PUBLIC HEALTH STATEMENT
DINITROPHENOLS
CAS#: 51-28-5 (2,4-DNP)

Division of Toxicology **August 1995**

This Public Health Statement is the summary chapter from the Toxicological Profile for Dinitrophenols. 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 statement was prepared to give you information about dinitrophenols and to emphasize the human health effects that may result from exposure to them. The Environmental Protection Agency (EPA) has identified 1,408 hazardous waste sites as the most serious in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal clean-up activities. Dinitrophenols have been found in at least 61 of the sites on the NPL. However, the number of NPL sites evaluated for dinitrophenols is not known. As EPA evaluates more sites, the number of sites at which dinitrophenols are found may increase. This information is important because exposure to dinitrophenols may cause harmful health effects and because these sites are potential or actual sources of human exposure to dinitrophenols.

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. You may be exposed by breathing, eating, or drinking substances containing the substance or by skin contact with it.

If you are exposed to substances such as dinitrophenols, many 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, lifestyle, and state of health.

1.1 WHAT ARE DINITROPHENOLS?

Dinitrophenols are a class of synthetic organic chemicals that can exist in six individual forms. Dinitrophenols do not occur naturally in the environment. This profile mainly contains information on the most commercially important dinitrophenol, 2,4-dinitrophenol, which is called DNP in this document. Industries manufacture dinitrophenols. DNP is sold under many trade names, some are Caswell No. 392®, Sulfo Black B®, and Nitro Kleenup®. It is a yellow solid with no known smell. It dissolves slightly in water. DNP present in water and soil as a pollutant does not easily evaporate to air. The taste of DNP is not known. Commercial DNP is primarily used for making dyes, other organic chemicals, and wood preservatives. It is also used to make photographic developer, explosives, and insect control substances.

1.2 WHAT HAPPENS TO DINITROPHENOLS WHEN THEY ENTER THE ENVIRONMENT?

DNP enters the air, water, and soil during its manufacture and use. It forms in the air when other pollutants react with oxides of nitrogen present in polluted air. Automobile exhaust releases DNP into the air. Burning certain wastes also produces DNP. Wastes containing DNP that are generated during its manufacture and use are sometimes disposed in landfills. DNP enters the environment from these landfills. It also enters the environment from accidental spills during transport and leaks from storage containers.

The loss of DNP into air due to chemical reactions with other pollutants or interaction with sunlight may not be significant. It eventually returns from air to land and water by settling and washout by snow and rainwater. We do not know how long it stays in the air before it is removed. Chemical reactions do not remove significant amounts of DNP from natural bodies of water. The action of microorganisms in water may be the most important process to remove DNP from water. The loss of DNP from water due to evaporation into air is insignificant. The percentage of DNP in water that sticks to particles present in water becomes substantial in acidic water containing particles high in organic matter and clay. This process partially transfers DNP from water to the bottom sediment. DNP is not likely to build up in fish from water. We do not know how long DNP remains in water. Chemical reactions do not remove DNP from soil under natural conditions. The loss of DNP from soil to the air due to evaporation is not important. The extent that DNP seeps into soil from rainwater depends on the properties of the soil. DNP may travel deeper into certain soils than others, especially soils that are not acidic. Groundwater from a few disposal sites contains DNP. DNP in soil is destroyed primarily by microorganisms. It may take between 4 and 80 days for the level of DNP in soil to decrease by half.

1.3 HOW MIGHT I BE EXPOSED TO DINITROPHENOLS?

During the 1930s, DNP was used extensively as a diet pill, so those most exposed were dieters who used these pills. Because of the harmful effects observed (cataracts in young people) the use of DNP was stopped by the United States government in 1938. Since that time, there has been at least one case where a doctor gave DNP to patients for weight reduction even though DNP is known to be harmful. Today, people can be exposed to DNP by breathing contaminated air, drinking contaminated water, eating contaminated food, or by contact with contaminated soil. Other than the air in certain workplaces, the levels of DNP in air we breathe are not known. DNP is present in waste water from certain industries. For example, waste water from a dye manufacturing plant contained 3.2 milligrams DNP per liter of water (mg/L) (1 mg = one thousandth of a gram and 1 liter = about one quart). Groundwater from a waste site that was once occupied by a factory that used DNP contained 30.6 mg DNP/L of water. The levels of DNP in drinking water and food are not known. Certain people may be exposed to low levels of DNP where they live or work. People who live near waste sites with DNP may be exposed by breathing contaminated air. Children playing at or near these sites may be exposed by touching and eating soil that contains DNP. You may be exposed to DNP if your work involves manufacturing or using DNP. You also

may be exposed to DNP if your work involves incinerating certain wastes or cleaning up waste sites containing DNP.

1.4 HOW CAN DINITROPHENOLS ENTER AND LEAVE MY BODY?

DNP can readily enter your body through the lungs by breathing, through the stomach if swallowed. It can probably be absorbed through the skin also. Animal studies show that after DNP enters the body, the blood can carry it to organs and tissues such as the liver, the kidneys, and the eyes. DNP does not build up in organs and tissues, but it is metabolized or broken down to other chemicals. We do not know if these breakdown products are harmful. DNP and these breakdown products leave your body in the urine.

1.5 HOW CAN DINITROPHENOLS AFFECT MY HEALTH?

Most of what we know about how DNP can affect your health comes from old reports by doctors who prescribed DNP to patients who wanted to lose weight. A person could even buy DNP at a drug store without a prescription. DNP has been banned by the U.S. Food and Drug Administration as a diet pill since 1938 because of the harmful effects that occurred in their patients, especially cataracts. Most of the ways that DNP can affect your health do not depend on how you are exposed or for how long. Some people who took DNP were harmed, while others were not, even though they took the same or higher doses. Although some people became ill after taking DNP for short periods, other people could take DNP for longer periods before becoming ill. This means that some people are more sensitive to the harmful effects of DNP than others. Brief or long-term exposure to DNP can cause increased basal metabolic rates (the rate that you use energy at complete rest); a feeling of warmth; sweating; weight loss; and increased heart rate, breathing rate, and body temperature. Some or all of these effects have occurred in some people after they swallowed doses as high as 46 milligrams of DNP per kilogram of their body weight per day (mg/kg/day) or doses as low as 1 mg/kg/day DNP. Some people who took doses of 2 mg/kg/day DNP or more for short or long periods experienced numbness in their hands and feet. Some people who swallowed doses of 6 mg DNP/kg/day for short periods or doses of 1 to 4 mg/kg/day DNP for long periods had a serious decrease of certain types of white blood cells that fight disease. Some people who swallowed doses of 1 to 4 mg/kg/day DNP for short or for long periods developed serious skin reactions that sometimes disappeared even while they were still being exposed. DNP caused cataracts in both eyes of some people who swallowed about 2 to 4 mg/kg/day DNP for short or long periods. This condition could lead to blindness in both eyes. If you breathe in, swallow, or have skin contact with large amounts of DNP, you may die. A few people have died after swallowing 3 to 46 mg/kg/day of DNP for short periods or doses as low as 1 to 4 mg/kg/day for long periods. Some workers who breathed in air containing 40 mg DNP per cubic meter of air (mg/m^3) or more for long periods have also died.

The effects of DNP found in animals are similar to those in humans, except that the effects on feeling in the hands and feet, and on white blood cells were not found in animals. Cataracts also occurred in some types of animals that swallowed DNP.

We do not know whether DNP causes reproductive or birth defects or cancer in humans. One study in rats suggested that if DNP is swallowed during pregnancy or nursing, it may cause death in newborn babies. Two other studies in mice suggested that DNP did not have effects on the unborn infant. We do not know whether DNP causes cancer in animals.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO DINITROPHENOLS?

DNP can be measured in blood, urine, and several body tissues. The main breakdown product of DNP in people, 2-amino-4-nitrophenol, can also be measured in the blood, urine, and tissues. The Derrien test is routinely used to measure this breakdown product in urine. This test produces a purple color if 2-amino-4-nitrophenol is present, but similar chemicals can also produce a purple color with this test. The total amount or concentration of DNP and its main breakdown products in urine or blood is a better indicator of DNP exposure. More modern tests can now identify and measure total DNP and breakdown products in blood or urine. However, these tests are not routinely available at your doctor's office, but can be performed at special laboratories or hospitals. These tests have not been used to tell exactly how much DNP people were exposed to or for how long. They also have not been used to predict harmful effects.

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

EPA lists DNP as a hazardous air pollutant under the Clean Air Act. EPA recommends that the amount present in bodies of water, such as lakes and rivers, should not be more than 0.07 mg/L in water used for swimming or where water might possibly be swallowed. No more than 0.765 mg/L should be present in water where people catch fish to eat, but there is no swimming.

EPA requires industry to report releases or spills of 10 pounds or more of DNP. EPA has designated DNP as a hazardous substance, and intends to cancel, restrict, or require reregistration of pesticide products containing dinitrophenols. DNP is also listed as a waste constituent and specific regulations regarding its disposal are in effect.

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:

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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). 1995. Toxicological profile for dinitrophenols. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.