

Pentachlorophenol

87-86-5

Hazard Summary

Pentachlorophenol was once one of the most widely used biocides in the United States, but it is now a restricted use pesticide and is no longer available to the general public. It was primarily used as a wood preservative. Pentachlorophenol is extremely toxic to humans from acute (short-term) ingestion and inhalation exposure. Acute inhalation exposures in humans have resulted in neurological, blood, and liver effects, and eye irritation. Chronic (long-term) exposure to pentachlorophenol by inhalation in humans has resulted in effects on the respiratory tract, blood, kidney, liver, immune system, eyes, nose, and skin. Human studies are inconclusive regarding pentachlorophenol exposure and reproductive effects. Human studies suggest an association between exposure to pentachlorophenol and cancer. Oral animal studies have reported increases in liver tumors and two uncommon tumor types. EPA has classified pentachlorophenol 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) (2), which contains information on oral chronic toxicity of pentachlorophenol and the RfD and the carcinogenic effects of pentachlorophenol including the unit cancer risk for oral exposure, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Pentachlorophenol. (1)

Uses

- Pentachlorophenol was once one of the most widely used biocides in the United States, but it is now a restricted use pesticide and is no longer available to the general public. (1)
- The principal use for pentachlorophenol is as a wood preservative; it is also used for the formulation of fungicidal and insecticidal solutions and for incorporation into other pesticide products. (1)

Sources and Potential Exposure

- Exposure to pentachlorophenol in the indoor air of pressure-treated log homes brushed with pentachlorophenol has been measured at 0.0005 to 0.01 parts per billion (ppb), and levels in the air of industrially dipped, non-pressure-treated log homes have been measured at 0.034 to 0.0104 ppb. Levels in outdoor air are much lower, and the general population is estimated to breathe in about 0.063 milligrams per day (mg/day). (1)
- Workers at wood treatment facilities and lumber mills are estimated to breathe in about 10.5 to 154 mg/day, and workers who handle treated lumber can absorb about 35 mg/day through the skin. (1)
- Pentachlorophenol has been detected at low levels in drinking water and food. (1)
- Exposure may also occur through dermal contact with pentachlorophenol or with wood products treated with pentachlorophenol. (1)

Assessing Personal Exposure

- Pentachlorophenol and its breakdown products can be measured in blood, urine, and tissues. (1)

Health Hazard Information

Acute Effects:

- Pentachlorophenol is extremely toxic when ingested by humans. (2)
- Acute inhalation exposure to pentachlorophenol in humans may result in effects on the cardiovascular system, blood, liver (jaundice), and eyes (visual damage and irritation). (1,3)
- Neurological effects reported following exposure of humans to high levels of pentachlorophenol include lethargy, tachypnea, tachycardia, delirium, and convulsions. (1)
- Animal studies have reported effects on the cardiovascular system, blood, liver, immune system, and central nervous system (CNS) from acute oral exposure to pentachlorophenol. (1)
- Tests involving acute exposure of rats and mice have shown pentachlorophenol to have **high** toxicity from inhalation exposure and **extreme** toxicity from oral exposure. (1,4)

Chronic Effects (Noncancer):

- Chronic exposure by inhalation to pentachlorophenol in humans has resulted in inflammation of the upper respiratory tract and bronchitis, blood effects such as aplastic anemia, effects on the kidney and liver, immunological effects, and irritation of the eyes, nose, and skin. (1,3)
- Chronic oral exposure to pentachlorophenol in animals has resulted in effects on the liver, kidney, blood, endocrine, immune system, and CNS. (1,2,5)
- EPA has not established a Reference Concentration (RfC) for pentachlorophenol. (2)
- The Reference Dose (RfD) for pentachlorophenol is 0.03 milligrams per kilogram body weight per day (mg/kg/d) based on liver and kidney pathology in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral 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 RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (2)
- EPA has high confidence in the study on which the RfD is based because a moderate number of animals/sex were used in each of three doses, a comprehensive analysis of parameters was conducted, and a reproductive study was also performed; medium confidence in the supporting database because only one chronic study is available; and, consequently, medium confidence in the RfD. (2)
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of 0.1 milligrams per cubic meter (mg/m³) based on a route to route extrapolation of EPA's RfD. (9)

Reproductive/Developmental Effects:

- One study reported that 22 out of 90 women with histories of spontaneous abortions, unexplained infertility, or menstrual disorders were found to have elevated blood levels of pentachlorophenol and/or lindane. However, a direct causal relationship with pentachlorophenol exposure cannot be inferred from this study due to the presence of lindane in the blood and other possible confounding factors. (1)
- Oral animal studies suggest that exposure to pentachlorophenol decreases the survival of the offspring in rats. Other oral animal studies have found evidence that pentachlorophenol produces maternal toxicity (depressed maternal body weight), but does not cause birth defects. (1,2)

Cancer Risk:

- Case reports suggest a possible association between inhalation pentachlorophenol exposure and cancer (Hodgkins disease, soft tissue sarcoma, and acute leukemia); however, concomittent exposure to other toxic substances may have contributed to the reported carcinogenic effects. (1)
- Oral animal studies have reported increases in liver tumors (hepatocellular adenomas and carcinomas) and two uncommon tumors (adrenal medulla pheochromocytomas, hemangiosarcomas, and hemangiomas) in mice. (1,2)
- EPA has classified pentachlorophenol as a Group B2, probable human carcinogen. (2)

- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from ingesting water containing a specified concentration of a chemical. EPA calculated an oral unit risk estimate of $3 \times 10^{-6} (\mu\text{g/L})^{-1}$. EPA estimates that, if an individual were to ingest water containing pentachlorophenol at an average concentration of 0.3 $\mu\text{g/L}$ 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 ingesting water containing this chemical. Similarly, EPA estimates that ingesting water containing 3.0 $\mu\text{g/L}$ would result in not greater than a one-in-hundred thousand increased chance of developing cancer, and water containing 30 $\mu\text{g/L}$ 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. (2)
- EPA has also calculated an oral cancer slope factor (CSF) of $0.12 (\text{mg/kg/d})^{-1}$. (2)

Physical Properties

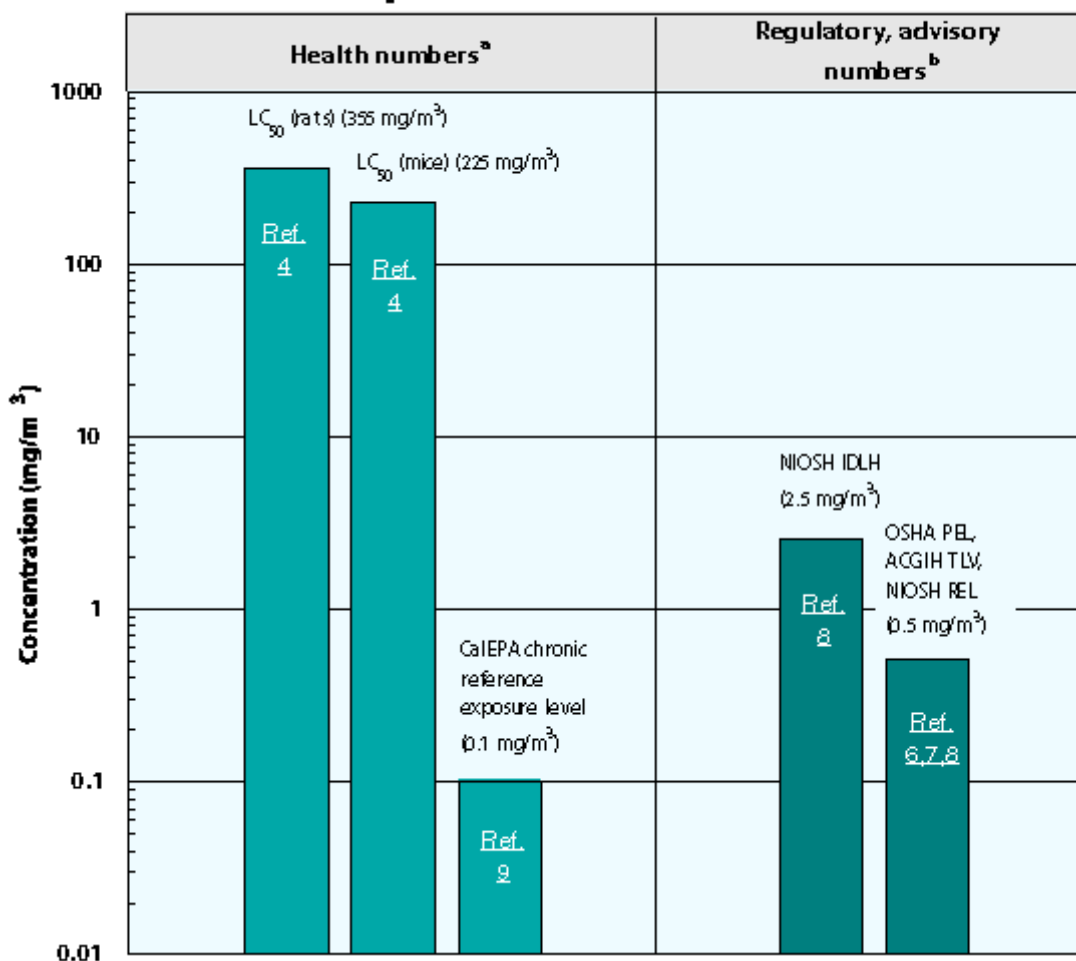
- Pentachlorophenol exists as colorless or white crystals (when pure) with a sharp, phenolic odor when hot, but very little odor at room temperature. (1)
- The odor threshold for pentachlorophenol is approximately 12 parts per million (ppm). (1)
- Impure pentachlorophenol is dark gray to brown and exists as dust, beads, or flakes. (1)
- The chemical formula for pentachlorophenol is $\text{C}_6\text{HCl}_5\text{O}$, and its molecular weight is 266.35 g/mol. (1)
- The vapor pressure for pentachlorophenol is 0.00011^5 mm Hg at 25 °C, and it has a log octanol/water partition coefficient ($\log K_{ow}$) of 5.01. (1)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg/m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For pentachlorophenol: 1 ppm = 10.9 mg/m^3 . To convert concentrations in air from $\mu\text{g/m}^3$ to mg/m^3 : $\text{mg/m}^3 = (\mu\text{g/m}^3) \times (1 \text{ mg} / 1,000 \mu\text{g})$.

Health Data from Inhalation Exposure

Pentachlorophenol



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.

LC₅₀ (Lethal Concentration₅₀)--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.

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.

References

Summary created in April 1992, updated in January 2000

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