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

5.1 PRODUCTION

Trichloroethylene is currently produced in the United States using ethylene dichloride (a product of ethylene and chlorine feedstocks) (CMR 2005; EPA 1985e; Rossberg 2006; Snedecor et al. 2004). 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. Use of acetylene as a feedstock for trichloroethylene production declined significantly during the 1970s, and this method is no longer used (Rossberg 2006; Snedecor et al. 2004).

The production volume of trichloroethylene in the United States was reported to be 354 million pounds in 1960, 612 million pounds in 1970, 267 million pounds in 1980, and 195 million pounds in 1987 (Mertens 2000). The U.S. production demand was 165 million pounds in 1993, 192 million pounds in 2000, and 218 million pounds in 2004 (CMR 1989, 2005). According to the U.S. EPA Inventory Update Reporting database, the annual production of trichloroethylene during 2006 was between 100 and 500 million pounds (EPA 2010a). More recent production data for trichloroethane have not been located. According to the EPA Chemical Data Reporting rule, there were nine domestic manufacturers of trichloroethylene in 2012, with a national production volume of 224,674,308 pounds per year (EPA 2015a).

Table 5-1 summarizes the number of facilities in each state that manufactured or processed trichloroethylene in 2017, the ranges of maximum amounts on site, if reported, and the activities and uses as reported in the Toxics Release Inventory (TRI) (TRI17 2018). The data listed in this table should be used with caution since only certain types of facilities are required to report. This is not an exhaustive list.

5.2 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 time period, exports of trichloroethylene fell from 60 million pounds to 18 million pounds. Reported U.S. imports

Table 5-1. Facilities that Produce, Process, or Use Trichloroethylene

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AL	3	1,000	99,999	12
AR	2	100	999,999	12
AZ	2	1,000	99,999	12
CA	2	1,000	99,999	7,12
CO	1	10,000	99,999	12
CT	4	1,000	999,999	9,12
DE	1	10,000	99,999	12
GA	8	1,000	999,999	7,9,12
IA	1	1,000	9,999	11
IL	15	1,000	99,999	1,2,3,4,6,7,9,10,11,12
IN	4	1,000	999,999	9,11,12,14
KS	6	100	99,999	1,5,7,10,11,12
KY	6	100	9,999,999	1,3,6,9,12
LA	14	0	49,999,999	1,3,4,5,6,12,13,14
MA	5	1,000	49,999,999	7,9,12
ME	1	1,000	9,999	11
MI	2	1,000	9,999	7,11
MN	7	1,000	99,999	6,10,12
MO	8	1,000	99,999	2,3,7,9,11,12
NE	2	10,000	999,999	9,12
NJ	2	1,000	999,999	7,9,12
NM	1	10,000	99,999	12
NV	1	10,000	99,999	7
NY	3	100	9,999	12
OH	13	1,000	999,999	7,10,12
OK	1	1,000	9,999	12
OR	2	10,000	999,999	11,12
PA	9	1,000	999,999	7,9,11,12
SC	4	100	999,999	6,12
TN	3	10,000	99,999	10,12
TX	10	1,000	499,999,999	1,3,4,5,6,7,9,12,13,14
UT	3	100	999,999	11,12
VA	2	1,000	99,999	7,11
VT	1	1,000	9,999	12
WA	1	100	999	6,7,12

Table 5-1. Facilities that Produce, Process, or Use Trichloroethylene

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
WI	3	1,000	99,999	7,9,11,12
WV	1	0	0	0

[a]Post office state abbreviations used.
[b]Amounts on site reported by facilities in each state.
[c]Activities/Uses:

1. Produce
2. Import
3. Used Processing
4. Sale/Distribution
5. Byproduct
6. Reactant
7. Formulation Component
8. Article Component
9. Repackaging
10. Chemical Processing Aid
11. Manufacture Aid
12. Ancillary
13. Manufacture Impurity
14. Process Impurity

Source: TRI17 2018 (Data are from 2017)

during the years 2000, 2002, and 2004 were 10, 19, and 20 million pounds, respectively (CMR 2005). Reported U.S. exports during these same 3 years were 76, 52, and 55 million pounds, respectively (CMR 2005). The continued strength of U.S. exports during this time period was most likely due to the high global demand for trichloroethylene as a feedstock for the refrigerant HFC-134a (CMR 2002, 2005; Snedecor et al. 2004). More recent data regarding US imports and exports of trichloroethylene have not been located.

5.3 USE

The end-use pattern of trichloroethylene in the United States during 2004 was estimated as follows (CMR 2005): hydrofluorocarbon (HFC-134a) intermediate, 73%; metal degreasing, 24%; and miscellaneous uses, 3%. Historically, the most important use of trichloroethylene has been vapor degreasing of metal parts, which is closely associated with the automotive and metals industries (CMR 1983). This use has declined over the past decade due to increased environmental regulations governing trichloroethylene emissions (CMR 2000, 2002, 2005). During the same time period, trichloroethylene found increasing use as a feedstock for HFC-134a, a refrigerant that was introduced as a replacement for CFC-12 during the 1990s (CMR 1995, 1997, 2000, 2002, 2005; Snedecor et al. 2004).

Trichloroethylene is an excellent extraction solvent for greases, oils, fats, waxes, and tars and has been used by the textile processing industry to scour cotton, wool, and other fabrics (Bakke et al. 2007; IARC 1979; ACS 1986; Verschueren 1983). The textile industry has also used trichloroethylene as a solvent in waterless drying and finishing operations (Bakke et al. 2007; McNeill 1979; Snedecor et al. 2004). As a general solvent or as a component of solvent blends, trichloroethylene has been used with adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners (Bakke et al. 2007; IARC 1979; McNeill 1979; PPG 2005).

Trichloroethane has had widespread use as a chain transfer agent in the production of polyvinyl chloride (PVC) (CMR 2005; PPG 2005; Snedecor et al. 2004). Other chemical intermediate uses of trichloroethylene have included production of pharmaceuticals, polychlorinated aliphatics, flame retardant chemicals, and insecticides (Bakke et al. 2007; Windholz 1983). Trichloroethylene is used as a refrigerant for low-temperature heat transfer (Cooper and Hickman 1982; IARC 1979; McNeill 1979; Snedecor et al. 2004) and in the aerospace industry for flushing liquid oxygen (PPG 2005).

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; Snedecor et al. 2004).

5.4 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 trichloroethylene-containing 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 2002; McNeill 1979; Snedecor et al. 2004). 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.