perawin \*\*PEER REVIEWED\*\*  
 SYNONYMS Perc \*\*PEER REVIEWED\*\*  
 SYNONYMS Perchlor \*\*PEER REVIEWED\*\*  
 SYNONYMS Percosolv \*\*PEER REVIEWED\*\*  
 SYNONYMS Perk \*\*PEER REVIEWED\*\*  
 SYNONYMS Perklone \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetraguer \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetralex \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetravec \*\*PEER REVIEWED\*\*  
 SYNONYMS Tetroguer \*\*PEER REVIEWED\*\*  
 MOLECULAR FORMULA C2-Cl4 \*\*PEER REVIEWED\*\*  
 RTECS NUMBER NIOSH/KX3850000  
 SHIPPING NAME/NUMBER - UN 1897; Tetrachloroethylene; Perchloroethylene  
 DOT/UN/NA/IMO  
 SHIPPING NAME/NUMBER - IMO 6.1; Tetrachloroethylene  
 DOT/UN/NA/IMO  
 STCC NUMBER 49 403 55; Tetrachloroethylene  
 EPA HAZARDOUS WASTE U210; A toxic waste when a discarded commercial  
 NUMBER chemical product or manufacturing chemical  
 intermediate or an off-specification commercial  
 chemical product or a manufacturing chemical  
 intermediate.  
 EPA HAZARDOUS WASTE F002; A hazardous waste from nonspecific sources  
 NUMBER when a spent solvent.

**METHODS OF MANUFACTURING**

MANUFACTURED BY CATALYTIC OXIDN OF 1,1,2,2-TETRACHLOROETHANE:  
 ELLSWORTH, VANCAMP, US PATENT 2,951,103 (1960 TO COLUMBIA-SOUTHERN  
 CHEM); FEATHERS, ROGERSON, US PATENT 3,040,109 (1962 TO PITTSBURGH  
 PLATE GLASS) ... BY CATALYTIC CHLORINATION OF ACETYLENE: THERMET,  
 PARVI, US PATENT 2,938,931 (1960 TO SOCIETE D'ELECTROCHIMIE,  
 D'ELECTROMETALLURGIE ET DES ACIERIES ELECTRIQUES D'UGINE). [The

Merck

Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. , p. 1315]

**\*\*PEER REVIEWED\*\***

#### METHODS OF MANUFACTURING

Prepared primarily by two processes: (1) The Huels method whereby direct chlorination of ethylene yields 70% perchloroethylene, 20% carbon tetrachloride, and 10% other chlorinated products; (2) Hydrocarbons such as methane, ethane, or propane are simultaneously chlorinated and pyrolyzed to yield over 95% perchloroethylene plus carbon tetrachloride and hydrochloric acid. [Fishbein L; Potential Indust Carcin & Mutagens p.148 (1977) USEPA 560/5-77-005] **\*\*PEER REVIEWED\*\***

#### METHODS OF MANUFACTURING

Tetrachloroethylene is produced mainly by oxyhydrochlorination, perchlorination, and/or dehydrochlorination of hydrocarbons or chlorinated hydrocarbons such as 1,2 dichloroethane, propylene, propylene dichloride, and 1,1,2-trichloroethane. [WHO; Environ Health Criteria: Tetrachloroethylene p.15 (1984)] **\*\*PEER REVIEWED\*\***

#### FORMULATIONS/PREPARATIONS

Available in the United States ... in veterinary preparations (eg, Nema Worm Capsules (Parke-Davis)). These capsules contain pure tetrachloroethylene. Avail sizes are 0.2, 0.5, 1.0, 2.5 & 5 ml. [American Medical Association, Department of Drugs. Drug Evaluations. 6th ed. Chicago, Ill: American Medical Association, 1986. , p. 1612] **\*\*PEER REVIEWED\*\***

#### FORMULATIONS/PREPARATIONS

Tetrachloroethylene is avail in the USA in the following grades: purified, technical, USP, spectrophotometric, & dry-cleaning. The technical & dry-cleaning grades both meet specifications for technical grade & differ only in the amount of stabilizer added to prevent decomposition. Stabilizers ... incl amines or mixtures of epoxides & esters. Typical analysis of the commercial grade is ... nonvolatile residue, 0.0003%; free chlorine, none; moisture, no cloud at -5 deg C ... USP grade contains not less than 99.0% & no more than 99.5% tetrachloroethylene, the remainder consisting of ethanol. ... [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). V20 492 (1979)] **\*\*PEER REVIEWED\*\***

#### FORMULATIONS/PREPARATIONS

Food Grade [Kuney, J.H. and J.N. Nullican (eds.) Chemcyclopedia. Washington, DC: American Chemical Society, 1988. , p. 116] **\*\*PEER REVIEWED\*\***

#### FORMULATIONS/PREPARATIONS

/Tetrachloroethylene (BP) may/ ... contain thymol 0.01% wt/wt as a preservative. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The

Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p. 106] \*\*PEER REVIEWED\*\*

#### FORMULATIONS/PREPARATIONS

Tetrachloroethylene Capsules (USP, BP, 1973) [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p. 107] \*\*PEER REVIEWED\*\*

#### FORMULATIONS/PREPARATIONS

Tetrachloroethylene Draught (BNF, 1966): tetrachloroethylene 2.5 ml, acacia 2 g, peppermint emulsion 0.3 ml, chloroform water to 50 ml.

[Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p. 107] \*\*PEER REVIEWED\*\*

#### FORMULATIONS/PREPARATIONS

Perklone (ICI Mond, UK): a brand of tetrachloroethylene for dry-cleaning purposes. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p. 107] \*\*PEER REVIEWED\*\*

#### MANUFACTURERS

Dow Chemical USA, Hq 2020 Dow Center, Midland, MI 48640, (517) 636-1000; Production sites: Pittsburg, CA 94565; Plaquemine, LA 70764 [SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. , p. 825] \*\*UNREVIEWED\*\*

#### MANUFACTURERS

Occidental Petroleum Corporation, Hq, 10889 Wilshire Boulevard, Suite 1500, Los Angeles, CA 90024, (213) 879-1700; Subsidiary: Occidental Chemical Corporation, 5005 LBJ Freeway, Dallas, TX 75244, (214) 404-3800; Electrochemicals, Detergent & Specialty Products Division; Detergent & Specialty Products Group; Electrochemicals Group; Production site: Deer Park, TX 77536 [SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. , p. 825] \*\*UNREVIEWED\*\*

#### MANUFACTURERS

PPG Industries, Inc, Hq One PPG Place, Pittsburgh, PA 15272, (412) 434-3131; Production site: Chemicals Group, Lake Charles, LA 70601 [SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. , p. 825] \*\*UNREVIEWED\*\*

#### MANUFACTURERS

Vulcan Materials Company, Metal Division, Hq, PO Box 7497, Birmingham, AL 35253, (205) 877-3000; Vulcan Chemicals, division, PO Box 7689, Birmingham, AL 35253; Production sites: Geismar, LA 70734; Wichita, KS 67277 [SRI. 1989 Directory of Chemical Producers - United States of America. Menlo Park, CA: SRI International, 1989. , p. 825] \*\*UNREVIEWED\*\*

#### OTHER MANUFACTURING INFORMATION

Method of purification: distillation [Sax, N.I. and R.J. Lewis, Sr.

(eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. , p. 886] \*\*PEER REVIEWED\*\*

MAJOR USES

Used in the textile industry for dry-cleaning & for processing & finishing; used in both cold cleaning & vapor degreasing of metals; it is used as a chem intermediate in the synthesis of fluorocarbon 113, 114, 115, & 116; it is used as a heat-exchange fluid [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). V20 494 (197)] \*\*PEER REVIEWED\*\*

MAJOR USES

SCOURING, SIZING & DESIZING AGENT IN TEXTILE MANUFACTURE [SRI ]

\*\*PEER

REVIEWED\*\*

MAJOR USES

COMPONENT OF AEROSOL LAUNDRY-TREATMENT PRODUCTS [SRI ] \*\*PEER REVIEWED\*\*

MAJOR USES

SOLVENT, EG, FOR SILICONES [SRI ] \*\*PEER REVIEWED\*\*

MAJOR USES

INSULATING FLUID & COOLING GAS IN ELECTRIC TRANSFORMERS [SRI ]

\*\*PEER

REVIEWED\*\*

MAJOR USES

In typewriter correction fluids (eg, Liquid Paper, Wite-Out, Snopake, etc) [Greer JE; South Med J 77 (3): 297-8 (1984)] \*\*PEER REVIEWED\*\*

MAJOR USES

MEDICATION VET: use in small animals as a ruminant anthelmintic (vermifuge) has been largely replaced by drugs that are less toxic & easier to admin [Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982. , p. 839] \*\*PEER REVIEWED\*\*

MAJOR USES

Formerly used, but no longer approved, in mixtures with grain protectants and certain liquid grain fumigants [Farm Chemicals Handbook 87. Willoughby, Ohio: Meister Publishing Co., 1987. C-248] \*\*PEER REVIEWED\*\*

CONSUMPTION PATTERNS

The consumption pattern in the USA in 1974 is est to have been as follows: Textile and dry cleaning industries, 69%; Metal cleaning, 16%; Chemical intermediate (eg, prepn of trichloroacetic acid in some fluorocarbons), 12%; Miscellaneous uses, 3%. [Fishbein L; Potential Indust Carcins & Mutagens p.148 (1977) EPA-560/5-77-005] \*\*PEER REVIEWED\*\*

CONSUMPTION PATTERNS

Demand: (1982), 545 million lb; (1983), 679 million lb; (1987), 625 million lb [Kavaler. Chem Market Reporter 1983] \*\*PEER REVIEWED\*\*

#### CONSUMPTION PATTERNS

(1974) Dry cleaning & textile processing, 59%; Industrial metal cleaning, 21%; Exports, 11%; Chemical intermed (mostly fluorocarbons), 6%; Other, 3%. [Kavaler. Chem Market Reporter 1983] \*\*PEER REVIEWED\*\*

#### CONSUMPTION PATTERNS

SOLVENT IN DRY CLEANING, 46%; DEGREASING SOLVENT, 21%; CHEM INTERMED

FOR FLUOROCARBONS, 12%; AGENT IN TEXTILE MFR, 7%; COMPONENT OF AEROSOL

PRODUCTS, 2%; OTHER, 12% (1980, EST) [SRI ] \*\*PEER REVIEWED\*\*

#### CONSUMPTION PATTERNS

CHEMICAL PROFILE: Perchloroethylene. Demand: 1988: 495 million lb; 1989: 495 million lb; 1993 /projected/: 495 million lb. (Includes exports, but not imports, which totaled 121 million lb last yr). [Kavaler AR; Chemical Marketing Reporter 235 (6): 46 (1989)] \*\*QC REVIEWED\*\*

#### CONSUMPTION PATTERNS

CHEMICAL PROFILE: Perchloroethylene. Dry cleaning and textile processing, 50%; chemical intermediate (mostly fluorocarbon F-113), 28%; industrial metal cleaning, 9%; exports, 10%; other, 3%. [Kavaler AR; Chemical Marketing Reporter 235 (6): 46 (1989)] \*\*QC REVIEWED\*\*

#### U.S. PRODUCTION

(1981) 3.16X10+11 GRAMS [US INT'L TRADE COMM. SOC SERIES C/P-82-1] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1976) 121x10+6 lb [Fishbein L; Potential Indust Carcins & Mutagens p.35 (1977) USEPA 560/ 5-77-005] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1978) 3.34X10+11 G [SRI ] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1983) 2.40X10+11 G [SRI ] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1985) 3.08X10+11 g [USITC. SYN ORG CHEM-U.S. PROD/SALES 1985 p.268] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1986) 4.05X10+8 LB [USITC. SYN ORG CHEM-U.S. PROD/SALES. PRELIMINARY 1988 SERIES C/P-87-5] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1987) 4.70X10+8 LB [USITC. SYN ORG CHEM-U.S. PROD/SALES. PRELIMINARY 1988 SERIES C/P-87-5] \*\*PEER REVIEWED\*\*

#### U.S. PRODUCTION

(1982) 550 million lb [USITC; USITC Publications 1422 (1983) as cited in USEPA; Health Advisories for 25 Organics: Tetrachloroethylene p.306]

- (1987) PB 87-235578] \*\*PEER REVIEWED\*\*  
 U.S. IMPORTS  
 (1977) 5.98X10+10 G [SRI ] \*\*PEER REVIEWED\*\*  
 U.S. IMPORTS  
 (1982) 1.70X10+10 G [SRI ] \*\*PEER REVIEWED\*\*  
 U.S. IMPORTS  
 (1985) 6.36X10+10 g [BUREAU OF THE CENSUS. U.S. IMPORTS FOR  
 CONSUMPTION  
 AND GENERAL IMPORTS 1985 p.1-584] \*\*PEER REVIEWED\*\*  
 U.S. IMPORTS  
 (1986) 1.83X10+5 LB [BUREAU OF THE CENSUS. US IMPORTS FOR  
 CONSUMPTION  
 AND GENERAL IMPORTS 1986 P.1-530] \*\*PEER REVIEWED\*\*  
 U.S. EXPORTS  
 (1978) 2.90X10+10 G [SRI ] \*\*PEER REVIEWED\*\*  
 U.S. EXPORTS  
 (1983) 2.47X10+10 G [SRI ] \*\*PEER REVIEWED\*\*  
 U.S. EXPORTS  
 (1985) 9.84X10+9 g [BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E,  
 1985 p.2-69] \*\*QC REVIEWED\*\*  
 COLOR/Form Colorless liquid [The Merck Index. 10th ed.  
 Rahway, New Jersey: Merck Co., Inc., 1983. , p.  
 1315] \*\*PEER REVIEWED\*\*  
 ODOR Ethereal-like odor [The Merck Index. 10th ed.  
 Rahway, New Jersey: Merck Co., Inc., 1983. , p.  
 1315] \*\*PEER REVIEWED\*\*  
 ODOR Mildly sweet, chloroform-like odor [U.S. Coast  
 Guard, Department of Transportation. CHRIS -  
 Hazardous Chemical Data. Volume II. Washington,  
 D.C.: U.S. Government Printing Office, 1984-5. ]  
 \*\*PEER REVIEWED\*\*  
 ODOR Chlorinated solvent odor [Ruth JH; Am Ind Hyg  
 Assoc J 47: A-142-51 (1986)] \*\*PEER REVIEWED\*\*  
 BOILING POINT 121 DEG C AT 760 MM HG [Weast, R.C. (ed.) Handbook  
 of Chemistry and Physics, 68th ed. Boca Raton,  
 Florida: CRC Press Inc., 1987-1988. C-272] \*\*PEER  
 REVIEWED\*\*  
 MELTING POINT -19 DEG C [Weast, R.C. (ed.) Handbook of Chemistry  
 and Physics, 68th ed. Boca Raton, Florida: CRC  
 Press Inc., 1987-1988. C-272] \*\*PEER REVIEWED\*\*  
 MOLECULAR WEIGHT 165.83 [Weast, R.C. (ed.) Handbook of Chemistry  
 and Physics, 68th ed. Boca Raton, Florida: CRC  
 Press Inc., 1987-1988. C-272] \*\*PEER REVIEWED\*\*  
 CORROSIVITY Corrosion of aluminum, iron, & zinc, which is  
 negligible unless water is present, can be

- inhibited by the addition of stabilizers  
 [Kirk-Othmer Encyclopedia of Chemical Technology.  
 3rd ed., Volumes 1-26. New York, NY: John Wiley  
 and Sons, 1978-1984. 5(79) 756] \*\*PEER REVIEWED\*\*
- CRITICAL TEMPERATURE & PRESSURE 347.1 deg C; 9.74 MPa (to convert MPa to atm,  
 divide by 0.101) [Kirk-Othmer Encyclopedia of  
 Chemical Technology. 3rd ed., Volumes 1-26. New  
 York, NY: John Wiley and Sons, 1978-1984. 5(79)  
 755] \*\*PEER REVIEWED\*\*
- DENSITY/SPECIFIC GRAVITY 1.6227 AT 20 DEG C/4 DEG C [Weast, R.C. (ed.)  
 Handbook of Chemistry and Physics, 68th ed. Boca  
 Raton, Florida: CRC Press Inc., 1987-1988. C-272]  
 \*\*PEER REVIEWED\*\*
- HEAT OF COMBUSTION 679.9 kJ/mol (constant pressure with formation of  
 aq hydrochloric acid; 831.8 kJ/mol (constant  
 volume at 18.7 deg C) (to convert J to cal, divide  
 by 4.184) [Kirk-Othmer Encyclopedia of Chemical  
 Technology. 3rd ed., Volumes 1-26. New York, NY:  
 John Wiley and Sons, 1978-1984. 5(79) 755] \*\*PEER  
 REVIEWED\*\*
- HEAT OF VAPORIZATION 90.2 BTU/lb= 50.1 cal/g= 2.10X10+5 J/kg [U.S.  
 Coast Guard, Department of Transportation. CHRIS -  
 Hazardous Chemical Data. Volume II. Washington,  
 D.C.: U.S. Government Printing Office, 1984-5. ]  
 \*\*PEER REVIEWED\*\*
- OCTANOL/WATER PARTITION COEFFICIENT log Kow= 3.40 [Hansch C, Leo AJ; Medchem Project  
 Issue No. 26 Claremont, CA: Pomona College (1985)]  
 \*\*PEER REVIEWED\*\*
- SOLUBILITIES Miscible with alcohol, ether, chloroform, benzene  
 [The Merck Index. 10th ed. Rahway, New Jersey:  
 Merck Co., Inc., 1983. , p. 1315] \*\*PEER  
 REVIEWED\*\*
- SOLUBILITIES Miscible with solvent hexane; dissolves in most of  
 the fixed and volatile oils [Osol, A. (ed.).  
 Remington's Pharmaceutical Sciences. 16th ed.  
 Easton, Pennsylvania: Mack Publishing Co., 1980. ,  
 p. 1184] \*\*PEER REVIEWED\*\*
- SOLUBILITIES 0.015 G/100 ML WATER AT 25 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). V20 492  
 (1979)] \*\*PEER REVIEWED\*\*
- SPECTRAL PROPERTIES SADTLER REF NUMBER: 237 (IR, PRISM); 79 (IR,  
 GRATING) [Weast, R.C. (ed.). Handbook of Chemistry

- and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979. C-298] \*\*PEER REVIEWED\*\*
- SPECTRAL PROPERTIES Index of Refraction: 1.5053 at 20 deg C/D [Weast, R.C. (ed.) Handbook of Chemistry and Physics, 68th ed. Boca Raton, Florida: CRC Press Inc., 1987-1988. C-272] \*\*PEER REVIEWED\*\*
- SPECTRAL PROPERTIES IR: 4786 (Coblentz Society Spectral Collection) [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. V1 627] \*\*QC REVIEWED\*\*
- SPECTRAL PROPERTIES MASS: 1053 (Atlas of Mass Spectral Data, John Wiley & Sons, New York) [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. V1 627] \*\*QC REVIEWED\*\*
- SURFACE TENSION 31.74 dynes/cm at 20 deg C in contact with vapor [Weast, R.C. (ed.) Handbook of Chemistry and Physics, 68th ed. Boca Raton, Florida: CRC Press Inc., 1987-1988. F-37] \*\*PEER REVIEWED\*\*
- VAPOR DENSITY 5.7 (AIR= 1) [Browning, E. Toxicity and Metabolism of Industrial Solvents. New York: American Elsevier, 1965. , p. 213] \*\*PEER REVIEWED\*\*
- VAPOR PRESSURE 18.47 mm Hg at 25 deg C [Riddick JA et al; Organic Solvents: Physical Properties and Methods of Purification. Techniques of Chemistry. 4th ed. Wiley-Interscience pp. 1325 (1986)] \*\*PEER REVIEWED\*\*
- RELATIVE EVAPORATION RATE EVAPORATION RATE SLOWER THAN THAT FOR TRICHLOROETHYLENE, ABOUT 3-1. [Browning, E. Toxicity and Metabolism of Industrial Solvents. New York: American Elsevier, 1965. , p. 213] \*\*PEER REVIEWED\*\*
- VISCOSITY Liquid: 0.932, 0.839, 0.657 & 0.534 CP at 15, 25, 50 & 75 deg C, respectively; Vapor: 9900 CP at 60 deg C [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984. 5(79) 755] \*\*PEER REVIEWED\*\*
- OTHER CHEMICAL/PHYSICAL PROPERTIES Liquid-water interfacial tension: 44.4 dynes/cm= 0.0444 N/m at 25 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. ] \*\*PEER REVIEWED\*\*

OTHER CHEMICAL/PHYSICAL Conversion factors: 1 mg/l equals 147.4 ppm and 1  
 PROPERTIES ppm equals 6.78 mg/cu m at 25 deg C, 760 mm Hg

[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. , p. 3561] \*\*PEER REVIEWED\*\*

OTHER CHEMICAL/PHYSICAL Partition coefficients at 37 deg C for  
 PROPERTIES tetrachloroethylene into blood= 13.1; into oil=

1,920 [Sato A, Nakajima T; Scand J Work Environ  
 Health 13: 81-93 (1987)] \*\*PEER REVIEWED\*\*

OTHER CHEMICAL/PHYSICAL Sat concn in air: 126 g/cu m at 20 deg C, 210 g/cu  
 PROPERTIES m at 30 deg C [Verschueren, K. Handbook of

Environmental Data of Organic Chemicals. 2nd ed.  
 New York, NY: Van Nostrand Reinhold Co., 1983. ,  
 p. 1076] \*\*PEER REVIEWED\*\*

OTHER CHEMICAL/PHYSICAL DECOMP SLOWLY IN WATER TO YIELD  
 TRICHLOROACETIC

PROPERTIES AND HYDROCHLORIC ACIDS; OXIDIZED BY STRONG

OXIDIZING AGENTS [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). V20 492 (1979)]  
 \*\*PEER REVIEWED\*\*

OTHER CHEMICAL/PHYSICAL MP: -22.4 deg C [Sax, N.I. and R.J. Lewis, Sr.  
 PROPERTIES (eds.). Hawley's Condensed Chemical Dictionary.

11th ed. New York: Van Nostrand Reinhold Co.,  
 1987. , p. 886] \*\*PEER REVIEWED\*\*

#### HAZARDS SUMMARY

The major hazards encountered in the use and handling of tetrachloroethylene stem from its toxicologic properties. Exposure to this colorless liquid may occur from its use as a solvent and as an intermediate in chemical syntheses. In addition to eye and skin inflammation from contacting liquid tetrachloroethylene, inhalation of its vapor can cause central nervous system depression, liver necrosis, and effects on the lung, heart, and kidney. The ACGIH recommends a workplace limit (TLV) of 50 ppm as an 8 hr time-weighted average (TWA) with a note to prevent skin contact. Tetrachloroethylene's sweet chloroform-like odor may warn of its presence at a sub-TLV level of 4.68 ppm; however, to assure against exposure, it is recommended that self-contained breathing apparatus and full protective clothing be worn, especially in fire or spill situations. Although considered nonflammable, containers of tetrachloroethylene may explode in the heat of a fire and its vapor will decompose in contact with open flames or red-heated materials to yield the poisonous gas, phosgene. For small

fires involving tetrachloroethylene, extinguish with dry chemical or CO<sub>2</sub>, and for large fires, use water spray, fog, or foam. Cool containers with water. If the fire involves a tank car or truck, isolate the area for 1/2 mile in all directions. Tetrachloroethylene should be stored in a cool, dry, well-ventilated location, away from strong oxidizers, potential fire hazards, caustic soda, potash, and chemically active metals such as barium, lithium, and beryllium. Regulated by the IATA, tetrachloroethylene may be shipped in tank cars, tank trucks, and 5- and 55-gallon steel drums. For small spills of tetrachloroethylene, ventilate the area then take up with vermiculite, dry sand, or earth. Large spills should be diked for later disposal. Prior to implementing land disposal of waste residues (including waste sludge), consult environmental regulatory agencies for guidance. \*\*PEER REVIEWED\*\*

#### DOT EMERGENCY GUIDELINES

Health Hazards: Vapors may cause dizziness or suffocation. Exposure in an enclosed area may be very harmful. Contact may irritate or burn skin and eyes. Fire may produce irritating or poisonous gases. Runoff from fire control or dilution water may cause pollution. [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987. G-74] \*\*QC REVIEWED\*\*

#### DOT EMERGENCY GUIDELINES

Fire or Explosion: Some of these materials may burn, but none of them ignites readily. Most vapors are heavier than air. Container may explode in heat of fire. [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987. G-74] \*\*QC REVIEWED\*\*

#### DOT EMERGENCY GUIDELINES

Emergency Action: Keep unnecessary people away. Stay upwind; keep out of low areas. Self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing will provide limited protection. Isolate for 1/2 mile in all directions if tank car or truck is involved in fire. Remove and isolate contaminated clothing at the site. CALL CHEMTREC AT 1-800-424-9300 FOR EMERGENCY ASSISTANCE. If water pollution occurs, notify the appropriate authorities. [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987. G-74] \*\*QC REVIEWED\*\*

#### DOT EMERGENCY GUIDELINES

Fire: Small Fires: Dry chemical, CO<sub>2</sub> or Halon. Large Fires: Water spray, fog or standard foam is recommended. Cool containers that are exposed to flames with water from the side until well after fire is out. Stay away from ends of tanks. [Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S.

Government Printing Office, 1987. G-74] **\*\*QC REVIEWED\*\***

#### DOT EMERGENCY GUIDELINES

Spill or Leak: Stop leak if you can do it without risk. Shut off ignition sources; no flares, smoking or flames in hazard area. Small

Liquid Spills: Take up with sand, earth or other noncombustible

absorbent material. Large Spills: Dike far ahead of liquid spill for

later disposal. [Department of Transportation. Emergency Response

Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987. G-74] **\*\*QC REVIEWED\*\***

#### DOT EMERGENCY GUIDELINES

First Aid: Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult,

give oxygen. In case of contact with material, immediately flush eyes

with running water for at least 15 minutes. Wash skin with soap and

water. Remove and isolate contaminated clothing and shoes at the site.

Use first aid treatment according to the nature of the injury.

[Department of Transportation. Emergency Response Guidebook 1987. DOT P 5800.4. Washington, DC: U.S. Government Printing Office, 1987. G-74]

**\*\*QC REVIEWED\*\***

#### FIRE POTENTIAL

Non-flammable [National Fire Protection Association. Fire Protection

Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire

Protection Association, 1986. 49-86] **\*\*PEER REVIEWED\*\***

#### NFPA HAZARD CLASSIFICATION

Flammability 0. 0= Materials that will not burn. [National Fire

Protection Association. Fire Protection Guide on Hazardous Materials.

9th ed. Boston, MA: National Fire Protection Association, 1986. 49-86]

**\*\*PEER REVIEWED\*\***

#### NFPA HAZARD CLASSIFICATION

Health 2. 2= Materials hazardous to health, but areas may be entered

freely with self-contained breathing apparatus. [National Fire

Protection Association. Fire Protection Guide on Hazardous Materials.

9th ed. Boston, MA: National Fire Protection Association, 1986. 49-86]

**\*\*PEER REVIEWED\*\***

#### NFPA HAZARD CLASSIFICATION

Reactivity 0. 0= Materials which are normally stable even under fire

exposure conditions and which are not reactive with water. Normal fire

fighting procedures may be used. [National Fire Protection Association.

Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA:

National Fire Protection Association, 1986. 49-86] **\*\*PEER REVIEWED\*\***

#### FLASH POINT

No flash point in conventional closed tester. [National Fire Protection

Association. Fire Protection Guide on Hazardous Materials. 9th ed.

Boston, MA: National Fire Protection Association, 1986. 49-86] **\*\*PEER**

**REVIEWED\*\***

**FIRE FIGHTING PROCEDURES**

**USE WATER SPRAY TO KEEP FIRE-EXPOSED CONTAINERS COOL. WATER SPRAY MAY**

**BE USED TO FLUSH SPILLS AWAY FROM EXPOSURES.** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986. 49-86] **\*\*PEER REVIEWED\*\***

**FIRE FIGHTING PROCEDURES**

**PERSONAL PROTECTION: WEAR SELF-CONTAINED BREATHING APPARATUS /IN FIRE**

**CONDITIONS/.** [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986. 49-86] **\*\*PEER REVIEWED\*\***

**TOXIC COMBUSTION PRODUCTS**

Vapors decompose at high temp from open flame, red-heated materials with release of poisonous gases such as chlorine, carbon monoxide, and phosgene. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. , p. 507] **\*\*PEER REVIEWED\*\***

**EXPLOSIVE LIMITS AND POTENTIAL**

Mixtures with lithium shavings ... are impact-sensitive and will explode, sometimes violently. [Bretherick, L. Handbook of Reactive Chemical Hazards. 3rd ed. Boston, MA: Butterworths, 1985. , p. 1261] **\*\*PEER REVIEWED\*\***

**EXPLOSIVE LIMITS AND POTENTIAL**

The presence of 0.5% of trichloroethylene as impurity in tetrachloroethylene during unheated drying over solid sodium hydroxide caused the generation of dichloroacetylene. After subsequent fractional distillation, the volatile fore-run exploded. [Bretherick, L. Handbook of Reactive Chemical Hazards. 3rd ed. Boston, MA: Butterworths, 1985. , p. 208] **\*\*PEER REVIEWED\*\***

**EXPLOSIVE LIMITS AND POTENTIAL**

Mixtures of /dinitrogen/ tetraoxide with ... tetrachloroethylene are explosive when subjected to shock of 25 g TNT equivalent or less. [Bretherick, L. Handbook of Reactive Chemical Hazards. 3rd ed. Boston, MA: Butterworths, 1985. , p. 1297] **\*\*PEER REVIEWED\*\***

**REACTIVITIES & INCOMPATIBILITIES**

Granular barium in contact with ... tetrachloroethylene ... is susceptible to detonation. [Bretherick, L. Handbook of Reactive Chemical Hazards. 3rd ed. Boston, MA: Butterworths, 1985. , p. 78] **\*\*PEER REVIEWED\*\***

**REACTIVITIES & INCOMPATIBILITIES**

Reacts with metals to form explosive mixtures; Sodium hydroxide, possible explosion. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information

Institute, 1982. , p. 696] **\*\*PEER REVIEWED\*\***

#### REACTIVITIES & INCOMPATIBILITIES

Several cases of violent reaction between aluminum and ... tetrachloroethylene in vapor degreasers have been noted. [Bretherick, L. Handbook of Reactive Chemical Hazards. 3rd ed. Boston, MA: Butterworths, 1985. , p. 26] **\*\*PEER REVIEWED\*\***

#### REACTIVITIES & INCOMPATIBILITIES

Incompatible /with/ chemically active metals, such as barium, lithium, and beryllium. /From table/ [NIOSH. Pocket Guide to Chemical Hazards. 5th Printing/Revision. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt. of Documents, GPO, Sept. 1985. , p. 220] **\*\*PEER REVIEWED\*\***

#### DECOMPOSITION

When in contact with activated charcoal decomposes to form hexachloroethane and hexachlorobenzene at 700 deg C. [Gonikberg MG et al; Bul Acad Sci USSR Dir Chem Sci p.739 (1956)] **\*\*PEER REVIEWED\*\***

#### DECOMPOSITION

... decomposes slowly in contact with moisture to yield trichloroacetic acid and hydrochloric acid [WHO; Environ Health Criteria: Tetrachloroethylene p.9 (1984)] **\*\*PEER REVIEWED\*\***

#### DECOMPOSITION

It affords various decomp products depending on conditions, but mostly hydrogen chloride & phosgene. [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984. 5(79) 754] **\*\*PEER REVIEWED\*\***

#### ODOR THRESHOLD

The distinctive odor of tetrachloroethylene does not necessarily provide adequate warning. Because tetrachloroethylene quickly desensitizes olfactory responses, persons can suffer exposure to vapor concentrations in excess of TLV limits without smelling it. [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984. 5(79) 761] **\*\*PEER REVIEWED\*\***

#### ODOR THRESHOLD

Recognition in air: 4.68 ppm (chemically pure) [Fazzalari, F.A. (ed.). Compilation of Odor and Taste Threshold Values Data. ASTM Data Series DS 48A (Committee E-18). Philadelphia, PA: American Society for Testing and Materials, 1978. , p. 155] **\*\*PEER REVIEWED\*\***

#### ODOR THRESHOLD

Perchloroethylene has a not unpleasant ethereal or aromatic odor. ... 50 ppm, odor threshold (very faint) to unacclimated; no physiological effects (8 hr). 100 ppm, odor (faint) definitely apparent to unacclimated; very faint to not perceptible during exposure; no physiological effects (8 hr). 200 ppm, odor (definite) moderate to faint upon exposure; faint to moderate eye irritation; minimal

light-headedness; (eye irritation threshold 100-200 ppm). 400 ppm, odor (strong) unpleasant; definite eye irritation, slight nasal irritation; definite incoordination (2 hr). 600 ppm, odor (strong) very unpleasant but tolerable; definite eye & nasal irritation; dizziness, loss of inhibitions (10 min). 1000 ppm, odor (very strong) intense, irritating; markedly irritating to eyes & resp tract; considerable dizziness (2 min). 1500 ppm, odor (almost intolerable) gagging; irritation almost intolerable to eyes & nose; complete incoordination within minutes to unconsciousness within 30 min. [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. , p. 3567]

**\*\*PEER REVIEWED\*\***

#### SKIN, EYE AND RESPIRATORY IRRITATIONS

Eye exposure can lead to conjunctivitis; Skin exposure can lead to inflammation; Inhalation can lead to respiratory tract irritation.

[ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. , p. 507] **\*\*PEER REVIEWED\*\***

#### SKIN, EYE AND RESPIRATORY IRRITATIONS

Tetrachloroethylene vapor is a mucous membrane & upper resp irritant at levels above 75 to 100 ppm. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. , p. 986] **\*\*PEER REVIEWED\*\***

#### PROTECTIVE EQUIPMENT & CLOTHING

FOR HIGH VAPOR CONCEN USE APPROVED CANISTER OR AIR-SUPPLIED MASK; CHEMICAL GOGGLES OR FACE SHIELD; PLASTIC GLOVES. [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5. ] **\*\*PEER REVIEWED\*\***

#### PROTECTIVE EQUIPMENT & CLOTHING

PRECAUTIONS FOR CARCINOGENS: ... dispensers of liq detergent /should be available./ ... Safety pipettes should be used for all pipetting.

... In animal laboratory, personnel should ... wear protective suits (preferably disposable, one-piece & close-fitting at ankles & wrists), gloves, hair covering & overshoes. ... In chemical laboratory, gloves & gowns should always be worn ... however, gloves should not be assumed to provide full protection. Carefully fitted masks or respirators may be necessary when working with particulates or gases, & disposable plastic aprons might provide addnl protection. ... gowns ... /should be/ of distinctive color, this is a reminder that they are not to be worn outside the laboratory. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No.

33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 8] **\*\*PEER REVIEWED\*\***

#### PROTECTIVE EQUIPMENT & CLOTHING

Respirator selection: Upper limit devices recommended by NIOSH: > at any detectable concn: any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode; escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister or any appropriate escape-type self-contained breathing apparatus [NIOSH. Pocket Guide to Chemical Hazards. 5th Printing/Revision. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt. of Documents, GPO, Sept. 1985. , p. 221] **\*\*PEER REVIEWED\*\***

#### PROTECTIVE EQUIPMENT & CLOTHING

Wear appropriate equipment to prevent repeated or prolonged skin contact; wear eye protection to prevent reasonable probability of eye contact [NIOSH. Pocket Guide to Chemical Hazards. 5th Printing/Revision. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt. of Documents, GPO, Sept. 1985. , p. 221] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

Contact lenses should not be worn when working with this chemical. [NIOSH. Pocket Guide to Chemical Hazards. 2nd Printing. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt. of Documents, GPO, February 1987. , p. 221] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

Contact lens use in industry is controversial. A survey of 100 corporations resulted in the recommendation that each company establish their own contact lens use policy. One presumed hazard of contact lens use is possible chemical entrapment. /It was/ found that contact lens minimized injury or protected the eye. The eye was afforded more protection from liquid irritants. Soft contact lenses do not worsen corneal damage from strong chemicals and in some cases could actually protect the eye. Overall, the literature supports the wearing of contact lenses in industrial environments as part of the standard eye protection, eg, face shields; however, more data are needed to establish the value of contact lenses. [Randolph SA, Zavon MR; J Occup Med 29: 237-42 (1987)] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

Employees should wash promptly when skin becomes contaminated; promptly

remove non-impervious clothing that becomes contaminated [NIOSH. Pocket Guide to Chemical Hazards. 5th Printing/Revision. DHHS (NIOSH) Publ. No. 85-114. Washington, D.C.: U.S. Dept. of Health and Human Services, NIOSH/Supt. of Documents, GPO, Sept. 1985. , p. 221] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

... all containers should bear /toxicity/ warning label. [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984. 5(79) 759] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

**PRECAUTIONS FOR CARCINOGENS:** Smoking, drinking, eating, storage of food or of food & beverage containers or utensils, & the application of cosmetics should be prohibited in any laboratory. All personnel should remove gloves, if worn, after completion of procedures in which carcinogens have been used. They should ... wash ... hands, preferably using dispensers of liq detergent, & rinse ... thoroughly.

Consideration should be given to appropriate methods for cleaning the skin, depending on nature of the contaminant. No standard procedure can be recommended, but the use of organic solvents should be avoided.

Safety pipettes should be used for all pipetting. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 8] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

**PRECAUTIONS FOR CARCINOGENS:** In animal laboratory, personnel should remove their outdoor clothes & wear protective suits (preferably disposable, one-piece & close-fitting at ankles & wrists), gloves, hair covering & overshoes. ... clothing should be changed daily but ... discarded immediately if obvious contamination occurs ... /also,/ workers should shower immediately. In chemical laboratory, gloves & gowns should always be worn ... however, gloves should not be assumed to provide full protection. Carefully fitted masks or respirators may be necessary when working with particulates or gases, & disposable plastic aprons might provide addnl protection. If gowns are of distinctive color, this is a reminder that they should not be worn outside of lab. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 8] **\*\*PEER REVIEWED\*\***

#### OTHER PREVENTIVE MEASURES

**PRECAUTIONS FOR CARCINOGENS:** ... operations connected with synth & purification ... should be carried out under well-ventilated hood.

Analytical procedures ... should be carried out with care & vapors evolved during ... procedures should be removed. ... Expert advice should be obtained before existing fume cupboards are used ... & when new fume cupboards are installed. It is desirable that there be means for decreasing the rate of air extraction, so that carcinogenic powders can be handled without ... powder being blown around the hood. Glove boxes should be kept under negative air pressure. Air changes should be adequate, so that concn of vapors of volatile carcinogens will not occur. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 8] \*\*PEER REVIEWED\*\*

#### OTHER PREVENTIVE MEASURES

**PRECAUTIONS FOR CARCINOGENS:** Vertical laminar-flow biological safety cabinets may be used for containment of in vitro procedures ... provided that the exhaust air flow is sufficient to provide an inward air flow at the face opening of the cabinet, & contaminated air plenums that are under positive pressure are leak-tight. Horizontal laminar-flow hoods or safety cabinets, where filtered air is blown across the working area towards the operator, should never be used ... Each cabinet or fume cupboard to be used ... should be tested before work is begun (eg, with fume bomb) & label fixed to it, giving date of test & avg air-flow measured. This test should be repeated periodically & after any structural changes. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 9] \*\*PEER REVIEWED\*\*

#### OTHER PREVENTIVE MEASURES

**PRECAUTIONS FOR CARCINOGENS:** Principles that apply to chem or biochem lab also apply to microbiological & cell-culture labs ... Special consideration should be given to route of admin. ... Safest method of administering volatile carcinogen is by injection of a soln. Admin by topical application, gavage, or intratracheal instillation should be performed under hood. If chem will be exhaled, animals should be kept under hood during this period. Inhalation exposure requires special equipment. ... unless specifically required, routes of admin other than in the diet should be used. Mixing of carcinogen in diet should be carried out in sealed mixers under fume hood, from which the exhaust is fitted with an efficient particulate filter. Techniques for cleaning mixer & hood should be devised before expt begun. When mixing diets, special protective clothing &, possibly, respirators may be required.

/Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 9] \*\*PEER REVIEWED\*\*

#### OTHER PREVENTIVE MEASURES

PRECAUTIONS FOR CARCINOGENS: When ... admin in diet or applied to skin, animals should be kept in cages with solid bottoms & sides & fitted with a filter top. When volatile carcinogens are given, filter tops should not be used. Cages which have been used to house animals that received carcinogens should be decontaminated. Cage-cleaning facilities should be installed in area in which carcinogens are being used, to avoid moving of ... contaminated /cages/. It is difficult to ensure that cages are decontaminated, & monitoring methods are necessary. Situations may exist in which the use of disposable cages should be recommended, depending on type & amt of carcinogen & efficiency with which it can be removed. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 10] \*\*PEER REVIEWED\*\*

#### OTHER PREVENTIVE MEASURES

PRECAUTIONS FOR CARCINOGENS: To eliminate risk that ... contamination in lab could build up during conduct of expt, periodic checks should be carried out on lab atmospheres, surfaces, such as walls, floors & benches, & ... interior of fume hoods & airducts. As well as regular monitoring, check must be carried out after cleaning-up of spillage. Sensitive methods are required when testing lab atmospheres for chem such as nitrosamines. Methods ... should ... where possible, be simple & sensitive. ... /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 10] \*\*PEER REVIEWED\*\*

#### OTHER PREVENTIVE MEASURES

PRECAUTIONS FOR CARCINOGENS: Rooms in which obvious contamination has occurred, such as spillage, should be decontaminated by lab personnel engaged in expt. Design of expt should ... avoid contamination of permanent equipment. ... Procedures should ensure that maintenance workers are not exposed to carcinogens. ... Particular care should be taken to avoid contamination of drains or ventilation ducts. In cleaning labs, procedures should be used which do not produce aerosols

or dispersal of dust, ie, wet mop or vacuum cleaner equipped with high-efficiency particulate filter on exhaust, which are available commercially, should be used. Sweeping, brushing & use of dry dusters or mops should be prohibited. Grossly contaminated cleaning materials should not be re-used ... If gowns or towels are contaminated, they should not be sent to laundry, but ... decontaminated or burnt, to avoid any hazard to laundry personnel. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 10] \*\*PEER REVIEWED\*\*

#### OTHER PREVENTIVE MEASURES

**PRECAUTIONS FOR CARCINOGENS:** Doors leading into areas where carcinogens are used ... should be marked distinctively with appropriate labels. Access ... limited to persons involved in expt. ... A prominently displayed notice should give the name of the Scientific Investigator or other person who can advise in an emergency & who can inform others (such as firemen) on the handling of carcinogenic substances. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 11] \*\*PEER REVIEWED\*\*

#### STABILITY/SHELF LIFE

**RAPIDLY DETERIORATES IN WARM CLIMATES** [Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. , p. 1031] \*\*PEER REVIEWED\*\*

#### STABILITY/SHELF LIFE

Tetrachloroethylene is stable up to 500 deg C in the absence of catalysts, moisture, and oxygen. [WHO; Environ Health Criteria: Tetrachloroethylene p.9 (1984)] \*\*PEER REVIEWED\*\*

#### STABILITY/SHELF LIFE

**THE MATERIAL IS EXTREMELY STABLE & RESISTS HYDROLYSIS** [Sax, N.I. Dangerous Properties of Industrial Materials. 6th ed. New York, NY: Van Nostrand Reinhold, 1984. , p. 2518] \*\*PEER REVIEWED\*\*

#### STABILITY/SHELF LIFE

**PURE CMPD IS SLOWLY DECOMP BY VARIOUS METALS IN PRESENCE OF MOISTURE**

[Osol, A. (ed.). Remington's Pharmaceutical Sciences. 16th ed. Easton, Pennsylvania: Mack Publishing Co., 1980. , p. 1177] \*\*PEER REVIEWED\*\*

#### STABILITY/SHELF LIFE

The physical stability of emulsions of tetrachloroethylene can be enhanced by diluting the tetrachloroethylene with arachis oil before

emulsification. This practice may be harmful because the oil increases the absorption, & thus the toxicity, of the drug. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p. 107] \*\*PEER REVIEWED\*\*

#### SHIPMENT METHODS AND REGULATIONS

Whenever hazardous materials are to be transported, Title 49 CFR, Transportation, Parts 100-180, published by the US Dept of Transportation, contain the regulatory requirements and must be consulted. [52 FR 16482 (5/5/87)] \*\*PEER REVIEWED\*\*

#### SHIPMENT METHODS AND REGULATIONS

Shipping description: Tetrachloroethylene, IMO 6.1, UN 1897. Label(s) required: Keep Away From Food. Acceptable Modes of transportation: Air, rail, road, and water. [52 FR 16655 (5/5/87)] \*\*PEER REVIEWED\*\*

#### SHIPMENT METHODS AND REGULATIONS

Int'l Air Shipments: Shipping description: Tetrachloroethylene, IMO 6.1, UN 1897. Label(s) required: Keep Away From Food. Packaging Instructions: 5.6.605 (passenger); 5.6.612 (cargo). [IATA. Dangerous Goods Regulations. 28th ed. Montreal, Canada: International Air Transport Association. Dangerous Goods Board, January 1, 1987. , p. 210] \*\*PEER REVIEWED\*\*

#### SHIPMENT METHODS AND REGULATIONS

Water shipments: Shipping description: Tetrachloroethylene, IMO 6.1, UN 1897. Label(s) required: Keep Away From Food. [IMDG; International Maritime Dangerous Goods Code; International Maritime Organization (1986)] \*\*PEER REVIEWED\*\*

#### SHIPMENT METHODS AND REGULATIONS

PRECAUTIONS FOR CARCINOGENS: Procurement ... of unduly large amt ... should be avoided. To avoid spilling, carcinogens should be transported in securely sealed glass bottles or ampoules, which should themselves be placed inside strong screw-cap or snap-top container that will not open when dropped & will resist attack from the carcinogen. Both bottle & the outside container should be appropriately labelled. ... National post offices, railway companies, road haulage companies & airlines have regulations governing transport of hazardous materials. These authorities should be consulted before ... material is shipped.  
/Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 13] \*\*PEER REVIEWED\*\*

#### SHIPMENT METHODS AND REGULATIONS

PRECAUTIONS FOR CARCINOGENS: When no regulations exist, the following procedure must be adopted. The carcinogen should be enclosed in a securely sealed, watertight container (primary container), which should

be enclosed in a second, unbreakable, leakproof container that will withstand chem attack from the carcinogen (secondary container). The space between primary & secondary container should be filled with absorbent material, which would withstand chem attack from the carcinogen & is sufficient to absorb the entire contents of the primary container in the event of breakage or leakage. Each secondary container should then be enclosed in a strong outer box. The space between the secondary container & the outer box should be filled with an appropriate quantity of shock-absorbent material. Sender should use fastest & most secure form of transport & notify recipient of its departure. If parcel is not received when expected, carrier should be informed so that immediate effort can be made to find it. Traffic schedules should be consulted to avoid ... arrival on weekend or holiday ... /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 13] \*\*PEER REVIEWED\*\*

#### STORAGE CONDITIONS

STORE IN COOL, DRY, WELL-VENTILATED LOCATION, AWAY FROM ANY AREA WHERE

FIRE HAZARD MAY BE ACUTE. [National Fire Protection Association. Fire Protection Guide on Hazardous Materials. 9th ed. Boston, MA: National Fire Protection Association, 1986. 49-86] \*\*PEER REVIEWED\*\*

#### STORAGE CONDITIONS

It is stored in mild steel tanks equipped with breathing vents & chemical driers. It can be transferred through seamless black iron pipes, with gasketing materials of compressed asbestos, asbestos reinforced with metal, or asbestos impregnated with Teflon or Viton, employing centrifugal or positive displacement pumps of cast iron or steel construction. Small quantities ... may be stored safely in green or amber glass containers. [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984. 5(79) 759] \*\*PEER REVIEWED\*\*

#### STORAGE CONDITIONS

TEMPERATURE: AMBIENT. VENTING: PRESSURE-VACUUM. [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5. ] \*\*PEER REVIEWED\*\*

#### STORAGE CONDITIONS

PRECAUTIONS FOR CARCINOGENS: Storage site should be as close as practicable to lab in which carcinogens are to be used, so that only small quantities required for ... expt need to be carried. Carcinogens should be kept in only one section of cupboard, an explosion-proof

refrigerator or freezer (depending on chemico-physical properties ...) that bears appropriate label. An inventory ... should be kept, showing quantity of carcinogen & date it was acquired ... Facilities for dispensing ... should be contiguous to storage area. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 13] \*\*PEER REVIEWED\*\*

#### CLEANUP METHODS

1. VENTILATE AREA OF SPILL OR LEAK. 2. COLLECT FOR RECLAMATION OR ABSORB IN VERMICULITE, DRY SAND, EARTH, OR A SIMILAR MATERIAL.

[Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH) Publication No. 81-123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981. , p. 4] \*\*PEER REVIEWED\*\*

#### CLEANUP METHODS

PRECAUTIONS FOR CARCINOGENS: A high-efficiency particulate arrestor (HEPA) or charcoal filters can be used to minimize amt of carcinogen in exhausted air ventilated safety cabinets, lab hoods, glove boxes or animal rooms ... Filter housing that is designed so that used filters can be transferred into plastic bag without contaminating maintenance staff is avail commercially. Filters should be placed in plastic bags immediately after removal ... The plastic bag should be sealed immediately ... The sealed bag should be labelled properly ... Waste liquids ... should be placed or collected in proper containers for disposal. The lid should be secured & the bottles properly labelled. Once filled, bottles should be placed in plastic bag, so that outer surface ... is not contaminated ... The plastic bag should also be sealed & labelled. ... Broken glassware ... should be decontaminated by solvent extraction, by chemical destruction, or in specially designed incinerators. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 15] \*\*PEER REVIEWED\*\*

#### DISPOSAL METHODS

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. [CITATION ] \*\*PEER REVIEWED\*\*

#### DISPOSAL METHODS

TETRACHLOROETHYLENE MAY BE DISPOSED OF BY ABSORBING IT IN VERMICULITE,

DRY SAND, EARTH OR SIMILAR MATERIAL & DISPOSING IN A SECURED SANITARY

LANDFILL /SRP: MORE DESIRABLE METHODS OF DISPOSAL ARE AVAILABLE/

[Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.).

NIOSH/OSHA - Occupational Health Guidelines for Chemical Hazards.

DHHS(NIOSH) Publication No. 81-123 (3 VOLS). Washington, DC: U.S.

Government Printing Office, Jan. 1981. , p. 5] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

... Tower aeration is the most cost-effective technique for removing volatile organic chlorine chemicals from drinking water. /Volatile organic chlorine chemicals/ [Clark RM et al; J Environ Eng 110 (6): 1146-62 (1984)] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

PRECAUTIONS FOR CARCINOGENS: There is no universal method of disposal that has been proved satisfactory for all carcinogenic compounds & specific methods of chem destruction ... published have not been tested on all kinds of carcinogen-containing waste. ... summary of avail methods & recommendations ... /given/ must be treated as guide only. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 14] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

PRECAUTIONS FOR CARCINOGENS: Total destruction ... by incineration may be only feasible method for disposal of contaminated laboratory waste from biological expt. However, not all incinerators are suitable for this purpose. The most efficient type ... is probably the gas-fired type, in which a first-stage combustion with a less than stoichiometric air:fuel ratio is followed by a second stage with excess air. Some ... are designed to accept ... aqueous & organic-solvent solutions, otherwise it is necessary ... to absorb soln onto suitable combustible material, such as sawdust. Alternatively, chem destruction may be used, esp when small quantities ... are to be destroyed in laboratory. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 15] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

PRECAUTIONS FOR CARCINOGENS: HEPA (high-efficiency particulate

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arrestor) filters ... can be disposed of by incineration. For spent charcoal filters, the adsorbed material can be stripped off at high temp & carcinogenic wastes generated by this treatment conducted to & burned in an incinerator. ... LIQUID WASTE: ... Disposal should be carried out by incineration at temp that ... ensure complete combustion. SOLID WASTE: Carcasses of lab animals, cage litter & misc solid wastes ... should be disposed of by incineration at temp high enough to ensure destruction of chem carcinogens or their metabolites. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 15] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

PRECAUTIONS FOR CARCINOGENS: ... small quantities of ... some carcinogens can be destroyed using chem reactions ... but no general rules can be given. ... As a general technique ... treatment with sodium dichromate in strong sulfuric acid can be used. The time necessary for destruction ... is seldom known ... but 1-2 days is generally considered sufficient when freshly prepd reagent is used. ... Carcinogens that are easily oxidizable can be destroyed with milder oxidative agents, such as sat soln of potassium permanganate in acetone, which appears to be a suitable agent for destruction of hydrazines or of compounds containing isolated carbon-carbon double bonds. Concn or 50% aqueous sodium hypochlorite can also be used as an oxidizing agent. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E.Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 16] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

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

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Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 17] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

Chemical Treatability of Tetrachloroethylene; Concentration Process: Activated carbon; Chemical Classification: Halocarbon; Scale of Study: Laboratory scale; Type of Wastewater Used: Well water; Results of Study: Performance for treatment of water containing several halogens. Virgin: 5100 BV to 33 ppb compound leakage; 13.3 days; gal treated/cu ft sorbent, 38,250. Regenerated: 4000 BV to 33 ppb compound leakage; 10.4 days; gal treated/cu ft sorbent, 30.0; (column studies 14 mm diameter glass tubes, height 4 in (15 cu cm adsorbent) Flow-2 gpm/cu ft (16 BV/hr) regenerated at 37 lb steam/cu ft @ 5 psig). [USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-159 (1982)] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

Chemical Treatability of Tetrachloroethylene; Concentration Process: Resin Adsorption; Chemical Classification: Halocarbon; Scale of Study: Laboratory Scale; Type of Wastewater Used: Well Water; Comments: Column studies: 14 mm diameter glass tubes, height 4 in (15 cu cm adsorbent) Flow-2 gpm/cu ft (16 BV/hr) regenerated at 37 lb steam/cu ft @ 5 psig. [USEPA; Management of Hazardous Waste Leachate, EPA Contract No. 68-03-2766 p.E-192 (1982)] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

A potential candidate for liquid injection incineration at a temperature range of 650 to 1,600 deg C and a residence time of 0.1 to 2 seconds. A potential candidate for rotary kiln incineration at a temperature range of 820 to 1,600 deg C and residence times of seconds for liquids and gases, and hours for solids. A potential candidate for fluidized bed incineration at a temperature range of 450 to 980 deg C and residence times of seconds for liquids and gases, and longer for solids. [USEPA; Engineering Handbook for Hazardous Waste Incineration p.3-15 (1981) EPA 68-03-3025] \*\*PEER REVIEWED\*\*

DISPOSAL METHODS

Incineration, preferably after mixing with another combustible fuel. Care must be exercised to assure complete combustion to prevent the formation of phosgene. An acid scrubber is necessary to remove the halo acids produced. Alternatively, it may be recovered from waste gases and reused. Recommendable method: Incineration. Not recommendable method: Discharge to sewer. [United Nations. Treatment and Disposal Methods for Waste Chemicals (IRPTC File). Data Profile Series No. 5. Geneva, Switzerland: United Nations Environmental Programme, Dec. 1985. , p. 180] \*\*QC REVIEWED\*\*

**DISPOSAL METHODS**

Landfill: May be disposed of by adsorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill. [United Nations. Treatment and Disposal Methods for Waste Chemicals (IRPTC File). Data Profile Series No. 5. Geneva, Switzerland: United Nations Environmental Programme, Dec. 1985. , p. 180] \*\*QC REVIEWED\*\*

**TOXIC HAZARD RATING**

Classification of carcinogenicity: 1) Evidence in humans: inadequate; 2) evidence in animals: sufficient; Overall summary evaluation of carcinogenic risk to humans is group 2B: The agent is possibly carcinogenic to humans. /From table/ [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). S7 335 (1987)] \*\*PEER REVIEWED\*\*

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 THE FOLLOWING OVERVIEW IS A SUMMARY. CONSULT THE COMPLETE  
 POISINDEX (R)

DATABASE FOR TREATMENT PURPOSES. COPYRIGHT 1974-YEAR  
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Overview Title: TETRACHLOROETHYLENE

**EMERGENCY MEDICAL TREATMENT**

## o LIFE SUPPORT :

This overview assumes that basic life support measures  
 have been instituted.

## o CLINICAL EFFECTS :

**SUMMARY**

- o Acute tetrachloroethylene exposure can cause CNS depression, liver or kidney injury, and death from anesthetic effects. Overexposure can cause malaise, dizziness, fatigue, headache, lightheadedness, sweating, a staggering gait, inebriation, and mental dullness which most often clear rapidly when the victim is moved to fresh air. Workers rendered unconscious for hours have survived without sequelae.
- 1. A dry, scaly, and fissured dermatitis may occur with repeated direct skin contact. Dermal blistering may also occur. Exposure to high airborne concentrations

can cause irritation of the eyes and upper respiratory tract. Chronic inhalation exposure has been associated with the development of peripheral neuropathies.

2. Hepatic injury can occur following tetrachloroethylene exposure. Chronic occupational exposure has resulted in hepatitis, confusion, disorientation, muscle cramps, fatigue, and agitation. At high airborne concentrations, tetrachloroethylene can cause eye, nose and throat irritation, and nausea or other gastrointestinal upsets.
  - o In experimental animals, hepatic and renal injury and a lowering of the myocardial threshold to the arrhythmogenic action of epinephrine have been demonstrated.
  - o Tetrachloroethylene is carcinogenic in experimental animals, but epidemiologic evidence from studies of laundry and dry cleaning workers has been judged to be inadequate to assess the potential of this agent for human carcinogenicity.

#### HEENT

- o Eye, nose, and throat irritation may occur.

#### CARDIOVASCULAR

- o Cardiac arrhythmias may be seen.

#### RESPIRATORY

- o Upper respiratory tract irritation may occur.

#### NEUROLOGIC

- o CNS depression, coma, and peripheral neuropathies may develop.

#### GASTROINTESTINAL

- o Nausea and vomiting may be noted.

#### HEPATIC

- o Hepatotoxicity with elevated enzyme levels may be seen.

#### GENITOURINARY

- o Proteinuria, hematuria, and oliguric renal failure have occurred.

#### DERMATOLOGIC

- o Dermatitis, a burning sensation, and erythema may be seen.

#### ENDOCRINE

- o Effects on the adrenal glands have been reported.

#### PREGNANCY/BREAST MILK

- o Fetotoxicity and developmental abnormalities have been described in experimental animals only.

#### CARCINOGENICITY

- o Tetrachloroethylene is carcinogenic in experimental animals. Epidemiologic data suggest a possible increased incidence of liver and urinary tract tumors in humans, but data are inadequate.

#### OTHER

- o A vinyl chloride disease-like condition has been described.
- o Individuals with environmental exposure may have elevated tetrachloroethylene levels, but the significance is unclear.

#### GENOTOXICITY

- o Chromosome abnormalities were seen in lymphocytes from exposed workers.

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#### o LABORATORY :

- o Monitor liver and renal function tests and urinalysis in patients with significant exposure. Tetrachloroethylene may be radiopaque following ingestion.
- o Expired air tetrachloroethylene or urinary metabolite measurements may be useful for monitoring chronically exposed workers.

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#### o TREATMENT OVERVIEW :

#### SUMMARY

- o Move victims of inhalation exposure from the toxic environment and administer 100% humidified supplemental oxygen with assisted ventilation as required. Exposed skin and eyes should be copiously flushed with water. Following ingestion, measures to decrease absorption may be useful if the patient is seen soon after the exposure.
- 1. Rescuers must not enter areas with potential high airborne concentrations of this agent without **SELF-CONTAINED BREATHING APPARATUS (SCBA)** to avoid becoming secondary victims.

#### ORAL EXPOSURE

- o **EMESIS:** May be indicated in recent substantial ingestion unless the patient is or could rapidly become obtunded, comatose or convulsing. Is most effective if initiated within 30 minutes. (Dose of Ipecac Syrup: **ADULT:** 30 mL; **CHILD 1 to 12 years:** 15 mL).
- o **GASTRIC LAVAGE:** May be indicated if performed soon after ingestion, or in patients who are comatose or at

risk of convulsing. After control of any seizures present, perform gastric lavage. Protect airway by placement in Trendelenburg and left lateral decubitus position or by cuffed endotracheal intubation. Lavage return should approximate fluid given.

- o **ACTIVATED CHARCOAL/CATHARTIC:** Administer charcoal slurry, aqueous or mixed with saline cathartic or sorbitol. Usual charcoal dose: 30 to 100 g in adults and 15 to 30 g in children (1 to 2 g/kg in infants). Administer one dose of a cathartic, mixed with charcoal or given separately. See **ORAL/PARENTERAL EXPOSURE** section for doses.
- o Monitor level of consciousness, EKG, adequacy of respirations and oxygenation, and liver and renal function tests.
  1. Endotracheal intubation and ventilatory assistance with supplemental oxygen may be required if CNS and respiratory depression are present.
- o **PULMONARY EDEMA:** Maintain ventilation and oxygenation with close arterial blood gas monitoring. If PO<sub>2</sub> remains less than 50 mmHg, PEEP or CPAP may be necessary. Avoid net positive fluid balance; monitor through central line or Swan-Ganz catheter.
- o Epinephrine or other beta-adrenergic agents should be used only with caution and only when clearly indicated. Careful EKG monitoring for the possible induction of dysrhythmias should be done, and resuscitation medications and equipment should be readily available. Beginning therapy with the lowest effective doses of these agents is advisable.
- o Koppel et al (1985) have demonstrated that controlled hyperventilation enhanced pulmonary elimination of tetrachloroethylene in a child who had ingested 8 to 10 milliliters of this chemical.
  1. While there is little clinical experience with this treatment modality, it is physiologically attractive and most likely safe in patients requiring endotracheal intubation and mechanical ventilation for CNS and respiratory depression.

#### **INHALATION EXPOSURE**

- o **DECONTAMINATION:** Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. Administer 100 percent humidified supplemental oxygen with assisted

ventilation as required.

- o Monitor level of consciousness, EKG, adequacy of respirations and oxygenation, and liver and renal function tests.
- 1. Endotracheal intubation and ventilatory assistance with supplemental oxygen may be required if CNS and respiratory depression are present.
- o Respiratory tract irritation, if severe, can progress to pulmonary edema which may be delayed in onset up to 24 to 72 hours after exposure in some cases.
- o PULMONARY EDEMA: Maintain ventilation and oxygenation with close arterial blood gas monitoring. If PO<sub>2</sub> remains less than 50 mmHg, PEEP or CPAP may be necessary. Avoid net positive fluid balance; monitor through central line or Swan-Ganz catheter.
- o Epinephrine or other beta-adrenergic agents should be used only with caution and only when clearly indicated. Careful EKG monitoring for the possible induction of dysrhythmias should be done, and resuscitation medications and equipment should be readily available. Beginning therapy with the lowest effective doses of these agents is advisable.
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- 1. While there is little clinical experience with this treatment modality, it is physiologically attractive and most likely safe in patients requiring endotracheal intubation and mechanical ventilation for CNS and respiratory depression.

#### EYE EXPOSURE

- o DECONTAMINATION: Exposed eyes should be irrigated with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.

#### DERMAL EXPOSURE

- o DECONTAMINATION: Wash exposed area extremely thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.
- o Treat dermal irritation or burns with standard topical therapy. Patients developing dermal hypersensitivity reactions may require treatment with systemic or topical corticosteroids or antihistamines.

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 o RANGE OF TOXICITY :

- o Exposure to between 200 and 1500 ppm can cause irritant and CNS depressant effects. Chronic exposure to 60 to 450 ppm has caused CNS effects in workers. Ingestion of as much as 500 mg/kg has been survived.

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 o REFERENCE : [Rumack BH & Spoerke DG: POISINDEX(R) Information System. Micromedex Inc., Denver, CO, 1994; CCIS CD-ROM Volume 80, edition exp May, 1994. ] \*\*PEER REVIEWED\*\*

MEDICAL SURVEILLANCE

Periodical exam of the liver and kidneys. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. , p. 508] \*\*PEER REVIEWED\*\*

MEDICAL SURVEILLANCE

Exhaled air was analyzed for tetrachloroethene in teachers and 4-5 year old pupils of a kindergarten situated near a factory, and in residents of an old folks home situated near a former chemical waste dump. The tetrachloroethene concentrations were higher in the exhaled air of children living near the factory (mean 24 ug/cu m, n= 6) than in control children (mean 2.8 ug/cu m, n= 11). In the old folks home, the tetrachloroethene concentrations in the exhaled air of people living on the first floor were higher (mean 7.8 ug/cu m, n= 10) than in the exhaled air of the people living on the second floor and higher (mean 1.8 ug/cu m, n= 19). From the results of this study, it is clear that in environmental exposure to tetrachloroethene, biological monitoring of exhaled air is a simple, efficient, effective, and convenient method of assessing total ambient exposure of both young and aged subjects. [Monster AC, Smolders JF; Int Arch Occup Environ Health 53 (4): 331-6 (1984)] \*\*PEER REVIEWED\*\*

MEDICAL SURVEILLANCE

PRECAUTIONS FOR CARCINOGENS: ... in relation specifically to cancer hazards, there are at present no health monitoring methods that may ensure the early detection of preneoplastic lesions or lesions which may precede them. Whenever medical surveillance is indicated, in particular when exposure to a carcinogen has occurred, ad hoc decisions should be taken concerning additional tests that might become useful or mandatory. /Chemical Carcinogens/ [Montesano, R., H. Bartsch, E. Boyland, G. Della Porta, L. Fishbein, R. A. Griesemer, A.B. Swan, L. Tomatis, and W. Davis (eds.). Handling Chemical Carcinogens in the Laboratory: Problems of Safety. IARC Scientific Publications No. 33. Lyon, France: International Agency for Research on Cancer, 1979. , p. 23] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

Ingestion of a small amount of tetrachloroethylene is unlikely to cause permanent injury. [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984. 5(79) 761] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

... acute hepatic necrosis and oliguric uremia have followed human exposure. [Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984. II-165] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

/CNS depressant/ ... in high concentrations. Defatting action on skin can lead to dermatitis. [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. , p. 1315] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

Excessive exposure ... has resulted in effects on the central nervous system, mucous membranes, eyes, & skin, & to a lesser extent the lungs, liver, kidneys. The effects most frequently noted have been on the nervous system. Unconsciousness, dizziness, headache, vertigo or light ... /CNS depression/ have occurred in many instances after occupational exposures. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986. , p. 464] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

Perchloroethylene has been reported to produce effects on the liver in humans. The concn ... generally appeared to be in excess of 100 ppm. [American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values, 4th ed., 1980. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists, Inc., 1980. , p. 325] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

Several studies of the effects of prolonged exposure to perchloroethylene vapors on human volunteers are avail. ... Prolonged exposure to 200 ppm results in early signs of CNS depression, while there was no response in men or women repeatedly exposed to 100 ppm for 7 hr/day. Clinical chemical studies indicate no liver or kidney effects at these levels but massive exposure to concentrations causing unconsciousness have resulted in proteinuria & hematuria. [American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986. , p. 464] \*\*PEER REVIEWED\*\*

**HUMAN TOXICITY EXCERPTS**

A CASE OF CNS DEPRESSION & 2 CASES OF ACUTE OLIGURIC UREMIA AFTER

INHALATION OF PERCHLORETHYLENE VAPORS FROM NEWLY CLEANED CLOTHES IN A

SELF-SERVICE DRY-CLEANING MACHINE ARE REPORTED. [LARSEN NA ET AL; UGESKR LAEG 139 (5): 270-5 (1977)] \*\*PEER REVIEWED\*\*

HUMAN TOXICITY EXCERPTS

A PT IS REPORTED WHO HAD A CONNECTIVE TISSUE TYPE OF DISEASE CLINICALLY

SIMILAR TO VINYL CHLORIDE DISEASE, POSSIBLY CAUSED BY ABNORMAL SENSITIVITY TO PERCHLORETHYLENE TO WHICH HE WAS EXPOSED IN HIS OCCUPATION. [SPARROW GP; CLIN EXP DERMATOL 2 (1): 17-22 (1977)] \*\*PEER REVIEWED\*\*

HUMAN TOXICITY EXCERPTS

CHANGES IN NEUROLOGICAL NATURE OF WORKERS EXPOSED TO TETRACHLOROETHYLENE AT GREATER THAN MAC (MAXIMUM PERMISSIBLE CONCENTRATION) WERE RELATED TO DEFECTIVE ACTION OF LIVER & SUPRARENAL

GLAND CORTEX. INCR IN AMINOTRANSFERASE IN BLOOD SERUM & SLIGHT SHIFTS

IN PROTEINOGRAMS OBSERVED. [CHMIELEWSKI J ET AL; BULL INST MARIT TROP

MED GDYNIA 27 (2): 197-205 (1976)] \*\*PEER REVIEWED\*\*

HUMAN TOXICITY EXCERPTS

SIX WK OLD BREAST-FED INFANT HAD OBSTRUCTIVE JAUNDICE & HEPATOMEGALY.

TETRACHLOROETHYLENE WAS DETECTED IN MILK & BLOOD. AFTER DISCONTINUANCE

OF BREAST-FEEDING RAPID CLINICAL & BIOCHEM IMPROVEMENT WERE NOTED.

[BAGNELL PC, ELLENBERGER HA; CAN MED ASSOC J 117 (9): 1047-8 (1977)] \*\*PEER REVIEWED\*\*

HUMAN TOXICITY EXCERPTS

LYMPHOCYTES FROM 10 FACTORY WORKERS EXPOSED TO TETRACHLOROETHYLENE FOR

3 MO TO 18 YR SHOWED NO SIGNIFICANT DOSE-RELATED CHANGES IN CHROMOSOME

ABERRATIONS, SISTER CHROMATID EXCHANGE RATE, PROPORTION OF M2+M3

METAPHASES OR MITOTIC INDEX, COMPARED WITH CONTROLS. [IKEDA M ET AL;

TOXICOLOGY LETTERS 5: 251 (1980)] \*\*PEER REVIEWED\*\*

HUMAN TOXICITY EXCERPTS

A new form of substance abuse in adolescents is the inhalation of fumes from typewriter correction fluids (Liquid Paper, Wite-Out, Snopake, etc), which are composed of various chlorinated solvents, /including tetrachloroethylene/, to induce euphoria. Medical complications of such

abuse and medical management of acute toxic episodes are discussed herein, along with suggestions for controlling this substance abuse.

[Greer JE; South Med J 77 (3): 297-8 (1984)] \*\*PEER REVIEWED\*\*

#### HUMAN TOXICITY EXCERPTS

After ingestion of 12-16 g tetrachloroethylene, a 6 year old boy was admitted to the clinic in coma. In view of the high initial tetrachloroethylene blood level, hyperventilation therapy was performed. Under this therapeutic regimen, the clinical condition of the patient improved considerably. The tetrachloroethylene blood level profile which was determined under hyperventilation therapy could be computer fitted to a two compartment model. Elimination of tetrachloroethylene from the blood compartment occurred via a rapid and a slow process with half-lives of 30 min and 35 hours, respectively. These values compared favorably with the half-lives of 160 min and 33 hours under normal respiratory conditions. During hyperventilation therapy, the relative contribution to the fast elimination process increased from 70% for physiological minute volume to 99.9%. A minor fraction of the ingested dose was excreted with the urine (integral of 1% during the first 3 days). In contrast to previous results, trace amounts of unchanged tetrachloroethylene were detected in the urine besides trichloroacetic acid and trichloroethanol. [K'oppel C et al; J Toxicol Clin Toxicol 23 (2-3): 103-15 (1985)] \*\*PEER REVIEWED\*\*

#### HUMAN TOXICITY EXCERPTS

Pulmonary edema occurred in a laundry worker who was found unconscious after exposure to tetrachloroethylene vapor. ... Multiple premature ventricular contractions in otherwise healthy workers have been reported in occupational tetrachloroethylene exposures, but no direct link with sudden death has been made. Chronic exposure has not produced cardiovascular toxicity. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. 986-7] \*\*PEER REVIEWED\*\*

#### HUMAN TOXICITY EXCERPTS

A 68 year old launderette worker was anesthetised & suffered erythema & 30% superficial burns after spilling a container of tetrachloroethylene over his clothes. The defatting property of tetrachloroethylene would lead to cracking of damaged skin. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p. 107] \*\*PEER REVIEWED\*\*

#### HUMAN TOXICITY EXCERPTS

A 21 year old man who had been exposed to fumes of tetrachloroethylene developed acute pulmonary edema & became comatose. He received isoprenaline 800 ug in 1 l of dextrose injection iv, frusemide 40 mg, aminophylline 250 mg, & dexamethasone 10 mg iv. Oxygen was admin. After 6 hr, improvement was noted. No evidence of liver or kidney damage was seen. [Reynolds, J.E.F., Prasad, A.B. (eds.) Martindale-The Extra

Pharmacopoeia. 28th ed. London: The Pharmaceutical Press, 1982. , p.  
107] \*\*PEER REVIEWED\*\*

#### HUMAN TOXICITY EXCERPTS

... Residual organ damage is not commonly observed in humans who have been exposed to large quantities of the compound. Tetrachloroethylene was formerly used widely as an intestinal anthelmintic. ... Oral doses of 2.8 to 4.0 ml given for this purpose were quite effective & safe. Inebriation was the only troublesome side effect that was noted in 46,000 treated patients. Inhalation of tetrachloroethylene sufficient to produce inebriation & unconsciousness has failed to elicit hepatic, renal, or hematological abnormalities in some individuals. However, in other cases, mild to severe hepatotoxicity has been diagnosed. In most such instances, liver injury was not manifest until several days after exposure. Recovery was uneventful, but sometimes prolonged, particularly in the more severe cases. Tetrachloroethylene was quite slowly eliminated, in that approx 1 ppm tetrachloroethylene was measured in the breath of victims as long as 11 to 12 days after exposure. Little evidence of kidney injury or damage of any other organ was noted in any of the aforementioned cases. ... [National Research Council. Drinking Water and Health. Volume 3. Washington, DC: National Academy Press, 1980. , p. 136] \*\*PEER REVIEWED\*\*

#### NON-HUMAN TOXICITY EXCERPTS

UNCONSCIOUSNESS WAS OBSERVED IN RATS WITHIN FEW MIN @ CONCN OF 6000 PPM

OR MORE & AFTER SEVERAL HOURS AT 3000 PPM, BUT UNCONSCIOUSNESS WAS NOT

OBSERVED AT 2000 PPM. AT THESE HIGH-LEVEL SINGLE EXPOSURES, THE PREDOMINANT RESPONSE WAS ... DEPRESSION OF NERVOUS SYSTEM. THERE WERE

SLIGHT CHANGES IN LIVER, CHARACTERIZED BY SLIGHT INCR IN WT, SLIGHT INCR IN TOTAL LIPID, AND SLIGHT CLOUDY SWELLING. [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. , p. 3562] \*\*PEER REVIEWED\*\*

#### NON-HUMAN TOXICITY EXCERPTS

EXCESSIVE ABSORPTION OF DRUG WILL RESULT IN DIZZINESS AND INCOORDINATION ... AND EVEN DEATH. [Jones, L.M., et al. Veterinary Pharmacology & Therapeutics. 4th ed. Ames: Iowa State University Press, 1977. , p. 1034] \*\*PEER REVIEWED\*\*

#### NON-HUMAN TOXICITY EXCERPTS

IN HOST MEDIATED ASSAY IN MICE, USING SALMONELLA TYPHIMURIUM TA1950,

TA1951 AND TA1952, THERE WAS A SIGNIFICANT INCR IN NUMBER OF REVERTANTS

WITH DOSES EQUIV TO LD50 & HALF THE LD50, BUT THIS WAS NOT DOSE

RELATED. ... THERE WAS NO NO INDUCTION OF CHROMOSOMAL  
ABERRATIONS IN

BONE MARROW CELLS OF MICE THAT HAD RECEIVED EITHER SINGLE (HALF  
LD50)

OR 5 DAILY IP INJECTIONS (1/6 LD50) OF ... /TETRACHLOROETHYLENE/.

[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). V20  
503 (1979)] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

... pregnant mice and rats /were exposed/ to concn of 300 ppm. Both  
species were exposed for /periods of/ 7 hours daily, on days 6 through  
15 of gestation. No fetal toxicity or teratogenicity was detected.

[Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD:  
The Johns Hopkins University Press, 1986. , p. 547] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

... behavioral tests /were performed/ on the offspring of rats exposed  
to 100 ppm for 7 hr daily on days 14-20 of gestation ... no changes ...  
/were observed in/ the control pups. At exposure levels of 900 ppm the  
maternal animals gained less weight and the offspring performed less  
well on neuromotor tests and had lower levels of brain acetylcholine  
and dopamine. Pair fed controls were not used. [Shepard, T.H. Catalog  
of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins  
University Press, 1986. , p. 547] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

GROUPS OF 50 MALE & 50 FEMALE B6C3F1 MICE, APPROX 5 WK OLD ... WERE  
ADMIN TETRACHLOROETHYLENE IN CORN OIL BY GAVAGE ON 5

CONSECUTIVE

DAYS/WK FOR 78 WK. ... TIME-WEIGHTED AVG DOSES WERE 536 AND 1072

MG/KG

BODY WT/DAY IN MALES & 386 AND 772 MG/KG BODY WT/DAY IN FEMALES.

GROUPS

OF 20 MALE AND 20 FEMALE MICE WERE EITHER UNTREATED OR RECEIVED  
CORN

OIL ALONE. ... THE SHORTER LIFESPAN IN TREATED ANIMALS WAS DUE TO  
EARLY

TOXICITY & HIGH INCIDENCES OF HEPATOCELLULAR CARCINOMAS IN  
ANIMALS OF

BOTH SEXES ... [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). V20 497 (1979)] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

... ONLY A NEARLY LETHAL /ORAL/ DOSE (4 G/KG BODY WT) CAUSED  
SWELLING

OF THE CONVOLUTED /KIDNEY/ TUBULES AND HYDROPIIC DEGENERATION IN  
MALE

MICE ... IP DOSES OF 1.6-2.3 G/KG BODY WT ... CAUSED SLIGHT  
CALCIFICATION OF THE TUBULES OF THE KIDNEY IN DOGS ... [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). V20 502 (1979)]  
\*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

MALE RATS WERE EXPOSED FOR 4 HR TO VARIOUS CONCEN OF  
TETRACHLOROETHYLENE. THE ENZYMES SGOT, SGPT, AND OCT WERE  
MARKEDLY

ELEVATED AS A RESULT OF EXPOSURE. [DREW RT ET AL; TOXICOL APPL  
PHARMACOL 45 (3): 809-20 (1978)] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

Rats inhalation: No pathological effects @ 70 ppm, 8 hr/day, 5 days/wk,  
7 mo; Some pathological changes in liver and kidneys @ 230 ppm, 8  
hr/day, 5 days/wk, 7 mo. [Verschueren, K. Handbook of Environmental  
Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold  
Co., 1983. , p. 1080] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

/Tetrachloroethylene was not/ mutagenic ... in 2 strains of Salmonella  
typhimurium in the presence of a postmitochondrial mouse liver  
supernatant, following exposure to vapors ... [Bartsch H et al; Arch  
Toxicol 41 (4): 249-78 (1979)] \*\*PEER REVIEWED\*\*

NON-HUMAN TOXICITY EXCERPTS

The cardiac effects of tetrachloroethylene ... were studied in several  
species. To standardize the dosimetry, tetrachloroethylene was prepared  
for iv injection in soln of Tween 80, which had no demonstrable  
cardiotoxicity. In rabbits under urethane anesthesia and in cats and  
dogs under pentobarbital anesthesia, tetrachloroethylene increased the  
vulnerability of the ventricles to epinephrine induced extrasystoles,  
bigeminal rhythms, and tachycardia. The mean threshold doses of  
tetrachloroethylene were 10 mg/kg in rabbits, 24 mg/kg in cats, and 13  
mg/kg in dogs. In rabbits this threshold dose for cardiac arrhythmias  
corresponded to blood levels between 2.2 and 3.6 ug/ml. Animals  
demonstrating a reflex bradycardia to vasopressor doses of epinephrine  
were relatively resistant to the arrhythmogenic action of  
tetrachloroethylene. Ventricular arrhythmias occurred in less than 30%  
of the animals after tetrachloroethylene alone. In cats higher doses of  
tetrachloroethylene (40 mg/kg) produced acute pulmonary edema.  
Tetrachloroethylene (30-40 mg/kg) decreased left intraventricular dP/dt  
(max) in dogs, without significantly increasing left intraventricular  
end diastolic pressure, although there was a transient decrease in  
arterial blood pressure that accompanied the early phase of myocardial

depression. [Kobayashi S et al; J Toxicol Environ Health 10: 23-30 (1982)] \*\*PEER REVIEWED\*\*

#### NON-HUMAN TOXICITY EXCERPTS

A study was designed to determine the effects of tetrachloroethylene on the phyto- and zooplankton community at initial concentrations of 1.2 and 0.44 mg/l in separated compartments of an experimental pond. Measurements in the surrounding water were made simultaneously to detect possible effects of compartmentalization. Residues as low as 0.1 mg/l could be analyzed 5 days (low dose) and 38 days (high dose) post-application. In all applied biotopes, a lethal effect on the *Daphnia* population was detected. The phytoplankton community showed an increase of relative abundance and a decrease in species diversity. Studies of the frequency distribution of 6 selected phytoplankton species. (*Spirogyra* species, *Microcystis flos-aquae*, *Stichococcus bacillaris*, *Nitzschia acicularis*, *Chilomonas parameium*, *Actinophrys* species) demonstrated the total elimination of at least 4 species from the treated compartments. In spite of different dosing, only weak differences were found in toxic effects between the low and high dosed compartments. No significant chemically induced effect was observed on the physicochemical properties of the treated water. [Lay JP et al; Arch Environ Contam Toxicol 13 (2): 135-42 (1984)] \*\*PEER REVIEWED\*\*

#### NON-HUMAN TOXICITY EXCERPTS

Exptl momentary spraying of rabbits eyes with tetrachloroethylene from a pressurized fire extinguisher from a distance of 1 foot caused immediate pain & blepharospasm. The corneal epithelium became granular & optically irregular, & patches of epithelium were lost, but the eyes recovered completely within 2 days. [Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986. , p. 888] \*\*PEER REVIEWED\*\*

#### NON-HUMAN TOXICITY EXCERPTS

Results of the mutagenicity test using L5178Y mouse lymphoma cells were positive for tetrachlorethylene. [NTP; Fiscal Year 1987 Annual Plan p.82 (1987) NTP-87-001] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 *Poecilia reticulata* (guppy) 18 ppm/7 days /Conditions of bioassay not specified/ [Verschuere, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. , p. 1080] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 *Pimephales promelas* (fathead minnow) 18.4 mg/l/96 hr (flow-through bioassay) [Verschuere, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. , p. 1080] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 *Pimephales promelas* (fathead minnow) 21.4 mg/l/96 hr (static

bioassay) [Verschuere, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. , p. 1080] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 LEPOMIS MACROCHIRUS (BLUEGILL SUNFISH) 46 MG/L/24 HR AT 21-23

#### DEG

C (95% CONFIDENCE LIMIT 11-15 MG/L) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [BUCCAFUSCO RJ ET AL; BULL ENVIRONM CONTAM TOXICOL 26:

446

(1981)] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 LEPOMIS MACROCHIRUS (BLUEGILL SUNFISH) 13 MG/L/96 HR AT 21-23

#### DEG

C (95% CONFIDENCE LIMIT 11-15 MG/L) /CONDITIONS OF BIOASSAY NOT SPECIFIED/ [BUCCAFUSCO RJ ET AL; BULL ENVIRONM CONTAM TOXICOL 26:

446

(1981)] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 Daphnia magna (water flea) 18 mg/l/48 hr, static bioassay, at 22 deg C [Le Blanc GA; Bull Environ Contam Toxicol 24: 684-91 (1980) as cited in WHO; Environ Health Criteria: Tetrachloroethylene p.15 (1984)]

\*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 Salmo gairdneri (rainbow trout) 5 mg/l/96 hr, static bioassay at 12 deg C [Shubat PJ et al; Bull Environ Contam Toxicol 28: 7-10 (1982) as cited in WHO; Environ Health Criteria: Tetrachloroethylene p.24

(1984)] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 Limanda limanda (dab) 5 mg/l/96 hr, flow-through bioassay [Pearson CR, McConnell G; Proc R Soc Land B 189: 305-32 (1975) as cited in WHO; Environ Health Criteria: Tetrachloroethylene p.24 (1984)] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 Tanytarsus dissimilis (midge) 30, 840 ug/l/48 hr, static bioassay [USEPA; Task 11, Contract No 68-01-3887 (1980) as cited in USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.B-1 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### ECOTOXICITY VALUES

LC50 Lepomis macrochirus (bluegill sunfish) 12,900 ug/l/96 hr, static bioassay [USEPA; Contract No 68-01-4646 (1978) as cited in USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.B-2 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### IARC SUMMARY AND EVALUATION

Inadequate evidence of carcinogenicity 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). S7 72 (1987)] \*\*PEER REVIEWED\*\*

#### TSCA TEST SUBMISSIONS

The ability of tetrachloroethylene to induce morphological transformation in the BALB/3T3 mouse cell line (Cell Transformation assay) was evaluated. Based on preliminary toxicity test determinations (exposure time=3 days), tetrachloroethylene was tested at 0, 2, 10, 50 and 250 ug/ml, with cell survival ranging from 100% to 51% relative to untreated controls. None of the tested concentrations produced significantly greater transformation frequencies relative to untreated controls. [Arthur D. Little, Inc.; Cell Transformation Assays of 11 Chlorinated Hydrocarbon Analogs. (1983), EPA Document No. 40-8324457, Fiche No. OTS0509392 ] \*\*UNREVIEWED\*\*

#### TSCA TEST SUBMISSIONS

The mutagenicity of tetrachloroethylene was evaluated in Salmonella tester strains TA98, TA100, TA1535 and TA1537 (Ames Test), both in the presence and absence of added metabolic activation by Aroclor-induced rat liver S9 fraction. Tetrachloroethylene did not cause a positive response in any of the tester strains with or without added metabolic activation. Tetrachloroethylene was evaluated using a protocol in which the test article was usually tested over a minimum of 6 dose levels, the highest nontoxic dose level being 10 mg/plate unless solubility, mutagenicity or toxicity dictated a lower upper limit. [SRI International; Investigations of the Species Sensitivity and Mechanism of Carcinogenicity of Halogenated Hydrocarbons. (1984), EPA Document No. 40-8424225, Fiche No. OTS0509408 ] \*\*UNREVIEWED\*\*

#### TSCA TEST SUBMISSIONS

The ability of tetrachloroethylene to induce DNA repair in the hepatocyte primary culture (HPC) system was evaluated using hepatocytes from male B6C3F1 mice and Osborne-Mendel rats. In both the mouse and rat HPC/DNA repair assays, tetrachloroethylene was cytotoxic from 0.01% to 0.1% and was not genotoxic from 0.001% to 0.00001%. [Naylor Dana Institute; DNA Repair Tests of 11 Chlorinated Hydrocarbon Analogs, Final Report. (1983), EPA Document No. 40-8324292, Fiche No. OTS0509403] \*\*UNREVIEWED\*\*

#### POPULATIONS AT SPECIAL RISK

... individuals with diseases of the heart, liver, kidneys, and lung. [ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982. , p. 508] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

... READILY ABSORBED THROUGH THE LUNG AND TO A MUCH SMALLER DEGREE

THROUGH SKIN OR MUCOUS MEMBRANES OR FOLLOWING INGESTION. [Arena, J.M.

and Drew, R.H. (eds.) Poisoning-Toxicology, Symptoms, Treatments. 5th ed. Springfield, IL: Charles C. Thomas Publisher, 1986. , p. 257]

**\*\*PEER REVIEWED\*\***

**ABSORPTION, DISTRIBUTION AND EXCRETION**

**METABOLISM ... IS RELATIVELY SLOW WITH ONLY FEW PERCENT OF DOSE BEING**

**EXCRETED AS METABOLITES, MAJOR ONE BEING TRICHLOROACETIC ACID ...**

[Doull, J., C.D. Klaassen, and M. D. Amdur (eds.). Casarett and Doull's Toxicology. 2nd ed. New York: Macmillan Publishing Co., 1980. , p. 476]

**\*\*PEER REVIEWED\*\***

**ABSORPTION, DISTRIBUTION AND EXCRETION**

**(36)CL-TETRACHLOROETHYLENE FED TO RATS IS EXCRETED LARGELY UNCHANGED IN**

**EXPIRED AIR (98% OF DOSE IN 2 DAYS), AND IS METABOLIZED, TO ONLY SLIGHT**

**EXTENT, INTO TRICHLOROACETIC ACID (2%) WHICH IS EXCRETED IN URINE.**

[Parke, D. V. The Biochemistry of Foreign Compounds. Oxford: Pergamon Press, 1968. , p. 213] **\*\*PEER REVIEWED\*\***

**ABSORPTION, DISTRIBUTION AND EXCRETION**

Concn curves of perchloroethylene in blood and exhaled air after exposure showed that it was eliminated from the body at three different rates with corresponding half-life. [Monster AC, Houtkooper JM; Int Arch Occup Env Health 42: 319 (1979)] **\*\*PEER REVIEWED\*\***

**ABSORPTION, DISTRIBUTION AND EXCRETION**

Personal monitoring of exposure to tetrachloroethylene ... and analyses of urine for total trichloro-compounds were carried out in two groups of workers ... one group (20 males and 19 females) in dry-cleaning workshops and the other (16 males and 6 females) engaged in the removal of glue from silk cloth. Comparison of the urinary trichloro-compounds levels with tetrachloroethylene in the environment revealed that, while the metabolite levels increased essentially linear to tetrachloroethylene concn up to 100 ppm, leveling off was apparent in the metabolite excretion when the exposure to tetrachloroethylene was more intense (eg more than 100 ppm), indicating that the capacity of humans to metabolize tetrachloroethylene is rather limited. A tentative calculation ... indicated that, at the end of an 8 hr shift with exposure to tetrachloroethylene at 50 ppm (TWA), 38% of the tetrachloroethylene absorbed through the lung would be exhaled unchanged and less than 2% would be metabolized to be excreted into the urine, while the rest would remain in the body to be eliminated later.

[Ohtsuki T et al; Int Arch Occup Environ Health 51: 381-90 (1983)]

**\*\*PEER REVIEWED\*\***

**ABSORPTION, DISTRIBUTION AND EXCRETION**

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Tetrachloroethylene was still detectable in the breath of rats 16 hr after a single exposure to levels of 339-3390 mg/cu m for 1-40 hr. [WHO; Environ Health Criteria: Tetrachloroethylene p.21 (1984)] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Male Sprague-Dawley rats exposed to (14)C-tetrachloroethylene by either gavage (1.0 mg/kg) or inhalation (10 ppm, 10.4 mg/kg) excreted 70% of the dose unchanged in expired air. Approximately 3% was excreted as carbon dioxide, and approximately 23% was excreted in the urine and feces as nonvolatile metabolites. [NTP; Toxicology and Carcinogenesis Studies of Tetrachloroethylene p.19 Report #311 (1986) NIH Pub# 86-2567] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Once in the bloodstream, tetrachloroethylene tends to distribute to body fat. In human tissue at autopsy, ratios of fat to liver concentrations are greater than 6:1 [McConnell G et al; Endeavor 34: 13-8 (1975) as cited in USEPA; Health Advisories for 25 Organics: Tetrachloroethylene p.307 (1987) PB 87-235578] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

An autopsy after a fatal tetrachloroethylene exposure revealed an 8 times greater concn in brain compared with blood ... [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. , p. 986] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Tetrachloroethylene (PCE) is eliminated primarily via the lung. The respiratory half-life for PCE elimination has been estimated at 65 to 70 hours. [Stewart RD et al; Arch Environ Health 20: 224-9 (1970) as cited in USEPA; Health Advisories for 25 Organics: Tetrachloroethylene p.307 (1987) PB 87-235578] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Tetrachloroethylene reached near steady-state levels in blood of human volunteers with two hours of continuous exposure. [Stewart RD et al; Arch Environ Health 2: 516 (1961) as cited in USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.C-3 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Absorption of tetrachloroethylene (PCE) through the skin by immersing the thumbs of volunteers in PCE for 40 minutes and measuring the PCE in the exhaled air. High concentrations of PCE in exhaled breath (160 to 260 ug/cu m) were measurable five hours after exposure. [Stewart RD and Dodd HC; Am Ind Hug Assoc Jour 25: 439 (1964) as cited in [USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.C-4 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Tetrachloroethylene excretion in breast milk has been associated with obstructive jaundice in newborn infants. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. , p. 986] \*\*PEER REVIEWED\*\*

#### ABSORPTION, DISTRIBUTION AND EXCRETION

Nine unrelated groups (659 males) working in plastic boat, chemical, plastic button, paint, and shoe factories were studied. Urine samples were collected at the beginning of the workshift and at the end of the first half of the shift. A close relationship (correlation coefficient always above 0.85) between the average environmental solvent concentration (mg/cu m) measured in the breathing zone and the urinary concentration of unchanged solvent (ug/L) was observed. The authors recommended a biological equivalent exposure limit of 101 ug/L. biological exposure data for urine collected over 4 hr during random sampling for at least 1 yr could be used to evaluate long-term exposure and probability of non-compliance for individual or groups of workers. [Ghittori S et al; Am Ind Hyg Assoc J 48 (9): 786-90 (1987)] \*\*QC REVIEWED\*\*

#### METABOLISM/METABOLITES

METABOLITES: TRICHLOROACETIC ACID; TRICHLOROETHANOL; INORG CHLORIDE;

TRANS-1,2-DICHLOROETHYLENE IN EXPIRED AIR. /FROM TABLE/ [Sunshine, I. (ed.). CRC Handbook of Analytical Toxicology. Cleveland: The Chemical Rubber Co., 1969. , p. 381] \*\*PEER REVIEWED\*\*

#### METABOLISM/METABOLITES

IN TETRACHLOROETHYLENE EXPOSURE, URINARY METABOLITE LEVELS OF TRICHLOROETHANOL, TOTAL TRICHLORO COMPOUNDS, AND TRICHLOROACETIC ACID

INCREASED UNTIL THE ATMOSPHERIC CONCEN OF THE SOLVENT REACHED 50 TO 100

PPM; LITTLE INCR IN THESE METABOLITES OCCURRED AT HIGHER SOLVENT CONCEN.

[IKEDA M ET AL; BRIT J IND MED 29 (3): 328-33 (1972)] \*\*PEER REVIEWED\*\*

#### METABOLISM/METABOLITES

The relationship among dose, metabolism and hepatotoxicity in mice which resulted from subchronic exposure to the chlorinated solvents trichloroethylene and perchloroethylene were examined. Male Swiss-Cox mice received either trichloroethylene (0 to 3200 mg/kg/day) or perchloroethylene (0 to 2000 mg/kg/day) in corn oil by gavage for 6 weeks. Urinary metabolites from individual mice were quantified to estimate the extent to which each compound was metabolized. Four parameters of hepatotoxicity were assessed: liver weight, triglycerides, glucose-6-phosphatase activity, and serum glutamic-pyruvic transaminase (SGPT) activity. Trichloroethylene

significantly affected liver weight and glucose-6-phosphatase activity; perchloroethylene affected all four parameters. The metabolism of trichloroethylene was linearly related to dose through 1600 mg/kg, but then became saturated. The metabolism of perchloroethylene was saturable. The dose-effect curves of the affected hepatotoxicity parameters of both compounds were nonlinear and resembled the dose-metabolism graph of the corresponding solvent. Plots of the hepatotoxicity data of each compound against total urinary metabolites were linear in all cases, suggesting that the hepatotoxicity of both perchloroethylene and trichloroethylene in mice is directly related to the extent of their metabolism. This pattern is consistent with formation of the toxic intermediate in the primary metabolic pathway of each compound. [Buben JA, O'Flaherty EJ; Toxicol Appl Pharmacol 78 (1): 105-22 (1985)] \*\*PEER REVIEWED\*\*

#### BIOLOGICAL HALF-LIFE

The elimination of tetrachloroethylene in expired air ranged from 50 to 150 ppm (339 to 1,017 mg/cu m) for up to 8 hr. Biological half-life for fat stores was 71.5 hr. [Gruberan E, Fernandez J; Brit J Ind Med 31: 159 (1974)] \*\*PEER REVIEWED\*\*

#### BIOLOGICAL HALF-LIFE

The biological half-life of tetrachloroethylene metabolites (as measured as total trichloro-compounds) is 144 hours. [Ikeda M and Imamura T; Int Arch Arbeitsmed 31: 209 (1973) as cited in USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.C-4 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### BIOLOGICAL HALF-LIFE

Elimination is slow (biological half-life of 65 hours for exhaled perchloroethylene) because of continuing release of perchloroethylene from fat stores. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. , p. 986] \*\*PEER REVIEWED\*\*

#### MECHANISM OF ACTION

... /TETRACHLOROETHYLENE HAS BEEN/ SHOWN ... TO RELEASE LYSOSOMAL ENZYMES FROM GRANULAR FRACTIONS PREPARED FROM NEMATODES.

SINCE GUT OF

NEMATODES SEEMS TO BE SPECIALIZED FOR LYSOSOMAL INTRACELLULAR DIGESTION

OF NUTRIENTS, INTERFERENCE WITH THIS PROCESS MAY WELL EXPLAIN ACTION OF

TETRACHLOROETHYLENE ... IT HAS BEEN ASSUMED THAT AFFECTED WORMS ARE

PARALYZED SUFFICIENTLY TO RELEASE THEIR ATTACHMENT TO INTESTINAL WALL

... [Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. ,

p. 1031] \*\*PEER REVIEWED\*\*

#### INTERACTIONS

/When formerly used/ ... alcohol must be avoided before and for 24 hours after use of tetrachloroethylene. ... No laxative should be given, since this increases the toxic effects and decreases the effectiveness of the drug. [American Medical Association, Department of Drugs. Drug Evaluations. 6th ed. Chicago, Ill: American Medical Association, 1986. , p. 1612] \*\*PEER REVIEWED\*\*

#### INTERACTIONS

Intubation of rats with mixtures of benzene and tetrachloroethylene yielded a combined toxicity which was only slightly less than additive. Mixtures of toluene with tetrachloroethylene resulted in LD50 values of less than than predicted for simple additivity, indicating synergistic effects. [USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.C-17 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### THERAPEUTIC USES

VET: After the advent of phenothiazine ... little use has been made of the chlorinated hydrocarbons ... /as a ruminant anthelmintic/.

Tetrachloroethylene has continued to be used in small animals over the years but has been largely replaced by drugs that are less toxic & easier to admin. [Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982. , p. 839] \*\*PEER REVIEWED\*\*

#### THERAPEUTIC USES

... /IT/ IS USEFUL ONLY AGAINST HOOKWORM INFESTATIONS IN MAN.

#### TREATMENT

WITH THIS AGENT IS MORE EFFECTIVE AGAINST NECATOR AMERICANUS THAN

AGAINST ANCYLOSTOMA DUODENALE ... /FORMER USE/ [Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. , p. 1032] \*\*PEER REVIEWED\*\*

#### THERAPEUTIC USES

... SINGLE DOSE /ORAL/ OF 0.12 ML/KG ... MAX OF 5 ML. ... DIET BEFORE ADMIN ... SHOULD BE LOW IN FAT & PT SHOULD EAT ONLY LIGHT MEAL PREVIOUS

EVENING. NEXT MORNING ... /DRUG/ INGESTED ON EMPTY STOMACH ... SINGLE

TREATMENT ... GENERALLY REMOVE ... WORMS, BUT TWO OR MORE TREATMENTS @

4-DAY INTERVALS ... TO CLEAR INFESTATION. /FORMER USE/ [Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. , p. 1031] \*\*PEER REVIEWED\*\*

#### THERAPEUTIC USES

TETRACHLOROETHYLENE, USP ... AVAILABLE IN SOFT GELATIN CAPSULES CONTAINING 0.2, 1.0, OR 2.5 ML OF DRUG. IT MAY BE DIFFICULT TO OBTAIN DRUG IN CAPSULE FORM FOR HUMAN USE. /FORMER USE/ [Goodman, L.S., and

A.

Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975. , p. 1031] \*\*PEER REVIEWED\*\*

DRUG WARNINGS

VET: AT ONE TIME IT WAS USED FAIRLY EXTENSIVELY AGAINST GI PARASITES OF RUMINANTS. ITS DISADVANTAGE IN RUMINANTS IS NECESSITY OF STIMULATING CLOSURE OF ESOPHAGEAL GROOVE SO THAT MEDICATION IS DELIVERED DIRECTLY

TO ABOMASUM RATHER THAN PASSING INTO RUMEN WHICH ... REDUCES EFFECTIVENESS OF DRUG. ... NO FOOD OR WATER SHOULD BE ALLOWED FOR 12-18

HR BEFORE & FOR 4 HR AFTER DOSING. ... /IT/ IS CONTRAINDICATED IN TAPEWORM-INFECTED ANIMALS SINCE IRRITATION OF THESE WORMS MAY RESULT IN

THEIR BALLING UP & OCCLUDING DIGESTIVE PASSAGE. IT IS ... CONTRAINDICATED IN ANIMALS WITH DISTEMPER ... & SHOULD NOT BE ADMIN TO

NURSING ANIMALS OR THOSE WEIGHING LESS THAN 2 LB (APPROX 1 KG). [Booth,

N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982. , p. 839] \*\*PEER REVIEWED\*\*

DRUG WARNINGS

VET: RESTRICT DIETARY FAT WITHIN 2 DAYS BEFORE AND AFTER USE TO AVOID

ENHANCED ABSORPTION OF THIS FAT SOL LIVER TOXICANT. CONTRAINDICATED IN

FEBRILE DISEASES OR IN DEBILITATED ANIMALS. STRONG MUCOSAL IRRITANT.

BREAKING CAPSULES IN MOUTH HAS PRODUCED ATAXIA, CONVULSIONS, AND

ANESTHESIA. [Rossoff, I.S. Handbook of Veterinary Drugs. New York: Springer Publishing Company, 1974. , p. 587] \*\*PEER REVIEWED\*\*

DRUG WARNINGS

Food and Environmental Agents: Effect on Breast-Feeding: Tetrachloroethylene-cleaning fluid (perchloroethylene): Obstructive jaundice, dark urine. /from Table 7/ [Report of the American Academy of Pediatrics Committee on Drugs in Pediatrics 93 (1): 142 (1994)] \*\*QC REVIEWED\*\*

## ENVIRONMENTAL FATE/EXPOSURE SUMMARY

Tetrachloroethylene (PCE) is likely to enter the environment by fugitive air emissions from dry cleaning and metal degreasing industries and by spills or accidental releases to air, soil, or water. If PCE is released to soil, it will be subject to evaporation into the atmosphere and to leaching to the groundwater. Biodegradation may be an important process in anaerobic soils based on laboratory tests with methanogenic columns. Slow biodegradation may occur in groundwater where acclimated populations of microorganisms exist. If PCE is released to water, it will be subject to rapid volatilization with estimated half-lives ranging from <1 day to several weeks. It will not be expected to significantly biodegrade, bioconcentrate in aquatic organisms or significantly adsorb to sediment. PCE will not be expected to significantly hydrolyze in soil or water under normal environmental conditions. If PCE is released to the atmosphere, it will exist mainly in the gas-phase and it will be subject to photooxidation with estimates of degradation time scales ranging from an approximate half-life of 2 months to complete degradation in an hour. Some of the PCE in the atmosphere may be subject to washout in rain based on the solubility of PCE in water; PCE has been detected in rain. Major human exposure is from inhalation of contaminated urban air, especially near point sources such as dry cleaners, drinking contaminated water from contaminated aquifers and drinking water distributed in pipelines with vinyl liners, and inhalation of contaminated occupational atmospheres in metal degreasing and dry cleaning industries. (SRC) [CITATION ]  
**\*\*PEER REVIEWED\*\***

## NATURAL OCCURRING SOURCES

Tetrachloroethylene is not known to occur in nature. (SRC) [CITATION ]  
**\*\*PEER REVIEWED\*\***

## ARTIFICIAL SOURCES

Water pollution by tetrachloroethylene leaching from vinyl liners in asbestos-cement water pipelines for water distribution. [Yuskus LR; J Am Water Works Assoc 76 (2): 76-81 (1984)] **\*\*PEER REVIEWED\*\***

## ARTIFICIAL SOURCES

Vaporization losses from dry cleaning and industrial metal cleaning(1). Wastewater, particularly from metal finishing, laundries, aluminum forming, organic chemical/plastics manufacturing and municipal treatment plants. It is also estimated that emissions account for approximately 90% of the tetrachloroethylene produced in the United States(2). [(1) Chemical Marketing Reporter. Chemical Profile March 14, 1983 (1983) (2) Singh HB et al; Atmospheric Distributions, Sources and Sinks of Selected Halocarbons, Hydrocarbons, SF6 and N2O; p.34 EPA-600/3-79-107 (1979)] **\*\*PEER REVIEWED\*\***

## ARTIFICIAL SOURCES

During chlorination water treatment, it can be formed in small

quantities. [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977. , p. 769] \*\*PEER REVIEWED\*\*

#### ENVIRONMENTAL FATE

**TERRESTRIAL FATE:** If tetrachloroethylene (PCE) is released to soil, it will evaporate fairly rapidly into the atmosphere due to its high vapor pressure and low adsorption to soil. It can leach rapidly through sandy soil and therefore may reach groundwater(1-3). Biodegradation may be an important process in anaerobic soils based on laboratory tests with methanogenic columns. Slow biodegradation may occur in groundwater where acclimated populations of microorganisms exist. There is some evidence of slow degradation in subsurface soils from a groundwater recharge project. PCE should not hydrolyze under normal environmental conditions. (SRC) [(1) Wilson JT et al; J Environ Qual 10: 501-6 (1981) (2) Tomson MB et al; Water Res 15: 1109-16 (1981) (3) Schwarzenbach RP et al; Environ Sci Technol 17: 472-9 (1983)] \*\*PEER REVIEWED\*\*

#### ENVIRONMENTAL FATE

**AQUATIC FATE:** If tetrachloroethylene (PCE) is released in water, the primary loss will be by evaporation. The half-life for evaporation from water will depend on wind and mixing conditions and is estimated to range from 3 hours to 14 days in rivers, lakes and ponds. Chemical and biological degradation are expected to be very slow. PCE will not be expected to significantly bioconcentrate in aquatic organisms or to adsorb to sediment. A mesocosm experiment was conducted to simulate Narraganset Bay during different seasons. Volatilization was the major removal process during all seasons and seasonal differences can be explained by hydrodynamics and the measured half-lives were 25 days in spring, 11 days in winter and 14 days in summer(4). In one experiment in which half-lives were calculated from concentration reduction between sampling points on the Rhine River and a lake in the Rhine basin, half-lives were 10 days and 32 days, respectively(1). In a seawater aquarium, an 8 day half-life was demonstrated to be predominately the result of evaporation(2). In a natural pond, PCE disappeared in 5 and 36 days at low (25 ppm) and high (250 ppm) dose levels, respectively(3). [(1) Zoeteman BCJ et al; Chemosphere 9: 231-49 (1980) (2) Jensen S, Rosenberg R; Water Res 9: 659-61 (1975) (3) Lay JP et al; Arch Environ Contam Toxicol 13: 135-42 (1984) (4) Wakeham SG et al; Environ Sci Technol 17: 611-7 (1983)] \*\*PEER REVIEWED\*\*

#### ENVIRONMENTAL FATE

**ATMOSPHERIC FATE:** If tetrachloroethylene (PCE) is released to the atmosphere, it will be expected to exist in the vapor phase(5) based on a reported vapor pressure of 18.47 mm Hg at 25 deg C(4). Vapor phase PCE will be expected to degrade by reaction with photochemically produced hydroxyl radicals or chlorine atoms produced by photooxidation of PCE. Estimated photooxidation time scales range from an approximate

half-life of 2 months(1,2) to complete degradation in an hour(3). Some of the PCE in the atmosphere may be subject to washout in rain based on the solubility of PCE in water (150 ppm(4)); PCE has been detected in rain. [(1) Singh HB et al; Atmos Environ 15: 601-12 (1981) (2) Howard CJ; J Chem Phys 65: 4771-7 (1976) (3) Dimitriades B et al; J Air Pollut Control Assoc 33: 575-87 (1983) (4) Riddick JA et al.; Organic Solvents: Physical Properties and Methods of Purification. Techniques of Chemistry. 4th ed. Wiley-Interscience pp. 1325 (1986) (5) Eisenreich SJ et al; Environ Sci Technol 15: 30-8 (1981)] \*\*PEER REVIEWED\*\*

#### BIODEGRADATION

Tetrachloroethylene (PCE) can be transformed by reductive dehalogenation to trichloroethylene (TCE), dichloroethylene and vinyl chloride (VC) under anaerobic conditions. In addition, (14)C-PCE was at least partially mineralized to carbon dioxide. Mineralization of 24% of the PCE occurred in a continuous flow mixed film methanogenic column with a liquid detection time of 4 days. TCE was the major intermediate formed, but traces of dichloroethylene isomers and VC were also found. In other column studies under a different set of methanogenic conditions, nearly quantitative conversion of PCE to VC was found. TCE and VC are major intermediates in PCE biotransformation under anaerobic conditions and the potential exists for the complete mineralization of PCE to CO<sub>2</sub> in soil and aquifer systems and in biological treatment processes. [Vogel TM, McCarty PL; Appl Environ Microbiol 49 (5): 1080-3 (1985)] \*\*PEER REVIEWED\*\*

#### BIODEGRADATION

No degradation occurred in 21 days in 3 biodegradability tests with acclimated or unacclimated inocula or in a river die-away test(4). Microbial degradation did not contribute to the removal of tetrachloroethylene (PCE) in a mesocosm experiment which simulated Narraganset Bay, RI(5). Under aerobic conditions there is no degradation in 25 weeks in a batch experiment with a sewage inoculum(1) or when low concentrations of PCE (16 ug/l) were circulated through an acclimated aerobic biofilm column over a period of 1 year(2). While only 3.75% of the PCE treated by conventional, extended and 2-stage activated-sludge pilot plants appeared in the effluent, most of the PCE was discharged to the air from the extended aeration(3). [(1) Bouwer EJ et al; Environ Sci Technol 15: 596-9 (1981) (2) Bouwer EJ, McCarty PL; Environ Sci Technol 16: 836-43 (1982) (3) Watanabe H; Gesuido Kyokaiski 20: 29-37 (1983) (4) Mudder TI; Amer Chem Soc Div Env Chem Conf p. 52-3 (1982) (5) Wakeham SG; Environ Sci Technol 17: 611-7 (1983)] \*\*PEER REVIEWED\*\*

#### BIODEGRADATION

There is evidence that slow biodegradation of tetrachloroethylene (PCE) occurs under anaerobic conditions when the microorganisms have been acclimated, yielding trichloroethylene (TCE) as a product(1,2). An

experiment in a continuous-flow laboratory methanogenic column using well acclimated mixed culture and a 2-day detention time had an average PCE removal rate of 76%(3). In a continuous-flow mixed-film methanogenic column with a liquid detention time of 4 days, mineralization of 24% of the PCE present occurred; TCE was the major intermediate formed(72%), but traces of dichloroethylene isomers and VC were also found(4). In other column studies under a different set of methanogenic conditions, nearly quantitative conversion of PCE to VC was found in 10 days(4). Removal of 86% PCE occurred in a methanogenic biofilm column (8 weeks of activation followed by 9-12 weeks of acclimation(5)). [(1) Bouwer EJ, McCarty PL; Appl Environ Microbiol 45: 1286-94 (1983) (2) Wilson JT et al; Devel Indust Microbiol 24: 225-33 (1983) (3) Bouwer EJ, McCarty PL; Ground Water 22: 433-40 (1984) (4) Vogel TM, McCarty PL; Appl Environ Microbiol 49: 1080-3 (1985) (5) Bouwer EJ, Wright JP; Am Chem Soc Div Environ Chem. 191st Natl Meet 26: 42-5 (1986)] \*\*PEER REVIEWED\*\*

#### BIODEGRADATION

A large reduction of tetrachloroethylene which had been recirculated through a soil column for 14 days was attributed to adsorption and volatilization(2). In a microcosm containing muck from an aquifer recharge basin, 72.8% loss was observed in 21 days against 12-17% in controls, and the metabolites trichloroethylene, cis- and trans-1,2-dichloroethylene, dichloromethane, and chloroethene were identified(3). However, when subsurface samples were aseptically removed from above and below the water table and incubated in the laboratory, no degradation occurred in 16 weeks(4). In one field groundwater recharge project, degradation was observed in the 50 day recharge period(1). [(1) Bouwer EJ et al; Environ Sci Technol 15: 596-99 (1981) (2) Bouwer EJ et al; Water Res 15: 151-59 (1981) (3) Parsons F et al; J Amer Wat Works Assoc 76: 56-9 (1984) (4) Wilson JT et al; Ground Water 21: 134-42 (1983)] \*\*PEER REVIEWED\*\*

#### ABIOTIC DEGRADATION

Tetrachloroethylene can be transformed by reductive dehalogenation to trichloroethylene under anaerobic conditions. [Vogel TM, McCarty PL; Appl Environ Microbiol 49 (5): 1080-3 (1985)] \*\*PEER REVIEWED\*\*

#### ABIOTIC DEGRADATION

Tetrachloroethylene (PCE) reacts with hydroxyl radicals which are produced by sunlight in the troposphere with an estimated half-life of about 2 months or a loss of 1.5% per sunlit day(1,2). Photooxidation in pure air with simulated tropospheric light is much faster than that predicted from the reaction with hydroxyl radicals with complete degradation occurring in 7 days in 1 report(3) and from 0.5% to 100% loss per hour in another(4). The rate of loss is very sensitive to radiation in the 280-330 nm region and increases with increasing PCE concentration, the presence of nitrogen oxides has little effect on the

rate of loss(4), and the main reaction product is phosgene (70-85%) with smaller amounts of carbon tetrachloride (8%), dichloroacetyl chloride, and trichloroacetyl chloride(3). The proposed mechanism involved the molecular reaction with chlorine radicals produced by photooxidation of PCE(4). [(1) Singh HB et al; Atmos Environ 15: 601-12 (1981) (2) Howard CJ; J Chem Phys 65: 4771-7 (1976) (3) Singh HB et al; Environ Lett 10: 253-6 (1975) (4) Dimitriades B et al; J Air Pollut Control Assoc 33: 575-87 (1983)] \*\*PEER REVIEWED\*\*

#### ABIOTIC DEGRADATION

Photodegradation in the stratosphere is rapid(1). Some photodegradation occurs when tetrachloroethylene (PCE) in air-saturated water is exposed to sunlight. In one year, 75% degradation occurred whereas 59-65% degradation was noted for dark controls(2). When PCE adsorbed to silica gel is irradiated through a pyrex filter, 50-90% is lost in 6 days(3). It is not clear whether PCE adsorbed on particulate matter will photodegrade as readily(SRC). Hydrolysis is not a significant degradative process (half-life 9 months at 25 deg C in purified, de-ionized water)(2). [(1) Mueller JPH Korte F; Chemosphere 3: 195-8 (1977) (2) Dilling WL et al; Environ Sci Technol 9: 833-8 (1975) (3) Gaeb S et al; Nature 270: 331-3 (1977)] \*\*PEER REVIEWED\*\*

#### BIOCONCENTRATION

BCF: fathead minnow (*Pimephales promelas*), 38.9(1); bluegill sunfish (*Lepomis macrochirus*) 49(2). Based on a reported log Kow of 3.40(4), a BCF of 226 was estimated(3, SRC). Based on the reported and estimated BCF's, tetrachloroethylene will not be expected to significantly bioconcentrate in aquatic organisms(SRC). [(1) Neely WB et al; Environ Sci Technol 8: 1113-15 (1974) (2) Barrows ME et al; Dyn., Exposure Hazard Assess. Toxic Chem. Ann Arbor MI: Ann Arbor Sci. p. 379-92 (1980) (3) Lyman WJ et al; Handbook of Chem Property Estimation Methods NY: McGraw-Hill p. 5-5 (1982) (4) Hansch C, Leo AJ; Medchem Project Issue No. 26 Claremont, CA: Pomona College (1985)] \*\*PEER REVIEWED\*\*

#### SOIL ADSORPTION/MOBILITY

... Tetrachloroethylene ... /was/ ... slightly adsorbed on ... sand and clay minerals. ... The Henry's adsorption coefficients were approx in proportion to the organic content of the soil samples. [Urano K, Murata C; Chemosphere 14 (3-4): 292-9 (1985)] \*\*PEER REVIEWED\*\*

#### SOIL ADSORPTION/MOBILITY

Koc: 209(1); 210(2). In a laboratory system simulating a rapid-infiltration site, tetrachloroethylene (PCE) appeared in the effluent but at significantly reduced concentration levels(3,7) although in a bank-infiltration system in Switzerland and The Netherlands, PCE was rapidly transported to groundwater(4,5). It is estimated that in a bay such as Narraganset Bay, RI, only about 0.01% of PCE is adsorbed to particulate matter(6). [(1) Schwarzenbach RP, Westall J; Environ Sci Technol 15: 1360-67 (1981) (2) Chiou CT et al;

Science 206: 831-2 (1979) (3) Hutchins SR, Ward CH; J Hydrol (Amsterdam) 67: 223-33 (1984) (4) Gegir W et al; Ges, Wasser, Abwasser 63: 517-31 (1983) (5) Piet GJ et al; Studies Env Sci 17: 557-64 (1981) (6) Wakeham SG et al; Environ Sci Technol 17: 611-7 (1983) (7) Hutchins SR et al; Environ Toxicol Chem 2: 195-216 (1983)] \*\*PEER REVIEWED\*\*

#### SOIL ADSORPTION/MOBILITY

A Koc of 238 was calculated(2, SRC) based on a reported Kom of 137.7 in a peaty soil(1). Based on a reported log Kow of 3.40(3), a Koc of 1,685 was estimated(2, SRC). Based on the reported and estimated Koc's, tetrachloroethylene will be expected to exhibit low to medium mobility in soil(4) and therefore may leach slowly to the groundwater(SRC). [(1) Friesel P et al; Fresenius Z Anal Chem 319: 160-4 (1984) (2) Lyman WJ et al; Handbook of Chem Property Estimation Methods NY: McGraw-Hill p. 4-2 to 4-9 (1982) (3) Hansch C, Leo AJ; Medchem Project Issue No.26 Claremont, CA: Pomona College (1985) (4) Swann RL et al; Res Rev 85: 17-28 (1983)] \*\*PEER REVIEWED\*\*

#### VOLATILIZATION FROM WATER/SOIL

Tetrachloroethylene will evaporate rapidly from water based on estimates of half-life for the evaporation from water which range from fractions of an hour to several hours in laboratory experiments(1-4). Two values of the ratio of the volatilization rate constant relative to the reaeration rate of oxygen are 0.52(4) and 0.61(5). Using representative oxygen reaeration rates for various bodies of water, the half-lives for evaporation are as follows: pond 5-12 days; river 3 hr-7 days; lake 3.6-14 days(4, SRC): Measured volatilization half-lives in a mesocosm simulating Narraganset Bay, RI were 11 days in winter, 25 days in spring, and 14 days in summer(6). [(1) Dilling WL; Environ Sci Technol 11: 405-9 (1977) (2) Chiou CT et al; Environ Inter 3: 231-6 (1980) (3) Smith JH et al; Environ Sci Technol 14: 1332-7 (1980) (4) Lyman WL et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 15-35 (1981) (5) Roberts PV, Dandliker PG; Environ Sci Technol 17: 484-9 (1983) (6) Wakeham SG; Environ Sci Technol 17: 611-7 (1983)] \*\*PEER REVIEWED\*\*

#### VOLATILIZATION FROM WATER/SOIL

Due to its high vapor pressure (18.47 mm Hg at 25 deg C(1)) and low adsorption to soil, volatilization of tetrachloroethylene from dry soil should be rapid(SRC). [(1) Riddick JA et al; Organic Solvents: Physical Properties and Methods of Purification. 4th. Wiley-Interscience pp. 1325 (1986)] \*\*PEER REVIEWED\*\*

#### WATER CONCENTRATIONS

Samples for analysis of volatile organic compounds were collected from 315 wells in the Potomac-Raritan-Magothy aquifer system in southwestern New Jersey and a small adjacent area in Pennsylvania (USA) during 1980-1982. Volatile organic compounds were detected in all 3 aquifer units of the Potomac-Raritan-Magothy aquifer system. Most of the

contamination appeared to be confined to the outcrop area. Low levels of contamination were found downdip of the outcrop area in the upper and middle aquifer. Trichloroethylene, tetrachloroethylene and benzene were the most frequently detected compounds. Differences in the distributions of light chlorinated hydrocarbons, /(including tetrachloroethylene)/, trichloroethylene, and aromatic hydrocarbons, ie, benzene, were noted and were probably due to differences in the uses of the compounds and the distribution patterns of potential contamination sources. The distribution patterns of volatile organic compounds differed greatly among the 3 aquifer units. The upper aquifer, which cropped out mostly in less-developed areas, had the lowest percentage of wells with volatile organic compounds detected (10% of wells sampled). The concentrations in most wells in the upper aquifer which had detectable levels were <10 ug/l. In the middle aquifer, which cropped out beneath much of the urban and industrial area adjacent to the Delaware River, detectable levels of volatile organic compounds were found in 22% of wells sampled, and several wells contained concentrations >100 ug/l. The lower aquifer, which was confined beneath much of the outcrop area of the aquifer system, had the highest percentage of wells (28%) with detectable levels. This was probably due to vertical leakage of contamination from the middle aquifer and the high percentage of wells tapping the lower aquifer in the most heavily developed areas of the outcrop. [Fusillo TV et al; Ground Water 23 (3): 354-60 (1985)] \*\*PEER REVIEWED\*\*

#### WATER CONCENTRATIONS

The National Health Department (Italy) had promoted and supported a preliminary survey on the presence of some chlorinated organic compounds in the drinking water. The drinking water of some cities of northern Italy was analyzed for the presence of trichloroethylene, tetrachloroethylene, methylchloroform, carbon tetrachloride, trihalomethanes, polychlorinated biphenyls, and the most common chlorinated pesticides. From March, 1981 to June, 1982, 8 controls were done for 11 sampling points. All water underwent different treatments with carbon. In the raw water, trichloroethylene (47/48) and tetrachloroethylene (34/48) showed the highest frequency of positivity. One well had the highest concentrations of these compounds (trichloroethylene 81-158 ug/l; tetrachloroethylene 15-32 ug/l). In the finished waters, carbon trichloride the most abundant trihalomethane formed during chlorination, was detected in 80% of the 39 samples, against 31% in the 48 raw water samples. No polychlorinated biphenyls and chlorinated pesticides were found at the chosen detection limit (0.05 ug/l). [Ziglio G et al; Ig Mod 82 (3): 419-35 (1984)] \*\*PEER REVIEWED\*\*

#### WATER CONCENTRATIONS

DRINKING WATER: 180 USA cities with finished surface water - 0.3 ppb

median, 21 ppb max; 36 US cities with finished groundwater - 3.0 ppb median; roughly 25% of the samples were positive(1). Contaminated wells had much higher concentrations (a maximum of 1.5 ppm)(2,3). 30 Canadian potable water treatment facilities (treated water) 1 ppb avg, 2 ppb max(4); 230 Groundwater public drinking water sources in the Netherlands: 64 are >10 ppb, 12 are >100 ppb, 4 are >1 ppm and 2 are >100 ppm(5). Federal survey of finished waters in USA:

Tetrachloroethylene occurred in 26.1% of groundwater supplies, max concentrate in groundwater and surface water supplies 1500 and 21 ppb, respectively(6). [(1) Coniglio WA et al; Occurrence of Volatile Organics in Drinking Water. p. 7 Unpublished EPA report (1980) (2) Burmaster DE; Environ 24: 6-13, 33-6 (1982) (3) Giger W, Molnar-Kubica E; Bull Environ Contam Toxicol 19: 475-80 (1978) (4) Otson R et al; J Assoc Off Anal Chem 65: 1370-4 (1982) (5) Trouwborst T; Sci Total Environ 21: 41-6 (1981) (6) Dyksen JE, Hess AF III; J Amer Water Works Assoc 74: 394-403 (1982)] \*\*PEER REVIEWED\*\*

#### WATER CONCENTRATIONS

DRINKING WATER: Maximum concentration in tapwater from bank filtered Rhine water in the Netherlands 50 parts per trillion(1). Old Love Canal, Niagara Falls, NY (9 homes) 350-2900 parts per trillion, 470 parts per trillion median(2). USA surveys: State data, 1569 samples, 14% pos, trace to 3000 ppb, National Organics Monitoring Survey (NOMS, initiated in 1975), 113 samples, 42.4% pos, 0.2-3.1 ppb, National Screening Program (NSP, 1977-1981), 142 samples, 16.9% pos, trace to 3.2 ppb, Community Water Supply Survey (CWSS, 1978), 452 samples, 4.9% pos, 0.5-30 ppb, Ground Water Supply Survey (GWS, 1982, finished drinking water), 466 samples selected at random from 1000 in survey, 7.3% pos, 0.5 ppb median, 23 ppb max(3). [(1) Piet GJ, Morra CF; pp. 31-42 in Artificial Groundwater recharge; Huismon L, Olsthorn TN eds; Pitman Pub (1983) (2) Barkley J et al; Biomed Mass Spectrum 7: 139-47 (1980) (3) Cotruvo JA et al; pp. 511-30 in: Organic Carcinogens in Drinking Water (1986)] \*\*PEER REVIEWED\*\*

#### WATER CONCENTRATIONS

GROUNDWATER: 27 USA cities, 0.6 ppb median (range 0.1-2 ppb)(1) San Fernando Valley, CA (1981-1983) - 17 of 106 wells exceeded 4 ppb, max 130 ppb(2). 10 British groundwaters: Equal or <2 ppb in 8 waters and higher levels at 2 sites where the aquifer was grossly polluted(3). Groundwater underlying 2 rapid infiltration sites 0.07 and 0.63 ppb(4). Japan, national groundwater survey, 1982, 1,083 shallow wells (most for domestic uses other than drinking water in private homes), 27% pos, 0.2-23,000 ppb, 277 deep wells (public, industrial, and commercial supplies), 30% pos, 0.2-150 ppb(5). [(1) Coniglio WA et al; Occurrence of Volatile Organics in Drinking Water. p. 7 Unpublished EPA report (1980) (2) Chemical Engineering 90: 35 (1983) (3) Fielding M et al; Environ Technol Lett 2: 545-50 (1981) (4) Hutchins SR et al; Environ

Toxicol Chem 2: 195-216 (1983) (5) Magara Y, Furuichi T; pp. 231-43 in:  
New Concepts and Development in Toxicol. Chambers PL et al eds.  
Elsevier Sci Publ (1986)] **\*\*PEER REVIEWED\*\***

#### WATER CONCENTRATIONS

**SURFACE WATER:** 154 USA cities - 2.0 ppb median, 13.6% positive(1). Ohio R (1980-81, 11 stations, 4972 samples) - 49% positive, 340 basins in USA (204 sites)-77 sites above 1 ppb, 1 site above 11 ppb(2). Lake Ontario (95 stations) 9 parts per trillion mean standard deviation 65 parts per trillion(3). Rhine R, km 865 (1976-1982) 0.12-0.62 ppb with lower concentrations after 1978(4). Surface of Lake Zurich - 25-140 parts per trillion, greater concentrations below the surface(5,6).  
**STORET Database,** 9,323 data points, 38.0% pos, 0.100 ppb median(7).  
[(1) Coniglio WA et al; Occurrence of Volatile Organics in Drinking Water. p. 7 Unpublished EPA report (1980) (2) Ewing BB et al; Monitoring to Detect Previously Unrecognized Pollutants in Surface Water. EPA-560/6-77-015 & EPA-560/6-77-015A (1977) (3) Kaiser KLE et al; J Great Lakes Res 9: 212-23 (1983) (4) Malle KG; Z Wasser Abwasser Forsch 17: 75-81 (1984) (5) Grob K, Grob G; J Chrom 90: 303-13 (1974) (6) Schwarzenbach RP et al; Environ Sci Technol 13: 1367-73 (1979) (7) Staples CA et al; Environ Toxicol Chem 4: 131-42 (1985)] **\*\*PEER REVIEWED\*\***

#### WATER CONCENTRATIONS

**SEAWATER:** 0.1 to 0.8 parts per trillion(1,2). May be several orders of magnitude higher (10 ppb) near source, but concentration diminishes rapidly away from source(3). Gulf of Mexico (open and coastal) 0-40 parts per trillion where there is anthropogenic influence and <1 parts per trillion in unpolluted areas(4). Surface seawater Eastern Pacific Ocean 1981 (0-10 m depth), 30 samples, 90% pos, range of pos, 0.1-2.8 parts per trillion, avg of all data, 0.7 parts per trillion(5). [(1) Murray AJ, Riley JP; Nature 242: 37-8 (1973) (2) Pearson CR, McConnell G; Proc Roy Soc London Ser B 189: 305-32 (1975) (3) Helz GR, Hsu RY; Limnol Oceanogr 23: 858-69 (1978) (4) Sauer TC Jr; Org Geochem 3: 91-101 (1981) (5) Singh HB et al; J Geophys Res 88: 3675-83 (1983)] **\*\*PEER REVIEWED\*\***

#### WATER CONCENTRATIONS

**RAIN/SNOW:** West Los Angeles (3/26/82) - 21 parts per trillion(2). Industrial city in England - 150 parts per trillion(1). La Jolla, California - 5.7 parts per trillion(3). Central and Southern California - 1.4 and 2.3 parts per trillion resp(3). [(1) Pearson CR, McConnell G; Proc Roy Soc London Ser B 189: 305-32 (1975) (2) Kawamura K, Kaplan IR; Environ Sci Technol 17: 497-501 (1983) (3) Su C, Goldberg ED; Mar Poll Transfer 1976: 353-74 (1976)] **\*\*PEER REVIEWED\*\***

#### EFFLUENTS CONCENTRATIONS

Industrial 1-20 ppb; Municipal treatment plants 1-10 ppb(1); Baltimore Municipal Treatment Plant 8-129 ppb (higher levels in winter)(2).

Industries in which mean or maximum levels in raw wastewater exceeded 1 ppm are (number of samples, percent pos, mean, max, ppm): raw wastewater: auto and other laundries (28 samples, 71.4% pos, <8.4 ppm mean, 93 ppm max), aluminum forming (4, 100%, <2.6, <4.0), metal finishing (96, 42.7%, 4.5, 110), organic chemical/plastics manufacturing (number of samples not reported, 19 pos, 5.1 mean, max concn not reported), and paint and ink formulation (36, 55.6%, 0.95, 4.9); treated wastewater: auto and other laundries (5 samples, 80% pos, 0.58 ppm mean, 1.0 ppm max), aluminum forming (16, 87.5%, <0.24, 3.0), metal finishing (not reported), organic chemical/plastics manufacturing (number of samples not reported, 14 pos, 0.047 mean, max concn not reported), and paint and ink formulation (24, 33.3%, 0.19, 0.70)(3). Industrial effluent, STORET Database, 1,390 data points, 10.1% pos, 5.0 ppb median(4). [(1) STORET Data Base (2) Helz GR, Hsu RY; Limnol Oceanogr 23: 858-69 (1978) (3) US EPA; Treatability Manual. p.I.12.26-1 to I.12.26-5 USEPA-600/2-82-001A (1981) (4) Staples CA et al; Environ Toxicol Chem 4: 131-42 (1985)] \*\*PEER REVIEWED\*\*

#### SEDIMENT/SOIL CONCENTRATIONS

SEDIMENT: Liverpool Bay/172 stations - 4.8 parts per trillion avg(1). STORET Database, 359 data points, 7% pos, <0.050 ppb median(2). [(1) Pearson CR, McConnell G; Proc Roy Soc London Ser B 189: 305-32 (1975) (2) Staples CA et al; Environ Toxicol Chem 4: 131-42 (1985)] \*\*PEER REVIEWED\*\*

#### ATMOSPHERIC CONCENTRATIONS

U.S. 577 sites, 1 ug/cu m median(5). BACKGROUND: Northern hemisphere background - 40 parts per trillion(3). RURAL/REMOTE: Barrows Alaska - 128 parts per trillion max (Feb), 56 parts per trillion min (Sept)(2). US - remote sites - typical levels 20-130 parts per trillion(1,2,3). Northern and Southern Atlantic, 7 sites, 85.7% pos, 84 samples, range of means of pos, 0.05-0.27 parts per trillion(6). Norwegian arctic air, 9 samples, July 1982, 0.0184 ppb avg, Spring 1983, 0.0382 ppb avg(7). URBAN/SUBURBAN: Seven U.S. cities, 1980-1981 range of means, 0.290-0.590 ppb, 7.60 ppb max, background, 0.050 ppb; 3 cities in NJ, 1981, 6 weeks in summer, range of means, 0.240-0.450(4). [(1) Lillian D et al; Amer Chem Soc Symp Ser 17: 152-8 (1975) (2) Khalil MAK, Rasmussen RA; Environ Sci Technol 17: 157-64 (1983) (3) Singh HB et al; Atmospheric Distributions, Sources and Sinks of Selected Halocarbons, Hydrocarbons, SF6 and N20. EPA-600/3-79-107 p. 88,117-8 (1979) (4) Andelman JB; Environ Health Persp 62: 313-8 (1985) (5) Eichler DL, Mackey JH; Proc APCA 79th Ann Meeting pp. 17 (1986) (6) Class T, Ballschmiter K; Chemosphere 15: 413-27 (1986) (7) Hov O et al; Geophys Res Lett 11: 425-8 (1984)] \*\*PEER REVIEWED\*\*

#### ATMOSPHERIC CONCENTRATIONS

Avg worldwide distribution in 1978 (parts per trillion): Northern Hemisphere, 56.0, Southern Hemisphere, 14.0, Global, 35.0(8).

URBAN/INDUSTRIAL: USA- Urban/Industrial Areas - typical levels 0.3-1.5 ppb but reaches 10 ppb and even higher(1-5). INDUSTRIAL/SOURCE DOMINATED: Old Love Canal, Niagara, NY - Ambient air outside and inside 9 homes, 109 and 71 parts per trillion median(6). Classroom and playground in school situated near facility, 1.9 and 0.15 ppb, respectively(7). Nursing home situated near former chemical waste dump, 1.2 and 0.2 ppb on first and second floors, respectively(7). [(1) Lillian D et al; Amer Chem Soc Symp Ser 17: 152-8 (1975) (2) Pellizzari ED; Quantation of Chlorinated Hydrocarbons in Previously Collected Air Samples. EPA-450/3-78-112 (1978) (3) Singh HB et al; Environ Sci Technol 16: 872-80 (1982) (4) Su C, Goldberg ED; Mar. Pollut Transfer pp. 353-74 (1976) (5) Leoy PJ et al; Atmos Environ 17: 2321-30 (1983) (6) Barkley J et al; Biomed Mass Spectron 7: 139-47 (1980) (7) Monster AC, Smolders JFJ; Int Arch Occup Environ Health 53: 331-6 (1984) (8) Herbert P et al; Chem Ind 24: 861-9 (1986)] \*\*PEER REVIEWED\*\*

#### FOOD SURVEY VALUES

Chinese style sauce, 2 ppb; Quince jelly, 2.2 ppb; Crab apple jelly, 2.5 ppb; Grape jelly, 1.6 ppb; Chocolate sauce, 3.6 ppb. Not detected in seven market basket composites of meats (detection limit = 4.6 ppb), oils and fats (detection limit = 13 ppb), beverages (detection limit = 0.5 ppb) or dairy products (detection limit = 2.3 ppb)(1). Various categories of food in England - 0.01-13 ppb, highest values in fats and oils(2). USA, wheat, 10 samples, 20% pos, 1.8-2.1 ppb, corn, 2 samples, 100% pos, 0.45-0.54 ppb; not detected in one sample each of oats and corn grits, 2 samples of corn meal(3). [(1) Entz RC, Hollifield HC; J Agric Food Chem 30: 84-8 (1982) (2) McConnell G et al; Endeavour 34: 13-18 (1975) (3) Heikes DL, Hopper ML; J Assoc Off Anal Chem 69: 990-8 (1986)] \*\*PEER REVIEWED\*\*

#### FOOD SURVEY VALUES

Tetrachloroethylene concentrations in foods ranged from non-detectable amounts (<0.01 ug/kg) in orange juice to 13 ug/kg in English butter. [McConnell G et al; Endeavour 34: 13 as cited in USEPA; Ambient Water Quality Criteria Doc: Tetrachloroethylene p.C-1 (1980) EPA 440/5-80-073] \*\*PEER REVIEWED\*\*

#### PLANT CONCENTRATIONS

13-23 ppb in marine algae(1). [(1) Pearson CR, McConnell G; Proc Roy Soc London Ser B 189: 305-22 (1975)] \*\*PEER REVIEWED\*\*

#### FISH/SEAFOOD CONCENTRATIONS

0.3-43 ppb in marine fish, 0.5-176 ppb in marine invertebrates in England(1), 250 ppb in American eel (Delaware River), 1050 ppb in American eel (Newark Bay), 77 ppb in carp (Delaware River), 108 ppb in striped bass (Raritan River), 88 ppb in spot fish (Houston Ship Channel)(2). Rhine River from Strassburg to Lake Constance - a small number of fish 25-100 ppb, a few exceeded 100 ppb(3). [(1) Pearson CR, McConnell G; Proc Roy Soc London Ser B 189: 305-32 (1975) (2) Dickson

AG, Riley JP; Mar Pollut Bull 7: 167-9 (1976) (3) Binnemann PH et al; A Lebensm - Unters Forsch 176: 253-61 (1983)] \*\*PEER REVIEWED\*\*

#### ANIMAL CONCENTRATIONS

0.6-19 ppb in grey seal blubber (NE Coast of England); 1.4-39 ppb in marine and freshwater birds (coast of England)(1). [(1) Pearson CR, McConnell G; Proc Roy Soc London Ser B 189: 305-32 (1975)] \*\*PEER REVIEWED\*\*

#### MILK CONCENTRATIONS

Not detected (detection limit = 2.3 ppb) in seven market basket composites of dairy products(1). Has been detected in 7 of 8 samples in mother's milk from 4 urban areas in the USA(2). One hour after a visit to a dry cleaning plant, one sample of mother's milk contained 10 ppm tetrachloroethylene. This decreased to 3 ppm after 24 hr(3). [(1) Entz RC et al; J Agric Food Chem 30: 846-9 (1982) (2) Pellizzari ED et al; Bull Environ Contam Toxicol 28: 322-8 (1982) (3) Jensen AA; Res Rev 89: 1-128 (1983)] \*\*PEER REVIEWED\*\*

#### PROBABLE ROUTES OF HUMAN EXPOSURE

Human exposure to tetrachloroethylene will occur through inhalation of contaminated ambient air and ingestion of contaminated drinking water (especially from polluted groundwater sources). Occupationally, exposure will occur from inhalation of contaminated air (especially in urban/industrial areas, in and around metal degreasing and dry cleaning industries). Food does not appear to be a major source, but the data are poor. (SRC) [CITATION ] \*\*PEER REVIEWED\*\*

#### AVERAGE DAILY INTAKE

AIR INTAKE (assume 0.3-1.5 ppb(1-5)) 41-207 ug; WATER INTAKE (assume 0.3-3 ppb(6)) 0.6-6 ug; FOOD INTAKE - insufficient data(SRC). [(1) Lillian D et al; Amer Chem Soc Symp Ser 17: 152-8 (1975) (2) Pellizzari ED; Quantation of Chlorinated Hydrocarbons in Previously Collected Air Samples. EPA-450/3-78-112 (1978) (3) Singh HB et al; Environ Sci Technol 16: 872-80 (1982) (4) Su C, Goldberg ED; Mar. Pollut Transfer pp. 353-74 (1976) (5) Leoy PJ et al; Atmos Environ 17: 2321-30 (1983) (6) Coniglio WA et al; Occurrence of Volatile Organics in Drinking Water. p. 7 Unpublished EPA report (1980)] \*\*PEER REVIEWED\*\*

#### PROBABLE EXPOSURES

Time-weighted average (8-hour) exposures to PCE in the dry cleaning industry are reported as high as 178 ppm in air(1). NIOSH (NOES Survey 1981-1983) has statistically estimated that 129,494 workers are exposed to tetrachloroethylene (PCE) in the USA(2). NIOSH (NOHS Survey 1972-1974) has statistically estimated that 1,597,072 workers are exposed to PCE in the USA(3). [(1) NIOSH; Criteria for Recommended Standard. Occupational Exposure to Tetrachloroethylene. NIOSH Pub No 76-185 (1976) (2) NIOSH; The National Occupational Exposure Survey (NOES) (1983) (3) NIOSH; The National Occupational Hazard Survey (NOHS) (1974)] \*\*PEER REVIEWED\*\*

**PROBABLE EXPOSURES**

Currently at risk of exposure are more than 500,000 workers, primarily in the dry cleaning & textile industries, which use more than 2/3 of the domestically produced tetrachloroethylene. [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. , p. 986] **\*\*PEER REVIEWED\*\***

**BODY BURDENS**

Has been detected in 7 of 8 samples in mother's milk from 4 urban areas in the US(1). One hour after a visit to a dry cleaning plant, one sample of mother's milk contained 10 ppm tetrachloroethylene. This decreased to 3 ppm after 24 hr(2). Old Love Canal, NY - 9 individuals: Human breath 600-4500 ng/cu m; Blood 0.35-260 ng/ml; Urine 120-690 ng/ml(3). Human body fat (8 subjects) 0.4-29.2 ppb; Various human organs less than 6 ng/g(4). Alveolar air geometric mean in 136 residents living near 12 dry-cleaning stores were: Living equal to or <5 floors above the stores 5 mg/cu m, adjacent houses 1 mg/cu m, one house away 0.2 mg/cu m, across street <.1 mg/cu m, whereas the mean concentration in 18 workers was 73 mg/cu m(5). [(1) Pellizzari ED et al; Bull Environ Contam Toxicol 28: 322-8 (1982) (2) Jensen AA; Res Rev 89: 1-128 (1983) (3) Barkley J et al; Biomed Mass Spectrom 7: 139-47 (1980) (4) McConnell G et al; Endeavour 34: 13-8 (1975) (5) Verberk MM, Scheffers TML; Environ Res 21: 432-7 (1980)] **\*\*PEER REVIEWED\*\***

**BODY BURDENS**

Whole blood, USA survey of 250 (121 males, 129 females), 0.7-23 ppb, 2.4 ppb avg(1). Breath samples (ug/cu m, weighted statistics), Elizabeth and Bayonne, NJ, 1981, 295-339 samples, 93% pos, 280 max, 13.0 avg, 6.8 median(2). Alveolar air in children and teachers in school situated near factory were 24 ug/cu m avg for children and 11 and 47 ug/cu m for the teachers(3). The mean concentration of tetrachloroethylene in the classroom was 13 ug/cu m(3). Alveolar air of residents of a nursing home situated near a former chemical waste dump averaged 7.8 ug/cu m first floor and 1.8 ug/cu m on the second floor, where ambient concentrations averaged 8.2 and 1.6 ug/cu m, respectively(3). USA FY82 National Human Adipose Tissue Survey specimens, 46 composites, 61% pos (>3 ppb, wet tissue concn), 94 ppb max(4). [(1) Antoine SR et al; Bull Environ Contam Toxicol 36: 364-71 (1986) (2) Wallace L et al; J Occup Med 28: 603-7 (1986) (3) Monster AC, Smolders JFJ; Int Arch Environ Health 53: 331-6 (1984) (4) Stanley JS; Broad Scan Analysis of the FY82 National Human Adipose Tissue Survey Specimens Vol. I Executive Summary p. 5 USEPA-560/5-86-035 (1986)] **\*\*PEER REVIEWED\*\***

**IMMEDIATELY DANGEROUS TO LIFE OR HEALTH**

NIOSH has recommended that tetrachloroethylene be treated as a potential human carcinogen. [NIOSH. NIOSH Pocket Guide to Chemical

Hazards. DHHS(NIOSH) Publication No. 90-117. Washington, DC: U.S. Government Printing Office, June 1990 , p. 208] \*\*QC REVIEWED\*\*

#### ACCEPTABLE DAILY INTAKES

Suggested No-Adverse-Response Level (SNARL): In light of the lack of definitive information regarding the quantity of TCE that must be ingested to depress psychophysiological function, it seems appropriate that calculations for a SNARL be based upon quantities of the chemical that are required to produce tissue injury. ... the 0.3 ml/kg (0.49 g/kg) dose appears to be a reasonable minimum toxic dose from which to calculate a 24-hr SNARL for contamination of drinking water, assuming that the sole source of TCE during this period will be from 2 l/day of drinking water consumed by a 70 kg human. A safety factor of 100 is applied: 490 mg/kg times 70 kg/100 times 2 l= 172 mg/l. The above considerations ignore the possibility that TCE may be carcinogenic. ... a 7-day standard for drinking water contamination, which was obtained by dividing the 24-hr standard by 7 (172 mg/l/7 days= 24.5 mg/l), should protect against adverse effects by the chemical. [National Research Council. Drinking Water and Health. Volume 3. Washington, DC: National Academy Press, 1980. , p. 140] \*\*PEER REVIEWED\*\*

#### OSHA STANDARDS

Meets criteria for OSHA medical records rule. [29 CFR 1910.20 (7/1/87)] \*\*PEER REVIEWED\*\*

#### OSHA STANDARDS

During an 8 hr work shift, an employee may be exposed to a concentration of tetrachloroethylene above 200 ppm (but never above 300 ppm) only for a maximum period of 5 minutes in any 3 hours. Such exposure must be compensated by exposures to concentrations less than 100 ppm so that the cumulative exposure for the entire 8 hr work shift does not exceed a weighted average of 100 ppm. [29 CFR 1910.1000 (7/1/87)] \*\*PEER REVIEWED\*\*

#### NIOSH RECOMMENDATIONS

NIOSH recommends that tetrachloroethylene be treated as a potential human carcinogen. [NIOSH/CDC. NIOSH Recommendations for Occupational Safety and Health Standards Sept. 1986. (Supplement to Morbidity and Mortality Weekly Report 35 No. 15, Sept. 26, 1986) 30S] \*\*PEER REVIEWED\*\*

#### THRESHOLD LIMIT VALUES

8 hr Time Weighted Avg (TWA) 25 ppm, 170 mg/cu m; Short Term Exposure Limit (STEL) 100 ppm, 685 mg/cu m (1993) [American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1993-1994. Cincinnati, OH: ACGIH, 1993. , p. 28] \*\*QC REVIEWED\*\*

#### THRESHOLD LIMIT VALUES

BEI (Biological Exposure Index): Perchloroethylene in end-exhaled air

prior to the last shift of workweek is 10 ppm. (1989-90 adoption)  
 [American Conference of Governmental Industrial Hygienists. Threshold  
 Limit Values for Chemical Substances and Physical Agents and Biological  
 Exposure Indices for 1993-1994. Cincinnati, OH: ACGIH, 1993. , p. 59]  
 \*\*QC REVIEWED\*\*

#### THRESHOLD LIMIT VALUES

BEI (Biological Exposure Index): Perchloroethylene in blood prior to  
 the last shift of workweek is 1 mg/l. (1989-90 adoption) [American  
 Conference of Governmental Industrial Hygienists. Threshold Limit  
 Values for Chemical Substances and Physical Agents and Biological  
 Exposure Indices for 1993-1994. Cincinnati, OH: ACGIH, 1993. , p. 59]  
 \*\*QC REVIEWED\*\*

#### THRESHOLD LIMIT VALUES

BEI (Biological Exposure Index): Trichloroacetic acid in urine at end  
 of workweek is 7 mg/l. The determinant is nonspecific, since it is  
 observed after exposure to some other chemicals. These nonspecific  
 tests are preferred because they are easy to use and usually offer a  
 better correlation with exposure than specific tests. In such  
 instances, a BEI for a specific, less quantitative biological  
 determinant is recommended as a confirmatory test. The biological  
 determinant is an indicator of exposure to the chemical, but the  
 quantitative interpretation of the measurements is ambiguous. (1989-90  
 adoption) [American Conference of Governmental Industrial Hygienists.  
 Threshold Limit Values for Chemical Substances and Physical Agents and  
 Biological Exposure Indices for 1993-1994. Cincinnati, OH: ACGIH, 1993.  
 , p. 59] \*\*QC REVIEWED\*\*

#### THRESHOLD LIMIT VALUES

A3. A3= Animal carcinogen. [American Conference of Governmental  
 Industrial Hygienists. Threshold Limit Values for Chemical Substances  
 and Physical Agents and Biological Exposure Indices for 1993-1994.  
 Cincinnati, OH: ACGIH, 1993. , p. 59] \*\*QC REVIEWED\*\*

#### OTHER OCCUPATIONAL PERMISSIBLE LEVELS

Maximum allowable concentrations range from 10 mg/cu m (1.5 ppm,  
 ceiling value) in the USSR, 140 mg/cu m (20 ppm, TWA) in Sweden, and  
 250 mg/cu m (37 ppm) in Czechoslovakia to 340 mg/cu m (50 ppm) in the  
 Federal Republic of Germany, Japan. Short-term exposure limits range  
 from 340 mg/cu m (50 ppm) in Sweden to 1250 mg/cu m (183 ppm) in  
 Czechoslovakia and 1340 mg/cu m (200 ppm) in the USA. The acceptable  
 limit in Brazil is 525 mg/cu m (78 ppm) for 48 hr per week. [WHO;  
 Environ Health Criteria: Tetrachloroethylene p.35 (1984)] \*\*PEER  
 REVIEWED\*\*

#### OTHER OCCUPATIONAL PERMISSIBLE LEVELS

Maximum allowable concentrations are 1.0 mg/cu m average per day or 4.0  
 mg/cu m average per 0.5 hr in Czechoslovakia and 0.06 mg/cu m average  
 per day in the USSR. [WHO; Environ Health Criteria: Tetrachloroethylene

p.35 (1984)] **\*\*PEER REVIEWED\*\***

#### ATMOSPHERIC STANDARDS

National Emission Standards for Hazardous Air Pollutants (NESHAP) for source categories: Perchloroethylene Dry Cleaning Facilities. /Final rule dealing with/ the applicability, definitions, and record keeping and reporting requirements for the NESHAP for perchloroethylene drycleaning facilities. Ammendments in 58 FR 66287 (12/20/93) /indicate the following/: ... extends the time for reporting information to EPA; and deleting the requirement of having reports submitted to EPA certified before a notary public. [58 FR 49354 (10/22/93)] **\*\*QC REVIEWED\*\***

#### FEDERAL DRINKING WATER STANDARDS

EPA 5 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER STANDARDS

(CA) CALIFORNIA 5 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER STANDARDS

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

#### STATE DRINKING WATER STANDARDS

(NJ) NEW JERSEY 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) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER STANDARDS

(WI) WISCONSIN 5 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER GUIDELINES

(AZ) ARIZONA 0.67 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER GUIDELINES

(CT) CONNECTICUT 5 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER GUIDELINES

(ME) MAINE 3 ug/l [USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] **\*\*QC REVIEWED\*\***

#### STATE DRINKING WATER GUIDELINES

(MN) MINNESOTA 7 ug/l [USEPA/Office of Water, Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) ] \*\*QC REVIEWED\*\*

#### CLEAN WATER ACT REQUIREMENTS

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)] \*\*QC REVIEWED\*\*

#### TSCA REQUIREMENTS

Pursuant to section 8(d) of TSCA, EPA promulgated a model Health and Safety Data Reporting Rule. The section 8(d) model rule requires manufacturers, importers, and processors of listed chemical substances and mixtures to submit to EPA copies and lists of unpublished health and safety studies. As cited in the preamble of 51 FR 41329.

Tetrachloroethylene is included on this list. [40 CFR 712.30 (7/1/88)] \*\*PEER REVIEWED\*\*

#### RCRA REQUIREMENTS

As stipulated in 40 CFR 261.33, when tetrachloroethylene, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to Federal and/or State hazardous waste regulations. Also defined as a hazardous waste is any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5). [40 CFR 261.33 (7/1/88)] \*\*PEER REVIEWED\*\*

#### RCRA REQUIREMENTS

When tetrachloroethylene is a spent solvent, it is classified as a hazardous waste from a nonspecific source (F002), as stated in 40 CFR 261.31, and must be managed according to state and/or federal hazardous waste regulations. [40 CFR 261.31 (7/1/87)] \*\*PEER REVIEWED\*\*

#### RCRA REQUIREMENTS

The Environmental Protection Agency has amended its regulations concerning ground-water monitoring with regard to screening suspected contamination at land based hazardous waste treatment, storage, and disposal facilities. /There are/ new requirements to analyze for a specified core list of chemicals plus those chemicals specified by the Regional Administrator on a site-specific basis. ... ..

/Tetrachloroethylene is included on this list./ [52 FR 25942 (7/9/87)]

\*\*PEER REVIEWED\*\*

#### SAMPLING PROCEDURES

Volatile organic compounds pose a challenge to ground-water sampling protocols, since they can be lost as a water sample degasses or lost due to sorption on tubing or pump materials. Laboratory sorption experiments were conducted with 5 common flexible tubing materials to

determine the impact of sorptive bias for chloroform, trichloroethylene, trichloroethane and tetrachloroethylene. Tubes made of Teflon, polyethylene, polypropylene, polyvinyl chloride and silicone rubber were all found to sorb the test compounds in short exposure periods. Virgin tubing materials introduce substantial amounts of leachable organic matter in similar exposures. Tubing made of Teflon showed the least absorption and leaching problems and should be the tubing material of choice for detailed organic sampling purposes. Absorption into the polymer matrix is the likely mechanism for the errors. [Barcelona MJ et al; Anal Chem 27 (2): 460-4 (1985)] \*\*PEER REVIEWED\*\*

#### SAMPLING PROCEDURES

Analyte: Tetrachloroethylene; Matrix: Air; Sampler: Solid sorbent tube (coconut shell charcoal, 100 mg/50 mg); Flow rate: 0.01-0.2 l/min; Vol: min: 0.2 @ 100 ppm, max: 40; Stability: not determined [U.S. Department of Health and Human Services, Public Health Service. Centers for Disease Control, National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods, 3rd ed. Volumes 1 and 2 with 1985 supplement, and revisions. Washington, DC: U.S. Government Printing Office, February 1984. V2 1003-1] \*\*PEER REVIEWED\*\*

#### ANALYTIC LABORATORY METHODS

A freeze-out concn method is used to determine trace levels of tetrachloroethylene in the presence of other compd. Detection limit is 0.2 ppt (1.36X10<sup>-6</sup> mg/cu m) for 500 ml aliquots of ambient air samples. Samples are measured by gas chromatography coupled with electron capture configuration. When freeze-out is completed, tetrachloroethylene remains behind; While oxygen and nitrogen gasses are passed through as the freeze-out loop is heated. Carrier gas sweeps the contents onto the column. [Rasmussen RA et al; J Air Poll Cont Assoc 27: 579 (1977)] \*\*PEER REVIEWED\*\*

#### ANALYTIC LABORATORY METHODS

DETERMINATION OF TRACE AMT OF 136 C1-C13 ORG CMPD (INCL TETRACHLOROETHYLENE) IN AIR SAMPLES COLLECTED FROM THE

#### ATMOSPHERE OF

STREETS BY GC IS DISCUSSED. [IOFFE BV ET AL; J CHROMATOGR 142: 787-95 (1977)] \*\*PEER REVIEWED\*\*

#### ANALYTIC LABORATORY METHODS

TETRACHLOROETHYLENE IN DRINKING WATER IS ANALYZED DIRECTLY WITH GAS

CHROMATOGRAPHY EQUIPPED WITH ELECTRON CAPTURE DETECTION. THE LIMIT OF

DETECTION IS 0.5 UG/L (NICHOLSON AA ET AL; ANAL CHEM 49: 814-9 (1977)). [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). V20

498 (1979)] **\*\*PEER REVIEWED\*\***  
ANALYTIC LABORATORY METHODS  
TETRACHLOROETHYLENE WAS DETERMINED IN WASTE-CONTAMINATED  
SOIL AND  
CHEMICAL STILL BOTTOM EXTRACTS BY GAS CHROMATOGRAPHY. [GURKA  
DF,  
BETOWSKI LD; ANAL CHEM 54: 1819 (1982)] **\*\*PEER REVIEWED\*\***  
ANALYTIC LABORATORY METHODS  
DETERMINATION OF TETRACHLOROETHYLENE IN FISH BY GAS  
CHROMATOGRAPHY;  
DETECTION LIMITS IN 0.1-1.0 PPB RANGE. [OFSTAD EB ET AL; THE SCIENCE OF  
THE TOTAL ENVIRONMENT 20: 205-16 (1981)] **\*\*PEER REVIEWED\*\***

ANALYTIC LABORATORY METHODS

Analyte: Tetrachloroethylene; Matrix: air; Procedure: Gas  
chromatography, flame ionization detector; Desorption: 1 ml CS<sub>2</sub>, stand  
30 min; Range: 0.4 to 12 mg/sample; Precision: 0.052; Est LOD: 0.01  
mg/sample; Interferences: none [U.S. Department of Health and Human  
Services, Public Health Service. Centers for Disease Control, National  
Institute for Occupational Safety and Health. NIOSH Manual of  
Analytical Methods, 3rd ed. Volumes 1 and 2 with 1985 supplement, and  
revisions. Washington, DC: U.S. Government Printing Office, February  
1984. V2 1003-1] **\*\*PEER REVIEWED\*\***

ANALYTIC LABORATORY METHODS

EPA Method 8010: Halogenated Volatile Organics. For the analysis of  
solid waste, a representative sample (solid or liquid) is collected in  
a standard 40 ml glass screw-cap VOA vial equipped with a Teflon-faced  
silicone septum. Sample agitation, as well as contamination of the  
sample with air, must be avoided. Two vials are filled per sample  
location, then placed in separate plastic bags for shipment and  
storage. Samples may be analyzed by direct injection or purge-and-trap  
using gas chromatography, with detection achieved with a  
halogen-specific detector. A temperature program is used in the gas  
chromatograph to separate the organic compounds. Column 1 is an 8-ft by  
0.1-in ID stainless steel or glass column packed with 1% SP-1000 on  
Carbopack-B 60/80 mesh or equivalent. Column 2 is a 6-ft by 0.1-in ID  
stainless steel or glass column packed with chemically bonded n-octane  
on Porasil-C 100/120 mesh (Durapak) or equivalent. Under the prescribed  
conditions, tetrachloroethylene has a detection limit of 0.03 ug/l, an  
average recovery range of four measurements of 8.1-29.6 ug/l, and a  
limit for the standard deviation of 5.4 ug/l. [USEPA; Test Methods for  
Evaluating Solid Waste SW-846 (1986)] **\*\*PEER REVIEWED\*\***

ANALYTIC LABORATORY METHODS

EPA Method 8240: Gas Chromatography/Mass Spectrometry for Volatile  
Organics Method 8240 can be used to quantify most volatile organic  
compounds that have boiling points below 200 deg C and that are

insoluble or slightly soluble in water, including the title compound. Volatile water-soluble compounds can be included in this analytical technique, however, for the more soluble compounds, quantitation limits are approximately ten times higher because of poor purging efficiency. The method is also limited to compounds that elute as sharp peaks from a gas chromatograph column packed with graphitized carbon lightly coated with a carbowax (6 ft by 0.1 in ID glass, packed with 1% SP-1000 on Carbopack-B (60/80 mesh) or equivalent). This gas chromatography/mass spectrometry method is based on a purge-and-trap procedure. The practical quantitation limit for Method 8240 for an individual compound is approximately 5 ug/kg (wet weight) for wastes and 5 ug/l for ground water. Practical quantitation limits will be proportionately higher for sample extracts and samples that require dilution or reduced sample size to avoid saturation of the detector. A representative sample (solid or liquid) is collected in a standard 40 ml glass screw-cap vial equipped with a Teflon-faced silicone septum. Sample agitation, as well as contamination of the sample with air, must be avoided. Two vials are filled per sample location, then placed in separate plastic bags for shipment and storage. Under the prescribed conditions, tetrachloroethylene has an average recovery range for four samples of 17.0-26.6 ug/l with a limit for the standard deviation of 5.0 ug/l and a retention time of 22.2 min. [USEPA; Test Methods for Evaluating Solid Waste SW-846 (1986)] \*\*PEER REVIEWED\*\*

#### ANALYTIC LABORATORY METHODS

EPA Method 601 A purge and trap gas chromatography method for the analysis of tetrachloroethylene in municipal and industrial discharges, consists of a stainless steel column, 8 ft x 0.1 in ID, packed with Carbopack B (60/80 mesh) coated with SP-1000, with electrolytic conductivity detection, and helium as the carrier gas at a flow rate of 40 ml/min. A sample injection volume of 2 to 5 ul is suggested, the column temperature is held isothermal at 45 deg C for 3 minutes then programmed at 8 deg/min to final temperature of 220 deg C. This method has a detection limit of 0.03 ug/l and an overall precision of 0.18 times the average recovery +2.21, over a working range of 8.0 to 500 ug/l. [40 CFR 136 (7/1/87)] \*\*PEER REVIEWED\*\*

#### ANALYTIC LABORATORY METHODS

EPA Method 624: A purge and trap gas chromatography/mass spectrometry method for the analysis of tetrachloroethylene in municipal and industrial discharges, consists of a glass column, 6 ft x 0.1 in, packed with Carbopack B (60/80 mesh) coated with 1% SP-1000, with the detection performed by the mass spectrometer, and helium as the carrier gas at a flow rate of 30 ml/min. A sample injection volume of 2 to 5 ul is suggested, the column temperature is held isothermal at 45 deg C for 3 minutes and then programmed at 8 deg/min to a final temperature of 220 deg C. This method has a detection limit of 4.1 ug/l and an overall

precision of 0.16 times the average recovery - 0.45, over a working range of 5 to 600 ug/l. [40 CFR 136 (7/1/87)] \*\*PEER REVIEWED\*\*

#### ANALYTIC LABORATORY METHODS

EPA Method 1624: An isotope dilution gas chromatography/ mass spectrometry method for the determination of volatile organic compounds in municipal and industrial discharges is described. This method is designed to meet the survey requirements of Effluent Guidelines Division (EGD) and the National Pollution Discharge Elimination System (NPDES). Under the prescribed conditions, unlabeled tetrachloroethylene has a minimum level of 10 ug/l and a mean retention time of 1528 sec. The labeled compound has a characteristic primary m/z of 166/172. This method has an initial precision of 6.6 ug/l, an accuracy of 15.1-28.5 ug/l, and a labeled compound recovery of 31-181%. [40 CFR 136 (7/1/87)] \*\*PEER REVIEWED\*\*

#### CLINICAL LABORATORY METHODS

##### DETERMINATION OF TETRACHLOROETHYLENE IN FISH BY GAS CHROMATOGRAPHY;

DETECTION LIMITS IN 0.1-1.0 PPB RANGE. [OFSTAD EB ET AL; THE SCIENCE OF THE TOTAL ENVIRONMENT 20: 205-16 (1981)] \*\*PEER REVIEWED\*\*

#### CLINICAL LABORATORY METHODS

The expired breath of subjects, exposed for periods of approx 90 min to atmospheres artificially contaminated with low levels ... tetrachloroethylene (approx 50 ppm), was monitored during and after the exposure period using an atm pressure ionization mass spectrometer (API/MS), fitted with a direct breath analysis system. The retention of solvent by the subjects estimated from steady state levels in the expired breath, averaged 87%. The elimination of unchanged solvent via respiration during the post exposure period followed first order kinetics with a mean half-life value of 79 min. [Benoit FM et al; Int Arch Occup Health 55 (2): 113-20 (1985)] \*\*PEER REVIEWED\*\*

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SPECIAL REPORTS

NIOSH Current Intelligence Bulletin No 20 for Tetrachloroethylene (1978)

SPECIAL REPORTS

WHO; Environmental Health Criteria for Tetrachloroethylene No 31 (1984)

SPECIAL REPORTS

USEPA Ambient Water Quality Criteria for Tetrachloroethylene (1980) EPA 440/5-80-073

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DHHS/NTP; Sixth Annual Report on Carcinogens (1991)

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PRIOR HISTORY OF ACCIDENTS

On September 28, 1982, an Illinois Gulf Railroad freight train derailed 43 cars in Livingston, Louisiana. Thirty-six cars were tank cars, of

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which 27 contained various regulated hazardous or toxic chemical commodities, 2 contained nonregulated hazardous materials, and 5 contained flammable petroleum products. Fires resulted and toxic gases were released into the atmosphere. Residents within a 5 mile radius of the derailment were evacuated for up to two weeks. More than 200,000 gal of toxic chemical products were spilled and absorbed into the ground. Extensive excavation of the contaminated soil and its transportation to a distant dump site were required. Property damage was estimated to be greater than 14 million dollars and long-term closure of the railroad line and adjacent highway resulted. ...

Evacuation of the residents was accomplished successfully although no contingency plan had been developed. The effort to contain and remove chemical pollution resulting from the derailment was directed effectively by the Louisiana Department of Natural Resources. The principal problem was tetrachloroethylene, a non-regulated chemical that is nondegradable in soil. ... [Nat Transp Safety Board; Railroad Accident Report: Derailment of Illinois Central Gulf Railroad Freight Train Extra 9629 East and Release of Hazardous Materials at Livingston, LA on September 28, 1982 80 pp. (1983) NTSB/RAR-83105] \*\*QC REVIEWED\*\*

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