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Toxicological Profile for

TRICHLOROETHYLENE

Draft
For Public Comment

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

February 18, 1992

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1. PUBLIC HEALTH STATEMENT

This Statement was prepared to give you information about trichloroethylene and to emphasize the human health effects that may result from exposure to it. The Environmental Protection Agency (EPA) has identified 1,300 sites on its National Priorities List (NPL). Trichloroethylene has been found in at least 614 of these sites. However, we do not know how many of the 1,300 NPL sites have been evaluated for trichloroethylene. As EPA evaluates more sites, the number of sites at which trichloroethylene is found may change. This information is important for you to know because trichloroethylene may cause harmful health effects and because these sites are potential or actual sources of human exposure to trichloroethylene.

When a chemical 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 as a chemical emission. This emission, which is also called a release, does not always lead to exposure. You can be exposed to a chemical only when you come into contact with the chemical. You may be exposed to it in the environment by breathing, eating, or drinking substances containing the chemical or from skin contact with it.

If you are exposed to a hazardous chemical such as trichloroethylene, several factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, life style, and state of health.

1.1 WHAT IS TRICHLOROETHYLENE?

Trichloroethylene is also known as Triclene®, Vitran®, and other names used in industry. It is a nonflammable, colorless liquid at room temperature with an odor similar to ether or chloroform. It is a man-made chemical that does not occur naturally in the environment. Trichloroethylene is mainly used as a solvent to remove grease from metal parts. It is used as a solvent in other ways too and is used to make other chemicals. Further information can be found in Chapters 3 and 4.

1.2 WHAT HAPPENS TO TRICHLOROETHYLENE WHEN IT ENTERS THE ENVIRONMENT?

By far, the biggest source of trichloroethylene in the environment is evaporation from factories that use it to remove grease from metals. It can also get into the air and water when it is disposed of at chemical waste sites. It evaporates easily but can stay in the

soil. Once it is in the air, about half will be destroyed within a week. When trichloroethylene is broken down in the air, phosgene, a lung irritant, is formed. Once it is in the water, much will evaporate into the air; again, about half will leave within a week. It will take days to weeks to break down in surface water and groundwater. Very little trichloroethylene breaks down in the soil. It is found in groundwater and in some foods. It does not build up in fish or other animals. For more information on trichloroethylene in the environment, see Chapters 4 and 5.

1.3 HOW MIGHT I BE EXPOSED TO TRICHLOROETHYLENE?

Trichloroethylene is in the outdoor air at levels far less than 1 part trichloroethylene per one million parts of air (ppm). When measured several years ago, some of the water supplies in the United States were found to have trichloroethylene in them. The most recent monitoring study found levels of 0.04 ppm in surface water and 0.03 ppm in groundwater. About 400,000 workers are exposed to trichloroethylene in the United States on a full-time basis. It can also get into the air or water at waste treatment facilities; by evaporation from paints, glues, and other chemicals; or by accidental release from factories where it is made. Another way you may be exposed is by breathing the air around factories that use the chemical to remove grease from metals. People living near hazardous waste sites may be exposed to it in the air or in their drinking water. Products that may contain trichloroethylene are some types of typewriter correction fluids, paints and paint removers, glue, spot removers, rug cleaning fluids, and metal cleaners. For more information on exposure to trichloroethylene, see Chapter 5.

1.4 HOW CAN TRICHLOROETHYLENE ENTER AND LEAVE MY BODY?

Trichloroethylene can easily enter your body when you breathe air or drink water containing it. You could be exposed to contaminated water or air if you live near or work in a factory that uses trichloroethylene or if you live near a waste site that contains trichloroethylene. If you breathe the chemical, about half the amount you breathe will get into your bloodstream; you will exhale the rest. If you drink it, most of it gets into your blood. It can also enter your body if you get a lot on your skin.

Once in your blood, your liver changes trichloroethylene into other chemicals. These leave your body in the urine within a day. You will also quickly breathe out much of the trichloroethylene that is in your bloodstream. It is not likely to build up in your body. For more information on trichloroethylene in your body, see Chapter 2.

1.5 HOW CAN TRICHLOROETHYLENE AFFECT MY HEALTH?

Trichloroethylene was once used as an anesthetic for surgery. People who breathe very high amounts become unconscious. People who are exposed to high levels of trichloroethylene can become dizzy or sleepy. Many people have jobs where they work with trichloroethylene and can breathe it or get it on their skin. Some people exposed to high levels of trichloroethylene have damage to some of the nerves in the face. It is uncertain whether these people are at higher risk for cancer or if their children may have higher numbers of birth defects. The International Agency for Research on Cancer has determined that trichloroethylene is not classifiable as to its carcinogenicity to humans. People who used water for several years from a certain well that had high levels of trichloroethylene may have had more leukemia in their families than other people. However, since other chemicals were also in the water from this well, we do not know whether trichloroethylene alone can cause leukemia. We do not know if trichloroethylene will affect human reproduction. Some people who get trichloroethylene on their skin develop rashes.

The Agency for Toxic Substances and Disease Registry has calculated Environmental Media Evaluation Guides (EMEGs) for trichloroethylene. EMEGs are derived from Minimal Risk Levels (MRLs) which are calculated from human or animal data for trichloroethylene. The MRLs are further described in Chapter 2 and in the footnote to Table 2-2. If a person is exposed to trichloroethylene at a level below the EMEG for the period listed below, we do not expect harmful health effects to occur. Because these levels are based only on information currently available, some uncertainty is always associated with them. Also, an EMEG does not imply anything about the presence, absence or level of risk for cancer because the methods for deriving EMEGs do not use any information about cancer. The EMEGs are provided as concentrations in order to allow for comparison to levels people might encounter in air, water, and soil around homes or in other areas where children may play.

<u>Drinking water exposure</u>

Drinking water EMEGs represent the lower end of a range and are protective for both children and adults.

- A drinking water EMEG of 1 ppm for trichloroethylene was derived from animal data for exposures longer than 14 days but less than one year.

Soil exposure

Soil EMEGs represent the lower end of a range and are protective for both children and adults. However, this range is not protective for children (pica) who show increased desire for eating non-food items (such as soil).

- A soil EMEG of 5,000 ppm for trichloroethylene was derived from animal data for exposures longer than 14 days but less than one year.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO TRICHLOROETHYLENE?

There is a test that can tell if you have been recently exposed to trichloroethylene, since this chemical can be measured in your breath. Also, the doctor can have a number of breakdown products of trichloroethylene measured in your urine or blood. None of these tests is routinely available at your doctor's office. These tests can also tell whether you have been exposed to a large amount of trichloroethylene, or only a small amount. Because one of the breakdown products is removed very slowly from the body, it can be measured in the urine for up to about 1 week after trichloroethylene exposure. However, exposure to other similar chemicals can produce the same breakdown products in your urine and blood. Therefore, these methods cannot tell you for sure that you have been exposed to trichloroethylene. For more information on medical tests, see Chapters 2 and 6.

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

The EPA has set a drinking water standard of 5 parts of trichloroethylene per one billion parts of water (ppb, 1 ppb is 1,000 times less than 1 ppm). This standard became effective on January 9, 1989, and applies to community water systems and those which serve the same 25 or more persons for at least 6 months.

Trichloroethylene levels in the workplace are regulated by the Occupational Safety and Health Administration (OSHA). The occupational exposure limit for an 8-hour workday, 40-hour workweek is an average concentration of 50 ppm in air. The 15-minute average exposure that should not be exceeded at any time during a workday is 200 ppm. The OSHA standards do not take into consideration the cancer-causing potential of trichloroethylene. EPA requires industry to report spills of 1,000 pounds or more of trichloroethylene. It has been proposed that this level be reduced to 100 pounds. For more information, see Chapter 7.

1.8 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, E-29
Atlanta, Georgia 30333

This agency can also provide you with information on the location of the nearest occupational and environmental health clinic. These clinics specialize in the recognition, evaluation, and treatment of illnesses resulting from exposure to hazardous substances.

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1. PUBLIC HEALTH STATEMENT

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When a chemical 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 as a chemical emission. This emission, which is also called a release, does not always lead to exposure. You can be exposed to a chemical only when you come into contact with the chemical. You may be exposed to it in the environment by breathing, eating, or drinking substances containing the chemical or from skin contact with it.

If you are exposed to a hazardous chemical such as tetrachloroethylene, several factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, life style, and state of health.

1.1 WHAT IS TETRACHLOROETHYLENE?

Tetrachloroethylene is a man-made substance that is widely used for dry cleaning fabrics and for metal-degreasing operations. It is also used as a starting material (building block) for making other chemicals and is used in some consumer products. Other names for tetrachloroethylene include perchloroethylene, perc, tetrachloroethene, perclene, and perchlor. It is a liquid at room temperature. Some of it evaporates into the air producing a sharp, sweet odor. For more information, see Chapters 3 and 4.

1.2 WHAT HAPPENS TO TETRACHLOROETHYLENE WHEN IT ENTERS THE ENVIRONMENT?

Tetrachloroethylene enters the environment mostly by evaporating into the air during use. It can also get into water supplies and the soil during disposal of sewage sludge and factory waste. Tetrachloroethylene may also get into the air, soil, or water by leaking or evaporating from storage and waste sites. It can last for several months in the air before

it is broken down into other chemicals or is brought back down to the soil and water by rain. Some of the chemicals that are formed may also be harmful.

Much of the tetrachloroethylene that gets into water and soil will evaporate to the air. Some of it can travel through the soil and get into underground drinking water supplies. Tetrachloroethylene that gets into underground water may stay there for many months without being broken down. If conditions are right, bacteria will break down some of it and some of the chemicals formed may also be harmful. Under some conditions, tetrachloroethylene may stick to the soil and stay there. It does not seem to build up very much in animals that live in water, such as fish, clams, and oysters. We do not know if it builds up in plants grown on land. For more information on tetrachloroethylene in the environment, see Chapters 4 and 5.

1.3 HOW MIGHT I BE EXPOSED TO TETRACHLOROETHYLENE?

Humans can be exposed to tetrachloroethylene from environmental and occupational sources and from consumer products. Common environmental levels of tetrachloroethylene (called background levels) are several thousand times lower than levels found in some workplaces. Background levels are found in the air we breathe, in the water we drink, and in the food we eat. The chemical is found most frequently in air and, less often, in water. Tetrachloroethylene gets into air by evaporation from industrial or dry cleaning operations. One study showed tetrachloroethylene was present in 25% of drinking water samples tested in the study. In another study, 14 to 26% of groundwater samples contained tetrachloroethylene. There are no similar studies on how often the chemical is found in air samples, but we know it is widespread in the air. We do not know how often it is found in soil, but it was found in 5% of sediments sampled. Tetrachloroethylene also comes from releases from areas where chemical wastes are stored.

In general, tetrachloroethylene levels in air are higher in cities or industrial areas than in more rural or remote areas. The background levels of tetrachloroethylene in air are far less than 1 part in 1 million parts of air (ppm). You can smell it at levels of 5 ppm in air. The air close to dry cleaning shops and chemical waste sites has levels of tetrachloroethylene higher than background levels. These levels are still less than 1 ppm. Water, both above and below ground, may contain tetrachloroethylene. Levels in water are also usually much less than 1 ppm, but are higher than levels in air. Levels in water near disposal sites are higher than levels in water far away from those sites. Water with tetrachloroethylene pollution may have levels greater than 1 ppm. Background levels in soil are probably 100 to 1,000 times lower than 1 ppm.

You can also be exposed to tetrachloroethylene by using certain consumer products. Products that may contain tetrachloroethylene include auto brake quieters and cleaners,

suede protectors, water repellents, silicone lubricants, and belt lubricants. Other products include specialized aerosol cleaners, ignition wire driers, fabric finishers, spot removers, adhesives, and wood cleaners. Although uncommon, small amounts of tetrachloroethylene have been found in food. Tetrachloroethylene may also be found in the breast milk of mothers who have been exposed to the chemical. For more information, see Chapter 5.

The people with the greatest chance of exposure to tetrachloroethylene are those who work with it. According to estimates from a survey conducted by the National Institute for Occupational Safety and Health (NIOSH) more than 650,000 U.S. workers may be exposed to tetrachloroethylene. The estimated amount that the general population might breathe in per day ranges from 0.04 to 0.2 milligrams. The estimated amount that most people might drink in water is less than 0.006 milligrams per day. These are very small amounts.

1.4 HOW CAN TETRACHLOROETHYLENE ENTER AND LEAVE MY BODY?

Tetrachloroethylene can rapidly enter your body when you breathe air containing it. How much enters your body by this route depends on how much of the chemical is in the air, how fast and deeply you are breathing, and how long you are exposed to it. Tetrachloroethylene may also rapidly enter your body through drinking water or eating food containing the chemical. How much enters your body depends on how much of the chemical you drink or eat. These two routes are the most likely ways people will take in tetrachloroethylene. These are also the most likely ways that people living near areas polluted with the chemical, such as hazardous waste sites, might take in tetrachloroethylene. Since tetrachloroethylene does not pass through the skin to any significant extent, entry into your body by this path is not of much concern.

Most tetrachloroethylene leaves your body rapidly when you breathe out the chemical in your breath. This is true whether you take up the chemical by breathing, drinking, eating, or touching it. Some of the tetrachloroethylene is changed into other chemicals in your body, and these are removed from your body in urine. One of these chemicals, trichloroacetic acid, is also thought to be harmful. Most of the changed tetrachloroethylene is removed in a few days. A small amount of the tetrachloroethylene that you take in is stored in tissues of your body. Part of the tetrachloroethylene that is stored in fat may stay in your body for several days or weeks. For more information on how tetrachloroethylene enters and leaves your body see Chapter 2.

1.5 HOW CAN TETRACHLOROETHYLENE AFFECT MY HEALTH?

When concentrations in air are high--particularly in closed, poorly ventilated areas--single exposures to tetrachloroethylene can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, and possibly unconsciousness and death. Skin

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irritation may result from repeated or extended contact with the chemical. As you might expect, these symptoms occur almost entirely in work (or hobby) environments. Some people may be exposed to levels lower than those causing dizziness, sleepiness, and other nervous system effects. The health effects of breathing in air or drinking water with low levels of tetrachloroethylene are not known. The effects of exposing babies to tetrachloroethylene through breast milk are unknown. Results from some studies suggest that women who work in dry cleaning industries may have more menstrual problems and spontaneous abortions than women who are not exposed to tetrachloroethylene. However, we do not know if tetrachloroethylene was responsible for these problems because other possible causes were not considered. The chemical does not seem to cause birth defects in children whose parents are exposed.

Most people can smell tetrachloroethylene when it is present in the air at levels of 5 ppm or more. You can smell tetrachloroethylene in water if there is 0.3 ppm or more of it.

Animal studies, conducted with amounts much higher than those that most people are exposed to, show that tetrachloroethylene can cause liver and kidney damage and liver and kidney cancers. However, it has not been shown to cause cancer in people. The Department of Health and Human Services has determined that tetrachloroethylene may reasonably be anticipated to be a carcinogen. Tetrachloroethylene can be toxic to the fetuses of rats and mice. The only developmental effects seen in the offspring of rats that breathed very high levels of the chemical while they were pregnant were minor changes in the brain and behavior of the offspring. Since this was the only study showing developmental effects, we do not know how meaningful these results are at the present time.

For more information on the health effects of tetrachloroethylene, see Chapter 2.

The Agency for Toxic Substances and Disease Registry has calculated Environmental Media Evaluation Guides (EMEGs) for tetrachloroethylene. EMEGs are derived from Minimal Risk Levels (MRLs) which are calculated from human or animal data for tetrachloroethylene. The MRL(s) are further described in Chapter 2 and in the footnotes to Table 2-1 and 2-3. If a person is exposed to tetrachloroethylene at a level below the EMEG for the period listed below, we do not expect harmful health effects to occur. Because these levels are based only on information currently available, some uncertainty is always associated with them. Also, an EMEG does not imply anything about the presence, absence or level of risk for cancer because the methods for deriving EMEGs do not use any information about cancer. The EMEGs are provided as concentrations in order to allow for comparison to levels people might encounter in air, drinking water, and soil around homes or in other areas where children may play.

Air exposure

- An air EMEG of 0.6 ppm for tetrachloroethylene was derived from human data for exposures of 14 days or less.

- An air EMEG of 0.009 ppm for tetrachloroethylene was derived from animal data for exposures longer than 14 days but less than one year.

Drinking water exposure

Drinking water EMEGs represent the lower end of a range and are protective for both children and adults.

- A drinking water EMEG of 1 ppm for tetrachloroethylene was derived from animal data for exposures longer than 14 days but less than one year.

Soil exposure

Soil EMEGs represent the lower end of a range and are protective for both children and adults. However, this range is not protective for children (pica) who show increased desire for eating non-food items (such as soil).

- A soil EMEG of 5,000 ppm for tetrachloroethylene was derived from animal data for exposures longer than 14 days but less than one year.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO TETRACHLOROETHYLENE?

One way of testing for tetrachloroethylene exposure is to measure the amount of the chemical in the breath. This test has been used to measure levels of the chemical in persons living in areas where the air is contaminated with tetrachloroethylene or those exposed to the chemical through their work. This test is only useful, however, if the exposure is recent (less than a week) because tetrachloroethylene rapidly leaves the body. Tetrachloroethylene can also be detected in the blood. In addition, samples of blood and urine can be used to identify breakdown products of the chemical in persons suspected of being exposed to tetrachloroethylene. Some of the breakdown products can be identified in the blood and urine for only short periods after exposure. One product, trichloroacetic acid, can be detected for several days after exposure. Although these tests are relatively simple to perform, most physicians do not have the proper equipment and must rely on special laboratories to collect and test the samples. Because exposure to other chemicals can produce the same breakdown products in the urine and blood, these

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tests cannot determine if you have been exposed only to tetrachloroethylene. For more information on where and how tetrachloroethylene can be detected in your body after you have been exposed to it, see Chapters 2 and 6.

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

The government has developed regulations and guidelines for tetrachloroethylene. These are designed to protect the public from the potential adverse health effects of the chemical. The Environmental Protection Agency (EPA) has recommended limits on how much tetrachloroethylene can be present in drinking water. EPA advises that children should not have more than 2.0 milligrams tetrachloroethylene per liter of water (mg/L) (2 ppm) in 1 day or more than 1.4 mg/L (1.4 ppm) per day for long-term exposure. For long-term exposure in adults, EPA recommends that there should not be more than 5 mg/L (5.0 ppm) in the drinking water.

EPA considers tetrachloroethylene to be a hazardous waste. Many regulations govern its disposal. If amounts greater than 1 pound are released to the environment, The National Response Center of the federal government must be told immediately.

The Occupational Safety and Health Administration (OSHA) limits the amount of tetrachloroethylene that can be present in workroom air. This amount is now limited to 25 ppm for an 8-hour workday over a 40-hour workweek, but may be changed to 50 ppm in the near future. OSHA also proposed limiting the peak concentration for short-term exposure to not greater than 200 ppm. NIOSH recommends that tetrachloroethylene be handled as a chemical that might potentially cause cancer and states that levels of the chemical in workplace air should be as low as possible.

1.8 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:

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This agency can also provide you with information on the location of the nearest occupational and environmental health clinic. These clinics specialize in the recognition, evaluation, and treatment of illnesses resulting from exposure to hazardous substances.