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MERCURY

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Mercury

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Mercury was last produced as a principal product in the United States in 1992 when the McDermitt Mine in northern Nevada closed. In 2012, mercury was produced as a byproduct of processing domestic gold-silver ores, mainly in Nevada, and may have been produced as a byproduct of processing other metals. Imported byproduct mercury was refined domestically and the mercury was resold. Mercury also was recovered from end-of-service fluorescent and compact fluorescent (CFL) lamps and mercury-containing automobile convenience switches, batteries, dental amalgam, electronic waste, medical devices, and thermostats. It is likely that the manufacture of switches and relays was the leading domestic use for mercury, based on industry trends. Large quantities of mercury were involved in the manufacture of chlorine using mercury-cell technology but most of that mercury was recycled in-plant. Data on domestic byproduct and recycled mercury production were not available.

Since 1927, the common unit for measuring and pricing mercury has been the "flask," which was set to conform to the historical measuring system used at Almaden, Spain (Myers, 1951). One flask of mercury weighs 34.5 kilograms (kg), and 1 metric ton (t) of mercury is the equivalent to approximately 29 flasks. The flask itself is a screw-top, welded-steel container that is approximately the size of a 2-liter bottle.

Legislation and Government Programs

Under the terms of the Mercury Export Ban Act of 2008, the U.S. Government banned exports of elemental mercury after December 31, 2012. The Act also prohibited any Federal agency from conveying, selling, or distributing elemental mercury under the control or jurisdiction of a Federal agency (U.S. Congress, 2008).

In January 2012, the U.S. Environmental Protection Agency (EPA) incorporated new ASTM International standards in its final rule for the use of alternatives to mercury-containing thermometers, such as platinum resistance thermometers, thermistors, thermocouples, and portable electronic thermometers, for certain laboratory and field applications for petroleum refining, power generation, and polychlorinated biphenyl waste disposal. EPA determined that alternatives were readily available and comparable to mercury-containing thermometers in performance. The final rule became effective on March 19 (U.S. Environmental Protection Agency, 2012d).

In December, the EPA finalized changes to the Clean Air Act standards concerning mercury emissions from boilers and incinerators. The new standard was expected to reduce domestic mercury emissions by 2 to 3 metric tons per year (t/yr) from boilers and incinerators. Only the largest and highest emitting operations would be required to add pollution controls to meet the regulatory standards. The other operations would either be required to perform annual maintenance to minimize emissions or be excluded from the standard owing to their use of clean-burning fuels. The final ruling improves flexibility when implementing the requirements of the standard and reduces implementation costs. Full compliance is required by 2016 for major boilers and 2018 for commercial and industrial solid waste incinerators (U.S. Environmental Protection Agency, 2012a, b).

In December, the EPA issued final amendments to its air toxic standards for portland cement manufacturing. Mercury emissions will be limited to 25 kilograms per million metric tons (kg/Mt) of clinker production, averaged more than 30 days for existing source kilns, and 10 kg/Mt for new source kilns. The new standard was projected to reduce mercury emissions from cement kilns by 93%. Changes to the ruling were expected to reduce implementation costs by $52 million from previous estimates. The deadline for full compliance to the ruling was extended to September 2015 (U.S. Environmental Protection Agency, 2012c).

The National Defense Stockpile (NDS) inventory of 4,436 t of mercury was held at the Hawthorne Army Depot, Hawthorne, NV. As part of an agreement with the State of Nevada permitting storage at the depot, the inventory, contained in 128,672 steel flasks, was scheduled to be repackaged into 1-metric-ton containers during a 15-year period. An environmental assessment determined that repackaging would pose little or no risk to the workers involved in repackaging, the environment, or surrounding communities (Defense Logistics Agency, Strategic Materials, 2012).

The U.S. Department of Energy maintained an inventory of about 1,200 t of mercury in temporary storage facilities in Oak Ridge, TN. The agency began preparing an updated environmental impact statement (EIS) evaluating sites to permanently store the mercury. The agency's 2011 EIS considered seven sites in California, Idaho, Missouri, Nevada, South Carolina, Texas, and Washington for long-term storage of the mercury. A new EIS will evaluate two additional sites in New Mexico (U.S. Department of Energy, 2012).

Production

In 2012, byproduct mercury was recovered at several precious metals mines, mainly in Nevada. Data on the amount of byproduct mercury produced in the United States were not available.

Consumption

The U.S. Geological Survey does not collect end-use data on mercury. Based on industry trends and data in trade literature, domestic consumption of mercury was estimated to be less than 50 t in 2012. Consumption, which reached a record high

of 2,810 t in 1964, continued to decrease as mercury was eliminated from more consumer and industrial products.

Using data from The Chlorine Institute, Inc. (2009) and Weinert (2009), an estimated 67 t of mercury was used in the United States in 2007, 41% of which was used for switches and relays, 22% for dental amalgam, 14% for fluorescent lamps, 7% for chlorine-caustic soda (chloralkali) production, and 16% for miscellaneous uses, including batteries, chemicals, sphygmomanometers, thermometers, and thermostats. The chloralkali industry used 5 t of mercury in 2007 (calculated as the ratio of pounds of mercury used per metric ton of chlorine produced) but purchased 46 t. The U.S. market share for chloralkali, based on industry purchases of 46 t would have been 43%. Complete end use data were not available beyond 2007.

Global human health and environmental concerns about mercury have caused a decline in mercury purchases by the chloralkali industry as it continued to shift away from using mercury cell technology. Use of mercury by the U.S. chloralkali industry declined to 4 t in 2008 from 137 t in 1996 (Chlorine Institute, Inc., The, 2009). In 2012, Olin Corp. (2013, p. 4) closed its mercury cell chlorine-caustic soda unit in Augusta, GA, and converted its Charleston, TN, plant from mercury cell to membrane technology. Only two mercury cell plants remained operational in the United States, one in Ohio and one in West Virginia.

Recycling

Mercury was reclaimed from end-of-service automobile convenience switches, CFLs, dental amalgam, fluorescent lamps, laboratory and medical devices, mercury contaminated waste, and thermostats in 2012. The voluntary National Vehicle Mercury Switch Recovery Program (NVMSRP) was started in 2006 by the EPA to stop toxic emissions of mercury when cars are scrapped and then melted to make new steel. Funding for the program was depleted in July 2009. However, payments continued in 11 States where NVMSRP are required by law or that have a State-funded program using funds received from a 2011 settlement against a major vehicle manufacturer that did not contribute to the NVMSRP because of bankruptcy proceedings. The goal of the NVMSRP is to collect 80% to 90% of the automotive mercury switches by 2017 (Attorney General of Massachusetts, 2011; U.S. Environmental Protection Agency, undated).

During 2012, byproduct mercury from domestic and foreign sources and mercury reclaimed from end-of-service products were processed or recycled in the United States and then sold to domestic consumers or exported. With the U.S. ban on elemental mercury exports, only domestic markets remained after December 31.

In 2012, several companies that recycled mercury included AERC.com, Inc., Allentown, PA; Bethlehem Apparatus Co., Inc., Hellertown, PA; Clean Harbors, Inc., Norwell, MA; D.F. Goldsmith Chemical and Metal Corp., Evanston, IL; Onyx Environmental Services, Louisville, KY; and Waste Management, Inc., Houston, TX (Benivia LLC, undated).

Prices

The domestic price of mercury averaged $1,850 per flask in 2012, unchanged from 2011 but more than triple that in 2009. The price range for mercury, as quoted in Platts Metals Week, remained unchanged throughout the year. The low and high prices were quoted as $1,750 per flask and $1,950 per flask, respectively.

Foreign Trade

In 2012, mercury imports were 249 t and exports were 103 t. Imports increased significantly in 2012, in part owing to foreign companies storing byproduct mercury for 2 to 3 years before exporting it to the United States for processing and (or) increased availability of mercury from the closure of mercury cell units at foreign chloralkali plants. Argentina (130 t), Chile (52 t), Canada (46 t), and Germany (11 t) were the leading sources of imported mercury and accounted for 96% of the mercury imported into the United States in 2012. Indonesia (75 t), Nigeria (18 t), Peru (5 t), and Canada (4 t) were the principal export destinations for mercury in 2012 and accounted for 99% of U.S. exports of mercury.

In 2012, a total of 21 t of amalgam was imported into the United States. Amalgam is defined as mercury alloyed with one or more metals and may include mercury-containing chlorine-caustic soda waste. Principal amalgam source countries were Germany (6 t), Japan and Mexico (3 t each), and Argentina and the United Kingdom (2 t each). A total of 171 t of amalgam was exported from the United States, and principal destinations were Austria (36 t), Canada and Mexico (26 t each), Japan (19 t), India (13 t), and the Netherlands (10 t).

World Review

In 2012, world mercury mine production was estimated to be 1,810 t. China (1,350 t) and Kyrgyzstan (250 t) were the world's leading producers of mercury. World production estimates have a high degree of uncertainty because most companies and countries may not report primary mine, byproduct mine, or secondary production data owing to environmental and health concerns. Quantities may appear erratic from year to year because production may not be reported until shipped and stockpiling may occur prior to shipment.

Concerns continue over the exposure of workers in gold mines and gold shops and local residents. There were an estimated 15 million small-scale mine workers in Africa, Asia, and Latin America that used mercury to recover and refine gold. A United Nations (UN) study recorded mercury air concentration levels in gold shops in Segovia, Colombia, to be more than 1,000 times the public exposure limits set by the World Health Organization. In an effort to stem the use of mercury for gold refining in Colombia and elsewhere, the EU banned exports in 2011 and the United States banned exports after 2012 (Simpson and Walsh, 2012). The UN also continued with its program for reducing mercury emissions, promoting permanent mercury storage, and

eliminating the most environmentally unsound uses of mercury (United Nations Environment Programme, undated).

The number of chloralkali plants that used mercury cell technology decreased worldwide—the number of mercury cell plants decreased to 53 in 2011 from 91 in 2002. Mercury cell-based chlorine production capacity decreased to 5.3 million metric tons (Mt) in 2011 from 9.1 Mt in 2002. Mercury emissions from chloralkali plants decreased to 6.9 t/yr in 2011 from 24.6 t/yr in 2002 (Euro Chlor, 2012, p. 17).

Colombia was one of the leading three countries that used mercury. Because of the hazards of exposure to gold miners and gold refiners from mercury metal and vapors, the Colombian government continued a program designed to reduce mercury use by small-scale miners to 70 t/yr from 140 t/yr. Through their actions and those of international organizations, mercury use by intermediate-sized gold mines declined in Antioquia and Narino. In Chucó, use of mercury for gold mining when using dredges and sluices declined. Also, more gold refiners began capturing mercury vapors using a variety of methods when heating gold amalgams during processing (Brooks, 2012).

Outlook

Global mercury use continued to decline with the exception of mercury used in the CFL industry and in small-scale gold mining. If gold prices rise, they are likely to stimulate increased demand for mercury in the small-scale gold mining industry.

Mining and recycling companies are beginning to place more byproduct mercury into permanent storage rather than selling it as worldwide pressure continues to reduce mercury pollution. Newmont Mining Corp. (2012) began negotiating with the Federal Government concerning permanent storage of byproduct mercury from its Nevada operations. Newmont already was shipping its byproduct mercury from the Yanacocha mine in Peru to Germany for treatment and storage.

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 that include silver, gold, lead, cesium, and tin. Galinstan, an alloy of gallium, indium, and tin, is liquid at room temperatures and, owing to the low toxicity of its component metals, is a replacement for mercury in switches and measuring devices. Because of its higher reflectivity and lower density than mercury, galistan also is being considered as a replacement for mercury in liquid mirror telescopes for astronomy. Mercury-containing dental amalgam, which is less aesthetically pleasing, has declined in use, replaced by ceramic material with a more natural appearance. Closure of mercury cell chlorine-caustic soda production facilities worldwide, owing to pressure from international environmental and health organizations, was expected to result in release of large quantities of mercury for disposal, recycling, or storage.

Recycled mercury from mercury cell chlorine-caustic soda plants, commercial products, and byproduct mercury recovered from domestic and foreign precious metals operations are expected to be more than adequate to meet domestic needs.

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TABLE 1
SALIENT MERCURY STATISTICS[1]

(Metric tons unless otherwise specified)

		2008	2009	2010	2011	2012
United States:						
Secondary production, industrial		NA	NA	NA	NA	NA
Imports for consumption		155	206	294	110	249
Exports		732	753	459	133 r	103
Industry stocks, yearend:[2]		24	30	NA	NA	NA
Chloralkali		20	27	NA	NA	NA
Other		4	3	NA	NA	NA
Price, average, free market[3]	dollars per flask	600	610	1,076	1,850	1,850
World, mine production		1,820	1,990 r	2,250	2,000 r	1,810 e

eEstimated. rRevised. NA Not available.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Stocks at consumer and dealers only.
[3]Source: Platts Metals Week.

TABLE 2
U.S. IMPORTS AND EXPORTS OF MERCURY, BY COUNTRY[1]

Country	2011		2012	
	Quantity, gross weight (metric tons)	Value (thousands)	Quantity, gross weight (metric tons)	Value (thousands)
Imports:				
Argentina	--	--	130	$3,560
Canada	7	$34	46	133
Chile	90	224	52	139
Germany	3	183	11	862
Mexico	--	--	6	39
Peru	1	8	--	--
Ukraine	8	306	3	113
Other	(2)	22	1	15
Total	110	777	249	4,860
Exports:				
Australia	11 r	199 r	--	--
Canada	96	1,050	4	44
Guyana	22	687	--	--
Indonesia	--	--	75	102
Netherlands	(2)	7	--	--
Nigeria	--	--	18	17
Peru	--	--	5	13
Vietnam	2	81	--	--
Other	2	47 r	1	67
Total	133 r	2,070 r	103	243

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 3
U.S. IMPORTS AND EXPORTS OF AMALGAMS[1] OF PRECIOUS METALS, WHETHER OR NOT CHEMICALLY DEFINED, BY COUNTRY [2]

Country	2011		2012	
	Quantity, gross weight (metric tons)	Value (thousands)	Quantity, gross weight (metric tons)	Value (thousands)
Imports:				
Argentina	1	$17,600	2	$17,600
Germany	23	10,100	6	10,100
Japan	1	2,240	3	3,060
Mexico	3	4,790	3	4,790
United Kingdom	4	10,500	2	10,500
Other	2 r	22,100 r	5	30,200
Total	34	67,300	21	76,200
Exports:				
Austria	18	51	36	100
Canada	29	11,100	26	18,600
China	1	10,400	7	7,130
Denmark	--	--	(3)	19
France	1	10,600	(3)	6,690
Germany	4	2,470	6	23,500
Hong Kong	(3)	472	(3)	235
India	12	61,500	13	57,400
Japan	19	3,680	19	6,430
Korea, Republic of	2	26,400	3	38,000
Mexico	12	56,900	26	42,500
Netherlands	13	32,700	10	26,000
Peru	(3)	160	1	271
Philippines	--	--	3	24
Singapore	1	1,820	(3)	683
Taiwan	4	52,800	2	20,100
Thailand	4	39,300	2	17,900
Trinidad and Tobago	--	--	5	39
United Kingdom	4	10,400	6	5,950
Other	4	20,100	6	14,000
Total	128	341,000	171	286,000

rRevised. -- Zero.
[1]An alloy of mercury with one or more other metals.
[2]Data are rounded to no more than three significant digits; may not add to totals shown.
[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 4

MERCURY: WORLD MINE PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country[3]	2008	2009	2010	2011	2012[e]
Chile[4]	NA	88	176	90 [r]	52
China[e]	1,300	1,430 [r]	1,600	1,500	1,350
Finland	20	15	15	15	15
Kyrgyzstan[e]	250	250	250	250	250
Mexico[e, 5]	21	21	21	21	21
Morocco[e]	10	10	10	8 [r]	5
Peru, exports[4]	136	92	102	35	40
Russia[e]	50	50	50	50	50
Tajikistan[e]	30	30	30	30	30
United States[4]	NA	NA	NA	NA	NA
Total	1,820	1,990 [r]	2,250	2,000 [r]	1,810

[e]Estimated. [r]Revised. NA Not available.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through July 2, 2013.

[3]Canada and Spain are thought to produce byproduct mercury, but information on its production is inadequate to make reliable estimates.

[4]Byproduct mercury.

[5]Mercury data beginning in 2012 are obtained by subtracting imports from Mexican exports of mercury, as the Servicio Geológico Mexicano and the Secretaría de Economía do not publish mercury production data any longer.