



2011 Minerals Yearbook

BROMINE

BROMINE

By Joyce A. Ober

Domestic survey data and tables were prepared by Michelle B. Blackwell, statistical assistant, and the world production table was prepared by Lisa D. Miller, international data coordinator.

The United States was one of the world's leading producers of bromine. U.S. dominance has declined in recent years, especially as the result of increased production in Israel and Jordan. World production of bromine for 2011, excluding the United States, was estimated to be 683,000 metric tons (t), compared with 695,000 t in 2010 (tables 1, 6). China, Israel, Jordan, the United States, and seven other countries produced bromine. In 2011, bromine sold or used in the United States decreased compared with that of 2010, but data were withheld to avoid disclosing company proprietary data.

Bromine is one of two elements that are liquid at room temperature and is found principally as a dissolved species in seawater, evaporitic (salt) lakes, and underground brines associated with petroleum deposits. Primary uses of bromine compounds were in flame retardants (FRs), drilling fluids, water treatment, and brominated pesticides (mostly methyl bromide).

Production

Domestic production data for bromine were developed by the U.S. Geological Survey (USGS) from a voluntary canvass of the two U.S. producers (table 2). Albemarle Corp. and Chemtura Corp., both of which responded to the survey, represented 100% of total production. Production data collected by the USGS were withheld to avoid disclosing proprietary information (table 1).

Bromine was recovered from brine wells in Arkansas, where bromine is found in brines in the Smackover Formation at a depth of about 2,400 meters with concentrations of 5,000 to 6,000 parts per million (ppm) bromine; by comparison, seawater contains 60 to 70 ppm bromine (Hill, 2010; Albemarle Corp., 2011c, p. 55).

After bromine processing, the spent brine is returned underground into the production formation by class V injection wells that are regulated by the U.S. Environmental Protection Agency (EPA). The chemical composition of the spent brine is generally similar to that of the original, except that the concentration of the target elements (such as bromine and magnesium) is reduced, and the concentration of other elements (such as calcium) may have increased through substitution (U.S. Environmental Protection Agency, 1999, p. 1–2, 5).

Recycling

Some bromide solutions were recycled to obtain elemental bromine and to prevent the solutions from being disposed of as hazardous waste. Hydrogen bromide is emitted as a byproduct from many organic reactions. This byproduct waste is recycled with virgin bromine brines and is a major source of bromine production. Plastics containing brominated FRs (BFRs) can be incinerated as a solid organic waste, and the bromine can be recovered (Frim and Ukeles, 2007).

Consumption

The USGS did not collect consumption data on bromine compounds. Apparent consumption of bromine in the United States, calculated by the USGS from production plus imports minus exports, decreased in 2011. The major consumption categories were, in order of magnitude, FRs, pharmaceuticals and agricultural chemicals, drilling fluids, rubber, and water treatment chemicals (Albemarle Corp., 2012). Other uses included butyl rubber, dyes, mercury emission control, photographic chemicals, and surfactants.

Estimated bromine consumption in BFRs was slightly less than 50%; BFRs are chemicals commonly used in many domestic and industrial appliances, electronic equipment, and other items, such as computers, furniture, insulation boards, mattresses, mobile telephones, televisions, and textiles. About 90% of all electrical components contain BFRs.

Calcium bromide, sodium bromide, and zinc bromide, collectively referred to as clear brine fluids (CBFs), were used in the oil- and gas-well-drilling industry for high-density, solids-free completion, packer, and workover fluids to reduce the likelihood of damage to the well bore and productive zone. These high-density fluids also help to prevent migration of fluids between underground formations through the well bore. Oil and gas drilling activity in the United States, measured by the number of wells drilled, was higher in 2011 than in 2010, as a result of the economic recovery (American Petroleum Institute, 2012).

Another major use of bromine is as a water purifier and disinfectant, which is an alternative to using chlorine. Brominated compounds are used for water treatment in hot tubs and swimming pools and to control algae and bacterial growth in industrial processes.

Bromine compounds are effective pesticides, used both as soil fumigants in agriculture, particularly fruit growing, and as a fumigant to prevent pests from attacking stored grain and other produce. World trade in agricultural goods depends on the use of bromine compounds to ensure compliance with mandatory quarantine rules. Bromine compounds also are used as intermediates to make other agricultural chemicals. Methyl bromide is the leading bromine-containing pesticide in the world, but its use was declining owing to the ban imposed by the 1987 Montreal Protocol, which classified it as a class I ozone-depleting substance. As part of the Montreal Protocol, wealthy countries were to stop using the pesticide by 2005; however, the United States has received annual exemptions for crops and other critical uses (for example, cucumbers, melons, orchard replants, peppers, post-harvest uses, squash, strawberries, and tomatoes). The critical use exemption is for applications where no technically or economically feasible

alternatives to methyl bromide exist. In 2011, the EPA authorized use of 2,055 t or 8.1% of the historic 1991 baseline consumption of methyl bromide for approved critical uses (U.S. Environmental Protection Agency, 2011b, p. 60739). Use of methyl bromide also was allowed through a quarantine and preshipment exemption for agricultural commodities and lumber. Methyl bromide is a broad spectrum pesticide used in the control of nematodes, pathogens, pest insects, rodents, and weeds. Domestically, methyl bromide has proven to be difficult to replace because of its low cost and usefulness against a large variety of agricultural pests.

The use of bromine and bromine compounds to remove mercury from flue gas emissions at coal-fired electric powerplants was an expanding new use for bromine. Inorganic bromine compounds, such as calcium bromide and sodium bromide, when mixed with coal at powerplants, react with mercury in combustion zones, forming mercury compounds that are captured in scrubbers, removing 90% of mercury liberated during combustion (Chemtura Corp., 2009). Southern Research Institute (Birmingham, AL) developed a system that converts calcium bromide to elemental bromine gas, which then reacts with mercury in coal-fired powerplant flue gas to form mercuric bromide, which is captured and retained in the powerplants' wet scrubbers (Southern Research Institute, undated).

Transportation

Bromine in bulk quantities is transported in the United States in 7,570- and 15,140-liter (L) lead-lined pressure tank railcars or 6,435- to 6,813-L nickel-clad pressure tank trailers. The trailers must be filled at least 92% full to prevent inertia effects of the heavy liquid while on the highway. International shipments by The Dead Sea Bromine Group are in 15.2- to 23.3-t lead-lined tank containers (isotanks) with a volume of 5,300 to 8,000 L. For smaller quantities, lead-lined tanks ("goslars") of 3.5 t (four tanks packed on one isoframe) and drums of 400 kilograms are used. Dry nitrogen gas is recommended for use in pressure transferring bromine, although dry air may be used. The gas used must be absolutely dry or severe corrosion results. When exposed to a high-humidity atmosphere, the water content of bromine can exceed 300 ppm. If the water content exceeds 70 ppm, the corrosiveness of bromine to many metals increases (Frim and Ukeles, 2007).

Prices

Prices for bromine and bromine compounds rose through about midyear in response to rising demand in China. Because the bromine industry has few producers, published price lists of bromine and bromine compounds were not available. Although companies normally do not publish price data, in 2011, a few of the price announcements were accompanied with price data, and others quantified only price increases. Price increases were announced by product categories separately, usually as elemental bromine and hydrobromic acid, brominated FRs, or clear brine fluids. For instance, Albemarle announced price increases for elemental bromine and hydrobromic acid and clear brine fluids twice during 2011, but increased prices on various FRs four times. Albemarle announced the

global minimum price for elemental bromine, delivered, to be \$4,500 per metric ton (Albemarle Corp., 2011a). Albemarle and Chemtura announced price increases throughout the year for other bromine compounds, indicating that prices for most bromine compounds rose during the year, but without actual prices listed.

Although not exactly the same as prices, average unit values of exported and imported bromine were used to identify price trends for bromine in 2011. The average value of exported elemental bromine, including cost, insurance, and freight, was \$1,920 per metric ton, a 9% increase from \$1,760 per ton in 2010. The average values of exported ethylene dibromide and methyl bromide decreased by 8% and slightly, respectively. The average value of imported elemental bromine decreased by about 12% to \$2,210 per ton. Price trends for imported bromine compounds varied greatly. The compounds with the highest quantities of imports, however, including ammonium bromide, decabromodiphenyl ether, hydrobromic acid, sodium bromide, and tetrabromobisphenol A (all with more than 1,000 t of imports), all increased in average value by about 20%.

Foreign Trade

Bromine exports were about 14% lower than those in 2010 (tables 1, 3). The value of exported elemental bromine and bromine compounds decreased by 17% compared with that of 2010. Bromine imports were about 5% lower than those of 2010, but total imports of bromine and bromine compounds were 4% higher. Overall, the import value for elemental bromine and bromine compounds increased by 16% in 2011.

World Review

The U.S. share of world bromine production has decreased as other countries have strengthened their positions as world producers of elemental bromine. Israel, the United States, Jordan, China, Japan, and Turkmenistan, in descending order, had the leading bromine production capabilities in 2011, although none of these countries operated at capacity (tables 2, 5). Actual production did not necessarily reflect capacity.

China.—In China, bromine operations are in Shandong Province. Many unlicensed bromine facilities operated in the area, but since 2006, the Shandong Provincial government and the Government of China had closed down the unlicensed operations. Only six companies were thought to be licensed to produce bromine.

Bromine production capacity was available for only one company in China, no capacity information is available for other bromine producers. For that reason, China's estimated bromine production is substantially higher than the capacity listed in table 5. Although specific information, by operation, was not available, the bromine industry in China likely was operating at capacity of about 150,000 t/yr.

India.—Chemtura signed a letter of intent to form a strategic alliance with Archean Group (Chennai) involving bromine byproduct from a potash project under development at the Rann of Kutch, a salt marsh in western India. The first phase of the project was a long-term sourcing agreement through which

Chemtura would market all bromine produced. The second phase would include a joint venture to construct a plant to produce bromine derivative compounds, which Chemtura also would market (Chemtura, 2011).

Israel.—ICL Industrial Products (Tel Aviv) was one of the world's leading producers of elemental bromine, with approximately 40% of global capacity. In 2010, ICL produced 202,000 t of elemental bromine. ICL processes brines from the Dead Sea, which contain 10 to 12 grams per liter (g/l) of bromine, much higher than the next richest source in U.S. brine wells that contain 2 to 6 g/l (ICL Industrial Products, undated).

Jordan.—Albemarle announced plans to double bromine production capacity at Jordan Bromine Co. (its joint venture with Arab Potash Co.) on the Dead Sea. The expansion of the plant to produce 100,000 t/yr of elemental bromine was expected to be completed in 2012 and would include increased capacity for bromine compounds as well (Albemarle Corp., 2011b).

The Natural Resources Authority (NRA) of Jordan estimated bromine production in 2010 to be 329,200 t, up from 69,000 t in 2009 (Natural Resources Authority, 2011, p. 29). Even when fully operational, the expansion project at Jordan Bromine would not result in such a dramatic expansion of bromine production. No reports indicated that more than one bromine producer operated in Jordan, although the Government data indicated that Jordan had become the world's leading bromine producer. Discrepancies between reported capacity and production estimates made by the NRA in 2007–09 possibly could be the result of double counting of bromine production and derivative compounds. The 2010–11 discrepancies remained unexplained.

Outlook

Between 40% and 50% of domestic consumption of bromine is for FRs. In 2011, demand for FRs, particularly in the construction and electronics industries, increased as the economy recovered. Although FR usage fluctuates along with overall cycles in the economy, world consumption of FRs is expected to increase, assuming sustained economic growth. Recycling efforts in Europe for BFR plastics in electrical usage, which are easier to recycle than some other FR compounds, may increase the demand for BFR products. Use of BFRs, however, will likely increase at a slower pace than FRs in general because of legislative mandates and customer demand for more environmentally friendly materials.

Increased demand for FRs would be driven by the use of FRs in developing countries as they begin to adopt more stringent flammability standards and begin to use more plastics. Countries in Asia and the Pacific region likely would be the leading consumers of FRs. Above-average gains in the demand for FRs were expected to take place in Africa, Eastern Europe, the Middle East, and Latin America. More moderate growth in FR use was expected for markets in North America and Western Europe (Freedonia Group, The, 2009a).

Bromine use in CBFs is highly dependent on fluctuations in the oil and natural gas drilling industry. Consumption of CBFs in crude oil and natural gas drilling was expected to increase as demand for these commodities increases.

Bromine water treatment chemical use was expected to show modest growth during the next several years. Bromine has been found to be safer than its substitutes in sanitary preparations because bromine has a higher biocidal activity level for the same volume of product. The use of bromine compounds was expected to continue increasing in the hot tub, spa, and swimming pool sector as a gentler disinfectant than chlorine. Global demand for water treatment products was projected to increase in developing markets, such as China and India, as a result of continued industrial expansion and increased efforts to expand access to safe water supplies (Freedonia Group, The, 2009b).

Bromine use in photography is declining as digital imaging replaces film in consumer and professional photography. Most feature films for movie theater presentation are shot using printed film; however, the use of digital technology was expected to increase and overtake film in these applications during the next decade.

The market potential for bromide-based technologies to remove mercury emissions at coal-fired powerplants is an area of potential growth for the industry. Using bromide compounds to neutralize mercury emissions appears to be more cost effective compared with other materials like chlorine-, fluorine-, or iodine-base compounds. New regulations proposed by the EPA in early 2011 for reducing mercury emissions at powerplants by an estimated 91% within 4 years of the rule taking affect were likely to increase demand for bromine and bromine compounds for that application (U.S. Environmental Protection Agency, 2011a).

References Cited

- Albemarle Corp., 2011a, Albemarle to increase price of elemental bromine and hydrobromic acid: Baton Rouge, LA, Albemarle Corp. news release, May 12. (Accessed October 10, 2011, at <http://investors.albemarle.com/phoenix.zhtml?c=117031&p=irol-newsArticle&ID=1563416&highlight=>.)
- Albemarle Corp., 2011b, Jordan Bromine Company expands bromine capacity: Baton Rouge, LA, Albemarle Corp. news release, March 3. (Accessed October 10, 2011, at <http://investors.albemarle.com/phoenix.zhtml?c=117031&p=irol-newsArticle&ID=1535747&highlight=>.)
- Albemarle Corp., 2011c, Vision 2015—2011 investor day: Baton Rouge, LA, Albemarle Corp., Presentation, May 3, 95 p. (Accessed July 2, 2012, at http://media.corporate-ir.net/media_files/IROL/11/117031/2011_Investor_Day_Presentation.pdf.)
- Albemarle Corp., 2012, Albemarle 2012 investor day: Baton Rouge, LA, Albemarle Corp., Presentation, May 22, 83 p. (Accessed July 2, 2012, via <http://investors.albemarle.com/phoenix.zhtml?c=117031&p=irol-calendar>.)
- American Petroleum Institute, 2012, Oil well completions increase from year ago levels: Washington, DC, American Petroleum Institute news release, January 27. (Accessed July 10, 2012, at <http://www.api.org/news-and-media/news/newsitems/2012/jan-2012/oil-well-completions-increase-january-2012.aspx>.)
- Chemtura Corp., 2009, Mercury removal for a cleaner, greener future: West Lafayette, IN, Chemtura Corp. product information, 1 p. (Accessed July 2, 2012, at [http://www.chemtura.com/deployedfiles/Business Units/Polymer_Additives-en-US/Document Downloads/GeoBrom/GeoBrom Product information Sheet.pdf](http://www.chemtura.com/deployedfiles/Business%20Units/Polymer_Additives-en-US/Document%20Downloads/GeoBrom/GeoBrom%20Product%20information%20Sheet.pdf).)
- Chemtura Corp., 2011, Chemtura and Archean Group sign letter of intent: Philadelphia, PA, Chemtura Corp. news release, January 14, 2 p. (Accessed July 10, 2012, at <http://chemtura.investorhq.businesswire.com/press-release/company-news/chemtura-and-archean-group-sign-letter-intent>.)
- Freedonia Group, The, 2009a, Flame retardants—US industry study with forecasts for 2013 & 2018: Cleveland, OH, The Freedonia Group, December, 8 p. (Accessed May 11, 2010, at <http://www.freedoniagroup.com/brochure/25xx/2557smwe.pdf>.)

Freedonia Group, The, 2009b, World water treatment products—Industry study with forecasts for 2013 & 2018: Cleveland, OH, The Freedonia Group, November, 8 p. (Accessed May 11, 2010, at <http://www.freedoniagroup.com/brochure/24xx/2412smwe.pdf>.)

Frim, R., and Ukeles, S.D., 2007, Bromine: Mining Engineering, v. 59, no. 6, June, p. 22–23.

Hill, Julie, 2010, Bromine, in The encyclopedia of Arkansas history and culture: Little Rock, AR, The Central Arkansas Library System, November 12. (Accessed July 2, 2012, at <http://www.encyclopediaofarkansas.net/encyclopedia/entry-detail.aspx?entryID=4514>.)

ICL Industrial Products, [undated], ICL Industrial Products—World's #1 producer of elemental bromine: Tel Aviv, Israel, ICL Industrial Products. (Accessed June 21, 2011, at <http://www.icl-group.com/iclgroup/Pages/IndustrialProducts.aspx>.)

Natural Resources Authority, 2011, Mining sector performance during 2010: Amman, Jordan, Natural Resources Authority, 40 p.

Southern Research Institute, [undated], Bromine injection technology: Birmingham, AL, Southern Research Institute. (Accessed July 2, 2012, at <http://www.southernresearch.org/environment-energy/air-pollution-control/bromine-injection-technology>.)

U.S. Environmental Protection Agency, 1999, The class V underground injection control study—Spent brine flow wells: U.S. Environmental Protection Agency EPA/816–R–99–014i, 27 p.

U.S. Environmental Protection Agency, 2011a, EPA proposes first national standard for mercury pollution from power plants—Mercury and air toxics standards represent one of the strongest health protections from air pollution

since passage of Clean Air Act: U.S. Environmental Protection Agency news release, March 16. (Accessed June 29, 2011, at <http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceac8525735900400c27/55615df6595fba3852578550050942f%21OpenDocument>.)

U.S. Environmental Protection Agency, 2011b, Protection of stratospheric ozone—The 2011 critical use exemption from the phaseout of methyl bromide: Federal Register, v. 76, no. 190, September 30, p. 60736–60748.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Bromine. Ch. in Mineral Commodity Summaries, annual.

Evaporites and Brines. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Historical Statistics for Mineral and Material Commodities in the United States, Data Series 140.

Other

Bromine. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.

Bromine Science and Environmental Forum.

TABLE 1
SALIENT BROMINE STATISTICS¹

(Metric tons and thousand dollars)

	2007	2008	2009	2010	2011
United States:					
Bromine sold or used:²					
Quantity	W	W	W	W	W
Value	W	W	W	W	W
Exports:³					
Quantity (Br equivalent)	8,560	9,640	6,130 ^r	8,150	7,150
Value	15,200	16,200	12,500 ^r	22,300	18,400
Imports for consumption:^{4,5}					
Quantity (Br equivalent)	32,200	41,200	36,000 ^r	45,400 ^r	47,100
Value	817,000	97,300	81,000 ^r	88,900 ^r	103,000
Apparent consumption	W	W	W	W	W
World, production ⁶	415,000	415,000	367,000 ^r	695,000 ^r	683,000

¹Estimated. ^rRevised. W Withheld to avoid disclosing company proprietary data.

²Data are rounded to no more than three significant digits.

³Elemental bromine sold as such to nonproducers, including exports, or used by primary U.S. producers in preparing bromine compounds.

⁴Export values are free alongside ship.

⁵Source: U.S. Census Bureau or PIERS (see table 4).

⁶Import values are cost, insurance, and freight.

⁷Excludes U.S. production.

TABLE 2
ELEMENTAL-BROMINE-PRODUCING PLANTS IN THE UNITED STATES IN 2011

State and company	County	Plant	Production source	Capacity ¹ (thousand metric tons)
Arkansas:				
Albemarle Corp.	Columbia	Magnolia South	Well brines	NA
Do.	do.	Magnolia West	do.	NA
Do.	Union	Satellite plants	do.	NA
Total				148 ²
Chemtura Corp.	do.	El Dorado Central and El Dorado South	do.	71 ³
Do.	do.	Marysville West	do.	36
Do.	do.	Newell	do.	23
Total				59
Grand total				278

Do., do. Ditto. NA Not available.

¹Actual production capacity is limited by brine availability.

²Cumulative capacity of Magnolia South, Magnolia West, and Satellite plants.

³Cumulative capacity of El Dorado Central and El Dorado South plants.

TABLE 3
U.S. EXPORTS OF BROMINE AND BROMINE COMPOUNDS^{1,2}

Compound	HTS ³ number	2010			2011		
		Gross weight (metric tons)	Br equivalent (metric tons)	Value ⁴ (thousands)	Gross weight (metric tons)	Br equivalent (metric tons)	Value ⁴ (thousands)
Elemental bromine	2801.30.2000	4,530	4,530	\$7,970	4,580	4,580	\$8,790
Other compounds:							
Ethylene dibromide	2903.31.0000	2,270	1,930	8,180	1,490	1,260	4,940
Methyl bromide	2903.39.1520	2,000	1,690	6,090	1,540	1,300	4,670
Grand total		8,810	8,150	22,300	7,610	7,150	18,400

¹These data detail the information included in table 1 under "Exports."

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Harmonized Tariff Schedule of the United States.

⁴Declared cost, insurance, and freight valuation.

Source: U.S. Census Bureau.

TABLE 4
U.S. IMPORTS OF BROMINE AND BROMINE COMPOUNDS^{1,2}

Compound	HTS ³ number	2010				2011			
		Gross weight (metric tons)	Br equivalent (metric tons)	Value ⁴ (thousands)	Gross weight (metric tons)	Br equivalent (metric tons)	Value ⁴ (thousands)	Principal sources in 2011	
Elemental bromine	2801.30.2000	1,040	1,040	\$2,620	997	997	\$2,200	Israel, 54%; Jordan, 42%.	
Inorganic bromine compounds:									
Ammonium bromide	2827.59.2500	38,600	31,500	50,400	37,200	30,300	49,600	Israel, 93%.	
Calcium bromide ⁵	2827.59.2500	255	204	403 ^e	3,090	2,470	6,770 ^e	Israel, 100%.	
Potassium bromate	2829.90.0500	53	25	244	71	34	447	China, 100%.	
Potassium bromide ^{5,6}	2827.51.0000	672 ^r	451 ^r	1,170 ^r	968	650	1,910 ^e	Israel, 61%; France, 23%.	
Sodium bromate	2829.90.2500	575	305	1,770	746	395	3,110	China, 100%.	
Sodium bromide ^{5,6}	2827.51.0000	8,030	6,230	11,700 ^e	7,530	5,850	11,100 ^e	Israel, 69%; China, 24%.	
Organic bromine compounds:									
Decabromodiphenyl oxide and octabromodiphenyl oxide	2909.30.0700	3,610	2,890	11,500	3,690	2,950	15,500	Israel, 90%; China, 10%.	
Dibromoneopentyl glycol ⁵	2905.59.3000	130	74	618 ^e	--	--	--	XX.	
Ethylene dibromide	2903.31.0000	21	18	117	23	20	113	China, 95%.	
Hydrobromic acid	2811.19.3000	1,540	1,520	1,750	2,110	2,080	3,600	Israel, 65%; France, 18%.	
Methyl bromide	2903.39.1520	367	309	2,350	373	314	2,720	Israel, 73%; China, 20%.	
Tetrabromobisphenol A	2908.19.2500	1,310	768	4,410	1,750	1,030	6,320	Israel, 93%.	
Total		56,200 ^r	45,400 ^r	88,900 ^r	58,500	47,100	103,000		

^eEstimated. ^rRevised. ^{XX} Not applicable. -- Zero.

¹These data detail the information included in table 1 under "Imports for consumption."

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Harmonized Tariff Schedule of the United States.

⁴Declared cost, insurance, and freight valuation.

⁵Source: PIERS.

⁶Potassium bromide and sodium bromide import data are reported under a common HTS number, 2827.51.0000.

Source: U.S. Census Bureau.

TABLE 5
SELECTED WORLD BROMINE ANNUAL PLANT CAPACITIES AND SOURCES AS OF DECEMBER 31, 2011¹

Country and company or plant	Location	Capacity (metric tons)	Source
Azerbaijan, Neftechala Bromine Plant	Baku	4,000	Underground brines.
China, Laizhou Bromine Works	Shandong	43,000	Do.
India:			
Hindustan Salts Ltd.	Jaipur	NA	Seawater bitterns from salt production.
Mettur Chemicals Ltd.	Mettur Dam	NA	Do.
Tata Chemicals Ltd.	Mithapur	NA	Do.
Total		1,500	
Israel, ICL Industrial Products	Sodom	280,000	Bitterns of potash production from surface brines.
Japan, Toyo Soda Manufacturing Co. Ltd.	Tokuyama	20,000	Seawater.
Jordan, Jordan Bromine Co. Ltd.	Safi	50,000	Bitterns of potash production from surface brines.
Spain, Derivados del Etilo S.A.	Villaricos	900	Seawater.
Turkmenistan:			
Cheleken Chemical Plant	Cheleken Region	4,740	Do.
Nebitdag Iodine Plant	Vyshka	2,370	Underground brines.
Ukraine, Perekop Bromine Plant	Krasnoperekopsk	3,000	Do.

Do. ditto. NA Not available.

¹Excludes U.S. production capacity, which is detailed in table 2.

TABLE 6
BROMINE: ESTIMATED WORLD REFINERY PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

Country ³	2007	2008	2009	2010	2011
Azerbaijan	2,000	3,500	3,500	3,500	3,500
China	137,000	135,000	140,000	150,000	150,000
Germany ⁴	1,612 ⁵	1,680 ^{r,5}	985 ^{r,5}	1,500 ^{r,5}	1,500
India	1,500	1,500	1,500	1,500	1,500
Israel	159,395 ⁵	164,042 ⁵	127,689 ⁵	184,696 ^{r,5}	202,000
Japan	20,000	20,000	20,000	20,000	20,000
Jordan	85,105 ⁵	85,000	69,000 ^r	329,000 ^r	300,000
Spain	100	100	100	100	100
Turkmenistan	150	150	150	150	150
Ukraine	7,824 ⁵	4,416 ⁵	4,121 ⁵	4,100	4,100
United States ⁶	W	W	W	W	W
Total ⁷	415,000	415,000	367,000 ^r	695,000 ^r	683,000

^rRevised. W Withheld to avoid disclosing company proprietary data; not included in total.

¹World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through May 25, 2012.

³In addition to the countries listed, several other nations, including Iran, produced bromine, but output data were not reported; available general information is inadequate to formulate reliable estimates of output levels.

⁴Includes bromides and oxides.

⁵Reported figure.

⁶Sold or used by producers.

⁷Excludes U.S. production.