



2017 Minerals Yearbook

MERCURY [ADVANCE RELEASE]

MERCURY

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In 2017, mercury was produced in the United States as a byproduct of processing gold-silver ores, mainly in Nevada, and may have been produced as a byproduct of processing other metal ores. Secondary mercury was recovered from end-of-service automobile convenience switches, dental amalgam, electronic waste, fluorescent lamps and compact fluorescent lamps (CFLs), laboratory and medical measuring devices, mercury-contaminated waste, and thermostats. About 20,300 kilograms (kg) of mercury was imported in 2017, 16% less than that in 2016, representing the third consecutive year of decline (table 1).

The global use of mercury continued to decline in 2017 owing to environmental and health concerns. Unable to sell it to an oversupplied domestic market and precluded from exporting it, mining and recycling companies placed additional byproduct mercury into permanent storage. However, the use of mercury in artisanal and small-scale gold mining (ASGM) operations and in the production of vinyl chloride monomer (VCM) in China continued to be substantial, and mercury consumption for these uses was estimated to have increased in 2017. Globally, ASGM accounted for about 37% of mercury consumption, and VCM production accounted for about 25% (United Nations Environment Programme, 2017, p. 62).

Production

Mercury was last produced as a principal product in the United States in 1992 when the McDermitt Mine in northern Nevada closed. Since then, mercury has been recovered chiefly as a byproduct of processing gold-silver ores, mainly in Nevada. Since 1998, data on the amount of primary and secondary mercury produced in the United States have not been available.

Mercury was reclaimed from end-of-service automobile convenience switches, dental amalgam, electronic waste, fluorescent lamps and CFLs, laboratory and medical measuring devices, mercury-contaminated waste, and thermostats. Reclaimed mercury was either sold to domestic customers or placed in permanent storage.

Consumption

Based on industry trends and data in trade literature, domestic consumption of mercury was estimated to be less than 40,000 kg in 2017. Consumption continued to decrease as mercury was eliminated from more consumer and industrial products. Some of the domestic uses were in batteries, dental amalgam, lighting, measuring devices, switches and relays, and thermostats (Interstate Mercury Education and Reduction Clearinghouse, 2015).

Mercury was used as a cathode in chloralkali production; however, most of the mercury was recycled internally, and only a small quantity of additional or make-up mercury was required. The chloralkali industry continued to shift away from

using mercury cell technology with only two mercury cell plants remaining in the United States in 2017—one in Ashtabula, OH (ASHTA Chemicals Inc.), and one in New Martinsville, WV (Westlake Chemical Corp.) (United Nations Environment Programme, 2017, p. 14).

Prices

The average European Union price, minimum 99.99% mercury, published by Argus Media group – Argus Metals International, was \$1,041.27 per flask in 2017, 26% less than the average price in 2016 and 69% less than the highest average price in 2013 (table 1). The quoted price range for mercury started the year at \$950 to \$1,100 per flask and rose to \$1,100 to \$1,250 per flask by yearend. Prices of mercury in the European Union and the United States were generally lower than those in other regions because a surplus of mercury existed as a result of export bans and reduced consumption (United Nations Environment Programme, 2017, p. VIII). One flask of mercury weighs 34.5 kg, and 1 metric ton (t) of mercury is equivalent to approximately 29 flasks.

Foreign Trade

Beginning on January 1, 2013, U.S. exports of elemental mercury were banned, except when the following criteria are met: there are no alternatives to mercury use for a specified application, mercury is not available from other sources in the destination country, the destination country supports the export ban exemption, the exported mercury will be used at a specific facility, and the mercury will be handled in a manner to protect human health and the environment. In 2013, 90 kg of mercury was exported to South Africa under this exemption and, in 2015, 30 kg of mercury was exported to Mexico.

In 2017, mercury imports were 20,300 kg valued at \$284,000 compared with 24,300 kg valued at \$276,000 in 2016. France (50%), Canada (37%), and Switzerland (10%) were the leading sources of mercury imported into the United States in 2017 (table 2).

In 2017, 22,800 kg of amalgam valued at \$67.2 million was imported into the United States, which was 13% more than the quantity imported in 2016. Amalgam is defined as mercury alloyed with one or more metals, but amalgam imports may include mercury-containing chlorine-caustic soda waste. Principal amalgam source countries were Germany (41%), South Africa (18%), Italy (8%), India (7%), Japan (6%), and Argentina (5%) (table 3). In 2017, 112,000 kg of amalgam valued at \$479 million was exported from the United States, 5% more than the quantity exported in 2016. Principal destinations for these exports were China (20%), Mexico (15%), Canada (12%), and India (12%) (table 3).

World Review

In 2017, world mercury mine production was estimated to be 3,790 t (table 4). China (3,380 t) was the world's leading producer of mercury, and Mexico was a leading exporter of mercury, most of which was produced in Mexico. World mercury production estimates have a high degree of uncertainty because most companies and countries do not report principal mine, byproduct mine, or recycling data for mercury. Only four countries had primary mercury mines—China, Indonesia, Kyrgyzstan, and Mexico. Other countries, including China and Mexico, that produced mercury recovered it as a byproduct of other metal mining. Relatively high gold prices and ongoing demand (especially for ASGM and VCM production) combined with uncertain supply in recent years have contributed to increases and volatility in the free market price of mercury, which in turn have encouraged new mercury mining in Indonesia and Mexico (United Nations Environment Programme, 2017, p. 5, 7, 9–10). Quantities may appear erratic from year to year because production may not be reported until it is shipped and stockpiling may take place prior to shipment (table 4).

In October 2013, representatives of 92 countries signed the terms of the Minamata Convention, a global treaty that addresses releases of mercury into the environment. The convention, when ratified, will require participating countries to develop strategies to reduce and, if possible, eliminate the use of mercury. Among the convention's conditions are the phasing out of primary mercury mining; ceasing the manufacture, import, and export of many mercury-containing products by 2020; reducing or eliminating the use of mercury in ASGM; reducing mercury emissions by industrial plants; and planning for safe storage of waste mercury (United Nations Environment Programme, 2013, p. 1–6). In November 2013, the United States became the first country to ratify the convention; by yearend 2017, 128 countries had signed and 84 additional countries had ratified the convention (Minamata Convention on Mercury, 2018).

ASGM operations accounted for about 12% to 15% of the world's gold production and employed about 15 million people in remote and rural regions. This type of mining relies on rudimentary methods and technologies and was typically performed by miners with limited economic capital, who often operated in the informal economic sector, sometimes illegally. Countries where ASGM activities were observed were typically in regions where few economic alternatives were available for workers. ASGM tends to be even more attractive when the world gold price is elevated. Most of the mercury used in ASGM was not recycled and was released into the environment. The ASGM sector accounted for an estimated 37% of global mercury consumption (United Nations Environment Programme, 2017, p. 49–50, 81).

VCM production in China constituted 80% to 90% of world VCM production and was used to produce polyvinyl chloride (PVC), a widely used plastic. The majority of China's VCM facilities used a coal-based process that required the use of mercury. China represented about 99% of the mercury used by the VCM industry, with the remainder used in India and Russia. It was estimated that the VCM industry accounted for about 25% of global mercury consumption (U.S. Environmental

Protection Agency, 2016, p. 3–2; United Nations Environment Programme, 2017, p. 51, 62, 81).

The number of chloralkali plants that used mercury cell technology decreased worldwide to 34 plants in 2016 from 38 plants in 2015. Mercury emissions from chloralkali plants decreased to 4.38 metric tons per year (t/yr) in 2015 from 5.59 t/yr in 2015 (World Chlorine Council, 2017). Data for 2017 were not available. It was estimated that the chloralkali industry used about 6% of the mercury consumed globally (United Nations Environment Programme, 2017, p. 81).

Other major applications for mercury were, in descending order of consumption, measuring and control devices (7% of estimated global consumption), dental applications (6%), batteries (5%), electrical and electronic devices (3%), and lamps (3%) (United Nations Environment Programme, 2017, p. 81).

Mercury was also used in mercury compounds and other minor applications, which included catalysts, chemical intermediates, cosmetics such as eye makeup and skin-lightening creams, cultural and ritual uses, fungicides, laboratory chemicals, novelty items, paints, pesticides, pharmaceuticals, porosimeters, pycnometers, and traditional medicine. These applications accounted for about 8% of global consumption (United Nations Environment Programme, 2017, p. 59, 81).

Outlook

Global mercury use is expected to continue to decline as more countries enact restrictions and (or) bans on the use and trade of mercury. If the Minamata Convention is ratified by more of the 128 signatories, global mercury trade and use are expected to be further reduced, most significantly in countries where mercury is used for artisanal gold mining. As a result of reduced consumption and restrictions on sales and trade, mining and recycling companies are expected to place increasing quantities of byproduct mercury into permanent storage. Use of mercury in CFL and other fluorescent lighting may decrease owing to lower unit loading and increased sales of alternative light-emitting diode (LED) lighting. Mercury use in electronics and measuring devices is also expected to further decrease. Gallium alloys may provide nontoxic substitutes for mercury in a wide variety of applications that include electrical switches, liquid mirror telescopes, pumps, and sensors. Gallium can be alloyed with a variety of metals, including cesium, gold, lead, silver, and tin. Galinstan® alloy, which contains gallium, indium, and tin, is liquid at room temperatures and, owing to the low toxicity of its component metals, is used as a replacement for mercury in thermometers and is being investigated for use in switches and various measuring devices. Because it has higher reflectivity and lower density than mercury, Galinstan® alloy also is being considered as a replacement for mercury in liquid mirror telescopes for astronomy. Mercury-containing dental amalgam continues to decline in use, replaced by ceramic material with a more natural appearance. Closure of mercury cell chloralkali production facilities worldwide, owing to pressure from international environmental and health organizations, is expected to further reduce consumption and result in the release of large quantities of mercury for disposal, recycling, or storage.

Recycled mercury recovered from mercury cell chloralkali plants and commercial products and byproduct mercury recovered from domestic and foreign precious metals operations are expected to exceed domestic needs.

References Cited

- Interstate Mercury Education and Reduction Clearinghouse, 2015, Mercury-added product fact sheets: Boston, MA, Interstate Mercury Education and Reduction Clearinghouse, December. (Accessed April 28, 2016, at <http://www.newmoa.org/prevention/mercury/imerc/factsheets/>.)
- Minamata Convention on Mercury, 2018, Countries: Geneva, Switzerland, United Nations Environment Programme. (Accessed May 22, 2018, at <http://www.mercuryconvention.org/Countries/tabid/3428/Default.aspx>.)
- United Nations Environment Programme, 2013, Minamata Convention on Mercury—Text and annexes: Geneva, Switzerland, United Nations Environment Programme, October, 59 p. (Accessed June 7, 2017, at http://mercuryconvention.org/Portals/11/documents/Booklets/Minamata%20Convention%20on%20Mercury_booklet_English.pdf.)
- United Nations Environment Programme, 2017, Global mercury supply, trade and demand: Geneva, Switzerland, United Nations Environment Programme, 81 p. (Accessed May 28, 2018, at https://wedocs.unep.org/bitstream/handle/20.500.11822/21725/global_mercury.pdf?sequence=1&isAllowed=y.)
- U.S. Environmental Protection Agency, 2016, Report to Congress on the global supply and trade of elemental mercury: Washington, DC, U.S. Environmental Protection Agency, December, 55 p. (Accessed May 18, 2017, at https://www.epa.gov/sites/production/files/2017-01/documents/mercury_global_supply_and_trade_rtc_and_signed_transmittal_letters.pdf.)
- World Chlorine Council, 2017, WCC-Chlor-alkali industry mercury consumption and emissions in kg/year (absolute data): World Chlorine Council, July. (Accessed April 3, 2018, at <http://www.worldchlorine.org/wp-content/uploads/2017/07/WCC-Hg-reporting-for-2016.xlsx>.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.
- Materials Flow of Mercury in the Economies of the United States and the World, The. Circular 1197, 2000.
- Mercury. Ch. in Mineral Commodity Summaries, annual.
- Mercury. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
- Mercury (Hg). Ch. in Metal Prices in the United States Through 2010, Scientific Investigations Report 2012–5188, 2013.
- Mercury in the Environment. Professional Paper 713, 1970.

Other

- Economics of Mercury, The. Roskill Information Services Ltd., 1990.
- Materials Flow of Mercury in the United States, The. U.S. Bureau of Mines Information Circular 9412, 1994.
- Mercury. Ch. in Kirk-Othmer Encyclopedia of Chemical Technology, John Wiley and Sons, Inc., 2005.
- Mercury. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
- Mercury Process for Making Chlorine. Euro Chlor, 1998.
- United Nations Environment Programme.
- World Health Organization.

TABLE 1
SALIENT MERCURY STATISTICS¹

(Kilograms unless otherwise specified)

	2013	2014	2015	2016	2017	
United States:						
Imports for consumption	37,700	49,500	25,800	24,300	20,300	
Exports	90	--	30	--	--	
Price, average, European Union ²	dollars per flask	3,412	3,037	1,954	1,402	1,041
World, mine production	metric tons	2,320 ^r	2,770	3,300 ^r	3,670 ^r	3,790

^rRevised. -- Zero.

¹Table includes data available through June 27, 2018. Data are rounded to no more than three significant digits, except prices.

²Source: Argus Media group – Argus Metals International.

Note: Industrial secondary production, stockpile, and consumption data were not available.

TABLE 2
U.S. IMPORTS AND EXPORTS OF MERCURY, BY COUNTRY OR LOCALITY¹

Country or locality	2016		2017	
	Quantity, gross weight (kilograms)	Value (thousands)	Quantity, gross weight (kilograms)	Value (thousands)
Imports:				
Canada	14,800	\$156	7,530	\$112
Colombia	--	--	10	3
France	7,330	57	10,100	74
India	200	11	700	56
Japan	--	--	3	4
Switzerland	1,990	52	2,000	33
United Kingdom	--	--	2	2
Total	24,300	276	20,300	284
Exports	--	--	--	--

-- Zero.

¹Table includes data available through June 27, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 3
U.S. IMPORTS AND EXPORTS OF AMALGAMS¹ OF PRECIOUS METALS,
WHETHER OR NOT CHEMICALLY DEFINED, BY COUNTRY OR LOCALITY²

Country or locality	2016		2017	
	Quantity, gross weight (kilograms)	Value (thousands)	Quantity, gross weight (kilograms)	Value (thousands)
Imports:				
Argentina	1,630	\$12,800	1,200	\$8,840
Canada	526	599	329	577
Colombia	728	141	979	122
Germany	9,030 ^r	5,470 ^r	9,350	7,650
India	104	14	1,580	569
Italy	2,210	194	1,870	574
Japan	776	667	1,420	12,900
Mexico	93	649	45	684
South Africa	1,800	9,520	4,040	32,700
United Kingdom	2,690	3,700	498	1,540
Other	595 ^r	560 ^r	1,450	1,080
Total	20,200	34,300	22,800	67,200
Exports:				
Australia	35	28	137	30
Austria	20	44	11	39
Belgium	306	817	229	771
Brazil	327	1,950	59	289
Canada	13,400	11,300	13,500	14,900
China	15,600	9,790	22,000	36,900
France	485 ^r	173 ^r	420	339
Germany	3,310	2,630	8,460	6,660
Hong Kong	560	181	17	29
India	11,500	46,900	13,000	68,600
Italy	1,010	6,380	2,870	15,300
Japan	918	4,790	1,200	12,900
Korea, Republic of	8,140	9,580	6,650	6,730
Mexico	26,300	158,000	16,200	258,000
Netherlands	8,150	14,100	9,090	13,400
Peru	80	34	10	15
Saudi Arabia	407	3,980	274	3,980
Singapore	4,940	3,140	2,750	4,360
Taiwan	1,090	8,110	1,860	10,400
Thailand	302	1,420	1,640	8,410
United Kingdom	7,090	11,500	6,260	14,600
Other	2,940	2,670	5,200	2,400
Total	107,000	297,000	112,000	479,000

^rRevised.

¹Alloys of mercury with one or more other metals.

²Table includes data available through June 27, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 4
MERCURY: WORLD MINE PRODUCTION, BY COUNTRY OR LOCALITY¹

(Metric tons)

Country or locality ²	2013	2014	2015	2016	2017 ^P
Argentina	28	25 ^e	25 ^e	25 ^e	25 ^e
Chile ³	19	18 ^{r,e}	14 ^{r,e}	2 ^{r,e}	2 ^e
China ^e	1,820	2,260	2,800 ^r	3,250 ^r	3,380
Iran	10 ^r	12 ^r	14 ^r	--	--
Kyrgyzstan	71	48	46	40 ^{r,e}	20 ^e
Mexico ^{e,4}	266	301	306 ^r	262 ^r	197
Morocco ^e	8	8	5	5	10
Norway ^e	25	25	20	20	20
Peru, exports ³	45	40 ^e	35 ^e	40 ^e	40 ^e
Tajikistan ^e	30	35	30	30	100
United States ³	NA	NA	NA	NA	NA
Total	2,320 ^r	2,770	3,300 ^r	3,670 ^r	3,790

^eEstimated. ^PPreliminary. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through May 29, 2018. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Canada, Germany, India, Japan, the Netherlands, Russia, Spain, and Ukraine may have produced byproduct mercury, but available information was inadequate to make reliable estimates of output.

³Byproduct mercury.

⁴Based on net exports.