

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

### 4.1 PRODUCTION

The production volume of 2,4-DNP is Confidential Business Information (CBI) (EPA 1991). Therefore, information on the annual production volumes of 2,4-DNP in the United States in recent years has not been published, although the production volumes are substantial (EPA 1991). In 1977, the production volume for 2,4-DNP was <1,000 pounds by Alpine Laboratories, Inc., in Bay Minette, Alabama. Production volumes in 1977 for two alternate production sites (Mobay Chemical Corp. in Charleston, South Carolina, and Martin Marietta Corp. in Charlotte, North Carolina) and one plant, whose name remains confidential, were not reported (TSCAPP 1993). According to the most recent obtainable data from the United States International Trade Commission publication on U.S. production and sales of synthetic organic chemicals (USITC 1970), 863,000 pounds of 2,4-DNP were produced in 1968. One chemical company, Sandoz Chemicals Corp., in Charlotte, North Carolina, is listed as a domestic manufacturer of 2,4-DNP in 1992 (SRI 1994) and its yearly production volume is in the range 0.1-1.0 million pounds (see Table 4-1). Vertac Chemical Corp. in Memphis, Tennessee, was listed as a manufacturer of 2,5-DNP, 2,6-DNP, and a dinitrophenol mixture containing the 2,3-, 2,4-, and 2,6- isomers (HSDB 1994). 2,6-DNP is also produced by American Hoechst Corp. in North Hollywood, California (OHM/TADS 1993). Besides these producers of dinitrophenols, Table 4-1 reports the number of facilities in each state that manufacture and process 2,4-dinitrophenol and the range of maximum amounts of 2,4-DNP stored on-site. The data reported in Table 4-1 are derived from the Toxics Release Inventory (TRI) of EPA (TRI92 1994). The TRI data should be used with caution since only certain types of facilities were required to report. Thus, this is not an exhaustive list. Neither production sites nor volumes for any of the other dinitrophenol isomers were located in the available literature.

The commercial dinitrophenol mixture is produced by heating phenol with dilute sulfuric acid, cooling the product, and then nitrating while keeping the temperature below 50 °C, or by nitrating with a mixed acid under careful temperature control (Sax and Lewis 1987). 2,3-, 2,5-, and 3,4-DNP are prepared by nitration of *m*-nitrophenol. 3,5-DNP is prepared by the replacement of one nitro group by methoxyl in 1,3,5-trinitrobenzene and demethylation of the dinitroanisole by anhydrous aluminum chloride. 2,6-DNP is prepared by sulfonation and nitration of *o*-nitrophenol (Harvey 1959). 2,6-DNP is also produced as a byproduct in the synthesis of 2,4-DNP by way of 2,4-dinitrochlorobenzene.

**Table 4-1. Facilities that Manufacture or Process 2,4-Dinitrophenol**

Facility	Location <sup>a</sup>	Range of maximum amounts on site in pounds	Activities and uses
Rubicon Inc.	LA	1,000–9,999	Produce; As a by-product
BASF Corp.	Geismar, LA	0–99	Produce; As a by-product
First Chemical Corp.	Pascagoula, MS	1,000–9,999	Produce; As a by-product
Sandoz Chemicals Corp	Charlotte, NC	10,000–99,999	Produce; for on-site use/processing; for sale/distribution; as a reactant
Osmose Wood Preserving, Inc.	Buffalo, NY	10,000–99,999	As a product component
Shenango, Inc.	Pittsburgh, PA	10,000–99,999	Produce; as an impurity
Sharon Steel Corp.	Monessen, PA	1,000–9,999	Produce; as an impurity
Du Pont Beaumont Plant	Beaumont, TX	100–999	Produce; as a by-product

Source: TRI92 1994

<sup>a</sup> Post office state abbreviations used

Heating with 6% aqueous sodium hydroxide at 95-100 C° for 4 hours hydrolyzes 2,4-dinitrochlorobenzene. 2,4-DNP in the hydrolyzed product is precipitated by adding acid; the precipitate is removed by filtration. The residue is washed to remove added acid and the more soluble 2,6-DNP (Booth 1991).

#### **4.2 IMPORT/EXPORT**

During 1985, 102,000 pounds of 2,4-DNP were imported into the United States (HSDB 1994). Neither import nor export data for any of the other dinitrophenol isomers were located in the available literature.

#### **4.3 USE**

Dinitrophenol (commercial mixture of the 2,3- and 2,6- isomers, but mostly the 2,4- isomer) is used in the synthesis of dyes, picric acid, picramic acid, wood preservatives, diaminophenol dihydrochloride (a photographic developer), explosives, and insecticides, and as a pH indicator. 2,4-DNP was formerly used as a weight-reducing agent. 2,5-DNP is used in the manufacture of dyes, organic chemicals, and as a pH indicator. 2,4-DNP is used as an insecticide, acaricide, and fungicide. Dinitrophenols are also used in the manufacture of acaricides, herbicides, fungicides, and in the manufacture of styrene as inhibitors in the purification stills to reduce polymerization (Merck 1989; Coulter et al. 1969; HSDB 1994; Metcalf 1966; Sax and Lewis 1987).

#### **4.4 DISPOSAL**

2,4-DNP has been identified as a hazardous waste by EPA, and disposal of this waste is regulated under the Federal Resource Conservation and Recovery Act (RCRA). Specific information regarding federal regulations on 2,4-DNP disposal on land, in municipal solid waste landfills, and in incinerators is available in the Code of Federal Regulations (EPA 1992a, 1992b, 1992c). Details of such regulations and guidelines are given in Chapter 7.

A method that utilizes the classical Fenton reaction (reaction with ferrous chloride and hydrogen peroxide) has been suggested for the treatment of phenolics in waste waters (Lipczynska-Kochany 1991; Vella and Munder 1993). At a nitrophenol to ferrous chloride concentration ratio of 1:3 and in

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the presence of excess hydrogen peroxide (nitrophenol/hydrogen peroxide ratio =1:18), >90% of nitrophenol was destroyed in less than 7 hours and no aromatic degradation products were detected (Lipczynska-Kochany 1991). However, the Fenton's system is very susceptible to inhibitors and hydroxyl radical scavengers (e.g., phosphate and carbonate) (Vella and Munder 1993). Alternative treatment methods for the reduction of nitrophenol concentrations in waste water include activated carbon treatment and biological treatment methods (Vella and Munder 1993). Ultimate disposal of dinitrophenol isomers can be accomplished in an incinerator equipped with an acid scrubber for removing oxides of nitrogen ( $\text{NO}_x$ ). EPA suggests rotary kiln and fluidized bed incineration as methods for disposal of DNP. Because dinitrophenol has been used as a pesticide, the disposal of containers that contained DNP is required by EPA. Combustible containers from organic or many metalloorganic pesticides may be disposed of in pesticide incinerators or in specified landfill sites. Noncombustible containers may be disposed of in a designated landfill or recycled (HSDB 1994).