

Toxicological Profile for

POLYCYCLIC AROMATIC HYDROCARBONS

**ACENAPHTHENE
ACENAPHTHYLENE
ANTHRACENE
BENZO(a)ANTHRACENE
BENZO(a)PYRENE
BENZO(b)FLUORANTHENE
BENZO(g,h,i)PERYLENE
BENZO(k)FLUORANTHENE
CHRYSENE
DIBENZO(a,h)ANTHRACENE
FLUORANTHENE
FLUORENE
INDENO(1,2,3-cd)PYRENE
PHENANTHRENE
PYRENE**

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



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TOXICOLOGICAL PROFILE FOR
POLYCYCLIC AROMATIC HYDROCARBONS

Prepared by:

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1. PUBLIC HEALTH STATEMENT

This Statement was prepared to give you information about polycyclic aromatic hydrocarbons (PAHs) and to emphasize the human health effects that may result from exposure to them. The Environmental Protection Agency (EPA) has identified 1,177 sites on its National Priorities List (NPL). At this time, all of the polycyclic aromatic hydrocarbons discussed in this profile have been found at several of these NPL hazardous waste sites. Dibenz(a,h)anthracene has been found at the lowest number of sites (6) and benzo(a)pyrene has been found at the highest number of sites (84). However, we do not know how many of the 1,177 NPL sites have been evaluated for PAHs. As EPA evaluates more sites, the number of sites at which PAHs are found may change. The information is important for you because PAHs may cause harmful health effects and because these sites are potential or actual sources of human exposure to PAHs.

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

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

1.1 WHAT ARE POLYCYCLIC AROMATIC HYDROCARBONS?

PAHs are a group of chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances. PAHs can be man-made or occur naturally. There is no known use for most of these chemicals except for research purposes. A few of the PAHs are used in medicines and to make dyes, plastics, and pesticides. They are found throughout the environment in the air, water, and soil. There are over one hundred different PAH compounds. Although the health effects of the individual PAHs are not exactly alike, the following 15 PAHs are considered as a group in this profile:

- acenaphthene
- acenaphthylene
- anthracene

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- benz(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- benzo(ghi)perylene
- benzo(k)fluoranthene
- chrysene
- dibenz(a,h)anthracene
- fluoranthene
- fluorene
- indeno(1,2,3-cd)pyrene
- phenanthrene
- pyrene

As pure chemicals, PAHs generally exist as colorless, white, or pale yellow-green solids. Most PAHs do not occur alone in the environment (including those found at hazardous waste sites), rather they are found as mixtures of two or more PAHs. They can occur in the air either attached to dust particles, or in soil or sediment as solids. They can also be found in substances such as crude oil, coal, coal tar pitch, creosote, and road and roofing tar. Most PAHs do not dissolve easily in water, but some PAHs readily evaporate into the air. PAHs generally do not burn easily and they will last in the environment for months to years.

More information on the chemical and physical properties of PAHs can be found in Chapter 3 and on their occurrence and break down in the environment in Chapter 5.

1.2 HOW MIGHT I BE EXPOSED TO POLYCYCLIC AROMATIC HYDROCARBONS?

PAHs are present throughout the environment, and you may be exposed to these substances at home, while outside, or at the workplace. Typically, you will not be exposed to an individual PAH alone, but to a mixture of PAHs.

In the environment, you are exposed to PAH vapors or PAHs that are attached to dust and other particles in the air. Other sources include vehicle exhausts, asphalt roads, coal, coal tar, wild fires, agricultural burning, and hazardous waste sites. Background levels of PAHs in the air are reported to be 0.02-1.2 mg/m³ in rural areas and 0.15-19.3 mg/m³ in urban areas. You may be exposed to PAHs in soil near areas where coal, wood, gasoline, or other products have been burned. You may be exposed to PAHs in the soil on or near hazardous waste sites, such as former manufactured-gas sites and wood-preserving facilities. PAHs have been found in some drinking water supplies in the United States. The background level of PAHs in drinking water ranges from 4 to 24 nanograms per liter (ng/L).

In the home, PAHs are present in tobacco smoke, smoke from home heating of wood, creosote-treated wood products, cereals, grains, flour, bread, vegetables, fruits, meat, processed or pickled foods, and beverages. Food

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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. The level of PAHs in the typical U.S. diet is less than 2 parts of total PAHs per billion parts of food (ppb).

For many people, the greatest exposure to PAHs occurs in the workplace. PAHs have been found in coal-tar production plants, coking plants, bitumen and asphalt production plants, coal-gasification sites, smoke houses, aluminum production plants, coal-tarring activities, and municipal trash incinerators. PAHs have also been found in other facilities where petroleum, petroleum products, or coal are used or where wood, cellulose, corn, or oil are burned. For more information on human exposure to PAHs see Chapter 5.

1.3 HOW CAN POLYCYCLIC AROMATIC HYDROCARBONS ENTER AND LEAVE MY BODY?

PAHs can enter your body through your lungs when you breathe air that contains them. This is one of the most significant route of exposure for people living near hazardous waste sites. Drinking water or swallowing food, soil, or dust particles that contain PAHs are other routes for these chemicals to enter your body. Under normal conditions of environmental exposure, PAHs could enter your body if your skin comes into contact with soil that contains high levels of PAHs (this could occur near a hazardous waste site); or with heavy oils or other products (such as coal tar, roofing tar, or creosote) that contain PAHs.

PAHs enter your body quickly and easily by all routes of exposure. The rate at which PAHs enter your body is increased when they are present in oily mixtures. They go to all the tissues of your body that contain fat, and tend to be stored mostly in your kidneys, liver, and fat, with smaller amounts in your spleen, adrenal glands, and ovaries. Results from animal studies show that PAHs do not tend to be stored in your body for a long time; most PAHs that enter the body leave within a few days, primarily in the feces and urine. More information on how PAHs enter and leave your body can be found in Chapters 2 and 6.

1.4 HOW CAN POLYCYCLIC AROMATIC HYDROCARBONS AFFECT MY HEALTH?

PAHs can cause harm to your health. Several of the PAHs, including benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, have caused tumors in laboratory animals when they ate them, when they were applied to their skin, or when they breathed them in the air for long periods of time. Reports in humans show that individuals exposed by breathing or skin contact for long periods of time to mixtures of other compounds and PAHs can also develop cancer.

Mice fed high levels of benzo(a)pyrene during pregnancy had difficulty reproducing and so did their offspring. The offspring from pregnant mice fed

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benzo(a)pyrene also showed other harmful effects, such as birth defects and decreased body weight. Similar effects could occur in humans, but we have no information to show that these effects do occur.

Studies in animals have also shown that PAHs can cause harmful effects on skin, body fluids, and the body's system for fighting disease after both short- and long-term exposure. These effects have not been reported in humans. More information on the health effects associated with exposure to PAHs can be found in Chapter 2.

1.5 WHAT LEVELS OF EXPOSURE HAVE RESULTED IN HARMFUL HEALTH EFFECTS?

Tables 1-1 through 1-4 show the relationship between exposure to PAHs and known health effects in humans and animals. As can be seen, no information is available from human studies to determine health effects resulting from exposure to specific levels of the individual PAHs, although inhalation and skin exposure to mixtures containing PAHs has been associated with cancer in humans.

A Minimal Risk Level (MRL) is also included in Table 1-3. This MRL was derived from animal data for short-term exposure, as described in Chapter 2 and in Table 2-2. The MRL provides a basis for comparison with levels that people might encounter in food. If a person is exposed to PAHs at an amount below the MRL, it is not expected that harmful (noncancer) health effects will occur. Because this level is based only on information currently available, some uncertainty is always associated with it. Also, because the method for deriving MRLs does not use any information about cancer, an MRL does not imply anything about the presence, absence, or level of risk for cancer.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO POLYCYCLIC AROMATIC HYDROCARBONS?

In your 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 after exposure to PAHs. However, this test is still being developed and it is not known yet how well it works. PAHs or their breakdown products can also be measured in urine. Although these tests can tell that you have been exposed to PAHs, it is not yet possible to use these tests to predict the severity of any health effects that might occur or to determine the extent of your exposure to the PAHs. These tests are not routinely available at a doctor's office because they require special equipment for sampling and detecting these chemicals. More information on tests used to determine PAHs in your body is presented in Chapters 2 and 6.