

## 4. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

### 4.1 PRODUCTION

Tetryl has been produced in a batch process by dissolving dimethylaniline in an excess of concentrated sulfuric acid at 20-30 °C to give dimethylaniline sulfate (Kirk-Othmer 1980). The solution was nitrated with a mixture of nitric and sulfuric acids to produce 2,4-dinitrodimethylaniline and eventually crude tetryl. The crude product was filtered, washed with water, and dissolved in acetone. The acetone was evaporated and the product filtered to yield purified tetryl. In a second production process 2,4- or 2,6-dinitrochlorobenzene was reacted with methylamine to form dinitrophenyl methylamine, which was nitrated to form tetryl (Gibbs and Popolato 1980).

Tetryl is not produced commercially in the United States (Army 1984c, 1989b; HSDB 1994). Prior production was limited to Army ammunition plants such as Joliet Army Ammunition Plant (Illinois), which produced tetryl until 1973 (HSDB 1994). Data on past production volumes for tetryl are not available. Other Army ammunition plants that have handled tetryl include Alabama (Alabama), Anniston (Alabama), Crane (Indiana), Fort Wingate (New Mexico), Hawthorne (Nevada), Letterkenny (Pennsylvania), Lexington (Kentucky), Louisiana (Louisiana), McAlester (Oklahoma), Milan (Tennessee), Navajo (Arizona), Pine Bluff (Arkansas), Pueblo (Colorado), Red River (Texas), Savanna (Illinois), Seneca (New York), Sierra (California), Tooele (Utah), and Umatilla (Oregon) (Army 1986a, 1986b).

Because tetryl releases are not required to be reported under SARA Section 313, there are no data on tetryl in the Toxics Release Inventory (TRI 1993).

### 4.2 IMPORT/EXPORT

Current import and export data for tetryl are not available.

### 4.3 USE

The primary use of tetryl from 1916-1979 was as a common component of military explosives (Jenkins and Walsh 1994). It has been largely replaced by RDX in modern explosive formulations

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(Army 1984c, 1989b; Gibbs and Popolato 1980; Jenkins and Walsh 1994). Tetryl was used as an explosive in detonators and primers, as a detonating agent for other less sensitive high explosives, and as a booster charge for military devices (HSDB 1994; Sax and Lewis 1987). As a component in binary explosives, tetryl was used with 2,4,6-trinitrotoluene (TNT) to form tetrytols (80% tetryl, 20% TNT) that were used as a base charge in detonators (Army 1986b; Gibbs and Popolato 1980). Tetryl has also been used as a chemical indicator in the pH range between 10.8 (colorless) and 13.0 (redbrown) (Merck 1989).

##### 4.4 DISPOSAL

Beginning in 1963, the U.S. Navy loaded munitions on obsolete liberty ships and sank them at selected oceanic sites (CEQ 1970; Hoffsommer and Rosen 1972). Tetryl was one of the most common and abundant explosives dumped in this manner (Hoffsommer and Rosen 1972), but ocean dumping has not been used since 1970 (CEQ 1970). Waste waters from tetryl manufacture were passed to holding lagoons for primary settling of solid materials before being released to rivers and streams (Harvey et al. 1993). Tetryl is completely deactivated into nonexplosive, water-soluble products by the action of sodium sulfite, and this reaction was used for the disposal of waste material (Bergman 1952). The deactivation was accomplished by adding the explosive to an aqueous solution containing 13% by weight of hydrated sodium sulfite. By-products, such as those created during the manufacture of tetryl, were openly burned or detonated at many Army ammunition plants. As much as 80% of waste munitions and propellants that have been disposed of in recent years have been incinerated (Army 1986d).

Wastes containing tetryl have been incinerated by grinding and spraying the ground material with water to form a slurry. The types of incineration that have been used to destroy waste munitions such as tetryl include rotary kiln incineration, fluidized bed incineration, and pyrolytic incineration (Army 1986d). The primary disadvantage of open burning or incineration is that explosive contaminants are often released into the air, water, and soils (Army 1986b). Wastes generated in the manufacturing of tetryl are classified as EPA hazardous wastes and any stored tetryl or tetryl-containing wastes from hazardous waste sites must be disposed according to EPA regulations (EPA 1990b). For more information on hazardous waste regulations that apply to tetryl, see Chapter 7.

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Over 90% of tetryl wastes found in soils were transformed to non-carbon dioxide products in testing composts using substances such as hay-horse feed and sewage sludge-wood shavings (Army 1986a). The chemical has been destroyed from contaminated lagoon sediments using aqueous thermal decomposition (heating under pressure to 200-250 °C in an aqueous medium) (Army 1985). Tetryl waste munitions have also been removed from waste waters by activated carbon columns (Army 1986b, 1987a). Once carbon columns were saturated with the explosive, they were traditionally destroyed by open burning. Since this practice is no longer allowed in many areas, other alternatives of disposing of spent carbons, such as thermal reactivation for reuse, oxidative incineration and burial, or thermal deactivation and carbon burial, have been investigated (Army 1987a). A method for removing tetryl from contaminated waste water and lagoons using a chemical reaction with a surfactant containing a quaternary ammonia group under basic conditions (pH 11-11.5) followed by filtration to remove the precipitate has been tested (Army 1984c).

