Carbon disulfide

75-15-0

Hazard Summary

Exposure to carbon disulfide occurs mainly in the workplace. Acute (short-term) inhalation exposure of humans to carbon disulfide has caused changes in breathing and chest pains. Nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy, blurred vision, delirium, and convulsions have also been reported in humans acutely exposed by inhalation. Neurologic effects, including behavioral and neurophysiological changes, have been observed in chronic (long-term) human and animal inhalation studies. Reproductive effects, such as decreased sperm count and menstrual disturbances, have been observed in humans exposed to carbon disulfide by inhalation. Animal studies support these findings. EPA has not classified carbon disulfide for human carcinogenicity.

Please Note: The main sources of information for this fact sheet are the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Carbon disulfide (1) and EPA's Integrated Risk Information System (IRIS) (5), which contains information on oral chronic toxicity and the RfD and inhalation chronic toxicity and the RfC.

Uses

- Carbon disulfide is used predominantly in the manufacture of rayon, cellophane, and carbon tetrachloride. (1,2)
- Carbon disulfide is also used to produce rubber chemicals and pesticides. (1,2)

Sources and Potential Exposure

- The main route of exposure to this compound is in the workplace. Workers in plants that use carbon disulfide in their manufacturing processes have a high degree of exposure potential. (1)
- Releases of carbon disulfide from industrial processes are almost exclusively to the air; individuals in proximity to these sites may be exposed. Concentrations of carbon disulfide in urban/suburban areas were measured at about 65 parts per trillion (ppt) and in rural areas at about 41 ppt. (1,2)
- Carbon disulfide has been detected in some samples of drinking water. (1)
- Low amounts of carbon disulfide may be emitted naturally from volcanoes and marshes. (1)

Assessing Personal Exposure

- Carbon disulfide breaks down into other chemical substances after it enters the body. Medical tests can measure levels of these substances in urine and blood, but the tests are not reliable indicators of total exposure. (1)

Health Hazard Information

Acute Effects:

- Acute inhalation exposure of humans caused changes in breathing and some chest pains during an accidental release of carbon disulfide. (1)
- Nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy, blurred vision, delirium, and

convulsions have also been reported in humans acutely exposed by inhalation. (3)
- Brain chemistry changes and sensory and motor nerve conduction alterations were observed in rats acutely exposed to carbon disulfide by inhalation. (1)
- Animal studies show transitory effects associated with the target organ toxicity (central nervous system (CNS), blood, liver, eyes) seen from chronic exposure. (1)
- Tests involving acute exposure of rats, mice, and rabbits have shown carbon disulfide to have low acute toxicity from inhalation and moderate acute toxicity by ingestion. (4)

Chronic Effects (Noncancer):
- Neurotoxic effects have been observed in chronic human and animal inhalation studies. Behavioral and neurophysiological changes, reduced nerve conduction velocity, peripheral neuropathy, and polyneuropathy have been observed in chronically exposed workers. (1,2,5)
- An increased incidence of coronary heart disease has been observed in an epidemiological study of workers who chronically inhaled carbon disulfide in the workplace. Concomitant exposure to other chemicals and a failure to control for other coronary heart disease risk factors have been noted with this study. An increased incidence of angina has been reported in another occupational study. (1,2)
- Muscle pain, headaches, and general fatigue have been reported by workers chronically exposed to carbon disulfide in the air. (1,3)
- Ocular effects have been observed in chronically exposed workers. (1)
- Workers who handled fibers made from a polymer solution in carbon disulfide developed blisters and eczematous lesions on their hands. (1,3)
- Chronic inhalation exposure has been observed to affect the CNS, blood, liver, and kidneys in animals. (1)
- The Reference Concentration (RfC) for carbon disulfide is 0.7 milligrams per cubic meter (mg/m^3) based on neurological effects in humans. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (5)
- EPA has medium confidence in the study on which the RfC was based because it is well designed and conducted, uses adequate numbers of subjects, and is well supported by other occupational studies examining the same effect; however, considerable uncertainty exists regarding the exposure histories of the cohorts examined; medium confidence in the database because a considerable number of well-conducted occupational studies have defined the effects of carbon disulfide in humans; however, a significant question remains regarding the possibility of developmental effects in humans; and consequently medium confidence in the RfC. (5)
- The Reference Dose (RfD) for carbon disulfide is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on fetal toxicity/malformations in rabbits. (5)
- EPA has medium confidence in the study on which the RfD was based because this study was a well-designed multispecies study that provided adequate toxicologic endpoints; medium confidence in the database because it contains supportive reproductive and epidemiologic studies; and, consequently, medium confidence in the RfD. (5)

Reproductive/Developmental Effects:
- Reproductive effects, such as decreased sperm count and decreased libido in men and menstrual disturbances in women, have been reported from occupational settings involving inhalation exposure to carbon disulfide. (1-3)
- Developmental effects, including skeletal and visceral malformations, embryotoxicity, and functional and behavioral disturbances, have been observed in several animal studies across a wide exposure range. (2)
- Pharmacokinetic studies indicate that carbon disulfide and its metabolites cross the placenta and localize in the target organs of the fetus (brain, blood, liver, and eyes). (1)

Cancer Risk:

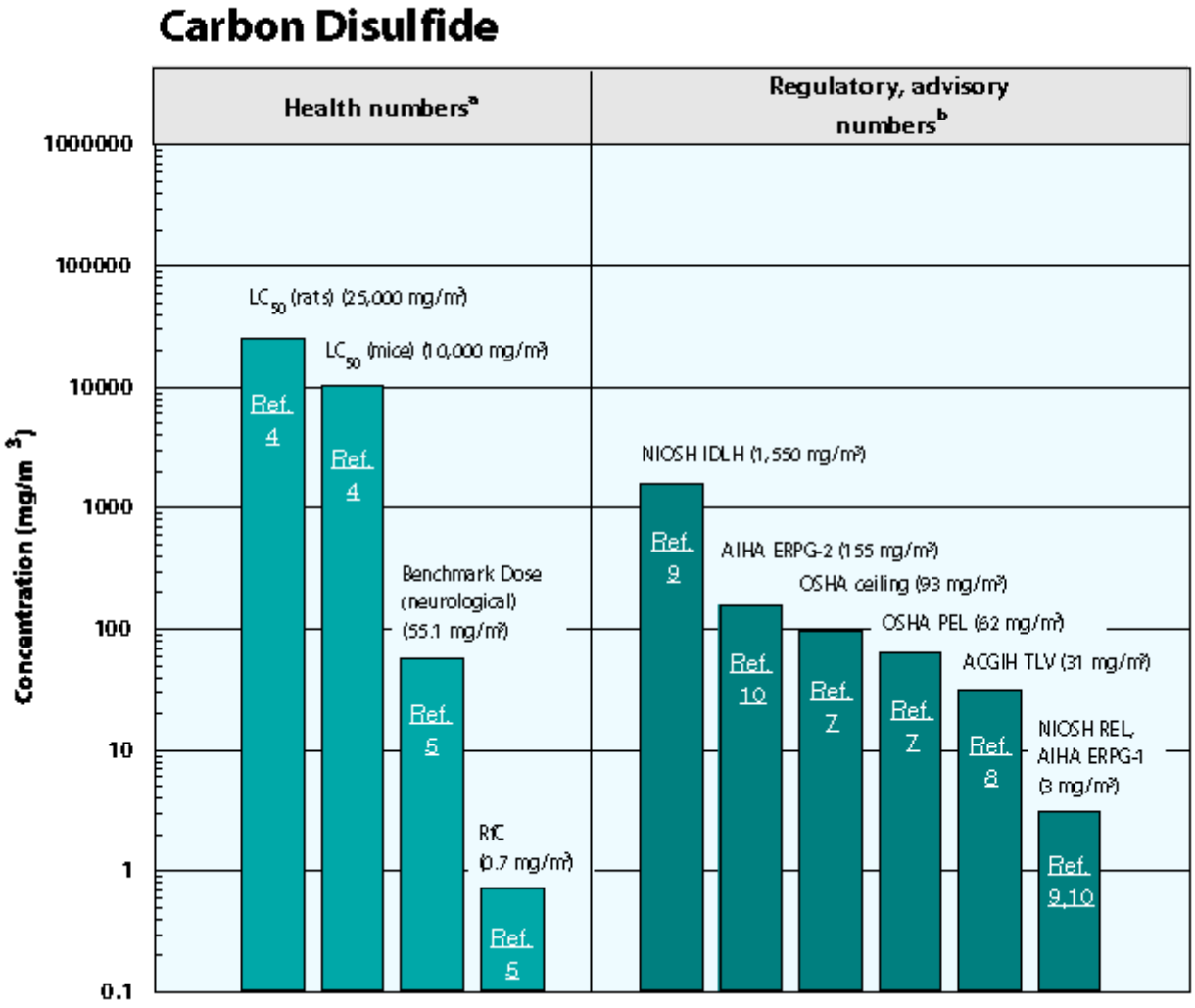
- In a study of workers exposed by inhalation to carbon disulfide and other solvents, an increased incidence of lymphatic leukemia was reported. However, there were many confounding factors in this study, making it difficult to interpret the results. (1,2)
- EPA has not classified carbon disulfide for human carcinogenicity. (5)

Physical Properties

- The chemical formula for carbon disulfide is CS_2, and its molecular weight is 76.14 g/mol. (1,8)
- Pure carbon disulfide occurs as a colorless liquid that is not very soluble in water; impure carbon disulfide is yellowish. Carbon disulfide evaporates rapidly at room temperature and is flammable. (1,8)
- Pure carbon disulfide has a sweet, pleasant, chloroform-like odor, with an odor threshold of 0.05 mg/m^3. Commercial grades of carbon disulfide have a foul odor, smelling like rotten eggs. (1)
- The vapor pressure for carbon disulfide is 352.6 mm Hg at 25 °C, and its log octanol/water partition coefficient (log K_{ow}) is 1.84 to 2.16. (1)

To convert concentrations in air (at 25 °C) from ppm to mg/m^3: mg/m^3 = (ppm) × (molecular weight of the compound)/(24.45). For carbon disulfide: 1 ppm = 3.1 mg/m^3. To convert concentrations in air from $\mu g/m^3$ to mg/m^3: mg/m^3 = ($\mu g/m^3$) × (1 mg/1,000 µg).

Health Data from Inhalation Exposure



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.
AIHA ERPG--American Industrial Hygiene Association's emergency response planning guidelines. ERPG 1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed upo one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor; ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.
LC_{50} (Lethal Concentration $_{50}$)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.
NIOSH IDLH -- National Institute of Occupational Safety and Health's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.
NIOSH REL--NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.
OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.
OSHA PEL ceiling --Occupational Safety and Health Administration's permissible exposure limit ceiling value; the concentration of a substance that should not be exceeded at any time.

The health and regulatory values cited in this factsheet were obtained in December 1999.
[a] Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.
[b] Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.
[c] This benchmark dose is from the critical study used as the basis for the RfC.

Summary created in April 1992, updated in January 2000.

References

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