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

4.1 PRODUCTION

Trichloroethylene is currently produced in the United States using ethylene dichloride (a product of ethylene and chlorine feedstocks) (EPA 1985e). PPG Industries uses a single-step oxychlorination process, which yields trichloroethylene and tetrachloroethylene. In the PPG process, ethylene dichloride is reacted with chlorine and/or hydrogen chloride and oxygen to form the trichloroethylene and tetrachloroethylene. DOW Chemical produces trichloroethylene by a direct chlorination process, in which ethylene dichloride is reacted with chlorine to form trichloroethylene and tetrachloroethylene.

U.S. production volumes of trichloroethylene in recent years have been reported as follows: 299 million pounds in 1978, 319 million in 1979, 266 million in 1980, 258 million in 1981, and 200 million in 1982 (USITC 1979, 1980, 1981, 1982, 1983). U.S. production demand for trichloroethylene in 1983, 1985, and 1986 is estimated to be 235, 180, and 170 million pounds, respectively (CMR 1983, 1986). The U.S. International Trade Commission (USITC) has not published more recent production statistics because there are only two U.S. manufacturers (HSDB 1994).

The only U.S. manufacturers of trichloroethylene are DOW Chemical in Freeport, Texas, and PPG Industries in Lake Charles, Louisiana (CMR 1986; SRI 1987). These two manufacturers have a combined annual production capacity of 320 million pounds (SRI 1987). Prior to 1982, Ethyl Corporation, Diamond Shamrock, and Hooker Chemical manufactured trichloroethylene (CMR 1983; Mannsville 1992).

The facilities that manufactured or processed trichloroethylene in 1993 are listed in Table 4- 1.

4.2 IMPORT/EXPORT

As a result of the strength of the U.S. dollar in foreign markets, imports of trichloroethylene rose steadily from 8 million pounds in 1980 to 40 million pounds in 1985 (CMR 1986). During the same

Table 4-1. Facilities That Manufacture or Process Trichloroethylene

State[a]	Number of facilities	Range of maximum amounts on site in thousands of pounds[b]	Activities and uses[c]
AL	12	1-1,000	2, 3, 7, 8, 12, 13
AR	11	1-1,000	8, 9, 11, 12, 13
AZ	4	1-10	12, 13
CA	5	1-10,000	1, 5, 8, 10, 11, 13
CO	1	10-100	12
CT	15	1-100	11, 12, 13
DE	1	100-1,000	13
FL	14	0-100	11, 12, 13
GA	12	1-1,000	8, 12, 13
IA	5	1-10	12, 13
IL	99	0-100,000	1, 4, 8, 9, 10, 11, 12, 13
IN	50	0-10,000	7, 8, 10, 11, 12, 13
KS	12	0-1,000	8, 10, 11, 12, 13
KY	17	1-50,000	1, 3, 7, 10, 12, 13
LA	11	1-10,000	1, 3, 4, 5, 6, 7, 8, 12, 13
MA	36	0-1,000	8, 10, 11, 12, 13
MD	4	1-100	2, 3, 12, 13
ME	2	10-100	13
MI	41	1-1,000	2, 3, 8, 10, 11, 12, 13
MN	28	0-100	11, 12, 13
MO	28	0-1,000	2, 3, 8, 10, 12, 13
MS	6	1-1,000	12, 13
NC	19	0-100	10, 11, 12, 13
NE	10	1-100	11, 12, 13
NH	4	1-100	11, 13
NJ	11	1-1,000	8, 12, 13
NY	55	0-1,000	3, 7, 10, 11, 12, 13
OH	55	0-1,000	8, 10, 11, 12, 13
OK	5	1-100	2, 3, 13
OR	7	0-1,000	11, 12, 13
PA	54	1-1,000	3, 8, 10, 11, 12, 13
PR	1	10-100	13

Table 4-1 (*continued*)

State[a]	Number of facilities	Range of maximum amounts on site in thousands of pounds[b]	Activities and uses[c]
RI	5	0-100	8, 12, 13
SC	12	1-1,000	7, 12, 13
SD	2	10-100	13
TN	14	1-1,000	2, 3, 7, 11, 12, 13
TX	34	1-50,000	1, 3, 4, 5, 6, 7, 8, 10, 12, 13
VA	12	1-1,000	12, 13
VT	3	1-100	11, 13
WA	9	0-100	12, 13
WI	42	0-1,000	8, 10, 11, 12, 13

Source: TRI93 1995

[a]Post office state abbreviations used
[b]Data in TRI are maximum amounts on site at each facility
[c]Activities/Uses:

1. Produce
2. Import
3. For on-site use/processing
4. For sale/distribution
5. As a by-product
6. As an impurity
7. As a reactant
8. As a formulation component
9. As a product component
10. For repackaging only
11. As a chemical processing aid
12. As a manufacturing aid
13. Ancillary or other uses

time period, exports of trichloroethylene fell from 60 million pounds to 18 million pounds. Trends are not easy to predict, however. According to the National Trade Data Bank, imports of trichloroethylene were 3.8 million pounds in 1991, 0.7 million pounds in 1992, and 16.3 million pounds in 1993, while exports were 72.8 million pounds in 1991, 108 million pounds in 1992, and 108 million pounds again in 1993 (NTDB 1994).

4.3 USE

The end-use pattern of trichloroethylene in the United States was estimated as follows (CMR 1986): vapor degreasing of fabricated metal parts, 80%; chemical intermediates, 5%; miscellaneous uses, 5%; and exports, 10%. The most important use of trichloroethylene, vapor degreasing of metal parts, is closely associated with the automotive and metals industries (CMR 1983).

Trichloroethylene is an excellent extraction solvent for greases, oils, fats, waxes, and tars and is used by the textile processing industry to scour cotton, wool, and other fabrics (IARC 1979; Kuney 1986; Verschueren 1983). The textile industry also uses trichloroethylene as a solvent in waterless dying and finishing operations (McNeil1 1979). As a general solvent or as a component of solvent blends, trichloroethylene is used with adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners (Hawley 1981; IARC 1979; McNeil1 1979).

Approximately 10 million pounds of trichloroethylene are used annually as a chain transfer agent in the production of polyvinyl chloride (McNeil1 1979). Other chemical intermediate uses of trichloroethylene include production of pharmaceuticals, polychlorinated aliphatics, flame retardant chemicals, and insecticides (Mannsville 1992; Windholz 1983). Trichloroethylene is used as a refrigerant for low-temperature heat transfer (Cooper and Hickman 1982; IARC 1979; McNeil1 1979) and in the aerospace industry for flushing liquid oxygen (Hawley 1981; Kuney 1986).

Various consumer products found to contain trichloroethylene include typewriter correction fluids, paint removers/strippers, adhesives, spot removers, and rug-cleaning fluids (Frankenberry et al. 1987; IARC 1979).

Prior to 1977, trichloroethylene was used as a general and obstetrical anesthetic; grain fumigant; skin, wound, and surgical disinfectant; pet food additive; and extractant of spice oleoresins in food and of caffeine for the production of decaffeinated coffee. These uses were banned by a U.S. Food and Drug Administration (FDA) regulation promulgated in 1977 (IARC 1979).

4.4 DISPOSAL

The recommended method of trichloroethylene disposal is incineration after mixing with a combustible fuel (Sittig 1985). Care should be taken to carry out combustion to completion in order to prevent the formation of phosgene (Sjoberg 1952). Other toxic byproducts of incomplete combustion include polycyclic aromatic hydrocarbons and perchloroaromatics (Blankenship et al. 1994; Mulholland et al. 1992). An acid scrubber also must be used to remove the haloacids produced.

According to EPA regulations, land disposal of halogenated organic solvents (such as trichloroethylene) is restricted (EPA 1987e). Before land disposal of trichloroethylene or trichloroethylenecontaining materials is attempted, proper authorization must be obtained from federal, state, and local authorities.

There has been an emphasis on recovery and recycling of trichloroethylene to reduce emissions of this photoreactive chemical to the atmosphere (CMR 1986; McNeil1 1979). Photooxidative destruction has been successfully used in conjunction with air-stripping techniques to volatilize trichloroethylene from water and degrade it to nontoxic products (Bhowmick and Semmens 1994). If possible, recycling should be used instead of disposal.