

## BROMINE

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

**Domestic Production and Use:** Bromine was recovered from underground brines by two companies in Arkansas. Bromine was the leading mineral commodity, in terms of value, produced in Arkansas. The two bromine companies in the United States accounted for about one-third of world production capacity.

Primary uses of bromine compounds are in flame retardants, drilling fluids, brominated pesticides (mostly methyl bromide), and water treatment. Bromine is also used in the manufacture of dyes, insect repellents, perfumes, pharmaceuticals, and photographic chemicals. Other bromine compounds are used in a variety of applications, including chemical synthesis, mercury control, and paper manufacturing.

<b>Salient Statistics—United States:</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011<sup>e</sup></b>
Production	W	W	W	W	W
Imports for consumption, elemental bromine and compounds <sup>1</sup>	32,200	41,200	35,000	45,000	43,000
Exports, elemental bromine and compounds	8,560	9,640	6,120	8,150	7,400
Consumption, apparent	W	W	W	W	W
Price, cents per kilogram, bulk, purified bromine	NA	NA	NA	NA	NA
Employment, number <sup>e</sup>	1,000	1,000	1,000	950	950
Net import reliance <sup>2</sup> as a percentage of apparent consumption	<25	<25	<25	<25	<25

**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 in many organic reactions. This byproduct waste is recycled with virgin bromine brines and is a major source of bromine production. Plastics containing bromine flame retardants can be incinerated as solid organic waste, and the bromine can be recovered. This recycled bromine is not included in the virgin bromine production reported to the U.S. Geological Survey by companies but is included in data collected by the U.S. Census Bureau.

**Import Sources (2007–10):** Israel, 84%; China, 8%; Germany, 4%; Jordan, 2%; and other, 2%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-11</b>
Bromine	2801.30.2000	5.5% ad val.
Hydrobromic acid	2811.19.3000	Free.
Potassium or sodium bromide	2827.51.0000	Free.
Ammonium, calcium, or zinc bromide	2827.59.2500	Free.
Other bromides and bromide oxides	2827.59.5100	3.6% ad val.
Potassium bromate	2829.90.0500	Free.
Sodium bromate	2829.90.2500	Free.
Ethylene dibromide	2903.31.0000	5.4% ad val.
Methyl bromide	2903.39.1520	Free.
Bromochloromethane	2903.49.1000	Free.
Tetrabromobisphenol A	2908.19.2500	5.5% ad val.
Decabromodiphenyl and octabromodiphenyl oxide	2909.30.0700	5.5% ad val.

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

**Government Stockpile:** None.

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**Events, Trends, and Issues:** Although still the leading bromine producer in the world, the United States' dominance has decreased as other countries, such as Israel, Japan, and Jordan, strengthened their positions as world producers of elemental bromine. A United States bromine company announced plans to double production capacity at its joint-venture operation on the Dead Sea in Jordan. The project was expected to be completed in 2012. China also is a significant bromine producer, although environmental restrictions to protect farmland, limits to plant expansions, and shutdowns of unlicensed bromine operations have resulted in tight supplies. Bromine and bromine compound prices increased in 2011, reflecting the expanding markets of bromine, especially in China, and increases in the costs of energy, raw materials, regulatory compliance, and transportation.

The leading use of bromine is in flame retardants; however, this use is in decline because of the environmental considerations and potential health effects related to specific bromine flame-retardant compounds. In the United States in 2010, bromine chemical producers and importers reached an agreement with the U.S. Environmental Protection Agency to voluntarily phase out the production, importation, and use of decabromodiphenyl ether (Deca-BDE), a widely used flame retardant, in all consumer products by December 2012, and in all products by the end of 2013.

Several companies were pursuing new markets for bromine to mitigate mercury emissions at powerplants. Bromine compounds bond with mercury in flue gases from coal-fired powerplants creating mercuric bromide, a substance that is more easily captured in flue-gas scrubbers than the mercuric chloride that is produced at many facilities. Wide acceptance of the new technology would likely increase demand for bromine, counteracting, at least in part, the decline expected from the ban on Deca-BDE.

**World Production and Reserves:** Reserve data for Ukraine have been revised to "not available" because no current information is available to confidently and accurately quantify reserves for that country.

	Production		Reserves <sup>3</sup>
	2010	2011 <sup>e</sup>	
United States	W	W	11,000,000
Azerbaijan	3,500	3,500	300,000
China	150,000	155,000	NA
Germany	985	1,500	NA
India	1,500	1,500	NA
Israel	185,000	200,000	NA
Japan	20,000	20,000	NA
Jordan	85,000	75,000	NA
Spain	100	100	1,400,000
Turkmenistan	150	150	700,000
Ukraine	4,100	4,100	NA
World total (rounded)	<sup>4</sup> 450,000	<sup>4</sup> 460,000	Large

**World Resources:** Bromine is found principally in seawater, evaporitic (salt) lakes, and underground brines associated with petroleum deposits. In the Middle East, the Dead Sea is estimated to contain 1 billion tons of bromine. Seawater contains about 65 parts per million of bromine, or an estimated 100 trillion tons. Bromine is also recovered from seawater as a coproduct during evaporation to produce salt.

**Substitutes:** Chlorine and iodine may be substituted for bromine in a few chemical reactions and for sanitation purposes. There are no comparable substitutes for bromine in various oil and gas well completion and packer applications that do not harm the permeability of the production zone and that control well "blowouts." Because plastics have a low ignition temperature, alumina, magnesium hydroxide, organic chlorine compounds, and phosphorus compounds can be substituted for bromine as fire retardants in some uses. Bromine compounds and bromine acting as a synergist are used as fire retardants in plastics, such as those found in electronics.

<sup>e</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Imports calculated from items shown in Tariff section.

<sup>2</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>3</sup>See Appendix C for resource/reserve definitions and information concerning data sources.

<sup>4</sup>Excludes U.S. production.