BROMINE

By Lori E. Apodaca

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 the world’s leading producer of bromine; however, the U.S. portion of world production has decreased steadily since 1973, when the United States produced 71% of the world supply. World production of bromine for 2009, excluding the United States, was estimated to be 375,000 metric tons (t) compared with 412,000 t in 2008 (tables 1, 6). The world producers of bromine included China, Israel, Jordan, the United States, and seven other countries. In 2009, bromine sold or used in the United States was estimated to have decreased from 243,000 t valued at $339 million produced in 2006 (table 1); however, 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, represent 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 brine is found in the Smackover Formation at a depth of about 2,400 meters with concentrations of 4,000 to 5,000 parts per million (ppm) bromine; by comparison, seawater contains 65 ppm bromine.

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, was estimated to have decreased in 2009 owing to the decline in demand. The major consumption categories, in order of magnitude, were FRs, drilling fluids, water treatment, and pesticides. Other uses included butyl rubber, dyes, mercury emissions, pharmaceuticals, photographic chemicals, and surfactants.

An estimated 50% of bromine consumption was in BFRs, chemicals commonly used in many domestic and industrial appliances and equipment, such as computers, furniture, insulation boards, mattresses, mobile telephones, televisions, and textiles. About 90% of all electrical components contain BFRs.

Albemarle and Chemtura reached an agreement with the EPA for a voluntary phaseout of decabromodiphenyl ether (decaBDE) flame retardant. DecaBDE is used in consumer electronics, furniture, plastic shipping pallets, and textiles. The two companies signed a memorandum of understanding (MOU) with the EPA to end production, importation, and sales of decaBDE for most uses by December 2012 and for all uses by the yearend 2013 (U.S. Environmental Protection Agency, 2009a).

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.

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

Bromine—2009
in the world, but its use is 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). In 2009, the EPA authorized use of 4,195 t or 16.4% of the historic 1991 baseline consumption of methyl bromide for approved critical uses (U.S. Environmental Protection Agency, 2009b, p. 16). Methyl bromide is a broad spectrum pesticide used in the control of nematodes, pathogens, pest insects, rodents, and weeds. Domestically, methyl bromide had proven to be difficult to replace because of its low cost and usefulness against a large variety of agricultural pests.

Bromide-base technologies to remove mercury emissions at coal-fired powerplants are an area of potential growth for the industry. Albemarle signed an MOU with MeadWestvaco Corp. to form a partnership to develop a domestic supply of activated carbon to remove mercury from coal-fired plant emissions. The two companies were to continue to develop brominated wood-based activated carbons for use in mercury control (Albemarle Corp., 2009). Chemtura had also developed bromine and brominated derivative products for use in the control of mercury emissions from coal-fired plants (Chemtura Corp., 2009).

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 cylinders 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

In the beginning of 2009, prices for bromine and bromine compounds were lower as a result of the poor market conditions worldwide. Prices began to rebound in the latter part of 2009 owing to increased demand. The increase in bromine and bromine compound prices reflected the rising market value of bromine and increases in the cost of energy, key raw materials, regulatory compliance, and transportation.

Bromine exports were about 36% lower than those in 2008 (tables 1, 3). The value of exported elemental bromine and bromine compounds decreased by 23% compared with that of 2008. Bromine imports were about 17% lower than those of 2008. The value of imported elemental bromine and some bromine compounds increased, with the exception of ammonium bromide, potassium bromate, sodium bromate, methyl bromide, tetrabromobisphenol A, decabromodiphenyl oxide, and octabromodiphenyl oxide (tables 1, 4). Overall the import value for elemental bromine and bromine compounds decreased by 14% in 2009.

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 2009 (table 5).

Canada.—Environment Canada has issued a performance agreement to control, monitor, and minimize the release of decaBDE from Canadian facilities where decaBDE is used or handled. The proposed agreement aims to manage and reduce releases of decaBDE from its use in plastic and textile manufacturing facilities (Environment Canada, 2009, p. 2).

China.—Shouguang City Haoyuan Chemical Company Ltd. (SCHC) (a subsidiary of Gulf Resources, Inc.) started production of the bromine assets acquired in January. The assets were expected to add an additional 4,000 metric tons per year (t/yr) of bromine production capacity, increasing capacity to 38,700 t/yr (Gulf Resources, Inc., 2009a, b).

Israel.—ICL Industrial Products (a subsidiary of Israel Chemicals Ltd.) began a program designed to accelerate the market’s transition to sustainable flame retardant solutions by developing next-generation polymeric flame retardants and beginning a 3-year phaseout of sales of decaBDE to the U.S. market (ICL Industrial Products, 2009).

ICL has developed a bromine compound to remove mercury emission from coal-fired powerplants and, to a lesser degree, emissions by hazardous substance kilns, production of chlorine, and incineration of medical waste products (ICL Industrial Products, 2010).

Outlook

Between 40% and 50% of domestic consumption of bromine is for FRs. In the first half of 2009, demand for FRs, particularly in the construction and electronics industries, declined as a result of the poor market conditions. 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. BFR products are thought to be more environmentally friendly, especially where recycling is an important concern, such as in Europe and Japan. However, use of BFRs will likely increase at a slower pace owing to legislative mandates and customer demand for more environmentally friendly materials.

The Freedonia Group forecast FR global consumption to rise by 4.7% per year through 2011 (Freedonia Group, The, 2007). The increase 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 plastic materials. Asia and the Pacific would be the leading consumer of FRs, with consumption rising by 7% per year. More moderate growth in FR use was expected for markets in North America and Western Europe. U.S. demand was forecast to rise by 2.7% per year through 2013 as a result of bromine use in insulated wire and cable and in construction as well as more stringent fire codes and flammability requirements (Freedonia Group, The, 2009a). Above-average gains in the demand for FRs were expected to take place in Africa, Eastern Europe, the Middle East, and Latin America.

Bromine use in CBFs is highly dependent on fluctuations in the oil and natural gas drilling industry. Oil and gas drilling activity in the United States was lower in 2009 than in 2008 as a result of the economic downturn. Production for crude oil and natural gas production 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 is used in both commercial and residential hot tubs, swimming pools, and whirlpools. In addition, bromine is used to treat industrial cooling water. 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-base technologies to remove mercury emissions at coal-fired powerplants is expected to be 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.

References Cited

Albemarle Corp., 2009, Albemarle announces strategic alliance with MeadWestvaco to expand mercury removal product and services line: Baton Rouge, LA, Albemarle Corp. press release, September 8, 1 p.

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Gulf Resources, Inc., 2009a, Gulf Resources begins formal production of new bromine and crude salt assets: Shouguang City, China, Gulf Resources Inc. press release, December 14, 1 p.

Gulf Resources, Inc., 2009b, Gulf Resources provides expected net income contribution of acquired manufacturing assets: Shouguang City, China, Gulf Resources Inc. press release, September 25, 1 p.


GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications


Other


Bromine Science and Environmental Forum.
### TABLE 1

**SALIENT BROMINE STATISTICS**

(Metric tons and thousand dollars)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>United States:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromine sold or used:*</td>
<td>226,000</td>
<td>243,000</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td>168,000</td>
<td>339,000</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>Exports:*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>9,740</td>
<td>12,400</td>
<td>8,560 `</td>
<td>9,640 `</td>
<td>6,120</td>
</tr>
<tr>
<td>Value</td>
<td>16,800</td>
<td>23,000</td>
<td>15,200 `</td>
<td>16,200 `</td>
<td>12,400</td>
</tr>
<tr>
<td>Imports for consumption:*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>59,100</td>
<td>43,100</td>
<td>32,200 `</td>
<td>41,200 `</td>
<td>34,200</td>
</tr>
<tr>
<td>Value</td>
<td>55,800</td>
<td>78,100</td>
<td>817,000 `</td>
<td>97,300 `</td>
<td>83,300</td>
</tr>
<tr>
<td>Apparent consumption</td>
<td>277,000</td>
<td>275,000</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>World, production:*</td>
<td>654,000 `</td>
<td>669,000</td>
<td>408,000 `</td>
<td>412,000 `</td>
<td>375,000 `</td>
</tr>
</tbody>
</table>

*Estimated. `Revised. W Withheld to avoid disclosing company proprietary data.

1Data are rounded to no more than three significant digits.

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

3Export values are free alongside ship.

4Source: U.S. Census Bureau or United Business Media Global Trade Port Import/Export Reporting Service (see table 4).

5Import values are cost, insurance, and freight.

6Excludes U.S. production.

### TABLE 2

**ELEMENTAL-BROMINE-PRODUCING PLANTS IN THE UNITED STATES IN 2009**

<table>
<thead>
<tr>
<th>State and company</th>
<th>County</th>
<th>Plant source metric tons</th>
<th>Capacity `</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arklemarle Corp.</td>
<td>do.</td>
<td>Magnolia South</td>
<td>Well brines</td>
</tr>
<tr>
<td>do.</td>
<td>do.</td>
<td>Magnolia West</td>
<td>do.</td>
</tr>
<tr>
<td>do.</td>
<td>Union</td>
<td>Satellite plants</td>
<td>do.</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemtura Corp.</td>
<td>do.</td>
<td>El Dorado Central and El Dorado South</td>
<td>do.</td>
</tr>
<tr>
<td>do.</td>
<td>do.</td>
<td>Marysville West</td>
<td>do.</td>
</tr>
<tr>
<td>do.</td>
<td>do.</td>
<td>Newell</td>
<td>do.</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Do., do. Ditto. NA Not available.

`Actual production capacity is limited by brine availability.

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

Cumulative capacity of El Dorado Central and El Dorado South plants.
### TABLE 3
U.S. EXPORTS OF BROMINE AND BROMINE COMPOUNDS¹,²

<table>
<thead>
<tr>
<th>Compound</th>
<th>HTS³ number</th>
<th>2008 (metric tons)</th>
<th>Value⁴ (thousands)</th>
<th>2009 (metric tons)</th>
<th>Value⁴ (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gross weight</td>
<td>Br equivalent</td>
<td>Gross weight</td>
<td>Br equivalent</td>
</tr>
<tr>
<td>Elemental bromine</td>
<td>2801.30.2000</td>
<td>6,140</td>
<td>6,140</td>
<td>3,810</td>
<td>3,810</td>
</tr>
<tr>
<td>Other compounds:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylene dibromide</td>
<td>2903.31.0000</td>
<td>2,750</td>
<td>2,340</td>
<td>1,760</td>
<td>1,500</td>
</tr>
<tr>
<td>Methyl bromide</td>
<td>2903.39.1520</td>
<td>1,380</td>
<td>1,160</td>
<td>968</td>
<td>815</td>
</tr>
<tr>
<td>Grand total</td>
<td></td>
<td>10,300</td>
<td>9,640</td>
<td>6,540</td>
<td>6,120</td>
</tr>
</tbody>
</table>

¹Revised.
²These data detail the information included in table 1 under “Exports.”
³Data are rounded to no more than three significant digits; may not add to totals shown.
⁴Harmonized Tariff Schedule of the United States.
⁵Declared cost, insurance, and freight valuation.

Source: U.S. Census Bureau.
<table>
<thead>
<tr>
<th>Compound</th>
<th>HTS number</th>
<th>2008 (metric tons)</th>
<th>2009 (metric tons)</th>
<th>Value $ (thousands)</th>
<th>2008 (metric tons)</th>
<th>2009 (metric tons)</th>
<th>Value $ (thousands)</th>
<th>Principal sources in 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elemental bromine</td>
<td>2801.30.2000</td>
<td>Gross weight 1,950</td>
<td>Br equivalent 1,950</td>
<td>$2,280</td>
<td>Gross weight 1,390</td>
<td>Br equivalent 1,390</td>
<td>$3,020</td>
<td>Israel, 95%</td>
</tr>
<tr>
<td>Ammonium bromide</td>
<td>2827.59.2500</td>
<td>37,000</td>
<td>30,200</td>
<td>56,500</td>
<td>25,600</td>
<td>20,900</td>
<td>39,200</td>
<td>Israel, 85%; Germany, 11%</td>
</tr>
<tr>
<td>Calcium bromide</td>
<td>2827.59.2500</td>
<td>684</td>
<td>547</td>
<td>595</td>
<td>1,760</td>
<td>1,410</td>
<td>1,690</td>
<td>China, 64%; Israel, 30%</td>
</tr>
<tr>
<td>Potassium bromate</td>
<td>2829.90.0500</td>
<td>84</td>
<td>40</td>
<td>349</td>
<td>54</td>
<td>26</td>
<td>203</td>
<td>China, 100%</td>
</tr>
<tr>
<td>Potassium bromide</td>
<td>2827.51.0000</td>
<td>272</td>
<td>182</td>
<td>1,030</td>
<td>279</td>
<td>187</td>
<td>1,170</td>
<td>Israel, 78%; China, 16%</td>
</tr>
<tr>
<td>Sodium bromate</td>
<td>2829.90.2500</td>
<td>686</td>
<td>363</td>
<td>1,810</td>
<td>223</td>
<td>118</td>
<td>547</td>
<td>China, 99%</td>
</tr>
<tr>
<td>Sodium bromide</td>
<td>2827.51.0000</td>
<td>4,320</td>
<td>3,350</td>
<td>7,050</td>
<td>6,490</td>
<td>5,040</td>
<td>11,900</td>
<td>Israel, 57%; China, 30%; Belgium, 13%</td>
</tr>
<tr>
<td>Hydrobromic acid</td>
<td>2811.19.3000</td>
<td>422</td>
<td>417</td>
<td>483</td>
<td>970</td>
<td>958</td>
<td>1,520</td>
<td>Israel, 52%; France, 33%; United Kingdom, 14%</td>
</tr>
<tr>
<td>Ethylene dibromide</td>
<td>2903.31.0000</td>
<td>84</td>
<td>71</td>
<td>53</td>
<td>105</td>
<td>89</td>
<td>178</td>
<td>Israel, 85%; Japan, 13%</td>
</tr>
<tr>
<td>Methyl bromide</td>
<td>2903.39.1520</td>
<td>647</td>
<td>545</td>
<td>4,850</td>
<td>565</td>
<td>476</td>
<td>4,260</td>
<td>Israel, 98%</td>
</tr>
<tr>
<td>Dibromoneopentyl glycol</td>
<td>2905.50.3000</td>
<td>536</td>
<td>306</td>
<td>NA</td>
<td>606</td>
<td>345</td>
<td>NA</td>
<td>China, 90%; Israel, 10%</td>
</tr>
<tr>
<td>Tetabromobisphenol A</td>
<td>2908.19.2500</td>
<td>1,140</td>
<td>675</td>
<td>7,760</td>
<td>1,860</td>
<td>1,100</td>
<td>7,250</td>
<td>Israel, 63%; Jordan, 35%</td>
</tr>
<tr>
<td>Decabromodiphenyl oxide and octabromodiphenyl oxide</td>
<td>2909.30.0700</td>
<td>4,480</td>
<td>2,580</td>
<td>14,500</td>
<td>3,810</td>
<td>2,190</td>
<td>12,400</td>
<td>Israel, 92%</td>
</tr>
<tr>
<td>Grand total</td>
<td></td>
<td>52,300</td>
<td>41,200</td>
<td>97,200</td>
<td>43,700</td>
<td>34,200</td>
<td>83,300</td>
<td></td>
</tr>
</tbody>
</table>

1. Declared cost, insurance, and freight valuation.
3. These data detail the information included in table 1 under “Imports for consumption.”
4. Data are rounded to no more than three significant digits; may not add to totals shown.

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

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**

(Metric tons)

<table>
<thead>
<tr>
<th>Country</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
<td>3,500</td>
<td>3,500</td>
</tr>
<tr>
<td>China</td>
<td>104,500</td>
<td>124,000</td>
<td>137,000</td>
<td>135,000</td>
<td>140,000</td>
</tr>
<tr>
<td>Germany</td>
<td>274</td>
<td>431</td>
<td>1,612</td>
<td>1,680</td>
<td>1,400</td>
</tr>
<tr>
<td>India</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
</tr>
<tr>
<td>Israel</td>
<td>207,048</td>
<td>179,493</td>
<td>159,395</td>
<td>164,042</td>
<td>128,000</td>
</tr>
<tr>
<td>Japan</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Jordan</td>
<td>89,785</td>
<td>94,500</td>
<td>85,105</td>
<td>85,000</td>
<td>80,000</td>
</tr>
<tr>
<td>Spain</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Ukraine</td>
<td>1,878</td>
<td>3,138</td>
<td>700</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td>United States</td>
<td>226,000</td>
<td>243,000</td>
<td>W</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>654,000</strong></td>
<td><strong>669,000</strong></td>
<td><strong>408,000</strong></td>
<td><strong>412,000</strong></td>
<td><strong>375,000</strong></td>
</tr>
</tbody>
</table>

---

1Revised. W Withheld to avoid disclosing company proprietary data; not included in total.  
2World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.  
3Table includes data available through May 13, 2010.  
4In 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.  
5Includes bromides and oxides.  
6Reported figure.  
7Sold or used by producers.  
8Excludes U.S. production.