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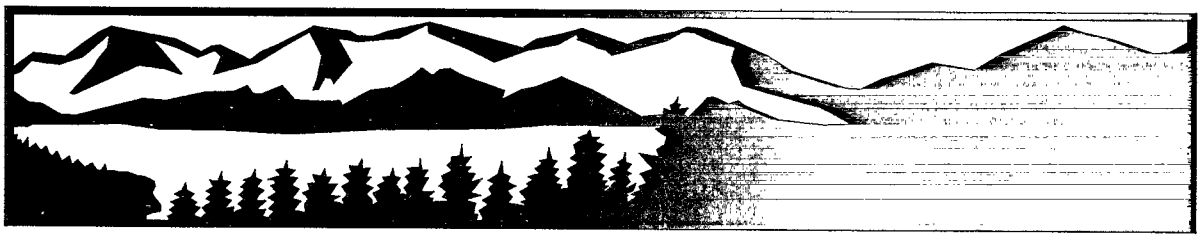
Common Chemicals



Found at Superfund Sites

EPA

INTRODUCTION

This booklet contains one page fact sheets on the most common chemicals found at hazardous waste sites across the nation. it is meant to help you understand more about the chemical.

It answers such questions as: How can a person be exposed to the chemical? How can it affect human health? How does it enter and leave the body? What levels of exposure result in harmful effects? What recommendations has the federal government made to protect human health from the chemical? and What are the methods for treatment and disposal of the chemical?

If you have more questions about the chemicals mentioned in this booklet or would like information on the U.S. Environmental Protection Agency's Superfund hazardous waste cleanup program, please call the *Superfund Hotline at 1-800-424-9346 or 1-800-535-0202.*

EPA Facts About *Ammonia*

June 1992

What is ammonia?

Ammonia, the most abundant basic (alkaline) gas in the environment, is a colorless gas with a very sharp odor. The odor is familiar to most people because ammonia is used in smelling salts and household cleaners. Ammonia dissolves easily in water where most of it changes to liquid ammonium.

Ammonia is very important to animal and human life. Because of its significance in natural cycles, ammonia has a *background concentration* in most environmental media, and is found in water, soil, and air. Ammonia is a source of much-needed nitrogen for plants and animals.

How might exposure to ammonia occur?

Since ammonia occurs naturally in the environment, we are regularly exposed to low levels of ammonia in air, soil, and water. Ammonia exists naturally in air at levels between one and five parts per billion (ppb). The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles or a penny in ten million dollars, a very small amount. It is commonly found in rain water. The ammonia levels in rivers and bays are usually less than 6 parts per million (ppm). Soil typically contains about 1 to 5 ppm of ammonia. The levels of ammonia vary throughout the day, as well as from season to season. Generally, ammonia levels are highest in the spring and summer, when nature is most active.

Ammonia may be released to the atmosphere by *volatilization* from decaying organic matter; animal livestock waste; fertilization of soil; sewage or wastewater effluent; burning of coal, wood, and other natural products; and volcanic eruptions. The amount of ammonia produced by man is very small compared to that produced by nature every year. However, when ammonia is found at a level that may cause concern, it is usually produced either directly or indirectly by man.

Exposure to high levels of ammonia in the air can be caused by leaks and spills at production plants and storage facilities, and from pipelines, tank trucks, rail cars, and ships that transport ammonia. Ammonia can be found as an atmospheric gas near hazardous waste sites. It can also be found dissolved in ponds or other bodies of water, and adheres (attaches) to soil at these sites. Ammonia does not persist in the environment. Because it is recycled naturally, nature has many ways of incorporating and transforming ammonia. In soil or water, plants and microorganisms take up ammonia rapidly, reducing the amount in soils to low levels within a few days. Ammonia remains in the air for about one week.

How can ammonia affect human health?

Exposure to very high levels of ammonia can result in severe health effects. For example, walking into a dense cloud of ammonia or spilling concentrated ammonia on exposed skin can cause severe burns to the skin, eyes, throat, or lungs. These burns may be serious enough to cause permanent blindness, lung disease, or death. Similarly, accidental ingestion of large amounts of ammonia could cause burns in the mouth, throat, and stomach. Mild exposure to ammonia gas can produce headaches, salivation, burning of the throat, nausea, and vomiting.

How can ammonia enter and leave the body?

Ammonia can enter the body through *inhalation* of ammonia gas or ingestion of water or food containing ammonia. Spills of ammonia on exposed skin can cause a small amount of ammonia to enter the body; however, more ammonia will probably enter through inhalation of the fumes. Most inhaled ammonia exits the body quickly through the lungs. Ingested ammonia will enter the blood and be carried throughout the body within minutes. Most of the ammonia that enters the body changes rapidly into harmless substances. The remaining ammonia leaves the body in urine within a couple of days.

What levels of exposure have resulted in harmful health effects?

Ammonia has a very strong odor that can be smelled in the air at levels above 50 ppm. Therefore, severe inhalation exposure, which would require levels above human detection, would likely be avoided by most individuals.

Ammonia in water at levels of approximately 35 ppm can be tasted. Lower levels occur naturally in food and water. Swallowing even small amounts of ammonia in household cleaner can cause burns in the mouth and throat.

Is there a medical test to identify ammonia exposure?

There are tests that measure ammonia in blood and urine; however, these tests probably would not accurately indicate exposure to ammonia because it is normally found in the body. Exposure to harmful amounts of ammonia will be noticed immediately because of the strong, unpleasant smell and taste, and skin, eye, nose, and throat irritation.

What recommendations has the federal government made to protect human health?

The U.S. Environmental Protection Agency (EPA) regulates the ammonia content in wastewater released by industry. In addition, any discharge or spill of ammonia of 100 pounds or more, or of ammonium salts of 1,000 or 5,000 pounds (depending upon the compound) must be reported to EPA.

Maximum allowable levels have been set for ammonium salts in processed food. The U.S. Food and Drug Administration (FDA) has determined that the levels of ammonia and ammonia compounds normally found in food do not pose a health risk. Ammonia is necessary for normal bodily functions.

What are the methods of treatment and disposal of ammonia?

Solutions of ammonia can be highly diluted with water, or alternatively, diluted with water and neutralized with hydrochloric acid and then routed to the sewer system. Limited amounts of gaseous ammonia may be discharged to the atmosphere.

Disposal of liquified ammonia or of large quantities of *gaseous* or *aqueous* ammonia directly into water is not desirable because of the large amount of heat generated. Recovery of ammonia from aqueous waste solutions is a viable option for many industries.

GLOSSARY

Aqueous: A substance which is dissolved in water.

Background Concentration: The concentration of any substance which would normally be found in an area. This level is used as a basis of comparison in identifying contamination levels.

Gaseous: The vapor form (for example, air) of any substance.

Inhalation: To draw air, vapor, etc. into the lungs; to breathe.

Volatilization: The process by which substances are released into the atmosphere as a gas through rapid vaporization or evaporation.

For more information about Ammonia, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Ammonia, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December 1990. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Arsenic*

June 1992

What is arsenic?

Arsenic is a naturally occurring element. Pure arsenic is a gray-colored metal, but this form is not common. It is usually found in combination with one or more other elements such as oxygen, chlorine, and sulfur. Arsenic combined with these elements is referred to as inorganic arsenic, whereas arsenic combined with carbon and hydrogen is referred to as organic arsenic. Organic forms of arsenic are usually less *toxic* than the inorganic forms.

Arsenic is produced primarily as a by-product from the operation of nonferrous smelters, glass manufacturing, pesticide production and application, and burning of fossil fuels. Arsenic is also produced as a result of natural forces, that is, volcanos and weathering of arsenic-containing rocks. The major uses of arsenic are as wood preservatives and agricultural pesticides.

How might exposure to arsenic occur?

Arsenic is very widely distributed in the environment, and everyone is exposed to low levels. For most people, food constitutes the largest source of arsenic intake, with lower amounts coming from air and drinking water. Some edible fish and shellfish contain elevated levels of arsenic, but this is predominantly in an organic form known as "fish arsenic" that has a low toxicity. Above-average levels of exposure are usually associated with one or more of the following circumstances: (1) Natural mineral deposits containing large quantities of arsenic (may result in elevated inorganic arsenic levels in drinking water); (2) Chemical waste disposal sites, which contain large quantities of improperly-contained arsenic, (may allow the chemical to escape into the groundwater); (3) Elevated levels of arsenic in soil (may lead to exposure from ingesting soil); (4) Manufacturing (smelting) of copper and other metals (often releases inorganic arsenic into the air); (5) Burning of fossil fuels (results in low levels of inorganic arsenic emissions into the air); and, (6)Widespread application of pesticides (may lead to water or soil contamination).

How does arsenic enter the body?

Arsenic enters the body principally through ingestion of food or water. Most ingested arsenic is quickly absorbed through the stomach and intestines and enters the blood stream. Arsenic which is inhaled (low levels of arsenic are present in cigarette smoke) is also well-absorbed into the blood stream through the lungs. Small amounts of arsenic may enter the body through the skin.

Most arsenic absorbed into the body is converted by the liver to a less-toxic form that is efficiently excreted in the urine. Consequently, arsenic does not have a strong tendency to accumulate in the body except at high exposure levels.

How can arsenic exposure affect human health?

Large doses of inorganic arsenic can be fatal. Lower levels of exposure may injure a number of different body tissues or systems, producing *systemic effects*. When taken orally, a common effect is irritation of the digestive tract, leading to pain, nausea, vomiting, and diarrhea. Other effects include decreased production of red and white blood cells, abnormal heart function, blood vessel damage, liver and/or kidney injury, and impaired nerve function causing a "pins and needles" feeling in the feet and hands.

Perhaps the systemic effect most characteristic of oral exposure to inorganic arsenic is a pattern of skin abnormalities including the appearance of dark and light spots on the skin, and small "corns" on the palms, soles, and trunk. Some of these corns may ultimately progress to skin cancer. Arsenic ingestion has also been reported to increase the risk of internal cancer, especially in the liver, bladder, kidneys, and lungs.

Inhalation exposure to inorganic arsenic dusts or fumes sometimes produces the same types of systemic health effects produced by oral exposure. However, this is not common, and the effects are usually mild. Of much greater concern is the ability of inhaled arsenic to increase the risk of lung cancer. Direct skin contact with arsenic compounds, frequently from inorganic arsenic dusts in air, may result in mild to severe irritation of the skin, eyes and throat.

Is there a medical test to identify arsenic exposure?

Measuring the levels of arsenic in urine is the best way to identify recent exposures. However, some common tests do not distinguish nontoxic forms such as fish arsenic from other forms. Consequently, a high concentration of arsenic in urine may not necessarily indicate a health problem. Measurement of arsenic in hair or fingernails is sometimes used to detect chronic exposures; however, this method is not very reliable for detecting low levels of arsenic exposure.

What levels of exposure have resulted in harmful health effects?

Generally, inorganic forms of arsenic are more toxic than organic forms, and forms that dissolve easily in water tend to be more toxic than those that dissolve poorly in water. Studies indicate considerable variation among different individuals, and it is difficult to identify with certainty the range of exposures which are of concern. The levels of arsenic that most people ingest in food or water are not usually considered to be a health concern. In fact, arsenic in trace amounts may be essential to good health.

For inhalation exposure, air concentrations of around 0.2 parts per billion (ppb) are associated with irritation to the nose, throat and exposed skin. The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount. Higher levels may occasionally lead to mild signs of systemic toxicity similar to that seen with oral exposure.

What currently happens to arsenic wastes?

The principal waste product of arsenic is slag, a by-product of ore smelting. Arsenic production is a dry operation (no water is used); only small quantities are discharged in wastewater. There is no recycling of arsenic from its principal use in wood preservatives and agricultural chemicals.

What recommendations has the federal government made to protect human health?

The U.S. Environmental Protection Agency (EPA) has established limits on the amount of arsenic released to the environment. EPA has also restricted or prohibited many of the uses of arsenic in pesticides and is considering further restrictions. EPA has established a *Maximum Contamination Level (MCL)* of 50 ppb for arsenic in drinking water.

GLOSSARY

Maximum Contaminant Level: EPA evaluates the health risks associated with various contaminant levels to ensure that public health is adequately protected. The MCL, as it is commonly known, is the maximum allowable concentration of a specific contaminant in public drinking water.

Systemic Effect: Impacts of contamination which affect the entire organism or bodily system.

Toxic: Acting as a poisonous or hazardous substance; having poisonous or harmful qualities.

For more information about Arsenic, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

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EPA Facts About *Asbestos*

June 1992

What is asbestos?

Asbestos is the name used for a group of six different minerals (amosite, chrysotile, tremolite, actinolite, anthophyllite, and crocidolite) that occur naturally in the environment. The most common mineral type is white (chrysotile), but others may be blue (crocidolite), gray (anthophyllite), or brown (amosite). These minerals are made up of long, thin fibers similar to fiberglass. Asbestos fibers are very strong and are resistant to heat and chemicals. These properties of asbestos have led to its use in a wide range of products, mostly in building materials, friction products (for example, braking linings and clutch plates), and heat-resistant fabrics.

Because the fibers are so resistant to chemicals, they are also very stable in the environment. Asbestos fibers do not evaporate into the air or dissolve in water, and are not broken down over time; their natural tendency is to settle out of air and water and be deposited in soil or sediment. However, some fibers are small enough that they can remain in suspension in both air and water and be transported long distances.

How might asbestos exposure occur?

Inhaling tiny asbestos fibers suspended in air is the most likely *exposure route*. Low levels of asbestos can be detected in almost any air sample. In rural areas, there are usually an average of 0.03 to 3 fibers present in a cubic meter of outdoor air. (A cubic meter is about the amount of air you breathe in 1 hour.) Higher levels are usually found in cities. In the air near an asbestos mine or factory, levels could reach 2,000 fibers per cubic meter or higher. Levels could also be above average near a building that is being torn down or renovated, or near waste sites where asbestos wastes are not properly protected from wind erosion. Asbestos has been detected at approximately 52 of the 1,300 *National Priorities List* hazardous waste sites eligible to receive *Superfund* money for cleanup.

Asbestos exposure can also result from drinking fibers present in water. Even though asbestos does not dissolve in water, fibers can enter water by being eroded from natural deposits or piles of waste asbestos, or from cement pipes used to carry drinking water. Most drinking water supplies in the United States have concentrations of less than 1 million fibers per liter.

How can asbestos affect human health?

Information on the health effects of asbestos comes mostly from studies of workplace exposure to high levels of asbestos. Such asbestos exposure has been found to increase the chances of getting two types of cancer: cancer of the lung tissue itself, and mesothelioma, a cancer of the thin membrane that surrounds the lung and other internal organs. Both lung cancer and mesothelioma are usually fatal. These diseases do not appear immediately, but develop only after a number of years. There is also some evidence that breathing asbestos can increase the chances of getting cancer in other locations (for example, the esophagus, stomach, intestines, pancreas, and kidneys).

Besides causing cancer, breathing asbestos can also cause a slow accumulation of scar-like tissue in the lungs and in the membrane which surrounds the lungs. This tissue does not expand and contract like normal lung tissue, making breathing difficult. Blood flow to the lungs may also be decreased, and this causes the heart to enlarge. When the injury is mostly in the lungs, the disease is called asbestosis. This is a serious disease, and can eventually lead to disability or death.

How can asbestos enter and leave the body?

Asbestos fibers inhaled in air may be deposited in the passages and on the cells of the lungs. However, very few of these fibers move through the lungs into the body. Instead, most fibers are removed from the lungs by being carried away in a layer of mucus to the throat, where they are swallowed into the stomach. This usually takes place within a few hours, but fibers deposited in the deepest parts of the lung are removed more slowly. Some can remain for many years and may never be removed.

Nearly all the swallowed asbestos fibers pass along the intestines within a few days and are excreted. A small number of fibers remain in cells that line the stomach or intestines, and a few penetrate into the blood. Some of these become trapped in other tissues, and some are removed in the urine.

What levels of exposure have resulted in harmful health effects?

The levels of asbestos in air that lead to lung disease depend primarily on three factors: (1) the duration of each exposure, (2) the number of years exposure continues, and (3) whether or not an individual smokes cigarettes. There is also a debate concerning the differences in the amount of disease caused by different fiber types and sizes. Most data indicate that fiber size is the most important factor in cancer-causing potential.

Is there a medical test to identify asbestos exposure?

The most common test used to determine exposure to asbestos is a chest x-ray. The x-ray cannot detect the asbestos fibers themselves, but can detect early signs of lung disease caused by asbestos. It is also possible to test for the presence of asbestos fibers in urine, feces, mucus, or material rinsed out of the lungs by a doctor. Low levels of asbestos fibers are found in nearly all people. Higher-than-average levels indicate that exposure has occurred.

What recommendations has the federal government made to protect human health?

Despite ongoing debate concerning health effects resulting from the different asbestos fiber types, the Agency for Toxic Substances and Disease Registry considers the different mineral forms of asbestos to be known human cancer-causing substances. Fibers have a prolonged latency period (they may be deposited in the lungs and not produce harmful effects for many years) of 10 to 30 years between exposure and the onset of disease.

The Environmental Protection Agency (EPA) has proposed a limit of 7 million fibers per liter for concentrations of long fibers present in drinking water. The Food and Drug Administration regulates the use of asbestos in the preparation of drugs, and restricts the use of asbestos in food-packaging materials.

How are we disposing of asbestos?

Currently, asbestos-containing wastes may only be deposited in landfills approved and regulated by the federal government. These regulations are intended to ensure that asbestos at these sites is not dispersed into the environment. Proposed new recordkeeping and reporting requirements will help ensure that landfill operators provide data on the location and amounts of asbestos at disposal sites.

GLOSSARY

Exposure Route: The way in which people come into contact with a substance. The main routes are ingestion, inhalation, and absorption through the skin.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

For more information about Asbestos, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Asbestos, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, October, 1987. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Beryllium*

June 1992

What is beryllium?

Beryllium is a naturally occurrin *element* which, ir its purest form, is a hard grayish metal. Two kinds of mineral rocks, bertrandite and beryl, are mined commercially for the recovery of beryllium. Very pure gem quality beryl is better known as either aquamarine or emerald.

Most of the beryllium ore that is mined is converted into metal alloys, many of which are used in electronics or structural applications. Beryllium ore is processed into beryllium hydroxide which is further refined into beryllium metal, alloys, and oxides.

The major source of beryllium emissions to the environment is the combustion of coal and fuel oil, which releases *particulates* anc *fly ash* containing beryllium into the atmosphere. These particulates eventually settle to the earth's surface or are removed from the atmosphere by rainfall. Upon reaching soil and sediment, beryllium is absorbed and held in an insoluble (does not readily dissolve in water) and relatively immobile form.

Atmospheric emissions of beryllium dusts and particulates are also associated with ore processing, metal fabrication, and beryllium oxide production and use. Natural emission sources include windblown dusts and volcanic particles. The amounts of beryllium released to the atmosphere from natural sources are relatively small.

How might exposure to beryllium occur?

Each of us is exposed to small amounts of beryllium in the air we breathe, in many foods we eat, and in some water we drink. Most of the beryllium that is inhaled is released into the air by burning coal and fuel oil. Beryllium occurs naturally in various tobaccos, and is inhaled during smoking. People who smoke cigarettes may breathe considerably more beryllium than those who do not smoke. Beryllium is also present in many fruits and vegetables.

The greatest exposure to beryllium, usually in the form of beryllium oxide, occurs in the workplace. Occupational exposure to beryllium occurs where it is mined, processed, and converted into metal, alloys, and chemicals. Workers engaged in machining metals containing beryllium, in reclaiming beryllium from scrap alloys, or in using beryllium products will also be exposed. People who live near these industries, or near hazardous waste sites that contain high concentrations of beryllium, can also be exposed to small amounts.

How can beryllium affect my health?

Beryllium is a substance that can be harmful, depending on the amount and length of exposure. Not all of the effects that beryllium and its compounds have on human health are well understood, and not all forms of beryllium are equally toxic. The primary organs affected by beryllium are the lungs. Short-term exposure to high levels of soluble beryllium compounds can lead to the development of inflammation or reddening and swelling of the lungs, a condition known as Acute Beryllium Disease (similar to pneumonia). Removal from exposure can result in a reversal of symptoms. Long-term exposure to beryllium or beryllium oxide at much lower levels has reportedly caused Chronic Beryllium Disease in sensitive individuals. This disease is characterized by shortness of breath, scarring of the lungs, and berylliosis (noncancerous growths in the lungs).

Both Acute and Chronic Beryllium Disease can be fatal, depending on the severity of the exposure. In addition, a skin allergy can develop when sensitized individuals are exposed to soluble beryllium compounds. If beryllium enters through cuts, noncancerous growths can form on the skin or mucous membrane and may ulcerate, becoming open sores.

Evidence from laboratory tests using animals suggests that inhalation of beryllium or its compounds may have some cancer causing potential. No studies, in animals or humans, provide convincing evidence that the ingestion of beryllium or its compounds causes cancer.

How does beryllium enter and leave the body?

Animal studies have shown that only small amounts of beryllium are absorbed (pass into) the blood and other tissues after ingestion of beryllium or its compounds. Most of the ingested beryllium leaves the body through wastes in a few days without having entered the bloodstream. This low rate of absorption also holds true for skin exposure, although contact with the skin is, in itself, sufficient to cause irritation. These studies have also shown that the most efficient way in which beryllium enters the body of animals is through inhalation of beryllium particles suspended in the air. Beryllium which is inhaled may require months to years to leave the body because of the time it takes to leave the lungs and enter the stomach or the bloodstream. The small amount of beryllium that moves from the lungs, stomach, and intestines into the bloodstream is carried by the blood to the kidneys. Beryllium leaves the kidneys (and the body) in the urine.

What recommendations has the federal government made to protect human health?

The Environmental Protection Agency (EPA) restricts the amount of beryllium emitted into the environment by industries that produce beryllium ores, metal, oxide, alloys, or waste to amounts that would result in atmospheric levels of 0.01 parts per trillion (ppt) of beryllium in air, averaged over a 30-day period. The term "parts per trillion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per trillion is equal to one inch in a distance of about sixteen million miles (or a penny in ten billion dollars), a very small amount.

Is there a medical test to identify beryllium exposure?

Beryllium levels in the urine and blood can be measured, however, levels in the urine may be highly variable. Elevated levels in the urine and blood indicate exposure, but not necessarily the disease. Another procedure involving the sampling of tissues, that is, a biopsy, may be performed so that beryllium levels in those tissues can be measured. There is also a medical test which involves the examination of cells that have been washed out of the lungs. This test helps doctors to identify noncancerous growths in the lungs; however, this test cannot distinguish growths that were caused by beryllium (Chronic Beryllium Disease) from growths caused by other factors. A test in which lymphocytes (blood cells involved in immunity) are transformed in the presence of beryllium can definitively diagnosis Chronic Beryllium Disease.

What are the methods of treatment and disposal of beryllium?

Beryllium dust has been designated by EPA as a hazardous waste. Most of these wastes result from pollution control methods such as containment of solid particles or liquid suspensions resulting from *air-scrubbing* processes. Recycling of the wastes is the most desirable method of handling. Burial in plastic-lined, metal drums is recommended for landfill disposal.

GLOSSARY

Air-scrubbing: Various processes are used to remove particles from gaseous emissions, usually produced during incineration. One process uses electronically-charged plates to collect particles; another uses atomized water to remove particles suspended in gases.

Atmospheric Emissions: Release or discharge of fumes, dust, or particulates into the air.

Element: All substances are made up of elements, which are the basic components, or parts, of all materials. Elements cannot be separated or broken down into smaller units by ordinary chemical means.

Fly Ash: Airborne bits of unburnable dust or fine particles, usually associated with combustion of fossil fuels or incinerators. Environmental regulations require that fly ash be captured by air pollution control devices.

Particulates: An extremely tiny fragment or small piece of material which can be carried by the wind.

Toxic: Acting as a poisonous or hazardous substance; having poisonous or harmful qualities.

For more information about Beryllium, please contact EPA at the following address:

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Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

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EPA Facts About *Cadmium*

June 1992

What is cadmium?

Cadmium is a naturally occurring element. Pure cadmium is a soft bluish-white metal; however, this form is not common. Cadmium is most often found in combination with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfide). These combinations, or compounds, are all stable solids that do not evaporate, although small particles of cadmium oxide are often found in the air.

Most cadmium used in the U.S. is obtained as a by-product from the smelting of zinc, lead, or copper ores. Cadmium has a number of industrial applications; it is used mostly in metal plating, pigments, batteries, and plastics.

How might exposure to cadmium occur?

Small quantities of cadmium occur naturally in air, water, soil, and food. For most people, food is the primary source of cadmium exposure, since food products tend to absorb and retain cadmium. For example, plants draw cadmium from soil, and fish absorb cadmium from water.

The application of phosphate fertilizers or sewage sludge may increase cadmium levels in soil, which, in turn, can cause increased cadmium levels in crops. Cadmium is not often encountered at levels of concern in water, although it can leach into *groundwater* from pipes and solder or may enter groundwater from chemical waste disposal sites.

The largest sources of cadmium are the burning of fossil fuels and the incineration of municipal wastes. Cadmium may also escape into the environment from zinc, lead, or copper smelters, resulting in above-average concentrations.

Smoking is another major source of cadmium. Like most plants, tobacco contains cadmium, some of which is inhaled in cigarette smoke. Most people who smoke have about twice as much cadmium in their bodies as do nonsmokers.

How does cadmium enter the body?

Cadmium can enter the blood by absorption from the stomach or intestines following ingestion of food or water, or by absorption from the lungs after inhalation. Very little cadmium is absorbed through the skin. Usually only about 1 to 5% of what is ingested is absorbed into the blood; about 30 to 50% of what is inhaled is absorbed. Once cadmium enters the body, it is retained; therefore, even low doses may build up significant cadmium levels if the exposure is long-term.

How can cadmium affect human health?

Cadmium can cause a number of adverse health effects. Ingestion of high doses causes severe irritation to the stomach, leading to vomiting and diarrhea. Inhalation of high doses leads to severe irritation of the lungs. Such exposures are extremely rare today. The effects which may occur following long-term, low-level exposure are of greater concern. Examples of adverse health effects resulting from various exposure levels and times are: kidney damage in people exposed to excess cadmium either through air or diet; and lung damage, such as emphysema, in factory workers where cadmium levels in air are high.

Lung cancer has been shown to occur in animals exposed to cadmium in air for long periods. Studies in humans also suggest that long-term inhalation of cadmium can increase the risk of lung cancer. Exposure to cadmium through contaminated foods is not believed to cause cancer.

Other tissues reported to be injured by cadmium exposure include the liver, the testes, the immune and nervous systems, and the blood. Reproductive and developmental effects have been observed in animals treated with cadmium, however, these effects have not been reported in humans.

Is there a medical test to identify cadmium exposure?

One test for excessive cadmium exposure involves measuring the amount of cadmium present in the blood, urine, or hair. The amount in the blood is a good indicator of recent exposures, whereas the amount in urine is a reflection of total cadmium present in the body. The amount of cadmium in hair is not usually considered to be reliable, since cadmium can bind to the outside of hair and give faulty test results. Another approach is to measure cadmium concentrations in the liver or kidneys; however, it is usually too costly and inconvenient for routine use.

What levels of exposure have resulted in harmful health effects?

The amount of cadmium known to cause harmful health effects depends on the chemical and physical form of the element. In general, cadmium compounds that dissolve easily in water (e.g., cadmium chloride), or those that can be dissolved in the body (e.g., cadmium oxide), tend to be more *toxic* than compounds that are very hard to dissolve (e.g., cadmium sulfide).

Airborne concentrations of 1 part per million of cadmium in air are associated with acute irritation to the lungs. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. Long-term exposure may increase the risk of lung disease, such as emphysema. These same levels are also associated with development of kidney injury similar to that observed following oral exposure. Levels of cadmium exposure through food, water, and air typical for most people are not a major health concern. For example, the intake of cadmium in the diet is usually about one-tenth the amount required to cause kidney damage via this route.

What are the methods of disposal of cadmium?

Most waste cadmium is disposed of in landfills. Municipal waste disposal of cadmium-containing products to landfills accounts for the majority of cadmium disposal. Cadmium wastes can also be destroyed through high temperature incineration.

What recommendations has the federal government made to protect human health?

The U.S. Environmental Protection Agency (EPA) has established limits on the quantity of cadmium that may be discharged into water or disposed of as solid wastes. EPA is considering regulations that would limit the amount of cadmium emitted into outside air. The Agency has also established an interim *Maximum Contaminant Level (MCL)* of 5 parts per billion of cadmium in drinking water.

GLOSSARY

Groundwater Water found below the ground surface in a rock or sand formation. Much of our domestic water supplies are drawn from groundwater wells.

Maximum Contaminant Level: EPA evaluates the health risks associated with various contaminant levels to ensure that public health is adequately protected. The MCL, as they are commonly known, is the maximum allowable concentration of a specific contaminant in public drinking water.

Toxic: Acting as a poisonous or hazardous substance; having poisonous or harmful qualities.

For more information about Cadmium, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Cadium , Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, March 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About Carbon Tetrachloride

June 1992

What is carbon tetrachloride?

Carbon tetrachloride (CCl_4) is a clear, heavy liquid with a sweet odor. Because it evaporates very quickly, most CCl_4 that escapes into the environment is found in the air as a gas. Small amounts can also be found dissolved in water.

CCl_4 does not occur naturally. It is produced in large quantities to make refrigerants and propellants for aerosol cans. Since these products have been found to affect the earth's ozone layer, production of these chemicals is being phased out. Consequently, the manufacture and use of CCl_4 will also tend to decline.

In the past, CCl_4 was widely used as a cleaning fluid, both in industry, where it served as a degreasing agent, and in the household, where it was used to remove spots from clothing, furniture, and carpeting. Because CCl_4 does not burn, it was also used in fire extinguishers. These uses were discontinued in the mid-1960s. Until recently, CCl_4 was used to fumigate grain, but this was stopped in 1986.

CCl_4 is very stable and, therefore, remains in the environment. Although it is broken down by chemical reactions in air, this happens so slowly that it takes between 30 and 100 years for one-half of the original amount of CCl_4 to be destroyed.

How might exposure to carbon tetrachloride occur?

Past and present releases of CCl_4 have resulted in low levels of this compound being dispersed throughout the environment. In air, concentrations of 0.1 parts per billion (ppb) are common around the world, with somewhat higher values (0.2 to 0.6 ppb) in cities. The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles, or a penny in ten million dollars, a very small amount. CCl_4 is also found in some drinking water supplies, usually below 0.5 ppb. Exposure to levels of CCl_4 higher than these typical *background levels* may occur at industrial locations where CCl_4 is still used or near waste sites where releases into air, water, or soil are not properly controlled. Exposure from such sites could occur by breathing CCl_4 in air, by drinking water contaminated with CCl_4, or by getting contaminated soil on the skin. CCl_4 has been found in water or soil at about 7% of the waste sites investigated under *Superfund*, at concentrations from less than 50 to over 1,000 ppb.

How can carbon tetrachloride affect human health?

Exposure to high levels of CCl_4 can cause a number of harmful health effects, including death. The most immediate health effects usually involve the brain. Common effects are headaches and dizziness, along with nausea and vomiting. In severe cases, stupor or even coma may result. These effects usually disappear within a day or two following exposure, but permanent damage to nerve cells may occur in severe cases.

The liver is especially sensitive to CCl_4. In mild cases, the liver becomes swollen and tender, and fat tends to build up inside the tissue. In severe cases, many cells may be killed, leading to decreased liver function.

The kidneys are also sensitive to CCl_4, with the main effect being a decrease in urine formation. This can lead to accumulation of water in the body (especially in the lungs) and buildup of waste products in the blood. Kidney failure is often the main cause of death in people who die as a result of exposure to CCl_4.

Fortunately, if injuries to the liver and kidneys are not too severe, these effects disappear once exposure ceases. This is because both organs can repair damaged cells and replace dead tissue. Function is often nearly normal within a few days or weeks following exposure. CCl_4 also causes harm to other tissues in the body, but this is not usually as important as the effects on the liver, kidneys, and brain. Limited information from animal studies indicates that CCl_4 does not cause birth defects, but might decrease the survival rate of newborn animals. Most information on the health effects of CCl_4 in humans stems from cases in which individuals have been exposed only once or for a short period of time to relatively high levels of the chemical. Studies of the effects of long-term exposure to low levels of CCl_4 on humans have not been performed and the effects of such exposures are unknown.

Is there a medical test to identify carbon tetrachloride exposure?

Several very sensitive and specific tests can detect CCl_4 in exposed persons. The most convenient way is simply to measure CCl_4 in exhaled air; CCl_4 can also be measured in the blood, fat, or other tissues. Because special equipment is needed, these tests are not routinely performed in doctors' offices. Although these tests can identify exposure to CCl_4, the test results cannot yet be used to predict harmful health effects. Because CCl_4 is removed from the body fairly quickly, these methods are best suited to detection of exposures that have occurred within the past several days.

How can carbon tetrachloride enter and leave the body?

Carbon tetrachloride can enter the body through the lungs by breathing air containing CCl_4, or through the stomach by swallowing food or water containing CCl_4. Liquid CCl_4 can also pass through the skin into the body. Most CCl_4 is exhaled through the lungs within a few hours. Some CCl_4 in the body is temporarily absorbed by fat, and is then removed more slowly by the lungs.

What recommendations has the federal government made to protect human health?

The federal government has limited or banned the use of CCl_4 in most common household products and fire extinguishers, and has discontinued its use as a grain *fumigant*. The U.S. Environmental Protection Agency (EPA) has also set limits on the amount of CCl_4 released from an industrial plant into waste water, and is preparing to set limits on the amounts of CCl_4 released into outside air. One additional case of cancer may result in a group of 100,000 people exposed to CCl_4 in concentrations above 4 parts per billion in air or water over a period of 70 years.

What levels of exposure have resulted in harmful health effects?

Not all people are affected equally by exposure to CCl_4. Individuals who drink alcohol are usually much more susceptible than people who do not. Most serious or fatal cases of CCl_4 *toxicity* have involved people who have had several alcoholic drinks before or during exposure to CCl_4.

GLOSSARY

Background Levels: The concentration of any substance which would normally be found in an area. This level is used as a basis of comparison in identifying contamination levels.

Fumigant: Substance producing fumes used to disinfect or to destroy pests.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

Toxicity: The degree to which a substance acts as a poison.

For more information about Carbon Tetrachloride, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Carbon Tetrachloride, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Chloroform*

June 1992

What is chloroform?

Chloroform is a colorless liquid with a pleasant odor. It is both a naturally-occurring and a man-made compound, or combination, of several chemicals. Most of the chloroform manufactured in the United States (93%) is used to make fluorocarbon-22, which is used in the production of fluoropolymers and as a cooling fluid in air conditioners. It is also used in the manufacture of pesticides and dyes, and in such products as fire extinguishers, dry cleaning spot removers, and various solvents.

How might exposure to chloroform occur?

Chloroform released to soil will either vaporize rapidly from the surface or *leach* readily through the soil, eventually entering groundwater. It is believed to persist for relatively long periods of time in groundwater. Exposure to chloroform can result from breathing air or ingesting drinking water, beverages, or foods contaminated with chloroform. Exposure may also occur during skin contact with various consumer products containing this compound or from exposure to chlorinated waters, for example, bath water and swimming pool water.

The primary sources of chloroform release to the environment are pulp and paper mills, drug and chemical manufacturing plants, chlorinated wastewater from sewage treatment plants, and chlorinated drinking water. Pulp and paper mills emit more chloroform to the environment than any other single source. Most of the chloroform released to the environment eventually enters the atmosphere. Once in the atmosphere, chloroform may be transported long distances before ultimately being degraded by *photochemical reaction*. Much smaller amounts enter groundwater as the result of filtration through the soil. Chloroform leaches into groundwater primarily from spills, landfills, and industrial sources. Chloroform in soil may come from improper land disposal of waste materials containing chloroform or other chlorine-containing compounds that are broken down to form chloroform.

How does chloroform enter the body?

Chloroform can enter the body by breathing air, eating food, or drinking water that contains chloroform. Chloroform readily penetrates the skin, therefore, chloroform may also enter the body by bathing in water containing chloroform. Foods such as dairy products, seafood, meat, vegetables, bread, and beverages may contain small, but measurable, amounts of chloroform. Drinking-water supplies containing organic contaminants may contain chloroform as a by-product of chlorination of the water supply for disinfection purposes.

Is there a medical test to identify chloroform exposure?

Chloroform can be detected in blood, urine, and body tissues; however, because chloroform is rapidly eliminated from the body, these methods are not very reliable. In addition, the presence of chloroform may have resulted from the biological breakdown of other chlorine compounds. An elevated level of chloroform may reflect exposure to these other compounds.

How can chloroform affect human health?

Chloroform affects the central nervous system, liver, and kidneys. It was once used as a surgical anesthetic before its harmful effects on the liver and kidneys were recognized. Short-term exposure to high concentrations of chloroform in the air causes tiredness, dizziness, and headaches. Longer-term exposure to high levels of chloroform can affect liver and kidney function. Toxic effects may include jaundice and burning urination. High doses of chloroform have also been found to cause liver and kidney cancer in experimental animals. The risks of cancer, if any, from low-level exposures to chloroform in drinking water as a result of chlorination, however, are far outweighed by the benefits of chlorination in terms of the greatly decreased incidence of *waterborne diseases.*

What levels of exposure have resulted in harmful health effects?

Based on available data for animals, the U.S. Environmental Protection Agency (EPA) has estimated that exposure to 1 part per billion (ppb) chloroform in air may result in 2.3 additional cases of cancer in a population of 100,000 people exposed over a period of 70 years. Exposure to drinking water containing 10 ppb chloroform may result in 17 additional cases of cancer in a population of 100,000 people exposed over a period of 70 years. The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount.

What recommendations has the federal government made to protect human health?

EPA sets rules for the amount of chloroform allowed in water. EPA has established a drinking water *Maximum Contaminant Level (MCL)* for total trihalomethanes, a group of chemicals which includes chloroform, of 0.1 ppm as a technically and economically feasible level for municipal water supplies which serve 10,000 people or more. In addition, the Agency requires that chloroform spills of 10 pounds or more be reported to the National Response Center.

What are the methods of treatment and disposal of chloroform?

EPA requires that individuals who generate, transport, treat, store, or dispose of this compound comply with the regulations of the Resource Conservation and Recovery Act. One method used to dispose of chloroform involves *sedimentation* followed by filtration and *adsorption* onto activated carbon. Chloroform can be disposed of by incineration, preferably after it is mixed with another combustible fuel.

GLOSSARY

Adsorption: A treatment method which uses activated carbon to remove organic matter from wastewater.

Leach: To pass through the soil due to rain or groundwater moving through contaminated materials. The process by which substances are released from the soil by dissolving in fluids, usually rain and surface water, and are carried down through the soil. Leaching can cause hazardous substances to enter the soil, surface water, or groundwater.

Maximum Contaminant Level (MCL): EPA evaluates the health risks associated with various contaminant levels to ensure that public health is adequately protected. The MCL, as it is commonly known, is the maximum allowable concentration of a specific contaminant in public drinking water.

Photochemical Reaction: A chemical change caused by the action of light on a substance.

Sedimentation: The settling of solids out of wastewater by gravity during wastewater treatment.

Waterborne Diseases: Diseases caused by organisms spread in water; for example, amoebic dysentery and cholera.

For more information regarding Chloroform, please contact EPA at the address shown below:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Chloroform, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, January, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Chromium*

June 1992

What is chromium?

Chromium is a naturally occurring element found in soil and in volcanic dust and gases. It exists in three forms: metallic chromium (chromium(0)), trivalent chromium (chromium(III)), and hexavalent chromium (chromium(VI)). Trivalent chromium occurs naturally in the environment; hexavalent chromium and metallic chromium are generally produced by industrial processes. Metallic chromium is a steel-gray solid. Chromium is used mainly for making steel and other alloys. The mineral chromite is used by the refractory industry to make bricks for metal smelting furnaces. Chromium compounds are used for chrome plating, the manufacture of pigments, leather tanning, and wood treatment.

How might exposure to chromium occur?

Exposure to small amounts of chromium results from breathing air and ingesting water and food containing this chemical. Chromium has been found in approximately 815 of 1,300 hazardous waste sites on the *National Priorities List (NPL)*. Much higher exposure occurs for people working in certain chromium industries and those who smoke cigarettes.

The two largest sources of chromium *emissions* into the atmosphere are from the chemical manufacturing industry and combustion of natural gas, oil, and coal. Other sources of chromium exposure are: cement plants; asbestos brake linings from automobiles or similar sources of wind-carried asbestos; incineration of municipal refuse and sewage sludge; and exhaust emissions from catalytic converters in automobiles. Emissions from air conditioning cooling towers that use chromium compounds as rust inhibitors; wastewaters from electroplating, leather tanning, and textile industries; solid wastes from the manufacture of chromium compounds; and ashes from municipal incineration when disposed of improperly in landfill sites constitute additional sources of chromium.

How does chromium enter the body?

Most chromium enters the body through the diet. Some exposure occurs from breathing air or drinking water contaminated with chromium; however, exposure from these sources is normally small compared to intake in food. Chromium exposure from breathing chromium may increase for people breathing air near industrial sites where chromate, a form of chromic acid, is produced or used. Exposure may also increase by drinking water which has passed through steel alloy pipes containing chromium.

Is there a medical test to identify chromium exposure?

Trivalent and hexavalent chromium can be measured in the hair, urine, blood serum, and red blood cells. However, because trivalent chromium is normally present at low levels in these tissues and fluids, measurements for chromium are not very useful in determining slight elevations in chromium exposure over the low levels normally present in the environment. With relatively high exposure levels (usually occupational), chromium levels in the urine and red blood cells can provide indications of exposure to compounds of hexavalent chromium, but not to trivalent chromium compounds.

How does chromium affect human health?

Chromium is considered an essential nutrient that helps maintain the normal *metabolism* of glucose, cholesterol, and fat. Signs of chromium deficiency include weight loss and impairment of the body's ability to remove glucose from the blood.

Short-term high-level exposure to hexavalent chromium can result in adverse effects at the point of contact, such as ulcers of the skin, perforation of the nasal septum, and irritation of the nasal mucous membrane and *gastrointestinal tract*. Hexavalent chromium may also cause adverse effects in the kidneys and liver. Trivalent chromium does not result in these effects and is the form that is thought to be an essential food nutrient. Most chromium in food is trivalent. Metallic chromium exposure is less common and information concerning potential health effects is not well-developed.

Long-term exposure of workers to elevated levels of chromium in the air has been associated with lung cancer. Lung cancer may occur long after exposure to chromium has ended. Although it is not clear which form of chromium is responsible for this effect in workers, only hexavalent chromium compounds have been found to cause cancer in animal studies.

What levels of exposure have resulted in harmful health effects?

Based on occupational exposure data for hexavalent chromium compounds, the U.S. Environmental Protection Agency (EPA) estimates that lifetime exposure to 1 part per million (ppm) of hexavalent chromium in air could result in 1,200 additional cases of cancer in a population of 100,000 people. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount.

The known health effects from ingesting foods containing chromium indicate that a single dose of a hexavalent chromium compound is more toxic (causes death at a lower exposure level) than a single dose of a trivalent chromium compound. Long-term exposure of animals to chromium compounds, particularly trivalent chromium compounds, in drinking water or food, has not resulted in any adverse effects. The known health effects from absorbing chromium through the skin indicate that the most common effect of skin exposure to chromium is skin allergy in sensitive individuals.

What recommendations has the federal government made to protect human health?

EPA has established a level of total chromium of 0.1 ppm as the current drinking water regulation. The Agency requires industry to report discharges or spills of 1 pound or more of chromium and 1,000 pounds or more or various chromium compounds.

What is the method of treatment and disposal of chromium?

Approximately 15% of chromium used in the metal industry is recycled, largely from stainless steel scrap. Large amounts of chromium-containing wastewaters are discharged into surface waters. Very little is known about disposal methods for other chromium processes such as refractory materials used in metal smelting furnaces and chemical industries producing such products as chromium-containing pigments.

GLOSSARY

Emissions: Release or discharge of fumes, dust or particulates into the air.

Gastrointestinal Tract: That portion of the digestive system made up of the stomach and the intestines.

Metabolism: A chemical and physical process in which substances (such as glucose) are transformed into energy and waste products.

National Priorities List (NPL): EPA's list of the uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under the Superfund Program.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

For more information about Chromium, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Chromium, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, October, 1987. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Copper*

June 1992

What is copper?

Copper is a reddish metal that occurs naturally in rock, soil, water, sediment, and air. It is an essential element for all living organisms, including humans and other animals. Copper also occurs naturally in plants.

It is most commonly seen in the United States penny, electrical wiring, and some water pipes. It is also found in many alloys, such as brass and bronze. Many compounds, or combinations, of copper exist. The most commonly used compound of copper is copper sulfate. Many copper compounds can be recognized by their blue-green color.

Copper is extensively mined and processed and is primarily used as copper metal or alloy in the manufacture of wire, sheet metal, pipe, and other metal products. Copper compounds are most commonly used in agriculture to treat plant diseases, such as mildew; for water treatment; and as preservatives for wood, leather, and fabrics.

How can copper affect human health?

Copper is necessary for good health; however, very large daily intakes of copper can be harmful. Long-term exposure to copper dust can irritate the nose, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea. Vomiting, diarrhea, stomach cramps, and nausea may occur following ingestion of water containing high levels of copper. Large amounts of copper can cause liver and kidney damage, and even death. Very young children are more sensitive to copper toxicity. Long-term exposure to high levels of copper in food or water may cause liver damage or death. Copper is not known to cause cancer.

How can copper enter and leave the body?

Copper can enter the body through ingestion of water or food, soil, or other substances that contain copper. It may also enter the lungs through inhalation of air containing *copper dust, copper fumes,* or other particles. The body is very good at blocking high levels of copper from entering the bloodstream. Following ingestion of high levels of copper, vomiting or diarrhea may result; this prevents copper from entering the blood. Ingested copper is excreted from the body within several days. Little data is available concerning exposure through the lungs or skin.

How might exposure to copper occur?

The largest release of copper, by far, is to land. The major sources of release are mining operations, agriculture, solid waste, and sludge from municipal treatment works. Copper is released to water as a result of natural weathering of soil and discharges from industries and sewage treatment plants. Much of this copper is attached to dust and other particles in the air.

Most copper compounds found in air, water, sediment, soil, and rock are so strongly attached to dust and dirt or imbedded in minerals that they cannot easily affect health. Copper found at hazardous waste sites is likely to be of this form. Some copper in the environment is less tightly bound to particles and may be absorbed by plants and animals. Dissolved copper compounds that are most commonly used in agriculture, are more likely to threaten human health.

Exposure to high levels of dissolved copper can result from drinking contaminated water. This is because copper is picked up from copper pipes and brass faucets when the water sits in the pipes overnight. The average concentration of copper in tap water ranges from 20 to 75 parts of copper per billion parts of water (ppb). The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount.

What levels of exposure to copper have resulted in harmful health effects?

The levels of copper in air that can result in harmful health effects in humans are not known. Exposure to low levels of copper in air affects the lungs of animals.

Copper can usually be tasted in drinking water at levels below those which cause adverse health effects. Ingestion of excessive amounts of copper in water may result in vomiting, diarrhea, and stomach cramps. Drinking water contaminated with high levels of copper may have harmful health effects on infants at levels lower than those for adults. High levels of copper in drinking water or food have been shown to cause liver and kidney damage in animals.

Is there a medical test to identify copper exposure?

There are reliable and accurate ways to measure copper in the body. It can be measured in the urine and blood. Blood plasma or urine samples can be collected in a doctor's office and sent to a laboratory for analysis using special equipment to measure copper levels. However, such measurements cannot predict the extent of exposure or the potential health effects.

What recommendations has the federal government made to protect human health?

The Environmental Protection Agency (EPA) has determined that the level of copper in surface water (rivers, lakes, streams, etc.) should be limited to one part per million (ppm) to protect the public from the toxic properties of copper ingested through water and contaminated aquatic organisms. EPA has also determined that copper levels in drinking water should not exceed 1.3 ppm. EPA has developed regulations controlling the amount of copper released by industry.

What are the methods of treatment and disposal of copper?

An estimated 60% of all copper in scrap materials is recycled. Copper or copper compounds not recycled are disposed of in landfills, or released into wastewater. Copper-containing sludge generated by wastewater treatment facilities is disposed of by landfilling, *landspreading,* incineration, or ocean disposal.

GLOSSARY

Copper Dust: Solid particles of copper suspended in air.

Copper Fume: Gaseous form of copper which can enter the atmosphere.

Landspreading: A disposal technique in which liquid or solid contaminated materials are applied to the surface of the ground. Sunlight and bacterial action then breakdown the contaminants. Landspreading is one alternative to landfilling.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

For more information about Copper, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Copper, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1990. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Cyanide*

June 1992

What is cyanide?

Cyanides are both man-made and naturally occurring substances. They are found in combination with other chemicals. Of these combinations, or compounds, those with which people are most likely to come into contact are hydrogen cyanide, sodium cyanide, and potassium cyanide. Hydrogen cyanide is a colorless gas or liquid with a faint, bitter odor. Sodium cyanide and potassium cyanide are both colorless solids that have a slightly bitter odor.

How can cyanide affect human health?

Cyanide, in the form of vitamin B_{12} (cyanocobalamin), is needed as part of a healthy diet to prevent iron poor blood, or anemia.

The harmful effects of cyanide may vary from person to person, depending upon such factors as general health, family traits, age, and sex. Short-term exposure to high levels of cyanide harms the central nervous, respiratory, and cardiovascular systems. Such exposures can also cause coma or death. Brief exposures to lower levels can result in rapid, deep breathing; shortness of breath; convulsions; and loss of consciousness. These effects disappear with time because cyanide does not remain in the body. In some cases, quick medical treatment can revive a person who has been poisoned by cyanide.

Skin contact with the dust of certain cyanide compounds can cause skin irritation and ulcerations. Ingestion of food containing low levels of cyanide over an extended period has resulted in damage to the nervous system and thyroid gland.

Effects on the nervous system believed to stem from long-term exposure to cyanide include deafness, vision problems, and loss of muscle coordination. Effects on the thyroid gland can cause *cretinism*, or enlargement and overactivity of the gland.

How might exposure to cyanide occur?

Exposure to cyanide stems from environmental, occupational, and consumer product sources. The single largest source of cyanide in the air is vehicle exhaust. Other sources of release to the air may include emissions from chemical processing industries, steel and iron industries, metal plating and finishing industries, and petroleum refineries. Cyanides may also be released from municipal waste incinerators, from landfill wastes, and during the use of cyanide-containing pesticides. Cyanides are released when certain types of plastics, silk, wool, and paper are burned. Smokers are exposed to larger amounts of cyanide than nonsmokers.

The major sources of cyanide release to water are discharges from wastewater treatment works, iron and steel production plants, and organic chemical industries. Much smaller amounts of cyanide may enter water through storm-water runoff in locations where cyanide-containing road salts are used. Groundwater can be contaminated by cyanide from landfills as it passes downward through the soil. The largest sources of cyanide releases to soil are probably the disposal of cyanide wastes in landfills and the use of road salts. Cyanide has been found in approximately 366 of the 1,300 sites on the *National Priorities List (NPL)*.

How does cyanide get into the body?

Cyanide can enter the body through inhaling air containing hydrogen cyanide vapor or dust containing cyanide compounds. This may be a common *exposure route* for individuals who work with the chemical, and for those who smoke. It is probably also an exposure route for those who live near industrial and commercial areas where large amounts of the compound are used or disposed of at waste sites. Cyanide can also enter the body through ingestion of food or water tainted with cyanide. Although exposure to cyanide through contact with the skin can occur, it is not common outside the workplace.

Is there a medical test to identify cyanide exposure?

Blood and urine levels of cyanide and thiocyanate, a compound produced from cyanide, can be measured. Because these compounds are always found in the body, these measurements are only useful when exposure to large amounts of cyanide has occurred.

What levels of exposure have resulted in harmful health effects?

Inhalation of cyanide quickly causes harmful health effects. Exposure at a level of 110 parts per million (ppm) can cause death within 30 minutes. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. Levels of about 18 ppm may cause headaches, weakness, and nausea. Animal deaths have been reported at exposure levels ranging from 20 ppm for 4.5 hours to 503 ppm for 5 minutes.

Only limited, long-term exposure information is available. Nervous system effects have been seen in dogs exposed to hydrogen cyanide at 45 ppm for 30 minutes a day for up to 22 weeks. Information concerning health effects stemming from eating cyanide is also limited. Short-term exposures resulting from suicides and suicide attempts have been reported. Ingestion of very small amounts of cyanide has been fatal.

What recommendations has the federal government made to protect human health?

The government has made recommendations to protect the general public from cyanide exposure in food and in the workplace. Hydrogen cyanide is sometimes used to treat food after it is harvested to prevent pest damage. The Environmental Protection Agency (EPA) permits levels of cyanide in food ranging from 25 ppm in dried beans, peas, and nuts to 250 ppm in spices. The proposed *Maximum Contaminant Level* for hydrogen cyanide in drinking water is 0.2 ppm.

What are the methods of treatment and disposal of cyanide?

The most widely used method for treating cyanides is alkaline chlorination. This process converts cyanide solution to less toxic cyanate. Other treatment techniques include large-scale outdoor burning (following special precautions); ozonation; and decomposition to less toxic compounds through physical or chemical processes. Following these treatments, cyanide wastes are disposed of in a secured sanitary landfill.

GLOSSARY

Cretinism: A congenital deficiency of the thyroid gland resulting in physical deformities and mental deficiencies.

Exposure Route: The way in which people come into contact with a substance. The main routes are ingestion, inhalation, and absorption through the skin.

Maximum Contaminant Level: EPA evaluates the health risks associated with various contaminant levels to ensure that public health is adequately protected. The MCL, as they are commonly known, is the maximum allowable concentration of a specific contaminant in public drinking water.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

For more information about Cyanide, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Cyanide, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About
1,1 Dichloroethene

June 1992

What is 1,1-dichloroethene (DCE)?

Dichloroethene (DCE), a man-made chemical also known as vinylidene chloride, is used to make certain plastic wraps and flame-retardant fabrics. It is a clear, colorless liquid that evaporates quickly at room temperature and has a mild, sweet smell.

DCE is also found as a by-product of other chemicals. Although high amounts of DCE in soil and water will quickly escape into the air, small amounts will remain and are broken down. How long it will remain in soil and water is unknown. DCE breaks down quickly in the air; releases into the atmosphere are estimated to be degraded by the sun in about two days.

How might exposure to DCE occur?

DCE may be released into the environment in the air and water coming from factories where it is made, at hazardous waste sites where it has been dumped, and from accidental spills.

In addition to these high exposures, low-level exposures may occur in the environment. DCE is found in very low amounts in indoor and outdoor air, estimated at less than one part per trillion (ppt). The term "parts per trillion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per trillion is equal to one inch in a distance of about sixteen million miles (or a penny in ten billion dollars), a very small amount. Therefore, the potential for exposure in the environment is extremely low.

The amount of DCE in the air near production sources is unknown. In air around waste sites, DCE amounts range from 0.39 to 36.4 parts per billion (ppb). Levels of DCE in air around waste sites are usually much lower than those that affect the health of laboratory animals. DCE was found at approximately 16% of all hazardous waste sites tested by the U.S. Environmental Protection Agency (EPA) and is found at approximately 432 of the 1,300 *National Priorities List (NPL)* hazardous waste sites.

A small percentage (3%) of the drinking water sources in the U.S. have been found to contain low amounts of DCE (0.2-0.5 ppb). These amounts are very low when compared with levels expected to affect human health. Levels in groundwater samples taken from hazardous waste sites where DCE was found averaged 1.38 parts per million (ppm).

How can DCE enter and leave the body?

DCE can easily enter the body through the lungs as an air pollutant or through the digestive tract in contaminated food or water. DCE probably also enters the body through the skin. This assumption is based on (1) its physical and chemical properties, (2) the fact that similar chemicals are known to be absorbed through the skin, and (3) the occurrence of *toxic* effects in animals after DCE was applied to their skin. The most common means of DCE exposure is breathing contaminated air.

Research on animals indicates that within hours of exposure, DCE begins to leave the body through the lungs. DCE remaining in the body is broken down into other substances and removed through the kidneys within two days. Low to moderate levels inhaled or ingested leave the body mainly as *breakdown products* in the urine. As the levels of DCE exposure increase, more and more leaves the body in exhaled breath. DCE is not stored in the body following moderate exposure.

How can DCE affect human health?

The health effects of DCE on humans are unknown. In animal studies, high amounts of DCE have caused liver, kidney, heart, and lung damage; nervous system disorders; and death after short exposures. Liver damage has also been seen in cases of prolonged exposure. The amount of damage depends on the level of exposure and the length of time exposed. Exposure by breathing DCE appears to be more harmful to animals than through food or water.

Harmful effects on the developing fetus of pregnant animals which had inhaled this chemical have been seen. An increased risk of cancer has been shown in animals exposed to DCE. EPA considers it to be a possible cancer-causing substance in humans.

Is there a medical test to identify DCE exposure?

DCE can be measured in the breath, blood, urine, and body tissues of exposed individuals. However, only relatively high levels of DCE can be detected in body tissues and fluids using currently available techniques. Because breath samples are easily collected, tests of exhaled air are now the most common way to identify exposure to high levels of DCE. Other medical tests can measure breakdown products of the chemical in the blood and urine. Because DCE leaves the body fairly quickly, these methods are best for identifying recent exposures. Measured levels in the body may not reflect exposure to DCE alone, since exposure to DCE at hazardous waste sites is likely to include exposure to other organic compounds that produce similar breakdown products.

What levels of exposure have resulted in harmful health effects?

Except for loss of breath, fainting, and nervous system disorders like drunkenness that result from exposure to high amounts of DCE in a closed space, there are few medical reports which document ill health effects.

Animal studies indicate that the normal actions of the liver, kidney, lungs, heart, and blood can be affected by DCE exposure. Harmful effects begin to occur at levels of 15 ppm following 5 days of exposure. Animals exposed to DCE levels of 98 ppm for 7 days have died. Animals which had very large amounts of DCE placed in their stomachs developed liver disease; some died. Those fed small amounts in drinking water over a period of months to years also developed liver disease.

What recommendations has the federal government made to protect human health?

Current EPA requirements limit DCE in drinking water to 7 ppm and mandate the reporting of all releases exceeding 5,000 pounds. Work is now underway by EPA to measure the levels of DCE at abandoned waste sites.

The Food and Drug Administration (FDA) regulates the use of plastic packaging films. The FDA does not consider the low levels of DCE found in foods wrapped in these films to be a health risk to the consumer.

What are the methods of treatment and disposal of DCE?

DCE is classified as a flammable liquid hazardous waste. Current disposal regulations require that DCE be dissolved in combustible solvents and scatter-sprayed into a furnace equipped with an afterburner and alkaline scrubber. Significant revision of the criteria for land treatment and burial is underway.

GLOSSARY

Breakdown Products: Most contaminants are combinations of specific substances. Contaminants are degraded, or separated, into these individual substances through chemical or physical means.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

Toxic: Acting as a poisonous or hazardous substance; having poisonous or harmful qualities.

For more information about DCE, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Dichloroethene, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Dioxin*

June 1992

What is dioxin?

Chlorinated dibenzo-p-dioxins are a class of compounds referred to as dioxins. There are 75 possible forms of dioxin. One of these, containing four chlorine atoms, is called 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and is the most toxic form of dioxin. It is a colorless solid with no known odor. 2,3,7,8-TCDD does not occur naturally, nor is it intentionally manufactured by industry.

How might exposure to dioxin occur?

Important environmental sources of dioxin are the use of herbicides; in wood preservatives; pulp and paper manufacturing plants; incineration of municipal and certain industrial wastes; and transformer or capacitor fires involving chlorinated benzenes and biphenyls.

Although 2,4,5-T, 2,4,5-trichlorophenol and hexachlorophene are no longer produced commercially (except for certain medical purposes), disposal sites of past production wastes are sources of present exposure. 2,3,7,8-TCDD has been found in at least 57 of the 1,300 hazardous waste sites on the *National Priorities List (NPL).*

Very low levels have been detected in air surrounding such activities. 2,3,7,8-TCDD in drinking water has not been reported; the compound has not been detected in most rural soils examined, but it can be present in trace amounts in urban soils. It has been detected in fish caught in contaminated surface waters. It has also been detected in human milk, fat, and blood serum; however, the levels of dioxin considered to be harmful have not yet been determined.

How can dioxin affect human health?

Exposure to high doses of 2,3,7,8-TCDD can cause chloracne, a severe skin lesion that usually occurs on the head and upper body. Chloracne is more disfiguring than common acne, and often lasts for years after the initial exposure. There is suggestive evidence that 2,3,7,8-TCDD may cause liver damage, as indicated by an increase in levels of certain enzymes in the blood.

Although not demonstrated in humans, animal studies involving high dioxin dosage levels have shown various forms of *toxicity*. Severe liver damage occurred in some species. It may cause loss of appetite, weight loss, and digestive disorders. Animal exposure to the compound has resulted in severe loss of body weight prior to death. Animal studies have also revealed that 2,3,7,8-TCDD produces toxicity to the immune system. Some animal species exposed during pregnancy have had offspring with deformities. Although detected in human milk, the effects on infants and children are unknown.

Both the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC) have concluded that 2,3,7,8-TCDD causes cancer in animals and probably causes cancer in humans.

Is there a medical test to identify dioxin exposure?

No common medical test is available to convincingly demonstrate exposure to 2,3,7,8-TCDD. It is believed that a blood test to detect certain enzymes indicating liver damage may be helpful in determining whether exposure has occurred; other substances, including alcoholic beverages, can produce similar results.

Other tests are available that are not commonly conducted by doctors, but appear to more adequately indicate dioxin exposure. One test consists of analysis of a small piece of body fat removed by a simple surgical procedure. In another recently developed test, blood serum is analyzed for the presence of 2,3,7,8-TCDD. The initial study appears to indicate that the method is sensitive enough to detect extremely low levels. If the levels of 2,3,7,8-TCDD are higher than the determined *background range,* the test indicates probable above-average exposure, or exposure more recent than that of the comparison group. In addition, detection of 2,3,7,8-TCDD in mother's milk also indicates exposure; levels in the milk may provide some indication of whether exposure is due to background levels or additional exposure.

How does dioxin enter the body?

The 2,3,7,8-TCDD form of dioxin can be adsorbed through the skin following contact with contaminated materials such as soil. Ingestion of 2,3,7,8-TCDD can occur through consumption of contaminated fish, milk, foodstuffs, and soil. Breathing contaminated air is also a source of exposure. This *exposure route* may contribute very small amounts to total body intake; particulates such as *fly ash* from municipal and industrial incineration may also constitute a source of exposure. Intake of 2,3,7,8-TCDD from the consumption of drinking water is considered negligible.

What recommendations has the federal government made to protect human health?

The EPA has calculated health advisories (HAs) for 2,3,7,8-TCDD in drinking water, that is, estimates of containment levels below which adverse health effects are not expected. The 1-day (of exposure) HA is 1 part per trillion (ppt), for a child; the 10-day HA is 0.1 ppt for a child. The longer-term HA is 0.01 ppt for a child and 0.035 ppt for an adult; the lifetime HA is also 0.035 ppt for adults. These are very small amounts. The term "parts per trillion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per trillion is equal to one inch in a distance of about sixteen million miles (or a penny in ten billion dollars). EPA has also performed a *risk assessment* and found that the amount of 2,3,7,8-TCDD in surface waters (lakes and rivers) that would be associated with one additional incidence of cancer in a population of 100,000 could be as low as 0.13 parts per quadrillion (an extremely small amount), based on the consumption of contaminated water or fish.

What are the methods of treatment and disposal of dioxin?

Incineration at a minimum temperature of 800° to 1,200°C for at least 30 seconds can destroy dioxin. Stabilization of buried dioxin through the addition of cement and asphalt materials; biological degradation (breaking down) with a white rot fungus; and ultraviolet destruction by light are other techniques that may have application in the disposal of dioxin. Other proposed methods achieve stabilization by placing a protective cap over the contaminated soil.

GLOSSARY

Background Range: The concentration of any substance which would normally be found in an area. This range is used as a basis of comparison in identifying contamination levels.

Exposure Route: The way in which people come into contact with a substance. The main routes are ingestion, inhalation, and absorption through the skin.

Fly Ash: Airborne bits of unburnable dust or fine particles, usually associated with combustion of fossil fuels or incinerators. Environmental regulations require that fly ash be captured by air pollution control devices.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

Risk Assessment: An evaluation process that determines the projected health effects caused by exposure to a specific contaminant based on (1) an evaluation of the characteristics and concentration of the contaminant, (2) the exposure pathways present, (3) the projected incidence of human exposure, and (4) toxicity (poisonous) factors.

Toxicity: The degree to which a substance acts as a poison.

For more information about Dioxin, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

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EPA Facts About *Ethyl Benzene*

June 1992

What is ethyl benzene?

Ethyl benzene is a colorless liquid that smells like gasoline. It evaporates at room temperature and burns easily. Ethyl benzene occurs naturally in coal tar and petroleum. It is also found in many man-made products, including paints, inks, gasoline, and insecticides.

How might exposure to ethyl benzene occur?

Persons living near factories or heavily traveled highways may be exposed to ethyl benzene in the air. Releases of ethyl benzene into these areas occur from burning oil, gas, and coal and from discharges of ethyl benzene from some factories.

Exposure to ethyl benzene can also occur in the workplace. Gas and oil workers may be exposed either through contact with the skin or by breathing ethyl benzene vapors. Varnish workers, spray painters, and persons involved in gluing operations may also be exposed to high levels of ethyl benzene. Exposure may occur in factories that use ethyl benzene to produce other chemicals.

Many individuals are exposed to small doses of ethyl benzene in their daily lives. Gasoline is a common source. Other sources of ethyl benzene exposure stem from its use as a solvent in pesticides, carpet glues, varnishes and paints, and from the use of tobacco products.

What levels of exposure have resulted in harmful health effects?

No reliable data on the effects of ethyl benzene exposure after eating, drinking, or breathing this chemical or following direct exposure to the skin are available. Animal studies have documented eye damage and skin irritation in rabbits as a result of exposure to liquid ethyl benzene. Additional animal studies are in progress at federal research laboratories.

How can ethyl benzene enter and leave the body?

Exposure via the lungs occurs when air containing ethyl benzene vapor is inhaled. Food and water contaminated with ethyl benzene can result in exposure through the digestive tract. It may also be absorbed through the skin during contact with contaminated liquids. Absorption of ethyl benzene vapors through the skin is not significant. People living in urban areas or in areas near hazardous waste sites may be exposed by breathing air or drinking water contaminated with ethyl benzene.

Once in the body, ethyl benzene is broken down into other chemicals. Most of it leaves in the urine within two days. Small amounts can also leave through the lungs and in bodily wastes. Liquid ethyl benzene which enters through the skin is also broken down.

How can ethyl benzene affect human health?

Short-term exposure to low levels of ethyl benzene in the air for short periods of time has caused eye and throat irritation. Exposure to higher levels has caused more severe effects such as decreased movement and dizziness. No studies have reported fatalities following exposure to ethyl benzene. However, evidence from animal studies suggests that it can cause death at very high concentrations. Short-term exposure of laboratory animals to high concentrations of ethyl benzene in air may cause liver and kidney damage, nervous system changes, and changes in the blood. Birth defects have occurred in newborn animals whose mothers were exposed by breathing air contaminated with ethyl benzene. The seriousness of these effects appears to increase with higher exposure levels.

Is there a medical test to identify ethyl benzene exposure?

Ethyl benzene is found in the blood, urine, breath, and some body tissues of exposed individuals. Urine is most commonly tested to identify exposure to ethyl benzene. The test measures the presence of substances formed following exposure to ethyl benzene. Because these substances leave the body very quickly, the test must be performed within a few hours of exposure. Although this test can identify exposure to ethyl benzene, it cannot yet be used to predict the kind of health effects that might develop as a result of that exposure.

What recommendations has the federal government made to protect human health?

The Environmental Protection Agency's (EPA's) Maximum Contaminant Level for ethyl benzene in drinking water supplies is 0.7 parts per million (ppm). The Maximum Contaminant Level is the highest acceptable concentration of a specific contaminant in drinking water. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. This value is for lifetime exposure and is not expected to increase the risk of (noncancer) health effects. EPA also recommends that no fish or water from a body of water containing more than 1.4 ppm ethyl benzene be ingested. EPA requires that releases of 1,000 pounds or more of ethyl benzene be reported to the National Response Center in Washington, D.C.

For more information about Ethyl Benzene, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

What are the methods of treatment and disposal of ethyl benzene?

Disposal methods for ethyl benzene are *rotary kiln incineration liquid injection incineration* and *fluidized bed incineration*. Ethyl benzene can also be concentrated, that is, the waste volume can be reduced, through biological treatment, *chemical precipitation,* air and steam stripping, solvent extraction, or activated carbon treatment. Each of these treatment forms reduces the amount of contaminated material which must then be disposed of in a landfill. Waste ethyl benzene solvents and residues from the recovery of these solvents are designated hazardous wastes and are subject to EPA handling and recordkeeping requirements.

GLOSSARY

Chemical Precipitation: Application of chemicals or heat to a liquid waste solution containing slightly soluble contaminants to cause contaminants to become insoluble and "settle out" of solution. Settled solids can then be collected for proper disposal.

Fluidized Bed Incineration: A treatment process that destroys solid and liquid wastes using recycled gases to produce temperatures of 1600°F.

Liquid Injection Incineration: A treatment process which uses high temperatures to destroy liquid and gas wastes in which the wastes are sprayed (atomized through a nozzle) into a combustion chamber heated to between 1300°F and 3000°F.

Rotary Kiln Incineration: A treatment process which uses high temperatures to destroy solid and liquid wastes using a two-step process. Wastes are first treated in a rotating chamber at 1600°-1800°F, then fed to a second chamber with temperatures of 2400°F.

The information in this fact sheet was compiled from the Toxicological Profile for Ethyl Benzene, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1990. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Lead*

June 1992

What is lead?

Lead is a bluish-gray metal which occurs naturally throughout the environment. Lead and its compounds are found in plants and animals used for food, and in air, drinking water, surface waters, and soil.

Lead is mined from ore deposits or salvaged from recycled scrap metal. It is used in a wide range of products; the main use is in the manufacture of storage batteries. Other uses are the production of chemicals, including paint, gasoline additives, ammunition and various metal products (for example, sheet lead, solder, and pipe).

How can lead and its compounds affect human health?

Lead exposure is especially dangerous for unborn children because their bodies can be harmed while they are being formed. Exposure of the mother during pregnancy can cause premature birth, low birth weight, or even miscarriage. Young children are also at an increased risk because more of the lead ingested into their bodies is absorbed and they are more sensitive than adults to its effects. Lead exposure in infants and young children has been shown to decrease IQ scores, retard physical growth, and cause hearing problems. These health effects can occur at exposure levels once thought to be safe.

A link between lead exposure and cancer in humans has not been demonstrated. However, because laboratory animals fed lead throughout their lives have developed tumors, lead should be considered a possible cancer-causing substance in humans.

Exposure to high levels of lead can cause severe brain and kidney damage. Lead exposure may increase blood pressure in middle-aged men; high levels may also affect the male reproductive system.

Is there a medical test to identify lead exposure?

Lead exposure can be identified by measuring the amount of a substance called erythrocyte protoporphyrin (EP) present in red blood cells. The amount of EP is high when the amount of lead in the blood is high. However, there are problems associated with this technique. Unless the lead levels are extremely high, EP levels may be within what are considered normal limits. In addition, other diseases which affect the red blood cells, such as some types of anemia, can cause high EP levels. Exposure can also be identified by using x-ray techniques to measure the amount of lead present in bone and teeth. However, this test is not commonly used.

How does lead enter the body?

Lead exposure stems primarily from contact with contaminated dust or water. Lead present in the air attaches to dust. Dust contaminated with lead is removed from the air by rain. Lead can remain in the soils where it is deposited for many years, however, heavy rainfall can cause lead contaminated soil to move into both groundwater and surface waters. Lead and lead compounds have been found at 853 of approximately 1,300 sites on the National Priorities List of hazardous waste sites in the U.S.

Lead can enter the body through inhalation of air contaminated with lead particles or dust which contains lead. Nearly all lead entering the lungs moves to the blood and then to other parts of the body. In adults, very little of the amount of lead ingested in food, beverages, water, and dust enters the blood from the intestinal tract. However, when children swallow food or soil containing lead, much more of the lead enters their blood and moves to other parts of the body. Relatively small amounts of lead enter the body through the skin.

Regardless of the route by which lead enters the body, most is stored in bone. Since additional lead is stored with each new exposure, the level in bones and teeth increases with age. Lead that is not stored in the body is removed in bodily wastes.

What recommendations has the federal government made to protect human health?

The Centers for Disease Control (CDC) recommends that screening for lead poisoning be included in health care programs for children, especially those between the ages of 6 months and 9 years.

The CDC recommends immediate medical treatment for children found to have blood lead levels of 250 parts per billion (ppb) or greater. The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount. There is now concern that levels as low as 100 to 150 ppb might be harmful to children, and because of this, the CDC is reviewing current screening criteria.

The Consumer Product Safety Commission (CPSC) does not permit lead content in most paints to be above 0.06%. The CPSC suggests that all painted surfaces in homes be tested for lead. Paint which is found to contain high levels of lead should be removed.

The Environmental Protection Agency (EPA) prohibits lead levels in drinking water above 15 ppb of lead in water. EPA suggests that public water systems treat their water to decrease contamination from plumbing (pipes, solder, etc.) if the level of lead in tap water that has been standing overnight exceeds 15 ppb. Drinking water in schools must be tested for lead and provision made for its removal if lead levels exceed allowable limits.

How might exposure to lead occur?

Lead exposure can result from inhaling air, drinking water, or ingesting foods or soil that contain lead. Inhaling air containing lead-contaminated dust or ingesting lead-contaminated soil, both of which may be found at hazardous waste sites or near areas with heavy automobile traffic, are also exposure sources. Children may be exposed to lead by swallowing such non-food items as chips of paint which contain lead.

Until recently, the largest single source of lead in air was vehicle exhaust. Other sources of release to the air include emissions from iron and steel production, smelting operations, municipal waste incinerators, and lead-acid battery manufacturers. Cigarette smoke is also a source of lead.

The major sources of lead released to water are lead plumbing and solder in houses, schools, and public buildings; lead-contaminated dust and soil carried into water by rain and wind; and wastewater from industries that use lead.

Lead can be released to the soil from lead-contaminated wastes in municipal and hazardous waste landfills, and from fertilizers that contain sewerage sludge. Plants can absorb lead from contaminated soil, and as a result, food and beverages may contain lead.

What is the method of treatment and disposal of lead?

The primary method of disposing of lead is recycling; an estimated 70-75 percent of the lead produced in the U.S. is considered recyclable. Certain uses of lead preclude recycling, for example, lead used in gasoline. Over 90 percent of the lead used in manufacturing lead-acid storage batteries is recycled; 50 percent of the lead requirements are met by recycled lead, mostly from lead batteries.

A substantial amount of lead is disposed of in municipal and hazardous waste landfills. Lead is commonly disposed of as lead-containing waste products such as storage batteries, ammunition waste, sheet lead, solder, pipes, lead-based paints, and solid waste from lead mining and mineral ore processing.

For more information about Lead, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Lead, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, June, 1990. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.* *impacts on the environment, including plants and animals.*

EPA Facts About *Mercury*

June 1992

What is mercury?

Mercury is a naturally occurring *element* found in several forms. One form, used in thermometers, is called "metallic mercury". Mercury is also used in barometers, and in other common consumer products. Mercury can combine with other chemicals such as chlorine, carbon, or oxygen to form either *"inorganic"* or *"organic"* mercury compounds. Mercury is unusual in that one form of organic mercury, called methylmercury, can accumulate in certain fish. As a result, rather low levels of mercury in bodies of water can significantly contaminate these fish.

Mercury released into the environment will persist for a long time. It can change between organic and inorganic forms. For example, some or all released organic mercury will slowly break down to become inorganic mercury. Some released inorganic mercury will also slowly be changed into organic mercury (specifically, methylmercury) in soil and water by reaction with substances produced by *microorganisms* and various chemical processes.

How might exposure to mercury occur?

Air usually contains mercury in concentrations of approximately 2.4 parts per trillion (ppt). The term "parts per trillion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per trillion is equal to one inch in a distance of about sixteen million miles (or a penny in ten billion dollars), a very small amount. Levels near certain industries (such as mercury mines and refineries) can be nearly 1,800 ppt. Mercury levels in water samples taken from *Superfund* sites (including both *National Priorities List* (NPL) and non-NPL sites) were about 200 ppt. Levels greater than 500 ppt have been found in some drinking water wells tested during *groundwater* surveys.

People who eat large amounts of fish, such as tuna and swordfish, may be exposed to high levels of mercury because these fish can contain high levels of organic mercury. Environmental exposure can result from contact with water and air near spills and *toxic* waste sites contaminated with mercury. Mercury is found at above normal *background levels* at approximately 568 of 1,300 NPL sites.

How can mercury enter the body?

Mercury can easily enter the body if its *vapor* is inhaled or if fish or other foods contaminated with mercury are ingested. Mercury may also enter the body directly through the skin. Exposure to above-normal levels of mercury at NPL sites may result from drinking water contaminated with inorganic mercury salts. Some sites may have such high amounts of mercury in the soil or in containers, that breathing mercury metallic vapor may be a problem. Once mercury has entered the body, it may be months before all of it leaves. It is largely eliminated from the body in wastes.

Is there a medical test to identify mercury exposure?

There are reliable, accurate, and easily available ways to measure mercury levels in the body. Blood or urine samples can be taken in a doctor's office and tested in a laboratory using special equipment.

How can mercury affect human health?

Long-term exposure to either organic or inorganic mercury can permanently damage the brain, kidneys, and developing fetuses. The form of mercury and the method of exposure determine which of these health effects will be more severe. For example, organic mercury that is eaten in contaminated fish or grain may cause greater harm to the brain and developing fetuses than to the kidneys; inhaled metallic mercury vapor may cause greater harm to the brain; and inorganic mercury salts that are ingested may cause greater harm to the kidneys. Thus, maternal exposure to organic mercury may lead to brain damage in fetuses; adults exposed to metallic mercury vapor may develop shakiness (tremors), memory loss, and kidney disease.

Short-term exposure to high levels of inorganic and organic mercury will have similar health effects. However, full recovery is more likely after short-term exposure. Mercury has not been shown to cause cancer in humans.

What levels of exposure have resulted in harmful health effects?

An exact exposure level cannot be determined for some known health effects. For example, eating fish or grain contaminated with high levels of organic mercury can cause brain damage, especially in developing infants. However, an estimate of the exact level of mercury that would cause this effect cannot be determined because the amount of mercury in food, and the amount of contaminated food eaten, is unknown. In addition, long-term of high levels of mercury vapor can cause brain damage.

What recommendations has the federal government made to protect human health?

The Environmental Protection Agency (EPA) has limited the level of inorganic mercury in rivers, lakes, and streams to 144 parts per billion (ppb). EPA requires the reporting of all releases of more than one pound of mercury metal into the environment. The Food and Drug Administration limits levels of mercury in bottled water to no more than 2 ppb.

How are mercury releases controlled?

Current federal guidelines limit air emissions of mercury generated by incinerators or drying of wastewater sludge. Spills which do occur must be cleared with a special vacuum cleaner and washed with dilute calcium sulfide solution. Small quantities can be gathered by mixing the spilled mercury with copper metal granules.

For more information about Mercury, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

GLOSSARY

Background Levels: The concentration of any substance which would normally be found in an area. This level is used as a basis of comparison in identifying contamination levels.

Element: All substances are made up of elements, which are the basic components, or parts, of all materials. Elements cannot be separated or broken down into smaller units by ordinary chemical means.

Groundwater: Water found below the surface, usually in sands or a rock formation. Much of our domestic water supply is drawn from groundwater wells.

Inhalation: To draw air, vapor, etc. into the lungs; to breathe.

Inorganic: A compound which does not contain carbon and is derived from mineral sources. Metals are inorganic compounds.

Microorganisms: Microscopic animal or plant life; particularly any of the bacteria, protozoans, viruses, etc.

National Priorities List: EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under the Superfund Program.

Organic: A compound which contains carbon and is derived from animal or plant sources.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

Toxic: Acting as a poisonous or hazardous substance; having poisonous or harmful qualities.

Vapor: Gaseous form of a substance which can be carried in the air and may expose individuals through inhalation.

The information contained in this fact sheet was compiled from the Toxicological Profile for Mercury, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Methylene Chloride*

June 1992

What Is methylene chloride?

Methylene chloride, also called dichloromethane, is an *organic solvent* that looks like water, has a mild sweet odor, and evaporates very quickly. It is widely used as an industrial solvent and as a paint stripper. It is also a component in certain aerosol and pesticide products, and is used in the manufacture of photographic film.

How does methylene chloride affect human health?

High levels of methylene chloride in air (above 500 parts per million [ppm]) can irritate the eyes, nose, and throat. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. If this substance gets on the skin, it usually evaporates quickly and causes only mild irritation. However, methylene chloride can be trapped against the skin by gloves, shoes, or clothes and can cause a burn. If it comes into contact with the eyes, a severe (but temporary) eye irritation may result.

Methylene chloride can affect the *central nervous system.* If it is inhaled at levels above 500 ppm, effects much like those produced by alcohol, including sluggishness, irritability, lightheadedness, nausea, and headaches may result. Some effects have been observed at concentrations as low as 300 ppm. These symptoms usually disappear quite rapidly once exposure ceases.

Some of the effects of methylene chloride on the nervous system may be due to the breakdown of this compound to carbon monoxide (CO). Carbon monoxide interferes with the blood's ability to carry oxygen to the tissues and causes symptoms similar to the narcotic effects previously described. Since smoking increases the amount of CO in the blood, smokers may experience effects on the nervous system at lower levels of exposure to methylene chloride than do non-smokers. Animal studies suggest that frequent or lengthy exposures to methylene chloride can cause changes in the liver and kidneys. In certain laboratory experiments, animals exposed to high concentrations of methylene chloride throughout their lifetime developed cancer. Methylene chloride has not been shown to cause cancer in humans exposed at occupational levels; however, it should be treated as a potential cancer-causing substance.

Is there a medical test to identify exposure to methylene chloride?

Several methods exist for determining whether a person has been exposed to methylene chloride. The compound can be measured in the breath to determine recent exposure; the amount of the chemical detected will reflect the amount inhaled. The urine can also be analyzed by monitoring for methylene chloride itself or for some *intermediate products* (such as formic acid) . Blood can be analyzed to determine possible methylene chloride exposure by monitoring blood levels of carboxyhemoglobin (CO-Hb). Carbon monoxide formed in the blood through the breakdown of methylene chloride readily binds with the hemoglobin to form CO-Hb. Thus, excessive levels of CO-Hb in the blood can be an indication of exposure to high concentrations of methylene chloride.

How can methylene chloride enter the body?

Methylene chloride may enter the body when it is inhaled or ingested. No data are currently available on the absorption of methylene chloride through the skin. Since it vaporizes very quickly, the primary route of exposure is inhalation. Once methylene chloride enters the body, it is absorbed through body membranes (e.g., stomach, intestines, and lungs) and quickly enters the bloodstream.

What levels of exposure have resulted in harmful health effects?

In case studies involving people, the primary health effects are on the central nervous system. Short exposures to concentrations of 500 ppm and above result in chemical intoxication, fatigue, and irritability. One study reported a slight effect on sensory function at 300 ppm for 4 hours. At concentrations of 500 ppm and above, methylene chloride also irritates the nose and throat.

Rats have developed changes in liver cells following long-term ingestion of methylene chloride in drinking water. However, based on animal and human studies, it appears unlikely that this compound will cause serious liver effects in humans unless exposure is very high.

Methylene chloride is not known to cause cancer in humans, but based on animal studies, the Environmental Protection Agency (EPA) believes that it has the potential to cause cancer in humans. Exposures should, therefore, be avoided or, when unavoidable, kept to a minimum.

How might exposure to methylene chloride occur?

The highest exposures to methylene chloride usually occur in workplaces where this solvent is used or from contact with consumer products that contain it. Exposure to the solvent in outdoor air and water is generally low. Hobby and household use of paint-stripping chemicals and aerosol products containing methylene chloride are major sources of exposure. Exposure occurs as a result of breathing vapors given off by the product or from direct contact with the skin. Special efforts should be taken to follow label directions which recommend working in a well-ventilated area when using products containing methylene chloride.

What recommendations has the federal government made to protect human health?

EPA has provided guidelines concerning the amounts of methylene chloride which may cause risk to human health. The Agency recommends that exposure to methylene chloride in water not exceed 10 ppm for children for 1 day or 2 ppm for 10 days. The Food and Drug Administration (FDA) has established limits on the amounts of methylene chloride present in spice, hops extract, and decaffeinated coffee.

What are the methods of treatment and disposal of methylene chloride?

Methylene chloride wastes may be disposed of by controlled incineration, a high temperature combustion process used to destroy hazardous wastes. In 1988, about 11,500 tons of methylene chloride were transferred to landfills or other treatment facilities; 1,300 tons were sent to publicly-owned treatment works. Methylene chloride has been found in at least 311 of the approximately 1,300 *National Priorities List (NPL)* sites.

GLOSSARY

Central Nervous System: The group of nerve cells and tissues, including the brain, spinal cord, ganglia, nerves, and nerve centers which control and coordinate all bodily functions.

Intermediate Products: Those materials produced by the breakdown or degradation of substances in the body which can indicate the presence and concentration of the original substance.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

Organic Solvent: A carbon compound, usually a liquid, that can dissolve other substances.

For more information about Methylene Chloride, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Methylene Chloride, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, April, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Nickel*

June 1992

What is nickel?

Nickel is a naturally-occurring silvery metal. Nickel and its compounds can be detected throughout the environment in plants and animals used for human consumption, air, drinking water, rivers, lakes, oceans, and soil. Nickel used by industry comes from mined ores or recycled scrap metal. It is used primarily in making various steels and alloys, and in electroplating. Minor applications include use in ceramics, permanent magnets, and nickel-cadmium batteries.

How does nickel enter the body?

Because nickel occurs naturally in most foods, the highest level of exposure to nickel usually comes from our diet. Nickel is found in fruits, vegetables, grains, seafood, and in human and cow's milk.

The intake of nickel or its compounds by the ingestion of drinking water is typically less than through the diet; however, ingestion of nickel in drinking water can be increased significantly by the consumption of water from plumbing or faucets that contain nickel.

Nickel can also enter the body through inhalation of nickel dust or particles containing nickel compounds. Compared to oral intake, the typical amount of nickel inhaled is small. The amount of nickel entering the blood from the lungs, or remaining in the lungs, depends on the location in the lungs where the nickel has been deposited and on the properties of the nickel compound (for example, particle size and ability to dissolve in body fluids). Breathing tobacco smoke can significantly increase the amount of nickel inhaled.

Some nickel compounds, for example, nickel chloride, can penetrate skin, especially if the skin has been damaged. Skin exposures stem predominantly from nickel metal found in jewelry, coins, zippers, and cooking utensils. Nickel metal does not readily penetrate the skin, therefore, only those persons with skin allergies to nickel should be concerned with skin exposures to nickel metal.

Is there a medical test to identify nickel exposure?

The amount of nickel in the urine and blood can be measured. Although increased nickel levels in urine and blood have been noted in persons exposed to nickel compounds at work, information about the level in urine and blood cannot be used to identify the exposure levels. Similarly, information concerning the severity and length of exposure to nickel does not provide information about the levels that might then be found in the blood or urine.

How might exposure to nickel occur?

Exposure to nickel and its compounds can result from breathing air, ingesting drinking water and foods that contain nickel or nickel compounds, and skin contact with a wide range of consumer products. Segments of the population that may be exposed to higher levels of nickel include people whose diets contain foods naturally high in nickel, who are occupationally exposed to nickel, those living in the vicinity of a nickel processing facility, and people who smoke tobacco.

The single largest nickel source in the atmosphere is fuel oil combustion. Other sources include atmospheric *emissions* from mining and refining operations, emissions from municipal waste incineration, and windblown dust. Sources of nickel in water and soil include stormwater runoff, soil to which municipal sewage *sludge* has been added, wastewater from municipal sewage treatment plants, and groundwater near landfill sites.

What levels of exposure have resulted in harmful health effects?

Insufficient information is available to determine the levels at which nickel may cause health effects following skin contact. Based on what is known, the Environmental Protection Agency (EPA) has estimated that lifetime exposure to 1 part per trillion (ppt) of nickel refinery dust in air could result in 24 additional cases of cancer in a population of 100,000 people. The term "parts per trillion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per trillion is equal to one inch in a distance of about sixteen million miles (or a penny in ten billion dollars), a very small amount. Lifetime exposure to 1 ppt of nickel subsulfide in air could cause 48 additional cases of cancer in a population of 100,000. The major sources of nickel refinery dust and nickel subsulfide are nickel refineries. Because there are no nickel refineries operating in the United States, actual exposure of the general population to nickel refinery dust and nickel subsulfide is expected to be very low.

How can nickel affect human health?

The most common adverse effects of nickel exposure are skin allergies. Surveys indicate that 2.5 to 5.0% of the general population may be sensitive to nickel. For people not sensitive to nickel, normal long-term oral, inhalation, and skin exposures to low levels of nickel have not been associated with adverse health effects. Adverse effects have been caused by inhalation of nickel compounds in the workplace. Asthma has been reported in nickel platers exposed to nickel sulfate, and in welders exposed to nickel oxides. Inhalation exposure of workers to nickel refinery dust which contains nickel subsulfide has resulted in increased numbers of deaths from lung and nasal cavity cancers, and possibly cancer of the voice box. However, occupational exposure to nickel metal has not been associated with cancer.

Animal studies have shown that inhaling nickel compounds can increase susceptibility to respiratory infection, indicating that this effect may also be of concern for humans. These studies reveal that exposure to high levels of some nickel compounds during pregnancy can cause miscarriages, pregnancy complications, and low birth weight in newborns.There are no data regarding birth defects in humans due to nickel or its compounds. Additional effects that have been observed in animals exposed to nickel compounds include those on the kidneys, blood, and growth.

What are the methods of treatment and disposal for nickel?

Nickel products to be disposed of should be routed to a metal salvage facility for profitable reuse or sale as scrap. Methods for disposing of nickel-containing sludge are *landspreading,* landfilling, incineration, and ocean disposal.

What recommendations has the federal government made to protect human health?

For drinking water exposure, EPA advises that the following exposure concentrations of nickel are levels below which adverse effects would not be expected: 3.5 parts per million (ppm) of nickel in water for 10 days of exposure, and 0.1 ppm of nickel in water for lifetime exposure. These exposure concentrations are for adults; those for children and sensitive individuals would be slightly lower.

GLOSSARY

Emissions: Release or discharge of fumes, dust, or particulates into the air.

Landspreading: A disposal technique in which liquid or solid contaminated materials are applied to the surface of the ground. Sunlight and bacterial action then break down the contaminants. Landspreading is one alternative to landfilling.

Sludge: A semi-solid waste product generated from air or water treatment processes.

For more information about Nickel, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Nickel and Its Compounds, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1988. *This fact sheet focuses of the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About
P-Dichlorobenzene

June 1992

What is p-dichlorobenzene?

The compound 1,4-dichlorobenzene (p-DCB) is most commonly referred to as para-DCB or p-DCB, but approximately 20 additional terms are used for this chemical. Some of these names include Paramoth, para crystals, and paracide, reflecting its widespread use as a moth killer. It is also used to make deodorant blocks used in restrooms.

At room temperature, p-DCB is a colorless solid with a characteristic penetrating odor. When exposed to air, it is slowly transformed from its solid state into a vapor; the released vapor then acts as a deodorizer and insect killer.

p-DCB enters the environment primarily as a result of releases during use. Manufacturing accounts for only approximately 1.5% of the environmental releases. There are no natural sources of p-DCB.

How might exposure to p-DCB occur?

Dichlorobenzene is released to the environment during its manufacture and use. Heavily populated or industrialized areas tend to have the highest concentrations of p-DCB in air and in water, including surface water, *groundwater,* and drinking water.

Exposure to p-DCB is most likely to occur during its manufacture or processing, in the vicinity of industrial areas where it is produced, and near chemical waste disposal sites due to local air or water contamination. In addition, consumers are exposed to p-DCB through commonly used household products, such as mothballs and deodorant blocks used in public and household bathrooms. As a result, individuals can be exposed to p-DCB in the air, via drinking water, or from handling products containing p-DCB.

How does p-dichlorobenzene get into the body?

The major route of p-DCB entry into the body is through the lungs. This compound can also enter the body in drinking water, and has been found in drinking water in various locations throughout the U.S. It may also enter the body through the skin during contact with products containing p-DCB.

Is there a medical test to identify p-dichlorobenzene exposure?

A urine test can identify exposure to p-DCB and can give an estimate of the exposure level. A specific compound (2,5-dichlorophenol) is produced in the body following exposure to p-DCB. Detection of this chemical in the urine will indicate exposure to p-DCB within the past day or two. The amount of p-DCB in urine is also an indicator of the level present in the air when inhalation is the *exposure route.*

How can p-dichlorobenzene affect human health?

There is no evidence suggesting that brief low-level or moderate-level exposures to household products containing p-DCB cause human health problems. Higher p-DCB levels in air, such as the levels that are sometimes associated with industrial exposure, can cause headaches and dizziness. Levels that would result in death would be associated with an odor so intense that it would be very unpleasant, if not intolerable, and would serve as a warning.

Inhalation or ingestion of p-DCB has caused toxic effects in the liver and kidney of laboratory animals. Although there is no evidence that p-DCB can cause cancer in humans, laboratory animals treated with p-DCB in lifetime studies had increased rates of cancer. Based on the results of these animal studies, the potential for p-DCB to cause cancer in humans does exist. Animal studies also suggest that p-DCB exposure can result in birth defects.

What levels of exposure to p-DCB have resulted in harmful health effects?

Although there have been several reports of harmful effects in humans exposed to p-DCB, most information concerning p-DCB exposure is based on animal studies. For example, below normal weight gain has been observed in pregnant animals breathing p-DCB at similar levels (800 parts per million) for a few days. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. Slight abnormalities have also been observed in the circulatory systems of animal offspring.

When small amounts p-DCB were administered to rats and mice, even for a few days, subtle effects on the liver were seen. At much higher levels, a single dose resulted in the death of test animals. With long-term exposure, administering p-DCB orally led to damage to the liver, kidneys, and cancer in these organs resulted.

Based on the results of cancer studies in rats and mice, the excess risk of cancer in humans resulting from exposure to p-DCB has been calculated. The Environmental Protection Agency (EPA) estimates that lifetime exposure to 1 part per billion (ppb) of p-DCB could result in significantly less than one additional case of cancer in a population of 100,000 people.

What recommendations has the federal government made to protect human health?

The EPA has included p-DCB on the list of Hazardous Waste Constituents, making it subject to hazardous waste regulations. EPA has issued test rules requiring environmental and health effects testing of p-DCB. EPA has also established a maximum contaminant level of 75 ppb for p-DCB in drinking water. In addition, all pesticides are registered with EPA, and their manufacturers must submit certain information to EPA in order that the products be allowed to be used.

How are p-dichlorobenzene wastes handled?

Production of p-DCB generates wastes residues such as sludge, a thick semi-solid material. These are mainly disposed of in landfills. p-DCB wastes are also discharged to surface waters. Because p-DCB *sublimes* at room temperature, some of this waste may also reach the air. Small amounts of p-DCB also enters the atmosphere from hazardous waste disposal sites.

GLOSSARY

Exposure Route: The way in which people come into contact with a substance. The main routes are ingestion, inhalation, and absorption through the skin.

Groundwater: Water found below the ground surface in a rock or sand formation. Much of our domestic water supplies are drawn from groundwater wells.

Sublimes: A process in which a substance passes directly from a solid to a gas; vaporizes.

For more information about p-DCB, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for p-Dichlorobenzene, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, January 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Phenol*

June 1992

What is phenol?

Pure phenol is a flammable, colorless or white solid. It is mainly a man-made chemical, sold and used as a liquid. It has a strong odor that is sickeningly sweet and irritating. Phenol evaporates slowly and dissolves fairly well in water. It is also found in nature in animal wastes and organic material.

The largest single use of phenol is in the making of plastics, but it is also used to make caprolactam (used to make nylon 6 and other man-made fibers) and bisphenol A (used to make epoxy and other resins). It is also used as a *slimicide,* as a disinfectant, and in medical products.

How might exposure to phenol occur?

Small releases of phenol do not persist in the air (usually half is removed in less than one day), and usually do not remain in the soil for long periods (usually completely gone in 2-5 days). Above-average levels of phenol have been found in surface waters and surrounding air that were contaminated by industrial and commercial product releases containing phenol. It has been found in materials released from landfills and hazardous waste sites, and in the groundwater near these sites. Phenol is usually found in the environment below 100 parts per billion (ppb), although much higher levels have been reported. The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount.

Because phenol is used in many manufacturing processes and products, exposure to phenol may occur in the workplace or, in lower amounts, in the home. Phenol is present in a number of consumer products, including ointments, ear and nose drops, cold sore lotions, mouthwashes, gargles, toothache drops, analgesic rubs, throat lozenges, and antiseptic lotions. Phenol has been found in drinking water, air, automobile exhaust, tobacco smoke, marijuana smoke, and certain foods, including smoked summer sausage, fried chicken, mountain cheese, and some species of fish.

Phenol has not been reported in soil except at hazardous waste sites; this is likely due to the fact that phenol does not remain in soil very long, rather than never occurring there. Phenol has been found at 512 of the approximately 1,300 *National Priorities List* (NPL) hazardous waste sites.

How can phenol enter and leave the body?

Phenol can enter the body through ingestion of contaminated water or food, or through products containing phenol. It easily enters the body through the skin. Phenol also enters the lungs during smoking or inhaling air containing phenol.

The amount of phenol entering the body from skin contact with water containing phenol depends on the amount of phenol in the water, and on the length and extent of the exposure. Higher amounts of phenol will enter the body when large areas of skin are exposed to weak solutions of phenol than when small areas of skin are exposed to strong solutions of phenol. Phenol present in the air can enter the body through the skin and lungs. The skin may absorb as much as one-half the phenol entering the body exposed to phenol in air. Air exposures are limited to areas near spills and hazardous waste sites, as most spilled phenol will remain in soil or water rather than evaporate into air.

Studies show that most phenol entering the body through the skin, by breathing contaminated air, eating food, drinking water, or taking products containing phenol leaves the body in the urine within 24 hours.

Is there a medical test to identify phenol exposure?

Urine can be tested for phenol. This test can be used to identify recent exposures to phenol or to substances which are changed to phenol once in the body, (for example, benzene). No test can prove conclusively that a person has been exposed only to phenol, because many substances are changed to phenol in the body. Because most of the phenol that enters the body leaves in the urine within 24 hours, this test can only identify exposure that occurred 1 or 2 days prior to the test. Test results cannot be used to predict which health effects might result from phenol exposure. Measurement of phenol in urine requires special laboratory equipment and techniques not usually available in most hospitals or clinics.

How can phenol affect human health?

The serious effects of a harmful substance usually increase as both the level and length of exposure increase. Repeated exposure to low levels of phenol in drinking water has been linked with diarrhea and mouth sores in humans; eating very large amounts of phenol has resulted in death.

Laboratory animals fed very large amounts of phenol in water experienced muscle tremors and loss of coordination. Animals inhaling high levels of phenol suffered irritation to the lungs; repeated exposure for several days causes muscle tremors and loss of coordination. Exposure to high levels of phenol over several weeks results in paralysis and severe injury to the heart, kidneys, liver, and lungs, followed by death in some cases.

Phenol can have positive effects when used for medical reasons. It is an antiseptic (kills germs) when applied to the skin and may also have antiseptic properties when used as a mouthwash. It is an anesthetic (relieves pain) and is a part of some sore-throat remedies (lozenges and formulas). Small amounts of phenol in water have been injected into nerves to reduce pain caused by some nerve disorders. Phenol will kill the outer layers of skin if it remains on the skin; small amounts of strong solutions of phenol are sometimes applied to the skin to remove warts and to treat other skin spots and disorders.

What recommendations has the federal government made to protect human health?

The Environmental Protection Agency (EPA) has limited waters (lakes, streams) to 0.3 parts per million to protect human health from the possible harmful effects of exposure to phenol by drinking water and eating contaminated water plants and animals.

What are the methods of treatment and disposal of phenol?

Phenol may be disposed of by controlled burning. Dilute phenol solutions can be broken down, and rendered harmless, through the action of sewage organisms. Phenol can be recovered economically from solutions of greater than 1% phenol by steam stripping, distillation, or *carbon adsorption*.

GLOSSARY

Carbon Adsorption: A process which uses carbon particles to remove substances from air or liquids. Carbon is used because of its ability to collect or adsorb contaminants on its surface.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

Slimicide: A chemical used to kill bacteria and fungi that cause water slimes.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

For more information about Phenol, please contact EPA at the following address:

U.S Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Phenol, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Pentachlorophenol*

June 1992

What is pentachlorophenol?

Pure pentachlorophenol exists as colorless crystals with a very sharp characteristic odor when hot, but very little odor at room temperature. Impure pentachlorophenol (the form usually found at hazardous waste sites) can be dark gray to brown dust, beads or flakes. It does not burn easily, but does evaporate. Pentachlorophenol has two forms: pentachlorophenol and the sodium salt of pentachlorophenol. The sodium salt dissolves easily in water; pentachlorophenol does not.

Pentachlorophenol does not occur naturally in the environment. When it is found in the environment, it has come from releases from factories or hazardous waste sites or other sources, such as treated wood.

At one time, pentachlorophenol was one of the most extensively used pesticides in the United States. It is now a restricted-use pesticide. This compound is found in all environmental *media* as a result of widespread use in the past. It has been detected in surface waters and sediments, rainwater, drinking water, aquatic life, soils, foods, and human milk and urine. It is used industrially as a wood preservative for power poles, fence posts, etc.

How can pentachlorophenol affect human health?

Reports describing worker exposure to high levels of pentachlorophenol indicate that short-term exposures can cause harmful effects on the liver, kidneys, skin, blood, lungs, nervous system, and intestinal tract, and can cause death. Long-term exposure to low levels of pentachlorophenol such as those that occur in the workplace can also cause damage to the liver, kidneys, blood, and nervous system.

An increased risk of cancer has been identified in laboratory animals exposed to large amounts of pentachlorophenol. Harmful effects on the developing fetus have been seen in animals exposed to this chemical at exposure levels high enough to cause noticeable sickness in the mothers. EPA has classified pentachlorophenol as a probable cancer-causing agent in humans.

What levels of exposure have resulted in harmful health effects?

Pentachlorophenol can cause death if sufficiently large amounts are taken into the body. Although harmful health effects result following inhalation, the exact route of exposure (inhalation or skin contact) is not known, and the lengths of exposure or the levels that cause harmful effects have not been well documented. Studies in which animals breathed the sodium salt of pentachlorophenol show that this form of the chemical is very toxic by this exposure route.

Is there a medical test to identify pentachlorophenol exposure?

Pentachlorophenol and its *breakdown products* can be measured in the blood, urine, and tissues of exposed individuals. Although these tests can identify exposure to pentachlorophenol, they cannot yet be used to predict the severity of harmful health effects. Because pentachlorophenol leaves the body fairly quickly, these tests are best for identifying exposures that occurred within the past several days. Exposure to pentachlorophenol at hazardous waste sites usually includes exposure to other organic compounds as well that could break down into pentachlorophenol. Therefore, levels of pentachlorophenol measured by blood and urine tests may not show exposure to pentachlorophenol alone.

How can pentachlorophenol enter the body?

Pentachlorophenol can enter the body through the lungs as an air pollutant, through the digestive tract after eating contaminated food or water, or through the skin. Breathing and skin contact are the most significant *exposure routes.* Pentachlorophenol quickly leaves the body after a short exposure period; it does not appear to accumulate. Nearly all pentachlorophenol taken into the body leaves in the urine.

How might exposure to pentachlorophenol occur?

The majority of pentachlorophenol releases during production and use are to the air from wood preservation plants and cooling towers, and to land from commercial and home use of treated wood products. Pentachlorophenol is also released into surface waters, especially in storm water runoff and wood-treatment plant effluents.

Levels of pentachlorophenol in the workplace and near hazardous waste sites and accidental spills are usually higher than in the general environment. Pentachlorophenol has been found at approximately 228 of the 1,300 *National Priorities List* (NPL) hazardous waste sites in the United States.

Risk of exposure to pentachlorophenol through ingestion of contaminated food is small; the average intake in food is very low. People near pentachlorophenol sources may be exposed to higher levels.

Pentachlorophenol levels of 0.5 to 104 parts per billion (ppb) have been recorded in the indoor air of treated log homes. The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount.

What are the methods of treatment and disposal of pentachlorophenol?

Pentachlorophenol can be incinerated following treatment with sodium bicarbonate or a sand-soda ash mixture. Incineration of pentachlorophenol is one of the most significant sources of polychlorinated dibenzo-p-dioxins and dibenzofurans; therefore, care must be taken during this process.

Current land treatment and disposal practices are being reviewed. EPA requires that any release to the environment of more than 10 pounds be reported and is now working to measure the levels of pentachlorophenol found at abandoned waste sites.

What recommendations has the federal government made to protect human health?

The U.S. Environmental Protection Agency (EPA) limits the amount of pentachlorophenol in drinking water to no more than 1 ppb. For short-term exposures, EPA recommends that the concentration of pentachlorophenol in drinking water (for children) not exceed 1.0 part per million (ppm) for 1 day or 0.3 ppm for 10 days.

GLOSSARY

Breakdown Products: Most contaminants are combinations of specific substances. Contaminants are degraded, or separated, into these individual substances through chemical or physical means.

Exposure Routes: The way in which people come into contact with a substance. The main routes are ingestion, inhalation, and absorption through the skin.

Media: Air, water, and soil are the three environments, or media, subject to regulatory action by EPA.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

For additional information about Pentachlorophenol, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Pentachlorophenol, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, December, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About
Polychlorinated Biphenyl

June 1992

What are PCBs?

The abbreviation PCB refers to polychlorinated biphenyls. PCBs are a family of man-made chemicals that contain 209 individual compounds with varying toxicity. Commercial formulations of PCBs enter the environment as mixtures consisting of a variety of PCBs and impurities. Because of their insulating and nonflammable properties, PCBs have been used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs in the United States stopped in 1977 because of evidence that PCBs accumulate in the environment and may cause health hazards.

How might exposure to PCBs occur?

Although PCBs are no longer manufactured, human exposure still occurs. Many older transformers and capacitors use fluids that contain PCBs. The useful lifetime of many of these transformers can be 30 years or more.

The two main sources of human exposure to PCBs are environmental and occupational. PCBs are very persistent chemicals and are widely distributed throughout the environment. They have been found in approximately 314 of the 1,300 hazardous waste sites on the *National Priorities List (NPL). Background levels* of PCBs can be found in the outdoor air, on soil surfaces, and in water.

Eating contaminated fish can be a major source of PCB exposure. Although PCBs found in fish are generally concentrated in nonedible portions, the amounts in edible portions are high enough to make consumption a major source of exposure. Exposure through breathing outdoor air containing PCBs is small compared with the intake of PCBs through eating contaminated fish.

Most PCBs in outdoor air may be present because of a natural cycle. PCBs in surface water, or on soil surfaces, evaporate and are then returned to earth by rainfall or settling of dust particles. Re-evaporation repeats the cycle. Once in the air, PCBs can be carried long distances; they have been found in snow and seawater in the Antarctic. In addition, contaminated indoor air may be a major source of human exposure to PCBs, particularly in buildings with PCB-containing devices.

PCBs can be released into the environment from: (1) poorly maintained toxic waste sites that contain PCBs; (2) illegal or improper dumping of PCB wastes, such as transformer fluids; (3) leaks or *fugitive emissions* from electrical transformers containing PCBs; and (4) disposal of PCB-containing consumer products into municipal landfills, rather than into hazardous waste landfills.

How do PCBs enter the body?

PCBs enter the body through contaminated food and air and through skin contact. The most common route of exposure is eating fish and shellfish from PCB-contaminated water. Exposure from drinking water is minimal. It is known that nearly everyone has PCBs in their bodies, including infants who drink breast milk containing PCBs.

How do PCBs affect human health?

Animal experiments have shown that some PCB mixtures produce adverse health effects including liver damage, skin irritations, reproductive and developmental effects, and cancer. Therefore, it is prudent to consider that there may be health hazards for humans. Human studies to date show that skin irritations, such as acne-like lesions and rashes, can occur in PCB-exposed workers. Other studies of occupational exposure suggest that PCBs may cause liver cancer. Reproductive and developmental effects may also be related to occupational exposure and eating contaminated fish. While the role of PCBs in producing cancer, and reproductive and developmental effects in humans cannot be clearly delineated, the evidence provides an additional basis for public health concern over exposure to PCBs.

Is there a medical test to identify PCB exposure?

There are tests to determine PCBs in the blood, body fat, and breast milk. These tests are not routine clinical tests. Although the tests indicate exposure to PCBs, they do not predict potential health effects. Blood tests are the easiest, safest and, perhaps, the best method for detecting recent, large exposures. It should be recognized that nearly everyone has been exposed to PCBs, and that nearly everyone is likely to have detectable levels of PCBs in their bodies.

What levels of exposure have resulted in harmful health effects?

EPA advises that exposure to concentrations of PCB 1016 (one form of PCBs) below 3.5 parts per billion (ppb) is not expected to cause adverse health effects in adults. Children exposed to PCB 1016 concentrations below 1 ppb are not expected to experience adverse health effects. The term "parts per billion" is a way of expressing the concentration or strength of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount.

What recommendations has the federal government made to protect human health?

Based on evidence that PCBs cause cancer in animals, the Environmental Protection Agency (EPA) considers PCBs to be probable cancer-causing chemicals in humans.

The Food and Drug Administration (FDA) specifies PCB concentration limits of 0.2 to 3 parts per million in infant foods, eggs, milk (in milk fat), and poultry (fat).

What are the methods of treatment and disposal of PCBs?

Early federal regulations specified incineration as the only acceptable method of PCB disposal. EPA's present PCB disposal rules require disposal in chemical-waste landfills, or by destruction in high-temperature incinerators or high-efficiency boilers.

GLOSSARY

Background Levels: The concentration of any substance which would normally be found in an area. This amount is used as a basis of comparison in identifying contamination levels.

Fugitive Emissions: Any release of contaminants from products of manufacturing processes, usually in the form of gases escaping into the atmosphere.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

For more information about PCBs, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for PCBs, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, June, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About
Polycyclic Aromatic Hydrocarbon

June 1992

What are polycyclic aromatic hydrocarbons?

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals formed during the incomplete burning of coal, oil, gas, refuse, or other organic substances. They are a widespread product of combustion from common sources such as motor vehicles and other gas burning engines, wood burning stoves, cigarette smoke, industrial soot, and charcoal-broiled foods. Wood which has been treated with creosote also contains PAHs. Natural sources include volcanoes, forest fires, and shale oil.

As pure chemicals, PAHs generally exist as colorless, white, or pale yellow-green solids. Most PAHs do not occur alone in the environment; they are found as mixtures, or compounds, of two or more PAHs. They can occur in the air attached to dust particles, or in soil or sediment as solids. Except for research purposes, no known uses exist for most of these chemicals; there are over 100 different PAH compounds. Most do not dissolve easily in water; some readily evaporate into the air. They generally do not burn easily and will persist in the environment for months to years. PAHs have been detected at over 1,975 of the 2,783 hazardous waste sites analyzed.

How might exposure to polycyclic aromatic hydrocarbons occur?

Exposure to these chemicals may result from contact with PAH vapors or PAHs attached to dust and other particles in the air. Other sources include vehicle exhausts, wild fires, agricultural burning, and hazardous waste sites. Exposure to PAHs in soil may occur near areas where coal, wood, gasoline, or other products have been burned. Exposure to PAHs in the soil may also occur on or near hazardous waste sites, former manufactured-gas sites, and wood-preserving facilities. PAHs have been found in some drinking water supplies in the United States.

PAHs are present in tobacco smoke, smoke from wood-burning stoves and furnaces, creosote-treated wood products, cereals, grains, flour, bread, vegetables, fruits, meat, processed or pickled foods, and beverages. Food grown in contaminated soil or air may also contain PAHs. Cooking meat or other food at high temperatures, which happens during grilling or charring, increases the amount of PAHs in the food.

How can PAHs enter and leave the body?

PAHs can enter the body through the lungs when air that contains them is inhaled. This is one of the most significant routes of exposure for people living near hazardous waste sites. Drinking water or swallowing food, soil, or dust particles that contain PAHs are other exposure routes. Under normal conditions of environmental exposure, PAHs can enter the body if skin comes into contact with soil that contains high levels of PAHs. This type of exposure could occur near a hazardous waste site, or from contact with products that contain PAHs.

PAHs enter the body quickly by all routes of exposure. This rate is increased when PAHs are present in oily mixtures. PAHs travel to all tissues of the body that contain fat, and tend to be stored in the kidneys, liver, and fat, with smaller amounts in the spleen, adrenal glands, and ovaries. Most PAHs that enter the body leave within a few days, primarily in wastes.

Is there a medical test to identify polycyclic aromatic hydrocarbons?

Once in the body, PAHs are changed into chemicals that can attach to substances within the body. The presence of PAHs attached to these substances can then be measured in body tissues or blood following exposure to PAHs. However, this test is still in the developmental stage. PAHs or their *breakdown products* can also be measured in urine. Although these tests can reveal exposure to PAHs, they cannot predict the severity of any health effects that might occur or determine the extent of exposure.

How can PAHs affect human health?

Several of the PAHs, including benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, have caused tumors in laboratory animals when fed to them, applied to their skin, or when they breathed them in the air for long periods of time. Mice fed high levels of benzo(a)pyrene during pregnancy had difficulty reproducing and so did their offspring. The offspring from pregnant mice fed benzo(a)pyrene also showed other harmful effects, such as birth defects and decreased body weight. Similar effects could occur in humans, however, no information is available to document these effects.

Studies in animals have also shown that PAHs can cause harmful effects on skin, blood, and the immune system following both short and long-term exposures. These effects have not been reported in humans.

What levels of exposure have resulted in harmful health effects?

No information is available from human studies to determine health effects resulting from exposure to specific levels of the individual PAHs. However, long-term inhalation and skin exposure to mixtures containing PAHs have been associated with cancer in humans.

What are the methods of treatment and disposal of PAHs?

Approximately one-third of PAHs in solution bind to particles and can be removed by sedimentation, *flocculation*, and filtration processes. Remaining dissolved PAHs usually require oxidation (combining with oxygen) for partial removal or transformation.

Specific PAHs can be destroyed by *rotary kiln incineration* at temperatures ranging between 1,500°F and 3,000°F. Others can be oxidized using such agents as concentrated sulfuric acid. Anthracene, one form of PAH which may contaminate water, can be destroyed by *sorption* with powdered activated charcoal, filtration through a granular activated carbon bed, and chemical oxidation.

What recommendations has the federal government made to protect human health?

Based on data on benzo(a)pyrene, the federal government has developed regulatory standards and guidelines to protect individuals from the potential health effects of PAHs in drinking water. The U.S. Environmental Protection Agency (EPA) has provided estimates of levels of total cancer-causing PAHs in lakes and streams associated with various risks of developing cancer. EPA has also concluded that any release of PAHs of more than 1 pound should be reported.

GLOSSARY

Breakdown Products: Most contaminants are combinations of specific substances. Contaminants are degraded, or separated, into these individual substances through chemical or physical means.

Flocculation: A clean-up technique in which solid particles in water or sewage are clumped together by biological or chemical action. These larger clumps of solids can be more easily removed by filtration.

Rotary Kiln Incineration: A treatment process which uses high temperatures to destroy solid and liquid wastes using a two-step process. Wastes are first treated in a rotating chamber at 1600°-1800°F, then fed to a second chamber with temperatures of 2400°F.

Sorption: A process in which contaminants adhere to charcoal surfaces and, in this way, are removed from contaminated substances.

For more information about PAHs, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

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EPA Facts About *Toluene*

June 1992

What is toluene?

Toluene is a clear, colorless liquid with a sweet smell. It occurs naturally in crude oil and the tolu tree. Toluene is produced from petroleum refining, and as a by-product of styrene production and coke-oven operations. Industry uses it in refining gasoline; chemical manufacturing; manufacture of paints, lacquers, adhesives, rubber; and in some printing and leather tanning processes. Toluene is often disposed of at hazardous waste sites as a used solvent. Toluene does not usually remain in the environment; it readily breaks down in soil and evaporates from water.

How might exposure to toluene occur?

Exposure to toluene stems from many sources, including drinking water, food, air, workplaces, and consumer products. Exposure to toluene occurs mostly through breathing the chemical in the workplace or during deliberate glue sniffing or solvent abuse. Toluene readily evaporates and can be released to the air when toluene-containing products are used. Automobile exhaust can also be a significant source of toluene emissions. Petrochemical workers, workers in the chemical industry, dye makers, and paint workers are at the greatest risk of exposure. Because toluene is a common solvent found in many consumer products, exposures may occur in the home and outdoors. Consumer products containing toluene include gasoline, nail polish, cosmetics, rubber cement, paint solvents, stain removers, fabric dyes, inks, and adhesives. Smokers are exposed to toluene in cigarette smoke.

Exposure may occur at some hazardous waste sites. The U.S. Environmental Protection Agency (EPA) conducted a survey in 1988 and found toluene in either the groundwater, surface water, or soil at 29% of the hazardous waste sites surveyed. While toluene was found in varying amounts at these sites, the concentrations identified were below the *Maximum Contaminant Level* established for toluene. Federal and state surveys do not show toluene to be a widespread contaminant of drinking water supplies.

How can toluene affect human health?

The most important health concern from either intentional or occupational exposure to toluene is its harmful effects on the nervous system. These effects depend on both the amount and length of exposure. Short-term exposure to moderate amounts of toluene, such as elevated workplace exposures, can produce fatigue, confusion, general weakness, drunken-type actions, memory loss, nausea, and loss of appetite. These symptoms disappear when exposure ends.

Short-term exposure to high amounts of toluene results in sleepiness, unconsciousness, and, in some cases, death. When exposure ends before death occurs, these symptoms disappear. Long-term exposure to low and moderate amounts of toluene has caused slight effects on the kidneys in some individuals, however, other solvents are known to have contributed to these effects. Long-term exposure to high amounts of toluene by intentional abuse has been linked with permanent brain damage. Effects such as problems with speech, vision, and hearing; loss of muscle control; loss of memory and balance; and reduced scores on psychological tests have also been reported. Researchers have seen possible impacts on resistance to disease in individuals exposed to moderate and high amounts of chemical mixtures that contained toluene.

Is there a medical test to identify toluene exposure?

Several tests measure toluene and its breakdown products in the blood and urine. These tests are not commonly available at a doctor's office; however, they are easily done by specialized laboratories. Measurement of one of toluene's breakdown products in urine has been used to determine recent, workplace exposure. Because several other chemicals are also changed to the same *breakdown products* within the body, this test may not prove that toluene exposure has occurred. Other factors, such as the amount of body fat and body weight, the person's sex, and the exposure conditions, may also change estimates of toluene exposure.

How can toluene enter the body?

Toluene can enter the body by passing through the skin, being inhaled, or being ingested in contaminated food or water. Exposure occurs mainly by breathing air containing toluene. Diet and where an individual lives, works, and travels affect daily exposure to toluene. Such factors as age, sex, and health status affect what happens to toluene once it is in the body. Most toluene leaves the body within 12 hours in exhaled air and as a breakdown product in urine.

What recommendations has the federal government made to protect human health?

EPA has recommended that drinking water not contain more than 1 part per million (ppm) for lifetime consumption. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. Any release of more than 1,000 pounds of toluene into the environment must be reported to the National Response Center.

What levels of exposure have resulted in harmful health effects?

Toluene in air has an odor at a level of about 0.16 ppm and in water at a level of 0.04 ppm. It can also be tasted at a level of 0.04 ppm. Minimum Risk Levels (MRL) have been established based on animal data for both short-term and longer-term exposure. Exposure to toluene at an amount below the MRL is not expected to produce harmful noncancer health effects. An MRL does not imply anything about the presence, absence, or level of risk of cancer.

What is the method of treatment and disposal of toluene?

Federal regulations prohibit the disposal of industrial wastes and wastewaters containing spent solvents with high concentrations of toluene. Consumer products containing toluene are likely disposed of directly as a municipal waste. No data is available concerning disposal by municipal incineration, however, high temperature incineration (over 1,600°F) is likely very efficient in toluene destruction.

GLOSSARY

Breakdown Products: Most contaminants are combinations of specific substances. Contaminants are degraded, or separated, into these individual substances through chemical or physical means.

Maximum Contaminant Level: EPA evaluates the health risks associated with various contaminant levels to ensure that public health is adequately protected. The MCL, as they are commonly known, is the maximum allowable concentration of a specific contaminant in public drinking water.

Superfund Program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) that funds the EPA solid waste emergency and long-term removal and remedial activities.

For more information about Toluene, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

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EPA Facts About *Trichloroethylene*

June 1992

What is trichloroethylene?

Trichloroethylene (TCE) is a colorless liquid with an odor similar to ether. It is man-made and does not occur naturally in the environment. TCE is used mainly as a solvent to remove oils and grease from metal parts.

How might exposure to trichloroethylene occur?

Trichloroethylene has been found in approximately 745 of the 1,300 hazardous waste sites on the *National Priorities List (NPL).* Various federal and state surveys indicate that between 9 and 34% of the water supply sources in the United States may be contaminated with trichloroethylene. In addition, TCE present at disposal sites is released to the air by evaporation and to underground water as *leachate.*

Trichloroethylene can also be released to the environment through evaporation from adhesive glues, paints, coatings, and other chemicals; and during their production. Releases can also occur during air-cleaning processes at treatment facilities that receive wastewater containing TCE, and during incineration of municipal and hazardous wastes.

Is there a medical test to identify trichloroethylene exposure?

Recent or ongoing exposures to trichloroethylene can be determined by measuring TCE in the breath. Another way of determining whether exposure to trichloroethylene has occurred is by measuring a number of *breakdown products* (metabolites) of TCE in the urine or blood. Because one of the breakdown products, trichloroacetic acid, is removed very slowly from the body, it can be measured in the urine for up to about one week following exposure. Exposure to other chemicals can produce the same breakdown products in the urine and blood as TCE. Therefore, these methods cannot be used to indicate conclusively that exposure to trichloroethylene has occurred.

How can trichloroethylene affect human health?

Dizziness, headaches, slowed reaction time, sleepiness, and facial numbness have occurred in workers breathing trichloroethylene or in people using trichloroethylene products in small, poorly ventilated areas. These effects are also caused by ingestion of several ounces of undiluted TCE. Irritation of the eyes, nose, and throat can also occur under these conditions. More severe effects, such as unconsciousness or possibly death, can occur from drinking or breathing higher amounts of TCE. Generally, the less severe central nervous system effects that result from one or several exposures to trichloroethylene disappear when exposure ends.

Results of a few studies of pregnant animals exposed to trichloroethylene in air or in food showed effects on unborn animals or on newborns. Current information based on animal studies is not sufficient to determine whether cancer, or the effects seen in animal embryos following exposure to TCE, may also occur in humans.

Some harmful health effects may persist following long-term exposure to trichloroethylene. This information is based largely on animal studies. These studies show that ingesting or breathing levels of TCE that are higher than typical *background levels* can produce nervous system changes; liver and kidney damage; effects on the blood; tumors of the liver, kidney, lung, and male sex organs; and possibly cancer of the tissues that form white blood cells (leukemia). Alcohol consumption can heighten susceptibility to liver and kidney injury caused by trichloroethylene exposure.

How does trichloroethylene enter the body?

Trichloroethylene can enter the body through inhalation of contaminated air or ingestion of contaminated water. TCE can also enter the body through contact with the skin.

What levels of exposure have resulted in harmful health effects.

Tests using laboratory animals and humans show that short-term and long-term exposures to air containing about 50 parts per million (ppm) or more of trichloroethylene have produced harmful effects. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. Ingestion of TCE for more than two weeks produced harmful effects in the livers of animals. Drinking TCE over longer periods of time caused effects on unborn animals and the kidneys as well as the liver.

Based on animal studies, the Environmental Protection Agency (EPA) has estimated that breathing air containing 1 ppm trichloroethylene every day for 70 years may place as many as 930 persons in a population of 100,000 at risk of developing cancer. EPA has also estimated that drinking water containing 1 ppm TCE every day over a lifetime may place as many as 32 persons in a population of 100,000 at risk of developing cancer.

What recommendations has the federal government made to protect human health?

EPA has established a drinking water standard of 5 parts of trichloroethylene per billion parts of water (ppb). EPA requires industry to report spills of 1,000 pounds or more of trichloroethylene. A reduction of this amount to 100 pounds has been proposed.

What are the methods of treatment and disposal of trichloroethylene?

The recommended method of TCE disposal is incineration following mixing with a combustible fuel. Complete combustion must be achieved to prevent the formation of phosgene, a poisonous gas. An acid scrubber must be used to remove the haloacids produced. There has been an emphasis on recovery and recycling of TCE to reduce emissions into the atmosphere.

Glossary

Background Level: The concentration of any substance which would normally be found in an area. This level is used as a basis of comparison in identifying contamination levels.

Breakdown Products: Most contaminants are combinations of specific substances. Contaminants are degraded, or separated, into these individual substances through chemical or physical means.

Leachate: A contaminated liquid that results from water collecting contaminants as it trickles through wastes, agricultural pesticides, or fertilizers.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

For more information about Trichloroethylene, please contact EPA at the following address:

U.S.Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Trichloroethylene, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, October, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Vinyl Chloride*

June 1992

What is vinyl chloride?

Vinyl chloride is a colorless gas with a mild, sweet odor. It is a man-made chemical that does not occur naturally. Most of the vinyl chloride produced in the United States is used to make polyvinyl chloride (PVC). This material is used to manufacture a variety of plastic and vinyl products including pipes, wire and cable coatings, packaging materials, furniture and automobile upholstery, wall coverings, housewares, and automotive parts. Much smaller amounts of vinyl chloride are used as a cooling gas and in the manufacture of other compounds.

Emissions from vinyl chloride and PVC manufacturers are responsible for the majority of vinyl chloride released to the environment.

How might exposure to vinyl chloride occur?

Vinyl chloride has been found in approximately 418 of the 1,300 hazardous waste sites on the *National Priorities List (NPL)*. Vinyl chloride is mainly released into the air and discharged in wastewater from the plastics industry. Most of the vinyl chloride that enters the air gradually breaks down into less harmful substances. Levels of vinyl chloride found in the environment are usually more than a thousand times below levels found in occupational settings. Elevated outdoor levels are usually expressed in terms of parts of vinyl chloride present in a billion parts of air or water (ppb). The term "parts per billion" is a way of expressing the concentration of a contaminant in a liquid or air. One part per billion is equal to one inch in a distance of about sixteen thousand miles (or a penny in ten million dollars), a very small amount. Outdoor levels of vinyl chloride result from the discharge of exhaust gases from factories that manufacture or process vinyl chloride, or evaporation from areas where chemical wastes are stored. The highest outdoor levels have been measured in air near vinyl chloride factories or over chemical waste storage areas.

Vinyl chloride that enters drinking water comes from factories that release vinyl chloride wastes into rivers and lakes, and from *leaching* into groundwater in areas where chemical wastes are stored. Small amounts of vinyl chloride can enter drinking water from contact with polyvinyl chloride pipes. In the past, higher than expected amounts were present in foods packaged in plastic that contained vinyl chloride. Currently, the U.S. Food and Drug Administration (FDA) regulates the amount of vinyl chloride allowed in food packaging in order to limit the intake of vinyl chloride.

How can vinyl chloride affect human health?

Short-term exposures to very high levels of vinyl chloride in air can cause dizziness, lack of muscle coordination, headaches, unconsciousness, or death. Long-term exposure to lower amounts in factories which produce or use vinyl chloride has caused "vinyl chloride disease". This disease is characterized by severe damage to the liver, effects on the lungs, poor circulation in the fingers, changes in the bones of the fingers, thickening of the skin, and changes in the blood. An increased risk of developing cancer of the liver and possibly several other tissues has been linked with breathing air in factories containing vinyl chloride.

Some health effects observed in humans have also been seen in laboratory animals. Effects on the nervous system of animals have occurred following short-term exposure to very high levels of vinyl chloride in air. Animals exposed to high levels for a short period of time, as well as to low levels for a long period, developed liver damage. Kidney effects have also occurred following exposure to high levels. Animals developed cancer in several tissues after eating food or breathing air that contained vinyl chloride.

How can vinyl chloride enter the body?

The most likely way that vinyl chloride can enter the body is by inhalation. This *exposure route* is of concern for persons employed in vinyl chloride manufacturing or processing, for people living in communities where vinyl chloride plants are located, and for individuals living near hazardous waste disposal sites. Vinyl chloride can also enter the body through ingestion. Absorption of vinyl chloride through the skin is not likely to be an important exposure route.

Is there a medical test to identify vinyl chloride exposure?

Vinyl chloride can be measured in urine and body tissues, but these tests cannot be used to determine the level of vinyl chloride exposure. Measuring the amount of the major *breakdown product* of vinyl chloride in the urine may give some indication of recent exposure; however, the quantity of this breakdown product may vary for different people. Neither of these tests is routinely available at a doctor's office. Laboratory tests commonly used by doctors to evaluate liver damage and liver function are usually not helpful in determining whether liver damage has resulted from vinyl chloride exposure.

What levels of exposure have resulted in harmful health effects?

Vinyl chloride is regarded worldwide as a chemical that causes cancer in humans, but exposure levels necessary to cause cancer are not known. The U.S. Environmental Protection Agency (EPA), therefore, uses animal data to estimate risk in humans. According to this data, it is estimated that breathing air containing 1 ppm vinyl chloride for 70 years may place as many as 11,000 persons in a population of 100,000 at risk of developing cancer. Eating food containing 1 ppm vinyl chloride every day for 70 years may place as many as 6,440 persons in a population of 100,000 at risk of developing cancer. Similarly, drinking water containing 1 ppm vinyl chloride every day for 70 years may place as many as 9,570 persons in a population of 100,000 at risk of developing cancer.

What recommendations has the federal government made to protect human health?

EPA requires that community drinking water systems that regularly serve the same 25 persons for at least 8 months of the year must limit vinyl chloride in the drinking water to 2 ppb. Recently, the FDA changed its regulations regarding the vinyl chloride content of various plastics used in food packaging and to carry water used in food processing in order to limit the intake of vinyl chloride in food to levels considered to be safe. Limits range from 5 to 50 ppm depending on the nature of the plastic and its use.

What are the methods of treatment and disposal of vinyl chloride?

The recommended method of disposal of vinyl chloride is incineration, following mixing with another combustible fuel. Complete combustion must be ensured to prevent the formation of phosgene, a poisonous gas. An acid scrubber is also required to remove hydrochloric acid produced during incineration.

EPA has classified vinyl chloride as a "hazardous component of solid waste" in order to control the handling of this chemical. All releases greater than one pound must be reported to the National Response Center.

GLOSSARY

Breakdown Product: Most contaminants are combinations of specific substances. Contaminants are degraded, or separated, into these individual substances through chemical or physical means.

Exposure Route: The way in which people come into contact with a substance. The main routes are ingestion, inhalation, and absorption through the skin.

Leach: The process by which substances are released from the soil by dissolving in fluids, usually rain and surface water, and are carried down through the soil.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

For more information about Vinyl Chloride, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

The information contained in this fact sheet was compiled from the Toxicological Profile for Vinyl Chloride, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, in collaboration with the U.S. Environmental Protection Agency, August, 1989. *This fact sheet focuses on the impact of hazardous wastes on human health; however, EPA does evaluate these impacts on the environment, including plants and animals.*

EPA Facts About *Xylene*

June 1992

What is xylene?

Xylene is primarily a man-made chemical. Industries produce xylene from petroleum and, to a smaller extent, from coal. Xylene also occurs naturally in petroleum and coal tar, and is formed during forest fires. It is a colorless liquid with a sweet odor. There are three forms of xylene called isomers: *meta*-xylene, *ortho*-xylene, and *para*-xylene (*m*-, *o*-, and *p*-xylene). Isomers are substances with similar chemicals properties. Mixed xylene is a combination of the three forms of xylene and smaller amounts of other chemicals, primarily ethyl benzene.

Solvents and thinners for paints and varnishes often contain xylene. It is used as a solvent in the printing, rubber, and leather industries; and as a cleaning agent. It is also found in airplane fuel and gasoline, and is used in the chemical, plastic, and synthetic fiber industries, and as an ingredient in fabric and paper coatings. Isomers of xylene are used in the manufacture of certain polymers, such as plastics.

Xylene evaporates and burns easily. It does not mix well with water; however, it does mix with alcohol and many other chemicals. Because xylene is a liquid, it can leak into soil, surface water, or groundwater, where it may remain for 6 months or more before it is broken down into other chemicals. However, most xylene evaporates into the air, where it lasts for several days. Once in the air, xylene is broken down into other chemicals by sunlight.

How might exposure to xylene occur?

Xylenes are distributed throughout the environment. They have been detected in the atmosphere, rainwater, soils, surface waters and sediments, drinking water, and aquatic organisms; and in human blood, urine, and breath. Xylenes have been identified at approximately 576 of the 1,300 *National Priorities List (NPL)* sites.

Xylenes are released to the atmosphere primarily as *fugitive emissions* from industrial sources, in automobile exhaust, and through evaporation of solvents. Discharges into waterways and spills on land result primarily from the use, storage, and transport of petroleum products and waste disposal. Most of the xylenes released to the environment evaporate into the atmosphere. Xylenes are moderately mobile in soil and can *leach* into the groundwater, where they may persist for several years.

Human exposure to xylenes is believed to occur via inhalation of indoor and workplace air, inhalation of air containing auto emissions, ingestion of contaminated drinking water, smoking, and inhalation and skin absorption of solvents containing xylenes.

Is there a medical test to identify xylene exposure?

Once in the body, xylene is degraded (broken down) into other chemicals. Xylene exposure can be determined by measuring these chemicals which are eliminated in the urine. These measurements will specifically identify exposure to xylene. There is a high correlation between exposure to xylene and the concentration of chemicals produced when the body degrades xylene. A urine sample must be provided soon after exposure ends, because xylene leaves the body quickly.

How can xylene enter and leave the body?

Xylene is most likely to enter the body through breathing xylene vapors. It is rapidly absorbed by the lungs following inhalation of air containing xylene. Absorption of xylene through the skin also occurs rapidly following direct contact or exposure to xylene in liquid or vapor form. Exposure to xylene may also result from eating or drinking xylene-contaminated food or water. Absorption of xylene following ingestion is both rapid and complete. Hazardous waste disposal sites also serve as possible sources of exposure; breathing xylene vapors, drinking well water contaminated with this chemical, and direct contact with the skin are possible routes for xylene to enter the body. Xylene passes into the blood soon after entering the body.

Xylene is broken down into other chemicals in the liver and lungs. This process changes most of the xylene that is inhaled or ingested into a different form. Once xylene has been broken down, the products rapidly leave the body, mainly in urine. Some unchanged xylene also leaves in breath from the lungs. Most of the xylene that is taken in usually leaves the body within 18 hours after exposure ends. Storage of xylene in fat or muscle may prolong the time needed for it to leave the body.

How can xylene affect human health?

Short-term exposure to high levels of xylene or chemical mixtures containing xylene causes irritation of the skin, eyes, nose, and throat; difficulty in breathing; impaired function of the lungs; delayed response to visual stimulus; impaired memory; stomach discomfort; and possible changes in the liver and kidneys. Death can occur in individuals exposed to very high levels of xylene for short periods. Both short- and long-term exposure to high concentrations of xylene can also cause nervous system effects, such as headaches, lack of muscle coordination, dizziness, and confusion.

Results of animal studies indicate that large amounts of xylene can cause changes in the liver and adverse effects on the kidneys, lungs, heart, and nervous system. Short-term exposure to high concentrations of xylene causes death in some animals. Muscular spasms; coordination loss; hearing loss; and changes in behavior, organ weights, and enzyme activity have also been observed.

Exposure of pregnant women to high levels of xylene may cause adverse effects in the fetus. Studies with unborn animals indicate that high levels of xylene may cause increased numbers of deaths, decreased weight, skeletal changes, and delayed skeletal development. There is no data to indicate that xylene causes cancer.

What levels of exposure have resulted in harmful health effects?

Xylene or chemical mixtures containing xylene are deadly if sufficient quantities are swallowed or inhaled. However, the levels which cause death are not known. Lower levels (100-299 parts per million [ppm]) of inhaled xylene can cause eye, nose, and throat irritation, and poor memory. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. Direct contact with several drops of xylene causes skin irritation.

In animals, inhalation of moderate to high levels (1,300-2,000 ppm) of xylene for short periods of time may cause decreased breathing rate, hearing loss, inactivity, unconsciousness, and biochemical changes in the brain. With longer-term inhalation, adverse health effects in animals generally occur at lower levels (230-800 ppm). In animals breathing high levels over long-term exposures, possible adverse health effects include changes in heart rate and blood flow, changes in the chemical composition of nerves, and hearing loss. In animals given high levels (5,000 ppm) of xylene orally over shorter periods, a possible adverse health effect is impaired eye function. Death can occur in animals which ingest very high levels (40,000 ppm).

What recommendations has the federal government made to protect human health?

The U.S. Environmental Protection Agency (EPA) estimates that exposure to xylene at concentrations in water of 0.4 ppm each day for a lifetime (70 years) is unlikely to result in noncancerous adverse health effects. EPA has proposed a recommended maximum level of 10 ppm for xylene in drinking water. EPA requires that spills of 1,000 pounds or more of xylene or used xylene solvents be reported to the National Response Center.

What are the methods of treatment and disposal of xylene?

Various methods of incineration are used in the disposal of xylene isomers; the addition of a more flammable solvent has been suggested to facilitate this heat destruction process.

GLOSSARY

Fugitive Emissions: Any release of contaminants from products of manufacturing processes, usually in the form of gases escaping into the atmosphere.

Leach: To pass through the soil due to rain or groundwater moving through contaminated materials. The process by which substances are released from the soil by dissolving in fluids, usually rain and surface water, and are carried down through the soil. Leaching can cause hazardous substances to enter the soil, surface water, or groundwater.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites identified for possible long-term clean-up under the Superfund Program.

For more information about Xylene, please contact EPA at the following address:

U.S. Environmental Protection Agency
ATTN: Superfund Hotline
401 M Street, S.W.
Washington, D.C. 20460
1-800-424-9346 or 1-800-535-0202

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EPA Facts About *Zinc*

June 1992

What is zinc?

Zinc is a metal which may be found in its pure state or combined with other metals to form alloys such as brass. It also combines with other chemicals to form zinc compounds, such as chlorine (zinc chloride), in the same way that sodium (another metal) is found in table salt (sodium chloride).

Zinc compounds occur naturally in the air, soil, and water, and are present in all foods. Zinc is an essential food element; however, in large doses or exposures, zinc can also be harmful.

Zinc is most commonly used as a protective coating of other metals. It is also used in alloys such as bronze and brass, and for electrical components in numerous products. Salts of zinc are used as dissolving agents in many drugs, including insulin.

How might exposure to zinc occur?

Zinc is one of the most widely used metals in the world. The primary sources of zinc in the environment are metal wastes from smelter and refining operations. Releases to surface water and groundwater are probably the greatest sources of zinc in the environment. Zinc is also released to the soil due to discharges from industrial operations and natural weathering of zinc ore deposits.

The major source of zinc for the general population is food. Other sources of exposure include drinking water, contaminated air, tobacco products, and occupational exposure.

Zinc is released to the atmosphere as dust and fumes from zinc production facilities, automobile emissions, fuel combustion, and soil erosion. Refuse incineration, coal combustion, smelter operations, and some metal-working industries constitute the major sources of zinc in air. These sources, along with releases of zinc through metal corrosion and tire wear, contribute to *urban runoff* contamination.

Zinc is present in most rocks, certain minerals, and some carbonate sediments. As a result of weathering of these materials, *soluble compounds* of zinc are formed and may be released to water. However, this source of zinc is diluted and widely dispersed. Urban runoff, mine drainage, and municipal and industrial wastes represent smaller, but more concentrated sources of zinc in water.

Municipal wastewaters are major contributors of zinc in marine environments. Municipal wastewater treatment facilities receive the largest zinc discharges, including contributions from corrosion of water supply pipes, combined sewer runoff, and industrial and human wastes.

Limited information is available on total releases of zinc to the soil. Zinc present in the atmosphere is often deposited in soils and grasses. Municipal sludges applied to cropland soils can also be an important source of trace metals including zinc. Hazardous waste sites are additional sources of zinc in soil. Zinc has been found in approximately 711 of the 1,300 *National Priorities List (NPL)* hazardous waste sites.

Is there a medical test to identify zinc exposure?

Zinc can be measured in body fluids. The presence of excess zinc in bodily wastes can indicate high zinc exposure; high levels in the blood can show high zinc absorption.

How can zinc enter and leave the body?

Zinc enters the body through the digestive tract when food or water containing zinc is ingested. It can also enter through the lungs when zinc dust or fumes from zinc-smelting or welding operations are inhaled in the workplace. The amount of zinc that passes directly through the skin is relatively small. The most important route of exposure near NPL waste sites is likely to be through drinking zinc-contaminated water. Normally, zinc leaves the body in wastes.

What levels of exposure have resulted in harmful health effects?

The major effects of eating food or drinking water that contains too much zinc or taking too many dietary zinc supplements are digestive problems. Stomach cramps, nausea, and vomiting have resulted from taking 2 or 3 capsules (each containing 220 milligrams (mg) zinc sulfate or 50 mg zinc) each day. Decreased levels of high density lipoprotein (HDL)-cholesterol (the "good" cholesterol) in blood have been reported in people who took approximately one 150 mg capsule of zinc each day. Similar levels of zinc intake, when continued over an extended period, may alter the body's immune system.

What recommendations has the federal government made to protect human health?

The U. S. Environmental Protection Agency (EPA) has recommended that zinc levels in drinking water not exceed 5 parts per million. The term "parts per million" is a way of expressing the concentration of a contaminant in a liquid or air. One part per million is equal to one inch in a distance of about sixteen miles (or a penny in ten thousand dollars), a very small amount. This value is based on taste considerations rather than health effects. Any release of more than 1,000 pounds (or in some cases 5,000 pounds) of zinc or its compounds into the environment must be reported to EPA.

What are the methods of treatment and disposal of zinc?

Zinc processing plants have attempted to limit releases to the environment by using techniques such as water re-use, control of particulate emissions, and filtration. In addition, liquid effluents are limed and allowed to settle so that zinc can be removed from solution through *precipitation*. Disposal procedures for spills include the use of precipitation and *cement-based fixation* processes. The latter method renders zinc contaminants insoluble, that is, will not dissolve in groundwater, and stable in the environment.

GLOSSARY

Cement-based Fixation: A process used to stabilize wastes by adding chemicals (such as cement) to bind and solidify the contaminated soils. The resulting solidified mass is resistant to leaching and greatly reduces the mobility of the hazardous wastes.

National Priorities List (NPL): EPA's list of uncontrolled or abandoned hazardous waste sites eligible for long-term clean-up under the Superfund Remedial Program.

Precipitation: Application of chemicals or cold to a liquid waste solution containing slightly soluble contaminants causing them to become insoluble and "settle out" of solution. Settled solids can then be collected for proper disposal.

Soluble Compounds: Substances which can be dissolved in water.

Urban Runoff: The flow of rainwater in developed areas along the surface of the ground. These flows often contain pollutants, particularly hydrocarbons.

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