

1. PUBLIC HEALTH STATEMENT

This Statement was prepared to give you information about tetryl and to emphasize the human health effects that may result from exposure to it. The Environmental Protection Agency (EPA) has identified 1,397 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. Tetryl has been found in at least 12 of the sites on the NPL. However, the number of NPL sites evaluated for tetryl is not known. As EPA evaluates more sites, the number of sites at which tetryl is found may increase. This information is important because exposure to tetryl may cause harmful health effects and because these sites are potential or actual sources of human exposure to tetryl.

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 a substance such as tetryl, 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, gender, nutritional status, family traits, life-style, and state of health.

1.1 WHAT IS TETRYL?

Tetryl is a synthetic substance that was used to make explosives, mostly during World War I and World War II. It is no longer manufactured or used in the United States. The chemical name for tetryl is N-methyl-N,2,4,6-tetranitroaniline. Other commonly used names are 2,4,6-trinitrophenyl-N-methylnitramine, nitramine, tetralite, and tetril. Stocks of tetryl are

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found in storage at military installations and are being destroyed by the Department of Defense. Tetryl was frequently manufactured as pellets or powder. Under certain manufacturing conditions, it could exist in the air as a dust. Tetryl is a yellow, crystal-like solid at room temperature. It dissolves slightly in water. It can also dissolve in other liquids, including benzene, alcohol, and acetone. At temperatures of 369 °F (187 °C) or higher, tetryl will explode. Tetryl has no odor, but some of its manufactured forms may have odors due to the presence of other chemicals. In addition, high concentrations of tetryl dust have an irritating effect on the nose that produces a sensation that might seem to be an odor. See Chapters 3 and 4 for more information on what tetryl is and how it is used.

1.2 WHAT HAPPENS TO TETRYL WHEN IT ENTERS THE ENVIRONMENT?

Tetryl may be released to the air, water, and soil when old stores of the explosive are destroyed by exploding or burning. However, tetryl has not been measured in air during any of these activities. Tetryl that was manufactured or stored at military installations, like Army ammunition plants, may still be present in the soil and water at or around these sites. Tetryl is not likely to evaporate into air from water or soil surfaces. However, tetryl may be present in air associated with dust from these sites. Tetryl appears to break-down rapidly in some soils. Picric acid, is one of the break down products of tetryl in soil. Tetryl probably does not easily travel from soil to groundwater. Erosion of soil from contaminated sites may release tetryl to nearby surface water. Once it is in the water, tetryl may dissolve or associate with small particles of suspended solids, sediments, or organic debris. Some of these particles will settle to the bottom. Tetryl breaks down rapidly in sunlit rivers and lakes but much more slowly in groundwater. It is not known whether tetryl will build up in fish, plants, or land animals. See Chapters 4 and 5 for more information on tetryl in the environment.

1.3 HOW MIGHT I BE EXPOSED TO TETRYL?

Most people are not exposed to tetryl because contamination is localized around military installations where it was manufactured, used, or stored. Tetryl can move through soil and

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enter underground water. If you live at or near one of these installations with tetryl contamination, you may be exposed to tetryl by drinking contaminated well water. You may also be exposed to tetryl by skin contact with contaminated soil or water. Workers who were previously involved in the processes of making, using, packing, or loading tetryl were probably exposed to tetryl by breathing contaminated dust and through skin contact. Workers currently involved in the clean-up, disposal, and destruction of tetryl may also be exposed by these routes. We do not know how many workers are exposed to tetryl.

Tetryl has been found in soil and water at some military installations, such as Army ammunition plants, and in underground water at one site located near a military installation. See Chapter 5 for more information on exposure to tetryl.

1.4 HOW CAN TETRYL ENTER AND LEAVE MY BODY?

Tetryl can enter your body if you breathe it in the air, drink it in water, or get it on your skin. We do not know the extent to which tetryl enters your body by these routes. Based on limited information from animal studies, tetryl probably leaves your body in urine after being broken down to other substances. See Chapter 2 for more information on how tetryl enters and leaves your body.

1.5 HOW CAN TETRYL AFFECT MY HEALTH?

Most of the information on the health effects of tetryl is from studies on workers employed in military facilities during World War I and World War II. These workers were involved in the production, use, packing, or loading of tetryl. The levels of tetryl in air at these facilities were often not measured. Many workers who breathed tetryl-laden dust complained of coughs, fatigue, headaches, eye irritation, lack of appetite, nosebleeds, nausea, and/or vomiting. Most workers who routinely handled tetryl powder and pellets in munitions factories developed a distinct yellow staining of the hands, neck, and hair. Workers with this staining were sometimes referred to as “canaries.” Many workers who had skin contact with tetryl dust or compounds containing tetryl also developed skin rashes (dermatitis). The rashes

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ranged from mild to severe and symptoms often included reddening, itching, swelling, and peeling of skin. Most of these health effects usually developed within a few days to a few weeks after exposure to tetryl. Some workers were more sensitive to tetryl exposure and developed allergies to tetryl. These often included severe asthma-like reactions that sometimes required medical attention or hospitalization. Workers who developed allergies to tetryl had reactions within a few hours after being exposed again to tetryl. Many of these workers were moved to work areas where there was no tetryl. Little is known about the longer term health effects in workers exposed to tetryl.

There is no information on health effects in humans exposed to drinking water contaminated with tetryl. Rabbits fed high doses of tetryl every day for 6 to 9 months developed degenerative lesions of the liver and kidney. Decreased blood-clotting capability and changes in the spleen were also noted. We do not know if tetryl causes cancer or birth defects, or if it affects reproduction in humans or animals. The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency have not classified the carcinogenicity of tetryl. For more information on health effects, see Chapter 2.

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

During World War I and World War II, most workers who routinely handled tetryl powder and pellets in munitions factories developed a distinct yellow staining of the skin. Many workers also developed skin rashes. These workers were exposed to high concentrations of tetryl dust in the air and by direct contact with the explosives. There are no medical tests to show if you have been specifically exposed to tetryl. However, if the breakdown products of tetryl found in the urine of animals exposed to tetryl were also present in the urine of exposed humans, these breakdown products could be used to indicate exposure to tetryl or similar substances. The symptoms caused by exposure to tetryl can also occur for many other reasons; therefore, they cannot be used as proof of tetryl exposure. Refer to Chapters 2 and 6 for more information.

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

The federal government has developed standards and guidelines to protect people from the health effects of tetryl. The Department of Transportation has many regulations for the transportation of explosives such as tetryl. Although tetryl is no longer being manufactured or used, the Occupational Safety and Health Administration (OSHA) has set a regulatory level for tetryl in the workplace. The maximum allowable amount of tetryl in workroom air during an 8-hour workday, 40-hour workweek, is 1.5 milligrams of tetryl per cubic meter of air (mg/m^3). This level may apply to workers engaged in destruction of tetryl explosives and those who work in locations where tetryl is stored. The National Institute for Occupational Safety and Health recommends that workers not be exposed to air containing more than $1.5 \text{ mg}/\text{m}^3$ during a 10-Hour workday. For more information on federal and state recommendations, see Chapter 7.

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, E-29
Atlanta, Georgia 30333
(404) 639-6000

This agency can also provide you with information on the location of the nearest occupational and environmental health clinic. These clinics specialize in the recognition, evaluation, and treatment of illness resulting from exposure to hazardous substances.

1. HEALTH EFFECTS

2.1 INTRODUCTION

The primary purpose of this chapter is to provide public health officials, physicians, toxicologists, and other interested individuals and groups with an overall perspective of the toxicology of tetryl. It contains descriptions and evaluations of toxicological studies and epidemiological investigations and provides conclusions, where possible, on the relevance of toxicity and toxicokinetic data to public health.

A glossary and list of acronyms, abbreviations, and symbols can be found at the end of this profile.

2.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE

To help public health professionals and others address the needs of persons living or working near hazardous waste sites, the information in this section is organized first by route of exposure—*inhalation, oral, and dermal*—and then by health effect—*death, systemic, immunological/lymphoreticular, neurological, developmental, reproductive, genotoxic, and carcinogenic effects*. These data are discussed in terms of three exposure periods—*acute (14 days or less), intermediate (15-364 days), and chronic (365 days or more)*.

The existing database on tetryl is quite limited. Most of the information on health effects comes from case studies and reports on the health of workers employed in tetryl munitions plants during World War I and World War II. The levels of tetryl to which these workers were exposed were generally not reported. Few data exist from animal studies with tetryl. None of the data located were reliable enough to determine levels of significant exposure (LSE). Because of this, estimates of levels posing minimal risk to humans (Minimal Risk Levels, or MRLs) could not be derived.

2.2.1 Inhalation Exposure

The only studies located regarding health effects in humans after inhalation exposure to tetryl were case studies and other reports of workers exposed to tetryl dusts in manufacturing plants during World War I and World War II. Little information was available regarding the number of people exposed or

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the duration and level of exposure. Since exposure was to the tetryl-laden dusts, the effects could have been caused by inhalation, direct skin contact, or by swallowing. The dermal effects noted in these studies were most likely caused by direct skin contact and are described in Section 2.2.3. It is unknown whether the other effects were caused by inhaling or by swallowing tetryl; therefore, in this profile, it is assumed that the primary route of exposure was inhalation.

One study, which investigated skin and anaphylactic reactions of guinea pigs sensitized by inhalation of tetryl smoke (Gell 1944), is discussed below. No other health effects were studied in animals.

2.2.1 .1 Death

Only two studies reporting death in humans were located. One study reports about two men who died approximately 3-5 years after exposure to tetryl dusts in a manufacturing plant (Hardy and Maloof 1950). Air samples taken in 1942, the only period for which exposure data were provided, ranged from 1 to 18 mg/m³. The period of exposure for the 2 men ranged from 1 to 4 years. Both men complained of general symptoms, such as cough, fatigue, and weight loss, during and after the time they worked with tetryl. In both cases, death was attributed to liver failure, but the specific cause of the liver failure was difficult to determine. In one case, the liver failure was considered to be due to advanced hepatitis or cirrhosis, but rheumatic heart disease was also present. In the other case, symptoms were consistent with chemically-induced cirrhosis. A hepatoma that was observed at autopsy was considered a possible result of the cirrhosis. Neither subject had a history of excessive alcohol intake. One woman employed for approximately 2 years in a munitions factory in England died following clinical symptoms of toxic jaundice (Troup 1946). Autopsy revealed atrophy of the liver with distortion of the upper parts of the liver. Work subsequent to leaving the munitions factory and prior to death involved handling of closed containers of chlorinated naphthalenes. None of these deaths can be unequivocally attributed to tetryl; the possibility of complicating medical conditions and/or exposure to other toxic chemicals could also have been contributing factors in the deaths.

One of eight guinea pigs exposed to a tetryl smoke died of an anaphylactic reaction when later challenged with a picrylgelatin antigen which had a structure similar to suspected tetryl metabolites (Gell 1944).