



PUBLIC HEALTH STATEMENT CHLOROPHENOLS

Division of Toxicology

July 1999

This Public Health Statement is the summary chapter from the Toxicological Profile for Chlorophenols. 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 chlorophenols 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. Chlorophenols has been found in at least 116 of the 1,467 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 chlorophenols are 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 chlorophenols, 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 ARE CHLOROPHENOLS?

Chlorophenols are a group of chemicals in which chlorines (between one and five) have been added to phenol. Phenol is an aromatic compound derived from benzene, the simplest aromatic hydrocarbon, by adding a hydroxy group to a carbon to replace a hydrogen. There are five basic types of chlorophenols: mono[one]chlorophenols, di[two]chlorophenols, tri[three]chlorophenols, tetra[four]chlorophenols, and penta[five]chlorophenols. In all, there are 19 different chlorophenols. Eight are discussed in this document: 2-chlorophenol, 4-chlorophenol, 2,4-dichlorophenol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4,6-tetrachlorophenol, and 2,3,5,6-tetrachlorophenol. Pentachlorophenol is discussed in another document.

Except for 2-chlorophenol, which is a liquid at room temperature, all of the chlorophenols are solids. The chlorophenols have a strong medicinal taste and odor; small amounts (at parts per billion [ppb] to parts per million [ppm] concentrations) can be tasted in water. Very small amounts of chlorophenols can also make fish taste bad. All the compounds discussed are or were produced commercially.

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Chlorophenols with at least two chlorines either have been used directly as pesticides or converted into pesticides. Also, chlorophenols, especially 4-chlorophenol, have been used as antiseptics. In addition to being produced commercially, small amounts of some chlorophenols, especially the mono- and dichlorophenols, may be produced when waste water or drinking water is disinfected with chlorine, if certain contaminants are present in the raw water. They are also produced during the bleaching of wood pulp with chlorine when paper is being produced.

1.2 WHAT HAPPENS TO CHLOROPHENOLS WHEN THEY ENTER THE ENVIRONMENT?

Chlorophenols can enter the environment while they are being made or used as pesticides. Most of the chlorophenols released into the environment go into water, with very little entering the air. The compounds that are most likely to go into the air are the mono- and dichlorophenols because they are the most volatile (that is, have the greatest tendency to form vapors or gases). Once in the air, sunlight helps destroy these compounds and rain washes them out of the air. Chlorophenols stick to soil and to sediments at the bottom of lakes, rivers, or streams. However, low levels of chlorophenols in water, soil, or sediment are broken down by microorganisms and are removed from the environment within a few days or weeks.

1.3 HOW MIGHT I BE EXPOSED TO CHLOROPHENOLS?

Most people are exposed to very low levels of chlorophenols in drinking water that has been disinfected with chlorine (chlorinated drinking

water). Chlorophenols have been measured in chlorinated drinking water at parts per trillion (ppt) concentrations (that is, the amount [weight] of chlorophenols per trillion parts [volume] of water). In lakes, rivers, and streams, chlorophenols were found in less than 1 percent of the water that was tested. Chlorophenols have been measured in city air at concentrations of less than a part per trillion (the amount of chlorophenols [volume] per trillion parts [volume] of air).

It has been estimated during the National Occupational Exposure Survey (NOES) from 1981–1983 that about 5,000 people in the United States are exposed to 4-chlorophenol, 2,4,5-trichlorophenol, or 2,4,6-trichlorophenol at work (NOES 1990). It has not been estimated how many people are exposed at work to the other chlorophenols. People who make chlorophenols or use them as pesticides are most likely to have high exposure to these chemicals. For example, mixtures of tetrachlorophenols are used at sawmills as wood preservatives. Skin contact while treating wood with the tetrachlorophenols is the most likely route of exposure. Another likely route of exposure is breathing air contaminated by mono- and dichlorophenols.

1.4 HOW CAN CHLOROPHENOLS ENTER AND LEAVE MY BODY?

When chlorophenols are eaten, almost all of the compounds quickly enter the body. Chlorophenols also rapidly enter the body through the skin. Little is known about how much of the chlorophenols enter the body if one breathes air containing them. The monochlorophenols do not stay inside the body very long. They are changed to less harmful products, and most leave through the urine within

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24 hours. The other chlorophenols (dichlorophenol, trichlorophenols, tetrachlorophenols), which also leave through the urine as less harmful chemicals, can stay in the body for several days.

1.5 HOW CAN CHLOROPHENOLS 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.

One man who splashed pure 2,4-dichlorophenol on his arm and leg died shortly after the accident. Workers who made pesticides from chlorophenols and were exposed to chlorophenols as well as other chemicals through breathing and through the skin developed acne and mild injury to their livers. According to some studies, the risk of cancer was also slightly higher among workers who had made pesticides for a long time. These workers were exposed to very high levels of other chemicals as well as chlorophenols, so it is not certain whether the effects were caused by the chlorophenols or the other chemicals.

Animals that were given food or drinking water containing chlorophenols at high levels developed adverse or negative health effects. The major effects with exposure to high levels of chlorophenols were on the liver and the immune system. Also, the animals that ate or drank chlorophenols did not gain as much weight as the animals that ate food and drank water not containing chlorophenols.

Feeding rats and mice high doses of 2,4-dichlorophenol for a long time did not cause cancer. However, long-term treatment of rats and mice with high doses of 2,4,6-trichlorophenol in food caused leukemia in rats and liver cancer in mice, suggesting that 2,4,6-trichlorophenol may be a carcinogen. The Department of Health and Human Services has determined that 2,4,6-trichlorophenol may reasonably be anticipated to be a carcinogen. The International Agency for Research on Cancer (IARC) has determined that the chlorophenols as a group, are possibly carcinogenic to man. The Environmental Protection Agency (EPA) has determined that 2,4,6-trichlorophenol is a probable carcinogen.

Putting chlorophenols on the skin or eyes of animals causes severe injuries. Injury is greatest with exposure to the mono- and dichlorophenols. The signs of severe skin injury include redness, swelling, scabbing, and scar formation. The cornea was damaged when monochlorophenols were placed directly onto the eyes of rabbits.

1.6 HOW CAN CHLOROPHENOLS AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to

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maturity at 18 years of age in humans. Potential effects on children resulting from exposures of the parents are also considered.

The most likely source from which children could be exposed to chlorophenols is water that has been disinfected with chlorine. Children could receive larger doses because they consume more fluids per bodyweight than adults. Children may also be exposed in areas where chlorophenols have been sprayed as pesticides or herbicides. Children playing outdoors in areas with contaminated soil could be at risk for exposure because they often put objects or hands in their mouths.

Monochlorophenols are used as household antiseptics, and 2,4-DCP is used for mothproofing. More complex chlorophenols are used as biocides. Biocides are substances used to kill organisms.

We do not know whether chlorophenols cause birth defects in humans; chlorophenols have not been shown to cause birth defects in animals, even at high doses. High levels of chlorophenols given to pregnant female rats in the drinking water have tended to reduce the number of their newborn animals and to decrease the weights of the newborn. In one study animals exposed to chlorophenols showed delayed hardening of some bones. We do not know whether chlorophenols can cross the placenta or get into breast milk.

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

If your doctor finds that you have been exposed to significant amounts of chlorophenols, ask if children may also be exposed. When necessary

your doctor may need to ask your state department of public health to investigate.

The chlorophenols presented in this profile exist in eight different forms, each one having different properties and uses. Therefore, different routes exist in which a family may be exposed to chlorophenols. Chlorophenols are primarily used as antiseptics, disinfectants, herbicides, pesticides, and wood preservatives. People are at greater risk of exposure if they live near industrial facilities that use or manufacture chlorophenols or waste sites that could be releasing it into the environment. Most released chlorophenols are found in surface water or have become adsorbed in soil near the release point. Children should be kept from coming in contact with water or dirt in an area that could be contaminated. You should prevent your children from eating dirt. Make sure they wash their hands frequently and before eating. Discourage your children from putting their hands in their mouths or other hand-to-mouth activity.

People who do not live near production or waste sites can still be exposed to chlorophenols through other routes. Chlorophenols can be present in drinking water when chlorine is used to disinfect it. The safe drinking water standard for 2-chlorophenol is 39 mg/L (monthly average). At low concentrations, chlorophenols give water an unpleasant, medicinal taste.

Chlorophenols and other related chemicals are often used as herbicides and pesticides. 2,4-D and 2,4,5-T, the latter of which has been banned, are herbicides often used on food crops that can break down to form 2,4-DCP. Children should be deterred from playing in areas where 2,4-D or other chlorophenol based herbicides or pesticides have

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been sprayed. Children are lower to the ground than adults and may be exposed because they often get dirt, grass, and other outdoor material on their skin and in their mouths. Also, your children may be exposed to chlorophenols if an unqualified person applies pesticides containing them 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.

If you buy over-the-counter pesticide products to apply yourself, be sure the products are in unopened pesticide containers that are labeled and contain an EPA registration number. Carefully follow the instructions on the label. If you plan to spray inside, make sure the pesticide is intended for indoor use.

If you feel sick after a pesticide has been used in your home, consult your doctor or local poison control center.

Chlorophenols may also be present in many household products. 2,4-DCP is commonly used for mothproofing. 4-CP is used as a disinfectant in homes, farms, hospitals, and as an antiseptic for

root canal treatment. Monochlorophenols have been used as antiseptics, although they have largely been replaced by other chemicals. Pesticides and household chemicals should be stored out of reach of young children to prevent unintentional poisonings. Always store pesticides and household chemicals in their original labeled containers. Never store pesticides or household chemicals in containers children would find attractive to eat or drink from, such as old soda bottles.

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

There is no medical test that is specific for chlorophenols to determine whether you have been exposed to these chemicals. Compounds that have been made by your body from chlorophenols can be measured in the urine. However, these compounds can also be found in the urine when you are exposed to other chemicals such as lindane (an insecticide) or to 2,4-dichlorophenoxyacetic acid (a chemical that kills weeds).

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

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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.

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 chlorophenols include the following:

The EPA recommends that drinking water concentrations of 2-chlorophenol should not be more than 0.04 part per million (ppm), and concentrations of 2,4-dichlorophenol should not be more than 0.02 ppm; these are levels that can be tasted. In order for chlorophenols to be lower than levels that can be tasted, the EPA recommends levels of 0.1 part per billion (ppb; the amount of chlorophenols per billion parts of water) for monochlorophenols, 0.3 ppb for 2,4-dichlorophenols, and 1 ppb for 2,4,5-trichlorophenol and 2,3,4,6-tetrachlorophenol.

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). 1999. Toxicological profile for chlorophenols. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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