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2007 Minerals Yearbook

CADMIUM [ADVANCE RELEASE]

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CADMIUM

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In 2007, estimated cadmium metal production in the United States was 735 metric tons (t), slightly higher than that of 2006 (table 1). Apparent consumption of cadmium was 585 t, a 3% increase from that of 2006. Cadmium metal (including alloys, powders, and waste and scrap) was primarily exported to China (66%), the Netherlands (16%), and Belgium (6%) (table 3). Mexico (61%), Australia (11%), and Canada (8%) supplied the bulk of the corresponding imports (table 4). The average annual New York dealer price of cadmium metal in 2007 was $7.61 per kilogram ($3.45 per pound), an increase of 155% from the average annual price in 2006.

In 2007, global primary production of cadmium was 20,400 t. Most of the world's primary cadmium (approximately 51%) was being produced in Asia and the Pacific—specifically China, Japan, and the Republic of Korea—followed by North America (22%), Central Europe and Eurasia (18%), and Western Europe (6%). Global secondary cadmium production accounted for approximately 19% of all cadmium metal production, and this percentage was expected to increase in the future (Hugh Morrow, International Cadmium Association, unpub. data, 2007). Most secondary metal was produced from nickel-cadmium (NiCd) battery recycling. There were three major NiCd collection and recycling programs in the world—the Rechargeable Battery Recycling Corp. (RBRC) program in the United States and Canada, the Battery Association of Japan program, and the CollectNiCad program in Europe.

World refined cadmium consumption in 2007 increased 8% from that of 2006 (World Bureau of Metal Statistics, 2008, p. 35). Leading consumers of refined cadmium included—in descending order of quantity—Belgium, China, and Japan. NiCd battery production continued to be the leading end use of cadmium, accounting for the majority of global cadmium consumption. Other end uses of cadmium included alloys, anticorrosive coatings, pigments, polyvinylchloride stabilizers, and semiconducting compounds for solar cells. The percentage of cadmium consumed globally for NiCd battery production has been increasing, while the percentages for the other traditional end uses of cadmium—specifically, coatings, pigments, and stabilizers—have gradually decreased because of environmental and health concerns. Most of the NiCd battery market was concentrated in Asia.

Production

Mine production.—Data on domestic mine production of cadmium were not collected by the U.S. Geological Survey (USGS). Primary cadmium is generally recovered from zinc concentrates, with zinc-to-cadmium ratios in typical zinc ores ranging from 200:1 to 400:1. Sphalerite (ZnS), the most economically significant zinc mineral, is commonly impure; cadmium will often substitute for zinc in the crystal lattice. The cadmium mineral greenockite (CdS) is frequently associated with weathered sphalerites and wurtzites [(Zn, Fe)S], but usually at microscopic levels. In 2007, zinc concentrate-producing States included Alaska, Idaho, Missouri, Montana, New York, Tennessee, and Washington. At least 14 mines produced zinc concentrate in the United States.

Metal production.—Domestic metal production data were collected by the USGS from a voluntary survey on production of cadmium metal and compounds. In 2007, cadmium metal was thought to have been produced in three States—Ohio (Toxco, Inc.'s Lancaster facility), Pennsylvania (The International Metals Reclamation Co., Inc., INMETCO's Ellwood facility), and Tennessee (Nyrstar NV's Clarksville facility).

Primary.—Primary cadmium had been traditionally refined in two States—Illinois (Big River Zinc refinery) and Tennessee (Clarksville refinery). During 2007, the Big River Zinc (BRZ, Sauget, IL) refinery remained under care-and-maintenance status. Operating since 1929, BRZ had historically been an electrolytic zinc refinery that also produced a number of byproducts, including cadmium metal, zinc sulfate monohydrate, sulfuric acid, and various cobalt, copper, lead, and silver products. In May 2006, ZincOx Resources plc (Surrey, United Kingdom) acquired BRZ from Korea Zinc Co., Ltd. (Seoul, Republic of Korea). According to ZincOx, the BRZ electrolytic zinc refinery was shuttered in late 2005 owing to recent nearby zinc mine closures and the increasing cash price of high-purity zinc concentrate. Cadmium-bearing zinc concentrates had previously been sourced from Illinois, Missouri, and Tennessee. In 2007, ZincOx completed prefeasibility studies on an integrated U.S. zinc and iron recycling project, which included modifying the BRZ refinery to treat a crude zinc oxide concentrate produced by an electric arc furnace dust recycling operation that was to be built in Ohio.

Clarksville, owned and operated by Nyrstar (Balen, Belgium), is an electrolytic zinc refinery located in Montgomery County, TN, 80 kilometers (km) northwest of Nashville. The complex's byproducts included cadmium metal, intermediate copper cementate, leach product, sulfuric acid, and synthetic gypsum. The recently reopened Tennessee zinc mines supplied a portion of the concentrate feed.

Secondary.—INMETCO (a wholly owned subsidiary of Vale Inco, Canada) produced secondary cadmium metal (99.95%+ purity shot and ingot) at its metals recovery facility in Ellwood, PA. The cadmium recovery plant, which began operating in December 1995, thermally recovered cadmium from recycled NiCd batteries, including those collected by the RBRC. Cadmium was recovered from both large industrial NiCd batteries and small consumer NiCd batteries in eight cadmium retort furnaces. The bulk of the cadmium produced was sold

back to battery manufacturers. Chromium and nickel were also reclaimed in the recovery process as a ferrous remelt alloy for stainless steel production.

Toxco's (Anaheim, CA) recycling operations in Lancaster, OH, also produced secondary cadmium metal in the form of 7-pound ingots. Cadmium was recovered from industrial NiCd batteries in 12 cadmium retort furnaces, each with an 150-pound capacity.

Consumption

The USGS does not collect data on the consumption of cadmium metal. The International Cadmium Association, however, makes estimates on global end-use patterns. The last reported breakdown (2003) was as follows: NiCd batteries, 79%; pigments, 11%; coatings, 7%; stabilizers for plastics, 2%; and other minor uses, 1%.

Nickel-cadmium batteries.—Reactions within a NiCd rechargeable battery occur between the nickel compounds at the positive electrode and between the cadmium compounds at the negative electrode. NiCd batteries have a high number of charge-discharge cycles, high rate of energy discharge, and a wide operating temperature. They power portable consumer electronics (commonly, power tools), emergency backup systems for industrial applications, and aircraft electrical systems. NiCd battery use in consumer electronics was thought to be declining owing partly to the preference for other rechargeable battery chemistries—particularly lithium ion (Li-ion) batteries, which have already replaced NiCd batteries to a large degree in laptops and cellular telephones. During the year, The Black & Decker Corp. (Towson, MD) unveiled several new industrial power tools that were powered by Li-ion phosphate batteries. Li-ion batteries are used in lightweight electronic devices, because of their greater energy density (power-to-weight ratio) (McDonnell, 2007; Black & Decker Corp., The, 2008).

Industrial-sized NiCd batteries could be used to store energy produced by certain on-grid photovoltaic (PV) systems. Peak energy produced during the midday would be stored in a NiCd battery and later dispatched during periods of high electricity demand. NiCd batteries could be a favored battery chemistry for this use owing to their stability in offshore and harsh weather environments (Eurobat and European Photovoltaic Industry Association, 2008).

Solar cells.—Cadmium telluride (CdTe) thin-film solar cells are an alternative to traditional crystalline silicon solar cells and are practical for commercial rooftop applications and large-scale, ground-mounted utility systems. Thin film PV companies involved in developing CdTe thin-film technology within the United States included Ascentool, Inc., AVA Solar, Inc., Canrom Photovoltaics, Inc., China Nuvo Solar Energy, First Solar, Inc., Primestar Solar, Inc., Solar Fields LLC, and Zia Watt Solar (Ullal and von Roedern, 2007).

In 2006, the President launched the Solar America Initiative (SAI) to reduce the cost of solar generated electricity until it is cost-competitive with conventional forms of electricity by 2015. As of 2007, CdTe solar cells had achieved greater than 9% commercial module efficiency at a cost of $1.21 per watt, and the U.S. Department of Energy (DOE) has set a goal of 13% commercial module efficiency at a cost of $0.70 per watt by 2015 (Office of Management and Budget, 2007; U.S. Department of Energy, 2007).

In June, the DOE selected PrimeStar Solar (Golden, CO) to develop a commercial manufacturing process for 16.5% efficient CdTe solar cells, which were originally developed by the National Renewable Energy Laboratory. In November, Fist Solar (Tempe, AZ) announced plans to construct a fourth solar cell manufacturing plant in Malaysia. Production at the new facility was scheduled to start in the second half of 2009. In December, 5N Plus, Inc. (Montreal, Quebec, Canada) announced plans to construct a CdTe manufacturing plant in Eisenhuttenstadt, Germany. The facility would begin operating in July 2008, and the CdTe product would be sold to First Solar (First Solar, Inc., 2007; Metal-Pages, 2007a; PrimeStar Solar, Inc., 2007).

Recycling

Although NiCd battery recycling rates have increased and the consumption of NiCd batteries has decreased in the United States, only a small fraction of cadmium (approximately 12%) continues to be recycled when compared with the total amount of cadmium contained in all retired NiCd batteries for a given year. The remaining, unrecycled contained cadmium was either discarded as municipal solid waste or remained in temporary storage—for example, household storage or industry stockpiles (D.R. Wilburn, Physical Scientist, U.S. Geological Survey, unpub. data, September 2006).

Established when INMETCO began cadmium recycling in 1995, RBRC has organized a multifaceted rechargeable battery collection and recycling program to help manufacturers and consumers comply with various State laws and regulations regarding rechargeable battery disposal or recycling. The program was financed with proceeds from licensing its seal of approval to individual companies involved in the importation, manufacturing, and distribution of rechargeable batteries or battery-operated products. The RBRC recycling program, Call2Recycle, facilitates uniform battery labeling, removeability from appliances, a national network of collection systems, regulatory relief to facilitate battery collection, and widespread publicity to encourage public participation. To increase participation, RBRC has undertaken an extensive public education campaign and has established numerous collection sites throughout the United States and Canada. In 2007, RBRC collected 2,858 t (6.3 million pounds) of rechargeable batteries—92% of which was from the United States, an overall 12% increase from that of 2006. RBRC partly attributed the increase to a new consumer initiative launched by Circuit City, New York City's rechargeable battery law that went into effect in late 2006, and several public awareness campaigns initiated in Canada and New Mexico (Rechargeable Battery Recycling Corp., 2008).

Launched by Toxco in 2003, The Big Green Box program is a privately sponsored battery collection system. Program participants purchase an United Nations-approved box for collecting disposable and rechargeable batteries and portable

battery-operated electronic devices. Shipping and recycling fees are included in the purchase cost of the box. When the box is returned to a receiving facility, the batteries are separated by chemistry and sent for recycling.

Prices

Platts Metals Week publishes a weekly and monthly New York Dealer price for cadmium (minimum 99.95% purity) in dollars per pound. The 2007 average New York Dealer price for cadmium was $7.61 per kilogram ($3.45 per pound). Average monthly New York dealer prices rose through the first half of the year—beginning in January at $4.34 per kilogram ($1.99 per pound) and reaching a high in June at $12.43 per kilogram ($5.64 per pound)—and then declined through December ($6.17 per kilogram, $2.80 per pound). A number of published sources attributed cadmium's considerable price rise to a lack of available material on the spot market.

World Review

Australia.—Most of the cadmium metal produced domestically was exported; a small amount was consumed by specialized electroplating industries. Nyrstar's Hobart zinc smelter, in the State of Tasmania, produced cadmium metal from cadmium-bearing zinc concentrates sourced from Zinifex Ltd.'s Century and Rosebery Mines.

Sun Metals Corporation Pty. Ltd.'s (a subsidiary of Korea Zinc) zinc refinery located near Townsville, North Queensland, had the capacity to produce 1,000 metric tons per year (t/yr) of cadmium cake (containing an estimated 75% to 80% cadmium). Sun Metals was thought to have exported most of the cadmium cake to Korea Zinc's Onsan zinc-lead refinery in the Republic of Korea, where it was processed into metal. Sun Metals sold 563 t of cadmium cake in its 2006-07 financial year (Korea Zinc Co., Ltd., 2007, p. 27; Park, undated, p. 5).

Belgium.—A large portion of the cadmium metal consumed in Belgium was for the production of cadmium compounds, which were then exported out of the country to NiCd battery manufacturers.

Canada.—In 2007, production of refined cadmium totaled 1,388 t, a decrease of 34% from that in 2006. About 90% of cadmium produced in Canada was exported, mostly to Japan and the United States (Natural Resources Canada, 2008, p. 19).

During 2007, Noranda Income Fund (partially owned by Xstrata plc, Zug, Switzerland) halted the production of cadmium at the Canadian Electrolytic Zinc refinery (CEZinc), near Montreal. According to the company, cadmium production had become unprofitable. The company continued to produce byproduct copper cake and sulfuric acid. CEZinc's last reported annual production level for cadmium was 134 t in 2006 (Noranda Income Fund, 2007, p. 9; 2008, p. 8).

Teck Cominco Ltd. (under the operating subsidiary Teck Cominco Metals) has been producing approximately 1,000 t/yr of refined cadmium at its metallurgical complex at Trail, British Columbia. Refined zinc and lead metal were the main products produced at Trail along with a number of byproducts that included copper compounds, germanium dioxide, gold, indium, silver, and various sulfur products. The cadmium plant at Trail was constructed in 1991 to handle the increased cadmium input from the Red Dog Mine in Alaska and can produce up to 1,400 t/yr of refined cadmium. Cadmium metal products, which were mostly consumed by NiCd battery manufacturers, included balls, billets, and sticks. Teck Cominco also produced cadmium chemicals and continuously cast cadmium sheet. Cadmium sheet is commonly used to shield radiation measurement and control devices from slow neutrons (Teck Cominco Ltd., undated, p. 13).

Byproduct cadmium metal was also produced at HudBay Minerals Inc.'s (Winnipeg, Manitoba) copper smelting and zinc refining operations in Flin Flon, Manitoba. Xstrata, under the operating division Xstrata Copper Canada, also produced cadmium at the Kidd Metallurgical complex near Timmins, Ontario. The facility reportedly had recovered cadmium at a rate of 820 t/yr (MacRae, undated; Natural Resources Canada, 2007).

China.—Battery producers in Japan and the Republic of Korea, such as Matsushita Electric Industrial Co., Ltd. and Sanyo Electric Co., Ltd., have relocated production operations to China in recent years in order to take advantage of the country's growing economy and lower labor costs. As a result, China's NiCd production and demand for cadmium have increased substantially. Effective July 1, China reduced the export tax rebate on cadmium products to 5% (Teo, 2007).

Leading producers of refined cadmium in China were Huludao Zinc Smelter (Liaoning Province), Shaoguan Smelter (Guangdong Province), and Zhuzhou Lead-Zinc Smelter (Hunan Province).

European Union.—The European Commission issued a revised battery directive (2006/66/EC) in September 2006 repealing the 1991 battery directive (91/157/EEC). Both directives regulated battery waste in the environment by restricting certain types of batteries and requiring Member States to organize national battery collection and recycling programs. The 1991 directive applied to only 7% of all portable batteries placed on the market, making collection and recycling programs difficult to implement and confusing to consumers. Directive 2006/66/EC, which was to take effect on September 26, 2008, applies to all portable batteries. The directive specified that all NiCd batteries containing more than 0.002% cadmium by weight were to be banned from the market. However, NiCd batteries used in certain cordless power tools, emergency systems, and medical equipment were exempt. Each year, approximately 800,000 t of automotive batteries, 190,000 t of industrial batteries, and 160,000 t of portable consumer batteries enter into the European Union (EU) marketplace. The mandated collection rate for portable batteries is 25% after 6 years and 45% after 10 years. A recycling rate of 75% for cadmium-containing batteries, 65% for lead-containing batteries, and 50% for all other batteries is to be met after 3 years. If the target collections and recycling requirements outlined under the revised directive are achieved, an estimated 1,500 t of cadmium will be recovered each year (European Commission, 2006, p. 3, 7, 8).

The EU's Council of Environmental Ministers formally adopted the "Registration, Evaluation, and Authorization of

Chemicals" (REACH) regulation in late December 2006. The purpose of REACH is to better identify the properties of chemical substances manufactured and traded in the EU and to place greater responsibility on industry for managing risks associated with hazardous chemicals. REACH will require producers and importers to register all chemicals brought to the EU market in quantities greater than 1 t. An independent agency, the European Chemicals Agency, will be established to oversee the administrative, scientific, and technical aspects of the policy. Registration information of all chemicals will be evaluated for environmental and health risks. If a chemical is determined to pose an unacceptable risk, its use in consumer products may be restricted, or it may be completely banned. Enforcement of REACH policy was to begin in June 2007, with the European Chemicals Agency beginning operations in June 2008 (European Commission, 2007, p. 2, 3, 6). U.S. chemical firms have begun working through industry associations, consortia, and customer-supplier negotiations to facilitate compliance by the June 2007 deadline. Common cadmium compounds include cadmium hydroxide and cadmium oxide for NiCd batteries, cadmium sulfides for pigments, cadmium carboxylates for polyvinylchloride stabilizers, and cadmium telluride for photoelectric and photovoltaic devices.

India.—Hindustan Zinc Ltd. (HZL, Udaipur) produced cadmium metal at the Chanderiya lead-zinc smelter complex, Debari zinc smelter, and Vizag zinc smelter. During the financial year ending March 31, HZL's cadmium metal production capacity was 833 t/yr, an increase of 9% from that of the previous financial year. HZL also continued carrying out a research and development project that involved recovering cadmium metal from hot gas precipitator dust generated by the lead and zinc smelter at Chanderiya, which uses the Imperial Smelting Process (Raghavan, 2000; Hindustan Zinc Ltd., 2008, p. 52, 100).

Japan.—Japanese production of rechargeable batteries—including Li-ion, nickel-metal hydride (NiMH), and NiCd—decreased by 2% in the first half of 2007 compared with that of the same period in 2006. NiCd and NiMH battery production decreased 18% and 5%, respectively; Li-ion battery production, conversely, increased by 3%. The unit value of NiCd batteries rose 29% owing to the high price of nickel. However, on a per-unit value basis, NiCd batteries continued to remain the least expensive of the three batteries chemistries, at 64% less than Li-ion and 86% less than NiMH (Roskill's Letters From Japan, 2007).

Korea, Republic of.—Korea Zinc was one of the leading suppliers of cadmium metal to China. Production capacity of refined cadmium at the company's leading smelter, the Onsan zinc-lead refinery in Kyoung Nam Province, was approximately 3,000 t/yr. Korea Zinc (under the subsidiary, Sorin Corp., Seoul) exported a total of 2,800 t of cadmium in its 2006-07 financial year, mostly to NiCd battery manufacturers (Korea Zinc Co., Ltd., 2007, p. 25).

Mexico.—Refined cadmium in Mexico was produced mainly at Industrias Penoles S.A. de C.V.'s metallurgical complex in Torreon and Grupo Mexico S.A. de C.V.'s electrolytic zinc refinery in San Luis Potosi. Industrias Penoles produced 983 t of refined cadmium, down slightly from that in 2006. The company processed less cadmium-bearing zinc concentrates in 2007 than in 2006 as a result of purchasing fewer third party materials (Industrias Penoles S.A. de C.V., 2008, p. 31).

During 2007, Grupo Mexico produced 634 t of refined cadmium at its zinc refinery in San Luis Potosi, an increase of 55% from that of the previous year when a fire at the refinery's electrical substation hampered production. The cadmium-bearing zinc concentrates treated at the refinery were sourced from the company's mines in Mexico, with about one-half (estimated) from the Charcas zinc mine located 113 km (Southern Copper Corp., 2008, p. 55, 62-63).

Peru.—Cadmium metal was produced at Votorantim Metais Ltda.'s (Sao Paulo, Brazil, a unit of Grupo Votorantim) Cajamarquilla zinc refinery and at Doe Run Peru's (Lima) La Oroya metallurgical operations.

Cadmium production at Votorantim's Cajamarquilla zinc refinery increased in late 2007 after the completion of the first phase of a capacity expansion project. During the initial phase, zinc production capacity would increase by 20%, causing byproduct cadmium production to rise at an equivalent rate from 360 t/yr to more than 430 t/yr (Harris, 2007; Votorantim Metais Ltda., 2007).

Russia.—Cadmium metal in Russia was produced at Chelyabinsk Zinc Plant OJSC's (CZP, Chelyabinsk) zinc refinery and Ural Mining and Metallurgy Company's (UMMC, Sverdlovsk) Electrozinc lead-zinc refinery in Vladikavkaz.

CZP produced 557 t of cadmium in 2007, a 20% increase from that of 2006. An increase in zinc production during the year contributed to the rise in byproduct cadmium production. UMMC produced 236 t of cadmium metal at Electrozinc during the first 11 months of 2007 (latest data available), a 14% increase compared with production in the same period in 2006 (Metal-Pages, 2007b).

Outlook

Concern over cadmium's toxicity has spurred various legislative efforts, especially in the EU, to restrict the use of cadmium in most of its end-use applications. If recent legislation involving cadmium dramatically reduces long-term demand, a situation could arise, such as has been seen with mercury, where an accumulating oversupply of byproduct cadmium will need to be permanently stockpiled. However, demand for cadmium may increase owing to several new market opportunities for NiCd batteries, particularly in industrial applications. NiCd batteries power approximately 80% of battery electric vehicles in circulation and are also used as a source of power in a limited number of hybrid electric vehicles.

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TABLE 1
SALIENT CADMIUM STATISTICS[1, 2]

		2003	2004	2005	2006	2007
United States:						
Production of metal[3, 4]	metric tons	1,450	1,480	1,470	723 r	735
Shipments of metal by producers[4, 5]	do.	1,200	1,410	1,680	833 r	692
Exports of metal, alloys, scrap	do.	615	154	686	483	424
Imports for consumption, metal, alloys, and scrap	do.	112	263	288	180	316
Apparent consumption of metal	do.	1,020	1,840	699	568 r	585
Price, average, New York dealer[6]	dollars per pound	0.59	0.55	1.50	1.35	3.45
Do.[6]	dollars per kilogram	1.31	1.20	3.30	2.98	7.61
World, refinery production	metric tons	18,400 r	18,700 r	20,200 r	19,900 r	20,400

rRevised. Do., do. Ditto.
[1]Data are rounded to no more than three significant digits, except prices.
[2]Cadmium content.
[3]Primary and secondary cadmium metal. Includes equivalent metal content of cadmium sponge used directly in production of compounds.
[4]Partially estimated.
[5]Includes metal consumed at producer plants to make oxide and other cadmium compounds.
[6]Price for 1 - to 5-short ton lots of metal having a minimum purity of 99.95% (Platts Metal Week).

TABLE 2
SUPPLY AND APPARENT CONSUMPTION OF CADMIUM METAL[1, 2]

(Metric tons)

	2003	2004	2005	2006	2007
Producer stocks, January 1[3]	1,360	1,430	1,170	1,540	1,400
Production[3]	1,450	1,480	1,470	723 r	735
Imports for consumption, metal, alloys, and scrap	112	263	288	180	316
Shipments from Government stockpile excesses	146	--	--	--	--
Total supply	3,070	3,170	2,930	2,450 r	2,450
Exports of metal, alloys, scrap	615	154	686	483	424
Producer stocks, December 31[3]	1,430	1,170	1,540	1,400 r	1,440
Consumption, apparent[4]	1,020	1,840	699	568 r	585

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Excludes supply and apparent consumption of cadmium sulfide, cadmium telluride, and related cadmium chemicals.
[3]Partially estimated.
[4]Total supply minus exports and yearend stocks.

TABLE 3
U.S. EXPORTS OF CADMIUM PRODUCTS, BY COUNTRY AND TYPE[1]

	2006		2007	
	Quantity (kilograms)	Value	Quantity (kilograms)	Value
Cadmium metal:[2]				
Belgium	--	--	27,200	$117,000
Canada	25,200	$192,000	14,800	121,000
China	87,900	183,000	280,000	1,410,000
France	31,400	109,000	103	44,000
Germany	5,220	1,650,000	86	125,000
Honduras	--	--	7,870	19,500
Israel	12,000	52,500	14,800	92,300
Japan	--	--	4,030	198,000
Korea, Republic of	236,000	260,000	44	9,390
Mexico	2,000	34,200	1	3,900
Netherlands	--	--	68,900	602,000
Singapore	2,080	8,200	4,970	44,400
United Kingdom	80,000	1,370,000	108	5,210
Other	1,160	12,700	1,500	29,200
Total	483,000	3,870,000	424,000	2,820,000
Of which:				
Unwrought and powder	17,800	118,000	270,000	1,510,000
Waste and scrap	5,140	1,530,000	--	--
Other	460,000	2,210,000	154,000	1,310,000
Total	483,000	3,870,000	424,000	2,820,000
Cadmium sulfide, gross weight:				
France	--	--	10,800	5,640
Germany	--	--	103,000	109,000
Israel	9,110	4,740	11,900	6,160
Malaysia	9,550	4,970	9,950	5,180
Mexico	38,500	20,000	--	--
Philippines	4,860	2,530	--	--
Total	62,000	32,200	135,000	126,000
Total, calculated Cd content	48,200	XX	105,000	XX
Cadmium pigments:				
Canada	50,400	522,000	27,200	533,000
Chile	805	9,920	12,600	68,300
China	--	--	18,600	33,700
Colombia	21	3,310	79,400	306,000
Dominican Republic	--	--	136,000	234,000
Ecuador	601	3,000	4,180	62,700
France	778	9,230	19,400	70,500
Germany	6,010	26,300	24,000	56,900
Greece	1,550	3,900	44,000	65,600
Guatemala	5,750	6,830	188,000	317,000
Hong Kong	116,000	1,190,000	60,600	180,000
Japan	133,000	1,270,000	13,400	175,000
Mexico	32,600	150,000	251,000	1,120,000
New Zealand	--	--	204,000	315,000
Spain	1,330	6,430	114,000	117,000
Switzerland	--	--	3,250	964,000
Other	10,600	133,000	166,000	555,000
Total	359,000	3,330,000	1,370,000	5,180,000

XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes exports of cadmium in alloys (Schedule B 8107.90) and waste and scrap (Schedule B 8107.30).

Source: U.S. Census Bureau.

TABLE 4
U.S. IMPORTS OF CADMIUM PRODUCTS, BY COUNTRY AND TYPE[1]

	2006		2007	
	Quantity (kilograms)	Value	Quantity (kilograms)	Value
Cadmium metal:[2]				
Australia	88,300	$239,000	34,000	$155,000
Belgium	6,400	102,000	5,400	140,000
Canada	34,200	494,000	25,600	958,000
China	--	--	22	5,700
Germany	17,400	117,000	20,100	122,000
Hong Kong	--	--	18,000	238,000
India	23,000	81,100	323	139,000
Japan	15	16,300	1	2,500
Mexico	454	3,440	193,000	208,000
Peru	10,000	30,800	20,000	144,000
Taiwan	322	26,000	--	--
Other	--	--	1	2,110
Total	180,000	1,110,000	316,000	2,120,000
Of which:				
Unwrought and powder	179,000	902,000	315,000	1,880,000
Waste and scrap	--	--	--	--
Other	1,220	207,000	1,300	237,000
Total	180,000	1,110,000	316,000	2,120,000
Cadmium oxide:				
Belgium	189,000	1,030,000	150,000	1,420,000
Canada	2,040	20,300	--	--
Total	192,000	1,050,000	150,000	1,420,000
Total, calculated Cd content	168,000	XX	131,000	XX
Cadmium sulfide, gross weight:				
Canada	51	13,100	29,000	133,000
China	--	--	2	2,270
Russia	113,000	311,000	215,000	1,000,000
United Kingdom	2,270	26,600	1,350	9,840
Total	115,000	350,000	245,000	1,150,000
Total, calculated Cd content	89,700	XX	191,000	XX
Cadmium pigments:				
Brazil	8,890	134,000	7,290	129,000
Canada	10,800	63,700	4,910	76,200
China	17,000	17,900	--	--
Finland	10,400	304,000	8,050	242,000
France	8,820	169,000	6,920	101,000
Germany	4	5,310	1,000	5,740
India	4,810	34,900	9,980	73,600
Italy	340	16,400	--	--
Japan	26,800	126,000	300	6,850
Russia	4	2,450	--	--
Spain	1,200	30,600	--	--
Taiwan	--	--	1,000	2,800
United Kingdom	138,000	2,070,000	104,000	1,760,000
Total	227,000	2,980,000	143,000	2,390,000

XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes imports of cadmium in alloys [Harmonized Tariff Schedule of the United States (HTS) 8107.90] and waste and scrap (HTS 8107.30).

Source: U.S. Census Bureau.

TABLE 5
CADMIUM: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country[3]	2003	2004	2005	2006	2007[e]
Algeria[e]	5	--	--	--	--
Argentina	25	39	3	6 [r]	5
Australia	560 [r]	347 [r]	358 [r]	329 [r]	351
Brazil[5]	189	187	200	200	200
Bulgaria	307	356	319	319	320
Canada[6]	1,759	1,880	1,727 [r]	2,094 [r]	2,100 [p]
China[e]	2,710	2,800	4,080 [r]	3,790 [r]	4,000
France[7]	-- [r]	-- [r]	-- [r]	-- [r]	--
Germany[e]	640 [4]	640	640	640	640
India	477	489	409	457 [r]	580 [4]
Italy[e]	22 [4]	10 [r]	10 [r]	10 [r]	10
Japan	2,497	2,233	2,297	2,287	1,933 [4]
Kazakhstan	1,351	1,900	2,000	2,000	2,100
Korea, North[e]	200	200	200	200	200
Korea, Republic of	2,175	2,362	2,582	3,320 [r]	3,400
Macedonia[e]	75	--	--	--	--
Mexico[8]	1,590	1,615 [r]	1,653 [r]	1,401 [r]	1,617 [4]
Netherlands	480 [r]	493 [r]	494 [r]	524 [r]	495
Norway	331	260	260	153	150
Peru	529	532	481	416	420 [p]
Poland	375	356	350	356	350
Russia	629 [r]	532 [r]	621 [r]	690 [r]	810 [4]
Ukraine[e]	25	25	25	25	25
United Kingdom	22	--	--	--	--
United States	1,450	1,480	1,470	723 [r]	735
Total	18,400 [r]	18,700 [r]	20,200 [r]	19,900 [r]	20,400

[e]Estimated. [p]Preliminary. [r]Revised. -- Zero.

[1]This table gives unwrought production from ores, concentrates, flue dusts, and other materials of both domestic and imported origin. Sources generally do not indicate if secondary metal (recovered from scrap) is included or not; where known, this has been indicated by a footnote. Data derived in part from World Metal Statistics (published by World Bureau of Metal Statistics, Ware, United Kingdom) and from Metal Statistics (published jointly by Metallgesellschaft AG of Frankfurt am Main, Germany, and World Bureau of Metal Statistics). Cadmium is found in ores, concentrates, and/or flue dusts in several other countries, but these materials are exported for treatment elsewhere to recover cadmium metal; therefore, such output is not reported in this table to avoid double counting. This table includes data available through May 8, 2008.

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

[3]Romania, Thailand, and Uzbekistan may produce primary cadmium metal or oxide, but information is inadequate to make reliable estimates of output.

[4]Reported figure.

[5]Exports from Anuário Mineral Brasileiro (Departamento Nacional de Produção Mineral).

[6]Includes secondary.

[7]Excludes secondary production from recycled nickel-cadmium batteries. Metaleurop Nord's-Noyelles Godault lead and zinc plant, which produced byproduct cadmium, was closed in 2003.

[8]Excludes significant production of both cadmium oxide and cadmium contained in exported concentrates.