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

4.1 PRODUCTION

Table 4-1 lists the facilities in each state that manufacture or process chloromethane, the intended use, and the range of maximum amounts of chloromethane that are stored on site. The data listed in Table 4-l are derived from the Toxics Release Inventory (TRI96 1998). Only certain types of facilities were required to report. Therefore, this is not an exhaustive list. Based on the most current TRI information, there are currently 96 facilities that produce or process chloromethane in the United States.

Chloromethane (also commonly known as methyl chloride) is both an anthropogenic and naturally occurring chemical. Anthropogenic sources include industrial production, polyvinyl chloride burning, and wood burning; natural sources include the oceans, microbial fermentation, and biomass fires (e.g., forest fires, grass fires). Chloromethane is produced industrially by reaction of methanol and hydrogen chloride (HCl) or by chlorination of methane (Edwards et al. 1982a; Holbrook 1992; Key et al. 1980). While the reaction of methanol with HCl is the most common method, the choice of process depends, in part, on the HCl balance at the site (the methane route produces HCl, the methanol route uses it) (Edwards et al. 1982a; Holbrook 1992). Typically, manufacturing plants that produce chloromethane also produce higher chlorinated methanes (methylene chloride, chloroform, and carbon tetrachloride).

The methanol-HCl process involves combining vapor-phase methanol and HCl at 180-200 °C, followed by passage over a catalyst where the reaction occurs (Holbrook 1992; Key et al. 1980). Catalysts include alumina gel, gamma alumina, and cuprous or zinc chloride on pumice or activated carbon. The exit gases from the reactor are quenched with water to remove unreacted HCl and methanol. The quench water is stripped of the dissolved methanol and chloromethane, and the remaining dilute HCl solution is used inhouse or treated and discharged (Holbrook 1992; Key et al. 1980). The chloromethane is then dried by treatment with concentrated sulfuric acid, compressed, cooled, and stored.

In the methane chlorination process, a molar excess of methane is mixed with chlorine, and the mixture is then fed to a reactor, which is operated at 400 °C and 200 kPa pressure (Holbrook 1992; Key et al. 1980). The exit gases can then be scrubbed with chilled chloromethanes (mono- to tetrachloromethane) to remove most of the reaction chloromethanes from unreacted methane and HCl. The by-product HCl is removed by

Table 4-1. Facilities That Manufacture or Process Chloromethane

FACILITY	LOCATION [a]	RANGE OF MAXIMUM AMOUNTS ON SITE IN POUNDS	ACTIVITIES AND USES
HULS AMERICA INC.	THEODORE , AL	1,000 - 9,999	PRODUCE , BYPRODUCT
INTERNATIONAL PAPER	MOBILE , AL	0 - 99	PRODUCE , IMPURITY
CPS CHEMICAL CO.	WEST MEMPHIS , AR	100,000 - 999,999	REACTANT
INTERNATIONAL PAPER	PINE BLUFF , AR	0 - 99	PRODUCE , IMPURITY
AMVAC CHEMICAL CORP.	LOS ANGELES , CA	0 - 99	PRODUCE , BYPRODUCT
BOULDER SCIENTIFIC CO.	MEAD , CO	1,000 - 9,999	REACTANT
SYNTEX CHEMICALS INC.	BOULDER , CO	10,000 - 99,999	PRODUCE , BYPRODUCT , REACTANT
PFIZER INC-GROTON SITE	GROTON , CT	10,000 - 99,999	PRODUCE , BYPRODUCT , REACTANT
SPONGES INTL.	SHELTON , CT	10,000 - 99,999	MANUFACTURING AID
ZENECA INC.	NEW CASTLE , DE	10,000 - 99,999	REACTANT
BUCKEYE FLORIDA L.P.	PERRY , FL	0 - 99	PRODUCE , IMPURITY
BLACKMAN UHLER CHEMICAL DIV.	AUGUSTA , GA	10,000 - 99,999	REACTANT
GILMAN PAPER CO.	SAINT MARYS , GA	10,000 - 99,999	PRODUCE , IMPURITY
NUTRASWEET KELCO CO.	AUGUSTA , GA	1,000 - 9,999	PRODUCE , BYPRODUCT
TENNECO PACKAGING	CLYATTVILLE , GA	0 - 99	PRODUCE , BYPRODUCT , IMPURITY
MONSANTO CO.	MUSCATINE , IA	100 - 999	PRODUCE , BYPRODUCT
AKZO NOBEL CHEMICALS INC.	MORRIS , IL	100,000 - 999,999	REACTANT
AKZO NOBEL CHEMICALS INC.	MC COOK , IL	100,000 - 999,999	REACTANT
CABOT CORP.	TUSCOLA , IL	0 - 99	PRODUCE , BYPRODUCT
HENKEL CORP.	KANKAKEE , IL	10,000 - 99,999	REACTANT
LONZA INC.	MAPLETON , IL	10,000 - 99,999	REACTANT
MORTON INTL. INC.	RINGWOOD , IL	10,000 - 99,999	REACTANT
SHEREX CHEMICAL CO. INC.	MAPLETON , IL	100,000 - 999,999	REACTANT
ECOLAB INC.	HUNTINGTON , IN	10,000 - 99,999	REACTANT
ALLCO CHEMICAL CORP.	GALENA , KS	100,000 - 999,999	REACTANT
PALMER MFG. & TANK INC.	GARDEN CITY , KS	100 - 999	ANCILLARY/OTHER USE
VULCAN CHEMICALS	WICHITA , KS	1,000,000 - 9,999,999	PRODUCE , ON-SITE USE/PROCESSING , SALE/DISTRIBUTION , REACTANT
DOW CORNING CORP.	CARROLLTON , KY	1,000,000 - 9,999,999	PRODUCE , ON-SITE USE/PROCESSING , REACTANT
WESTVACO CORP.	WICKLIFFE , KY	10,000 - 99,999	PRODUCE , BYPRODUCT
DOW CHEMICAL CO.	PLAQUEMINE , LA	1,000,000 - 9,999,999	PRODUCE , ON-SITE USE/PROCESSING , SALE/DISTRIBUTION , IMPURITY , REACTANT , ANCILLARY/OTHER USE
EXXON CHEMICAL	BATON ROUGE , LA	100,000 - 999,999	CHEMICAL PROCESSING AID
FERRO CORP.	ZACHARY , LA	100,000 - 999,999	REACTANT
GEORGIA-PACIFIC CORP.	ZACHARY , LA	100 - 999	PRODUCE , BYPRODUCT
INTERNATIONAL PAPER CO.	BASTROP , LA	0 - 99	PRODUCE , IMPURITY
MONSANTO CO.	LULING , LA	1,000 - 9,999	PRODUCE , IMPURITY
RHONE-POULENC INC.	BATON ROUGE , LA	100,000 - 999,999	REACTANT
VULCAN MATERIALS CO.	GEISMAR , LA	1,000,000 - 9,999,999	PRODUCE , ON-SITE USE/PROCESSING , SALE/DISTRIBUTION , REACTANT
WITCO CORP.	KILLONA , LA	100,000 - 999,999	REACTANT
FMC CORP.	BALTIMORE , MD	100 - 999	PRODUCE , BYPRODUCT
WESTVACO CORP.	LUKE , MD	100 - 999	PRODUCE , IMPURITY

Table 4-1. Facilities That Manufacture or Process Chloromethane (continued)

FACILITY	LOCATION [a]	RANGE OF MAXIMUM AMOUNTS ON SITE IN POUNDS	ACTIVITIES AND USES
BASF CORP.	WYANDOTTE , MI	1,000 - 9,999	PRODUCE , BYPRODUCT , REACTANT
CYTEC IND. INC.	KALAMAZOO , MI	10,000 - 99,999	REACTANT
DOW CHEMICAL USA	MIDLAND , MI	100,000 - 999,999	PRODUCE , BYPRODUCT , IMPURITY , REACTANT
DOW CORNING CORP.	MIDLAND , MI	100,000 - 999,999	BYPRODUCT , PRODUCE , ON-SITE USE/PROCESSING , SALE/DISTRIBUTION , IMPURITY , CHEMICAL PROCESSING AID , MANUFACTURING AID
ESCO CO.	MUSKEGON , MI	10,000 - 99,999	REACTANT
DIVERSIFOAM PRODS.	ROCKFORD , MN	10,000 - 99,999	IMPORT , ON-SITE USE/PROCESSING , FORMULATION COMPONENT , CHEMICAL PROCESSING AID
BAYER CORP.	KANSAS CITY , MO	100 - 999	PRODUCE , BYPRODUCT
DUCOA L.P.	VERONA , MO	100,000 - 999,999	REACTANT
SYNTEX AGRIBUSINESS INC.	SPRINGFIELD , MO	100,000 - 999,999	REACTANT
INTERNATIONAL PAPER	NATCHEZ , MS	0 - 99	PRODUCE , IMPURITY
INTERNATIONAL PAPER	REDWOOD , MS	0 - 99	PRODUCE , BYPRODUCT
CHAMPION INTL. CORP.	CANTON , NC	0 - 99	PRODUCE , IMPURITY
FEDERAL PAPER BOARD CO. INC.	RIEGELWOOD , NC	0 - 99	PRODUCE , IMPURITY
CPS CHEMICAL CO. INC.	OLD BRIDGE , NJ	100,000 - 999,999	REACTANT
DUPONT CHAMBERS WORKS	DEEPWATER , NJ	1,000 - 9,999	PRODUCE , BYPRODUCT , ANCILLARY/OTHER USE
GE CO.	WATERFORD , NY	1,000,000 - 9,999,999	PRODUCE , ON-SITE USE/PROCESSING , REACTANT
AMOCO PERFORMANCE PRODS. INC.	MARIETTA , OH	10,000 - 99,999	REACTANT
ARISTECH CHEMICAL CORP.	HAVERHILL , OH	10,000 - 99,999	PRODUCE , BYPRODUCT
LINDERME TUBE CO.	EUCLID , OH	10,000 - 99,999	ANCILLARY/OTHER USE
MARSULEX INC.	OREGON , OH	10,000 - 99,999	ANCILLARY/OTHER USE
MORTON INTL. INC.	CINCINNATI , OH	100,000 - 999,999	REACTANT
AIR PRODS. & CHEMICALS INC.	TAMAQUA , PA	100,000 - 999,999	REPACKAGING
PPG IND. INC.	FOLCROFT , PA	1,000 - 9,999	REACTANT
PRESSURE CHEMICAL CO.	PITTSBURGH , PA	1,000 - 9,999	REACTANT
ROHM & HAAS CO.	PHILADELPHIA , PA	10,000 - 99,999	REACTANT
MERCK SHARP & DOHME QUIMICA	BARCELONETA , PR	10,000 - 99,999	PRODUCE , BYPRODUCT
ALBRIGHT & WILSON AMERICAS	CHARLESTON , SC	1,000 - 9,999	PRODUCE , BYPRODUCT
BALCHEM CORP.	GREEN POND , SC	10,000 - 99,999	REPACKAGING
BAYER CORP. BUSHY PARK	GOOSE CREEK , SC	10,000 - 99,999	REACTANT
NIPA HARDWICKE INC.	ELGIN , SC	10,000 - 99,999	REACTANT
ENENCO INC.	MEMPHIS , TN	100,000 - 999,999	REACTANT
GREAT LAKES CHEMICAL CORP.	NEWPORT , TN	100 - 999	PRODUCE , BYPRODUCT
TENNECO PACKAGING	COUNCE , TN	0 - 99	PRODUCE , BYPRODUCT
ZENECA SPECIALTIES	MOUNT PLEASANT , TN	0 - 99	PRODUCE , BYPRODUCT , REACTANT
AKZO NOBEL CHEMICALS INC.	DEER PARK , TX	1,000 - 9,999	REACTANT
BASF CORP.	BEAUMONT , TX	100,000 - 999,999	REACTANT
CORSICANA TECHS. INC.	CORSICANA , TX	10,000 - 99,999	REACTANT
DOW CHEMICAL CO.	FREEPORT , TX	1,000,000 - 9,999,999	PRODUCE , ON-SITE USE/PROCESSING , SALE/DISTRIBUTION , IMPURITY , REACTANT , ANCILLARY/OTHER USE

Table 4-1. Facilities That Manufacture or Process Chloromethane (continued)

FACILITY	LOCATION [a]	RANGE OF MAXIMUM AMOUNTS ON SITE IN POUNDS	ACTIVITIES AND USES
EASTMAN CHEMICAL CO.	LONGVIEW , TX	0 - 99	PRODUCE , IMPURITY
EXXON CHEMICAL AMERICAS	BAYTOWN , TX	100,000 - 999,999	MANUFACTURING AID
INLAND PAPERBOARD & PACKAGING	ORANGE , TX	0 - 99	PRODUCE , BYPRODUCT
ISK BIOSCIENCES CORP.	HOUSTON , TX	100,000 - 999,999	IMPORT , ON-SITE USE/PROCESSING , REACTANT
OCCIDENTAL CHEMICAL CORP.	GREGORY , TX	1,000 - 9,999	PRODUCE , BYPRODUCT
PETROLITE CORP.	PASADENA , TX	10,000 - 99,999	REACTANT
RHONE-POULENC INC.	FREEPORT , TX	10,000 - 99,999	PRODUCE , BYPRODUCT
SACHEM INC.	CLEBURNE , TX	100,000 - 999,999	REACTANT
STERLING CHEMICALS INC.	TEXAS CITY , TX	100 - 999	PRODUCE , BYPRODUCT
WITCO CORP.	HOUSTON , TX	10,000 - 99,999	REACTANT
ZENECA INC.	PASADENA , TX	100,000 - 999,999	REACTANT
HICKSON DANCHEM CORP.	DANVILLE , VA	10,000 - 99,999	REACTANT
MERCK & CO. INC.	ELKTON , VA	100 - 999	PRODUCE , BYPRODUCT
UNION CAMP CORP.	FRANKLIN , VA	0 - 99	PRODUCE , BYPRODUCT
BELL AROMATICS	MILWAUKEE , WI	10,000 - 99,999	REACTANT
SHEREX CHEMICAL WHOLLY OWNED	JANESVILLE , WI	100,000 - 999,999	REACTANT
TOMAH PRODS. INC.	MILTON , WI	100,000 - 999,999	REACTANT
DU PONT	BELLE , WV	100 - 999	PRODUCE , BYPRODUCT
OSI SPECIALTIES INC.	FRIENDLY , WV	10,000 - 99,999	PRODUCE , BYPRODUCT , REACTANT , MANUFACTURING AID

Source: TRI96 1998

[a] Post Office state abbreviations used

water wash, stripped of any chloromethanes, and either used in-house or sold; the unreacted methane is recycled through the process. The condensed chloromethanes are scrubbed with dilute NaOH to remove any HCl, dried, compressed, cooled, and then fractionally distilled to separate the four chloromethanes. While there are some variations to this process, including the use of catalysts, this is a general overview of the basic steps in the process.

It is difficult to estimate the total production levels for chloromethane at specific plants because many of the producers consume their output internally as a feedstock for other chemicals, including silicones and higher chlorinated methanes. Current production capacity in the United States is estimated to be in the neighborhood of 920 million pounds (417.3 million kg) per year (CMR 1995). The seven facilities with the largest production capacities are: (1) Dow Chemical Company plant at Freeport, Texas; (2) Dow Chemical Company plant at Plaquemine, Louisiana; (3) Dow Corning Corporation plant at Carrolton, Kentucky; (4) Dow Corning Corporation plant at Midland, Michigan; (5) GE Plastics Company plant at Waterford, New York; (6) Vulcan Chemical Company plant at Geismar, Louisiana; and (7) Vulcan Chemical Company plant at Wichita, Kansas (CMR 1995). All these facilities have production capacities in excess of 50 million pounds per year. At the GE Plastics facility and the two Dow Corning facilities, all the chloromethane generated is used on-site in silicone production; a large percentage of the output from the Dow plant in Freeport, Texas, and the two Vulcan facilities are also used on-site as feedstocks in the manufacture of other chemicals and products (CMR 1995).

Available estimates for annual production show a growth in output from the early 1980s through the mid-1990s. These production trends are documented in Table 4-2 (C&EN 1992, 1995). In addition to direct manufacture, chloromethane is also produced naturally and from a number of human industrial activities (e.g., the manufacture of vinyl chloride) that can lead to the inadvertent production and release of chloromethane to environmental media. These releases are discussed in Chapter 5.

4.2 IMPORT/EXPORT

In the period from 1990 through 1994, U.S. imports of chloromethane showed considerable fluctuations, with annual import levels ranging from 2,241,040 kg (4,930,288 lbs) in 1990 to a low value of 119,171 kg (262,176 lbs) in 1991. During 1992, imports rebounded to 657,612 kg (1,446,746 lbs); more recently, imports have increased to 1,682,383 kg (3,701,242 lbs) in 1993 and 1,916,523 kg (4,216,350 lbs) in 1994 (USDOC 1996). During the same period, exports also showed considerable volatility, with export levels

Table 4-2. Trends in U.S. Chloromethane Production

Year	Annual production in millions of pounds	Annual production in millions of kilograms
1981	405	183.7
1982	366	166.0
1983	409	185.5
1984	482	218.6
1985	410	185.9
1986	605	274.4
1987	373	169.2
1988	597	270.8
1989	461	209.1
1990	772	350.2
1991	916	415.5
1992	966	438.2
1993	1,053	477.6
1994	995	451.3

Source: based on data from C&EN 1992,1995

outpacing imports by a factor of about 2. In the period from 1991 through 1995, export levels ranged from 5,092,969 kg (11,204,532 lbs) in 1992 to 7,107,860 kg (15,637,292 lbs) in 1991 (USDOC 1996).

4.3 USE

Chloromethane is used mainly (72%) in the production of silicones (CMR 1986; Holbrook 1992). Chloromethane has also been used in the production of agricultural chemicals (8%), methyl cellulose (6%), quaternary amines (5%), butyl rubber (3%), and for miscellaneous uses including tetramethyl lead (2%) (CMR 1986). It has been used in the past as a component or propellant in some cleansers and industrial solvents (Howard 1990). It has also apparently been used in the past as a foam blowing agent and as an agricultural pesticide or fumigant (HSDB 1998). At the present time, virtually all of the commercial uses for chloromethane are consumptive in that the chloromethane is reacted to form another product during use. Thus, almost all chloromethane will be consumed when used and will no longer be available for release, disposal, or reuse.

4.4 DISPOSAL

Limited information was located in the literature concerning the disposal of chloromethane. Since most chloromethane is used consumptively, little remains to be disposed. Nonetheless, some chloromethane is present in waste, and chloromethane has been detected in hazardous waste landfills. Its presence in hazardous waste sites may result from the landfilling of still bottoms or other residues from the manufacture and use of chloromethane. Its presence in municipal waste landfills suggests that consumer products containing chloromethane were landfilled (e.g., propellants for aerosol cans, old refrigerators). Since chloromethane is an impurity in vinyl chloride, the disposal of vinyl chloride may also lead to chloromethane contamination. Like other chlorinated hydrocarbons, chloromethane can inhibit the combustion of such fuels as methane. Chloromethane has a considerable inhibitory effect on combustion when mixed with methane, the principal component of natural gas (Philbrick et al. 1993). Changes in the amounts of chloromethane added to the methane fuel stock did not produce well-defined relations with the combustion characteristics. Such phenomena would complicate the disposal of chloromethane using incineration technologies. When incineration was attempted under oxygen-starved conditions (Taylor and Dellinger 1988), chloromethane was shown to combine with other components of the combustion mixture to form, among other compounds, chlorinated ethanes, hexachlorobenzene, and octachlorostyrene.

Chloromethane is listed as a toxic substance under Section 313 of the Emergency Planning and Community Right to Know Act (EPCRA) under Title III of the Superfund Amendments and Reauthorization Act (SARA). Disposal of wastes containing chloromethane is controlled by a number of federal regulations (see Chapter 7).