

# BROMINE

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International distribution of bromine production in 1995 was as follows: The United States, 51%; Israel, 31%; the United Kingdom, 6%; and other countries, 12%. The U.S. portion of world production has decreased steadily since 1973, when the United States produced 71% of the world supply. The decrease in a world share has been a result of environmental constraints and the emergence of Israel as the world's second largest producer. Domestic capacity decreased 14% during the same period. The quantity of bromine sold or used in the United States was 218 million kilograms (kg) valued at \$186 million. The value of bromine sold or used was \$0.85 per kilogram. Primary uses of bromine compounds were in flame retardants (47%), agriculture (18%), water treatment and sanitizing (6%), petroleum additives (6%), well drilling fluids (5%), and other (18%).<sup>1</sup> (See table 1.)

## Legislation and Government Programs

The Environmental Protection Agency (EPA) planned work to establish criteria for determining the essential uses of methyl bromide. A spokesperson for the Methyl Bromide Working Group stated that the availabilities of methyl bromide alternatives are neither widely used nor effective. Scientists now agree that methyl bromide is not as harmful to the ozone layer as first suspected. The results of industry-commissioned research on methyl bromide ozone depletion potential were expected by early 1996. U.S. producers of methyl bromide are Great Lakes Chemical Corp. and Albemarle Corp. Production in 1990 was valued at about \$64 million. Methyl bromide was listed as a Class I ozone depleting substance in the 1990 Clean Air Act, and the chemical is scheduled to be phased out in the United States on January 1, 2001. World participants at a December 1995 meeting of the Montreal Protocol agreed to a world phaseout of methyl bromide by 2010. Developing nations will have consumption frozen in 2002 at the average level used between 1995-98. Third world countries will continue using methyl bromide with the approval of the Montreal Protocol or by not signing the Protocol. U.S. producers believe that the EPA ban would shift production to countries that permit methyl bromide use through the Montreal Protocol agreement.<sup>2</sup>

Methyl bromide is a manufactured chemical. It also occurs naturally in small amounts in the ocean where it is formed. Other names for methyl bromide include bromo methane, mono-bromomethane, and methyl fume. Methyl bromide is primarily used as a soil fumigant but the insecticide is also used to fumigate stored produce and grain, as well as commodities grown in areas that are quarantined because of outbreaks of pests. Methyl bromide is used to kill a variety of pests

including rats, insects, and fungi. It is also used to make other chemicals or as a solvent to get oil out of nuts, seed, and wool. EPA determined that methyl bromide is not classifiable as to its human carcinogenicity.<sup>3</sup>

## Production

Domestic production data for bromine were developed by the U.S. Geological Survey from a voluntary survey of U.S. operations. Of the operations to which a survey request was sent, six responded representing 100% of total elemental bromine sold or used. (See table 2.)

Albemarle, formerly Ethyl Corp.'s Chemical Division, and Great Lakes produced and marketed more than 60 different bromine-based chemicals from plants in Arkansas. Small amounts of unpurified bromine were produced in Michigan as a byproduct in the extraction of magnesium from brine and reprocessed from consumption in Arkansas. The Arkansas plants accounted for 96% of U.S. elemental bromine capacity at yearend 1995 and 100% of bromine sold or used.

Albemarle entered the second phase of a three-part program to increase brine field and bromine capacities at its facility in Magnolia, AR. The first phase involved additional brine field reserves and the second phase, additional brine field capacity and bromine recovery was completed in 1995. The third phase focused on bromine capacity and bromine recovery was also completed in 1995. The overall result of the program was planned to be a bromine production capacity increase of 30%.<sup>4</sup>

Albemarle granted a field services contract to Jacobs Engineering Group Inc., Pasadena, CA, for its bromine plants in Magnolia, AR. Jacobs was to provide necessary equipment and construction at the West and South plants.<sup>5</sup> Albemarle announced capacity increase by 20% for a brominated flame retardant used in textiles, coatings, and adhesives.<sup>6</sup>

Great Lakes announced an expansion of a reactive flame retardant capacity for unsaturated polyester resins to be completed by the third quarter 1996.<sup>7</sup> Great Lakes announced plans to form a fine chemicals business that went into effect January 1, 1995.<sup>8</sup>

Ambar Inc. planned to have on-stream in early 1997 a 14-million-kilogram (30 million pound) elemental bromine facility in Manistee, MI, that will produce elemental bromine and brominated salts. Ambar would be supplied by pipeline with brines from production of magnesium hydroxide from Martin Marietta Magnesia Specialties Inc. Ambar planned to manufacture and consume brominated well drilling fluids. Meridian Technologies Inc. was to market additional consumer products produced.<sup>9</sup>

According to SRI Consulting of Menlo Park, CA, three companies account for approximately 75% of methyl bromide production as follows: Great Lakes and Albemarle, United States; and Dead Sea Bromine Ltd. (DSB), Israel, which is marketed by Ameribrom Inc. in the United States. Elf Atochem S.A., France, is the dominant producer in Western Europe. Five Japanese producers account for 10% of the world market share.<sup>10</sup>

## Consumption

A study by Business Communications Co., Norwalk, CT, estimated the total U.S. market for flame retardants at 273 million kilograms (601 million pounds) in 1994 with an average annual growth rate of 4%, reaching 338 million kilograms (746 million pounds) in 1999. Bromine-based flame retardants were estimated to have a 46-million-kilogram (102 million pounds) market in 1994 and projected to have a 7% average annual growth rate. Demand for bromine-based flame retardants is expected to reach 64 million kilograms (142 million pounds) by 1999.<sup>11</sup>

## Foreign Trade

The General Agreement on Tariffs and Trade (GATT) was signed into law in December 1994 and took effect January 1, 1995. GATT lowered chemical tariffs by an average of 30%. Chemicals, including bromine, are the nation's largest export commodity, as more than 10 cents out of every export dollar is a product of the chemical industry. The agreement's intellectual property provisions include greater patent protection for products developed by American firms. GATT changes patent enforcement from 17 years from the date of issue to 20 years from the date of application. Patents issued on applications filed before June 8, 1995, will be enforceable for either 17 years from the issue date or 20 years from the filing date, whichever is longer. (See tables 3 and 4.)

## World Review

**China.**—Joint ventures were sought in several bromine compounds plants in the Shouguang Province by Weifang Salt & Chemical Industry Group General Corp. The State-owned enterprise is the largest base for the production of salt and salt chemicals in China. Projects are to include technology and equipment. (See table 6.)

**Europe.**—The Paris-based Organization for Economic Co-Operation and Development (OECD) and the producers of brominated flame retardants have reached an agreement. Producers, which include Albemarle, Great Lakes and Dead Sea Bromine (DSB), used the Chemical Manufacturers Association and the European Chemical Industry Council to negotiate the agreement. The agreement calls for no further production, export, or import of certain brominated compounds in Europe, except in the case of Elf Atochem, which is the only producer of a compound left. The producers also agreed not to produce

certain other noncommercial brominated compounds, exempting much of what is in production. And lastly, the agreement call for the improved purity of another compound and reducing production emissions. The agreement was part of an OECD pilot program that seeks voluntary risk reduction of substances to avoid restrictive legislation in European countries.<sup>12</sup>

**France.**—France's sole producer of potash at Mines de Potasse d'Alsac, part of State-owned chemicals group Entreprise Miniere et Chimique, operated two underground mines near Mulhouse in eastern France that produced by product bromine. Mines de Potasse d'Alsace will phase out all the Government operation by 2004. Marketing is through the trading subsidiary Société Commerciale de Potasse et d'Azote.<sup>13</sup>

**Germany.**—Kali und Salz GmbH is owned 51% by Kali und Salz Beteiligungs AG and 49% by Beteiligungs-Management Gesellschaft Berlin mbH, a 100% State-owned company. At the end of the restructuring program, the German potash industry will be fully integrated into the production of potash and salt. The production of bromine ceased at yearend 1995.

**Israel.**—Bromine has been produced as a byproduct from waste bitterns associated with potash production from the Dead Sea since 1957 by DSW. After potash is removed in solar ponds, the waste bitterns are processed with chlorine to recover bromine. The bromine-free bitterns are then processed to recover magnesium.

The Government began efforts in 1985 to sell a share of Israeli Chemical Co. Ltd. (ICL) to offset an investment program. ICL planned to split DSB from DSW and retain an 89% share in DSB. Much of the organic and inorganic chemical activity takes place within the framework of the massive ICL, which in 1986 was composed of 28 companies with a work force of 7,000. Formal bids for shares were accepted in 1990, but a number of Government representatives favored a public sale rather than sale to a foreign investor. In 1991, privatization terms for ICL were approved, and ultimately 25% of ICL was sold by 1993. On October 11, 1994, the Israeli government published a tender for the sale of 25% of ICL to a single investor or group of investors. Israel Corp. (IC), Tel Aviv, bought a 24.9% share of the ICL during 1995. IC will pay \$230 million for the ICL stake. The family of Israeli business executive Shoul Eisenberg controls 50% of IC and 50% is owned by an offshore corporation Eisenberg also controls. The Government will continue to hold a 27.1% share in ICL after completion of the international offering. On May 18, the Israeli Government canceled the planned global public offering of a 22% stake in IC. The decision was reported as a result of foreign investors valuing the company at less than the Government's minimum price.<sup>14</sup>

DSB has two production plants at Sdom and Ramat. A 50-50 joint venture between Great Lakes and DSB planned to come on-stream during 1996 to manufacture a flame retardant used primarily in epoxy circuit board production and other resin applications. The \$22 million flame retardant plant at Ramat planned to reach capacity by 1998. Each partner of the joint venture, called Tetrabrom Technologies Ltd., will market the product separately.<sup>15</sup> Tetrabrom could eventually represent 25%

of world flame retardants capacity.<sup>16</sup>

DSB announced plans in 1994 to construct a \$11.4 million bromine plant at Sdom. The plant was due on-stream in 1995 and was projected to increase capacity from 140,000 tons to 180,000 tons per year.

Dead Sea Bromine Group and Jordan's Arab Potash Corp. signed a memorandum of understanding to construct a \$50 million bromine plant on the Jordanian side of the Dead Sea. The 50-50 joint venture would be managed by the Jordanians and built with technical assistance by DSB. The \$50 million facility would have a total capacity of 25,000 metric tons per year of bromine and bromine derivatives. The plant was expected to be operational by 1998.<sup>17</sup> ICL stated that the lower wages in Jordan will make it difficult to match prices for Jordanian bromine. About 90% DSB's production is exported.<sup>18</sup> DSB signed a long-term agreement with Albemarle to provide a reported 20,000 tons per year of bromine for 20 years.<sup>19</sup>

**Japan.**—At yearend 1994, Japan agreed to drop import tariffs on five brominated compounds. The tariffs on the compounds would decrease from 4.6% to zero by April 1995.

**Jordan.**—Arab Potash Co. Ltd. and Albemarle were negotiating to form a joint-venture company to produce bromine from potash waste brines; ownership of the company was expected to be distributed 51% and 49%, respectively. The new company is called the Jordan Industrial Chemicals of the Dead Sea Minerals Co. The decision to form the company follows a memorandum of understanding with Albemarle for construction of a 50,000-ton-per-year plant. The investment in the plant would be \$145 million, and the plants are to be operational by 1997.<sup>20</sup>

Keir International, United Kingdom, has won a \$13.8 million contract to build a brine water intake system at the Dead Sea for Arab Potash Co. The project will include the construction of a 200-meter jetty supporting twin 2-meter diameter pipes for extracting brine to convert to potash.<sup>21</sup>

**Russia.**—A large deposit of bischofite with large concentrations of bromine was discovered in the 1960's while exploring for oil in the territory of Lower Povolzhie, Volgograd, region in middle Permian Age strata. Kausitc A/O is seeking joint-venture investors to expand the production.<sup>22</sup>

## Current Research and Technology

Methyl bromide, scheduled to be phased out in 2001, may have an alternative in methyl iodide. The results of 15 laboratory and field tests found that methyl iodide controls weeds, bacteria, worms, and insects at least as well as methyl bromide. Methyl iodide poses little threat to the earth's stratospheric atmosphere. Health and safety studies may take up to 5 years to complete at a cost up to \$60 million.<sup>23</sup>

The 1995 Nobel Prize in Chemistry was awarded to three individuals for their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone. The depletion of ozone over the Antarctic was attributed to ozone reacting chemically with chlorine and bromine from industrially

manufactured gases.<sup>24</sup>

Treatment of female urinary incontinence is a condition with severe economic and psychosocial impact. The condition is prevalent among adult women mostly in the form of stress incontinence. In Norway only emepronium bromide remains as a registered drug for the treatment of urge incontinence.<sup>25</sup>

Epilepsy is found in all breeds and mixed breeds of dogs. One study reported that 10 dogs that had uncontrolled seizures with phenobarbital alone had improved control with the addition of potassium bromide to their drug regime. Other studies reported that 5 of 9 epileptics uncontrolled by phenobarbital responded to the addition of potassium bromide to either phenobarbital or primidone. A third study reported that bromide therapy improved seizure control in 83% of dogs previously unimproved by phenobarbital.<sup>26</sup>

Methyl bromide is rapidly consumed by bacteria in soil, indicating that the agricultural fumigant may be less of a threat to the stratospheric ozone layer than was previously thought. The aerobic soil bacteria destroy the ozone-depleting chemical, noting that uptake stops if the soil is sterilized or treated with antibiotics.<sup>27</sup>

A new synthesis of a protein complex found to have antibiotic and anticancer properties was synthesized to yield 92% recovery of product. The process using a coupling reaction consists of two bromine atoms.<sup>28</sup>

## Outlook

**Petroleum.**—Demand for bromine as a gasoline additive has declined each year since the EPA issued regulations in the 1970's to reduce the lead in gasoline. Bromine in the form of ethylene dibromide or EDB is used as a "scavenger" for the lead to keep the lead from depositing in the engine. In 1979, the amount of bromine sold reached a peak of 225 million kilograms. The rapid decline to 141 million kilograms in 1986 was a direct result of the limits on lead in leaded gasoline. The European Community continued discussions to reduce lead levels in gasoline. The long-term outlook for bromine in petroleum additives continued to decline as federal laws enacted to encourage alternative forms of power in automotive engines are likely to have a depressive effect on increases in petroleum demand. The Clean Air Act Amendments of 1990 has an amendment that will require mobile sources, such as cars and trucks to use the most effective technology possible to control emission. Electric cars that do not require bromine gasoline additives are already on the market in California. The California Air Resources Board found that the technology for a commercially acceptable zero emission vehicle is not available. State quotas for 2% electric vehicles in 1998 and 5% in 2001 were dropped. The quota of 10% for 2003 was retained.

**Sanitary Preparations.**—Bromine has found usage in indoor swimming pools, hot tubs, and whirlpools. The sanitary preparation field is an area where bromine has been found to be safer than its substitutes because bromine has a higher biocidal activity level for the same amount of product. Applications in the pulp and paper industry and in cooling towers and

Government-regulated food-washing applications are growth areas. The use of bromine will continue to grow in this area, closely following the gross national product in real growth.

**Fire Retardants.**—Federal regulations covering flammability of private and public building materials and furnishings have required greater amounts of fire retardant chemicals to be used in these materials and furnishings. Fire retardants are expected to grow as organic materials replace metals in transportation, infrastructure, and packaging. Several state governments continue to support strong consumer laws that protect State residents from products with potential fire hazards produced in other States. The bromine based flame retardant market is growing at 8% to 10% per year. The demand is for home electronics, such as larger televisions and personal computer monitors, that require bigger and heavier housings is expected to continue. The growth is expected to continue for the next 5 years. More plastic and less metal are being utilized.

**Other Uses.**—Usage of calcium bromide and zinc bromide in well-drilling fluids decreased during the 1980's as the domestic petroleum industry suffered a severe recession. During 1995, Oil & Gas Journal listed the Baker Hughes Rig Count and the Smith Rig count. Both cited the number of work over rigs in the field in the United States was less for 1995 compared with that of 1994. Oil field chemicals used in drilling, completion and work over, and production operations have remained significantly more profitable internationally than in U.S. operations. The competition market included corrosion inhibitors, bactericides, viscosities and defoamers, as well as commodities such as calcium chloride and calcium bromide brines used to maintain well productivity. Because of the significant benefits of bromine compounds in the well-drilling fluids area, usage is expected to grow at the rate of 2% per year.

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<sup>1</sup>Breskin, I. Bromine Makers Cheer as Derivatives Business Warms. Chem. Week, v. 155, No. 21, 1994, pp. 40-41.

<sup>2</sup>Chemical Marketing Reporter. EPA to Work with Users on Methyl Bromide Cuts. V. 248, No. 6, 1995, p. 23.

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———. Methyl Bromide. V. 249, No. 1, 1995, pp. 4, 17.

<sup>3</sup><http://atsdrl.atsdr.dcd.gov:8080/tfacts27.html>.

<sup>4</sup>Chemical Marketing Reporter, Albemarle Project on Target. V. 248, No. 6, 1995, p. 4.

<sup>5</sup>———. Business Briefs: Jacobs Receives Contract. V. 247, No. 8, 1995, p. 41.

<sup>6</sup>———. Albemarle to Boost Flame Retardant Unit. V. 247, No. 10, 1995, p. 4.

<sup>7</sup>———. Great Lakes Expands in Flame Retardants. V. 249, No. 1, 1996, p. 4.

<sup>8</sup>———. Closing Market Developments: Great Lakes Sets Up Fine Chemicals Unit. V. 246, No. 26, 1994, p. 4.

<sup>9</sup>———. U.S. Bromine Market Poised for Ambar's Entry in 1996. V. 248, No. 1, 1995, pp. 5, 19.

<sup>10</sup>Reference cited in footnote 4.

<sup>11</sup>Chemical Marketing Reporter. Flame Retardant Industry Spurs Growth, Study Says. V. 248, No. 18, 1995, p. 13.

<sup>12</sup>Industrial Minerals. Anti-Br Flame Retardants Issue Smoulders On. No. 336, 1995, p. 17.

<sup>13</sup>Leblond, D. EMC Looks to Trade after MDPA Closure. Euro. Chem. News, v. 61, 1994, p. 23.

<sup>14</sup>Phosphorus & Potassium. News in Brief. No. 198, 1995, p. 15.

<sup>15</sup>Chemical Marketing Reporter. Closing Market Developments Great Lakes Starts Up Joint Venture TBBA Unit. V. 249, No. 16, 1996, p. 4.

<sup>16</sup>———. Financial Newsfront: Kemper Analyst Sees Great Lakes as Long-Term Buy. V. 248, No. 2, 1995, p. 26.

<sup>17</sup>———. Israel and Jordan Plan Bromine Plant. V. 248, No. 16, 1995, p. 5.

<sup>18</sup>Chemical Week. Newsletter: New Bromine Unit Will Hit ICL. V. 156, No. 4, 1995, p. 43.

<sup>19</sup>Reference cited in footnote 20.

<sup>20</sup>Green Markets. Jordan Forms Large Holding Company. V. 18, No. 8, 1994, p. 8.

<sup>21</sup>Phosphorus & Potassium, Jordan: Keir Wins APC's Brine Water Intake Contract. No. 201, 1995, p. 13.

<sup>22</sup>U.S. Embassy. Moscow, Russia. Bromine and Metallic Magnesium. State Dept. Telegram 024915. Aug. 30, 1994, 1 p.

<sup>23</sup>Chemical Marketing Reporter. Methyl Iodide Maybe Replacement for Bromide. V. 249, No. 16, 1996, p. 5.

<sup>24</sup><http://www.nobel.se/announcement/95-chemistry.html>.

<sup>25</sup><http://www.uib.no/isf/people/inkter.htm#other>.

<sup>26</sup><http://www.zmail.com/pet talk/dog-faqs/epilepsy.html>.

<sup>27</sup>Chemical & Engineering News. Science/Technology Concentrates. V. 73, No. 44, 1995, p. 14.

<sup>28</sup>Borman, S. Higher Yield Synthetic Route to Cyclic Eneidyne Developed. Chem. & Eng. News, v. 73, No. 35, 1995, pp. 28-29.

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Bromine. Ch. in Mineral Commodity Summaries, annual.

Bromine. Ch. in Mineral Facts and Problems, 1985.

TABLE 1  
SALIENT BROMINE AND BROMINE COMPOUND STATISTICS 1/

(Thousand kilograms unless otherwise specified)

	1991	1992	1993	1994	1995
<b>United States:</b>					
Bromine sold or used: 2/					
Quantity	170,000	171,000	177,000	195,000	218,000
Value thousands	\$124,000	\$125,000	\$123,000	\$155,000	\$186,000
<b>Exports:</b>					
Elemental bromine:					
Quantity	2,560	5,320	6,010	6,470	3,220
Value thousands	\$7,670	\$5,540	\$7,440	\$7,270	\$3,790
Bromine compounds: 3/					
Gross weight	17,100	20,000	15,800	13,700	13,300
Contained bromine	14,600	16,900	13,400	11,500	11,200
Value thousands	\$21,300	\$26,400	\$21,800	\$21,100	\$19,900
<b>Imports: 4/</b>					
Elemental bromine:					
Quantity	142	851	850	319	2,220
Value thousands	\$91	\$522	\$513	\$194	\$1,460
<b>Compounds:</b>					
Ammonium bromide:					
Gross weight	2,060	1,790	1,240	1,120	288 5/
Contained bromine	1,680	1,460	1,010	917	235 5/
Value thousands	\$3,130	\$2,870	\$2,020	\$1,850	\$832 e/ 5/
Calcium bromide:					
Gross weight	14,600	5,370	9,650	14,700 r/	730 5/
Contained bromine	11,700	4,290	7,720	11,700 r/	584 5/
Value thousands	\$7,130	\$3,210	\$3,740	\$5,380	\$262 e/ 5/
Potassium bromate:					
Gross weight	386	407	280	166	275
Contained bromine	185	195	134	79	132
Value thousands	\$1,240	\$1,250	\$892	\$538	\$933
Potassium bromide:					
Gross weight	888	883	1,180	1,280	171 5/
Contained bromine	595	592	790	858	\$115 5/
Value thousands	\$1,590	\$1,660	\$2,170	\$2,270	\$420 e/ 5/
Sodium bromate:					
Gross weight	229	176	290	276	944
Contained bromine	121	93	153	146	733
Value thousands	\$391	\$469	\$725	\$714	\$2,360
Sodium bromide:					
Gross weight	3,040	1,100	1,270	1,400	11,400 5/
Contained bromine	2,360	852	983	1,090	1,070 5/
Value thousands	\$3,880	\$1,620	\$1,730	\$1,770	\$21,100 e/ 5/
<b>Other:</b>					
Gross weight	11,600	11,700	12,500	14,300	8,270
Contained bromine	7,100	7,160	7,600	8,680	6,290
Value thousands	\$24,600	\$21,500	\$36,500	\$42,600	NA
World: Production: e/	392,000	397,000 r/	396,000 r/	412,000	432,000

e/ Estimated. r/ Revised. NA Not available.

1/ Data are rounded to three significant digits.

2/ Elemental bromine sold as such to nonproducers, including exports, or used in the preparation of bromine compounds by primary U.S. producers.

3/ Bureau of the Census. Includes methyl bromine and ethylene dibromide.

4/ Bureau of the Census.

5/ The Journal of Commerce Port Import/Export Reporting Service.

TABLE 2  
BROMINE-PRODUCING PLANTS IN THE UNITED STATES IN 1995

State and company	County	Plant	Production source	Elemental bromine plant capacity 1/ (million kilograms)
Arkansas:				
Arkansas Chemicals Inc.	Union	El Dorado	Well brines	23
Ethyl Corp.	Columbia	Magnolia	do.	45
Do.	do.	do.	do.	73
Great Lakes Chemical Corp.	Union	El Dorado	do.	48
Do.	do.	Marysville	do.	36
Do.	do.	El Dorado	do.	23
Michigan:				
The Dow Chemical Co.	Mason	Ludington	do.	11 2/
Total				259

1/ Actual production capacity is limited by brine availability.  
2/ Bromine produced at this plant is reprocessed in Arkansas.

TABLE 3  
YEAREND 1995 PRICES FOR ELEMENTAL BROMINE AND SELECTED COMPOUNDS

Product	Value per pound (cents)	Value per kilogram (cents)
Ammonium bromide, National Formulary (N.F.), granular, drums, carlots, truckloads, f.o.b. works	131	289
Bromine:		
Drums, truckloads, works 1/	123	271
Bulk, tank cars, works 1/	56 - 68	123
Bromochloromethane, drums, carloads, f.o.b. Midland, MI	127	280
Calcium bromide, bulk 2/	14	36
Ethyl bromide, technical, 98%, drums, truckloads	127	280
Ethylene dibromide, drums, carloads	95	209
Hydrobromic acid, 48%, drums, carloads, truckloads, f.o.b.	42	93
Hydrogen bromide, anhydrous, cylinders, 2,500 pounds, truckloads	475	1,047
Methyl bromide, tank cars	77	170
Potassium bromate, granular, powdered, 200-pound drums, carloads, f.o.b. works	179	395
Potassium bromide, N.F., granular, drums, carloads, f.o.b. works	110 - 112	245
Sodium bromide, technical, truckloads	70	154

1/ Delivered prices for drums and bulk shipped west of the Rocky Mountains, 1 cent per pound higher. Bulk truck prices 1 to 2 cents higher per pound for 30,000-pound minimum.

2/ Bureau of the Census. Average c.i.f. import value.

Source: Chemical Marketing Reporter. Current Prices of Chemicals and Related Materials. V. 249, No. 1, Jan. 1, 1996, pp. 26-33.

TABLE 4  
U.S IMPORTS OF OTHER BROMINE COMPOUNDS 1/

(Thousand metric tons and thousand dollars)

Compounds	H.T.S.U.S. 2/	1994		1995		Principal sources, 1995
		Gross weight	Value 3/	Gross weight	Value 3/	
Hydrobromic acid	2811195050	255	174	125	143	Israel 100%.
Ethylene dibromide	2903300500	NA	NA	836	599	Israel 100%.
Methyl bromide	2903301520	3,300	4,090	3,540	4,470	Israel 100%.
Chlorobromodifluoromethane	2903400020	4,700	33,900	182	391	Israel 90%, Netherlands 10%.
Dibromoethyldibromocyclohexane	2903591500	59	392	69	897	Germany 100%.
Dibromoneopentyl glycol	2905505000	188	478	--	--	
Tetrabromobisphenol A	2908102500	168	207	8	NA	Israel 100%.
Decabromodiphenyl oxide and octabromodiphenyl oxide	2909300700	1,760	3,340	1,340	3,050	Israel 98%, Japan 1%, Netherlands 1%.
Bromoxynil 4/	NA	2,820	NA	1,580	NA	France 48%, United Kingdom 48%, Netherlands 2%.
Bromamine acid 4/	NA	1,040	NA	583	NA	China 38%, Hong Kong 34%, Republic of Korea 25%.
Total		14,300	42,600	8,270	NA	

NA Not available.

1/ Data are rounded to three significant digits.

2/ Harmonized Tariff Schedule of the United States.

3/ Declared c.i.f. evaluation.

4/ The Journal of Commerce Port Import/Export Reporting Service.

Source: Bureau of the Census.

TABLE 5  
WORLD BROMINE ANNUAL PLANT CAPACITIES AND SOURCES 1/, DECEMBER 31, 1995

Country and company	Location	Capacity (thousand kilograms)	Source
<b>China:</b>			
Laizhou Bromine Works	Shandong	11,500	Underground brines.
<b>France:</b>			
Atochem	Port-de-Bouc	13,600	Seawater.
Mines de Potasse d'Alsace S.A.	Mulhouse	2,300	Bitterns of mined potash.
<b>Germany:</b>			
Kali und Salz AG: Salzdettfurth Mine	Bleichrode	2,500	Do.
<b>India:</b>			
Hindustan Salts Ltd.	Jaipur		
Mettur Chemicals	Mettur Dam	1,500	Seawater bitterns from salt production.
Tata Chemicals	Mithapur		
<b>Israel:</b>			
Dead Sea Bromine Co. Ltd.	Sodom	140,000	Bitterns of potash production from surface brines.
<b>Italy:</b>			
Societa Azionaria Industrial Bromo Italiana	Margherita di Savoia	900	Seawater bitterns from salt production.
<b>Japan:</b>			
Toyo Soda Manufacturing Co. Ltd.	Tokuyama	20,000	Seawater.
<b>Spain:</b>			
Derivados del Etilo S.A.	Villaricos	900	Do.
<b>Russia:</b>			
Kaustic A/O	Volgograd	3,000	Solution mining of bischofite.
<b>United Kingdom:</b>			
Associated Octel Co. Ltd.	Amlwch	30,000	Seawater.

1/ Excludes U.S. production capacity. See table 2.

TABLE 6  
BROMINE: ESTIMATED WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Thousand kilograms)

Country 3/	1991	1992	1993	1994	1995
Azerbaijan	XX	5,000	4,000	3,000	2,000
China	12,100	16,650	18,000	19,000	19,000
France	3,000	3,200 4/	2,290	2,500	2,000
Germany	1,500	750	750	750	750
India	1,300	1,300	1,400	1,400	1,500
Israel	135,000	135,000	135,000	135,000	135,000
Italy	400	300	300	300	300
Japan	15,000	15,000	15,000	15,000	15,000
Spain	300	250	200	200	200
Turkmenistan	XX	12,000	10,000	8,000	7,000
U.S.S.R. 5/	24,000	XX	XX	XX	XX
Ukraine	XX	7,000	5,000	4,000	3,500
United Kingdom	29,328 4/	29,903 4/	27,423 4/	28,000	28,000
United States 6/	170,000 4/	171,000 4/	177,000 4/	195,042 4/	218,000
Total	392,000	397,000	396,000	412,000	432,000

XX Not applicable.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through May 29, 1996.

3/ In addition to the countries listed, several other nations produce bromine, but output data are not reported, and available general information is inadequate to formulate reliable estimates of output levels.

4/ Reported figure.

5/ Dissolved in Dec. 1991.

6/ Sold or used by producers.