## **ARSENIC**

(Data in metric tons of arsenic unless otherwise noted)

<u>Domestic Production and Use</u>: Arsenic trioxide and arsenic metal have not been produced in the United States since 1985. Owing to environmental concerns and a voluntary ban on the use of arsenic trioxide for the production of chromated copper arsenate (CCA) wood preservatives at yearend 2003, imports of arsenic trioxide averaged 6,900 tons annually during 2004–09 compared with imports of arsenic trioxide that averaged more than 20,000 tons annually during 2001–03. Ammunition used by the United States military was hardened by the addition of less than 1% arsenic metal, and the grids in lead-acid storage batteries were strengthened by the addition of arsenic metal. Arsenic metal was also used as an antifriction additive for bearings, in lead shot, and in clip-on wheel weights. Arsenic compounds were used in fertilizers, fireworks, herbicides, and insecticides. High-purity arsenic (99.9999%) was used by the electronics industry for gallium-arsenide semiconductors that are used for solar cells, space research, and telecommunication. Arsenic was also used for germanium-arsenide-selenide specialty optical materials. Indium gallium arsenide was used for short-wave infrared technology. The value of arsenic compounds and metal consumed domestically in 2010 was estimated to be about \$4 million.

Salient Statistics—United States:	<u>2006</u>	<u> 2007</u>	2008	<u>2009</u>	2010 <sup>e</sup>
Imports for consumption:	· · · · · · · · · · · · · · · · · · ·	·			
Metal	1,070	759	376	438	980
Trioxide	9,430	7,010	4,810	4,660	4,900
Exports, metal	3,060	2,490	1,050	354	390
Estimated consumption <sup>1</sup>	7,450	5,280	4,130	4,740	5,500
Value, cents per pound, average:2					
Metal (China)	62	122	125	121	120
Trioxide (China)	21	23	23	18	20
Net import reliance <sup>3</sup> as a percentage of					
estimated consumption	100	100	100	100	100

**Recycling:** Electronic circuit boards, relays, and switches may contain arsenic. These scrap materials should be disposed of at sites that recycle arsenic-containing, end-of-service electronics or at hazardous waste sites. Arsenic contained in the process water at wood treatment plants where CCA was used was recycled. Arsenic was also recovered from gallium-arsenide scrap from semiconductor manufacturing. There was no recovery or recycling of arsenic from arsenic-containing residues and dusts at nonferrous smelters in the United States.

Import Sources (2006–09): Metal: China, 85%; Japan, 12%; and other, 3%. Trioxide: Morocco, 52%; China, 40%; Belgium, 5%; and other, 3%.

Tariff: Item	Number	Normal Trade Relations 12-31-10
Metal	2804.80.0000	Free.
Acid	2811.19.1000	2.3% ad val.
Trioxide	2811.29.1000	Free.
Sulfide	2813.90.1000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

**Events, Trends, and Issues:** Apparent exports of arsenic metal have increased and, arsenic-containing "e-waste" such as computers and other electronics, destined for reclamation and recycling, may have been included in this export category. The exported arsenic metal may also have been intended for use in electronics applications. In 2010, the main export destinations for this category were Honduras (43%), Chile (28%), and Canada (21%).

In 1975, the Safe Drinking Water Act mandated that the U.S. Environmental Protection Agency (EPA) identify and regulate drinking water contaminants, such as arsenic, that may have adverse effects on human health. Ongoing applied research technology showed that 60% of total arsenic in source water at test sites in California, Minnesota, Nevada, New Hampshire, and Wisconsin, was removed.

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According to university medical research scientists, the ability to have an immune response to H1N1 (Swine Flu) infection was compromised by low levels of arsenic exposure from contaminated well water. Researchers noted that Mexico has areas of high arsenic in well water that include locations where H1N1 was first identified. Laboratory experiments on mice showed that morbidity for arsenic-exposed mice was significantly higher than for lab mice similarly exposed to H1N1, and researchers concluded that arsenic exposure disrupts the immune system and the endocrine system.

Nanotechnology may help alleviate water-pollution problems by removing contaminants such as arsenic, mercury, and pesticides. University researchers have used nanoparticles of iron or "nanorust" to remove arsenic from drinking water. The large surface area of nanorust and the magnetic interaction means that 100 times more arsenic can be captured using nanorust filtration than with filtration systems using larger particles. A chemical-free method to remove arsenic from well water was used in India. The treatment system contains a nozzle that sprays oxygen into water from arsenic-bearing aquifers. The oxygenated water oxidizes iron adsorbed from the groundwater into an iron compound that removes the arsenic as a coprecipitate.

In response to human health issues, the wood-preserving industry made a voluntary decision to stop using CCA to treat wood used for decks and outdoor residential use by yearend 2003. However, because of known performance and lower cost, CCA may still be used to treat wood used for nonresidential applications. Arsenic may also be released from coal-burning powerplant emissions. Human health concerns, environmental regulation, use of alternative wood preservation material, and the substitution of concrete or plasticized wood products will affect the long-term demand for arsenic.

## **World Production and Reserves:**

World Froduction and Reserve	Production (arsenic trioxide)		Reserves <sup>4</sup>
	2009	2010 <sup>e</sup>	
Belgium	1,000	1,000	
Chile	11,000	11,500	World reserves are thought to be
China	25,000	25,000	about 20 times annual world
Kazakhstan	1,500	1,500	production.
Mexico	500	1,000	·
Morocco	8,500	8,000	
Peru	4,850	4,500	
Russia	1,500	1,500	
Other countries	505	<u>500</u>	
World total (rounded)	54,400	54,500	

<u>World Resources</u>: Arsenic may be obtained from copper, gold, and lead smelter dust as well as from roasting arsenopyrite, the most abundant ore mineral of arsenic. Arsenic was recovered from realgar and orpiment in China, Peru, and the Philippines; from copper-gold ores in Chile; and was associated with gold occurrences in Canada. Orpiment and realgar from gold mines in Sichuan Province, China, were stockpiled for later recovery of arsenic. Arsenic also may be recovered from enargite, a copper mineral. Global resources of copper and lead contain approximately 11 million tons of arsenic.

<u>Substitutes</u>: Substitutes for CCA in wood treatment include alkaline copper quaternary, ammoniacal copper quaternary, ammoniacal copper zinc arsenate, copper azole, and copper citrate. CCA-treated wood substitutes include concrete, steel, plasticized wood scrap, or plastic composite material. The use of silver-containing biocides is being considered as an alternative wood preservative in some humid areas.

eEstimated.

<sup>&</sup>lt;sup>1</sup>Estimated to be the same as net imports.

<sup>&</sup>lt;sup>2</sup>Calculated from U.S. Census Bureau import data.

<sup>&</sup>lt;sup>3</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>&</sup>lt;sup>4</sup>See Appendix C for resource/reserve definitions and information concerning data sources.