ARSENIC

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In 2001, as has been the case since 1985, the United States had no domestic production of arsenic and remained dependent on imports to meet its arsenic needs. Although the United States imported some arsenic metal, most domestic arsenic imports were in compound form, primarily arsenic trioxide. China remained the principal supplier of arsenic and its compounds to the U.S. market.

Legislation and Government Programs

As part of its research efforts, the U.S. Geological Survey (USGS) investigated and gathered data on a broad range of national and international issues related to arsenic and its distribution and mobility in the environment. Activities included long-term assessments, ecosystem analysis, predictive modeling, and process research on the occurrence, distribution, transport, and fate of arsenic in the environment as well as the impacts of contaminants on biota. Much of this work was conducted in partnership with other Federal and State agencies.

The Cheney Reservoir watershed in Kansas was the subject of a USGS water-resources report published in early 2001 (Mau, 2001). Sediment deposition, water-quality trends, and mass transport of phosphorus, nitrogen, selected pesticides, and selected trace elements, including arsenic, were examined. Analyses of selected sediment core samples found concentration levels of arsenic at many sites that could adversely affect aquatic organisms. Higher levels of arsenic were found nearer the dam than upstream. Given the lack of industrial or commercial land use in the watershed, the USGS concluded that the high arsenic concentrations could be the result of natural conditions.

The USGS also issued a report on water quality in the lower Illinois River Basin in central Illinois (Groschen and others, 2001). Water samples were collected to determine the level of nitrate, phosphorus, pesticides, volatile organic carbon compounds, and radon-222 in streams and ground water. Although 2 of the 30 wells tested had arsenic levels exceeding 50 parts per billion, the arsenic was regarded as naturally occurring.

In late October, the U.S. Environmental Protection Agency (EPA) announced that the permissible level of arsenic in drinking water would be reduced from 50 parts per billion to 10 parts per billion (U.S. Environmental Protection Agency, 2001). Public water systems have until 2006 to comply with the new standard.

Consumption

Trade data indicated that the United States, with an estimated demand of nearly 25,000 metric tons (t) in 2001, remained the world's largest consumer of arsenic. The estimated value of arsenic consumed domestically during the year was approximately $23 million. More than 95% of the arsenic consumed 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. The three principal producers of arsenical wood preservatives were Arch Wood Protection Inc., Smyrna, GA; Chemical Specialties Inc., Charlotte, NC; and Osmose Wood Preserving, Inc., Buffalo, NY. Osmose also produced arsenic acid that was used by the glass industry as a fining agent to disperse air bubbles. Arsenic also was used in some herbicides for weed control.

Arsenic metal was used as an additive to improve corrosion resistance and tensile strength in copper alloys and as a minor additive (0.01% to 0.5%) to increase the strength of the posts and grids in some lead-acid storage batteries. High-purity arsenic metal (99.9999% pure or higher) was used in the manufacture of gallium arsenide, a semiconductor used in various electronic devices, including wireless telephones and high-speed computers. Estimated consumption of high-purity arsenic metal fell to less than 30 t in 2001, reflecting a decrease in demand for various electronic products.

World Review

Arsenic trioxide was recovered from the smelting or roasting of nonferrous metal ores or concentrates in at least 15 countries in 2001. 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. Much of this material was stockpiled and could be available for future processing. Most countries did not report their arsenic production, and estimates of world production quantities had a high degree of uncertainty. China remained the world's largest producer in 2001.

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

Outlook

Given the abundance of arsenic in various waste streams, including nonferrous metal processing, world supplies of arsenic trioxide are expected to remain adequate to meet projected needs.

For the past two decades, most arsenic was consumed in the production of arsenical wood preservatives used in home construction and renovation and in commercial applications,

and arsenic demand was believed to have correlated with the homebuilding market for many years. In early 2002, the EPA announced that the wood-preserving industry had voluntarily decided to eliminate arsenical wood preservatives from residential applications by yearend 2003 (U.S. Environmental Protection Agency, 2002). While not eliminating all uses for arsenical wood preservatives, the decision will significantly reduce future demand for arsenic. Ammoniacal copper quaternary, copper azole, copper citrate, and copper dimethyldithiocarbamate are some of the alternative wood preservatives available that do not use arsenic. Concrete, steel, or plastic lumber may be substituted in some applications for treated wood.

Continued growth in the use of maintenance-free motor vehicle batteries, which require little or no arsenic, will lower the demand for arsenic metal in lead-acid storage batteries; this decline, however, is likely to be offset somewhat by increased consumption of arsenic in the form of gallium arsenide to manufacture semiconductors.

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TABLE 1
ARSENIC SUPPLY-DEMAND RELATIONSHIPS 1/

(Metric tons, arsenic content)

	1997	1998	1999	2000	2001
U.S. supply:					
Imports, metal	909	997	1,300	830	1,030
Imports, compounds	22,800	29,300	22,100	23,600	23,900
Total	23,700	30,300	23,400	24,500	25,000
Distribution of U.S. supply:					
Exports 2/	61	177	1,350	41	57
Apparent demand	23,700	30,100	22,000	24,400	24,900
Estimated U.S. demand pattern:					
Agricultural chemicals	1,400	1,500	1,100	-- r/	--
Glass	700	700	700	700	700
Wood preservatives	20,000	27,000	19,000	22,000 r/	23,000
Nonferrous alloys and electronics	900	1,000	1,300	800	1,000
Other	300	300	300	300	300
Total	23,700	30,100	22,000	23,800 r/	25,000

r/ Revised. -- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Metal only.

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

	2000		2001	
Class and country	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Arsenic trioxide:				
Belgium	576	$356	193	$129
Bolivia	212	118	120	68
Canada	1	2	--	--
Chile	9,110	3,620	5,110	2,070
China	15,400	7,800	17,800	9,250
France	1,340	871	319	210
Germany	4	15	18	20
Hong Kong	406	232	344	163
Mexico	1,900	1,330	1,810	1,120
Morocco	2,180	1,150	5,800	2,850
Total	31,100	15,500	31,500	15,900
Arsenic acid, Canada	--	--	2	3
Arsenic sulfide, Canada	--	--	(2/)	5
Arsenic metal:				
Chile	--	--	79	84
China	612	694	741	1,220
France	--	--	(2/)	3
Germany	21	3,410	6	1,210
Hong Kong	41	36	58	51
Japan	157	5,660	143	4,730
Singapore	--	--	1	62
United Kingdom	(2/)	2	2	34
Total	830	9,800	1,030	7,390

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Less than 1/2 unit.

Source: U.S. Census Bureau.

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

(Metric tons)

Country 4/	1997	1998	1999	2000	2001 e/
Belgium e/	2,000	1,500	1,500	1,500	1,000
Bolivia	282	284	437	318 r/	300
Canada e/	250	250	250	250	250
Chile	8,350	8,400	8,000 e/	8,000 r/ e/	8,000
China e/	15,000	15,500	16,000	16,000	16,000
France e/	2,500	2,000	1,000	1,000	1,000
Georgia e/	400	400	400	400	400
Germany e/	250	200	200	200	100
Ghana 5/	4,577	5,000	7,000 e/	3,000 e/	--
Iran e/	492 6/	323 r/ 6/	300 r/	400 r/	400
Japan e/	40	40	40	40	40
Kazakhstan e/	1,500	1,500	1,500	1,500	1,500
Mexico	2,999	2,573	2,419	2,522 r/	2,500
Namibia 7/	1,297	175	--	-- e/	--
Peru 8/	637 r/	624 r/	1,611 r/	2,495 r/	2,500
Portugal e/	50	50	50	50	50
Russia e/	1,500	1,500	1,500	1,500	1,500
Total	42,000 r/	40,300 r/	42,200 r/	39,200 r/	35,500

e/ Estimated. r/ Revised. -- Zero.

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 no more than three significant digits; may not add to totals shown.

3/ Table includes data available through April 1, 2002.

4/ Austria, Hungary, the Republic of Korea, South Africa, Spain, the United Kingdom, 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/ Production ceased in mid-2000. Ashanti Goldfields Ltd. Obuasi roaster closed.

6/ Reported.

7/ Output of Tsumeb Corp. Ltd. only; the smelter closed in April 1998.

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