

Chlordane

57-74-9

Hazard Summary

Exposure to chlordane occurs from its past use as a pesticide. The acute (short-term) effects of chlordane in humans consist of gastrointestinal distress and neurological symptoms, such as tremors and convulsions. Chronic (long-term) inhalation exposure of humans to chlordane results in effects on the nervous system. An occupational study reported an association between chlordane exposure and non-Hodgkin's lymphoma, while other human studies did not show an association between chlordane exposure and leukemia or multiple myeloma. Animal studies have reported liver cancer in mice and male rats exposed to chlordane via ingestion. EPA has classified chlordane as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's [Integrated Risk Information System \(IRIS\)](#) (7), which contains information on oral and inhalation chronic toxicity of chlordane and the RfD and the RfC, and the carcinogenic effects of chlordane including the unit cancer risk for inhalation exposure, EPA's [Toxicological Review of Chlordane in Support of Summary Information on the Integrated Risk Information System \(IRIS\)](#) (2), and the Agency for Toxic Substances and Disease Registry's (ATSDR's) [Toxicological Profile for Chlordane](#) (1).

Uses

- Chlordane was used as a pesticide in the United States from 1948 to 1988. In 1988, all approved uses of chlordane in the United States were canceled. (1,3)
- From 1983 to 1988, chlordane's only approved use was to control termites in homes. The pesticide was applied underground around the foundation of homes. (1,3)
- Before 1978, chlordane was also used as a pesticide on agricultural crops, lawns, and gardens and as a fumigating agent. In 1978, EPA canceled the use of chlordane on food crops and phased out other above-ground uses over the following 5 years. (1,3)

Sources and Potential Exposure

- Before 1988, exposure to chlordane may have occurred in the workplace; persons involved in the manufacture, formulation, or application of chlordane, such as farmers, lawn-care workers, and pest-control workers may have been exposed. (1)
- Studies on chlordane levels in indoor air reported levels ranging from < 1 to 610,000 nanograms per cubic meter (ng/m³). (1)
- Currently, exposure to chlordane appears to be highest for those persons living in homes that were treated for termites with chlordane. Chlordane may be found in the air in these homes for many years after treatment. (1)
- Additional exposure to chlordane may occur from digging in soil around the foundation of homes where chlordane was applied. Mean residue levels in soil around 30 homes treated with chlordane ranged from 22 to 2,540 parts per million (ppm). (1)
- Exposure to chlordane may also occur from eating chlordane-contaminated food. Chlordane remains in the food supply today because much of the farmland in the United States was treated with chlordane in the 1960s and 1970s, and it remains in the soil for over 20 years. (1)
- Chlordane has been listed as a pollutant of concern to EPA's [Great Waters Program](#) due to its persistence in

the environment, potential to bioaccumulate, and toxicity to humans and the environment (2).

Assessing Personal Exposure

- Levels of chlordane and its breakdown products in blood and fat can be measured and used as an indication of chlordane exposure. (1)

Health Hazard Information

Acute Effects:

- Neurological effects, such as headache, dizziness, irritability, and convulsions, and effects on the blood have been seen from acute chlordane exposure in animals and humans. (1,3,7)
- Chlordane is considered to have high acute toxicity based on short-term animal tests in rats. (4)

Chronic Effects (Noncancer):

- Chronic exposure of humans to chlordane by inhalation results primarily in effects on the nervous system. (1,3,7)
- Animal studies have reported effects on the liver, kidney, blood, thyroid, and respiratory and nervous systems from chronic exposure to chlordane via inhalation. (1,3,5,6,7)
- The Reference Concentration (RfC) for chlordane is 0.0007 milligrams per cubic meter (mg/m^3) based on liver effects in rats. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily 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. (3,7)
- EPA has low confidence in the RfC based on: (1) medium confidence in the principal study because it had relatively large group sizes in which histopathological analyses on the known animal target tissue, the liver, were thoroughly performed, and (2) low confidence in the database because hepatic toxicity was consistent across routes of exposure; however, recent evidence indicates that neurotoxicity, a known human endpoint in acute exposures, may be a relevant endpoint in chronic human exposures, and no chronic animal studies have examined neurotoxicity. Studies on pre- and post-natal animals indicating chlordane mimicry of sex steroids raise reproductive concerns, and no multigenerational reproductive studies, by any route, exist. (3,7)
- The Reference Dose (RfD) for chlordane is 0.0005 milligrams per kilogram body weight per day ($\text{mg}/\text{kg}/\text{d}$) based on liver necrosis in mice. (3,7)
- EPA has medium confidence in the RfD based on: (1) medium confidence in the principal study because it had large group sizes in which histopathological analyses on the known animal target tissue, the liver, were thoroughly performed, and (2) medium confidence in the database because hepatic toxicity was consistent across routes of exposure; however, recent evidence indicates that neurotoxicity, a known human endpoint in acute exposures, may be a relevant endpoint in chronic human exposures, and no chronic animal studies have examined neurotoxicity. No multigenerational reproductive studies have been performed by any route. The wide array of special studies and numerous chronic studies with consistent results are judged adequate information to rate the overall confidence in the database as medium. (3,7)

Reproductive/Developmental Effects:

- A study of women living in homes repeatedly treated for termites with chlordane revealed an increased incidence of ovarian and uterine disease, compared with a reference population. However, it is not possible to state whether these effects were solely due to chlordane or to other chemicals as well. (1,3,7)
- An animal study reported biochemical and behavioral alterations mimicking male sex steroids, while

another study reported alterations in reproductive behavior, both in male rats exposed to chlordane. (3,7)

Cancer Risk:

- An occupational study investigating men with non-Hodgkin's lymphoma found that the odds of chlordane use as an insecticide were significantly greater among cases than among controls. (1,3,7)
- Two other epidemiological studies did not find an association between chlordane exposure and leukemia or multiple myeloma. (1,3,7)
- Animal studies have reported liver cancer in mice and male rats exposed to chlordane via ingestion. (1,3,7)
- EPA considers chlordane to be a probable human carcinogen and has classified it as a Group B2 carcinogen. (3,7)
- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA calculated an inhalation unit risk estimate of $1.0 \times 10^{-4} (\mu\text{g}/\text{m}^3)^{-1}$. EPA estimates that, if an individual were to continuously breathe air containing chlordane at an average of $0.01 \mu\text{g}/\text{m}^3$ ($1 \times 10^{-5} \text{mg}/\text{m}^3$) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of breathing air containing this chemical. Similarly, EPA estimates that breathing air containing $0.1 \mu\text{g}/\text{m}^3$ ($1 \times 10^{-4} \text{mg}/\text{m}^3$) would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and air containing $1 \mu\text{g}/\text{m}^3$ ($1 \times 10^{-3} \text{mg}/\text{m}^3$) would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency estimates, please see IRIS. (3,7)
- EPA has calculated an oral cancer slope factor of $0.35 (\text{mg}/\text{kg}\text{-d})^{-1}$. (3,7)

Physical Properties

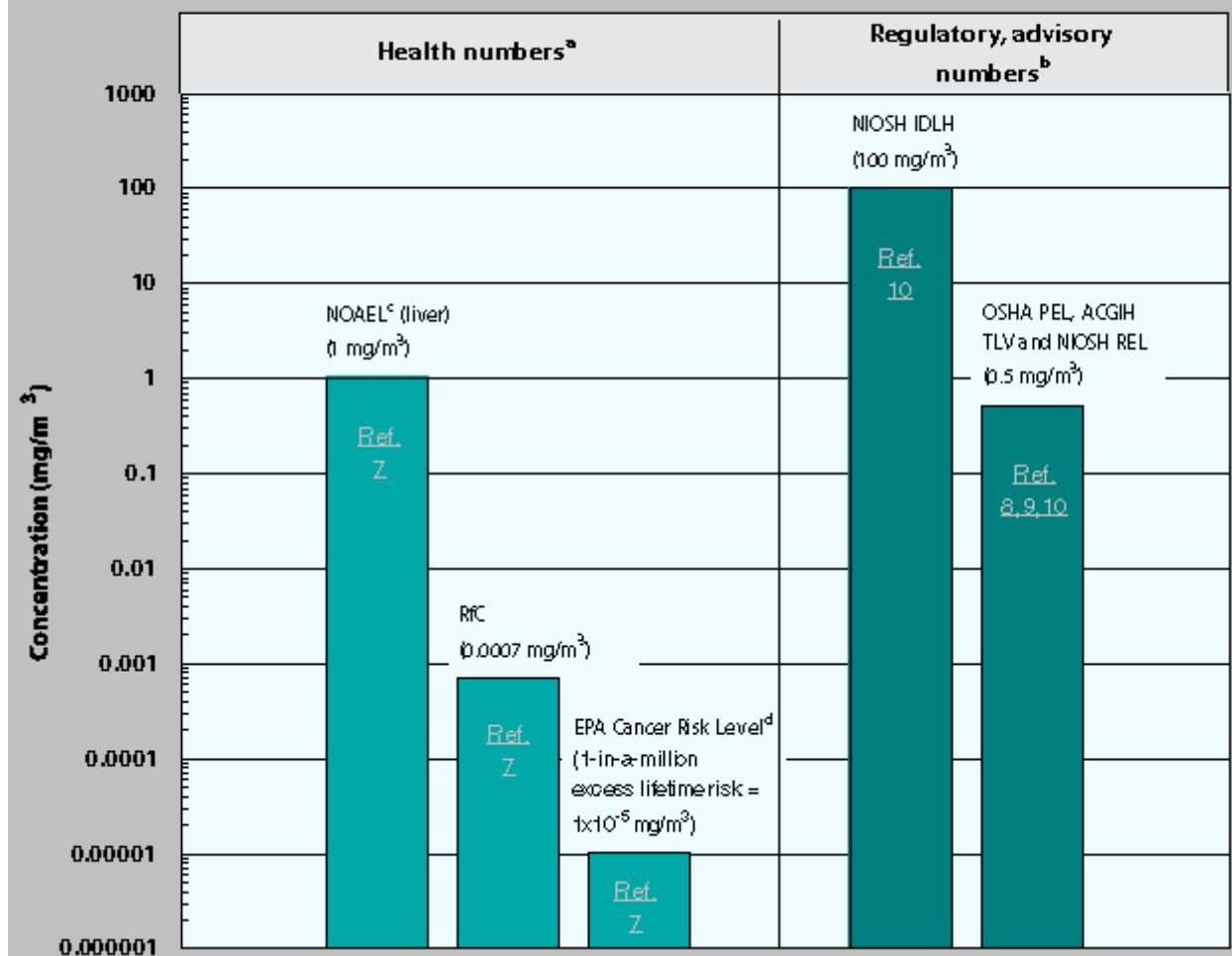
- Chlordane is a thick, liquid man-made chemical whose color ranges from colorless to amber. (1)
- Chlordane is not soluble in water and is either odorless or has a mild, irritating odor. The odor threshold for chlordane is not available. (1)
- The molecular formula for chlordane is $\text{C}_{10}\text{H}_6\text{Cl}_8$ and the molecular weight is 409.76 g/mol. (1)
- The vapor pressure for chlordane is 1×10^{-6} mm Hg at 25 °C and the log octanol/water partition coefficient ($\log K_{ow}$) is 5.54. (1,3)

Conversion Factors:

To convert concentrations in air (25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For chlordane: $1 \text{ ppm} = 16.8 \text{ mg}/\text{m}^3$.

Health Data from Inhalation Exposure

Chlordane



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.

NIOSH IDLH --National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; 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.

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 and ACGIH numbers are advisory.

^c This NOAEL is from the critical study used as the basis for the EPA RfC.

^d These cancer risk estimates were derived from oral data and converted to provide the estimated inhalation risk.

Summary created in April 1992, updated in January 2000.

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Chlordane (Update). Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1994.
2. U.S. Environmental Protection Agency. Deposition of Air Pollutants to the Great Waters. First Report to Congress. EPA-453/R-93-055. Office of Air Quality Planning and Standards, Research Triangle Park, NC. 1994.
3. U.S. Environmental Protection Agency. Toxicological Review of Chlordane (Technical). In Support of Summary Information on the Integrated Risk Information System (IRIS). National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1997.
4. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
5. U.S. Department of Health and Human Services. Hazardous Substances Databank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
6. U.S. Environmental Protection Agency. Updated Health Effects Assessment for Chlordane. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1988.
7. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on Chlordane. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
8. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations. 29 CFR 1910.1000. 1998.
9. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices. Cincinnati, OH. 1999.
10. National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.