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2021 Minerals Yearbook

CHROMIUM [ADVANCE RELEASE]

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Chromium

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In 2021, there was no chromite ore produced in the United States. Secondary production of chromium was 114,000 metric tons (t), which was mostly derived from the recycling of stainless-steel scrap. U.S. chromium apparent consumption (including recycling) was 614,000 t on a chromium-content basis, a 39% increase from that in 2020 (table 1). The increase in industry apparent consumption was primarily the result of an increase in imports and decreases in some exports. Because stainless-steel mill products contributed a significant amount of chromium to the domestic economy, trade in these products and their contribution was accounted for in chromium apparent consumption calculations. U.S. chromium apparent consumption in 2021 was 69% of the record high of 893,000 t in 1965.

Domestic reported consumption of chromium materials, excluding stainless steel, decreased by 5% (chromium content) in 2021 compared with that in 2020. Steelmaking was the leading end use for chromium materials and accounted for 95% of consumption in 2021. Superalloys and other end uses made up the remaining 5% (table 2).

Based on estimated chromium content of trade data for chromite ore, chromium chemicals, chromium ferroalloys, chromium metal, and stainless-steel mill products and scrap, chromium exports decreased by 17% to 114,000 t in 2021 compared with those in 2020, but chromium imports increased by 33% to 607,000 t compared with imports in 2020 (table 1).

World production of chromite ore in 2021 increased by 24% to 42.2 million metric tons (Mt) gross weight compared with the revised amount in 2020 (table 7). South Africa was the leading producer of chromite ore, accounting for an estimated 44% of global production. World production of ferrochromium increased by 16% to 14.5 Mt compared with the revised amount in 2020. China was the leading producer of ferrochromium, accounting for an estimated 41% of global production (table 8).

Government Actions and Legislation

Stockpile.—The Defense Logistics Agency Strategic Materials (DLA Strategic Materials), U.S. Department of Defense, disposed of chromium materials under its fiscal year 2021 (October 1, 2020, through September 30, 2021) Annual Materials Plan (AMP). Maximum disposal limits were based on the 2021 AMP for chromium materials, which were set at 21,800 t of chromium ferroalloys and 450 t of chromium metal (Defense Logistics Agency Strategic Materials, 2020).

As of December 31, 2021, the quantity of high-carbon chromium ferroalloys held in the National Defense Stockpile (NDS) decreased by 31% and the quantity of low-carbon chromium ferroalloys slightly increased compared with stocks at calendar yearend 2020 (table 2). The quantity of chromium metal decreased by 5% compared with stocks at the beginning of the year. As a result, the quantity of chromium materials in the NDS at yearend 2021 was equivalent to about 6% of U.S. chromium apparent consumption on a chromium-content basis in 2021.

Other Programs.—Trivalent chromium [Cr(III)] is required for normal glucose, protein, and fat metabolism, and thus an essential trace element for human health. Hexavalent chromium [Cr (VI)], however, is acutely toxic, chronically toxic, and (or) carcinogenic. The U.S. Environmental Protection Agency (EPA) regulates total chromium emissions into the air under section 112 of the Clean Air Act of 1990 (U.S. Environmental Protection Agency, 2002). The Occupational Safety and Health Administration regulates workplace exposure to Cr(VI). Currently, the permissible exposure limit for Cr(VI) is 5 micrograms per cubic meter of air, calculated as an 8-hour time-weighted average (U.S. Department of Labor, undated).

The EPA also regulates total chromium in drinking water under the national primary drinking water regulations. The maximum contaminant level for total chromium in drinking water, including Cr(III) and Cr(VI), was established in 1991 at 0.1 milligram per liter and is undergoing further review as part of an Integrated Risk Information System assessment (U.S. Environmental Protection Agency, undated).

Consumption

Domestic consumption data for chromium materials were developed by the U.S. Geological Survey (USGS) by means of monthly "Chromite Ores and Chromium Products" and "Consolidated Consumers" consumer surveys. Based on the results of these surveys, stainless-steel and heat-resisting-steel producers were the leading chromium consumers, and high-carbon ferrochromium was the leading chromium-containing material consumed (table 2).

The major marketplace chromium-containing materials were chromite ore and foundry sand; chromium chemicals, ferroalloys, and metal; and stainless steel. In 2021, the United States produced chromium chemicals and stainless steel.

Chromium Chemicals.—Chemical-grade chromite ore, which has a high chromium content with greater than 45% chromium oxide (Cr_2O_3), is typically processed via conversion to sodium dichromate. Sodium dichromate can then be used in other applications as oxidizing agents or in the production of dyes and inorganic chemicals, such as leather tanning liquors, metal plating and finishing solutions, drilling muds, and wood preservatives. In the United States, Elementis Chromium, a subsidiary of Elementis plc (United Kingdom), produced sodium dichromate from chromite ore in Castle Hayne, NC.

In September, the EPA fined Owens-Brockway Glass Container, Inc. $38,900 for failing to report its use of chromium chemicals at its Portland, OR, facility in 2017 and 2018 (U.S. Environmental Protection Agency, 2021). Under the Toxic Release Inventory rules of the Emergency Planning and

Community Right-to-Know Act, a company must report its chemical releases and transfers to the EPA and pertinent State agency when certain toxic chemicals such as Cr(VI) chemicals exceed threshold amounts.

Stainless Steel.—Chromium is essential to stainless-steel production by virtue of its oxide-forming properties, and to some grades of alloy steel as well as nickel-, iron-, and cobalt-base superalloys because of its alloying properties. Among a variety of uses, chromium is also used to reduce stress corrosion susceptibility and improve toughness in aluminum-magnesium, aluminum-magnesium-silicon, and aluminum-magnesium-zinc alloys.

In 2021, the U.S. stainless-steel industry produced 2.4 Mt of stainless steel and imported and exported stainless-steel mill products and scrap, making it a leading consumer of chromium materials in the United States (International Stainless Steel Forum, 2022, p. 8). North American Stainless Company (NAS), Cleveland-Cliffs Inc., Outokumpu Oyj (Finland), and Allegheny Technologies Incorporated (ATI), listed in descending order of total production, were the leading U.S. stainless-steel producers.

NAS is a subsidiary of Acerinox, S.A., based in Spain, and produced stainless steel in its Ghent, KY, facility. Melt shop production increased by 15% to 1.16 Mt in 2021 compared with 1.01 Mt in 2020, which made it the leading producer in the United States accounting for 48% of production (Acerinox S.A., 2021, p. 22; 2022, p. 16).

Cleveland-Cliffs Inc. produced stainless steel at manufacturing plants in Butler, PA, Mansfield, OH, and Middletown, OH (Cleveland-Cliffs Inc., 2022, p. 37–38). Stainless- and electrical-steel sales were about 610,000 t in 2021, an increase of 61% compared with approximately 380,000 t in 2020. The increase in sales volume was attributed to Cleveland-Cliffs' acquisitions of AK Steel and ArcelorMittal USA in 2020 (Cleveland-Cliffs Inc., 2022, p. 62, 90).

In April, Cleveland-Cliffs canceled a planned second quarter maintenance outage at its Indiana Harbor No. 7 blast furnace. Instead, it submitted a notice to the Indiana Department of Environmental Management that it would install a new blowdown treatment system and monitoring points while keeping the plant operational (Shenk, 2021). Following this, Cleveland-Cliffs announced that it would idle its Indiana Harbor No. 7 blast furnace for maintenance and repair beginning September 1. The planned maintenance would take approximately 45 days to complete, during which time other blast furnaces would operate (England, 2021).

Outokumpu Stainless USA, LLC, a subsidiary of Outokumpu Oyj, produced stainless steel at its Calvert, AL, and Richburg, SC, plants. Outokumpu reported that its total global stainless-steel shipments in 2021 were 2.4 Mt, a 13% increase compared with shipments in 2020. In 2021, 25% of the stainless-steel shipments (approximately 600,000 t) were from the United States and Mexico combined. Outokumpu also reported that it possessed 22% of the stainless-steel market share in the United States in 2021, which would make it the third-leading stainless-steel producer in the United States (Outokumpu Oyj, 2022, p. 5, 13).

ATI began exiting the standard stainless-steel production market in 2021 to focus on specialty alloys for the aerospace and defense markets, with exit completion expected to take place in the first half of 2022 (Allegheny Technologies Inc., 2022, p. F-3). Global overcapacity and increased competition in the stainless-steel market were cited as reasons for the shift. Sales for nickel-base alloys and specialty alloys, which included stainless steel, decreased by 10% compared with 2020 and made up 37% of overall sales. The decrease in sales was attributed to ATI's exit from the standard stainless sheet market and the effect of union strikes (Allegheny Technologies Inc., 2022, p. F-28–F-29).

Prices

Chromium materials are not openly traded. Purchase contracts are confidential between buyer and seller; however, trade journals report composite prices based on interviews with buyers and sellers, and the U.S. Department of Commerce reports the declared value of U.S. imports and exports. Thus, industry publications and U.S. trade statistics are sources of chromium material prices and values, respectively (table 3).

In 2021, the annual average import unit value (gross weight) of chromite ore increased by 10% from that in 2020, the annual average import unit value of ferrochromium increased by 54% from that in 2020, and the annual average import unit value of chromium metal increased by 10% from that in 2020. Prices and unit values of specific grades of chromite ore, chromium metal, and ferrochromium are reported in tables 1 and (or) 3.

Foreign Trade

Chromium-containing material exports from and imports to the United States included chromite ore, chromium chemicals, ferroalloys, metal, pigments, and stainless steel (tables 4, 5). Based on foreign trade statistics reported by the U.S. Department of Commerce for calendar year 2021, the value of foreign trade of these chromium materials, excluding stainless-steel mill products and scrap, was $24.1 million for exports (27% more than that in 2020) and $898 million for imports (65% more than that in 2020). A significant amount of chromium enters and exits the U.S. economy via trade of stainless-steel mill products and scrap. The value of foreign trade of chromium materials including stainless-steel mill products and scrap was $2.3 billion for exports (22% more than that in 2020) and $4.7 billion for imports (54% more than that in 2020).

World Review

Canada.—In March, Canada's Minister of Natural Resources announced a list of 31 minerals considered by Canada to be critical to its economy and global supply chains. This list included chromium (Bedder, 2021; Natural Resources Canada, 2021).

China.—Higher export duties on ferrochromium were imposed by the Government of China on August 1st in an effort to curtail production, which would reduce energy consumption in the steel industry. The new export tax was set to 40%, up from 15% (CRU Group, 2021b).

In addition, energy consumption guidelines were updated in Inner Mongolia Autonomous Region to ensure compliance with China's 14th Five-Year Plan (2021–2025). As a result, ferrochromium furnaces less than 25 millivoltamperes (mVA)

were ordered to be shut down. At facilities with furnaces greater than 25 mVA, only one furnace could operate at a time. In addition, companies were required to upgrade open and semiclosed furnaces to closed furnaces before the end of February 2021 (Backeberg and Tong, 2021). In May, quotas were established limiting the supply of electricity in Baotou City, Inner Mongolia Autonomous Region, after it failed to meet second quarter energy consumption targets. Baotou City had been a key producer of high-carbon ferrochromium in Inner Mongolia Autonomous Region. As such, high-carbon ferrochromium production was expected to be affected by these restrictions (Tong, 2021).

Finland.—Outokumpu Oyj owned and operated the Kemi chromite mine, the only chromite mine in Finland. Outokumpu also produced 515,000 t ferrochromium at its Tornio ferrochromium production facility using chrome extracted from its Kemi chromite mine (table 8). In 2021, Outokumpu reported total stainless-steel deliveries were 2.4 Mt, with a reported production capacity of 3.2 million metric tons per year (Mt/yr) and 90% of its material input from recycled materials (Outokumpu Oyj, 2022, p. 5, 11, 13, 96). Outokumpu also continued work on its Deep Mine project to extend the depth of the Kemi Mine to 1,000 meters below sea level. Completion of the expansion project was delayed by 6 months owing to an incident during construction. However, Outokumpu did not expect the effects to be significant and anticipated completion could still be achieved in 2022 (Outokumpu Oyj, 2021, p. 51; 2022, p. 5).

Kazakhstan.—Transnational Company Kazchrome JSC, a subsidiary of Eurasian Resources Group S.à r.l. (Luxembourg), completed testing its new floatation technology for the recovery of chromite from tailings at its Donskoy Mining and Processing Plant. The chromite recovered contained a chromium oxide content of up to 62% and thus was compatible with specifications required for use in its ferrochromium smelters (Sebetlela, 2021a; Transnational Company Kazchrome JSC, undated).

India.—Following acquisition of three chromite mining licenses in 2020, Tata Steel Mining Ltd. announced that it would increase ferrochromium capacity to 900,000 metric tons per year (t/yr), twice the existing capacity (Backeberg, 2021a). In July, Tata Steel signed an agreement with Jindal Stainless Ltd. to cooperatively mine the chromite ore situated between their respective mines in Sukinda. Final approval for the partnership would be required before mining could commence (Thomas, 2021).

Indian Metals & Ferro Alloys Ltd. (IMFA) announced plans to increase chromite production capacity from 650,000 t/yr to 1.2 Mt/yr at its Mahagiri and Sukinda Mines in Odisha State by March 2027. A 100,000-t/yr expansion at IMFA's Kalinganagar ferrochromium smelter was slated to accommodate the additional ore (CRU Group, 2021a).

Oman.—Oman Chromite Co. reported that it would be unable to meet future production targets unless new exploration licenses were granted by Oman's Ministry of Energy and Minerals. Declining reserves, the need to remove large quantities of waste material to reach chromite ore in existing mines, along with the effects of the global coronavirus disease 2019 (COVID-19) pandemic on the global economy were cited as reasons for the decline in production (CRU Group, 2021c).

Philippines.—The Mines and Geosciences Bureau (MGB) announced the opening of small-scale mining zones, known as Minahang Bayan (or the People's Mining Area), in the Cordillera Administration Region, including approximately 97 hectares (ha) (240 acres) in Benguet Province. In December, the Provincial Mining Regulatory Board of Benguet Province approved the renewal of the Small-Scale Mining Contract of the Loacan Itogon Pocket Miners' Association, covering about 15 ha (37 acres). These small-scale mining zones and contracts were attempts by MGB to increase gold, silver, and chromite production (Miraflor, 2021; Philippine Daily Inquirer, 2021).

South Africa.—Afarak Group Plc (Finland) announced that it approved the sale of its assets in the Stellite Mine, owned by its subsidiary Ilitha Mining Pty Ltd., to WMA Chrome Mining Property Ltd. and WMA Minmet Processing (Pty) Ltd. The assets included a plant and the mining right at the Stellite Mine (Afarak Group Plc, 2021; Decena, 2021). Afarak also halted all mining operations in South Africa in 2021 to reduce debt but planned to resume mining at some point (Afarak Group Plc, 2022, p. 3)

Merafe Resources Ltd. reported that its ferrochromium production was 42.7% more in 2021, owing to a decrease in the number of shutdowns related to COVID-19 as well as improved furnace efficiencies and production at its joint venture Wonderkop and Lion smelters with Glencore plc (Switzerland). Merafe also resumed operations at its Rustenburg smelter in the third quarter of 2021. However, the Lydenburg ferrochromium smelter and the Waterval and Boshoek Mines remained on care-and-maintenance status (Merafe Resources Ltd., 2022, p. 10).

Jubilee Metals Group Plc (United Kingdom) announced that its integrated chromite ore beneficiation plant, OBB Chrome, reached full operational status in October 2021. OBB Chrome consists of four integrated recovery circuits and is operated under an agreement with a subsidiary of Samancor Chrome Ltd. The plant is situated near the Western Limb of the Bushveld Complex adjacent to Jubilee's Inyoni PGM Operation and could process 960,000 t/yr of chromite ore (Jubilee Metals Group Plc, 2021, p. 13–14).

Zimbabwe.—The Government of Zimbabwe approved an export ban on raw chromite ore in early August, set to take effect in July 2022, to boost domestic ferrochromium production. Exports of chromite ore would only be permitted if all ferrochromium smelters in Zimbabwe were unable to process the ore (Backeberg, 2021b).

Zimasco (Pvt) Ltd, a subsidiary of Sinosteel Corp. (China), invested $35 million to construct new ferrochromium furnaces at its ferrochromium smelting complex in Kwekwe. The additional furnaces would increase production capacity by 40% to 252,000 t/yr. A new sinter plant would also be added to the complex, with a capacity of 300,000 t/yr, and would allow Zimasco to use friable ores during the smelting process (Sebetlela, 2021b).

Outlook

Domestic and global consumption of chromium is expected to closely follow the trend in stainless-steel production. U.S.

stainless-steel production was estimated by the American Iron and Steel Institute (2021, p. 69) to be 2.4 Mt (gross quantity of stainless steel) in 2021, an increase of 10% from that in 2020. World stainless-steel and heat-resisting-steel melt shop production (ingot or slab equivalent) was reported to be 58.3 Mt in 2021, an increase of 13% compared with that in 2020 (International Stainless Steel Forum, 2022, p. 8). Details of the outlook for the steel industry are discussed in the "Outlook" section of the Iron and Steel chapter of the 2021 USGS Minerals Yearbook, volume I, Metals and Minerals.

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TABLE 1
SALIENT CHROMIUM STATISTICS[1]

		2017	2018	2019	2020	2021
Components of U.S. supply, chromium content:						
Secondary[2]	metric tons	152,000	139,000	137,000 r	119,000 r	114,000
Imports:						
Chromite ore	do.	61,300	92,600	92,500	83,200	107,000
Chromium chemicals	do.	3,950	3,810	3,680	4,560	5,070
Chromium ferroalloys	do.	319,000	320,000	254,000	202,000	243,000
Chromium metal	do.	14,500	15,500	14,400	11,600	12,100
Stainless-steel mill products and scrap[2]	do.	235,000	219,000	165,000	155,000	240,000
Stocks, January 1:						
Government	do.	66,800	58,700	54,700	51,000	46,300
Industry[3]	do.	8,500	6,060	5,060	4,970	5,720
Total	do.	861,000	855,000	726,000 r	632,000 r	773,000
Distribution of U.S. supply, chromium content:						
Exports:						
Chromite ore[4]	do.	5,250	2,960	1,400	1,470	1,550
Chromium chemicals[5]	do.	640 r	643 r	186 r	84 r	85
Chromium ferroalloys and metal	do.	1,580	1,910	1,370	1,200 r	2,130
Stainless-steel mill products and scrap[2]	do.	248,000	206,000	146,000	135,000 r	110,000
Stocks, December 31:						
Government	do.	58,700	54,700	51,000	46,300	39,200
Industry[3]	do.	6,060	5,060	4,970	5,720	6,000
Total	do.	320,000	271,000	205,000	190,000 r	159,000
Consumption:						
Apparent, chromium content[6]	do.	541,000	583,000	521,000 r	442,000 r	614,000
Reported:						
Chromite ore and concentrates, gross weight	do.	W	W	W	W	W
Chromium ferroalloys:[7]						
Gross weight	do.	506,000	508,000	465,000	345,000	327,000
Chromium content	do.	285,000	290,000 r	267,000	199,000	189,000
Chromium metal, gross weight	do.	4,580	4,630	4,860	4,580	4,550
Stocks, December 31, gross weight:						
Government:						
Chromium ferroalloys	do.	76,800	71,200	66,100	59,600	49,900
Chromium metal	do.	3,860	3,850	3,850	3,750	3,560
Industry, consumer:						
Chromium ferroalloys[8]	do.	7,070	5,180	4,900	4,770	5,260
Chromium metal	do.	287	270	282	273	279
Other	do.	4,280	4,280	4,270	4,280	4,260
Price, average annual:						
Chromite ore, gross weight[9]	dollars per metric ton	280	209	174	154	201
Ferrochromium, chromium content[10]	dollars per pound	1.45	1.37	1.00	0.90	1.56
Aluminothermic chromium metal, gross weight[11]	do.	3.94	5.53	4.13	3.22	4.35
Value of trade:						
Imports	thousands	$1,040,000	$1,100,000	$779,000	$545,000	$898,000
Exports	do.	$32,200 r	$28,000 r	$25,200 r	$19,000 r	$24,100
Net imports[12]	do.	$1,010,000	$1,080,000	$753,000	$526,000	$874,000
Stainless steel:						
World production, chromium content[13]	metric tons	8,170,000	8,620,000	8,880,000	8,650,000	9,910,000
U.S. production:						
Gross weight[14]	do.	2,750,000	2,810,000	2,590,000	2,140,000 r	2,370,000
Chromium content[15]	do.	485,000 r	493,000 r	455,000	375,000 r	414,000 e
Average grade, dimensionless[16]		0.1762 r	0.1755 r	0.1755	0.1749	0.1750 e
Shipments, gross weight[17]	metric tons	2,500,000	2,490,000	2,280,000	2,010,000	2,250,000
Imports, gross weight	do.	1,100,000	959,000	767,000	694,000	1,140,000
Exports, gross weight	do.	974,000	668,000	436,000	321,000 r	355,000
Scrap, gross weight:						
Receipts	do.	892,000	819,000 r	804,000 r	701,000 r	672,000
Consumption	do.	1,330,000	1,230,000	1,240,000 r	1,080,000 r	1,010,000
Imports	do.	282,000	331,000	204,000	219,000	268,000
Exports	do.	486,000	545,000	422,000	474,000 r	293,000

See footnotes at end of table.

TABLE 1—Continued
SALIENT CHROMIUM STATISTICS[1]

		2017	2018	2019	2020	2021
Stainless steel:—Continued						
Scrap, gross weight:—Continued						
Value of trade:						
Imports	thousands	$3,730,000	$3,440,000	$2,820,000	$2,320,000	$3,450,000
Scrap imports	do.	$280,000	$345,000	$183,000	$197,000	$368,000
Exports	do.	$2,860,000	$2,470,000	$1,990,000	$1,570,000	$1,910,000
Scrap exports	do.	$424,000	$319,000	$345,000	$273,000 r	$336,000
Net imports[12, 18]	do.	$727,000	$994,000	$675,000 r	$674,000 r	$1,570,000

eEstimated. rRevised. do. Ditto. W Withheld to avoid disclosing company proprietary data.

[1]Table includes data available through August 30, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Calculated assuming chromium content of stainless steel and stainless-steel scrap to average 17% chromium.

[3]Includes consumer stocks of chromium ferroalloys and metal and other chromium-containing materials.

[4]Calculated based on the chromium content of imported chromite ore, typically between 46% and 63% chromium oxide (Cr_2O_3).

[5]Excludes pigments and preparations.

[6]Apparent consumption calculated as total U.S. distribution minus total U.S. supply.

[7]Chromium ferroalloys, chromite ore, and other chromium-containing materials excluding chromium metal.

[8]Consumer stocks of high- and low-carbon ferrochromium and ferrosilicon chromium.

[9]Time-weighted average price of South African chromite ore that contains 44% Cr_2O_3 free on board as reported by CRU Group.

[10]Time-weighted average U.S. price of imported high-carbon chromium that contains 62% to 70% chromium as reported by CRU Group.

[11]Time-weighted average U.S. price of imported aluminothermic chromium metal as reported by CRU Group.

[12]Defined as imports minus exports.

[13]Production estimated from publicly available sources. Chromium content estimated at 17%.

[14]Source: American Iron and Steel Institute annual report of stainless steel and heat-resisting raw steel production.

[15]Estimated mass-weighted average of the mean chromium content of stainless-steel production by grade.

[16]Ratio of estimated mass-weighted average chromium content of stainless-steel production by grade to production of stainless steel. Uncertainty is approximately ±0.01, owing to the range of chromium chemical specification limits by stainless-steel grade.

[17]Source: American Iron and Steel Institute annual report of stainless steel and heat-resisting raw steel shipments.

[18]Includes stainless steel and stainless-steel scrap.

TABLE 2
U.S. REPORTED CONSUMPTION AND STOCKS OF CHROMIUM PRODUCTS[1]

(Metric tons)

	2020		2021			
	Gross weight	Chromium content	Gross weight	Chromium content	Change[2] Quantity	Change[2] Percent
Consumption by end use:						
Steel:						
Carbon steel	3,670	2,380	3,870	2,520	143	6
High-strength low-alloy steel	1,950	1,290	1,960	1,290	6	(3)
Stainless and heat-resisting steel	289,000	165,000	270,000	155,000	-10,600	-6
Fully alloy steel	11,300	6,970	11,300	6,960	-4	(3)
Unspecified steel[4]	31,200	18,000	31,200	18,000	--	--
Superalloys	6,090	4,960	6,460	5,180	211	4
Other alloys and uses[5]	6,800	4,750	6,400	4,510	-242	-5
Total	350,000	204,000	331,000	193,000	-10,500	-5
Consumption by material:						
Low-carbon ferrochromium	26,200	18,000	25,500	17,400	-538	-3
High-carbon ferrochromium	302,000	172,000	285,000	162,000	-9,580	-6
Ferrochromium silicon	(6)	(6)	(6)	(6)	(6)	(6)
Chromium metal	4,580	4,280	4,550	4,250	-28	-1
Chromium-aluminum alloy	374	272	397	289	17	6
Other chromium materials	17,300	9,020	16,500	8,640	-379	-4
Total	350,000	204,000	331,000	193,000	-10,500	-5
Consumer stocks:						
Low-carbon ferrochromium	1,090	749	1,440	978	229	31
High-carbon ferrochromium	3,360	1,920	3,370	1,920	6	(3)
Ferrochromium silicon	(6)	(6)	(6)	(6)	(6)	(6)
Chromium metal	273	255	279	261	6	2
Chromium-aluminum alloy	(6)	(6)	(6)	(6)	(6)	(6)
Other chromium materials	4,600	2,800	4,710	2,840	40	1
Total	9,320	5,720	9,800	6,000	281	5
National Defense Stockpile stocks:[7]						
Chromium ferroalloys:[8]						
High-carbon ferrochromium	33,000	23,500	22,900	16,300	-7,190	-31
Low-carbon ferrochromium	26,600	19,000	27,000	19,300	289	2
Chromium metal[9]	3,750	3,750	3,560	3,560	-193	-5

-- Zero.

[1]Table includes data available through August 30, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Change based on chromium content of unrounded data of current year compared with that of previous year.

[3]Less than ½ unit.

[4]Includes electrical, tool, and unspecified steel end uses.

[5]Includes cast irons, welding and alloy hard-facing rods and materials, wear- and corrosion-resistant alloys, and aluminum, copper, magnetic, nickel, and other alloys.

[6]Withheld to avoid disclosing company proprietary data; included in "Other chromium materials."

[7]Data are based on the "Total Uncommitted Inventory" of stockpile material D–1 report by the Defense Logistics Agency Strategic Materials.

[8]Chromium content estimated using 71.4% chromium.

[9]Chromium content estimated using 100% chromium.

TABLE 3
VALUE OF IMPORTS AND U.S. PRICE QUOTATIONS FOR CHROMIUM MATERIALS[1]

(Dollars per metric ton)

Material	2020		2021	
	Gross weight	Chromium content	Gross weight	Chromium content
Value:[2]				
Chromite ore:				
Not more than 40% chromium oxide (Cr_2O_3)	177	694 r	137	621
More than 40% but less than 46% Cr_2O_3	205	470	164	378
46% or more Cr_2O_3	176	196	212	244
Average	179	217	197	268
Ferrochromium:				
Not more than 0.5% carbon	2,290	3,400	3,620	5,170
More than 0.5% but not more than 3% carbon	2,050	3,050	2,830	4,090
More than 3% but not more than 4% carbon	986	1,800	820	1,600
Average (not more than 4% carbon)	2,260	3,370	3,320	4,870
More than 4% carbon	889	1,640	1,300	2,360
Average (all grades)	1,050	1,880	1,620	2,840
Chromium metal[3]	7,930	XX	8,760	XX
Price:[4]				
Chromite ore, South Africa:				
38% to 40% Cr_2O_3	144	540 r	194	727
44% Cr_2O_3	154	511 r	201	667
42% Cr_2O_3	138	481 r	159	555
High-carbon ferrochromium:				
62% to 70% chromium	XX	90	XX	156
Low-carbon ferrochromium:				
0.05% carbon	XX	207	XX	264
0.10% carbon	XX	168	XX	260
0.15% carbon	XX	167	XX	255
Chromium metal, imported, aluminothermic	322	XX	435	XX

rRevised. XX Not applicable.
[1]Table includes data available through August 30, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Mass-weighted average based on customs value and quantity of imported material, as reported by the U.S. Census Bureau.
[3]Average for all grades.
[4]Source: CRU Group.

TABLE 4
U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE[1]

Schedule B code[2]	Type	2020 Quantity (metric tons)	2020 Value (thousands)	2021 Quantity (metric tons)	2021 Value (thousands)	Principal destinations in 2021 (Quantity in metric tons, value in thousands)
2610.00.0000	Chromite ore and concentrates:					
	Gross weight	1,780	$1,040	2,110	$1,430	Canada (1,330; $833), Mexico (434; $362), Indonesia (213; $120), Dominican Republic (98; $83), France (28; $16).
	Chromium content[3]	1,470	XX	1,550	XX	
	Chromium metal, gross weight:					
8112.21.0000	Unwrought chromium powders	215	5,330	385	6,840	Canada (129; $1,070), Netherlands (86; $2,120), Japan (35; $289), Malaysia (32; $914), Mexico (30; $369).
8112.22.0000	Chromium metal waste and scrap	30	235	12	104	Canada (8; $51), Russia (2; $330), United Kingdom (2; $20).
8112.29.0000	Chromium metal other than unwrought powders and waste and scrap	134	4,410	59	2,720	Spain (12; $74), Canada (7; $118), Ireland (6; $191), Mexico (6; $351), Republic of Korea (3; $289).
	Total chromium metal	379	9,970	456	9,660	
	Chromium ferroalloys:					
7202.41.0000	High-carbon ferrochromium:[4]					
	Gross weight	959 r	1,310	1,690	2,140	Mexico (918; $1,350), Canada (455; $493), Peru (276; $252), Republic of Korea (15; $13), Australia (10; $9).
	Chromium content	580 r	XX	840	XX	
7202.49.0000	Low-carbon ferrochromium:[5]					
	Gross weight	408 r	718	1,580	4,070	India (555; $1,930), Canada (476; $724), Turkey (194; $555), Netherlands (108; $390), Spain (87; $117).
	Chromium content	205 r	XX	786	XX	
7202.50.0000	Ferrochromium-silicon:					
	Gross weight	114 r	249	134	304	Mexico (73; $153), Canada (59; $148), Sweden (2; $4).
	Chromium content	40 r	XX	47	XX	
	Total chromium ferroalloys:					
	Gross weight	1,480 r	2,280	3,410	6,510	
	Chromium content	825 r	XX	1,670	XX	
	Chemicals, gross weight:					
2833.29.4000	Chromium sulfates:					
	Gross weight	7	34	3	19	Republic of Korea (2; $9), China (1; $7).
	Chromium content[6]	1	XX	1	XX	
	Salts of oxometallic or peroxometallic acids:					
2841.90.4500	Zinc and lead chromate:					
	Gross weight	9	507	8	544	South Africa (4; $474), Mexico (2; $46), Vietnam (2; $19).
	Chromium content[7]	2	XX	2	XX	
2841.50.1000	Potassium dichromate:					
	Gross weight	205	386	104	192	Taiwan (25; $85), Peru (19; $18), Netherlands (16; $14), Morocco (11; $10), Mexico (10; $21).
	Chromium content[8]	58	XX	30	XX	

See footnotes at end of table.

TABLE 4—Continued
U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE[1]

Schedule B code[2]	Type	2020 Quantity (metric tons)	2020 Value (thousands)	2021 Quantity (metric tons)	2021 Value (thousands)	Principal destinations in 2021 (Quantity in metric tons, value in thousands)
	Chemicals, gross weight:—Continued					
	Salts of oxometallic or peroxometallic acids:—Continued					
2841.50.9100	Other:					
	Gross weight	192	1,800	224	1,440	Canada (116; $232), Taiwan (28; $173), South Africa (16; $403), Saudi Arabia (14; $82), Jamaica (10; $65).
	Chromium content[8]	18	XX	21	XX	
	Total salts:					
	Gross weight	413	2,720	340	2,190	
	Chromium content	78	XX	52	XX	
3206.20.0000	Pigments and preparations:					
	Gross weight	377	2,930	1,040	4,280	Uruguay (517; $454), Mexico (169; $1,620), Canada (162; $739), Germany (65; $459), Dominican Republic (25; $151).
	Chromium content	NA	XX	NA	XX	

[r]Revised. NA Not available. XX Not applicable.
[1]Table includes data available through July 25, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Schedule B codes based on the Harmonized System commodity classification system of the United States.
[3]Calculated based on the chromium content of imported chromite ore, typically between 46% and 63% chromium oxide (Cr_2O_3).
[4]More than 4% carbon.
[5]Not more than 4% carbon.
[6]Calculated assuming the average chromium content was about 17%.
[7]Calculated assuming the average chromium content was about 20%.
[8]Calculated based on fraction of chromium in the chemical formula.

Source: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2020 Quantity (metric tons)	2020 Value[3] (thousands)	2021 Quantity (metric tons)	2021 Value[3] (thousands)	Principal sources in 2021 (quantity in metric tons, value in thousands)
	Chromite ore:					
2610.00.0020	Not more than 40% chromium oxide (Cr_2O_3):					
	Gross weight	3,490 r	$618 r	15,800	$2,170	South Africa (13,700; $1,570), Germany (1,250; $237), Brazil (843; $356).
	Cr_2O_3 content	890 r	XX	3,490	XX	
2610.00.0040	More than 40%, but less than 46% Cr_2O_3:					
	Gross weight	11,000	2,250	21,400	3,500	South Africa (20,600; $3,270), Italy (660; $210), Zimbabwe (116; $14), Netherlands (27; $12).
	Cr_2O_3 content	4,780	XX	9,270	XX	
2610.00.0060	46% or more Cr_2O_3:					
	Gross weight	86,300	15,200	108,000	23,000	South Africa (98,000; $19,500), Turkey (10,200; $3,290), Belgium (208; $44), China (35; $146), France (3; $6).
	Cr_2O_3 content	77,500	XX	94,300	XX	
	Total chromite ore:					
	Gross weight	101,000	18,000	146,000	28,700	
	Cr_2O_3 content	83,200	XX	107,000	XX	
	Chromium ferroalloys:					
	Ferrochromium:					
7202.49.5090	Not more than 0.5% carbon:					
	Gross weight	37,400	85,600	57,700	209,000	Russia (30,900; $120,000), Kazakhstan (13,600: $47,900), Germany (8,670; $27,600), Japan (1,580; $5,630), Turkey (1,540; $4,180).
	Chromium content	25,200	XX	40,400	XX	
7202.49.5010	More than 0.5%, but less than 3% carbon:					
	Gross weight	3,360	6,890	1,810	5,140	Kazakhstan (1,490; $4,700), Brazil (318; $436).
	Chromium content	2,260	XX	1,250	XX	
7202.49.1000	More than 3%, but less than 4% carbon:					
	Gross weight	212	210	6,700	5,490	South Africa (6,500; $5,340), Russia (195; $144), China (5; $2).
	Chromium content	116	XX	3,420	XX	
7202.41.0000	More than 4% carbon:					
	Gross weight	310,000	276,000	347,000	449,000	South Africa (205,000; $229,000), Kazakhstan (60,400; $117,000), Finland (24,500; $24,700), Russia (17,600; $26,200), Sweden (12,600; $18,700).
	Chromium content	169,000	XX	191,000	XX	
7202.50.0000	Ferrosilicon-chromium:					
	Gross weight	15,800	20,800	19,800	39,300	Kazakhstan (19,800; $39,200), Brazil (54; $93).
	Chromium content	5,740	XX	7,400	XX	
	Total chromium ferroalloys:					
	Gross weight	367,000	389,000	433,000	708,000	
	Chromium content	202,000	XX	243,000	XX	
	Chromium metal, gross weight:					
8112.21.0000	Unwrought chromium powders	9,790 r	79,900 r	10,300	90,800	Russia (3,710; $28,300), United Kingdom (2,230; $25,800), France (2,150; $19,700), China (1,270; $10,700), Germany (643; $3,880).
8112.22.0000	Waste and scrap	168	953	112	673	United Kingdom (73; $480), Canada (30; $122), Japan (5; $35), Taiwan (1; $15), Germany (1; $10).

See footnotes at end of table.

TABLE 5—Continued
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2020 Quantity (metric tons)	2020 Value[3] (thousands)	2021 Quantity (metric tons)	2021 Value[3] (thousands)	Principal sources in 2021 (quantity in metric tons, value in thousands)
	Chromium metal, gross weight:—Continued					
8112.29.0000	Other than waste and scrap	1,670 r	$11,500 r	1,710	$14,800	Russia (1,350; $9,610), Spain (135; $648), United Kingdom (76; $1,020), South Africa (76; $680), China (42; $976).
	Total chromium metal	11,600	92,300	12,100	106,000	
	Chemicals, gross weight:					
	Chromium oxides and hydroxides:					
2819.10.0000	Chromium trioxides	1,970	5,680 r	2,840	8,510	Kazakhstan (1,860; $4,730), India (396; $1,440), South Africa (194; $567), China (142; $693), Tunisia (104; $379).
2819.90.0000	Other	4,620	14,500	4,440	15,200	Italy (1,230; $1,260), Germany (1,180; $7,120), China (923; $4,480), Canada (891; $985), India (103; $441).
	Total oxides	6,590	20,200 r	7,280	23,700	
2833.29.4000	Sulfates of chromium	389	338	519	1,030	Turkey (354; $284), China (152; $716), Romania (11; $19), Germany (1; $3), Saudi Arabia (1; $3).
	Salts of oxometallic or peroxometallic acids:					
2841.90.4500	Chromates of lead and zinc	36	511	50	1,060	Italy (all).
2841.30.0000	Sodium dichromate	323	412	779	1,060	South Africa (633; $832), Turkey (144; $177), Italy (1; $48).
	Other chromates and dichromates; peroxochromates:					
2841.50.1000	Potassium dichromate	4	27	2	25	Colombia (2; $8).
2841.50.9100	Other	1,420	4,970	1,520	4,670	Austria (1,480; $4,480), France (33; $158), Colombia (4; $18), Italy (3; $10).
	Total salts	1,780	5,920	2,350	6,810	
2849.90.2000	Chromium carbide	154	3,110	162	4,340	China (52; $752), Israel (49; $2,180), United Kingdom (36; $504), Canada (23; $785), Russia (1; $64).
	Total chromium chemicals	8,910	29,500	10,300	35,900	
	Pigments and preparations based on chromium, gross weight:					
3206.20.0010	Chrome yellow	443	2,310	465	2,470	Canada (305; $1,440), Mexico (145; $958), Colombia (12; $52), India (3; $17).
3206.20.0020	Molybdenum orange	138	1,270	128	1,010	Canada (121; $982), Colombia (7; $33).
3206.20.0030	Zinc yellow	75	223	99	283	Austria (44; $125), China (34; $88), Colombia (12; $38), Canada (5; $18), Mexico (5; $12).
3206.20.0050	Other	1,620	12,200	1,820	15,600	Mexico (1,610; $14,200), Japan (50; $280), Germany (42; $578), Netherlands (42; $175), France (33; $142).
	Total pigments	2,280	16,000	2,510	19,400	

rRevised. XX Not applicable.
[1]Table includes data available through July 25, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States.
[3]Customs import value generally represents a value in the foreign country, and therefore, excludes U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise into the United States.

Source: U.S. Census Bureau.

TABLE 6
ESTIMATED WORLD PRODUCTION CAPACITY (CHROMITE ORE, FERROCHROMIUM, CHROMIUM METAL, CHROMIUM CHEMICALS, AND STAINLESS STEEL) AND CONSUMPTION FOR SELECTED COUNTRIES[1]

(Thousand metric tons, chromium content, unless otherwise specified)

	Production capacity in 2021					Chromium consumption[2]		
Country or locality	Ore[3]	Ferro-chromium[3]	Metal	Chemicals	Stainless steel[4]	2019	2020	2021
Afghanistan	7	--	--	--	--	1 r	1 r	(5)
Albania	1,700	100	--	--	--	250	180	130
Austria	--	--	--	--	15	31	22	24
Belgium	--	--	--	--	290	140	110	210
Brazil	800	300	--	--	80	66 r	11 r	37
Canada	--	--	--	--	--	23 r	19	24
China	140	12,000	61	240	5,700	6,600	6,100 r	6,100
Finland	2,800	530	--	--	250	570	520	540
France	--	--	12	--	60	30	25	36
Germany	--	36	1	3	100	130	100	130
India	10,000	2,000	--	40	690	850	410 r	1,700
Indonesia	--	600	--	--	860	530	580	1,000
Iran	200	120	--	2	--	2 r	42	40
Italy	--	--	--	7	260	--	--	(5)
Japan	--	25	3	9	560	410 r	310 r	380
Kazakhstan	8,500	2,400	--	60	--	1,300 r	1,100 r	1,200
Korea, Republic of	--	--	--	--	500	310	260	320
Kosovo	70	--	--	--	--	28	7	5
Madagascar	320	--	--	--	--	--	3 r	4
Oman	1,600	130	--	--	--	18 r	-- r	3
Pakistan	580	--	--	1	--	--	--	--
Papua New Guinea	150	--	--	--	--	36	25 r	31
Philippines	57	--	--	--	--	--	--	--
Poland	--	--	--	7	--	6	5	10
Russia	1,200	450	27	61	20	300 r	140 r	160
Slovenia	--	--	--	--	25	19	18	18
South Africa	26,000	5,150	--	18	100	--	--	--
Spain	--	--	--	3	170	100	75 r	110
Sudan	120	--	--	--	--	4 r	2 r	2
Sweden	--	255	--	--	110	13	10	--
Taiwan	--	--	--	--	240	90 r	75 r	110
Turkey	14,000	185	--	90	--	2,300	1,600 r	1,700
Ukraine	--	--	--	--	15	14	14	12
United Arab Emirates	240	58	--	--	--	27 r	13 r	18
United Kingdom	--	--	10	3	60	19	15	21
United States	--	--	--	40	480	330	280	340
Vietnam	1	60	--	--	--	1	(5) r	--
Zimbabwe	2,200	310	--	--	--	130	16	410
Total	70,700	24,700	114	584	10,600	XX	XX	XX

rRevised. XX Not applicable. -- Zero.

[1]Table includes data available through July 29, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Chromium content. Estimated based on chromite ore production reported by the U.S. Geological Survey and trade statistics for chromite ore, chromium metal, and ferrochromium as reported by Global Trade Tracker and U.N. Comtrade in July 2022 assuming that the average grade of chromite ore is 45% chromium oxide; ferrochromium, 57% chromium; and chromium metal, 100% chromium.

[3]Reported in gross weight.

[4]Chromium content of stainless steel was calculated assuming the average grade is 17% chromium.

[5]Less than ½ unit.

TABLE 7
CHROMITE ORE: WORLD PRODUCTION BY COUNTRY OR LOCALITY[1, 2]

(Metric tons, gross weight)

Country or locality	2017	2018	2019	2020	2021
Afghanistan[e]	4,500	4,500	3,000 [r]	3,000 [r]	1,500
Albania	808,016	1,142,719	1,288,315	626,627 [r]	650,200
Brazil, ore and concentrate	450,000 [e]	450,000 [e]	199,256 [r]	226,762 [r]	200,000 [e]
China	71,300	71,100	84,400	66,554 [r]	130,000 [e]
Finland, ore	1,954,282	2,211,284	2,415,287	2,293,330	2,273,857
India	3,478,276	4,075,560	4,138,817	2,401,508 [r]	4,248,973
Iran, concentrate	292,209	119,456	122,083	135,049	47,400
Kazakhstan, ore[3]	6,313,300	6,688,800	7,018,900	6,326,400 [r]	6,500,000 [e]
Kosovo	46,000	66,000	66,000 [e]	24,427	16,656
Madagascar	208,100	109,200	76,126	12,400 [r]	14,000 [e]
Oman	452,721	884,876	732,600 [r]	382,100 [r]	340,000 [e]
Pakistan	88,781	111,586	120,698	121,435 [r]	140,126
Papua New Guinea	78,000 [e]	92,139	115,573	100,000 [e]	100,000 [e]
Philippines	20,849	45,011	36,423 [r]	35,112	30,721
Russia	496,000	511,000	594,000 [r]	608,000 [r]	600,000 [e]
South Africa:					
44% to 48% Cr_2O_3	2,009,644	1,132,581	1,428,471	1,155,904 [r]	1,914,692
Less than 44% Cr_2O_3	14,660,938 [r]	16,717,882 [r]	16,227,031 [r]	12,040,976 [r]	16,634,948
Total	16,670,582 [r]	17,850,463 [r]	17,655,502 [r]	13,196,880 [r]	18,549,640
Sudan	32,000	27,000	12,728 [r]	6,000 [r, e]	5,000 [e]
Turkey, 34% to 43% Cr_2O_3	7,849,500	10,757,199	8,666,114	6,164,598 [r]	6,960,683
United Arab Emirates	57,797	190,146	136,100	62,413	21,800
Vietnam	750	--	--	--	-- [e]
Zimbabwe	1,673,996	1,756,126	1,550,064	1,196,837	1,325,126
Grand total	41,000,000 [r]	47,200,000 [r]	45,000,000 [r]	34,000,000 [r]	42,200,000

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

[1]Table includes data available through August 29, 2022. All data are reported unless otherwise noted; grand totals may include estimated data. Grand totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Figures for all countries and (or) localities represent marketable output.

[3]Reported in gross weight by the Statistical Committee of the Ministry of National Economy of the Republic of Kazakhstan.

TABLE 8
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons, gross weight)

Country or locality	2017	2018	2019	2020	2021
Albania	51,033	92,850	66,402	53,543 [r]	103,700
Brazil[2]	171,531	175,061	136,780	254,346	213,756
China	4,940,000	5,280,000	6,030,000	5,700,000 [e]	5,900,000 [e]
Finland	416,285	492,774	505,000	498,000	515,000
Germany	29,000 [r]	31,000 [r]	26,000 [r]	11,000 [r, e]	12,000 [e]
India	944,000	944,000	930,000	826,000 [r]	1,090,000
Indonesia	80,000	190,000	190,000	230,000	252,000
Iran	3,000	13,000	12,000	10,000 [e]	10,000 [e]
Japan[e]	16,000	15,000	13,000	9,900	11,000
Kazakhstan	1,640,300	1,740,000 [e]	1,858,130	1,841,309 [r]	1,704,561
Oman	79,563	70,000	84,938 [r]	23,500 [r]	82,250
Russia	434,452	332,261	384,089	342,622 [r]	350,000 [e]
South Africa	3,484,637 [r]	3,515,945 [r]	3,247,609 [r]	2,404,088 [r]	3,700,000 [e]
Sweden	92,390	101,370	118,198	87,000	114,600
Turkey	83,894	91,799	81,743	94,200	100,750
Zimbabwe	142,800	365,000	311,500	134,000	306,847
Total	12,600,000 [r]	13,500,000 [r]	14,000,000 [r]	12,500,000 [r]	14,500,000

[e]Estimated. [r]Revised.

[1]Table includes data available through August 29, 2022. All data are reported unless otherwise noted; totals may include estimated data. Totals and estimated data are rounded no more than to three significant digits; may not add to totals shown.

[2]Includes ferrosilicon-chromium.