



PUBLIC HEALTH STATEMENT CHLOROMETHANE

CAS#: 74-87-3

Division of Toxicology

December 1998

This Public Health Statement is the summary chapter from the Toxicological Profile for Chloromethane. 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 chloromethane 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. Chloromethane has been found in at least 172 of the 1,467 current or former NPL sites. However, it's unknown how many NPL sites have been evaluated for this substance. As more sites are evaluated, the sites with chloromethane may increase. This 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 chloromethane, 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 CHLOROMETHANE?

Chloromethane (also known as methyl chloride) is a clear, colorless gas. It has a faint, sweet odor that is noticeable only at levels which may be toxic. It is heavier than air and is extremely flammable.

Chloromethane is produced in industry, but the it also occurs naturally, and most of the chloromethane that is released to the environment (estimated at up to 99%) comes from natural sources. Chloromethane is always present in the air at very low levels. Most of the naturally occurring chloromethane comes from chemical reactions that occur in the oceans or from chemical reactions that occur when materials like grass, wood, charcoal, and coal are burned. It is also released to the air as a product of some plants or from rotting wood.

In the past, chloromethane was widely used as a refrigerant, but refrigerators no longer use chloromethane because of its toxic effects. It was also used as a foam-blowing agent and as a pesticide or fumigant. A working refrigerator that is more than 30 years old may still contain chloromethane, and may be a source of high-level exposure. Today, nearly all commercially produced chloromethane is used to make other substances, mainly silicones (72% of the total chloromethane used). Other products that are made from reactions involving chloromethane include agricultural

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chemicals (8%), methyl cellulose (6%), quaternary amines (5%), and butyl rubber (3%). Chloromethane is completely used up so that by the end of the process there is no or little chloromethane left to be released, disposed of, or reused. It is, however, found as a pollutant in municipal waste streams from treatment plants and industrial waste streams as a result of formation or incomplete removal. There are also some manufacturing processes for vinyl chloride that result in chloromethane as an impurity in the vinyl chloride end product.

1.2 WHAT HAPPENS TO CHLOROMETHANE WHEN IT ENTERS THE ENVIRONMENT?

Chloromethane has been identified in air, surface water, groundwater, soil, and sediment. Most releases of chloromethane will be to the air. Chloromethane rapidly moves through the air and is present at very low concentrations throughout the atmosphere. Naturally occurring chloromethane is continuously released into the atmosphere from oceans, rotting wood, forest fires, and volcanoes. When grass, coal, or wood are burned, chloromethane is released to the air. The burning of grasslands and forests accounts for about 20% (ranging from 10 to 40%) of the total chloromethane in the air. Releases from the oceans account for another 80 to 90%. Chemical companies release some chloromethane gas to the air during the production of chloromethane or when it is used to make other substances, but the amount is relatively very small (0.2 to 0.6%) compared to natural sources of the total chloromethane in the atmosphere.

Chloromethane breaks down very slowly (months to years) in the air. Chloromethane can dissolve in water, and small amounts of chloromethane in air may go into surface waters or groundwater when it rains. Chloromethane can also enter water from industrial or municipal waste streams or from water that comes in contact with municipal or hazardous waste sites. Chemical companies generally treat waste water to remove chloromethane.

Chloromethane is a gas at room temperature, and when present in water, most will evaporate rapidly to the air. Small amounts of dissolved chloromethane may move below the surface of the water or be carried to the groundwater. It breaks down very slowly (months to years) in plain water, but certain kinds of small organisms in water may break it down more quickly (days). When chloromethane comes in contact with soil it does not stick to the soil. Most of the chloromethane in soil will move to the air. Some may dissolve in water and move down through the soil layers to the groundwater or into well water. Chloromethane does not concentrate in sediments, or in animals and fish in the food chain.

1.3 HOW MIGHT I BE EXPOSED TO CHLOROMETHANE?

Most (99%) of the chloromethane in the environment comes from natural sources. Because chloromethane is made in the oceans by natural processes, it is present in air all over the world. In most areas, the outside air contains less than 1 part of chloromethane in a billion parts of air (ppb). In cities, human activities, mostly combustion and manufacturing, add to the chloromethane in the air, resulting in somewhat higher levels, up to 1 ppb. Chloromethane exposures in the less than 5 ppb

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range are much lower (1,000 to 10,000 times lower) than the exposure levels that have been shown to have toxic effects. Chloromethane is also present in some lakes and streams and has been found in drinking water (including well water) at very low levels in the parts per billion to part per trillion (ppt) range. Chloromethane may be formed to a small extent in tap water that has been chlorinated. You could be exposed to levels in air higher than the background levels if you live near a hazardous waste site or an industry that uses chloromethane. If chloromethane is present at waste sites, it can move through the soil into underground water. We have very little information on the levels of chloromethane in groundwater. Chloromethane is not generally found in food.

The people most likely to be exposed to increased levels of chloromethane in the air are those who work in chemical plants where it is made or used. Chloromethane is also an impurity in vinyl chloride when the vinyl chloride is produced by heating another chemical, 1,2-dichloroethane. Exposure to chloromethane can occur from this kind of vinyl chloride or the disposal of vinyl chloride waste from this process. The proper enforcement of workplace regulations and the recycling of chloromethane during the manufacturing process help prevent worker exposures to levels that would be considered harmful. In the past (more than 30 years ago), chloromethane was also widely used as the refrigerant in refrigerators. Some of these old refrigerators may still be in use or may be located in storage areas. Chloromethane may be released from leaks in these refrigerators, leading to potentially very high exposures, especially in areas with poor ventilation. Liquid contact could also occur following a leak in an older refrigerator containing chloromethane. Other general population sources

of chloromethane exposure include cigarette smoke; polystyrene insulation; aerosol propellants; home burning of wood, grass, coal, or certain plastics; and chlorinated swimming pools. The chloromethane in the outdoor environment, however, is almost totally from natural sources.

1.4 HOW CAN CHLOROMETHANE ENTER AND LEAVE MY BODY?

Chloromethane can enter your body through your lungs, if you breathe it in, or through your digestive tract if you drink water containing it. The chloromethane that you breathe in or drink rapidly enters the bloodstream from the lungs or the digestive tract and moves throughout the body to organs such as the liver, kidneys, and brain. Very little of the chloromethane that enters the body remains unchanged. The portion of the chloromethane that does not get changed in your body leaves in the air you breathe out. The rest is changed in your body to other breakdown products that mostly leave in the urine. The breakdown process takes anywhere from a few hours to a couple of days.

Breathing air that contains chloromethane vapor is the most likely way you would be exposed if you live near a hazardous waste site. Contact with liquid chloromethane is rare, but could occur in an industrial accident from a broken metal container. Prolonged skin contact with liquid chloromethane is unlikely, because it turns into a gas very quickly at room temperature. It is not known how much chloromethane liquid or gas will enter the body through contact with the skin, but the amount is probably very low.

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1.5 HOW CAN CHLOROMETHANE AFFECT MY HEALTH?

If the levels are high enough (over a million times the natural levels in outside air), even brief exposures to chloromethane can have serious effects on your nervous system, including convulsions, coma, and death. Some people have died from breathing chloromethane that leaked from refrigerators in rooms that had little or no ventilation. Most of these cases occurred more than 30 years ago, but this kind of exposure could still happen if you have an old refrigerator that contains chloromethane as the refrigerant. Some people who were exposed to high levels of chloromethane while they were repairing refrigerators did not die, but they did have toxic effects like staggering, blurred or double vision, dizziness, fatigue, personality changes, confusion, tremors, uncoordinated movements, nausea, or vomiting. These symptoms can last for several months or years. Complete recovery has occurred in some cases, but not in others. Exposure to chloromethane can also harm your liver and kidney, or have an effect on your heart rate and blood pressure. If you work in an industry that uses chloromethane to make other products, you might be exposed to levels that could cause symptoms resembling drunkenness and impaired ability to perform simple tasks.

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.

Harmful liver, kidney, and nervous system effects have developed after animals breathed air containing high levels of chloromethane (one million times higher than natural levels). Some of these animals died from exposure to high levels of chloromethane. Similar effects were seen in animals that breathed low levels continuously and animals that breathed high levels for shorter periods with some breaks from exposure.

Animals that breathed relatively low test levels of chloromethane (but still one hundred thousand to one million times higher than background levels people are exposed to) over a long period (weeks to months) had slower growth and developed brain damage. Some male animals were less fertile or even sterile or produced sperm that were damaged. Females that became pregnant by the exposed males lost their developing young.

Male mice that breathed air containing chloromethane (one million ppb) for 2 years developed tumors in their kidneys, but female mice and male and female rats did not develop tumors. It is not known whether chloromethane can cause sterility, miscarriages, birth defects, or cancer in humans. The Department of Health and Human Services (DHHS) has not classified chloromethane for carcinogenic effects. The International Agency for Research on Cancer (IARC) calls chloromethane

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a Group 3 compound, which means it cannot be determined whether or not it is a carcinogen because there is not enough human or animal data. The Environmental Protection Agency (EPA) considers chloromethane possibly carcinogenic to humans (i.e., Group C) based on limited evidence of carcinogenicity in animals.

1.6 HOW CAN CHLOROMETHANE 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 may be exposed to chloromethane from the same sources as adults. These sources include outside air, indoor air, and drinking water. Exposures are generally well below safe levels. The people most heavily exposed to chloromethane are workers in chemical plants where it is made or used. With proper safeguards to prevent children from entering these work areas, children would not be expected to have high exposures. Old refrigerators that used chloromethane as a refrigerant and that are leaking chloromethane, however, are a potential source that could result in high exposures to children.

There have been no studies on whether children are more or less susceptible than adults to harmful health effects from a given amount of chloromethane. We do not know if chloromethane affects the developing fetus or the development of young children. There is no information on exposure to high levels of chloromethane in children (for example, accidental poisoning), but we expect similar effects to those seen in adults (including harmful effects on the nervous system

and kidneys). We do not know if the effects for children would be similar to those in adults for lower levels or for longer exposures. There have been no studies where young animals were exposed to chloromethane. Animal studies have shown that female adult rats that were exposed to chloromethane during pregnancy had young that were smaller than normal, with underdeveloped bones, and possibly abnormal hearts (although this effect remains uncertain).

We do not know if chloromethane or its breakdown products in the body can cross the placenta and enter into the developing young. We also do not know if chloromethane or its breakdown products can enter into a nursing woman's milk. We do know that chloromethane is broken down and eliminated from the body very quickly in adults. Although we expect the breakdown and elimination of chloromethane to be the same in children as in adults, more studies are needed to answer this question and the other questions concerning the movement of chloromethane into the fetus or into nursing young through breast milk, and what amounts might result in harmful effects.

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

If your doctor finds that you have been exposed to significant amounts of chloromethane, ask your doctor if children may also be exposed. When necessary your doctor may need to ask your state Department of Public Health to investigate.

Families can reduce the risk of exposure to chloromethane by properly disposing of the older types of refrigerators that used chloromethane as a

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refrigerant. If you live near a chemical plant that makes or uses chloromethane, or near a hazardous waste site that stores it, you should teach your children not to play in or around these sites. If family members work in a chemical facility that manufactures or uses chloromethane, they should become familiar with the safety practices that are used to prevent exposure to harmful levels. They should also become familiar with their rights to obtain information from their employer concerning the use of chloromethane and any potential exposure they might be subject to at work.

You should teach your children about the dangers of breathing smoke from burning vinyl plastic or silicone rubber products, and should properly dispose of all such products. Chloromethane (as well as other toxic compounds) is released from burning polyvinyl chloride. If you are concerned that chloromethane may be in your drinking water, you can have your water tested and learn about the proper water filter to use to remove chloromethane (as well as other possible contaminants) from your drinking water. If you are concerned that products you are using might contain chloromethane, you can check the labels for ingredients or contact the manufacturer for additional information.

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

There are no known reliable medical tests to determine whether you have been exposed to chloromethane. Symptoms resembling drunkenness and food poisoning, along with a sweet odor of the breath, may alert doctors that a person has been exposed to chloromethane.

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

The federal government develops regulations and recommendations (sometimes called advisories or guidelines) 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.

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 chloromethane include the following:

To protect workers, OSHA has set a regulation of an average permissible exposure limit of 50 parts of

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chloromethane per million parts of workroom air (50 ppm) during each 8-hour work shift in a 40-hour workweek.

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). 1998. Toxicological profile for chloromethane. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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