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

5.1 PRODUCTION

No information is available in the Toxics Release Inventory (TRI) database on facilities that manufacture or process 1,2,3-trichlorobenzene and 1,3,5-trichlorobenzene because this chemical is not required to be reported under Section 313 of the Emergency Planning and Community Right-to-Know Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) (EPA 1998c).

Table 5-1 lists the facilities in each state that manufacture or process 1,2,4-trichlorobenzene, the intended use, and the range of maximum amounts of trichlorobenzenes that are stored on site. The data listed in Table 5-1 are derived from the Toxics Release Inventory (TRI12 2013). These data should be used with caution, however, since only certain types of facilities are required to report (EPA 2005b). Therefore, this is not an exhaustive list.

Chlorobenzenes are prepared industrially by reacting liquid benzene with gaseous chlorine in the presence of a Lewis acid catalyst such as ferric chloride (Rossberg et al. 2006). The reaction is carried out at moderate temperature and atmospheric pressure. Generally, mixtures of isomers and compounds with varying degrees of chlorination are obtained, because any given chlorobenzene can react further until hexachlorobenzene is ultimately produced. 1,2,3-Trichlorobenzene and 1,2,4-trichlorobenzene are formed in minor quantities in the production of monochlorobenzene and dichlorobenzene; however, trichlorobenzenes become the primary product if the chlorine input is increased to about 3 moles of chlorine per mole of benzene (Rossberg et al. 2006). 1,2,4-Trichlorobenzene can be obtained more directly via chlorination of 1,4-dichlorobenzene.

An additional method employed to produce 1,2,4- and 1,2,3-trichlorobenzene is based on the dehydrohalogenation of 1,2,3,4,5,6-hexachlorocyclohexane. By reacting hexachlorocyclohexane with aqueous alkali or alkaline earth solutions, ammonia, or other catalysts in the temperature range of 90–250°C, trichlorobenzene is produced. The yield is generally high, ranging between 80 and 99%, with the mixture consisting of 70–85% 1,2,4- trichlorobenzene and 13–30% 1,2,3-trichlorobenzene (Rossberg et al. 2006).

1,3,5-Trichlorobenzene is usually only produced in minor quantities during the chlorination of liquid benzene; however, it can be produced by Sandmeyer reaction on 3,5-dichloroaniline or by reacting

Table 5-1. Facilities that Produce, Process, or Use 1,2,4-Trichlorobenzene

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AL	48	0	999,999	2, 3, 4, 6, 7, 10, 11, 12
AR	8	100	99,999	7, 12
AZ	6	1,000	9,999	11, 12
CA	48	100	999,999	4, 7, 8, 9, 10, 11, 12
CT	1	1,000	9,999	1, 3, 7, 11
DE	14	1,000,000	49,999,999	1, 2, 3, 4, 7
FL	10	1,000	99,999	10, 11, 12
GA	23	0	999,999	2, 4, 6, 7, 9, 10, 11
IL	18	1,000	99,999	1, 5, 10, 12
IN	15	100	999,999	2, 3, 7, 9, 11, 12
KS	7	0	499,999,999	9, 12
KY	54	1,000	999,999	1, 3, 5, 6, 9, 10, 12
LA	48	0	999,999	1, 5, 6, 12, 13
MI	12	0	99,999	8, 9, 10, 12
MO	4	0	99,999	9, 12
MS	6	0	999,999	1, 5, 12
NC	145	100	999,999	1, 2, 3, 4, 6, 7, 8, 10, 11, 12
NE	7	1,000	999,999	12
NJ	11	1,000	99,999	7, 9, 11, 12
NY	4	1,000	99,999	9, 10, 12, 13
OH	61	0	49,999,999	7, 8, 9, 10, 11, 12
OK	8	100	9,999,999	1, 10, 12, 13
OR	4	10,000	999,999	12
PA	46	0	9,999,999	1, 2, 3, 5, 7, 9, 10, 12, 13
PR	3	1,000	9,999	7, 10
RI	7	1,000	99,999	2, 9, 10, 12, 13
SC	49	1,000	99,999	2, 3, 6, 7, 8, 9, 10, 12
SD	4	10,000	99,999	12
TN	12	10,000	999,999	10, 12
TX	110	0	49,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12
UT	4	100	99,999	7, 8, 11, 12
VA	27	0	99,999	4, 9, 10, 11, 12
WA	7	1,000	999,999	7, 12

Table 5-1. Facilities that Produce, Process, or Use 1,2,4-Trichlorobenzene

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
WI	1	1,000	9,999	10
WV	22	10,000	9,999,999	1, 4

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

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

Source: TRI12 2013 (Data are from 2012)

benzene-1,3,5-trisulfonic acid derivatives with phosgene (Rossberg et al. 2006). It can also be produced by diazotization of 2,4,6-trichloroaniline, followed by treatment with a reducing agent such as hypophosphorous acid (O’Neil et al. 2006).

The EPA Inventory Update Reporting rule requires chemical companies to submit data for compounds manufactured or imported in quantities of ≥25,000 pounds at a single site during a calendar year. For fiscal year 2005, three companies (Ashland Incorporated, BASF Corporation, and PPG Industries, Inc.) reported either manufacturing or importing quantities of 1,2,4-trichlorobenzene in quantities of >25,000 pounds (EPA 2010b, 2010e). Two of these corporations (Ashland Incorporated and BASF Corporation) also imported 1,2,3-trichlorobenzene. No data were located for 1,3,5-trichlorobenzene.

5.2 IMPORT/EXPORT

Non-confidential data obtained from the EPA Inventory Update Reporting rule indicated that <500,000 pounds of 1,2,3-trichlorobenzene were imported into the United States in 2005 and 1–<10 million pounds of 1,2,4-trichlorobenzene were imported in 2005 (EPA 2010b, 2010e). No export volumes were located.

5.3 USE

Trichlorobenzenes have primarily been used as solvents and chemical intermediates. In the past, mixed isomers of trichlorobenzene had been used for termite control in soil; however, there are currently no registered uses of trichlorobenzenes as a pesticide (HSDB 2010). 1,2,4-Trichlorobenzene is currently used in solvents in chemical reactions and to dissolve special materials such as oils, waxes, resins, greases, and rubber (Rossberg et al. 2006). It is used as a dye carrier and in the production of dyes (Rossberg et al. 2006). Other uses are associated with textile auxiliaries and as a dielectric liquid (a substance that conducts little or no electricity). 1,2,4-Trichlorobenzene is also one of the most important solvents used for extracting fullerenes from soot (Beer et al. 1997). 1,2,3-Trichlorobenzene is used as an intermediate for the manufacture of pesticides (through the production of 2,3,4-trichloronitrobenzene), and as an intermediate in several fine chemical products and particularly herbicides, pigments, and dyes (Euro Chlor 2002). There is some use of 1,3,5-trichlorobenzene but only as a chemical intermediate and in low quantities (Euro Chlor 2002). In Europe, 1,2,4-trichlorobenzene, has also been used in anti-corrosives paint or rust removing agents and as an additive in polish and maintenance products; however, most of these uses have been discontinued (European Communities 2003). Other former uses of trichlorobenzene include use of the substance in degreasing agents, septic tanks and drain cleaners, wood preservatives, and abrasive formulations (European Communities 2003). Approximately 7,000 metric tons were produced in Europe in 1994–1995 with approximately 75–90% exported (European Communities 2003).

5.4 DISPOSAL

The preferred method of disposal of trichlorobenzene is incineration, preferably after mixing with another combustible fuel (HSDB 2010). Care must be exercised to assure complete combustion to prevent the formation of phosgene. An alkali scrubber is necessary to remove the halo acids produced. Powdered activated carbon treatment (PACT) is used with the activated sludge for waste water treatment of trichlorobenzene (HSDB 2010). Primary treatment consists of neutralization with lime and settling followed by combined powdered activated carbon-activated sludge for secondary/tertiary treatment. Primary sludge consisting of metal salts and unreacted lime is dewatered before disposal in a lined landfill. Powdered activated carbon and return powdered activated carbon treatment sludge are added to the primary effluent as it is fed to aeration tanks. Treated effluent is discharged after first passing through a settling lagoon. Consistency and efficiency of removal varies greatly with reported ranges from 44% for 1,2-dichlorobenzene to 99% for a number of volatile organic compounds. For 1,2,4-trichlorobenzene, 66% was removed.