



2014 Minerals Yearbook

ARSENIC [ADVANCE RELEASE]

ARSENIC

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In 2014, the United States produced no arsenic and relied mainly on Morocco and China for arsenic trioxide and China for arsenic metal. No arsenic trioxide or commercial-grade arsenic metal has been produced domestically since 1985 following the closure of the ASARCO Incorporated copper smelter in Tacoma, WA. Arsenic trioxide was used mostly for the production of arsenic acid used in the formulation of chromated copper arsenate (CCA), a pesticide and preservative used to treat wood products for nonresidential applications such as guard rails, pilings, posts, railroad ties, and utility poles. Arsenic compounds were used in fertilizers, fireworks, glassmaking, herbicides, and insecticides. Arsenic metal was used for electronics applications and in nonferrous alloys. In 2014, estimated world production of arsenic trioxide was 36,400 metric tons (t). Production data for arsenic metal were not available.

Environmental and Human Health Issues

Arsenic, a naturally occurring element, may be present in drinking water as a result of weathering of arsenic-containing compounds or various human activities such as pesticide application and coal burning. Two recent U.S. Geological Survey (USGS) Scientific Investigations Reports addressed the occurrence of arsenic in drinking water or drinking water sources. USGS Scientific Investigations Report 2013–5107 presented the results of studies of five watersheds in New Jersey which analyzed the biogeochemical processes that affect arsenic mobility in groundwater discharge, streams, and stream sediments (Barringer and others, 2013, p. 2). USGS Scientific Investigations Report 2014–5051 documented the occurrence of selected chemical constituents to assess the vulnerability of the Denver Basin to groundwater contamination from geologic materials and from human activities (Musgrove and others, 2014, p. 2).

Consumption

In 2003, domestic manufacturers of CCA began a voluntary transition from CCA to alternative wood preservatives in residential uses that resulted in about a two-thirds decrease in 2004 in domestic consumption of arsenic. In 2014, domestic apparent consumption of arsenic, based on imports, was 5,940 t, a decrease of 13% from 6,810 t in 2013. The estimated value of arsenic compounds and metal consumed domestically in 2014 was approximately \$6.2 million. Domestic consumers of arsenic trioxide to produce CCA were Arch Wood Protection, Inc. (Norwalk, CT), Koppers Inc. (Pittsburgh, PA), and Viance LLC (Charlotte, NC).

Arsenic metal was used, along with antimony, to harden ammunition, in solders, and in other applications. Grids and posts in lead-acid storage batteries are strengthened by the

addition of arsenic metal. Arsenic is one of several metals used as an antifriction additive in babbitt metals (alloys that are used for bearings). High-purity (99.9999%) arsenic metal was used to produce gallium-arsenide (GaAs), indium-arsenide, and indium-gallium-arsenide semiconductors that were widely used in biomedical, communications, computer, electronics, and photovoltaic applications. Arsenic may be used for germanium-arsenide-selenide or GaAs specialty optical materials. The value of worldwide GaAs device sales was \$6.9 billion in 2014, an increase of 16% from that in 2013 (Higham, 2015). (For more information on GaAs use, see the Gallium chapter of the 2013 Minerals Yearbook, volume I, Metals and Minerals.)

Prices

There was little change in the overall arsenic market in 2014 compared with that in 2013. According to U.S. Census Bureau data, the value of arsenic trioxide originating from Morocco averaged 30 cents per pound, an increase of 11% from that in 2013. Prices for arsenic metal from China averaged 75 cents per pound, an increase of 3% from that in 2013.*

Foreign Trade

In 2014, domestic imports of arsenic compounds were estimated to contain about 5,260 t of contained arsenic, a decrease of 16% compared with the 6,290 t imported in 2013 (table 1). Arsenic trioxide contains about 76% arsenic. In 2014, Morocco was the source of 50% of the arsenic trioxide imported into the United States, China was the source of 40%, and Belgium was the source of 10% (table 2).

In 2014, the United States imported 688 t of arsenic metal, a 34% increase compared with the 514 t of arsenic metal imported in 2013. China was the leading source of arsenic metal in 2013, accounting for 90% of U.S. metal imports (table 2).

According to U.S. Census Bureau data, exports of arsenic metal from the United States in 2014 increased to 2,950 t from 1,630 t in 2013. Export destinations included the United Kingdom (25%), Honduras (22%), Sweden (14%), Colombia (11%), France (8%), Guatemala (8%), and Jamaica (8%). Because the United States did not produce arsenic metal, it was thought that much of the material reported as metal under the Harmonized Tariff Schedule code 2480.80.0000 was arsenic-containing compounds and waste, as well as nonferrous alloys containing relatively minor quantities of arsenic. The exports also may have included arsenic-containing electronic waste, such as circuit boards and other electronic components destined for reclamation and recycling. Therefore, actual exports of arsenic metal may be significantly less than reported.

*Correction posted May 23, 2016.

World Review

In 2014, commercial-grade arsenic trioxide was thought to have been recovered from the processing of nonferrous ores or concentrates. Reduction of arsenic trioxide to arsenic metal accounted for all world output of commercial-grade (99%-pure) arsenic metal. Arsenic-containing residues and smelter dusts recovered from nonferrous metals plants in several countries may not have been processed to recover commercial-grade arsenic trioxide in 2014 and may have been stockpiled for future treatment or disposed. Production data for most countries were estimated.

In 2014, China produced approximately 25,000 t of arsenic trioxide and remained the world's leading producer, followed by Morocco with 8,800 t. In China, in addition to reclaiming arsenic as a byproduct of nonferrous smelting, arsenic was recovered as a byproduct of gold mining from orpiment (As_2S_3) and realgar (AsS), the more common ore minerals of arsenic (Peters and others, 2002, p. 182).

Outlook

Specific industrial applications, such as marine timber, plywood roofing, and utility poles, are expected to continue to use CCA-treated wood. High-purity arsenic is used in military, solar cell, space, and telecommunications applications. The use of GaAs components in cellular handsets and the increased penetration of GaAs-based light-emitting diodes in general and automotive lighting applications are expected to increase arsenic metal consumption.

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TABLE 1
SALIENT ARSENIC STATISTICS¹

(Metric tons of arsenic content unless otherwise specified)

	2010	2011	2012	2013	2014
Imports:					
Metal ²	769	628	883	514	688
Compounds	4,530	4,990	5,740	6,290	5,260
Total	5,300	5,620	6,620	6,810	5,940
Exports, metal ²	481	705	439	1,630	2,950
Apparent consumption ³	5,300	5,620	6,620	6,810	5,940
Price, cents per pound, average: ⁴					
Metal (China)	72	74	75	72	75 *
Trioxide (Morocco)	20	22	24	27	30

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Listed as metal only, but may include alloys, waste, and compounds.

³Estimated to be the same as imports.

⁴Landed duty-paid unit based on U.S. imports for consumption.

*Correction posted May 23, 2016.

TABLE 2
U.S. IMPORTS FOR CONSUMPTION OF ARSENIC PRODUCTS¹

Class and country	2013		2014	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Arsenic trioxide:				
Belgium	858	\$499	696	\$438
China	2,700	1,220	2,770	1,250
Hong Kong	580	261	--	--
Japan	(2)	4	(2)	6
Liechtenstein	(2)	4	--	--
Morocco	4,170	2,490	3,470	2,310
Spain	(2)	2	--	--
Total	8,310	4,470	6,940	4,000
Arsenic acid, Japan	2	16	--	--
Arsenic metal:				
China	424	674	618	1,020
Germany	6	448	8	639
Hong Kong	19	24	--	--
Japan	64	719	62	547
Mexico	(2)	3	--	--
United Kingdom	(2)	15	(2)	5
Total	514	1,880	688	2,210

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 3
 ARSENIC TRIOXIDE: ESTIMATED WORLD PRODUCTION, BY COUNTRY^{1,2,3}

(Metric tons)

Country	2010	2011	2012	2013	2014
Belgium	1,000	1,000	1,000	1,000	1,000
Bolivia	155 ⁴	99 ⁴	104 ⁴	120 ^{r,4}	52 ⁴
China	25,000	25,000	26,000	25,000	25,000
Japan	40	45	45	45 ^r	45
Morocco	13,731 ⁴	8,154 ⁴	8,820 ^{r,4}	8,968 ^{r,4}	8,800
Portugal	15	15	15	--	--
Russia	1,500	1,500	1,500	1,500	1,500
Total	41,400 ^r	35,800 ^r	37,500 ^r	36,600 ^r	36,400

^rRevised. -- Zero.

¹Includes calculated arsenic trioxide equivalent of output of elemental arsenic compounds other than arsenic trioxide; inclusion of such materials would not duplicate reported arsenic trioxide production.

²World totals and estimated data have been rounded to no more than three significant digits; may not add to totals shown.

³Includes data available through April 30, 2015.

⁴Reported figure.