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2019 Minerals Yearbook

CADMIUM [ADVANCE RELEASE]

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Cadmium

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Refined cadmium was produced domestically by two companies. One company recovered cadmium as a byproduct of zinc recovery through the leaching of roasted sulfide concentrates at a smelter in Tennessee, and the other company recovered secondary cadmium metal from recycled nickel-cadmium (NiCd) batteries at a facility in Ohio. Annual domestic production and apparent consumption data were withheld to avoid disclosing company proprietary data.

The United States was a net importer of unwrought cadmium metal and powders in 2019, with net imports totaling 353 metric tons (t) compared with 233 t in 2018 (table 1). Imports increased by 41% to 385 t from 273 t in 2018, whereas exports decreased to 32 t from 40 t in 2018, significantly less than those in prior years. India replaced China as the leading export destination for unwrought cadmium metal and powders; an 81% decrease in exports to China in 2018 was followed by an 88% decrease in 2019 (table 2). Imports from China also decreased substantially, although there were large increases in imports from Australia, Belgium, Canada, Germany, and Japan, contributing to the higher import total in 2019 compared with that in 2018 (table 3).

Of the downstream cadmium products, the United States was a net importer of cadmium oxide and waste and scrap and a net exporter of cadmium sulfide and pigments in 2019 (tables 2, 3). Exports of cadmium pigments were 41% more than those in 2018, and Mexico continued to be the leading destination (table 2). Metal Bulletin's average global free market price of cadmium metal in 2019 decreased by 8% from that in 2018 to $2.67 per kilogram ($1.21 per pound) (table 1).

In 2019, global primary production of cadmium, excluding U.S. production, was estimated to be 24,400 t, 3% less than that in 2018 (table 5). Although detailed data on the global consumption of primary cadmium by end use in 2019 were not available, NiCd battery production continued to account for most of the global cadmium consumption. Other end uses for cadmium included alloys, anticorrosive coatings, pigments, polyvinyl chloride (PVC) stabilizers, radiation shielding, and semiconductors for solar cells and radiation detectors. Cadmium metal was sold in several shapes and forms depending on end use: slabs or sticks commonly were consumed for alloys; balls and spheres for plating; and flakes, powder, or sticks for chemicals and pigments.

Legislation and Government Programs

In March 2018, the Office of the United States Trade Representative (USTR) released the findings of its investigation under section 301(b) of the Trade Act of 1974, as amended. The USTR found China's acts, policies, and practices related to technology transfer, intellectual property, and innovation were unreasonable and discriminatory and burdened or restricted United States commerce. After two initial actions in July and August 2018, a third list of 5,745 full and partial tariff lines (including nonfuel mineral ores and concentrates and forms) became subject to an additional 10% import duty in late September 2018, increasing the tariff to 25% starting January 1, 2019. However, the implementation was delayed until May 10, 2019, while negotiations with China were underway. The increased tariff list included cadmium oxide, cadmium sulfide, unwrought cadmium and powder, cadmium waste and scrap, and other cadmium articles not elsewhere classified (Office of the U.S. Trade Representative, 2018, 2019).

The Defense Logistics Agency Strategic Materials (DLA Strategic Materials), U.S. Department of Defense, under its fiscal year 2020 Annual Materials Plan beginning October 1, 2019, again designated a ceiling of 32,000 square centimeters of cadmium zinc tellurium (CZT) for potential acquisition (Defense Logistics Agency Strategic Materials, 2019).

CZT is as an ideal material for high-resolution, high-efficiency, room-temperature radiation detectors and is used in national security, nuclear medicine, nuclear safeguard, and X-ray imaging applications. In July 2019, the Small Business Innovation Research program awarded Washington State University a grant to develop a new method of producing CZT. The new method would provide a threefold reduction in cost through faster production time and eliminate the need for post-growth processing. The grant also would establish a U.S. producer of CZT from which spectroscopic-grade CZT could be purchased for national security applications (U.S. Small Business Administration, 2019).

In August, the National Renewable Energy Laboratory (NREL) announced the findings of a collaborative project funded in part by the U.S. Department of Energy's Solar Technologies Office that would improve efficiency and increase the service life of cadmium telluride (CdTe) solar cells. The project involved finding a commercially feasible method to manufacture CdTe solar cells without the addition of copper. The original research, a collaborative project in 2016 between NREL and the University of Washington, found that record-high voltage could be generated if copper was replaced with Group V elements on the periodic chart, such as antimony or arsenic. The new manufacturing method involved adding the Group V elements while the cells were being grown and resulted in a cell efficiency of 20.8% (National Renewable Energy Laboratory, 2019). In 2019, efficiencies of mass produced advanced CdTe solar cells ranged from 17.0% to 18.2% at standard test conditions (First Solar, Inc., 2020a).

Production

Mine Production.—Domestic data on the recoverable cadmium content of zinc concentrates, the principal source of primary cadmium, were not available. Zinc concentrates typically contain between 0.2% and 0.3% cadmium. In 2019, zinc was mined in Alaska, Idaho, Missouri, New York, Tennessee, and Washington.

Washington's zinc source, the Pend Oreille Mine, was placed on care-and-maintenance status in mid-2019 after reserves were depleted. Zinc concentrates from Alaska, Idaho, Missouri, New York, and Washington were exported for processing. Zinc concentrates from Tennessee were smelted and refined in Tennessee and processed for byproduct cadmium recovery.

Metal Production.—Domestic metal production data were collected by the U.S. Geological Survey from a voluntary survey of cadmium metal and compounds producers. In 2019, cadmium metal was produced at one primary and one secondary smelter. Annual domestic production data were withheld to avoid disclosing company proprietary data.

Primary.—Nyrstar N.V.'s (Belgium) electrolytic zinc refinery in Clarksville, TN, produced zinc metal and several byproducts, including cadmium metal. In 2019, the company's East Tennessee and Middle Tennessee zinc mine complexes supplied most of the zinc concentrate feed treated at the Clarksville refinery.

Secondary.—Retriev Technologies Inc.'s (Anaheim, CA) battery recycling operations in Lancaster, OH, recovered cadmium metal in the form of ingot from consumer and industrial NiCd batteries.

Consumption

Data on the domestic consumption of cadmium were not available. According to the World Bureau of Metal Statistics (2020), global consumption of cadmium in 2019 decreased by 6% from that in 2018. Most of the cadmium consumed globally was used in NiCd batteries. Other uses included alloys, coatings, pigments, solar cells, and stabilizers.

Nickel-Cadmium Batteries.—Reactions within a NiCd rechargeable battery occur between the nickel compounds at the positive electrode and the cadmium compounds at the negative electrode. Although NiCd battery technology was one of the earliest in widespread use, in most consumer electronics, newer rechargeable battery technologies (especially lithium ion) that do not contain cadmium are now generally used and have higher energy densities allowing them to be smaller, lighter, and more powerful. However, when paired with a proper charging system, NiCd batteries for industrial applications remain widely used because their service life longevity makes them economical, and they are known for reliability in rugged conditions and extreme temperatures. Industrial NiCd batteries are often used in standby applications for emergency power and for the starting of large engines and turbines.

Most commercial and corporate aircraft use NiCd batteries. In addition to engine startup, the batteries are needed for functions such as emergency power, ground power, and improved electrical system stability, although other types of batteries, particularly lithium ion, are entering the market and are used in some newer airplane models because of their lighter weight. NiCd batteries have commonly been used because, compared with other battery technologies, they are less susceptible to overheating, are not prone to internal cell defects that may not be detected in standard testing unlike some newer technologies, are nonflammable, and can operate in a wide temperature range reliably. They can be designed for specific power requirements on aircraft with the ability to withstand mechanical and electrical problems, and they have a lower overall cost (Federal Aviation Administration, 2018a, p. 9–21; 2018b; Hanson and others, 2018, p. 2–3). Because of this reliability and cost advantage, NiCd batteries are also used in railway applications for electrical systems and engine starting and in trackside equipment. For telecommunications backup in hotter regions, NiCd batteries are often used (Zelinsky and others, 2017, p. 1). NiCd batteries are also designed to provide backup power in maritime applications including offshore oil and gas platforms. In remote locations, NiCd batteries are sometimes used for energy storage in solar or wind renewable energy projects because of their low maintenance requirements.

Coatings and Plating.—Cadmium anticorrosive coatings were used by the aerospace industry and military for critical applications where coating substitution might compromise operational safety. For example, the metal commonly was used to plate fasteners in aircraft landing gear and parachutes. Despite the toxicity of cadmium, cadmium coatings remained indispensable owing to a combination of properties not available from other coatings, including superior corrosion resistance and a low coefficient of friction.

Pigments.—Inorganic cadmium pigments are made from cadmium sulfide, which is golden yellow in color. The color spectrum of cadmium pigments, ranging from bright yellow to maroon, is derived by replacing cadmium with zinc or mercury and substituting selenium for sulfur. Cadmium pigments were used predominantly to color engineering plastics that were processed at high temperatures.

Solar.—Cadmium was used for the production of CdTe, a semiconducting compound used in thin-film photovoltaics. First Solar, Inc. (Tempe, AZ) was a leading producer of CdTe-based solar modules with manufacturing locations in the United States, Malaysia, and Vietnam. In October, the company opened a second manufacturing facility in Lake Township, OH, near the existing Perrysville, OH, factory, which increased the company's U.S. capacity to a total of 1.9 gigawatts (GW) of solar modules per year. The additional capacity in the United States plus that from a second plant built in Vietnam, that also began operation in 2019, allowed the company's total production to increase to 5.7 GW in 2019, more than double that in 2018 (First Solar, Inc., 2019; 2020b, p. 50). 5N Plus Inc. (Canada) provided CdTe semiconductor material to First Solar through long-term contracts that had been extended through 2021 (5N Plus Inc., 2018).

Prices

In 2019, the average Metal Bulletin global free market price for 99.95%-minimum-purity cadmium was $2.67 per kilogram ($1.21 per pound), 8% less than the average price in 2018 (table 1). This price reflected the average price of cadmium traded on a spot basis; however, most cadmium produced was sold through private long-term contracts. Although the 2019 average price was less than the 2018 price, it was significantly higher than that in 2017. The average monthly price started the year at $1.25 in January and increased to $1.38 per pound in March and then decreased to end the year at a monthly average of $1.17 per pound. As in previous years, buyers in India were the most significant purchasers on the spot market, and seasonal consumption in India remained strong.

World Industry Structure

Primary Production.—Global cadmium production, excluding U.S. production, decreased by 3% to an estimated 24,400 t in 2019 (table 5). The two leading producers were China and the Republic of Korea, accounting for 34% and 18%, respectively, of global production. Most (62%) of the world's refined cadmium was produced in Asia and the Pacific (Australia, China, Japan, and the Republic of Korea), followed by Europe and Central Eurasia (Bulgaria, Germany, Kazakhstan, the Netherlands, Norway, Poland, Russia, and Uzbekistan) with 22%; North America (Canada and Mexico), 13%; and South America (Peru), 3%. Major global producers of primary cadmium are listed in table 4.

Secondary Production.—Most secondary metal was recovered at NiCd battery recycling facilities in Asia, Europe, and the United States. In Asia, NiCd battery recyclers included KOBAR Ltd. in the Republic of Korea and Kansai Catalyst Co., Ltd., Nippon Recycle Center Corp., and Toho Zinc Co., Ltd. in Japan. In Europe, NiCd battery recycling took place at Accurec Recycling GmbH's facility in Germany, Saft Groupe SA's plant in Sweden, and Société Nouvelle d'Affinage des Métaux's (a subsidiary of Floridienne Group) recycling facilities in France.

Consumption.—Based on production and trade data, China was the leading consumer of cadmium, although its consumption was decreasing. India was a close second, and Belgium and Sweden were a distant third and fourth, respectively. In recent years, the transition to lithium-ion batteries for most purposes was accelerating in China, except for stable demand in emergency lighting, military applications, and rail transport (China Industrial Association of Power Sources, 2019). Another reason for decreasing consumption in China was the major environmental initiative, begun in 2016, to curb pollution from heavy metals, particularly cadmium. As a result, about 1,300 firms that produced or processed heavy metals were reportedly closed as of November 2019, including 700 operations that processed cadmium (Liqiang, 2019; Xu and Stanway, 2019). While production of cadmium in China remained relatively stable (table 5), net imports of unwrought cadmium and powders into China decreased from 9,140 t in 2016 to 2,200 t in 2019 (Zen Innovations AG, 2020).

While cadmium consumption in China was decreasing, consumption in India continued to increase. India's net imports of unwrought cadmium and powders increased for the eighth consecutive year, from 376 t in 2011 (Global Trade Information Services Inc., 2019) to 7,720 t in 2019, including a 34% increase from 5,740 t in 2018 (Zen Innovations AG, 2020). The increase in consumption was attributed to increasing industrialization. In 2014, the "Make in India" initiative was launched with the goal of increasing manufacturing in India to 25% of gross domestic product in 2025 from 16% in 2014. There were 25 sectors of focus including aviation, defense manufacturing, and railways (Department for Promotion of Industry and Internal Trade, undated). In India, the leading end use of cadmium was cadmium plating for corrosion protection, but it also was used in a variety of applications such as in alloys for bearings and electrical transmission wire, NiCd batteries, nuclear reactor control rods, and pigments (Indian Bureau of Mines, 2020).

As part of the "Make in India" initiative, upgrades and electrification of railroads across India were undertaken and, in 2019, two major freight corridors with a total length of 2,843 kilometers were being built that would be powered by overhead electrification (Dedicated Freight Corridor Corporation of India Ltd., 2019). Catenary wire used for this purpose was specified to be made of copper-cadmium alloy wire (Rail Vikas Nigam Ltd., 2018, p. 289). Completion of the freight lines was expected by the end of 2021.

In 2019, NiCd battery manufacturing was increasing in India, in part, because of the new rail initiative. Saft Groupe SA (France) scaled up production at its plant in Bidbadi, in support of a large contract for backup batteries for control and safety systems for 800 freight double locomotives; battery manufacturing for the contract would continue through 2028 (Saft Groupe SA, 2018). Exide Industries Ltd. (India) was licensed to use NiCd battery technology from Furukawa Battery Co. Ltd. (Japan) effective July 2018 to July 2023; in 2019, the company was developing a battery plant in Haldia that would include NiCd battery manufacturing (Batteries International, 2018; Exide Industries Ltd., 2018, p. 7, 112). In 2019, HBL Power Systems Ltd., also based in India, introduced a new line of NiCd batteries for engine and turbine starting (HBL Power Systems Ltd., 2019). In addition to industrial batteries, portable NiCd batteries were produced in India for consumer electronics.

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China.—Shenzhen Zhongjin Lingnan Nonfemet Co., Ltd. began a slag-processing upgrade project at the company's Danxia smelter that would recover cadmium and other metals and produce 413 metric tons per year (t/yr) of cadmium ingots from zinc slag generated at the Danxia smelter and the company's Shaoguan smelter (China Nonferrous Metals News, 2019). This was a part of ongoing efforts in China to mitigate cadmium pollution.

India.—No cadmium metal was produced in 2019, but an ancillary unit was under construction at Hindustan Zinc's Chanderiya lead zinc smelter that would treat all smelting process residue, including cadmium sponge from which cadmium metal would be produced. Construction was expected to be completed in 2020 (Vedanta Ltd., 2019, p. 84).

Japan.—Nippon Recycle Center Corp. was expanding its Tsukuda NiCd battery recycling plant to double capacity for NiCd battery recycling from 900 t/yr to 1,800 t/yr. The expansion was initiated because China was placing increasingly stringent restrictions on scrap imports such as NiCd batteries for processing. Conversely, in Japan, import restrictions of hazardous waste were eased beginning in 2018 through a preapproval system for qualified recycling companies, which would allow for increased imports of scrap NiCd batteries. Sources of batteries included the United States and industrial battery manufacturers in Asia. The expansion was expected to be completed in late 2020 (MIRU News & Report, 2019).

Korea, Republic of.—Young Poong Corp. closed its cadmium plant at its Seokpo Smelter in June to eliminate all possible sources of cadmium contamination in the surrounding environment (Young Poong Corp., 2020, p. 6, 31).

Russia.—One of the two zinc smelters in Russia that produced cadmium, Ural Mining and Metallurgy Co.'s Vladikavkaz zinc plant, which had been damaged significantly by a fire in October 2018, was placed on indefinite care-and-maintenance status after remaining stocks were shipped to the company's zinc smelter in Chelyabinsk in 2019. Cadmium capacity of the plant had been about 300 t/yr (Argus Metals International, 2019).

Outlook

Lithium-ion batteries have significantly replaced NiCd batteries in most consumer electronics, particularly power tools, and substitution is expected to continue as costs decrease. NiCd batteries have a lower energy density compared with newer alternatives, making them heavier for the same amount of power, and the cadmium contained in the batteries, although recyclable, is considered hazardous.

NiCd batteries are expected to continue to be used in certain industrial applications because of their superior reliability and stability in a wide range of operating temperatures and harsh environments with relatively little maintenance required. They have a low operating cost over the lifespan of the batteries, which can exceed that of other battery technologies. NiCd batteries can be engineered to provide high energy discharge in a short period of time, such as for starting large engines or generators, or lower energy discharges over a longer period, such as for backup power supply.

Cadmium will continue to be needed in its other end uses as well, such as for coatings to prevent corrosion in critical applications, in thin-film solar cells, and in control rods in nuclear reactors. Cadmium was to be considered for possible inclusion on a list of critical minerals for a low emissions economy, to be updated by the European Commission in 2020 (Lewis, 2019). However, only a relatively small amount of cadmium is needed for these applications. Cadmium-containing residues will continue to be produced as a byproduct from zinc smelting, regardless of cadmium demand. Although there is growth potential in certain end uses, if applications for and consumption of cadmium continue to decline, excess byproduct residues may need to be permanently stockpiled and managed.

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TABLE 1
SALIENT CADMIUM STATISTICS[1]

		2015	2016	2017	2018	2019
United States:						
Production of metal[2]	metric tons	W	W	W	W	W
Shipments of metal by producers	do.	W	W	W	W	W
Exports, unwrought metal and powders	do.	350	157	223	40	32
Imports for consumption, unwrought metal and powde	do.	237	240	274	273	385
Apparent consumption of metal	do.	W	W	W	W	W
Price, average, New York dealer[3]	dollars per pound	0.67	NA	NA	NA	NA
Do.[3]	dollars per kilogram	1.47	NA	NA	NA	NA
Price, average, free market[4]	dollars per pound	0.50	0.61	0.80	1.31	1.21
Do.[4]	dollars per kilogram	1.10	1.34	1.75	2.89	2.67
World, refinery production[5]	metric tons	25,100	25,800 r	25,500 r	25,100	24,400 e

eEstimated. rRevised. Do., do. Ditto. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Table includes data available through June 1, 2020. Data are rounded to no more than three significant digits.

[2]Although U.S. production data are withheld, primary and secondary cadmium were produced in the United States.

[3]Price for 1- to 5-short-ton lots of metal having a minimum purity of 99.95% (Source: S&P Global Platts Metals Week). Price discontinued as of yearend 2015.

[4]Price for 10-metric-ton lots of metal having a minimum purity of 99.95%. Cost, insurance, and freight; global ports Source: Metal Bulletin (Fastmarkets MB).

[5]Excludes U.S. production; estimated or reported production quantities for producer countries are listed in table 5.

TABLE 2
U.S. EXPORTS OF CADMIUM PRODUCTS, BY COUNTRY OR LOCALITY AND TYPE[1]

Product type and country or locality	2018 Quantity (kilograms)	2018 Value	2019 Quantity (kilograms)	2019 Value
Metal:				
Unwrought and powders:				
Brazil	--	--	4,000	$11,200
Canada	1,220	$20,600	3,660	45,200
China	38,100	80,600	4,430	10,800
India	--	--	20,000	55,900
Mexico	970	37,900	--	--
Other	212	23,400	58	13,000
Total	40,500	162,000	32,200	136,000
Wrought and other articles:				
Brazil	5,040	20,900	2,040	5,600
Canada	3,940	13,400	5,430	25,200
Germany	21,000	25,000	--	--
India	59,900	142,000	39,500	97,600
Italy	4,760	22,300	165	14,000
Jamaica	3,760	91,400	--	--
Korea, Republic of	--	--	8,280	42,100
Mexico	--	--	22,000	97,400
Singapore	--	--	1,560	9,530
United Kingdom	--	--	1,900	15,200
Other	147 r	18,000 r	3,230	41,200
Total	98,600	333,000	84,100	348,000
Waste and scrap, Mexico	42	4,370	5,970	14,500
Cadmium sulfide:				
British Virgin Islands	--	--	15	3,050
Germany	31	8,060	--	--
Korea, Republic of	13	2,690	--	--
Kuwait	15	2,950	--	--
Total	59	13,700	15	3,050
Cadmium pigments:				
Barbados	--	--	1,420	11,100
Brazil	4,560	17,400	7,620	33,900
Chile	4,800	85,800	1,060	12,200
China	1,370	8,140	--	--
Colombia	35,200	90,400	1,200	7,390
Costa Rica	--	--	1,770	5,540
Dominican Republic	--	--	2,100	10,900
El Salvador	5,730	27,500	3,160	13,800
Guatemala	1,270	10,600	--	--
Japan	14,000	3,360,000	60,000	4,070,000
Korea, Republic of	11,700	500,000	26,800	167,000
Mexico	422,000	3,820,000	570,000	5,150,000
Nicaragua	1,260	8,100	--	--
Pakistan	1,740	16,100	6,480	160,000
Switzerland	46,000	19,000,000	16,000	8,820,000
Taiwan	10,900	32,800	78	5,070
United Kingdom	1,500	21,100	7,500	149,000
Uruguay	--	--	87,900	618,000
Other	3,380 r	150,000 r	1,450	29,500
Total	565,000	27,200,000	795,000	19,300,000

rRevised. -- Zero.

[1]Table includes data available through May 8, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 3

U.S. IMPORTS FOR CONSUMPTION OF CADMIUM PRODUCTS, BY COUNTRY OR LOCALITY AND TYPE[1]

Product type and country or locality	2018 Quantity (kilograms)	2018 Value	2019 Quantity (kilograms)	2019 Value
Metal:				
Unwrought and powders:				
Australia	40,000	$107,000	86,000	$275,000
Belgium	7,490	89,000	21,900	110,000
Canada	2,710	213,000	83,100	376,000
China	140,000	738,000	24,000	384,000
Germany	52	7,440	90,200	282,000
Hong Kong	2,000	39,000	--	--
Japan	--	--	20,000	55,700
Korea, Republic of	23,000	79,700	20,000	56,900
Peru	58,100	147,000	40,000	108,000
United Kingdom	--	--	34	2,500
Total	273,000	1,420,000	385,000	1,650,000
Wrought and other articles:				
Canada	111	17,900	117	24,200
China	473	31,000	155	22,800
Germany	--	--	11	3,900
India	6	2,970	--	--
Italy	--	--	418	3,690
Korea, Republic of	--	--	20,000	56,000
United Kingdom	--	--	18	36,100
Total	590	51,900	20,700	147,000
Waste and scrap:				
Australia	20,000	66,900	79,000	267,000
Canada	--	--	6,520	3,570
China	59	2,910	--	--
Total	20,100	69,800	85,500	270,000
Cadmium oxide:				
Belgium	44,200	644,000	26,200	407,000
China	3,000	18,000	3,900	23,500
Japan	--	--	1,730	16,600
Russia	--	--	1,380	13,200
United Kingdom	3,980	126,000	--	--
Total	51,100	788,000	33,200	461,000
Cadmium sulfide:				
China	2,050	38,600	--	--
Germany	10	7,250	--	--
Russia	1,950	353,000	--	--
Total	4,010	399,000	--	--
Cadmium pigments:				
Austria	450	3,850	--	--
Belgium	690	12,900	--	--
Brazil	7,480	237,000	5,690	178,000
Canada	7,620	178,000	14,500	68,300
China	2,900	84,000	1,660	42,800
France	--	--	75	4,120
Germany	164,000	813,000	7,980	63,900
India	19,000	34,700	3,000	12,500
Italy	204	44,100	--	--
Japan	4,150	116,000	4,230	70,200
Korea, Republic of	15	3,000	20	4,040
Mexico	14,000	67,600	24,000	266,000
Sweden	1,320	8,060	--	--
United Kingdom	88,200	1,840,000	57,800	1,150,000
Total	310,000	3,440,000	119,000	1,860,000

-- Zero.

[1]Table includes data available through May 28, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 4
MAJOR PRIMARY CADMIUM PRODUCTION FACILITIES IN 2019, BY COUNTRY OR LOCALITY[1]

Country or locality	Major operating company	Location of main facilities
Algeria	Société Algérienne du Zinc S.p.A. (METANOF)	Ghazaouet, Tlemcen
Australia	Nyrstar N.V.	Hobart, Tasmania
Bulgaria	KCM AD	Plovdiv, Plovdiv
Canada	HudBay Minerals Inc.	Flin Flon, Manitoba
Do.	Teck Resources Ltd.	Trail, British Columbia
China	Baiyin Nonferrous Group Co. Ltd.	Baiyin, Gansu
Do.	Huludao Zinc Smelting Co.	Huludao, Liaoning
Do.	Hunan Sanli Group Co. Ltd.	Xiangxi, Hunan
Do.	Shaanxi Nonferrous Metals Holding Group Co. Ltd.	Shangluo, Shaanxi
Do.	Yuguang Gold-Lead Co. Ltd.	Jiyuan, Henan
Do.	Yunnan Chihong Zinc and Germanium Co. Ltd.	Qujing, Yunnan
Do.	Yunnan Luoping Zinc & Electricity Co. Ltd.	Do.
Do.	Zhuzhou Smelter Group Co. Ltd. (China Minmetals Corp.)	Zhuzhou, Hunan
Japan	Akita Zinc Co. Ltd. (Dowa Metals and Mining Co. Ltd.)	Iijima, Akita
Do.	Hachinohe Smelting Co. Ltd. (Mitsui Mining and Smelting Co. Ltd.)	Hachinohe, Aomori
Do.	Kamioka Mining & Smelting Co. Ltd. (Mitsui Mining and Smelting Co. Ltd.)	Hida, Gifu
Do.	Toho Zinc Co. Ltd.	Annaka, Gunma
Kazakhstan	Kazzinc JSC (Glencore plc)	Ust-Kamenogorsk, East Kazakhstan
Do.	Kazakhmys Corp.	Balkhash, Karaganda
Korea, Republic of	Korea Zinc Co. Ltd.	Ulsan
Do.	Young Poong Corp.[2]	Seokpo, North Gyeongsang
Mexico	Grupo México S.A.B. de C.V.	San Luis Potosi, San Luis Potosi
Do.	Industrias Peñoles S.A.B. de C.V.	Torreon, Coahuila
Netherlands	Nyrstar N.V.	Budel, Noord Brabant
Norway	Boliden AB	Odda, Hordaland
Peru	Nexa Resources S.A.	Cajamarquilla, Lima
Poland	Huta Cynku “Miasteczko Śląskie” S.A.	Miasteczko Slaskie, Silesia
Russia	Chelyabinsk Zinc Plant OJSC	Chelyabinsk, Chelyabinsk
United States	Nyrstar N.V.	Clarksville, TN
Uzbekistan	JSC Almalyk Mining Metallurgical Complex	Almalyk, Tashkent

Do. Ditto.
[1]Table includes data available through June 1, 2020.
[2]Cadmium plant closed mid-2019.

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

(Metric tons)

Country or locality[3]	2015	2016	2017	2018	2019
Argentina	30 e	--	--	--	--
Australia[e]	380	400	400	400	400
Brazil	200 e	-- r	-- r	-- r	--
Bulgaria	344	362	333	313 r	320 e
Canada	1,159	2,305	1,802	1,857 r	1,803
China	8,162	8,222	8,411 r	8,200 e	8,200 e
Germany[e]	400	400	500 r	500 r	500
India	130	21	61	-- r	-- e
Japan	1,959	1,988	2,142	1,979	2,000 e
Kazakhstan	1,475	1,500 e	1,500 e	1,500 e	1,500 e
Korea, Republic of	5,600 e	5,273	4,960	4,905 r	4,400 e
Mexico	1,283	1,244	1,142	1,357	1,395
Netherlands[e]	1,100	1,100	1,100	1,100	1,100
Norway	310	335	416 r	380 r	400 e
Peru	757	820	797	765	772
Poland	383	319	309 r	305 r	300 e
Russia[e]	1,200	1,200	1,200	1,150 r	900
United States[4]	W	W	W	W	W
Uzbekistan	220 e	300 e	470 r	375 r	400 e
Total	25,100	25,800 r	25,500 r	25,100	24,400 e

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

[1]Table includes data available through May 26, 2020. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]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.

[3]In addition to the countries and (or) localities listed, Algeria, North Korea, and Turkey may have produced cadmium, but available information was inadequate to make reliable estimates of output.

[4]Although U.S. production data are withheld, primary and secondary cadmium were produced in the United States.