4. PRODUCTION, IMPORT, USE, AND DISPOSAL

4.1 PRODUCTION

In 1985, 1,3-butadiene was the 36th highest-volume chemical produced in the United States (Sax and Lewis 1987). Domestic production of rubber-grade 1,3-butadiene in 1988 was approximately 3.2 billion pounds. Rubber grade monomer typically makes up 37% of the 1.8 billion pounds of the so-called 1,3-butadiene and butylene mixture produced in 1988 (Kirshenbaum 1978; USITC 1989). Similar data for 1987 were 2.9 and 1.2 billion pounds, respectively (USITC 1988). Total U.S. capacity for this compound stands at about 3.8 billion pounds (SRI 1991), although production capacity is highly dependent on the type of feedstock used (Chemical Marketing Reporter 1980). 1,3-Butadiene is currently produced by 11 manufacturers in Texas and Louisiana. These data are included in Table 4-1. 1,3-Butadiene is available as a liquified gas, with a stabilizer added for shipment (Kirshenbaum 1978).

According to the Toxic Chemical Release Inventory (TRI 1989), 146 facilities manufactured or processed 1,3-butadiene in 1987. Of these, 142 facilities reported the maximum amount of 1,3-butadiene that they would have on site. A summary of these data is presented in Table 4-2. The quality of the TRI data must be viewed with caution because the 1987 data represent first-time reporting by these facilities. Only certain types of facilities were required to report. This is not an exhaustive list.

Examination of the key chemical profiles on 1,3-butadiene (Chemical and Engineering News 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1985, 1986) reveals that, during this time period, production volume, capacity, and prices have fluctuated in response to market pressures, which are outside of domestic use patterns. Descriptions such as "the odd world of 1,3-butadiene" (Chemical and Engineering News 1982), and "the maverick of the petrochemical business" (Chemical and Engineering News 1983) attest to the unpredictability of the 1,3-butadiene market. Recent estimates put the growth of domestic production at 0%-l% annually through 1992 (Chemical Marketing Reporter 1988).

Except for a small amount of 1,3-butadiene produced by the oxydehydrogenation of n-butene, all the 1,3-butadiene produced in the United States is a co-product of ethylene manufacture, due in part to an increased demand for ethylene (Chemical and Engineering News 1985; Chemical Marketing Reporter 1988; IARC 1986; SRI 1991). In this process, feed streams ranging from light hydrocarbons to heavy gas oils (hydrocarbon fractions boiling in the approximate range of 315-480°C) are cracked in the presence of steam at 700-900°C (Chemical and Engineering News 1986; Kirshenbaum 1978). The fraction of 1,3-butadiene produced by this process varies widely with the type of feedstock used and is lowest with low-boiling input streams (IARC 1986; Kirshenbaum 1978).

The oxidative dehydrogenation of n-butene, used in the production of 1,3-butadiene, is a highly selective, irreversible process that involves

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TABLE 4-1. Current U.S. Producers of 1,3-Butadiene[a]

Company	Location
Amoco Corp.	Alvin, TX
Lyondell Petrochemicals	Channelview, TX
Exxon Corp.	Baton Rouge, LA
Exxon Corp.	Baytown, TX
Mobil Corp.	Beaumont, TX
Occidental Petroleum Corp.	Chocolate Bayou, TX
Occidental Petroleum Corp.	Corpus Christi, TX
Shell Oil Co.	Deer Park, TX
Shell Oil Co.	Norco, LA
Texaco, Inc.	Port Neches, TX
Texas Olefins Co.	Houston, TX

[a]Derived from SRI 1991; USITC 1989

TABLE 4-2. Facilities That Manufacture or Process 1,3-Butadiene[a]

State[b]	Number of facil-ities	Range of maximum amounts on site in thousands of pounds[c]	Activities and uses[d]
AL	1	100-999	7
AR	1	1-9	1, 3
CA	12	0-9,999	1, 3, 4, 5, 6, 7, 8, 9
CO	2	1-99	3, 6, 7
CT	1	1,000-9,999	7
DE	2	100-999	1, 6, 7
GA	3	100-9,999	7
HI	1	10-99	1, 3, 6, 7
IA	2	100-9,999	1, 3, 7
IL	7	1-9,999	1, 3, 5, 6, 7
IN	3	0.1-99	1, 3, 4, 6, 7, 8
KS	3	0.1-99	1, 3, 5, 6, 7
KY	6	10-9,999	1, 4, 5, 6, 7
LA	16	1-49,999	1, 2, 3, 4, 5, 6, 7, 13
MI	1	100-999	7
MN	1	1,000-9,999	1, 6
MO	1	100-999	7
MS	2	1-999	3, 5, 7
MT	2	0.1-9	1, 3, 6, 7
NC	2	0-999	7, 8
NE	1	0-0.09	3, 9, 12
NJ	2	0-9	1, 3, 5, 6, 7
NY	3	1-99	2, 4, 6, 7
OH	15	0-9,999	1, 3, 5, 6, 7, 8, 9
OK	3 (1)[e]	100-999	1, 3, 6, 7, 13
PA	4 (1)[e]	0.1-99	1, 3, 6, 7, 9
SC	1	10-99	7
TN	3	0-9,999	5, 6, 7
TX	49 (1)[e]	0-99,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13

TABLE 4-2 (Continued)

State[b]	Number of facil-ities	Range of maximum amounts on site in thousands of pounds[c]	Activities and uses[d]
VA	1	0.1-0.9	1, 4
WA	2	10-99	1, 5, 6
WV	2	100-9,999	7, 9

[a]TRI 1989
[b]Post office state abbreviations
[c]Data in TRI are maximum amounts on site at each facility.
[d]Activities/Uses:

1. synthesis
2. import
3. for on-site use/processing
4. for sale/distribution
5. as a byproduct
6. as an impurity
7. as a reactant
8. as a formulation component
9. as an article component
10. for repackaging only
11. as a chemical processing aid
12. as a manufacturing aid
13. ancillary or other use

[e]Number in parentheses indicates facilities reporting "no data" regarding maximum amount of the substance on site.

heating the starting material, air, and a suitable catalyst together at 400-450°C (IARC 1986; Kirshenbaum 1978). The hydrogen released in the dehydrogenation step combines with oxygen, producing large amounts of heat, which makes this process energy-efficient. Other products of this process include isobutylene, 1-butene, 2-butene, and n-butane.

Purification of the crude C^4 stream resulting from these processes cannot be achieved by a simple distillation due to the close boiling point of the various products (Kirshenbaum 1978). 1,3-Butadiene can be removed from the hydrocarbon stream by selective extraction with various solvents. These solvents include aqueous cupric ammonium acetate, acetonitrile, furfural, dimethylformamide, N,N-dimethylacetamide, N-methylpyrrolidinone and •-methoxypropionitrile (IARC 1986; Kirshenbaum 1978).

4.2 IMPORT/EXPORT

Large amounts of 1,3-butadiene are imported into the United States. The amount of 1,3-butadiene imported in 1987 represented 27% of the domestic production, a rise of 82% over the previous year (Chemical Marketing Reporter 1988). In 1986, approximately 500 million pounds were imported after a high of 900 million pounds in 1983 (Chemical and Engineering News 1983, 1986). As with production volumes, no clear import trends can be deduced. Export volumes of 1,3-butadiene from the United States are low, about 125 million pounds in 1986 (Chemical and Engineering News 1986), or about 4% of domestic production in 1987 (Chemical Marketing Reporter 1988). Exports may decrease with the expected increase in production of light hydrocarbons from petroleum sources in the North Sea, the Middle East and northern Africa.

4.3 USE

1,3-Butadiene is used as a monomer in the production of rubber and plastics, with approximately 75% going into the production of synthetic rubbers (Chemical and Engineering News 1986). 1,3-Butadiene uses can be broken down into the following categories: styrene butadiene rubber (SBR), 35%; polybutadiene, 22%; adiponitrile/hexamethylene diamine (HMDA), 12%; styrene-butadiene latex, 10%; neoprene rubber, 6%; ABS resins, 6%; exports, 4%; nitrile rubber, 3%; and other, 2% (Chemical Marketing Reporter 1988). It is also used extensively in copolymers including acrylics (Miller 1978).

4.4 DISPOSAL

1,3-Butadiene may be disposed of by incineration in a suitable combustion chamber or in a safe area. Gaseous 1,3-butadiene can be burned directly in most states; however, liquified 1,3-butadiene (in a compressed cylinder) must be converted to the gaseous state before burning (HSDB 1989).