

## BROMINE

(Data in thousand metric tons of bromine content, unless otherwise noted)

**Domestic Production and Use:** The quantity of bromine sold or used in the United States from four companies operating in Arkansas and Michigan accounted for 100% of elemental bromine production, which was valued at an estimated \$223 million. Arkansas, with six plants, continued to be the Nations leading bromine producer, and bromine was the leading mineral commodity in terms of value produced in the State.

Three bromine companies accounted for 78% of world production. Two of these companies are located in the United States and accounted for about 98% of U.S. production.

Bromine was used in fire retardants (40%), drilling fluids (24%), brominated pesticides (12%), water-treatment chemicals (7%), and other products, including photographic chemicals and rubber additives (17%). Other products included intermediate chemicals for the manufacture of products and bromide solutions used alone or in combination with other chemicals.

| <b>Salient Statistics—United States:</b>                                 | <b>1998</b> | <b>1999</b> | <b>2000</b> | <b>2001</b> | <b>2002<sup>e</sup></b> |
|--|-------------|-------------|-------------|-------------|-------------------------|
| Production <sup>1</sup>  | 230         | 239         | 228         | 212         | 225                     |
| Imports for consumption, elemental bromine and compounds <sup>2</sup>    | 10          | 10          | 20          | 11          | 10                      |
| Exports, elemental bromine and compounds                                 | 12          | 10          | 10          | 10          | 10                      |
| Consumption, apparent <sup>3</sup>                                       | 235         | 238         | 238         | 214         | 225                     |
| Price, cents per kilogram, bulk, purified bromine                        | 70.0        | 87.0        | 90.0        | 67.0        | 99.2                    |
| Employment, number   | 1,700       | 1,700       | 1,700       | 1,700       | 1,700                   |
| Net import reliance <sup>4</sup> as a percentage of apparent consumption | —           | E           | 4           | —           | —                       |

**Recycling:** Approximately 35% of U.S. bromine production was converted to byproduct sodium bromide solutions, which were recycled to obtain elemental bromine. This recycled bromine is not included in the virgin bromine production reported by the companies.

**Import Sources (1998-2001):** Israel, 91%; United Kingdom, 6%; Netherlands, 1%; and other, 2%.

| <b>Tariff: Item</b>                           | <b>Number</b> | <b>Normal Trade Relations<br/>12/31/02</b> |
|---|---------------|--|
| Bromine                                       | 2801.30.2000  | 5.5% ad val.                               |
| Bromides and bromide oxides                   | 2827.59.5000  | 3.6% ad val.                               |
| Bromochloromethane                            | 2903.49.1000  | Free.                                      |
| Ammonium, calcium, or zinc bromide            | 2827.59.2500  | Free.                                      |
| Decabromodiphenyl and octabromodiphenyl oxide | 2909.30.0700  | 8.4% ad val.                               |
| Ethylene dibromide                            | 2903.30.0500  | 5.4% ad val.                               |
| Hydrobromic acid                              | 2811.19.3000  | Free.                                      |
| Potassium bromate                             | 2829.90.0500  | Free.                                      |
| Potassium or sodium bromide                   | 2827.51.0000  | Free.                                      |
| Sodium bromate                                | 2829.90.2500  | Free.                                      |
| Tetrabromobisphenol A                         | 2908.10.2500  | 0.3¢/kg + 8.3% ad val.                     |
| Vinyl bromide, methylene dibromide            | 2903.30.1520  | Free.                                      |

**Depletion Allowance:** Brine wells, 5% (Domestic and foreign).

**Government Stockpile:** None.

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**Events, Trends, and Issues:** A U.S. company's subsidiary signed a joint-venture agreement with a Jordanian company to build a bromine complex at Safi, Jordan. Construction, which began in 2000 and was completed in October 2002, included a 50,000-ton-per-year bromine plant. Downturns in the world economy, especially in electrical products such as computers and telecommunication equipment, has led to a reduction in the demand for brominated fire retardants. Brominated fire retardants are competitive in terms of cost and performance in these electrical applications. Fire retardants accounted for approximately 40% of all plastic additives consumed in North America.

Israel was the second largest producer of bromine in the world and the largest producer of elemental bromine. Approximately 90% of production was for export, accounting for about 80% of international trade in bromine and bromine compounds to more than 100 countries. The purchase of the remaining public shareholdings of three subsidiaries, including bromine operations, was completed by the largest chemical company in Israel. Exports are used to produce bromine compounds at a plant in the Netherlands.

Under the Montreal Protocol, the U.S. phase of the global elimination of methyl bromide as a crop pesticide will occur during 2001-05. Imports of crops grown and treated with methyl bromide in Mexico are expected to continue, however, because Mexico is not required to phase out methyl bromide use until 2015.

### World Mine Production, Reserves, and Reserve Base:

|                            | Mine production |                   | Reserves <sup>5</sup> | Reserve base <sup>5</sup> |
|----------------------------|-----------------|-------------------|-----------------------|---------------------------|
|                            | 2001            | 2002 <sup>e</sup> |                       |                           |
| United States <sup>1</sup> | 212             | 225               | 11,000                | 11,000                    |
| Azerbaijan                 | 2.0             | 2.0               | 300                   | 300                       |
| China                      | 40.0            | 40.0              | 130                   | 3,500                     |
| France                     | 2.0             | 2.0               | 1,600                 | 1,600                     |
| Germany                    | 0.5             | 0.5               | ( <sup>6</sup> )      | ( <sup>6</sup> )          |
| India                      | 1.5             | 1.5               | ( <sup>7</sup> )      | ( <sup>7</sup> )          |
| Israel                     | 206             | 206               | ( <sup>8</sup> )      | ( <sup>8</sup> )          |
| Italy                      | 0.3             | 0.3               | ( <sup>7</sup> )      | ( <sup>7</sup> )          |
| Japan                      | 20.0            | 20.0              | ( <sup>9</sup> )      | ( <sup>9</sup> )          |
| Spain                      | 0.1             | 0.1               | 1,400                 | 1,400                     |
| Turkmenistan               | 0.15            | 0.15              | 700                   | 700                       |
| Ukraine                    | 3.0             | 3.0               | 400                   | 400                       |
| United Kingdom             | <u>50.0</u>     | <u>50.0</u>       | ( <sup>7</sup> )      | ( <sup>7</sup> )          |
| World total (rounded)      | 540             | 550               | NA                    | NA                        |

**World Resources:** Resources of bromine are virtually unlimited. The Dead Sea, in the Middle East, is estimated to contain 1 billion tons of bromine. Seawater contains about 65 parts per million of bromine or an estimated 100 trillion tons. The bromine content of underground water in Poland has been estimated at 36 million tons.

**Substitutes:** Chlorine and iodine may be substituted for bromine in a few chemical reactions and for sanitation purposes. Aniline and some of its derivatives, methanol, ethanol, and gasoline-grade tertiary butyl alcohol, are effective non lead substitutes for ethylene dibromide and lead in gasoline in some cars. There are no comparable substitutes for bromine in various oil and gas well completion and packer applications. Alumina, magnesium hydroxide, organic chlorine compounds, and phosphorous compounds can be substituted for bromine as fire retardants in some uses.

<sup>e</sup>Estimated. E Net exporter. NA Not available. — Zero.

<sup>1</sup>Sold or used by U.S. producers.

<sup>2</sup>Imports calculated from items shown in Tariff section.

<sup>3</sup>Includes recycled product.

<sup>4</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>5</sup>See Appendix C for definitions.

<sup>6</sup>From waste biterms associated with potash production.

<sup>7</sup>From waste biterms associated with solar salt.

<sup>8</sup>From the Dead Sea. See World Resources section.

<sup>9</sup>From seawater. See World Resources section.