PUBLIC HEALTH STATEMENT
ASBESTOS
CAS#: 1332-21-4

Division of Toxicology **September 2001**

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

This public health statement tells you about asbestos and the effects of exposure. The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Asbestos has been found in at least 83 of the 1,585 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which asbestos is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

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

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

1.1 WHAT IS ASBESTOS?

Asbestos is the name given to a group of six different fibrous minerals (amosite, chrysotile, crocidolite, and the fibrous varieties of tremolite, actinolite, and anthophyllite) that occur naturally in the environment. One of these, namely chrysotile, belongs to the serpentine family of minerals, while all of the others belong to the amphibole family. All forms of asbestos are hazardous, and all can cause cancer, but amphibole forms of asbestos are considered to be somewhat more hazardous to health than chrysotile. Asbestos minerals consist of thin, separable fibers that have a parallel arrangement. Nonfibrous forms of tremolite, actinolite, and anthophyllite also are found naturally. However, because they are not fibrous, they are not classified as asbestos minerals. Amphibole asbestos fibers are generally brittle and often have a rod- or needle-like shape, whereas chrysotile asbestos fibers are flexible and curved. Chrysotile, also known as white asbestos, is the predominant commercial form of asbestos; amphiboles are of minor commercial importance. Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water or evaporate and are resistant to heat, fire, chemical and biological degradation. Because of these properties, asbestos has been mined for use in a wide range of manufactured products, mostly in building materials, friction products, and heat-resistant

fabrics. Since asbestos fibers may cause harmful health effects in people who are exposed, all new uses of asbestos have been banned in the United States by the EPA. Please see the toxicological profile for more information on the properties and uses of asbestos.

1.2 WHAT HAPPENS TO ASBESTOS WHEN IT ENTERS THE ENVIRONMENT?

Asbestos fibers do not evaporate into air or dissolve in water. However, pieces of fibers can enter the air and water from the weathering of natural deposits and the wearing down of manufactured asbestos products. Small diameter fibers and fiber-containing particles may remain suspended in the air for a long time and be carried long distances by wind or water currents before settling. Larger diameter fibers and particles tend to settle more quickly. Asbestos fibers are not able to move through soil. They are generally not broken down to other compounds in the environment and will remain virtually unchanged over long periods. However, the most common form of asbestos, chrysotile, may have some minor mineral loss in acidic environments. Asbestos fibers may break into shorter pieces or separate into a larger number of individual fibers as a result of physical processes. When asbestos fibers are breathed in, they may get trapped in the lungs. Levels of fibers in lung tissue build up over time, but some fibers, particularly chrysotile fibers, can be removed from or degraded in the lung with time. Please see the toxicological profile for more information on the behavior of asbestos in the environment.

1.3 HOW MIGHT I BE EXPOSED TO ASBESTOS?

Asbestos minerals are widespread in the environment. They may occur in large natural deposits, or as contaminants in other minerals. For example, tremolite asbestos may occur in deposits of chrysotile, vermiculite, and talc. Asbestos may be found in soil that is formed from the erosion of asbestos-bearing rock. You are most likely to be exposed to asbestos by breathing in asbestos fibers that are suspended in air. These fibers can come from naturally occurring sources of asbestos or from the wearing down or disturbance of manufactured products including insulation, automotive brakes and clutches, ceiling and floor tiles, dry wall, roof shingles, and cement. However, these products do not always contain asbestos. Low levels of asbestos that present little, if any, risk to your health can be detected in almost any air sample. For example, 10 fibers are typically present in a cubic meter (fibers/m^3) of outdoor air in rural areas. (A cubic meter is about the amount of air that you breathe in 1 hour.) Health professionals often report the number of fibers in a milliliter (mL) (equivalent to a cubic centimeter [cm^3]) of air rather than in a cubic meter of air. Since there are one million cm^3 (or one million mL) in a cubic meter, there typically would be 0.00001 fibers/mL of asbestos in air in rural areas. Typical levels found in cities are about 10-fold higher.

Close to an asbestos mine or factory, levels may reach 10,000 fibers/m^3 (0.01 fibers/mL) or higher. Levels could also be above average near a building that contains asbestos products and that is being torn down or renovated or near a waste site where asbestos is not properly covered up or stored to protect it from wind erosion.

In indoor air, the concentration of asbestos depends on whether asbestos was used for insulation, ceiling or floor tiles, or other purposes, and whether these asbestos-containing materials are in good condition or are deteriorated and easily crumbled. Concentrations measured in homes, schools, and other buildings that contain asbestos range from about 30 to 6,000 fibers/m³ (0.00003–0.006 fibers/mL). People who work with asbestos or asbestos-containing products (for example, miners, insulation workers, asbestos abatement workers, and automobile brake mechanics) without proper protection are likely to be exposed to much higher levels of asbestos fibers in air. In addition, custodial and maintenance workers who are making repairs or installations in buildings with asbestos-containing materials may be exposed to higher levels of asbestos. Since vermiculite and talc may contain asbestos, occupational workers and the general population may be exposed to asbestos when using these products.

You can also be exposed to asbestos by drinking asbestos fibers that are 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, from asbestos-containing cement pipes used to carry drinking water, or from filtering through asbestos-containing filters. Most drinking water supplies in the United States have concentrations of less than 1 million fibers per liter (MFL), even in areas with asbestos deposits or with asbestos-cement water supply pipes. However, in some locations, water samples may contain 10–300 million fibers per liter or even higher. The average person drinks about 2 liters of water per day. Please see the toxicological profile for more information on how you could be exposed to asbestos.

1.4 HOW CAN ASBESTOS ENTER AND LEAVE MY BODY?

If you breathe asbestos fibers into your lungs, some of the fibers will be deposited in the air passages and on the cells that make up your lungs. Most fibers are removed from your lungs by being carried away or coughed up in a layer of mucus to the throat, where they are swallowed into the stomach. This usually takes place within a few hours. Fibers that are deposited in the deepest parts of the lung are removed more slowly. In fact, some fibers may move through your lungs and can remain in place for many years and may never be removed from your body. Amphibole asbestos fibers are retained in the lung longer than chrysotile asbestos fibers.

If you swallow asbestos fibers (either those present in water or those that are moved to your throat from your lungs), nearly all of the fibers pass along your intestines within a few days and are excreted in the feces. A small number of fibers may penetrate into cells that line your stomach or intestines, and a few penetrate all the way through and get into your blood. Some of these become trapped in other tissues, and some are removed in your urine.

If you get asbestos fibers on your skin, very few of these fibers, if any, pass through the skin into your body. Please see the toxicological profile for more information on how asbestos enters and leaves your body.

1.5 HOW CAN ASBESTOS AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Information on the health effects of asbestos in people comes mostly from studies of people who were exposed in the past to levels of asbestos fibers (greater than or equal to 5 μm in length) in workplace air that were as high as 5 million fibers/m^3 (5 fibers/mL). Workers who repeatedly breathe in asbestos fibers with lengths greater than or equal to 5 μm may develop a slow buildup of scar-like tissue in the lungs and in the membrane that surrounds the lungs. This scar-like tissue does not expand and contract like normal lung tissue and so breathing becomes difficult. Blood flow to the lung may also be decreased, and this causes the heart to enlarge. This disease is called asbestosis. People with asbestosis have shortness of breath, often accompanied by a cough. This is a serious disease and can eventually lead to disability or death in people exposed to high amounts of asbestos over a long period. However, asbestosis is not usually of concern to people exposed to low levels of asbestos. Changes in the membrane surrounding the lung, called pleural plaques, are quite common in people occupationally exposed to asbestos and are sometimes found in people living in areas with high environmental levels of asbestos.
Effects on breathing from pleural plaques alone are usually not serious. There is conflicting evidence as to whether their presence in a person accurately predicts more serious disease development in the future.

Asbestos workers have increased chances of getting two principal 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. These diseases do not develop immediately following exposure to asbestos, but appear only after a number of years. There is also some evidence from studies of workers that breathing asbestos can increase the chances of getting cancer in other locations (for example, the stomach, intestines, esophagus, pancreas, and kidneys), but this is less certain. Members of the public who are exposed to lower levels of asbestos may also have increased chances of getting cancer, but the risks are usually small and are difficult to measure directly. Lung cancer is usually fatal, while mesothelioma is almost always fatal, often within a few months of diagnosis. Some scientists believe that early identification and intervention of mesothelioma may increase survival.

The levels of asbestos in air that lead to lung disease depend on several factors. The most important of these are (1) how long you were exposed, (2) how long it has been since your exposure started, and (3) whether you smoked cigarettes. Cigarette smoking

and asbestos exposure increase your chances of getting lung cancer. Also, there is a scientific debate concerning the differences in the extent of disease caused by different fiber types and sizes. Some of these differences may be due to the physical and chemical properties of the different fiber types. For example, several studies suggest that amphibole asbestos types (tremolite, amosite, and especially crocidolite) may be more harmful than chrysotile, particularly for mesothelioma. Other data indicate that fiber size dimensions (length and diameter) are important factors for cancer-causing potential. Some data indicate that fibers with lengths greater than 5.0 μm are more likely to cause injury than fibers with lengths less than 2.5 μm. (1 μm is about 1/25,000 of an inch.) Additional data indicate that short fibers can contribute to injury. This appears to be true for mesothelioma, lung cancer, and asbestosis. However, fibers thicker than 3.0 μm are of lesser concern, because they have little chance of penetrating to the lower regions of the lung.

The health effects from swallowing asbestos are unclear. Some groups of people who have been exposed to asbestos fibers in their drinking water have higher-than-average death rates from cancer of the esophagus, stomach, and intestines. However, it is very difficult to tell whether this is caused by asbestos or by something else. Animals that were given very high doses of asbestos in food did not get more fatal cancers than usual, although some extra nonfatal tumors did occur in the intestines of rats in one study.

Several government offices and regulatory agencies have considered all of the evidence regarding the carcinogenicity of asbestos. The Department of Health and Human Services (DHHS) has determined that asbestos is known to be a human carcinogen. The EPA has determined that asbestos is a human carcinogen. The International Agency for Research on Cancer (IARC) has determined that asbestos is carcinogenic to humans. Please see the toxicological profile for more information on how asbestos can affect your health.

1.6 HOW CAN ASBESTOS AFFECT CHILDREN?

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

Asbestos exposure in both children and adults may occur while breathing air in or near buildings (public or private) containing asbestos building materials or near asbestos-related industrial operations. Children breathe differently and have different lung structures than adults. It is not known if these differences may cause a greater amount of asbestos fibers to stay in the lungs of a child when they are breathed in than in the lungs of an adult. Children drink more fluids per kilogram of body weight than adults and can also be exposed through asbestos-contaminated drinking water. Eating asbestos-contaminated soil and dust is another source of exposure for children. Certain children intentionally eat soil, and all young children eat more soil than adults through hand-to-mouth activities. Historically, family members have also been exposed to asbestos that was carried home on the clothing of other family members who worked in asbestos mines or mills. Breathing of asbestos fibers may result in difficulty in breathing, lung cancer, or mesothelioma (another form of cancer associated with asbestos exposure). These diseases usually appear many years following the first exposure to asbestos and are therefore not likely to

be seen in children. But since it may take up to 40 or more years for the effects of exposure to be seen, people who have been exposed to asbestos at a young age may be more likely to contract these diseases than those who are first exposed later in life. In the small number of studies that have specifically looked at asbestos exposure in children, there is no indication that younger people might develop asbestos-related diseases more quickly than older people. Developing fetuses and infants are not likely to be exposed to asbestos through the placenta or breast milk of the mother. Results of animal studies do not indicate that exposure to asbestos is likely to result in birth defects.

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

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

The most important way that families can lower their exposures to asbestos is to be aware of the sources of asbestos in their homes and avoid exposure to these sources. The most important source of asbestos in a home is from damaged or deteriorating asbestos-containing insulation, ceiling, or floor tiles. Should you suspect that your house may contain asbestos, contact your state or local health department or the regional offices of EPA to find out how to test your home for asbestos and how to locate a company that is trained to remove or contain the fibers. Federal law requires schools to identify asbestos-containing material in school buildings and take appropriate action to control release of asbestos fibers.

If you live close to where asbestos and certain other ores are mined or processed, where a building that contains asbestos products is being torn down or renovated, or a waste site where asbestos is not properly covered, then the levels of asbestos in dust and wind-blown soil may be higher. Pets can also bring asbestos into the home by carrying dust or dirt on their fur or feet if they spend time in places that have high levels of asbestos in the soil. Swallowing of asbestos in house dust or soil is a potential exposure pathway for children. This problem can be reduced in many ways. Regular hand and face washing to remove asbestos-containing dusts and soil, especially before meals, can lower the possibility of asbestos fibers on the skin being accidentally swallowed while eating. Families can lower exposures to asbestos by regularly cleaning the home of dust and tracked in soil. Door mats can help lower the amount of soil that is tracked into the home; removing your shoes before entering will also help. Planting grass and shrubs over bare soil areas in the yard can lower the contact that children and pets may have with soil and reduce the tracking of soil into the home.

You can bring asbestos home in the dust on your hands or clothes if you work in the mining or processing of minerals that contain asbestos, in asbestos removal, or in buildings with damaged or deteriorating asbestos. Federal law regulates work practices to limit the possibility of asbestos being brought home in this way. Your occupational health and safety officer at work can and should tell you whether chemicals you work with are dangerous and likely to be carried home on your clothes, body, or tools, and whether you should be showering and changing clothes before you leave work, storing your street clothes in a separate area of the workplace, or laundering your work clothes at home

separately from other clothes. Your employer should have Material Safety Data Sheets (MSDSs) for many of the chemicals used at your place of work, as required by the Occupational Safety and Health Administration (OSHA). Information on these sheets should include chemical names and hazardous ingredients, important properties (such as fire and explosion data), potential health effects, how you get the chemical(s) in your body, how to handle the materials properly, and what to do in an emergency. Your employer is legally responsible for providing a safe workplace and should freely answer your questions about hazardous chemicals. Either OSHA or your OSHA-approved state occupational safety and health program can answer any further questions and help your employer identify and correct problems with hazardous substances. OSHA and/or your OSHA-approved state occupational safety and health program will listen to your formal complaints about workplace health hazards and inspect your workplace when necessary. Employees have a right to seek safety and health on the job without fear of punishment.

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

The most common test used to determine if you have received sustained exposure to asbestos is a chest x-ray. A chest x-ray is recommended for detecting exposure to asbestos only in persons who have sustained relatively heavy exposure. A chest x-ray is of no value for detecting evidence of asbestos exposure in a person whose exposure to asbestos has been only brief or transient. The x-ray cannot detect the asbestos fibers themselves, but it can detect early signs of lung disease caused by asbestos. While other substances besides asbestos can sometimes produce similar changes in the lungs, this test is usually reliable for detecting asbestos-related effects produced by long-term exposures at relatively high concentrations of asbestos fibers. Other tests, such as gallium-67 lung scanning and high-resolution computed tomography, are also useful in detecting changes in the lungs. However, there are currently no means of detecting exposure-related effects from commonly encountered environmental exposures.

The most reliable test to determine if you have been exposed to asbestos is the detection of microscopic asbestos fibers in pieces of lung tissue removed by surgery, but this is a very invasive test. A test can also be run to determine the presence of asbestos fibers in material rinsed out of the lung. However, this test can cause some discomfort. Asbestos fibers can also be detected in mucus (sputum), urine, or feces, but these tests are not reliable for determining how much asbestos may be in your lungs. Low levels of asbestos fibers are found in these materials for nearly all people. Higher-than-average levels can show that you have been exposed to asbestos, but it is not yet possible to use the results of this test to estimate how much asbestos you have been exposed to, or to predict whether you are likely to suffer any health effects. Please see the toxicological profile for more information about how asbestos can be measured in people and in the environment.

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

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal

agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

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

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

The federal government has taken a number of steps to protect citizens from exposure to asbestos. First, on July 12, 1989, EPA established a ban on new uses of asbestos. Uses established before this date are still allowable. Second, EPA has established regulations that require school systems to inspect for asbestos and, if damaged asbestos is found, to eliminate or reduce the exposure, either by removing the asbestos or by covering it up so it cannot get into the air. In addition, EPA provides guidance and support for reducing asbestos exposure in other public buildings. Third, EPA regulates the release of asbestos from factories and during building demolition or renovation to prevent asbestos from getting into the environment. EPA also regulates the disposal of waste asbestos materials or products, requiring these to be placed only in approved locations. Fourth, EPA has proposed a limit of 7 million fibers per liter on the concentration of long fibers (length greater than or equal to 5 μm) that may be present in drinking water. Fifth, FDA regulates the use of asbestos in the preparation of drugs and restricts the use of asbestos in food-packaging materials. NIOSH has recommended that inhalation exposures not exceed 100,000 fibers with lengths greater than or equal to 5 μm per m^3 of air (0.1 fibers/mL). OSHA has established an enforceable limit on the average 8-hour daily concentration of asbestos allowed in air in the workplace to be 100,000 fibers with lengths greater than or equal to 5 μm per m^3 of air (0.1 fibers/mL). Additional sources of information about asbestos are the 10 regional offices of the EPA. Most EPA regional offices have an asbestos coordinator.

Please see the toxicological profile for more information about regulations and guidelines to protect people from exposure to asbestos.

1.10 WHERE CAN I GET MORE INFORMATION?

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

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

Information line and technical assistance:

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

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

To order toxicological profiles, contact:

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

Reference

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