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4. PRODUCTION, IMPORT, USE, AND DISPOSAL

4.1 PRODUCTION

Production of vinyl chloride monomer in the United States was approximately 13.75 billion pounds in 1993 (C&EN 1994; USITC 1994), an increase of nearly 22%. This exceeds the latest available U.S. estimated total production capacity figures (beginning of 1993) of 12.79 billion pounds at the beginning of 1993 (SRI 1993) and represents a substantial recent increase in production and capacity, even if vinyl chloride production is at full capacity. Previously, vinyl chloride production had grown only 1–5% per year over the last 5 years (C&EN 1994). Over the last 10 years, vinyl chloride production has grown at an average rate of about 7%, not including the large increase in 1993, although production volumes were fairly volatile (C&EN 1994).

Vinyl chloride is currently produced in the United States by 10 companies at 12 facilities, which are as follows (SRI 1994): Westlake Monomers Corporation in Calvert City, Kentucky; Borden Chemicals and Plastics in Geismar, Louisiana; Dow Chemical in Oyster Creek, Texas, and in Plaquemine, Louisiana; Georgia Gulf Corporation in Plaquemine, Louisiana; PPG Industries in Lake Charles, Louisiana; Vista Chemical Company in Lake Charles, Louisiana; B.F. Goodrich Company in LaPorte, Texas; Formosa Plastics Corporation in Baton Rouge, Louisiana, and in Point Comfort, Texas; Occidental Chemical Corporation in Deer Park, Texas; and Oxymar in Ingleside, Texas. Table 4-1 summarizes the facilities in the United States that manufacture or process vinyl chloride. This information was obtained from the 1992 Toxic Chemical Release Inventory (TRI92), and it summarizes the reported release data for 1992 (TRI92 1994). Table 4-1 also lists the maximum amounts of vinyl chloride that are present at these sites and the end uses of the vinyl chloride.

Vinyl chloride was first produced commercially in the 1930s by reacting hydrogen chloride with acetylene. Currently, vinyl chloride is produced commercially by the chlorination of ethylene through one of two processes, direct chlorination or oxychlorination. Direct chlorination reacts ethylene with chlorine to produce 1,2-dichloroethane. Similarly, oxychlorination produces 1,2-dichloroethane, but this is accomplished by reacting ethylene with dry hydrogen chloride and oxygen. After both processes, the 1,2-dichloroethane is subjected to high pressures (2.5–3.0 megapascals) and temperatures

Table 4-1. Facilities That Manufacture or Process Vinyl Chloride

Facility	Location[a]	Range of maximum amounts on site in pounds	Activities and uses
KEYSOR-CENTURY CORP.	SAUGUS, CA	1,000,000-9,999,999	As a reactant
UNION CARBIDE CORP.	TORRANCE, CA	10,000-99,999	As a reactant
FORMOSA PLASTICS CORP.	DELAWARE CITY, DE	1,000,000-9,999,999	As a reactant
GEORGIA GULF CORP.	DELAWARE CITY, DE	1,000,000-9,999,999	As a reactant
WESTLAKE PVC CORP.	PACE, FL	1,000,000-9,999,999	As a reactant
UNION CARBIDE CHEMICALS	TUCKER, GA	100,000-999,999	As a reactant
~~BF GOODRICH CO.~~	~~HENRY, IL~~	~~1,000,000-9,999,999~~	~~As a reactant; As a product component~~
BORDEN CHEMICALS & PLASTICS	ILLIOPOLIS, IL	No Data	As a reactant
~~BF GOODRICH CO.~~	LOUISVILLE, ~~KY~~	1,~~000,000-9,999,999~~	~~As a reactant~~
AIR PRODS. & CHEMICALS INC.	CALVERT CITY, KY	10,000-99,999	As a reactant
WESTLAKE PVC CORP.	CALVERT CITY, KY	1,000,000-9,999,999	As a reactant
WESTLAKE MONOMERS CORP.	CALVERT CITY, KY	1,000,000-9,999,999	Produce; For sale/distribution
VULCAN MATERIALS CO.	GEISMAR, LA	100,000 999,999	Produce; For on-siteuse/processing; As a by-product; As a reactant
BORDEN CHEMICALS & PLASTICS	GEISMAR, LA	No Data	Produce; For on-site use/processing; For sale/ distribution; As a reactant
PPG IND. INC.	LAKE CHARLES, LA	No Data	Produce; For sale/distribution; As a by-product; As an impurity; As a reactant
CERTAINTEED CORP.	SULPHUR, LA	1,000,000-9,999,999	As a reactant
VISTA CHEMICAL CO.	WESTLAKE, LA	No Data	Produce; For sale/distribution
FORMOSA PLASTICS CORP.	BATON ROUGE, LA	1,000,000-9,999,999	Produce; For on-site use/processing; For sale/distribution; As a by-product; As a reactant
RHONE POULENC BASIC CHEMICALS	BATON ROUGE, LA	10,000-99,999	Ancillary uses
DOW CHEMICAL CO.	PLAQUEMINE, LA	No Data	Produce; For sale/distribution; As a reactant; As a manufacturing aid; Ancillary uses

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

Facility	Location[a]	Range of maximum amounts on site in pounds	Activities and uses
~~BF GOODRICH CO.~~	~~PLAQUEMINE, LA~~	~~100,000-999,999~~	~~As a reactant~~
GEORGIA GULF CORP.	PLAQUEMINE, LA	No Data	Produce; For on-site use/processing; For sale/distribution; As a reactant
UNION CARBIDE CORP.	HAHNVILLE, LA	No Data	As a by-product
MARINE SHALE PROCESSORS INC.	AMELIA, LA	1,000-9,999	As a reactant
OCCIDENTAL CHEMICAL CORP.	ADDIS, LA	100,000-999,999	As a reactant
DOW CHEMICAL USA	MIDLAND, MI	100,000-999,999	As a reactant; Ancillary uses
MILES INC.	KANSAS CITY, MO	100,000-999,999	As a reactant
VISTA CHEMICAL CO.	ABERDEEN, MS	No Data	As a reactant
OCCIDENTAL CHEMICAL CORP.	BURLINGTON, NJ	1,000,000-9,999,999	As a reactant
~~BF GOODRICH CO.~~	~~GEORGETOWN, NJ~~	~~1,000,000-9,999,999~~	~~As a reactant~~
GOODYEAR TIRE & RUBBER CO.	NIAGARA FALLS, NY	100,000-999,999	As a reactant
VYGEN CORP.	ASHTABULA, OH	100,000-999,999	As a reactant
~~BF GOODRICH CHEMICAL CO. INC~~	~~AVON LAKE, OH~~	~~1,000,000-9,999,999~~	~~As a reactant~~
VISTA CHEMICAL CO.	OKLAHOMA CITY, OK	1,000,000-9,999,999	As a reactant
OCCIDENTAL CHEMICAL CORP.	POTTSTOWN, PA	1,000,000-9,999,999	As a reactant
GREENWOOD PLATING	GREENWOOD, SC	1,000,000-9,999,999	As a product component
DOW CHEMICAL CO.	FREEPORT, TX	No Data	Produce; As a by-product; As an impurity; As a reactant; As a chemical processing aid
SHINTECH INC.	FREEPORT, TX	No Data	Import; For on-site use/processing; As a reactant
FORMOSA PLASTICS CORP.	POINT COMFORT, TX	No Data	Produce; For on-site use/processing; As a by-product; As a reactant
UNION CARBIDE CHEMICALS &	GARLAND, TX	100,000-999,999	As a reactant
UNION CARBIDE CHEMICALS	TEXAS CITY, TX	1,000,000-9,999,999	As a reactant
OCCIDENTAL CHEMICAL CORP.	LA PORTE, TX	1,000,000-9,999,999	Ancillary uses
RHONE-POULENC BASIC CHEMICALS	HOUSTON, TX	10,000-99,999	Ancillary uses

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

Facility	Location*	Range of maximum amounts on site in pounds	Activities and uses
OCCIDENTAL CHEMICAL CORP.	PASADENA, TX	No Data	As a reactant
~~BF GOODRICH CO.~~	~~DEER PARK, TX~~	~~1,000,000-9,999,999~~	~~As a reactant~~
OCCIDENTAL CHEMICAL CORP.	DEER PARK, TX	No Data	Produce; For sale/distribution
GEON CO.	LA PORTE, TX	No Data	Produce; For sale/distribution
OCCIDENTAL CHEMICAL CORP.	GREGORY, TX	No Data	Produce; For sale/distribution
BONDCOTE CORP.	PULASKI, VA	100,000-999,999	As a formulation component

Source: TRI92 1994

* Post office state abbreviation used

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(550–550°C). This causes the 1,2-dichloroethane to undergo pyrolysis, or thermal cracking, which forms the vinyl chloride monomer and hydrogen chloride. The vinyl chloride monomer is then isolated (Cowfer and Magistro 1985). The technical grade product is available in 99.9% purity (HSDB 1994). Efforts are being made to minimize by-product formation in 1,2-dichloroethane pyrolysis (Cowfer and Magistro 1985).

4.2 IMPORT/EXPORT

Imports of vinyl chloride totaled 119 million pounds in 1992 and 164 million pounds in 1991 (CPS 1993). Imports have been steadily declining from a high of 302 million pounds in 1989, prior to which they had been increasing (CPS 1993). Exports of vinyl chloride were 1.63 billion pounds in 1992, down from the all time high of 1.78 billion pounds in 1991. Over the past 20 years, exports of vinyl chloride have fluctuated fairly widely, but have been generally increasing an average of about 17% per year since 1975.

4.3 USE

Vinyl chloride is an important industrial chemical because of its wide variety of end-use products and the low cost of producing polymers from it. Furthermore, polyvinyl chloride (PVC) is one of the most efficient construction materials available when analyzed on an energy-equivalent basis (Cowfer and Magistro 1985). Major end-use products include PVC products, such as automotive parts and accessories, furniture, packaging materials, pipes, wall coverings, and wire coatings, as well as vinyl chloride-vinyl acetate copolymer products, such as films and resins (Cowfer and Magistro 1985; Eveleth et al. 1990). End-use data for 1992 indicate that 98% of vinyl chloride monomer production is for making polyvinyl chloride and various polyvinyl chloride copolymers; the other 2% is for miscellaneous uses (CPS 1993).

Vinyl chloride has been used in the past as a refrigerant, as an extraction solvent for heat-sensitive materials, and in the production of chloroacetaldehyde and methyl chloroform (IARC 1979). In the United States, limited quantities of vinyl chloride were used as an aerosol propellant and as an ingredient of drug and cosmetic products; however, these practices were banned by the EPA in 1974 (IARC 1979; HSDB 1994).

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4.4 DISPOSAL

Since vinyl chloride has been identified by EPA as a hazardous material, its disposal is regulated under the Federal Resource Conservation and Recovery Act (RCRA) (EPA 1993d). The transportation of hazardous materials for disposal is regulated by the Department of Transportation in compliance with this act (DOT 1993). The recommended method of disposal is total destruction by incineration. The temperature of the incinerator must be sufficient to ensure the complete combustion of the vinyl chloride in order to prevent the formation of phosgene. The recommended temperature range for incineration is 450–1,600°C, with residence times of seconds for gases and liquids, and hours for solids (HSDB 1994). If in solution, the vinyl chloride product may need to be adsorbed onto a combustible material prior to incineration. Recommended materials include vermiculite, sawdust, or a sand-soda ash mixture (90/10) covered with wood and paper (OHM/TADS 1985). The vinyl chloride can also be dissolved in a flammable solvent prior to incineration. An acid scrubber should be used in conjunction with the incinerator in order to remove any hydrogen chloride that is produced by the combustion process (HSDB 1994; OHM/TADS 1985). Alternatively, chemical destruction may be used, especially with small quantities. One-to-two days is generally sufficient for complete destruction (HSDB 1994).

Aqueous by-product solutions from the production of vinyl chloride are usually steam-stripped to remove volatile organic compounds, neutralized, and then treated in an activated sludge system to remove nonvolatile organic compounds remaining in the waste water (Cowfer and Magistro 1983).

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