



PUBLIC HEALTH STATEMENT

PENTACHLOROPHENOL

CAS#: 87-86-5

Division of Toxicology

September 2001

This Public Health Statement is the summary chapter from the Toxicological Profile for Pentachlorophenol. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-888-422-8737.

This public health statement tells you about pentachlorophenol and the effects of exposure. The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Pentachlorophenol has been found in at least 313 of the 1,585 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which pentachlorophenol is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to pentachlorophenol, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS PENTACHLOROPHENOL?

Pentachlorophenol is a synthetic substance, made from other chemicals, and does not occur naturally in the environment. It is made by only one company in the United States. At one time, it was one of the most widely used biocides in the United States. Since 1984, the purchase and use of pentachlorophenol has been restricted to certified applicators. It is no longer available to the general public. Application of pentachlorophenol in the home as an herbicide and pesticide accounted for only 3% of its consumption in the 1970s. Before use restrictions, pentachlorophenol was widely used as a wood preservative. It is now used industrially as a wood preservative for power line poles, cross arms, fence posts, and the like. Pure pentachlorophenol exists as colorless crystals. It has a very sharp characteristic phenolic smell when hot but very little odor at room temperature. Most people can begin to smell pentachlorophenol in water at less than 12 parts pentachlorophenol per million parts of water (ppm). Impure pentachlorophenol (the form usually found at hazardous waste sites) is dark gray to brown and exists as dust, beads, or flakes. Pentachlorophenol can be found in two forms: pentachlorophenol itself or as the sodium salt of pentachlorophenol. The sodium salt dissolves easily in water, but pentachlorophenol does not. These two forms have some different physical properties, but

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are expected to have similar toxic effects. Humans are generally exposed to technical-grade pentachlorophenol, which usually contains such toxic impurities as polychlorinated dibenzo- p-dioxins and dibenzofurans.

1.2 WHAT HAPPENS TO PENTACHLOROPHENOL WHEN IT ENTERS THE ENVIRONMENT?

Pentachlorophenol is released to the air by evaporation from treated wood surfaces and factory (chemical manufacturing plants and wood preservation plants) waste disposal. It enters surface water and groundwater from factories, wood-treatment facilities, and hazardous waste sites. It also enters the soil as a result of spills, disposal at hazardous waste sites, and its use as a pesticide. The physical and chemical properties of the compound suggest that not much will evaporate into the atmosphere and that most of it will move with water and generally stick to soil particles. Movement of pentachlorophenol in soils depends on the soil's acidity. The compound can be present in fish or other species used for food, as demonstrated by the ongoing food monitoring program of the Food and Drug Administration (FDA). In air, soil, and surface water, pentachlorophenol lasts for hours to days. The compound is broken down in soil and surface water by microorganisms, and in air and surface water by sunlight, to other compounds, some of which may be harmful to humans.

1.3 HOW MIGHT I BE EXPOSED TO PENTACHLOROPHENOL?

In addition to workplace exposures, humans can be exposed to very low levels of pentachlorophenol

through indoor and outdoor air, food, soil, and drinking water. Exposure may also result from dermal contact with wood treated with preservatives that contain pentachlorophenol. Levels in the workplace, near certain hazardous waste sites, and near sites of accidental spills are usually higher than in the general environment. Exposure to pentachlorophenol by eating contaminated food is limited. The average intake in food is estimated to be 0.0105 milligrams of pentachlorophenol for a 70 kg human. Daily intake by drinking contaminated water is also low and is estimated to be about 0.021 mg for a 70 kg human. In its survey of various population groups in 1986–1991, the ongoing food monitoring program of the FDA observed a substantial decrease in the daily intakes of pentachlorophenol.

We do not have much information on the levels of pentachlorophenol in indoor and outdoor air, but the general population is estimated to breathe in about 0.063 mg/day. People who work or live near pentachlorophenol sources are exposed to higher levels. A 1984 report cites the measured concentration of pentachlorophenol in the indoor air of pressure-treated log homes brushed with pentachlorophenol in the range of 0.5–10 parts per trillion (ppt, 1 ppt is 1 million times less than 1 ppm) and in the air of industrially dipped, nonpressure-treated log homes at 34–104 ppt. Levels of pentachlorophenol in the air at wood-treatment facilities and lumber mills are much higher, and workers exposed at these places are estimated to breathe in 10.5–154.0 mg/day. Workers who handle treated lumber can take in about 35.0 mg/day through the skin.

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1.4 HOW CAN PENTACHLOROPHENOL ENTER AND LEAVE MY BODY?

Pentachlorophenol easily enters your body through your lungs when you breathe it, through your digestive tract after you eat contaminated food or water, or through your skin. The most significant ways are through breathing and skin contact. After a short exposure period, pentachlorophenol quickly leaves your body (studies in humans show that half the amount taken in is usually gone within 33 hours). It does not seem to build up in the body very much. Most of the pentachlorophenol taken into your body does not break down, but instead leaves in your urine. Much smaller amounts leave in your feces. Only a small amount escapes through your exhaled air. Some of the pentachlorophenol taken into your body is joined with other natural chemicals that make the pentachlorophenol less harmful. The combined product can then leave your body more easily.

1.5 HOW CAN PENTACHLOROPHENOL AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests. One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws

today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Some, but not all, of the harmful effects associated with exposure to pentachlorophenol are due to impurities present in commercial pentachlorophenol. Short exposures to large amounts of pentachlorophenol in the workplace or through the misuse of products that contain it can cause harmful effects on the liver, kidneys, blood, lungs, nervous system, immune system, and gastrointestinal tract. Contact with pentachlorophenol (particularly in the form of a hot vapor) can irritate the skin, eyes, and mouth. If large enough amounts enter the body, heat is produced by the cells in the body, causing an increase in body temperature. The body temperature can increase to dangerous levels, causing injury to various organs and tissues and even death. This effect is the result of exposure to pentachlorophenol itself and not the impurities. The lengths of exposure and the levels that cause harmful effects have not been well defined. Long-term exposure to low levels such as those that occur in the workplace can cause damage to the liver, kidneys, blood, and nervous system. Studies in animals also suggest that the endocrine system and immune system can also be damaged following long-term exposure to low levels of pentachlorophenol. All of these effects get worse as the level of exposure increases. Decreases in the number of newborn animals, harmful effects on reproductive organs of the mothers, decreases in the number of successful pregnancies, and increases in the length of pregnancy were observed in animals exposed to pentachlorophenol while they were pregnant. Harmful effects on reproductive organs of the females were also seen in animals exposed to

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pentachlorophenol while they were not pregnant. We do not know if pentachlorophenol produces all of the same effects in humans that it causes in animals.

An increased risk of cancer has been shown in some laboratory animals given large amounts of pentachlorophenol orally for a long time. There is weak evidence that pentachlorophenol causes cancer in humans. The International Agency for Research on Cancer (IARC) has determined that pentachlorophenol is possibly carcinogenic to humans, and the EPA has classified pentachlorophenol as a probable human carcinogen.

1.6 HOW CAN PENTACHLOROPHENOL AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans.

Children might be exposed to pentachlorophenol by eating fish and other foods contaminated with the substance, by accidentally or intentionally eating soil or drinking water contaminated with the substance, or by drinking breast milk contaminated with the substance. Tests have not been performed to measure pentachlorophenol in breast milk in the United States, although small amounts have been found in the milk of chemical workers in Eastern Europe. Children might also be exposed to pentachlorophenol by breathing air in homes that contain wood that has been treated with the substance or by skin contact with contaminated soils or with the exposed surface of wood that has been treated with the substance. For most people, food is the most important source of intake of

pentachlorophenol, and most of this intake is from root vegetables. Based on analyses of foods representative of the diets of different age/gender population groups, daily intakes of pentachlorophenol from the diet, although low overall, are higher in infants and toddlers than in teenagers and adults. Daily intakes of pentachlorophenol from food have decreased over time.

Newborn children who were accidentally exposed to diapers and bedding that were contaminated with pentachlorophenol had high fevers, a large amount of sweating, a hard time with breathing, and harmful effects on their nervous system and liver, and some died. In the newborn animals of mothers that were given pentachlorophenol by mouth, slight changes were seen in the formation of bones and their weight was decreased at weaning. One study in animals showed that large amounts of pentachlorophenol taken by mouth can damage the testes, but it is unknown whether such large amounts affect the ability of animals to have babies. The immune system was suppressed in family members, including children as young as 8 years old, who were exposed to pentachlorophenol while living in log homes.

Absorption of pentachlorophenol is expected by all routes of exposure, and the harmful effects of pentachlorophenol should be qualitatively similar over all routes of exposure; these effects might also occur in children exposed to low levels of pentachlorophenol by any route. There is not enough information to know whether children under 18 years of age differ from adults in their sensitivity to the health effects of pentachlorophenol. One study in animals found that small amounts of

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pentachlorophenol may cross the placenta, and it is possible that it can reach and cross the placenta in humans.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO PENTACHLOROPHENOL?

If your doctor finds that you have been exposed to significant amounts of pentachlorophenol, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

Pentachlorophenol was a widely used pesticide and a wood preservative (utility poles) for a long time. It is no longer present in any product you can buy today. It can be applied only by certified applicators. Although it is no longer commonly used, traces of pentachlorophenol are still found in small amounts in air, water, and soil. It is also found at some hazardous waste sites. Up until 1980, you could buy pentachlorophenol-containing pesticides. Since then, it has been regulated and can only be used in a restricted number of places. You may have old containers of pesticides in your attic, basement, or garage that contain pentachlorophenol. Removing these old containers will reduce your family's risk of exposure to pentachlorophenol. You should dispose of these old containers in an appropriate manner through your county's hazardous waste facility. Otherwise, place them out of reach of young children to prevent accidental exposures. You should never store pesticides or household chemicals in containers that children would find attractive to eat or drink from, such as soda bottles.

Your children may be exposed to pentachlorophenol if an unqualified person applies pesticides containing it around your home. In some cases, the improper use of pesticides banned for use in homes has turned homes into hazardous waste sites. Make sure that any person you hire is licensed and, if appropriate, certified to apply pesticides. Your state licenses each person who is qualified to apply pesticides according to EPA standards and further certifies each person who is qualified to apply "restricted use" pesticides. Ask to see the license and certification. Also ask for the brand name of the pesticide, a Material Safety Data Sheet (MSDS), the name of the product's active ingredient, and the EPA registration number. Ask whether EPA has designated the pesticide "for restricted use" and what the approved uses are. This information is important if you or your family react to the product.

Though pentachlorophenol has been found in some foods, its levels are low. You can minimize the risk of your family's exposure by peeling and thoroughly washing fruits and vegetables before cooking.

Small children have a tendency to eat soil, and to put their hands and foreign objects in their mouths. This could result in their exposure to pentachlorophenol that may be present in the soil and on objects. Children may be exposed to pentachlorophenol by absorption through the skin. Pentachlorophenol is known to be rapidly absorbed by the skin from the soil. You should prevent children from putting their hands and foreign objects in their mouths and you should discourage your children from eating dirt. Make sure they wash their hands frequently. Very low levels of pentachlorophenol have been detected in house and

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carpet dust. Keeping the house clean and free of dust will reduce your family's exposure to pentachlorophenol.

Pentachlorophenol was used for treating wood. It is no longer used for treating wood used in and around homes. But it is still used for treating wood utility poles and railroad ties. If you live near a utility pole or railroad tracks, you should prevent your children from playing, climbing, or sitting on them especially in the hot summer months. Old playground equipment may contain pentachlorophenol, and children may be exposed dermally when playing on it. If you have old treated wood in or around your house, covering it with epoxy paint may reduce the risk of your family's exposure to pentachlorophenol. Wood treated with pentachlorophenol (e.g., railway ties) should not be used for landscaping, especially near gardens or private wells

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO PENTACHLOROPHENOL?

Pentachlorophenol and its products can be measured in the blood, urine, and tissues of exposed persons. Because urine and blood samples are easily collected, testing these fluids is the best way to find out whether a person has been exposed. Neither test is usually available at a doctor's office because both require the use of special equipment. Although these tests can prove that a person has been exposed, they cannot be used to tell how severe any health effects might be. Because pentachlorophenol leaves the body fairly quickly, these tests are best for finding exposures that occurred within the last several days. Exposure at hazardous waste sites

usually includes exposure to other organic compounds, such as hexachlorobenzene, that could break down into pentachlorophenol. On the other hand, measurement of blood and urine levels for pentachlorophenol and its products in groups of exposed people and nonexposed people is a good way to tell whether exposure to pentachlorophenol or members of the same chemical family occurred.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA).

Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

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Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for pentachlorophenol include the following:

The federal government has set regulatory standards and guidelines to protect workers from the possible health effects of pentachlorophenol in air. OSHA has set a legally enforceable limit of 0.5 milligrams per cubic meter (mg/m³) in workroom air to protect workers during an 8-hour shift over a 40-hour work week.

The federal government has also set regulatory standards and guidelines to protect the public from the possible health effects of pentachlorophenol in drinking water. EPA decided that the amount in the drinking water should not be more than 0.022 milligram per liter (mg/L) and that any release of more than 10 pounds to the environment should be reported. For short-term exposures, EPA decided that drinking water levels should not be more than 1.0 mg/L for 1 day or 0.3 mg/L for 10 days. EPA also estimates that for an average-weight adult, exposure to 0.03 mg/kg/day will probably not cause any noncancer health effects. EPA is now working to measure the levels of pentachlorophenol found at abandoned waste sites.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333

Information line and technical assistance:

Phone: 888-422-8737
FAX: (770)-488-4178

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800-553-6847 or 703-605-6000

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2001. Toxicological profile for pentachlorophenol. Update. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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