



PUBLIC HEALTH STATEMENT

Polybrominated Biphenyls

Division of Toxicology

September 2004

This Public Health Statement is the summary chapter from the Toxicological Profile for Polybrominated Biphenyls and Polybrominated Diphenyl Ethers. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFQATM, is also available. This information is important because these substances 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 polybrominated biphenyls (PBBs) and the effects of exposure to PBBs.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. PBBs have been found in at least nine of the 1,647 current or former NPL sites. Although the total number of NPL sites evaluated for these substances is not known, the possibility exists that the number of sites at which PBBs are found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to these substances may harm you.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure.

You can be 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 PBBs, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with PBBs. You must also consider any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT ARE PBBs?

Polybrominated biphenyls (PBBs) are chemicals that were added to plastics used in a variety of consumer products, such as computer monitors, televisions, textiles, and plastic foams, to make them difficult to burn. Because PBBs were mixed into plastics rather than bound to them, they were able to leave the plastic and find their way into the environment. Commercial production of PBBs began in the 1970s. Manufacture of PBBs was discontinued in the United States in 1976. Concern regarding PBBs is mainly related to exposures resulting from an agriculture contamination episode that occurred in Michigan over a 10-month period during 1973–1974.

There are no known natural sources of PBBs in the environment. PBBs are solids and are colorless to off-white. PBBs enter the environment as mixtures containing a variety of individual brominated biphenyl (for PBBs) components, known as congeners. Some commercial PBB mixtures are known in the United States under the industrial

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trade name, FireMaster®. However, other flame retardant chemicals also may be identified by this name. PBBs are no longer used in North America because the agriculture contamination episode that occurred in Michigan in 1973–1974 led to the cessation of its production.

1.2 WHAT HAPPENS TO PBBs WHEN THEY ENTER THE ENVIRONMENT?

In the past, PBBs entered the air, water, and soil during their manufacture and use. In addition, animal feed was accidentally mixed with 500–1,000 pounds of PBBs in lower Michigan in 1973. This contamination of the food chain affected millions of farm animals and humans living in Michigan at this time. PBBs entered the environment during the disposal of contaminated animal feed and animal products during the agriculture contamination episode. PBBs also entered the environment from PBB-containing wastes that manufacturers disposed of in waste sites. Small quantities of PBBs also entered the environment from accidental spills during transport. PBBs are no longer manufactured in North America, but very small amounts of PBBs may be released into the environment from poorly maintained hazardous waste sites and improper incineration of plastics that contain PBBs.

1.3 HOW MIGHT I BE EXPOSED TO PBBs?

PBBs are no longer produced or used in the United States. Thus, the general population exposure to PBBs will only be from past releases. For people living in the lower peninsula of Michigan,

especially near PBB contaminated areas, exposure to PBBs may still be occurring today. However, environmental levels have decreased since the 1970s and current exposure, if any, will be at low levels. For other regions of the United States, the levels of exposure will either be very low or none.

Measured data in air, water, soil, and food, as well as body burden data (blood, urine, breast milk, and body fat), indicate that most people within the state of Michigan who were exposed to PBBs received very low levels of PBBs. The levels from exposure were slightly higher for people living in the lower peninsula of Michigan and highest among people living on contaminated dairy farms. Consumption of contaminated meat and dairy products caused the higher levels of PBBs in the body. Monitoring of the workplace environment, as well as the blood, urine, and body fat of workers indicated that those in PBB industries were exposed to higher levels of PBBs than the general population. These workers were exposed to PBBs by breathing contaminated workplace air and by skin contact with PBBs. Occupational exposure also could have occurred from the incineration of materials containing PBBs. Exposure in workplaces is no longer likely because PBBs are no longer manufactured. People who live near hazardous waste sites that contain PBBs may be exposed primarily by breathing air that contains PBBs.

1.4 HOW CAN PBBs ENTER AND LEAVE MY BODY?

If you breathe air that contains PBBs, or swallow food, water, or soil contaminated with PBBs, they can enter your body through your lungs and

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stomach and pass into the bloodstream. We don't know how much of the PBBs will pass into the blood from the lungs; although most will probably pass into the blood from the stomach and intestines. If you touch soil containing PBBs, it is highly unlikely that PBBs would pass through your skin into the bloodstream. It is not known how fast PBBs enter the blood from the lungs or stomach. There are no known current sources of PBBs because they are no longer produced and used in North America. They are rarely found in air and drinking water away from production plants and contaminated sites. Once PBBs are in your body, they can partially change into breakdown products called metabolites. Some metabolites and unchanged PBBs could leave your body, mainly in the feces and in very small amounts in the urine, within a few days. Other unchanged PBBs might stay in your body for many years. PBBs are stored mainly in your body fat, tend to concentrate in breast milk fat, and can enter the bodies of children through breast feeding. PBBs also can enter the bodies of unborn babies through the placenta.

1.5 HOW CAN PBBs AFFECT MY HEALTH?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. That sometimes involves animal testing. Animal testing may help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a

basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

Much of what is known about the health effects of PBBs in people comes from studies of ingestion in Michigan in the early-to-mid 1970s, where feed for farm animals was accidentally contaminated with a fire retardant containing PBBs. People were exposed to PBBs for several months when they ate meat, milk, and eggs from the contaminated animals. After news of the contamination episode became widespread, many Michigan residents complained of various health problems, including nausea, abdominal pain, loss of appetite, joint pain, fatigue, and weakness. However, it could not be clearly established that any of the problems were caused by eating the food contaminated with PBBs. PBBs also did not cause any definite changes in the livers or immune systems of the Michigan residents. However, some people who ate the contaminated food developed skin disorders, such as acne and hair loss. It is likely that PBBs caused the skin problems because other chemicals similar to PBBs also cause these effects. Workers who were exposed to PBBs for a few days to months by breathing and skin contact also developed acne, although not all persons exposed to PBBs developed acne. Very little is known about the health of people who are exposed to low levels of PBBs for long periods by eating, breathing, or skin contact.

Laboratory animals fed PBBs had body weight loss, skin disorders, and nervous system effects, and their livers, kidneys, thyroid glands, and immune systems

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were seriously injured. Some animals fed high amounts died. PBBs also caused birth defects in animals, but it is not known for sure whether PBBs make males or females infertile. Most of the effects in animals occurred after they ate large amounts of PBBs for short periods or smaller amounts for several weeks or months. Body weight loss and effects on the livers, kidneys, and thyroid glands were observed. A lifetime study of rats and mice fed PBBs at doses higher than those expected from environmental exposure. A few studies tested animals exposed to PBBs by skin contact. These animals had injuries to the liver and skin. Only one study tested animals exposed to PBBs by breathing, and no health effects were observed.

We do not know if PBBs caused or will cause cancer in people who ate food contaminated with PBBs. Rats developed cancer in their livers after eating a large amount of a PBB mixture only once. The babies of exposed rats developed cancer in their livers after eating a large amount of the same PBB mixture only once. Liver cancer also developed in rats and mice that ate smaller amounts of the PBB mixture for several months. Mice that had skin contact with a small amount of a PBB mixture for several months did not develop skin cancer. There are no cancer studies in animals that breathed PBBs. Because animals fed PBBs did develop cancer, the National Toxicology Program (NTP) of the Department of Health and Human Services (DHHS) determined that PBBs may reasonably be anticipated to be carcinogens. Similarly, the International Agency for Research on Cancer (IARC) has determined that PBBs are possibly carcinogenic to humans. The EPA has not classified the carcinogenicity of PBBs.

We do not know whether the effects found in animals exposed to PBBs would also occur in people exposed in the same way. The amounts of PBBs that caused health effects in animals are much greater than levels of PBBs normally found in the environment. Long-term exposure to these chemicals has a greater potential to cause health effects than does short-term exposure to low levels because they tend to build up in your body over many years.

1.6 HOW CAN PBBs AFFECT CHILDREN?

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

Children are exposed to PBBs in generally the same way as are adults, mainly by eating contaminated food. Because of their smaller weight, children's intake of PBBs per kilogram (or pound) of body weight may be greater than that of adults. The most likely way that infants will be exposed is from breast milk that contains PBBs, although fetuses in the womb are also exposed. Children who live near hazardous waste sites might accidentally eat some PBBs by putting dirty hands or other soil/dirt-covered objects in their mouths, by eating without washing their hands, or similar behavior. Some children also eat dirt on purpose. It is not possible that children could be exposed to PBBs following transport of the chemical on clothing from the parent's workplace to the home because PBBs are no longer being produced or used.

Some information on health effects of PBBs in children is available from studies of the Michigan

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contamination episode. Symptoms of ill health were not associated with increased exposure to PBBs, and general neurological examinations did not show any abnormalities. More detailed studies of physical and neuropsychological development showed no effects that were clearly related to PBBs among Michigan children exposed during the episode. Changes in nerve and brain function have been seen in animals that were exposed to PBBs in the womb and by nursing. Animal studies also found that exposure to PBBs during pregnancy or lactation caused changes in thyroid hormone levels in the newborn animals and, at high doses, increases in prenatal death and structural birth defects.

As indicated above, children can be exposed to PBBs before birth and from breast milk. PBBs are stored in the mother's body and can be released during pregnancy, cross the placenta, and enter fetal tissues. Because PBBs dissolve readily in fat, they can accumulate in breast milk fat and be transferred to babies and young children. PBBs have been found in breast milk; however, in most cases, the benefits of breast-feeding outweigh any risks from exposure in mother's milk. You should consult your health care provider if you have any concerns about PBBs and breast feeding. Because the nervous system and thyroid are still developing in the fetus and child, the effects of PBBs on these target systems might be more profound from exposure before and soon after birth. That could mean fetuses and children are more susceptible to PBBs than are adults.

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

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

Because PBBs are no longer produced or used, the risk of exposure to these compounds is limited. You and your children could be exposed to PBBs by eating fish or wildlife caught from contaminated locations. Children who live near hazardous waste sites should be discouraged from playing in the dirt near these sites because they could still contain PBBs. Children should also be discouraged from eating the dirt, and careful handwashing practices should be followed.

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

Special tests can determine whether PBBs are in the blood, body fat, and breast milk. These are not regular or routine clinical tests, but could be ordered by a doctor to detect PBBs in people exposed to them in the environment and at work. If your PBB levels are higher than the normal levels, this will show that you have been exposed to high levels of the chemicals. However, these measurements cannot determine the exact amount or type of PBBs that you have been exposed to, or how long you have been exposed. Although these tests can indicate whether you have been exposed to PBBs to a greater extent than the general population, they do

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not predict whether you will be harmed. Blood tests are the easiest, safest, and probably the best method for detecting recent or past exposures to large amounts of PBBs. Results of such tests should be reviewed and carefully interpreted by physicians with a background in environmental and occupational medicine. Exposures to PBBs have been of greatest concern in Michigan as explained in Sections 1.3 and 1.5.

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

Regulations and recommendations can be expressed as “not-to-exceed” levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure

times (an 8-hour workday or a 24-hour day), different animal studies, or other factors.

Recommendations and regulations are also updated periodically 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 PBBs include the following:

At present, there are no federal guidelines or recommendations for protecting human health from exposure to PBBs.

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, your regional Nuclear Regulatory Commission office, or contact ATSDR at the address and phone number below.

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.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the information and technical assistance toll-free number at 1-888-42ATSDR (1-888-422-8737), by email at atsdric@cdc.gov, or by writing to:

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Division of Toxicology
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

For-profit organizations may request a copy of final profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: <http://www.ntis.gov/>

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Telephone: 1-888-422-8737

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E-Mail: atsdric@cdc.gov