

# ARSENIC

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As has been the case since 1985, the United States recorded no domestic production of arsenic and, consequently, remained dependent on imports. Nearly all domestic imports were in compound form, primarily as arsenic trioxide, although some arsenic metal was also imported. China remained the principal supplier of arsenic and its compounds to the U.S. market.

## Legislation and Government Programs

On January 23, the U.S. Environmental Protection Agency and ASARCO Incorporated signed a historic agreement regarding alleged hazardous waste and water violations at two of Asarco's facilities (Environmental Protection Agency, 1998). This agreement represents the first time that the Government agreed to a consolidated settlement with a company regarding violations of different statutes at different facilities. Asarco agreed to pay \$50 million to reduce heavy metal discharges, including arsenic discharges, at its Ray Mine complex in Arizona. Also noteworthy in the agreement was Asarco's commitment to establish a court-enforced environmental management system to identify and correct the causes of the company's noncompliance with environmental regulations. The new system will be implemented at Asarco's 38 facilities in 6 States (Environmental Protection Agency, 1998).

## Consumption

Trade data indicated that the United States, with an estimated apparent demand of more than 30,000 metric tons (t), probably remained the world's largest consumer of arsenic. More than 95% of the arsenic consumed domestically was estimated to have been in compound form, primarily arsenic trioxide. The largest end use for arsenic trioxide was in the production of wood preservatives. Although apparent demand for arsenic trioxide in wood preservatives increased significantly in 1998, additions to industry stocks may have absorbed much of this material. The three principal producers of arsenical wood preservatives were Hickson Corp., Smyrna, GA, Chemical Specialties Inc., Harrisburg, NC, and Osmose Wood Preserving, Inc., Buffalo, NY. Osmose also produces arsenic acid that is used by the glass industry as a fining agent to disperse air bubbles.

Arsenic metal was consumed in the production of some nonferrous alloys. These were used in the manufacture of lead-acid batteries and in a semiconductor material. Arsenic metal was used as a minor additive (0.01% to 0.5%) to increase

strength in the posts and grids of lead-acid storage batteries and to improve corrosion resistance and tensile strength in copper alloys.

An estimated 15 t of high-purity arsenic metal (99.9999%-pure or higher) was used in the manufacture of crystalline gallium arsenide, a semiconducting material used in optoelectronic circuitry, high-speed computers, and other electronic devices.

Arsenic was used in some herbicides for weed control. ISK Bioscience Corp., Mentor, OH, produced the arsenical herbicide monosodium methanearsonate at a plant in Houston, TX.

## World Review

Arsenic trioxide was recovered from the smelting or roasting of nonferrous metal ores or concentrates in at least 18 countries. High-arsenic smelter or roaster dusts and residues that usually are not processed to commercial-grade trioxide were recovered in several other countries, as well as at plants in countries producing commercial-grade material. This material was frequently stockpiled and could be available for future processing. Most countries did not report their arsenic production, and world production values had a high degree of uncertainty. China was the world's largest producer, as well as the major source of U.S. imports.

Commercial-grade (99%-pure) arsenic metal, produced through the reduction of arsenic trioxide, accounted for the majority of world arsenic metal production. China may have accounted for nearly all the world's production of commercial-grade arsenic metal.

Approximately 10 companies produced high-purity arsenic (99.9999%-pure or higher), for use in the semiconductor industry.

## Outlook

Despite environmental regulation that has led to global dislocations of production over the past decade, including cessation of production in two historically large producing countries, Sweden and the United States, new suppliers have emerged to fill the void. Although environmental pressures may continue to cause curtailment of existing capacity, given the abundance of high-arsenic residues from nonferrous metal processing, world supplies of arsenic trioxide are expected to remain adequate to meet projected need. Environmental

regulation may, in fact, encourage commercial production from existing stockpiles of noncommercial material.

With the major market for arsenic being the production of arsenical wood preservatives, the demand for arsenic is closely tied to the home construction market, where wooden decks containing arsenical preservatives have become ubiquitous, and to the renovation of existing structures. As a result, future demand for arsenic is expected to follow the new home construction, and the replacement and renovation markets. Although the prohibition on use of chromated copper arsenate preservatives in certain applications and the greater acceptance of alternative preservatives may not have any significant impact in the short term, they could negatively affect future demand.

Continued growth in market share for maintenance-free automotive batteries, which require little or no arsenic, will likely lower the demand for arsenic metal.

### Reference Cited

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## SOURCES OF INFORMATION

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<sup>1</sup>Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1  
ARSENIC SUPPLY-DEMAND RELATIONSHIPS 1/

(Metric tons, arsenic content)

	1994	1995	1996	1997	1998
U.S. supply:					
Imports, metal	1,330	557	252	909	997
Imports, compounds	20,300	22,100	21,200	22,800	29,300
Total	21,600	22,700	21,400	23,700	30,300
Distribution of U.S. supply:					
Exports 2/	79	430	36	61	177
Apparent demand	21,500	22,300	21,400	23,700	30,100
Estimated U.S. demand pattern:					
Agricultural chemicals	1,200	1,000	950	1,400	1,600
Glass	700	700	700	700	700
Wood preservatives	18,000	19,600	19,200	20,000	27,000
Nonferrous alloys and electronics	1,300	600	250	900	1,000
Other	300	400	300	300	300
Total	21,500	22,300	21,400	23,700	30,100

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Metal only.

TABLE 2  
U.S. IMPORTS FOR CONSUMPTION OF ARSENICALS 1/

Class and country	1997		1998	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Arsenic trioxide:				
Belgium	514	\$268	371	\$208
Bolivia	181	88	142	87
Canada	2	9	2	9
Chile	9,290	2,790	10,700	3,120
China	15,100	8,090	20,500	11,000
France	1,860	1,070	1,320	823
Germany	(2/)	4	(2/)	7
Hong Kong	550	245	3,340	1,990
Mexico	2,500	1,730	2,130	1,480
Spain	--	--	(2/)	5
Switzerland	(2/)	2	123	76
Total	30,000	14,300	38,600	18,800
Arsenic acid:				
Canada	1	5	--	--
China	106	50	--	--
France	2	8	(2/)	5
United Kingdom	8	23	--	--
Total	117	86	(2/)	5
Arsenic metal:				
Belgium	17	14	--	--
Canada	20	24	--	--
China	783	559	890	1,120
Germany	12	2,590	16	3,230
Hong Kong	60	53	57	57
Japan	13	1,640	17	1,940
Korea, Republic of	4	55	--	--
Taiwan	--	--	18	19
United Kingdom	(2/)	1	(2/)	3
Total	909	4,930	997	6,380

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 3  
ARSENIC TRIOXIDE: WORLD PRODUCTION, BY COUNTRY 1/ 2/ 3/

(Metric tons)

Country 4/	1994	1995	1996	1997	1998 e/
Belgium e/	2,000	2,000	2,000	2,000	1,500
Bolivia	341	362	255	282 r/	290
Canada e/	250	250	250	250	250
Chile	4,050 r/	4,076 r/	8,000 r/	8,350 r/	8,400
China e/	18,000	21,000	15,000	15,000	15,500
France e/	6,000	5,000	3,000	2,500	2,000
Georgia e/	500	400	400	400	400
Germany e/	300	250	250	250	250
Ghana	3,897	4,409	5,443	4,577	5,000
Iran e/	500	500	500	500	500
Japan e/	40	40	40	40	40
Kazakhstan e/	1,500	1,500	1,500	1,500	1,500
Mexico	4,400	3,620	2,942	2,999 r/	3,000
Namibia 5/	3,047	1,661	1,559 r/	1,232 r/	300
Peru e/ 6/	286 7/	285	285	285	285
Philippines e/	-- r/	-- r/	-- r/	-- r/	--
Portugal e/	150	100	100	50	50
Russia e/	1,500	1,500	1,500	1,500	1,500
Total	46,800 r/	47,000 r/	43,000 r/	41,700 r/	40,800

e/ Estimated. r/ Revised.

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

2/ World totals and estimated data have been rounded to three significant digits; may not add to totals shown.

3/ Table includes data available through March 3, 1999.

4/ Austria, Hungary, the Republic of Korea, South Africa, Spain, the United Kingdom, the former Yugoslavia, and Zimbabwe have produced arsenic and/or arsenic compounds in previous years, but information is inadequate to make estimates of output levels, if any.

5/ Output of Tsumeb Corp. Ltd. only. Tsumeb Mine closed in 1996, and the smelter and all operations closed in April 1998.

6/ Output of Empress Minera del Centro del Perú (Centromín Perú) as reported by the Ministerio de Energía y Minas.

7/ Reported figure.