MERCURY

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In 2003, mercury was recycled in-plant, as home scrap, to supply the chlorine-caustic soda industry, which is the largest domestic end use for mercury in the United States. Global human health and environmental concerns about anthropogenic mercury releases brought about an overall market shift toward nonmercury alternatives for chlorine-caustic soda production and other mercury end uses. Some mercury was imported from Germany and Peru. Even though the primary ore of mercury, cinnabar, is found in several States in the United States, there is no primary production of mercury, and the last mine to produce mercury as its chief commodity, the McDermitt Mine in Nevada, closed in 1992. Mercury may also be obtained as a byproduct of gold or lead mining; production data, however, are not available. In 1971, the U.S. Environmental Protection Agency (EPA) indicated that mercury was a hazardous air pollutant, which added to the concern about the toxic effects of mercury on human health. The United States had 4,436 metric tons (t) of mercury stockpiled by the Defense Logistics Agency (DLA) at yearend 2003.

Health, Legislation, and Government Programs

Mercury is known to broadly affect human health, and anthropogenic sources of mercury releases include chlorine-caustic soda production, coal-fired powerplants and industrial boilers, hazardous waste disposal, municipal and medical waste disposal, and recycling (Clean Air Network, 2000§[1]; Mercury Instruments, 2003§). Volcanic activity, artisanal gold mining, and mercury mining are other sources of mercury releases on a global scale (Hylander and Meili, 2002). Trace amounts of mercury may be present in minerals in barite drilling mud used in offshore oil and gas exploration (Neff, 2002§). The nervous system, brain, kidneys, and fetal development may be adversely affected by exposure to mercury, and a link between autism in children and mercury in the environment seems likely (Hightower, 2001§). In the 1960s, the effects of mercury on human health in Japan, or “Minamata Disease,” caused headlines worldwide (Bunce and Hunt, 2003§), and recently, the United Nations Environmental Programme (2002§) completed a Global Mercury Assessment in which issues that concern mercury in the environment, health effects in less developed regions, the global fishing industry, and sources of mercury releases were examined. Mercury is now studied and regulated by environmental and government health agencies worldwide (Porcella and others, 1995; Hylander, 2002§). The environmental impact of mercury in a variety of global settings, such as wetland sediments in California and Connecticut, black shales in Finland, mine waste in the Philippines, mercury in the soil at an emission source, and mercury accumulation in snow were some of the featured articles in a special issue of Environmental Geology (2003) on mercury.

In the United States, the Omnibus Mercury Emissions Reduction Act of 2003 mandates reduced mercury emissions from all major sources, directs the EPA to issue new standards, and sets a timetable so that mercury emissions are reduced (Leahy and Snowe, 2003§). This Act addresses emission standards from a variety of sources and supports mercury research, encourages international collaboration, and prohibits sale of the 4,436 t of mercury held by the DLA on the global market.

In July 2002, the EPA specifically addressed mercury emissions from chlorine-caustic soda plants by using standards given in the Clear Air Act that reflect the maximum achievable control technology which would reduce emissions by 4,100 kilograms per year (kg/yr) (U.S. Environmental Protection Agency, 2002§). In 2000, the Mercury Policy Project, which is a public interest group, urged zero mercury use and urged the U.S. Department of Defense and the U.S. Department of Energy to accept 130 t of mercury from a closed chlorine-caustic soda plant in Maine into the DLA stockpile; the effort, however, apparently failed, and the mercury may have reached the global market (Bender, 2000§).

The EPA set a limit of 2 parts per billion (ppb) mercury in drinking water; the U.S. Food and Drug Administration set a maximum of 1 part per million of methylmercury (a toxic bacterial transformation of mercury) in seafood; and the U.S. Occupational Safety and Health Administration set a limit of 0.05 milligram of metallic mercury vapor per cubic meter in workplace air for an 8-hour shift and 40-hour workweek (Agency for Toxic Substances and Disease Registry, 2003b§). The American Medical Association resolved that the mercury content of foods, especially fish, be labeled and that physicians educate their patients as to the potential dangers of mercury ingestion (McCaffree, 2003§).

Research presented at a recent EPA National Forum on Contaminants in Fish showed that for pregnant women mercury in the umbilical cord blood may be 70% higher than the mercury content of the mother’s blood (Mahaffey, 2004§). Because one in six women of childbearing age in the United States has unsafe blood mercury levels, more than 600,000 babies are born every year at risk of mercury-related health problems (Physicians Committee for Responsible Medicine, 2004). Mercury may be traced to bioaccumulation of the metal from atmospheric mercury pollution that drifts worldwide from anthropogenic sources. For example, Canadian government studies showed elevated levels of pollution in the Artic and high levels of mercury in the blood and breast milk

[1]References that include a section mark (§) are found in the Internet References Cited section.

of Inuit mothers in Nunavut (Brown, 2004). A number of regulations have been proposed that would require coal-fired powerplants, which may contribute 48 t of mercury to the atmosphere, to cut emissions by target dates (Gugliotta, 2004).

U.S. Geological Survey (USGS) research on mercury in coal, mercury mines in Alaska and California, mercury contamination from hydraulic mining in California, and volcanic emissions of mercury was included in Gray (2003). The environmental impact of mercury associated with mineral districts worldwide and byproduct mercury from gold-silver and massive sulfide deposits was described by Rytuba (2003). Also, USGS research contributed to understanding the abundance of mercury in domestic coal (Tewalt and others, 2001), the health impacts of coal combustion (Finkelman, 2000), and the mercury content of coal in the world market (Finkelman and others, 2001). The USGS collaborates with other Federal and State agencies, universities, and tribal nations in the National Atmospheric Mercury Deposition Network, which is a national program that monitored mercury deposition through a network of standardized monitoring sites (Nilles, 2000, 2003§). USGS scientists also examined glacial ice cores as part of studies focused on the history of global mercury contamination (Krabbenhoft and Schuster, 2002). Media reports of mercury contamination from minerals in barite drilling mud used by oil and gas drill rigs in the Gulf of Mexico prompted USGS research into bottom sediment geochemistry of Lake Ponchartrain, LA; the data showed only a few samples with elevated mercury content (Manheim, 2002§). The USGS National Mercury Project indicates that effective policy decisions regarding mercury emissions require research that will provide better understanding of its cycle in the environment (Krabbenhoft and Herrmann, 2000§; Pinsker, 2003).

Academic, tribal, and research organizations and other Government agencies collaborate in periodic USGS/EPA Mercury Roundtable teleconferences (Krabbenhoft and Herrmann, 2000§). Topics included the bioaccumulation of methylmercury in fish, quantifying methylmercury in fish with regard to species and size, sources of mercury in the Everglades, and the toxic legacy of mercury mining in California.

The USGS Toxic Substances Hydrology Program and the Mine Drainage Interest Group characterized mercury contamination, bioaccumulation, and environmental problems related to mining across the country (Suchanek and Marvin-DiPasquale, 2003§). USGS study sites in Virginia include closed pyrite mines near Contrary Creek and Prince William Forest Park (Cravotta and others, 2003§).

The EPA and National Wildlife Federation studies showed that rain falling on Chicago's North Shore may contain up to 32 times the amount of mercury that is considered to be safe. This is of concern because of the bioaccumulation of mercury in fish (McCann, 1999§; Pierre, 2003). Coal-fired power plants in the region are considered to be the source of the mercury (Pennsylvania Department of Environmental Protection, 2003§). Warnings about mercury content of fish have been posted in some parts of Florida (Mercury Roundtable, oral commun., June 17, 2003). In 1989, a consumption advisory for mercury and organic chemicals for fish caught in the Anacostia and Potomac Rivers was issued by the District of Columbia (Agency for Toxic Substances and Disease Registry, 2003a§). The Virginia Department of Health issued warnings to limit the amount of fish consumed from several Virginia rivers because of elevated levels of mercury (Washington Post, 2004). Forty-four States have posted warnings about mercury contamination in lakes, streams, and rivers (Physicians Committee for Responsible Medicine, 2004). In the Pacific Northwest, USGS research indicated that the mercury content of fish in North Cascades National Park is approaching human health warning levels of 300 ppb and may pose a potential health risk (Moran and Black, 2003§; Pynn, 2004).

Proposed Clear Skies legislation in Congress will require powerplants to reduce overall pollution levels by 70% by 2018 (Planin, 2003a; U.S. Environmental Protection Agency, 2000a§). The Clean Air Planning Act, which is an alternative plan, would cut powerplant emissions of mercury, sulfur dioxide, and other pollutants by larger amounts by 2012 (Gugliotta and Planin, 2003). Mercury emissions from coal-burning plants are not regulated under Federal law and attempts to classify mercury as a hazardous pollutant, similar to asbestos and lead, were met with counter arguments that mercury be considered under a less stringent part of the Clean Air Act that includes pollutants that cause smog and acid rain and are not as toxic to humans (Lee, 2004). Approximately 48 metric tons per year (t/yr) of mercury were emitted annually by the Nation's 11,000 coal-fired powerplants, and emissions of mercury by some industrial sources pose an increasing health danger to children. Pollution from powerplants, which includes mercury, sulfur dioxide, and nitrogen oxides, may result in the premature deaths of thousands in the United States (Eilperin, 2004b). Legislation has been proposed that would cut emissions to 34 t in 2010 and 15 t by 2018 (Fialka, 2003). The EPA is also concerned about the approximately 65 t of mercury that is unaccounted for by the nine domestic chlorine-caustic soda plants that still rely on 1950s mercury cell technology (Eilperin, 2004a).

Mercury emission guidelines for hospital and medical waste incinerators are given by the U.S. Environmental Protection Agency (2003a§). Similar guidelines for electric steam generating units were also provided in the Federal Register (U.S. Environmental Protection Agency, 2000b§).

Approximately 6 million mercury thermometers, each of which contains approximately 0.7 gram of mercury, were sold in the United States during a single year (Goldstein, 2000). Continued use of such thermometers presents a health risk if broken in the user's home or if the thermometers are dumped in landfills or incinerated. Environmental and health organizations have petitioned Congress to limit the use of mercury fever thermometers and to improve the collection and management of mercury (Bill Summary, 2002§; Lyon, 2001§). Therefore, sale of mercury thermometers has been banned and the use of nonmercury thermometers has been encouraged (U.S. Environmental Protection Agency, 2003b§). For example, some local environmental agencies have recently offered to replace mercury thermometers with digital thermometers (Washington Post, 2003b). Mercury may still be found in some school laboratories. Recently, 250 milliliters of mercury was taken from a high school lab in Washington, DC, and was scattered around the school. This caused evacuation, closure, and EPA testing and decontamination of the school (Fahrenthold, 2003). At another school in Maryland, a thermometer was accidentally broken. This caused decontamination of the classroom, school bus, and testing of the student's clothing (Washington Post, 2003a).

Dental amalgam also uses mercury, and how much mercury is released into the environment by removal or replacement of mercury amalgam fillings is unknown (District of Columbia Dental Society, 2003§). Approximately 12,000 kilograms of amalgam were sold in the United States in 2001 (Maine Department of Environmental Protection, 2003§). The Watson-Burton bill (H.R. 1680: Mercury in Dental Filling Disclosure and Prohibition Act) seeks to prohibit the introduction of mercury for dental fillings into interstate commerce after 2008 (Burton, 2004§); some public health organizations, however, require that dental amalgam be used (Carlton, 2004§). The use of amalgam is declining, and composite resin substitutes are available.

Soap and cosmetics that contain mercury are manufactured by some European companies and sold as skin-lighteners in Africa, Asia, and the Caribbean. Both manufacturers and users may be subject to skin damage or mercury-related health problems (Mercury Soap Campaign, 2004§). Some Caribbean groups may use mercury as a folk remedy (Goldstein, 2003). Mercury use as a fungicide in paints has been discontinued. The use of mercury batteries, which were once widely used in watches, cameras, and hearing aids, has declined because of new technologies and concern for the environment (Battery-Index, 2003§).

Volcanic activity also contributes mercury to the global environment, and USGS research shows that mercury is lost from the forest floor during forest fires (Woodruff and Cannon, 2001).

At yearend 2003, the DLA had an inventory of 4,436 t of mercury at several sites in the United States and until 1994, this mercury was available for sale. Mercury sales have been suspended in response to environmental concerns. In early 2004, the DLA indicated that the mercury would be consolidated at one site (Joseph Johnson, Specialist, Defense Logistics Agency, written commun., April 30, 2004).

Production

Mercury has not been mined in the United States since closure of the McDermitt Mine in Nevada in 1992 (O'Driscoll, 2002§). The mine is now included on a list of EPA Superfund Sites (ToxicAlert, 2003§). Byproduct mercury is generated as a part of some domestic gold mining and smelting operations (Rogers, 2000§). In addition, mercury is recovered from domestic and imported scrap or byproduct mercury by recycling plants in the United States.

There are mercury occurrences in California (Dickson and Tunell, 1968; Linn, 1968), Idaho (Dickson and Tunell, 1968), Nevada (Dickson and Tunell, 1968; Fisk, 1968; Bateman, 1988), Texas (Bauer, 2000), and Utah. The geoenvironmental impact of mercury in Alaska and California is an ongoing USGS (2003§) research project. Occurrences of cinnabar were found in the Mercury District of Southwest Arkansas, and the USGS presented geochemical data on this area as a part of a national geochemical database (Moravec and Smith, 1997§).

In the United States, the largest amount of byproduct mercury comes from lode gold mining in Nevada. Data on the amount of byproduct mercury produced are not available. Sales of mercury retort systems permit the inference that byproduct mercury is recovered from ore processed at six mines in Nevada (Summit Valley Equipment and Engineering, Inc., 2004§). Mine owners in Nevada have voluntarily begun to reduce mercury emissions by 50% within a 3-year period (Gold, 2002).

Byproduct mercury from Peru's Pierina gold mine is recovered, carefully packed, transported, and shipped to the United States for recycling. All handlers of this mercury, even customs agents, receive training in the safe handling of mercury (Michael Merry, logistics superintendent, Barrick Peru, oral commun., May 3, 2004). Byproduct mercury from Peru's Yanacocha gold mine is sent to Spain for processing.

Mercury is used in artisanal placer gold mining worldwide to amalgamate gold flakes and mercury may be released during mining and amalgam treatment in some countries. In Brazil, burning the mercury-laden amalgam led to elevated levels of mercury in the urine of gold shop workers that was 20 times greater than the limit of 50 micrograms/liter established by the World Health Organization (Malm, 1998). In Venezuela, processing centers have been established where artisanal miners can take their gold-mercury concentrates for retorting and recovery of the gold and mercury. This reduces health risks to miners, who commonly burn their amalgam in the open air to drive off the mercury, and limits mercury releases to the environment (Viega, 1997§). Sediment samples taken in streams near artisanal gold workings or amalgamation sites in Peru gave high mercury content (Medina, 2001§). In Ghana, artisanal gold miners may inhale the vapors from the heated pots that are used to purify the gold-mercury amalgam. Any mercury discarded in the streams bioaccumulates in the fish, which is widely consumed, and may lead to physical and mental problems (Harkinson, 2003§).

The USGS led mercury and mining studies in California (Alpers, 2002§), Nevada (Gray, Crock, and LaSorsa, 2002), the Philippines (Gray and others, 2003), and Suriname (Gray and others, 2002). Use of mercury in Latin American mining operations was addressed at a conference in Vienna, Austria, in 1997. It was estimated that more than 200 t/yr of mercury are released through artisanal mining in Latin America (Veiga, 1997§). A spill of byproduct mercury recovered from gold processing in Peru in 2000 gained worldwide attention (Drillbits and Tailings, 2000§; Griffin, 2000§).

Consumption

Chlorine production, which is the major end use of mercury, provides an important industrial chemical for use in the pulp and paper industry. It is also used for water treatment, defense against biological attacks, antibiotics, microprocessors and computer housings, flak jackets, helmets, and bullet-proof glass (Chlorine Institute, 2003§). Elevated mercury concentrations were found in mud and biota in streams that received discharges from mercury cell chlorine-caustic soda plants (Georgia State Water Quality Control Board, 1971). Losses of mercury in the chlorine production process were initially as high as 200 grams of mercury per metric ton of chlorine output in the 1960s, but only 0.2 gram of mercury was reported lost per ton of chlorine produced today (Bunce and Hunt, 2003§).

Domestic chlorine-caustic soda plants use about 100 t/yr of mercury to replace mercury lost in the manufacturing process. But what happens to the mercury that is replaced is unknown (Planin, 2003b). The EPA is now concerned that as much as 65 t of mercury cannot be accounted for and may have been released into the environment (Eilperin, 2004b).

A limited amount of mercury was imported from Germany (19 t) and Peru (19 t) during 2003. The total amount of mercury imported in 2003 was 46 t which is much less than the 209 t of mercury imported in 2002. The change may be in response to a shutdown of mercury cell chlorine-caustic soda plants in Australia in 2001 (ACTED Consultants, 2004§). Closure of these plants may have been the source of the 107 t of mercury brought into the United States from Australia in 2002. The domestic chlorine-caustic soda industry has set a goal of reducing mercury use by 50% before 2005, in comparison with the base years of 1990 to 1995. Domestic mercury consumption is estimated to be 33% to 50% for chlorine manufacture, 33% to 50% for electronics, and the balance for other uses, such as dental applications, fluorescent lamps, and switches.

Recycling

The chief end use of mercury has been as a cathode in the electrolytic production of chlorine and caustic soda from brine. Sodium is removed from the sodium-mercury amalgam, and the mercury is recycled within the chlorine-caustic soda plant as home or in-plant scrap. Chlorine and sodium are important industrial chemicals with a variety of uses (Amato, 1994). Diaphragm and membrane cells are alternative methods for chlorine-caustic soda production and do not use mercury (Roskill Information Services Ltd., 1990). Closure of mercury-based chlorine-caustic soda plants and subsequent retirement, recycling, sale, or storage of the approximately 3,000 t of mercury contained in these domestic plants is a serious concern (Raloff, 2003§).

In previous years, approximately 46 t of mercury was used by the chlorine-caustic soda industry followed by 60 t for switches, 44 t for dental amalgam, 28 t for lighting, and 22 t for measuring instruments (Bender, 2002§). Mercury may be recycled from these products.

Mercury used in tilt switches in cars (McCann, 2002; Natural Resources Council of Maine, 2003§), fluorescent lamps (Abernathy, 2003), and thermostats (Massachusetts Department of Environmental Protection, 2004§) is of environmental concern because of the potential for mercury releases during scrapping, waste treatment, or demolition. The EPA has required foundries that shred vehicles to create policies on how mercury is minimized in those vehicles before the furnace becomes contaminated (American Metal Market, 2003). Mercury may also be recovered and recycled from unbroken fluorescent lamps.

In 2003, mercury recycling companies included AERC Recycling, VA; Bethlehem Apparatus Company, PA; D.F. Goldsmith Chemical and Metal Corporation, IL; Mercury Waste Solutions, MN; and Onyx Environmental Services, WI (Bethlehem Apparatus Company, 2003§; D.F. Goldsmith Chemical and Metal Corporation, 2003§; Mercury Waste Solutions, 2003§; AERC Recycling, 2004§; Onyx Environmental Services, 2004§). A list of more than 50 individuals and companies that recycle mercury is available (Mercury Recyclers, 2002§).

World Review

In 2003, world mercury production was estimated to be 1,530 t/yr, which was less than the 2,200 t/yr average world mercury production from 1990 to 2000. Production estimates have a high degree of uncertainty because most countries do not report primary or byproduct production data because of environmental and health concerns. Algeria, China, Kyrgyzstan, and Spain were the apparent leaders in world production of mercury; production from China estimated to be 610 t in 2003. Minas de Almaden (Spain) can produce 50,000 flasks[2] per year and new production was reported from Spain (Metal Bulletin, 2003). Both Algerian and Spanish producers were negotiating prices in the range of $175 to $195 per flask (Metal-Pages, 2003b). The U.S. domestic price per flask was $345 in June, 2004 (Platts Metals Week, 2004). Demand was strong in China and the Asian market, but information on use is limited. Chinese mercury production began to rise in 2002 (Metal-Pages, 2003a). Becton, Dickinson and Co. indicated that it will stop production of glass mercury thermometers at its plant in Brazil and will stop purchasing thermometers from China (Goldstein, 2000). Environmental concern caused a thermometer plant in India to close and the waste material to be transported to the United States for recycling (Marley, 2003).

Mercury releases in India were estimated to range between 60 to 70 t/yr (Bahuguna, 2003§) and 150 to 200 t/yr (Mercury in India, 2003§) as a result of chlorine production. The obligatory dismantling of 47 chlorine plants in Europe by 2007 will result in 15,000 t of mercury that must be managed (Faversham House Group, 2003§).

The Swiss company Batrec, founded in 1989, was Europe's leading recycler of materials containing mercury and produces mercury, zinc, and other metals from processing 3,300 t of batteries and sludges annually (Beck, 2004).

Outlook

Mercury demand and production will continue to be affected by ongoing global environmental and human health concerns. Technological advances and changes in the chlorine-caustic soda industry will result in a decline in mercury use as alternative production systems are used and mercury cell plants are closed in Europe (2007), the United States, and India, thereby releasing large

[2]Some international data and dealer prices are reported in flasks. Since 1927, mercury has commonly been measured and priced by the flask (approximately 76 pounds), a measure that is related to early mercury mining and processing in Spain (Myers, 1951). One metric ton of mercury contains approximately 29 flasks.

amounts of mercury for storage or sale. Voluntary reduction of mercury emissions by copper, gold, and zinc mining companies, stricter controls of mercury use in artisanal gold mining, and careful monitoring of mercury releases by the chlorine-caustic soda industry will lessen releases to the environment and may affect mercury prices. Recycled mercury from dismantled mercury cell chlorine-caustic soda plants, byproduct mercury from gold mining, and mercury contained in the National Defense Stockpile will be more than adequate to meet domestic needs.

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TABLE 1
SALIENT MERCURY STATISTICS[1]

(Metric tons unless otherwise specified)

	1999	2000	2001	2002	2003
United States:					
Secondary production, industrial	NA	NA	NA	NA	NA
Imports for consumption	62	103	100	209	46
Exports	181	182	108	201	287
Industry stocks, yearend[2]	NA	NA	NA	NA	NA
Industrial consumption	NA	NA	NA	NA	NA
Price, average per flask, free market[3]	140	140	140	140	140
World, mine production	1,320 r	1,360 r	1,500 r	1,510 r	1,530

[r]Revised. NA Not available.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Stocks at consumers and dealers not available. 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]

(Gross weight unless otherwise specified)

Country	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)
Imports:				
Australia	107	$187	--	--
Canada	11	14	6	$8
Chile	75	53	--	--
Germany	15	614	19	861
India	--	--	1	5
Peru	--	--	19	23
Spain	1	12	--	--
United Kingdom	(2)	9	(2)	18
Total	209	889	46	914
Exports:				
Brazil	2	23	7	50
Canada	4	26	5	40
Ecuador	--	--	2	32
France	8	124	3	42
Germany	21	54	4	26
Guyana	--	--	6	32
Hong Kong	--	--	17	75
India	21	68	25	80
Japan	2	59	--	--
Korea, Republic of	7	34	--	--
Malaysia	--	--	2	19
Mexico	33	237	35	399
Netherlands	73	281	57	270
Peru	--	--	51	185
Singapore	18	62	22	205
United Kingdom	--	--	2	21
Vietnam	--	--	40	172
Other	12	77	9	47
Total	201	1,050 r	287	1,690

[r]Revised. -- 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

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

(Metric tons)

Country	1999	2000	2001	2002	2003
Algeria	240	216	321 r	307 r	300 e
China[e]	200	200	190	435 r	610
Finland	40	76	71	70	65
Kyrgyzstan	300	257	300	300 r	300
Mexico[e]	15	15	15	15	15
Morocco[e]	10	10	10	9	9
Russia[e]	50	50	50	50	50
Spain	433	500	500	300	150
Tajikistan[e]	35	40	40	20	30
Ukraine	NA	NA	--	NA	--
United States[3]	NA	NA	NA	NA	NA
Total	1,320 r	1,360 r	1,500 r	1,510 r	1,530

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

[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, 2004.

[3]Data on byproduct mercury are not available.