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2020 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 2020. Several facilities imported indium metal for the production of high-purity indium metal, indium compounds, specialty indium alloys, solders, and other indium products. During 2020, U.S. imports for consumption of unwrought indium metal and indium powders equaled 115 metric tons (t), 22% greater than the 94.8 t imported in 2019 (table 1). Global primary refined indium production was estimated to have decreased slightly to 957 t in 2020 from 969 t (revised) in 2019 (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.

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.

In 2020, 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 had announced a nonbinding letter of intent for an option agreement with American West Metals Ltd. Following the signing of the option agreement, InZinc would receive a series of payments for 24 months and American West Metals Ltd. would receive 50% of the revenue from the sale of indium mined from West Desert. American West Metals Ltd. also had the option to reduce the revenue sharing by paying InZinc $5 million before the first sale of indium from West Desert. InZinc released a preliminary economic assessment of West Desert on April 1, 2014, projecting that about 38 metric tons per year (t/yr) of indium could be produced from the zinc concentrate during a 15-year mine life (InZinc Mining Ltd., 2014, 2020).

Consumption

Domestic indium apparent consumption was estimated by averaging imports for the previous 5 years. During 2016 through 2020, apparent consumption ranged from 123 to 134 t/yr. Imported indium metal was upgraded to higher purities and (or) consumed to produce 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). Four ITO producers, excluding those in China, accounted for about 90% of global capacity—JX Nippon Mining & Metals Corp. (Japan), LT Metal Co., Ltd., formerly Heesung Metal Co., 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 was reportedly 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 (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 or pure indium foil were used in electronics 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). 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 fifth generation (5G) fiber optic telecommunications networks. InP was also expected to be used with gallium arsenide in development of facial recognition and detection. InP was produced mostly 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 & Metals Corp. (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; Minor Metals Monthly, 2020).

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 increased in 2020. CIGS thin-film cells accounted for about 1% [1.5 gigawatts (GW)] of global solar cell production in 2020. Crystalline silicon continued to be the dominant solar cell type, accounting for 92% (144 GW) of global production (156 GW) in 2020. Solar Frontier K.K. (Japan) was thought to be the only mass producer of CIGS solar cells in 2020. The company operated two CIGS plants in Japan that had a combined capacity to produce approximately 1 gigawatt per year of solar cells (Roskill's Letter from Japan, 2016a, b; Fraunhofer ISE, 2021, p. 22–23; Solar Frontier K.K., undated).

Indium also was used to produce the semiconducting compound indium gallium zinc oxide (IGZO) used in organic light-emitting diode (OLED) displays and LCDs. IGZO replaced amorphous silicon as the thin-film transistor in some displays because it allows for more pixels per square inch on small displays and ultra-high definition on large displays. IGZO also requires 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 used IGZO in its OLED televisions (Cammell, 2012; Harrower, 2015, p. 17–19; Roskill's Letter from Japan, 2016a).

Prices

In 2020, 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 $395 per kilogram, a slight increase compared with that in 2019. The S&P Global Platts Metals Week New York dealer price for indium was discontinued as of September 11, 2020. The 2020 average Argus Media Group—Argus Metals International free on board price for indium decreased by 12% to $161 per kilogram in 2020 from $182 per kilogram in 2019. The average monthly free on board price for indium was $155 per kilogram in January and decreased through the first 8 months to a low of $145 per kilogram in August, then increased to an average monthly high of $179 per kilogram in December.

Foreign Trade

During 2020, U.S. imports for consumption of unwrought indium metal and indium powders equaled 115 t, a 22% increase from the 94.8 t imported in 2019 (table 1). Leading suppliers in 2020 were the Republic of Korea (34%), Canada (25%), China and Japan (11% each), and France (7%). Imports of indium increased substantially in 2020 from the Republic of Korea, by 15 t; Japan, 7.4 t; Russia, 7.0 t; China, 3.4 t; and Canada, 1.2 t. These increases were partially offset by a decrease in imports from France (by 15 t). 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 decreased slightly in 2020 from that in 2019, mostly because of decreased production in the Republic of Korea, which was slightly offset by increased production in Canada and China (table 3). 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 can extract and produce indium (Vareha-Walsh, 2016).

Belgium.—Indium metal was produced at Umicore NV's precious metals refinery at 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 (table 2) (Umicore NV, 2020).

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

China.—China was the leading producer of refined indium, producing an estimated 540 t of indium in 2020, accounting for 56% of global primary refined production, and was a slight increase in production from that in 2019. This increase was due to a new plant with a capacity of 5 t/yr of high-purity indium. The new line could produce up to 99.99999% indium and was part of a new 60-t/yr facility that was commissioned in 2019 (Argus Metals International, 2020b).

China's indium consumption for ITO production was estimated to have decreased by 25% to 100 t in 2020 from 133 t in 2019. 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 more than 10 t/yr of indium (Argus Metals International, 2019; Minor Metals Monthly, 2019a, b, 2021; Sun, 2019).

In November 2015, the Kunming municipal government took over the Fanya Metal Exchange warehouses that reportedly held 3,610 t of indium, equivalent to more than 4 years of global primary production. In February 2016, the Kunming municipal government announced that it had launched a criminal investigation into the Fanya Metal Exchange, and 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 officials that were involved in the Fanya Metal Exchange. The chairman and 21 other Fanya executives were charged with embezzlement and violating financial management laws and regulations. In 2019, three auctions were held to sell Fanya's stocks, but there were no sales. On January 17, 2020, another auction was held, and Kunming Rongke New Materials

(owned by Vital Materials) bought the 3,610 t of indium stocks from the Fanya Metal Exchange for $416 million. Kuning Rongke New Materials was the only participant in the auction (Gu, 2015; Metal-Pages, 2016; Stanway, 2018; Argus Metals International, 2019, 2020a; Manthey and Belda, 2020). Other exchanges in China that traded indium included the Tianfu Mercantile Exchange and the Wuxi Stainless Steel Exchange (Burton, 2013; Lu, 2014).

China resumed being a net exporter of indium in 2020, importing 66.5 t of unwrought indium, powders, and waste and scrap, a decrease of 55% from that in 2019, while exporting 118.7 t of unwrought indium, powders, and waste and scrap, an increase of 6.9% from that in 2019. The main source countries for imports were the Republic of Korea (48%) and the United States (22%), and the main destination countries for exports were the Republic of Korea (34%), Japan (20%), the United States (10%), and Taiwan (9%) (Minor Metals Monthly, 2021; Zen Innovations AG, 2021).

France.—On November 9, Nyrstar NV announced that the Auby plant would receive investment for upgraded and new equipment. This investment was driven by Nyrstar's new owner, Trafigura, and was intended to increase safety, durability, and production going forward. Nyrstar produced an estimated 38 t of indium in 2020, down from the estimated 40 t of indium produced in 2019 (Nyrstar NV, 2020).

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 (table 2). The other primary producers were Mitsui Mining and Smelter Co. Ltd. (Takehara plant) and Sumitomo Metal Mining Co. Ltd. (Harima refinery). 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 to produce ITO. ITO producers included Mitsui Mining & Smelting, which operated the 420-t/yr ITO manufacturing plant at Omuta, and JX Nippon Mining & Metals, which operated the world's leading ITO production plant (648-t/yr capacity) at Isohara near Tokyo (Roskill's Letter from Japan, 2018).

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 (180 t/yr) (Roskill's Letter from Japan, 2018; Young Poong Co., Ltd., 2019).

The Republic of Korea imported 96.8 t of indium (metal, powder, and scrap) in 2020, a decrease of 24% from that in 2019, mostly from China (40%), Japan, (30%), and Taiwan (15%). The Republic of Korea exported 194 t, a decrease of 11% from that in 2019, predominantly to Japan (63%), the United States (20%), and China (1%) (Zen Innovations AG, 2021).

Russia.—Chelyabinsk Zinc Plant OJSC and Ural Mining and Metals Co.'s Electrozink smelter produced refined indium. Most of Russia's refined indium output was thought to be exported. Production was estimated to be 5 t in 2020, unchanged from that in 2019 (table 2, 3).

United Kingdom.—U.S.-owned company II-VI Compound Semiconductor applied for an environmental permit to begin production of InP components. The new production line would be part of the gallium arsenide plant in Newton Aycliffe, County Durham (Willing, 2020).

Outlook

World indium production is expected to continue to increase, and indium consumption is expected 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 is used in telecommunications to provide faster data transfer speeds and allow more efficient calculations of data owing to lower data losses in transmission. Industry projections have estimated the number of devices used on the 5G network in 2019 at 10 million devices with an increase to 1.9 billion devices within 5 years. New facilities that produce InP semiconductors are expected in India and the United Kingdom to fulfill the expected demand of 5G technologies (Telefonaktiebolaget LM Ericsson, 2019, p. 6).

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

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

	2019		2020	
Country or locality	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Belgium	107	$21	--	--
Canada	27,300	5,600	28,500	$5,110
China	9,670	1,790	13,000	1,940
France	22,700	4,050	7,950	1,170
Germany	49	10	967	184
Japan	5,470	1,400	12,800	2,190
Korea, Republic of	24,800	4,710	39,800	5,800
Luxembourg	999	275	--	--
Poland	--	--	1,080	804
Russia	--	--	7,000	1,030
Singapore	150	22	--	--
South Africa	--	--	219	42
Taiwan	2,770	392	3,480	380
United Kingdom	728	95	450	20
Total	94,800	18,400	115,000	18,700

-- Zero.

[1]Table includes data available through July 14, 2021. 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
ESTIMATED WORLD PRIMARY INDIUM PRODUCTION CAPACITY[1, 2]

(Metric tons)

Country or locality	Major operating company	Location of main facilities	Primary annual capacity
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.	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.	Zhuzhou Smelter Group Co. Ltd.	Zhuzhou, Hunan	60
France	Nyrstar NV	Auby	48
Japan	Dowa Metals and Mining Co. Ltd.	Iijima, Akita	70
Do.	Mitsui Mining and Smelting Co. Ltd.	Takehara, Hiroshima	NA
Do.	Sumitomo Metal Mining Co. Ltd.	Harima, Hyogo	NA
Korea, Republic of	Korea Zinc Co. Ltd.	Onsan	160
Do.	Young Poong Corp.	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

Do., do. Ditto. NA Not available.
[1]Table includes data available through July 15, 2021. Data are rounded to no more than two significant digits.
[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]	2016	2017	2018	2019	2020
Belgium[e]	20,000	20,000	22,000	20,000	20,000
Canada	71,000	67,000	65,000 [r, e]	63,000 [r, e]	66,000 [e]
China	454,000	478,000	483,000 [r]	534,000 [r, e]	540,000 [e]
France	--	29,800	46,200	40,000 [e]	38,000 [e]
Japan[e]	70,000	70,000	70,000	70,000	66,000
Korea, Republic of	210,000	225,000 [e]	235,000 [e]	225,000 [e]	210,000 [e]
Peru[e]	10,000	10,000	11,000	12,000	12,000
Russia[e]	5,000	5,000	5,000	5,000	5,000
Total	840,000	905,000	937,000 [r]	969,000 [r]	957,000

[e]Estimated. [r]Revised. -- Zero.
[1]Table includes data available through June 23, 2021. All data are reported unless otherwise noted; totals may include estimated data. 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.