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2019 Minerals Yearbook

INDIUM [ADVANCE RELEASE]

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Indium

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Indium was not recovered from concentrates in the United States during 2019. Several facilities imported indium metal for the production of high-purity indium metal, indium compounds, specialty indium alloys, solders, and other indium products. During 2019, U.S. imports for consumption of unwrought indium metal and indium powders equaled 94.8 metric tons (t), 24% less than the 125 t imported in 2018 (table 1). Global primary refined indium production was estimated to have increased by 4% to 968 t in 2019 from that of the revised 2018 quantity (table 3).

Production

Globally, zinc concentrates were the principal source of primary indium. Although the United States was a significant producer of zinc concentrates, indium was not known to be recovered from these concentrates domestically or in other countries. In 2019, one indium-containing deposit in the United States continued to progress towards development—InZinc Mining Ltd.'s (Canada) West Desert zinc-copper-iron-indium deposit in Utah. InZinc Mining released a preliminary economic assessment of the West Desert deposit on April 1, 2014, projecting that about 38 metric tons per year (t/yr) of indium could be produced from the zinc concentrates during a 15-year mine life (InZinc Mining Ltd., 2014).

A significant amount of indium-containing scrap was recycled domestically from indium-containing products such as indium tin oxide, indium zinc oxide, and indium gallium alloys. Most recycling was done within a manufacturer's internal production process. Sufficient data were not available to estimate the quantity of indium recovered or recycled into new indium products.

Consumption

Domestic indium apparent consumption was estimated by averaging imports for the past 5 years. From 2015 through 2019, apparent consumption ranged between 123 and 135 t/yr. Imported indium metal was upgraded to higher purities and (or) consumed for the production of indium alloys, chemicals, shapes, and specialty products, which were sold to downstream users. Indium Corp. (Clinton, NY) accounted for the majority of U.S. consumption of indium. Other companies that consumed indium in the United States included 5N Plus Semiconductors LLC (St. George, UT), ACI Alloys, Inc. (San Jose, CA), AIM Specialty Materials USA (Cranston, RI), AXT Inc. (Fremont, CA), ESPI Metals Inc. (Ashland, OR), Exotech, Inc. (Pompano Beach, FL), and JX Nippon Mining & Metals USA, Inc. (Chandler, AZ).

Indium-Tin Oxide.—Production of indium-tin oxide (ITO) was the leading global use of indium. ITO was used principally as a transparent, electrically conductive, thin-film coating on flat-panel displays—most commonly, liquid crystal displays (LCDs). Excluding those in China, four ITO producers accounted for 90% of global capacity—JX Nippon Mining & Metals Corp. (Japan); LT Metal Co., Ltd, formerly Heesung Metal Ltd. (Republic of Korea); Mitsui Metal Mining Co., Ltd. (Japan); and Samsung Corning Precision Materials Korea Co., Ltd. (Republic of Korea). World consumption of ITO reportedly was estimated to be 1,500 t, with more than 95% consumed in China, Japan, the Republic of Korea, and Taiwan. Globally, a significant amount of indium was reclaimed from spent ITO targets and reused in the production of new ITO sputtering targets (Umicore NV, 2017; Roskill's Letter from Japan, 2018; Minor Metals Monthly, 2019a).

Alloys.—Indium-containing alloys were thought to be the second leading global end use of indium and were commonly used as solders in a wide range of applications owing to indium's high ductility and malleability, high thermal conductivity, and low melting point. Indium-lead solders were used to inhibit the leaching of gold components in electronic apparatus. Indium-silver alloys and pure indium foil were used as thermal interface materials (used to seal a heat-generating surface to a heat sink, filling microscopic air voids to allow for effective heat transfer) in electronics. Certain indium-tin alloys were used as bonding agents between nonmetallic materials. Indium also was used in dental alloys, in low melting temperature alloys for fuses, as a substitute for mercury, and in white gold alloys.

III-V Compound Semiconductor Materials.—An important use of indium was for III-V semiconductor materials, most commonly indium phosphide (InP) in optoelectronic devices (such as laser diodes) for fiber-optic communications. InP-based substrates were used in both laser and photo diodes in transceivers and in 5th generation (5G) fiber-optic telecommunications networks, which allowed for more devices to be supported on a cellular network, had lower latency within the network, reduced signal loss within optical fiber, and produced faster speeds for all users. InP and gallium arsenide were expected to be used in the development of facial recognition and detection. InP was produced primarily in Asia, followed by Europe and the United States, in descending order of quantity. Companies that produced InP-polycrystalline ingot or substrates included AXT, Beijing Tongmei Crystal Technology Co., Ltd. (China), InPACT Inc. (France), JX Nippon Mining and Metals (Japan), NeoPhotonics Corp. (United States), Phostec, s.r.o. (Slovakia), Sumitomo Electric Industries, Ltd. (Japan), and Wafer Technology Ltd. (United Kingdom) (Beijing Dimen International Information Consulting Co. Ltd., 2014; Dahlman and others, 2018, p. 57–71; Beijing Antaike Information Development Co., Ltd., 2019; Minor Metals Monthly, 2020a).

Other.—Indium was used in the manufacturing of copper-indium-gallium-selenide (CIGS) thin-film photovoltaic solar cells. Indium consumption for solar cells was estimated to have decreased in 2019. CIGS thin-film cells accounted for 1% [1.28 gigawatts (GW)] of global solar cell production in 2018. Crystalline silicon continued to be the dominant solar cell type, accounting for 96% (118 GW) of global production (124 GW) in 2018. Solar Frontier K.K. (Japan) was thought to be the only mass producer of CIGS solar cells in 2019. The company operated two CIGS plants in Japan with a combined capacity to produce approximately 1 gigawatt per year of solar cells (Roskill's Letter from Japan, 2016a, b; National Renewable Energy Laboratory, 2020, p. 70; Solar Frontier K.K., undated).

Indium also was used in the production of the semiconducting compound indium gallium zinc oxide (IGZO), in organic light-emitting diode (OLED) displays, and LCDs. IGZO replaced amorphous silicon as the thin-film transistor in some displays because it allowed for more pixels per square inch on small displays and ultra-high definition on large displays. IGZO also required less voltage to operate. Sharp Corp. (Japan) consumed IGZO for the production of small- and medium-sized high-performance LCD panels for smartphones and tablets at its Kameyama Plant No. 2 in Japan. Although IGZO had yet to be used commercially in large-screen LCD displays, LG Display (Republic of Korea) had been using IGZO in its OLED televisions (Cammell, 2012; Harrower, 2015, p. 17–19; Roskill's Letter from Japan, 2016a).

Prices

In 2019, the average S&P Global Platts Metals Week New York dealer price for indium (99.99% minimum purity in minimum lots of 50 kilograms) was $390 per kilogram, an increase of 4% compared with that in 2018. The 2019 average Metal Bulletin free market price for indium decreased by 36% from that in 2018 to $185 per kilogram. The average monthly free market price for indium was $226 per kilogram in January and decreased through the year to a low of $146 per kilogram in December. The yearend low price was the lowest price for indium since 2003.

Foreign Trade

During 2019, U.S. imports for consumption of unwrought indium metal and indium powders were 94.8 t, a 24% decrease from the 125 t imported in 2018 (table 1). Leading suppliers in 2019 were Canada (29%), the Republic of Korea (26%), France (24%), China, (10%), and Japan (6%). Imports of indium from China, Japan, Taiwan, and Luxembourg decreased substantially in 2019, decreasing by 48 t, 2.1 t, 1.5 t, and 1.1 t, respectively; these decreases were partially offset by increases in imports from France and the Republic of Korea, increasing by 15 t and 11 t, respectively. Imports from China were affected by concerns over tariffs causing increased imports from China at the end of 2018, prior to the imposition of the tariffs, and decreased imports from China during 2019, when the tariffs were imposed. Data on indium exports were not available because there was no exclusive domestic export Schedule B code for unwrought indium and indium powders.

World Review

Global production of primary indium increased by 4% in 2019 from that in 2018, resulting mostly from increased production in China (table 3). This increase in production was slightly offset by decreased production in the Republic of Korea (by 10 t), France (by 6 t), and Belgium (by 2 t). China continued to be the leading producer, followed by the Republic of Korea, Japan, and Canada.

Primary indium was recovered mainly from the residues generated during the smelting of zinc concentrates. Although an important factor, global changes in zinc mine production may not be an indicator of a corresponding change in the production of indium. It has been estimated that only about 35% of the indium contained in zinc concentrates reaches refineries that are capable of extracting and producing indium (Vareha-Walsh, 2016).

Belgium.—Indium metal was produced at Umicore NV's precious metals refinery in Hoboken. A specialty metals plant at the refinery had the capacity to recover 50 t/yr of indium from dusts and residues generated by the facility's lead refinery (Umicore NV, 2019) (table 2).

Canada.—Refined indium was produced at Teck Resources Ltd.'s metallurgical complex at Trail, British Columbia, as a byproduct of processing lead-zinc concentrates. Indium production capacity at Trail was 75 t/yr (Teck Cominco Ltd., 2006, p. 27) (table 2).

China.—China was the leading producer of refined indium, producing an estimated 535 t of indium in 2019, accounting for 55% of global primary refined production and an increase of 48 t from that in 2018. The increase in production was due to greater production from several companies, including Zhuzhou Metallurgical Corp. and Huludao Zinc Industry Co., as well as the restart of operations by Zhuzhou Smelting Group Co. Ltd. This increase was partially offset by the closure of smaller companies such as Shenzhen Zongjin Lingnan Nonfemet Co. Ltd. and Zhuzhou Hongyilong Industrial Co Ltd. Additionally, other producers of indium were closed by the Chinese Government because of environmental regulations. These producers were concentrated in the Chenzhou, Hechi, Quinyuan, Shaoguan, and Zhuzhou regions. The leading producer of indium, using zinc concentrates, was Yunxi Wenshan Zinc Indium Smelting Co., Ltd., producing more than 60 t/yr of indium (Argus Metals International, 2019a; Beijing Antaike Information Development Co., Ltd., 2019).

China's indium consumption for ITO production was estimated to have increased by 27% to 133 t in 2019 from 105 t in 2018. China consumed indium mostly for the production of ITO targets (70%), semiconductors (14%), and solder (6%). Five companies have been reported as large consumers of indium for ITO production in China, consuming greater than 10 t/yr of indium. With the increased demand for 5G technologies, China's InP production capabilities had increased. A new InP wafer fabrication plant opened in China in Jintan City in the Jiangsu Province. The new plant was owned by optical company Source Photonics, Inc. (West Hills, CA). Source Photonics also owned another facility in Hsinchu, Taiwan, and had doubled their production of InP wafers from 2016 to 2019 (Lu, 2014a; Minor Metals Monthly, 2018, 2019b, c; Argus Metals International, 2019c; Sun, 2019).

Large amounts of indium metal have been held in Fanya Metal Exchange commodity warehouses in China. In November 2015, the Kunming municipal government took over the Fanya Metal Exchange and found that the exchange warehouses held 3,610 t of indium, equivalent to about 4 years of global primary production. The Kunming municipal government announced that it had launched a criminal investigation into the Fanya Metal Exchange and, on February 5, 2016, the owner of the Fanya Metal Exchange was arrested on suspicion of unlawfully raising funds from the public. In July 2018, the Kunming municipal government announced the completion of a 2-day trial of Fanya Metal Exchange officials. The chairman and 21 other Fanya Metal Exchange executives were charged with embezzlement and violating financial management laws and regulations. On January 28, 2019, the Kunming court held an auction for a 37.14-t lot of indium, which failed. A second auction was held on April 24, 2019, for a 34.64-t lot of indium, which was purchased by the China National Corp. for Overseas Economic Cooperation. The third auction held by the Kunming court was held on December 29 and 30, for a lot of 3,609 t of indium at a starting price of $113 per kilogram[1] (790 yuan per kilogram) or a total price of $408 million. These three auctions affected the indium market by keeping prices down (Gu, 2015; Metal-Pages, 2016; Stanway, 2018; Argus Metals International, 2019b).

Other exchanges in China that traded indium included the Tianfu Mercantile Exchange and the Wuxi Stainless Steel Exchange (Burton, 2013; Lu, 2014b; Argus Metals International, 2020).China became a net importer of indium in 2019, importing 147 t of unwrought indium, powders, and waste and scrap, a decrease of 30% from that in 2018, while exporting 111 t of unwrought indium, powders, and waste and scrap, a decrease of 68% from that in 2018. The main source countries for imports were Indonesia (51%), Hong Kong (12%), and the United States (12%). The main destination countries for exports in 2019 were the Republic of Korea (46%) and Japan (20%). The decrease in exports was due to large purchases made at the end of 2018 owing to fears of the United States–China trade dispute, which in turn caused decreased demand in 2019, and low prices, causing indium smelters to warehouse stocks of indium (Sun, 2019; Minor Metals Monthly, 2020b; IHS Markit, 2021).

France.—Nyrstar NV resumed producing indium at its zinc smelter in Auby in the first quarter of 2017, after a fire closed the plant in November 2015. Nyrstar produced an estimated 40 t of indium in 2019, compared with the 42.6 t of indium produced in 2018 (Nyrstar NV, 2019, p. 12) (table 3).

Japan.—Japan was a significant producer and recycler of indium. Dowa Metals and Mining Co. Ltd. had the capacity to produce about 70 t/yr of primary indium and to recover up to 150 t/yr of secondary indium at its zinc smelter and rare metals recycling facility in Akita. The other primary producers were Mitsui Mining and Smelting Co. Ltd. (in Takehara) and Sumitomo Metal Mining Co. Ltd. (in Harima). Asahi Pretec Corp. had the capacity to produce 200 t/yr of secondary indium at its ITO-target recycling plant at Fukuoka. Other secondary indium producers included JX Nippon Mining & Metals, Mitsui Mining & Smelting Co. Ltd., Sumitomo Metal Mining Co. Ltd., and Toho Zinc Co. Ltd. (Metal-Pages, 2008).

Japan was a leading consumer of indium, mostly for the production of ITO. ITO producers included Mitsui Mining & Smelting, which operated the 420-t/yr ITO manufacturing plant in Omuta, and JX Nippon Mining & Metals, which operated the world's leading ITO production plant (648-t/yr capacity) in Isohara, near Tokyo (Roskill's Letter from Japan, 2018).

Japan's imports of indium metal, powder, waste, and scrap were estimated to have been 360 t in 2019, a 25% decrease from those in 2018, reportedly owing to increased imports at the end of 2018. Leading import sources for the first 4 months of 2019 included the Republic of Korea (69%), China (16%), Taiwan (6%), and Canada and France (4% each) (Roskill's Letter from Japan, 2019).

Korea, Republic of.—Korea Zinc Co. Ltd. was a significant producer of primary and secondary indium at its Onsan zinc refinery. Young Poong Co., Ltd. had the capacity to produce up to 100 t/yr of indium at its Sukpo smelter. The Republic of Korea was also a notable consumer of indium. Major consumers were the ITO producers Corning Precision Materials Korea Co., Ltd. (540 t/yr) and Heesung Metal Ltd. (180 t/yr) (Roskill's Letter from Japan, 2018; Young Poong Co., Ltd., 2019).

The Republic of Korea imported 127 t of indium (metal, powder, and scrap) in 2019, a decrease of 50% from that in 2018, mostly from China (53%), Japan (26%), and Taiwan (17%). The Republic of Korea exported 217 t, a decrease of 40% from that in 2018, predominantly to Japan (79%), the United States (10%), and China (7%) (IHS Markit, 2021).

Russia.—The Chelyabinsk Zinc Plant OJSC and Ural Mining and Metals Co.'s Electrozink smelter both produced refined indium. Most of Russia's refined indium output was thought to be exported. Production was estimated to be 5 t in 2019, unchanged from that in 2018.

Outlook

World indium production is expected to continue to increase, and indium consumption is expected to continue to increase with the development of 5G technologies, where InP lasers and receivers are used to send data through fiberoptic lines, providing the "backbone" for wired communications. 5G technology is used to provide faster data transfer speeds and allow more efficient calculations of data owing to lower data losses in transmission. Industry projections have estimated that 10 million devices used the 5G network in 2019, and will increase to 1.9 billion devices within 5 years (Telefonaktiebolaget LM Ericsson, 2019, p. 6).

China is expected to continue to be the main global supplier of primary indium metal. The Auby smelter in France reached full capacity in 2018 but, owing to the coronavirus disease 2019 (COVID-19) pandemic, indium production is expected to be less than full production in 2020 and 2021. Several indium-containing exploration or development projects, mostly in Canada, South America, and the United States, are advancing, but it is uncertain when or whether these projects will begin production (Metal-Pages, 2017).

[1]Where necessary, values have been converted from Chinese yuan renminbi (CNY) to U.S. dollars (US$) at the rate of CNY6.991=US$1.00 for 2019.

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TABLE 1
U.S. IMPORTS FOR CONSUMPTION OF UNWROUGHT INDIUM AND INDIUM POWDERS BY COUNTRY OR LOCALITY[1]

Country or locality	2018		2019	
	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Belgium	250	$8	107	$21
Canada	28,200	9,080	27,300	5,600
China	57,900	16,900	9,670	1,790
France	7,710	2,180	22,700	4,050
Germany	52	15	49	10
Hong Kong	2,110	713	--	--
Japan	7,570	5,210	5,470	1,400
Kazakhstan	8	2	--	--
Korea, Republic of	13,600	3,680	24,800	4,710
Luxembourg	2,120	575	999	275
Poland	396	65	--	--
Russia	625	207	--	--
Singapore	--	--	150	22
Taiwan	4,280	650	2,770	392
United Kingdom	531	85	728	95
Total	125,000	39,400	94,800	18,400

-- Zero.

[1]Table includes data available through July 21, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau. Harmonized Tariff Schedule of the United States code 8112.92.3000.

TABLE 2
WORLD PRIMARY INDIUM PRODUCTION CAPACITY[1, 2]

(Metric tons)

Country	Major operating company	Location of main facilities	Primary annual capacity[e]
Belgium	Umicore NV	Hoboken	50
Canada	Teck Resources Ltd.	Trail, British Columbia	75
China	Guangxi Debang Technology Co. Ltd.	Liuzhou, Guangxi	85
Do.	Guangxi Hechi Jinhe Mining and Smelting Co. Ltd.	Hechi, Guangxi	10
Do.	Guangxi Tanghan Zinc & Indium Co. Ltd.	do.	30
Do.	Hsikuangshan Twinkling Star Antimony Co. Ltd. (China Minmetals Group)	Lengshuijiang, Hunan	7
Do.	Huludao Nonferrous Metals Group Co.	Huludao, Liaoning	60
Do.	Huludao Zinc Industry Co.	do.	NA
Do.	Hunan Jingshi Group Co. Ltd.	Zhuzhou, Hunan	40
Do.	Laibin Smelter [Liuzhou Huaxi (China Tin) Group Co.]	Laibin, Guangxi	50
Do.	Liuzhou Zinc Products Co.	Liuzhou, Guangxi	20
Do.	Nanjing Germanium Co. Ltd.	Nanjing, Jiangsu	150
Do.	Nanjing Sanyou Electronic Material Co. Ltd.	do.	50
Do.	Shaoguan Smelter (Shenzhen Nonfemet Co.)	Shaoquan, Guangdong	25
Do.	Tibet Summit Industry Co. Ltd.	Xining, Qinghai	15
Do.	Xiangtan Zhengtan Nonferrous Metal Co. Ltd.	Xiangtan, Hunan	75
Do.	Yintai Technology Co. Ltd.	Liuzhou, Guangxi	40
Do.	Yuguang Gold-Lead Co. Ltd.	Jiyuan, Henan	20
Do.	Yunnan Chengfeng Nonferrous Metals Co. Ltd.	Gejiu, Yunnan	10
Do.	Yunnan Hualian Zinc and Indium Co. Ltd.	Wenshan, Yunnan	60
Do.	Yunnan Luoping Zinc & Electricity Co. Ltd.	Luoping, Yunnan	20
Do.	Yunnan Mengzi Mining and Smelting Co. Ltd.	Honghe, Yunnan	60
Do.	Yunxi Wenshan Zinc Indium Smelting Co. Ltd.	do.	60
Do.	Zhuzhou Metallurgical Corp.	do.	NA
Do.	Zhuzhou Smelting Group Co.	Zhuzhou, Hunan	60
France	Nyrstar NV	Auby	48
Japan	Dowa Metals and Mining Co. Ltd.	Iijima, Akita	70
Do.	Mitsui Mining and Smelter Co.	Takehara, Hiroshima	NA
Do.	Sumitomo Metal Mining Co. Ltd.	Harima, Hyogo	NA
Korea, Republic of	Korea Zinc Co. Ltd.	Onsan	160
Do.	Young Poong Co., Ltd.	Sukpo	100
Peru	Doe Run Peru S.R. Ltda.	La Oroya	5
Do.	Votorantim Metais Ltda.	Cajamarquilla	50
Russia	Chelyabinsk Zinc Plant OJSC	Chelyabinsk	15
Do.	Ural Mining and Metals Co.	Vladikavkaz	5

[e]Estimated; estimated data are rounded to no more than two significant digits. Do., do. Ditto. NA Not available.
[1]Table includes data available through August 27, 2020.
[2]China includes facilities that consume mineral concentrates as well as processors that consume unrefined indium.

TABLE 3
INDIUM: WORLD REFINERY PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Kilograms)

Country or locality[2]	2015	2016	2017	2018	2019
Belgium[e]	20,000	20,000	20,000	22,000	20,000
Canada	70,000 [e]	71,000	67,000	58,000 [e]	61,000 [e]
China	421,000	454,000 [r]	478,000 [r]	487,000 [r]	535,000 [e]
France	41,000	--	29,800	46,200 [r]	40,000 [e]
Japan[e]	70,000	70,000	70,000	70,000	70,000
Korea, Republic of	195,000	210,000	225,000 [e]	235,000 [e]	225,000 [e]
Peru[e]	10,000	10,000	10,000	11,000	12,000
Russia[e]	5,000	5,000	5,000	5,000	5,000
Total	832,000	840,000 [r]	905,000 [r]	934,000 [r]	970,000 [e]

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

[1]Table includes data available through August 12, 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]In addition to the countries and (or) localities listed, Kazakhstan and Ukraine may have produced primary indium, but available information was inadequate to make reliable estimates of output.