Safety Data Sheet

Carbon tetrachloride

Division of Safety
National Institutes of Health

WARNING!

THIS COMPOUND IS ABSORBED THROUGH THE SKIN AND THE RESPIRATORY AND INTESTINAL TRACTS. IT IS CARCINOGENIC. IT MAY IRRITATE TISSUES. AVOID FORMATION AND BREATHING OF AEROSOLS OR VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER. AVOID WASHING THE SKIN WITH SOLVENTS AND ELEVATING ITS TEMPERATURE.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, DRINK PLENTY OF WATER. REFER FOR GASTRIC LAVAGE. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF AEROSOLS OR VAPORS. USE ABSORBENT PAPER TO MOP UP SPILL. AFTER THE RESIDUE HAS EVAPORATED, WASH DOWN AREA WITH SOAP AND WATER. DISPOSE OF WASTE SOLUTIONS AND MATERIALS APPROPRIATELY.

A. Background

Carbon tetrachloride is a colorless, clear, volatile, nonflammable, heavy liquid with a sweet, distinctive odor. It is readily absorbed through skin, from the gastrointestinal tract, and by inhalation and is toxic by these routes. The chief target organs are the central nervous system, liver, and kidney. Eye exposure may produce irritation. It is carcinogenic in rodents and a suspect chronic human carcinogen. Because of its toxicity, the commercial use of

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carbon tetrachloride as metal degreaser, solvent, fumigant, fire extinguisher, and dry-cleaning agent has been abandoned or minimized. The present primary industrial use is as a chemical intermediate.

Chemical and Physical Data

1. Chemical Abstract No.: 56-23-5

2. Synonyms:

ENT 4705	Benzinoform
Halon 104	Perchloromethane
Necatorina	Methane tetrachloride
Necatorine	Methane, tetrachloro (9CI)

3. Molecular formula: CCl_4 structure: CCl_4

   weight: 153.84

4. Density: 1.5845 g/cm^3.

5. Absorption spectroscopy: UV absorption below 200 nm for vapo IR spectra are described by Hanst et al., 1975.

6. Volatility: Vapor pressure = 89.5 mm Hg at 20°C. (For value at other temperatures, see pp. D-174 and D-189 in Weast, 1981

7. Solubility: 0.8 g/liter in water; miscible with alcohols, be zene, chloroform, ether, carbon disulfide, petroleum ether.

8. Description, appearance, and odor: Colorless, nonflammable l quid with a sweet, distinctive odor.

9. Boiling point: 76.75°C.

   Melting point: -23°C.

10. Stability: Decomposes slowly in presence of moisture and UV light and rapidly in contact with a flame or very hot surface to yield toxic products that include phosgene, chlorine, chlorine dioxide, and hydrochloric acid. Reacts slowly in contact with copper and lead and faster (sometimes explosivel with aluminum and its alloys (Stern and Uhlig, 1953).

C. Fire, Explosion, and Reactivity Hazard Data

1. Carbon tetrachloride does not require special fire-fighting procedures or equipment. Fire-fighting personnel should wear air-supplied respirators with full-face masks.

2. Carbon tetrachloride is nonflammable but produces toxic products in contact with flames or hot surfaces. This reaction may be explosive in the presence of aluminum or its alloys.

3. Incompatible with copper, lead, and aluminum.

4. Hazardous decomposition products include phosgene, chlorine, and hydrochloric acid.

5. Nonspark equipment is not required. When handled in flammable solvents, the precautions required for such solvents apply.

D. Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving carbon tetrachloride.

Carbon tetrachloride penetrates several glove materials readily (Sansone and Tewari, 1978). This factor should be taken into account when handling carbon tetrachloride.

1. Chemical inactivation: No validated method reported.

2. Decontamination: Turn off equipment that could be affected by carbon tetrachloride or the materials used for cleanup. If more than 100 ml has been spilled or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Use absorbent paper to mop up spill. After the residue has evaporated, wash surfaces with copious quantities of water. Glassware should be rinsed (in a hood) with acetone, followed by soap and water. Animal cages should be washed with water.

3. Disposal: No waste streams containing carbon tetrachloride shall be disposed of in sinks or general refuse. Surplus carbon tetrachloride or chemical waste streams contaminated with carbon tetrachloride shall be handled as hazardous chemical waste and and disposed of in accordance with the NIH chemical waste disposal disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing carbon tetrachloride shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste

(e.g., tissue cultures) containing carbon tetrachloride shall be packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with carbon tetrachloride shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing carbon tetrachloride shall be handled in accordance with the NIH radioactive waste disposal system.

4. Storage: Store in sealed ampoules or amber screw-capped bottles (or vials) with Teflon cap liners, preferably under refrigeration. Avoid unnecessary exposure to sunlight and moisture.

Monitoring and Measurement Procedures Including Direct Field Measurement and Sampling for Subsequent Laboratory Analysis

1. Sampling: For air samples, the recommended method is adsorption on charcoal (NIOSH, 1977) in glass or stainless steel tubes and desorption with carbon disulfide or by heat. Silica gel and porous polymer packing (Tenax, Chromosorbs, Porapak Q) have also been used as adsorbents. Impingers containing m-xylene or pyridine have also been used. Water sampling may be accomplished by adsorption on charcoal or purging from water samples with nitrogen (Kloepfer, 1976).

2. Separation and analysis: The preferred method is GC in conjunction with MS (20 ppm [Cooper et al., 1971]), flame ionization (detection limit, 5 μg [NIOSH, 1975]), or electron capture detectors; the latter has been used principally in the analysis of air samples (Russell and Shadoff, 1977; Lillian et al., 1976). Colorimetric methods (color formation with alkaline pyridine [sensitivity, 1 ppm] or similar reagents) have been developed into commercial gas tube indicators (Ash and Lynch, 1971). Other methods include polarography and IR spectroscopy.

Biological Effects (Animal and Human)

1. Absorption: Carbon tetrachloride is readily absorbed through human and animal skin, lungs, and gastrointestinal tract.

2. Distribution: Detected in breath and blood of humans after drinking the compound. Radioactivity due to inhalation of ^{14}C-labeled carbon tetrachloride by monkeys is found (in decreasing order of concentration) in fat, liver, bone marrow, blood, brain, and kidney. Over 50% of a dose is exhaled unchanged (McCollister et al., 1951).

3. Metabolism and excretion: Carbon tetrachloride is metabolized in most organs to chloroform, hexachloroethane, and carbon

dioxide. The toxic action is usually ascribed to the intermediate formation of the trichloromethyl free radical (Gordis, 1969), which combines with unsaturated fatty acids in lipid membranes, and of the peroxide ion. An unidentified metaboli reacts with the ε-amino groups of proteins. The usual excreti products in animals and humans include unchanged carbon tetrachloride and carbon dioxide (in the breath), chloroform, and hexachloroethane.

4. Toxic effects: Acute LD50s are 2,800, 6,380, and 12,800 mg/kg orally in the rat, rabbit, and mouse, respectively, and 1,500 mg/kg intraperitoneally in both rat and dog (Fairchild, 1977). Human deaths have been reported after ingestion of doses as low as 5 ml (Stewart et al., 1963). The chief target organs in humans are central nervous system (depression), liver, and kidney. Chronic exposure results, additionally, in eye effect (blurred vision, restricted visual fields, optical atrophy). Immediate symptoms are nausea, dizziness, headache, and weakness, followed by convulsions and coma if the dose is high enough. Later symptoms include abdominal pain and vomiting, followed by disruption of liver function. Jaundice appears in about 4 days in nonfatal cases. The liver effects in experimental animals are fatty infiltration and necrosis. Death after acute poisoning in humans is ascribed to renal failure.

5. Carcinogenic effects: Hepatomas have been found in rodents (mice, rats, and hamsters) after administration of carbon tetrachloride by inhalation, ingestion, or subcutaneous injection. In humans, hepatomas have been reported up to seven years afte acute exposure (Tracey and Sherlock, 1968).

6. Mutagenic and teratogenic effects: Carbon tetrachloride appea to be nonmutagenic in several bacterial strains and nonteratogenic in rats.

Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash with soap and water. Since carbon tetrachlor is readily absorbed through the skin, avoid organic solvents ar elevated temperatures. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minute

2. Ingestion: Drink plenty of water. Refer for gastric lavage.

3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.

4. Refer to physician. Consider treatment for pulmonary irritatio

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