



# PUBLIC HEALTH STATEMENT

## 4,4'-METHYLENEDIANILINE

### CAS#: 101-77-9

Division of Toxicology

August 1998

This Public Health Statement is the summary chapter from the Toxicological Profile for 4,4'-Methylenedianiline. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFQA<sup>TM</sup>, 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 4,4'-methylenedianiline 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 clean-up activities. 4,4'-Methylenedianiline has not been found in any of the 1,445 current or former NPL sites. However, the total number of NPL sites evaluated is not known. As more sites are evaluated, the number of sites at which 4,4'-methylenedianiline is found may increase. This 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 can be exposed to a substance only when you come in

contact with it by breathing, eating, touching, or drinking.

If you are exposed to 4,4'-methylenedianiline, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), 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, and state of health.

#### 1.1 WHAT IS 4,4'-METHYLENEDIANILINE?

Methylenedianiline exists in several very similar forms. Of these various forms, 4,4'-methylenedianiline is the form used by industries. This profile discusses this important form of methylenedianiline. Other forms of methylenedianiline are only used as laboratory chemicals and have no commercial uses at this time. 4,4'-Methylenedianiline is also commonly known as diaminodiphenylmethane or MDA. It is a colorless (like an ice cube) to pale yellow solid with a faint amine odor (sharp odor). The taste of the compound is not known. It is very slightly soluble in water (does not mix well with water) and does not readily evaporate at room temperature. If left in an open container, it slowly turns brown because of chemical reactions with components present in air.

4,4'-Methylenedianiline is an industrially produced compound that is not known to occur naturally. It is produced by industries mainly for making polyurethane foams (such as insulating materials in mailing containers). Smaller amounts are used for making coating materials, epoxy resins (glues), Spandex<sup>®</sup> fiber, and dyes and for other purposes.

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### 1.2 WHAT HAPPENS TO 4,4'-METHYLENEDIANILINE WHEN IT ENTERS THE ENVIRONMENT?

Most 4,4'-methylenedianiline enters the environment when it's produced or when it's used to make other compounds. Of the total environmental release of at least 20,000 pounds per year, 52.6% is released to the air and 45% is released to deep soil during underground injection. Only 2.4% of the total is released to land and water. In addition, about 2,000 pounds per year are transferred to public sewer systems for treatment. No estimate is available for the amounts of 4,4'-methylenedianiline that enter the environment from accidental spills or from identified hazardous waste sites that may contain 4,4'-methylenedianiline.

The lack of experimental data makes it difficult to be certain about what happens to 4,4'-methylenedianiline when it enters the environment. In air, 4,4'-methylenedianiline will mostly be present as tiny particles and will eventually return to land and water by settling and by being brought down in rain and snow. In water, most of the 4,4'-methylenedianiline will tend to attach itself to particles and sediments, and will eventually settle to the bottom. 4,4'-Methylenedianiline present in water and sediment will eventually be broken down by bacteria and other microorganisms. This process may take as long as 10–40 days. 4,4'-Methylenedianiline does not tend to build up in the food chain, and it is uncertain whether it accumulates in fish. When deposited on soil, 4,4'-methylenedianiline will become strongly attached to it and, as a result, will not move quickly with rainwater into deeper groundwater. Bacteria and microorganisms present in soil will break down

4,4'-methylenedianiline, but the process may take as long as 10 days.

### 1.3 HOW MIGHT I BE EXPOSED TO 4,4'-METHYLENEDIANILINE?

You are most likely to be exposed to 4,4'-methylenedianiline if you work with it. The general population may be exposed to extremely low levels of 4,4'-methylenedianiline through consumer goods such as polyurethane cushioning or products that contain epoxy. The Food and Drug Administration (FDA) reports that the level of exposure to 4,4'-methylenedianiline through food is virtually zero. People who live near hazardous waste sites that contain 4,4'-methylenedianiline are susceptible to exposure if dust particles containing the substance are released from the waste site, enter the air, and are breathed into the body. Children playing near these sites may be exposed by touching and eating soil that contains 4,4'-methylenedianiline. However, there is no experimental or estimated value for the intake of 4,4'-methylenedianiline by the general population.

People who work in the following industries can be exposed to 4,4'-methylenedianiline by breathing in the dust or aerosol, or by getting it on their skin: manufacture, formulation, and packaging of 4,4'-methylenedianiline; certain paint making industries that use epoxy materials; pattern and tool making with polyurethane; potting and encapsulation with polyurethane; and casting and molding with resins made with 4,4'-methylenedianiline. 4,4'-Methylenedianiline has been detected in workplace air, in skin patches worn by workers, and in the urine of workers in these industries. However, the level in work atmospheres rarely exceeds the level

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of 0.8 milligram (mg) of 4,4'-methylenedianiline in a cubic meter of air (1 mg is equivalent to a thousandth of a gram), which is suggested as a safe level by the American Conference of Governmental Industrial Hygienists (ACGIH). The maximum exposure was found to occur in workers in the manufacturing and formulating industries. People with kidney diseases or who need frequent blood transfusions may be exposed to tiny amounts of 4,4'-methylenedianiline during their treatment by machines like dialyzers. The compound is released from polyurethane parts of equipment when they are sterilized with radiation or heat.

#### 1.4 HOW CAN 4,4'-METHYLENEDIANILINE ENTER AND LEAVE MY BODY?

If you breathe air containing dust contaminated with 4,4'-methylenedianiline, it can enter your body through your lungs and pass into the bloodstream. We do not know how much of the 4,4'-methylenedianiline will pass into your bloodstream or how fast this will happen. If you swallow food, water, or soil contaminated with 4,4'-methylenedianiline, some of it will probably enter your body and pass from the stomach into the bloodstream, but we do not know how much or how fast this will occur. If you touch soil containing 4,4'-methylenedianiline (for example, at a hazardous waste site), some 4,4'-methylenedianiline will pass through the skin into the bloodstream, but we do not know how much or how fast. For people living around waste sites, or processing or storage facilities, the most likely way it will enter their bodies is from skin contact with contaminated soil. For people who work with or around 4,4'-methylenedianiline, skin contact with contaminated dirt particles is the most likely way it will enter the

body. Once 4,4'-methylenedianiline is in your body, it may change into other related chemicals called metabolites. We think that some metabolites of 4,4'-methylenedianiline may be more harmful than unchanged 4,4'-methylenedianiline, but there is no conclusive experimental evidence to support this assumption. Some of the metabolites may leave your body in the urine within hours. We do not know if 4,4'-methylenedianiline is stored in the body.

#### 1.5 HOW CAN 4,4'-METHYLENEDIANILINE AFFECT MY HEALTH?

Studies in the workplace suggest that exposure to 4,4'-methylenedianiline may cause skin irritation and can damage your liver. People who ate bread that was accidentally contaminated with 4,4'-methylenedianiline also experienced liver damage. We do not know, however, how much 4,4'-methylenedianiline was in the bread. We do not know if breathing air contaminated with 4,4'-methylenedianiline, or eating contaminated food, or skin contact affects human reproduction or development. We also do not know if 4,4'-methylenedianiline affects the nervous system or the ability to fight disease in humans.

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

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would lose a basic method to get information needed to make wise decisions to protect public health. Scientists must treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Some mice that drank water containing large amounts of 4,4'-methylenedianiline for a short period died as a result. Rats that ate food or drank water containing smaller amounts of 4,4'-methylenedianiline for months or years had liver damage and thyroid gland injuries. Only a small amount of information exists on the health effects in animals exposed to 4,4'-methylenedianiline by breathing or skin contact. This information indicates that guinea pigs that breathed air contaminated with a very high amount of 4,4'-methylenedianiline for 2 weeks suffered damage to their eyes. Rabbits that received repeated skin exposure to relatively high amounts of 4,4'-methylenedianiline also had liver damage. There is not enough information to determine if exposure to 4,4'-methylenedianiline affects reproduction, development, the nervous system, or the ability to fight disease in animals.

There is not enough information on workers to determine if 4,4'-methylenedianiline is carcinogenic (causes cancer) in people. Rats and mice that drank water containing 4,4'-methylenedianiline throughout their lives developed cancer in their liver and thyroid glands. The International Agency for Research on Cancer (IARC) has determined that 4,4'-methylenedianiline is possibly carcinogenic to humans.

#### **1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO 4,4'-METHYLENEDIANILINE?**

Samples of your urine can be tested to find out if you have recently been exposed to 4,4'-methylenedianiline. These tests will only confirm if you have been exposed. They cannot estimate how much of it has entered your body and will not tell you whether your health will be affected by exposure to 4,4'-methylenedianiline. The exposure tests are not routinely available in hospitals and clinics because they require special analytical equipment and must be specially requested by your physician.

#### **1.7 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).

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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 4,4'-methylenedianiline include the following:

NIOSH recommends that workers should not breathe air that contains more than 0.03 milligram of 4,4'-methylenedianiline per cubic meter of air (0.03 mg/m<sup>3</sup>) during a 10-hour workday, 40-hour workweek.

OSHA recommends that workers should not be exposed to more than 0.081 mg/m<sup>3</sup> 4,4'-methylenedianiline during an 8-hour workday.

ACGIH recommends that workers should not be exposed to more than 0.81 mg/m<sup>3</sup> 4,4'-methylenedianiline for an 8-hour workday, 40-hour workweek.

#### 1.8 WHERE CAN I GET MORE INFORMATION?

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

Agency for Toxic Substances and Disease Registry  
Division of Toxicology  
1600 Clifton Road NE, 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). 1998. Toxicological profile for 4,4'-methylenedianiline. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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