

## 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 also is 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>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013<sup>e</sup></b>
Production	W	W	W	W	W
Imports for consumption, elemental bromine and compounds <sup>1</sup>	36,000	45,400	47,300	53,100	46,000
Exports, elemental bromine and compounds	6,130	8,150	7,150	6,430	5,000
Consumption, apparent	W	W	W	W	W
Employment, number <sup>e</sup>	1,000	950	950	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 (2009–12):** Israel, 79%; China, 11%; Germany, 5%; and other, 5%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–13</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	2903.79.1000	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 one of the leading bromine producers in the world, the United States' dominance has decreased as other countries, especially Israel and Jordan, strengthened their positions as world producers of elemental bromine. In March 2013, a project in Jordan was completed to double capacity to 100,000 tons per year at the joint-venture bromine operation of a United States bromine company and a Jordanian company. China also is a significant bromine producer; environmental restrictions to protect farmland, limits to plant expansions, and shutdowns of unlicensed bromine operations have stabilized production levels in China. Although companies did not announce prices for bromine and bromine compounds in 2013, prices were thought to have remained relatively stable.

An official publication from the Government of Jordan listed unexpectedly high bromine production beginning in 2010. Discrepancies between reported capacity and production estimates possibly could be the result of double counting of bromine production and derivative compounds. The discrepancies remained unexplained, although the company in Jordan reports bromine production capacity of about 100,000 tons.

The leading use of bromine is in flame retardants; this use, however, is in decline because of the environmental considerations and potential health effects related to specific bromine flame-retardant compounds. In 2010, U.S. 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 yearend 2013.

The use of bromine to mitigate mercury emissions at powerplants was a growth market for bromine producers. 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:** Because revised data indicated that bromine had not been produced in Spain since 1999, the country was removed from this table, although large bromine reserves may exist there.

	Production		Reserves <sup>3</sup>
	2012	2013 <sup>e</sup>	
United States	W	W	11,000,000
Azerbaijan	3,500	3,500	300,000
China	100,000	100,000	NA
Germany	1,500	1,500	NA
India	1,500	1,500	NA
Israel	174,000	180,000	NA
Japan	20,000	20,000	NA
Jordan	200,000	250,000	NA
Turkmenistan	150	480	700,000
Ukraine	4,100	4,100	NA
World total (rounded)	<sup>4</sup> 505,000	<sup>4</sup> 560,000	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.

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

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