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MERCURY

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MERCURY

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In 2006, there were no mercury mines in production in the United States. The last mine to produce mercury as its principal product, the McDermitt Mine in northern Nevada, closed in 1992. Mercury was produced in 2006 as a byproduct of domestic gold-silver processing, mainly in Nevada, and may have been produced as a byproduct of processing other metals. Imported byproduct mercury and calomel (Hg_2Cl_2) were processed and the mercury was resold. Recycled mercury was produced from reclamation of mercury contained in fluorescent lamps and a declining supply of mercury-containing batteries, dental amalgam, electronic waste, medical devices, and thermostats. The chlorine-caustic soda industry is the leading domestic user of mercury for its mercury-cell plants and some of that mercury is recycled in-plant. Data on domestic byproduct and recycled mercury production were not available.

In 2006, mercury imports totaled 94 metric tons (t) and exports totaled 390 t. Russia (51 t), Peru (22 t), and Germany (14 t) were the leading sources of imported mercury, and the Netherlands (118 t), India (80 t), Vietnam (74 t), and Singapore (25 t) were the principal destinations for mercury exported in 2006. Calomel, another source of mercury, was imported from Chile (112 t) and other countries (6 t), and approximately 60 t of mercury may have been recovered.

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

Legislation and Government Programs

In July, the U.S. Environmental Protection Agency (EPA) issued a report entitled "EPA's Roadmap for Mercury." The report addressed mercury releases to the environment, mercury use in products, commodity mercury supplies, communicating risk to the public, international mercury sources, and research (U.S. Environmental Protection Agency, 2006).

In late 2006, a series of EPA and U.S. Department of State-sponsored interagency meetings took place in Washington, DC, to discuss a Federal strategy for the management of mercury. Attendees included representatives from the Department of Commerce, the Department of Defense, the Department of Energy, the EPA, the Department of the Interior, the Department of State, the Office of Science and Technology, and the Office of the U.S. Trade Representative. Discussion topics included artisanal gold mining, a possible export ban, industrial uses of mercury, mercury mining, mercury risk communication, mercury supplies, powerplant sources of mercury, and stabilization of mercury and mercury containing waste. A recommendation was made to convene stakeholder panel meetings in 2007 with representatives from academia, industry, nongovernmental organizations, and state groups in order to provide input to the U.S. Government on managing mercury.

At yearend 2006, the Defense Logistics Agency's (DLA) National Defense Stockpile (NDS) held an inventory of 4,436 t of mercury at several sites in the United States. Mercury sales from the NDS stockpile were suspended in 1994 in response to environmental concerns. In 2004, the DLA indicated that the mercury would be consolidated at one site in Nevada (Joseph Johnson, specialist, Defense Logistics Agency, written commun., April 30, 2004). The U.S. Department of Energy has 1,329 t of mercury in storage facilities in Oak Ridge, TN.

Production

Mercury has not been mined as a principal product in the United States since 1992 when the McDermitt Mine in Nevada closed. In 2006, byproduct mercury and calomel (Hg_2Cl_2) were produced at several gold and silver mines in Nevada and from foreign sources. The mercury was recovered and refined for resale (Bethlehem Apparatus Company, Inc., 2006). Data on the amount of byproduct mercury and mercury recovered from calomel produced in the United States are not available.

Consumption

From 1996 through 2005, approximately 100 metric tons per year (t/yr) of mercury was purchased by the chlorine-caustic soda industry (Arthur E. Dungan, Vice President, The Chlorine Institute, written commun., May 13, 2006). Global human health and environmental concerns about mercury have caused an overall market shift toward nonmercury technology for chlorine-caustic soda production. As mercury-cell plants close around the world, that mercury, as well as mercury from remediation of the plant facilites and soil will become available for recycling and sale.

Mercury use is not carefully tracked in the United States; however, only about 200 t of mercury is consumed domestically each year. Domestic mercury consumption was broadly estimated to be 50% for chlorine-caustic soda manufacture and 50% for other uses. Compact fluorescent lamps, which contain only a few milligrams of mercury, are being promoted as alternatives to standard fluorescent lamps (Von Ahn, 2007).

Prices

In 2006, domestic mercury prices ranged from a low of $600 per flask in November-December to a high of $700 per flask for the remainder of the year (Platts Metals Week, 2006). In 2000-03, the average price was $140 per flask and this overall rise in price

correlates with a diminished supply of mercury from recycled mercury-containing products, rise in gold prices, and resultant growth in the global demand for mercury for artisanal gold mining.

Recycling

Mercury was reclaimed from end-of-service automobile convenience switches, dental amalgam, fluorescent lamps, lab/medical devices, and thermostats in 2006. These devices were treated in multistep high-temperature retorts in which the mercury is first volatized and then condensed for purification and sale (Brooks and Matos, 2005). Byproduct mercury from domestic and foreign sources, calomel, and mercury reclaimed from end-of-service products is processed or "recycled" in the United States and then sold into the international metals market (Fialka, 2006). No data are available on the amount of mercury recycled from these respective sources.

In 2006, the major companies that recycled mercury included AERC.com, Inc., Allentown, PA; Bethlehem Apparatus Company, Inc., Bethlehem, PA; Clean Harbors Environmental Services, Inc., Braintree, MA; D.F. Goldsmith Chemical and Metal Corporation, Evanston, IL; Mercury Waste Solutions, Mankato, MN; and Onyx Environmental Services, Lombard, IL. Mercury Recyclers maintains a list of as many as 50 companies whose role was mainly collection of mercury-containing materials that would ultimately be moved on to the larger companies for retorting (U.S. Environmental Protection Agency, 2007).

In 2006, Thermostat Recycling Corporation (TRC) reported record collection of mercury thermostats. TRC collected 113,600 thermostats containing 490 kg of mercury, an increase of 29% and 32%, respectively, more than those of 2005. The top five States in terms of mercury recovered in 2006 were Florida, Minnesota, California, Maryland, and Pennsylvania (Kohorst, 2007).

A total of 378 t of amalgam (not chemically defined) was exported, mainly to Canada (242 t), Hong Kong (37 t), and the United Kingdom (28 t) in 2006. Some of this material may have been landfilled in Canada, where mercury-containing chlorine-caustic waste was specifically included on a list of waste types accepted at a dedicated placement site (Stablex Canada Inc., 2005). Some mercury used for chlorine-caustic soda manufacture, however, was recycled and reused in-plant.

Owing to environmental concerns, diaphragm and membrane cells are the preferred, nonmercury alternatives for chlorine and caustic soda production. Approximately 3,000 t of mercury that could become available for recycling is contained in the U.S. nine remaining mercury-cell chlorine-caustic soda plants (Raloff, 2003).

Mercury and other byproduct metals may be contained in copper, lead, and zinc processing residue. Researchers at the Oak Ridge National Laboratory and the Colorado School of Mines have recovered mercury from a lead-gold-silver containing process stream at copper smelters using a commercially available rotary vacuum kiln (Berry and others, 2000).

Foreign Trade

The total amount of mercury imported in 2006 was 94 t, which was less than the 212 t of mercury imported in 2005. The principal sources were Russia (51 t) and Peru (22 t). Imports of mercury vary sharply from year to year, possibly owing to stockpiling of byproduct mercury at gold smelters before shipment or closure of chloralkali plants. The total amount of calomel imported was 118 t in 2006, which was far less than the 656 t imported in 2005. Dry calomel may contain 80% mercury and if the calomel contains water, then mercury recovery may be from 30% to 50% (Bruce Lawrence, president, Bethlehem Apparatus Company, Inc., written commun., June 11, 2007). Therefore, depending on water content, from 35 to 94 t of mercury may have been recovered from the 118 t of calomel imported in 2006; however, there are no data on the amount of mercury recovered from processing calomel.

World Review

In 2006, world mercury mine production was estimated to be 1,480 t. Production estimates have a high degree of uncertainty because most companies and countries do not report primary (including byproduct) or secondary production data owing to environmental and health concerns. In 2006, China (1,100 t) and Kyrgyzstan (250 t) were the leaders in world mine production of mercury. In China, mercury has historically been produced as a byproduct of gold mining and from mercury mines in the Upper Yangtze, Kuniun-Qinling, Sanjiang, and South China metallogenic regions (Lixian and Ruolan, 1992, p. 147).

Mercury used for artisanal or small-scale gold mining is a significant, but untracked, use of the metal in Ghana, Indonesia, Peru, Venezuela, Vietnam, and elsewhere. The mercury is used to amalgamate gold flakes and may be released to the environment during mining and treatment of the resulting amalgam to recover the gold. Viega (1997) estimated that a minimum of 200 t/yr of mercury is released through artisanal mining in Latin America. In Indonesia, recent estimates indicated that as much as 60 t/yr of mercury may be lost at individual gold mining concessions (Alfred Whitehouse, Director, International Programs, U.S. Department of the Interior, Office of Surface Mining, oral commun., November 14, 2006).

In 2006, 22 t of byproduct mercury was shipped from Peru's large-scale gold mines to the United States for processing and resale. Mercury is imported by Peru from the United States, Kyrgyzstan, and Spain for artisanal gold mining, chloralkali production, and dental amalgam. Some of this mercury was transshipped to other destinations in Latin America that included Brazil, Colombia, Ecuador, and Guyana. Artisanal gold mining takes place in Peru from the Department of Piura in the northwest to the Departments of Madre de Dios and Puno in the southeast (Guerra, 2007).

Outlook

With the exception of the use of mercury for artisanal gold mining, global mercury use is expected to continue to decline. High gold prices are expected to increase demand for mercury use in artisanal mining and, therefore, stimulate increased gold exploration and large-scale production. In turn, this will result in byproduct mercury production from the opening of large-scale gold mines.

Digital thermometers and thermometers containing galistan, which is a gallium-indium-tin alloy, have replaced mercury thermometers (Pennsylvania Department of Environmental Protection, 2005). Mercury dental amalgam, which is less esthetically pleasing, was less used in favor of ceramic material with more natural colors. Closure of mercury cell chlorine-caustic soda production facilities worldwide owing to pressure from international environmental and health organizations, will result in release of large amounts of mercury for disposal, recycling, or storage.

Recycled mercury from mercury cell chlorine-caustic soda plants, byproduct mercury recovered from domestic and foreign gold operations, and mercury contained in the DNS will be more than adequate to meet domestic needs.

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TABLE 1
SALIENT MERCURY STATISTICS[1]

(Metric tons unless otherwise specified)

	2002	2003	2004	2005	2006
United States:					
Secondary production, industrial	NA	NA	NA	NA	NA
Imports for consumption	209	46	92	212	94
Exports	201	287	278	319	390
Industry stocks, yearend[2]	40	94	62	38	19
Chloralkali	28	87	52	35	17
Other	11	7	11	3	2
Industrial consumption	101	72	91	40	38
Price, average, free market[3] dollars per flask	140	140	365	555	670
World, mine production	1,980 r	2,120 r	1,640 r	1,430	1,480 e

See footnotes at end of table.

TABLE 1—Conitnued
SALIENT MERCURY STATISTICS[1]

[e]Estimated. [r]Revised. NA Not available.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Stocks at consumers and dealers only. Mine stocks withheld to avoid disclosing company proprietary data.
[3]Source: Platts Metals Week.

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

	2005		2006	
Country	Quantity, gross weight (metric tons)	Value (thousands)	Quantity, gross weight (metric tons)	Value (thousands)
Imports:				
Canada	13	$62	8	$64
Chile	31	210	--	--
China	(2)	4	(2)	19
Germany	11	620	14	882
Israel	29	343	--	--
Peru	128	1,280	22	209
Russia	--	--	51	1,140
United Kingdom	(2)	12	(2)	3
Other	--	--	(2)	3
Total	212	2,530	94	2,320
Exports:				
Argentina	--	--	3	52
Australia	5	144	3	61
Brazil	--	--	4	78
Canada	11	87	12	100
Chile	4	30	--	--
Colombia	6	129	4	84
France	--	--	2	40
Guyana	19	465	7	55
Hong Kong	17	340	--	--
India	19	385	80	1,280
Iraq	--	--	15	275
Israel	--	--	4	46
Korea, Republic of	1	27	1	8
Malaysia	--	--	1	34
Mexico	25	453	8	126
Netherlands	156	2,850	118	1,620
Peru	--	--	(2)	3
Philippines	4	129	3	60
Saudi Arabia	3	78	--	--
Singapore	--	--	25	312
Spain	21	375	21	340
United Arab Emirates	14	111	--	--
United Kingdom	--	--	2	83
Vietnam	3	62	74	1,140
Other[3]	10	146	4	67
Total	319	5,810	390	5,870

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than ½ unit.
[3]Includes Bolivia, Germany, Honduras, Japan, and Latvia.

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]

	2005		2006	
Country	Quantity, gross weight (metric tons)	Value (thousands)	Quantity, gross weight (metric tons)	Value (thousands)
Imports:				
Brazil	(3)	$334	(3)	$417
Canada	6	15,600	5	15,800
Colombia	(3)	22	--	--
Czech Republic	NA	NA	4	1,858
Germany	4	8,050	5	13,500
Ireland	(3)	2,500	1	5,180
Italy	1	1,320	(3)	1,650
Japan	(3)	501	(3)	425
Malaysia	28	3,670	NA	NA
Mexico	2	526	2	797
Netherlands	4	675	(3)	6
Russia	4	49,600	6	72,800
South Africa	(3)	499 r	--	--
Switzerland	(3)	611	(3)	141
Taiwan	(3)	1,390	--	--
United Kingdom	2	3,810	4	1,900
Other	(3)	13	(3)	228
Total	51	89,100	27	115,000
Exports:				
Argentina	--	--	2	33
Australia	6	7,300	3	12,500
Brazil	1	80	2	420
Canada	970	73,500	242	116,000
China	17 r	8,860 r	24	1,230
Columbia	2	38	(3)	10
France	2	554	1	601
Germany	7 r	1,610	22	1,350
Hong Kong	60	226	37	334
India	3	13,200	6	39,100
Ireland	(3)	861	(3)	37
Italy	(3)	548	(3)	212
Japan	4	1,160	2	2,260
Korea, Republic of	2	573	1	2,270
Malaysia	3	19	(3)	815
Mexico	21	98,600	12	210,000
Netherlands	12	8,210	9	11,900
Singapore	10	5,510	2	5,130
Switzerland	1 r	65 r	1	801
Taiwan	8	3,420	2	1,260
United Kingdom	28	6,460	28	23,600
Other	77	649	(3)	677
Total	1,230	231,000	397	430,000

rRevised. NA Not available. -- 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
U.S. IMPORTS OF MERCURY CHLORIDE[1] BY COUNTRY[2]

Country	2005 Quantity, gross weight (metric tons)	2005 Value (thousands)	2006 Quantity, gross weight (metric tons)	2006 Value (thousands)
Chile	654	$1,500	112	$370
China	1	20	1	25
India	1	23 r	4	130
Spain	(3)	7	--	--
Sweden	--	--	1	20
Switzerland	--	--	(3)	8
Total	656	1,550 r	118	554

rRevised. -- Zero.

[1]Calomel is a mercury-bearing byproduct generated from pollution control equipment using the Norzink process.

[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 5
MERCURY: WORLD MINE PRODUCTION, BY COUNTRY[1, 2, 3]

(Metric tons)

Country	2002	2003	2004	2005	2006e
Algeria	307	176	73	(4) e	NA
Chinae	495 r	610	1,140	1,100	1,100
Finland	51	25	24	20 r	20
Kyrgyzstan	300	300	300	200	250
Mexicoe	15	15	15	15	15
Moroccoe	10	10	10	10	10
Russiae	50	50	50	50	50
Spain	727 r	907 r	NA r	NA r	NA
Tajikistane	20	30	30	30	30
United States[5]	NA	NA	NA	NA	NA
Total	1,980 r	2,120 r	1,640 r	1,430	1,480

eEstimated. rRevised. 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 April 29, 2007.

[3]Canada, Chile, and Peru were believed to produce byproduct mercury, but information on their production was inadequate to make reliable estimates.

[4]Less than ½ unit.

[5]Data on byproduct mercury are not available.