

DDE

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DDE (1,1-DICHLORO-2,2-BIS(p-CHLOROPHENYL) ETHYLENE)

72-55-9

Hazard Summary

1,1-Dichloro-2,2-bis(p-chlorophenyl) ethylene (DDE) is a breakdown product of DDT, which was used in the past as an insecticide. No information is available on the acute (short-term) or chronic (long-term) effects of DDE. Acute, oral exposure to high doses of DDT in humans results in central nervous system (CNS) effects, such as headaches, nausea, and convulsions. The only effect noted in epidemiologic studies of workers exposed to DDT and other pesticides was an increase in activity of liver enzymes. Animal studies have reported effects on the liver, immune system, and CNS from chronic oral exposure to DDT. Human studies are inconclusive regarding DDE and cancer. Animal studies have reported an increased incidence of liver tumors in mice and hamsters, and thyroid tumors in female rats from oral exposure to DDE. EPA has classified DDE as a Group B2, probable human carcinogen.

Please Note: The main source of information for this fact sheet is the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for 4,4-DDT, 4,4-DDE, and 4,4-DDD (1) and EPA's Integrated Risk Information System (IRIS) (5), which contains information on the carcinogenic effects of DDE including the unit cancer risk for oral exposure.

Uses

- DDT was extensively used in the past for the control of malaria, typhus, and other insect-transmitted diseases. It was banned for use in the United States in 1972, except in the case of a public health emergency. (1)
- DDE is a breakdown product of DDT and has no uses. (1)

Sources and Potential Exposure

- DDE is found in the environment as a result of the breakdown of DDT, an insecticide. (1)
- Human exposure to DDE appears to be primarily through food; in the United States in 1981, consumption of DDE in foods was estimated to be 0.001 parts per million per day (ppm/d). However, the levels of DDE in foods have been decreasing and are expected to continue to decrease. (1)
- Levels of DDE in air and water samples are very low. (1)
- DDE 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

- DDE can be detected in fat, blood, urine, semen, and breast milk. (1)

Health Hazard Information

Acute Effects:

- No studies are available on the acute effects of DDE in humans. (1)
- Acute oral exposure to high doses of DDT in humans results in CNS effects, such as headaches, nausea, and convulsions. (1)
- Case reports in humans have noted that doses as high as 285 milligrams DDT per kilogram body weight per day (mg/kg/d) have been ingested accidentally with no fatal results. (1)
- Tests involving acute exposure of rats, guinea pigs, and rabbits have shown DDT to have moderate acute toxicity from oral exposure. (3)

Chronic Effects (Noncancer):

- The only effect noted in epidemiologic studies of workers exposed to DDT and other pesticides was an increase in activity of liver enzymes. No adverse effects on the blood, liver, heart, or CNS were noted. (1)
- Animal studies have reported effects on the liver, immune system, and CNS from chronic oral administration of DDT. (1,4,9)
- EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for DDE. (5)
- EPA has established an RfD of 0.0005 milligrams per kilogram body weight per day (mg/kg/d) for DDT based on liver effects in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous ingestion 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. (5)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of DDT or DDE in humans via inhalation exposure. (1)
- No studies are available on the developmental effects in humans after oral exposure to DDT or DDE. However, DDT and DDE have been found in human blood, placental tissue, and umbilical cord blood. (1)
- Epidemiologic studies did not find an association between DDT maternal blood levels and miscarriages or premature rupture of fetal membranes in humans. (1)
- Oral animal studies have reported reproductive effects, such as reduced fertility, adverse effects on spermatogenesis, and decreased testicular and ovarian weights from DDT exposure. Developmental effects, such as embryotoxicity and fetotoxicity, but not teratogenicity (birth defects) have also been observed in oral animal studies. (1)
- DDT has been shown to elicit estrogenic activity in rats after oral exposure (1).

Cancer Risk:

- Studies of workers exposed to DDT have yielded conflicting results. Three studies reported that tissue levels of DDT and DDE were higher in cancer victims than in those dying of other diseases. In other studies, no such relationship was seen. (5,9)
- Animal studies have reported an increased incidence of liver tumors in mice and hamsters and thyroid tumors in female rats from oral exposure to DDE. (5)
- EPA has classified DDE as a Group B2, probable human carcinogen. (5)
- 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 has calculated an oral cancer slope factor of $0.34 \text{ (mg/kg/d)}^{-1}$ and a unit risk estimate of $9.7 \times 10^{-6} \text{ (}\mu\text{g/L)}^{-1}$. EPA estimates that, if an individual were to continuously ingest water containing an average of DDE at $0.1 \mu\text{g/L}$ 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 $1.0 \mu\text{g/L}$ would result in not greater than a one-in-a-hundred-thousand increased chance of developing cancer, and water containing $10.0 \mu\text{g/L}$ 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. (5)

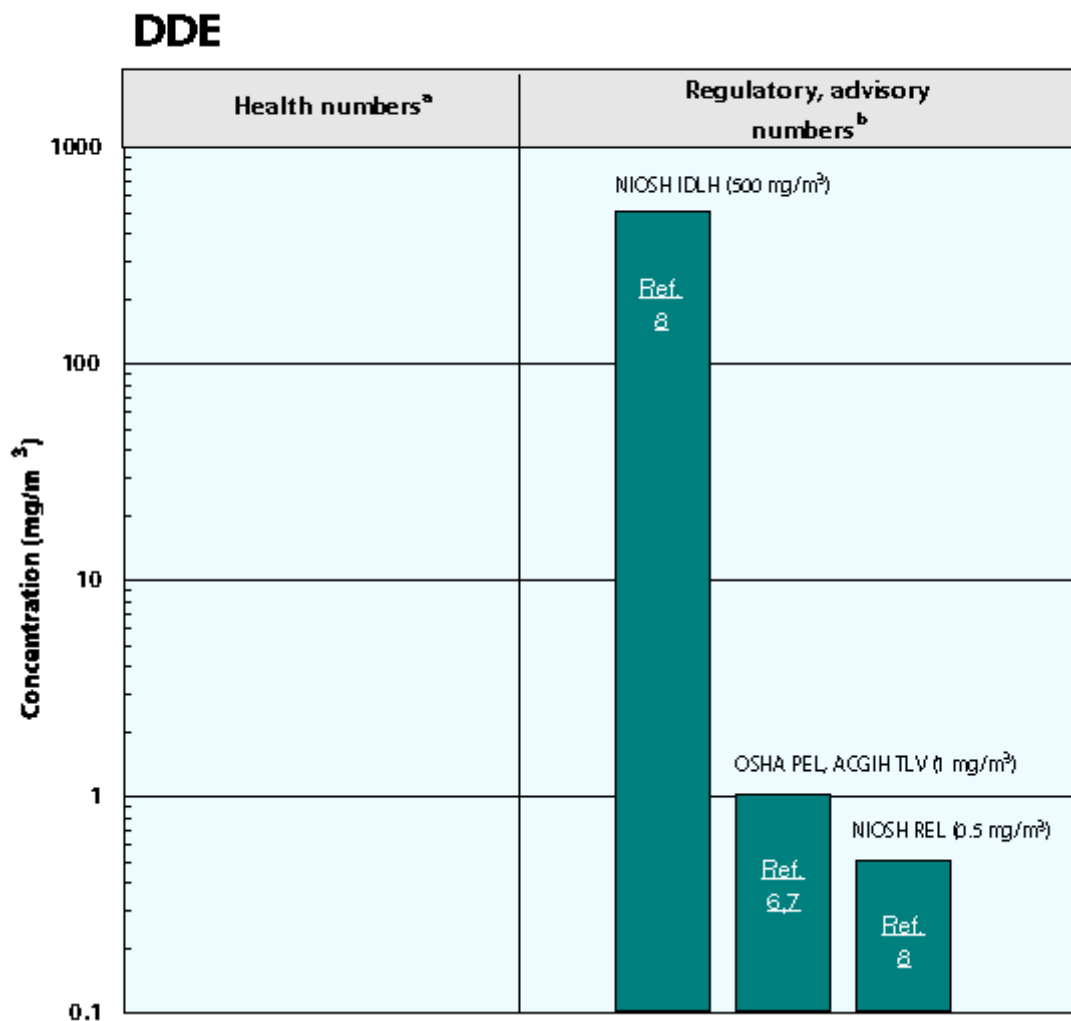
Physical Properties

- DDE is also known as 1,1-dichloro-2,2-bis(p-chlorophenyl) ethylene and p,p-dichlorodiphenyldichloroethylene.
- DDE is a white crystalline solid. (1)
- The odor threshold for DDE is not available. (1)
- The chemical formula for DDE is $C_{14}H_8Cl_4$, and the molecular weight is 318.03 g/mol. (1)
- The vapor pressure for DDE is 6.5×10^{-6} torr at 20 °C, and it has a log octanol/water partition coefficient ($\log K_{ow}$) of 7.0. (1)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm₃ to mg/m³: $mg/m^3 = (ppm) \times (molecular\ weight\ of\ the\ compound) / (24.45)$. For DDE: 1 ppm = 13.0 mg/m³; for DDT: 1 ppm = 14.5 mg/m³.

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.

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.

* All health and regulatory numbers are for DDT.

The health and regulatory values cited in this fact sheet 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.

Summary created in April 1992, updated January 2000

References

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 4,4-DDT, 4,4-DDE, and 4,4-DDD. 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](#). EPA-453/R-93-055. First Report to Congress. Office of Air Quality Planning and Standards, Research Triangle Park, NC. 1994.
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4. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, [online database](#)). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
5. U.S. Environmental Protection Agency. [Integrated Risk Information System \(IRIS\) on p,p-Dichlorodiphenyldichloroethylene](#). National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
6. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations. 29 CFR 1910.1000. 1998.
7. 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.
8. 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.
9. U.S. Environmental Protection Agency. [Integrated Risk Information System \(IRIS\) on p,p-Dichlorodiphenyltrichloroethane](#). National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.

A. This fact sheet focuses on the health effects of DDE. However, since DDE is a breakdown product of DDT, in those cases where no information is available on DDE and there is information on DDT, the information on DDT is presented.
