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2019 Minerals Yearbook

NIOBIUM [ADVANCE RELEASE]

U.S. Department of the Interior
U.S. Geological Survey

May 2024

Niobium

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In 2019, U.S. niobium apparent consumption (measured in niobium content) was 9,370 metric tons (t), 8% less compared with 10,100 t in 2018 (table 1). No domestic mine production of niobium ore was reported. The niobium content of world mine production was 97,000 t, 23% more than that of the previous year (tables 1, 4). The United States imported 10,100 t of niobium contained in niobium-bearing metal, alloys, ores, and concentrates, 9% less compared with 11,200 t in 2018 (table 1). In the same period, the United States exported 668 t of niobium contained in niobium-bearing alloys, ores, and concentrates, a decrease of 30% compared with exports in 2018. Trade of niobium materials included ferroniobium and niobium metal, ores and concentrates, and scrap. Ferroniobium was the leading traded niobium material by weight as well as value in the United States. The leading reported end use of niobium was as an alloying element in superalloys, followed by carbon steel and stainless steel (table 2).

Legislation and Government Programs

Niobium was first added to the U.S. Government stockpile in 1943 (as columbite ore), and the U.S. Congress designated niobium as a strategic and critical material in 1946 by means of the Strategic and Critical Materials Stock Piling Act as amended through P.L. 79–520, July 23, 1946 (DeMille, 1947, p. 135). The Defense Logistics Agency Strategic Materials (DLA Strategic Materials), U.S. Department of Defense, did not designate niobium materials for potential acquisition or disposal from the National Defense Stockpile under its fiscal year 2020 Annual Materials Plan (Defense Logistics Agency Strategic Materials, 2019a, b).

Production

Globally, pyrochlore was the leading mineral mined for niobium. Niobium minerals typically were converted to ferroniobium and other value-added products at the mine site. The primary marketable niobium materials were ferroniobium and niobium metal, ore, and oxide. Most niobium resources in the United States are of low grade and not commercially recoverable at current prices. As a result, domestic supply has been a concern during every national military emergency since World War I. In 2019, no domestic niobium mine production was reported. Recycled materials and stocks were the only domestic sources of niobium.

NioCorp Developments Ltd. (Centennial, CO), a resource company developing a niobium deposit in Elk Creek, NE, announced in December that it had received a Special Use Permit from Johnson County, NE, for the project. According to the company, the Elk Creek project would be the only niobium mine and primary niobium processing facility in the United States. According to a feasibility study completed on the project in 2019, Elk Creek would be an underground mining operation with onsite hydrometallurgical and pyrometallurgical plants that would produce 169,000 t of payable niobium in the form of ferroniobium, 3,410 t of scandium oxide, and 419,000 t of titanium dioxide over a 36-year mine life. The company needed to approve a construction program and budget before construction could begin on the project (NioCorp Developments Ltd., 2019a, p. 26, 29–30; 2019b).

Consumption

Domestic consumption data for niobium materials were developed by the U.S. Geological Survey by means of the "Columbium (Niobium) and Tantalum," "Consolidated Consumers," and "Specialty Ferroalloys" surveys sent to niobium consumers.

Total apparent domestic consumption of niobium (measured in niobium content) was 9,370 t in 2019, an 8% decrease compared with that in 2018 (table 1). Reported consumption of niobium by the steel industry was 5,100 t in 2019, a 4% decrease compared with 5,310 t of reported consumption in 2018 (table 2). Ferroniobium, the most commonly traded niobium material, was typically consumed in the production of high-strength low-alloy (HSLA) steel and stainless steel. Other uses included the fabrication of nonferrous and niobium alloys and production of niobium carbides and chemicals.

Prices

Niobium materials were not openly traded on exchanges; purchase contracts were confidential between buyer and seller. Based on U.S. Census Bureau data for 2019, the average unit value of traded (imported plus exported) niobium-containing materials was $35.42 per kilogram for niobium oxide (slightly more than that in 2018), $11.33 per kilogram for niobium ores and concentrates (25% less than that in 2018), and $22.71 per kilogram for ferroniobium (8% more than that in 2018) (tables 1, 3).

Foreign Trade

According to the U.S. Census Bureau, the United States exported niobium materials valued at $12.5 million in 2019 (a decrease of 37% from that in 2018) and imported niobium materials valued at $441 million (a 7% decrease from that in 2018) (table 3). Traded niobium materials included ferroniobium and niobium concentrates, metal, ores, and oxide. In 2019, exports of ferroniobium (niobium content) were 29% less than those in 2018 and imports for consumption decreased by 12% (table 1). Ferroniobium was the leading niobium material traded, by value, accounting for 61% of the total import value and 90% of the total export value (table 3). In 2019, Brazil continued to be the leading supplier of ferroniobium and niobium metal and oxides. Mexico, the Netherlands, and Taiwan were leading destinations of United States ferroniobium exports.

World Industry Structure

Niobium ore was mined primarily in Brazil, Canada, and countries in the Great Lakes region of Africa, including Congo (Kinshasa) and Rwanda, and typically was beneficiated to concentrates containing 55% to 60% niobium oxide (Nb_2O_5). Concentrates were further processed to produce ferroniobium or niobium metal and oxides. Ferroniobium, the leading commercial niobium-containing material, typically contained 66% niobium (Roskill Information Services Ltd., 2018, p. 67).

In 2019, world production of niobium contained in concentrates increased by 23% from that in 2018 to an estimated 97,000 t owing mostly to a significant increase in production in Brazil (table 4). Brazil and Canada were the leading producers of niobium mineral concentrates, accounting for nearly 99% of global niobium mineral concentrates production. In Brazil, the leading producers were Companhia Brasileira de Metalurgia e Mineração (CBMM) and Niobras Mineração Ltda. [a subsidiary of China Molybdenum Co., Ltd. (China)]. In Canada, the leading producer was Niobec Inc. (a subsidiary of Magris Resources Inc.).

World Review

Brazil.—CBMM reported that it produced 123,000 t (gross weight) of niobium products in 2019, including 109,400 t of ferroniobium, at its mining and industrial complex in Araxa, Minas Gerais State. This represented a 31% increase from the 93,800 t of niobium products produced in 2018. During the year, CBMM continued to advance a project that would increase its production capacity to 150,000 metric tons per year of niobium products, and the company expected the expansion project to be completed in 2020 (Companhia Brasileira de Metalurgia e Mineração, 2020).

Mineração Taboca S.A. [a subsidiary of MINSUR S.A. (Peru)] operated the Pitinga-Pirapora Mine complex in Amazonas State. The company reported that it produced 3,900 t (gross weight) of niobium and tantalum ferroalloys with an average combined niobium and tantalum content of 59%. This represented a slight decrease from total ferroalloy production in 2018 (MINSUR S.A., 2020, p. 27).

Niobras Mineração, a subsidiary of China Molybdenum, operated the Boa Vista Mine and ferroalloy plant in Goias State. China Molybdenum reported that it produced 7,490 t of niobium contained in ferroniobium in 2019, 16% less compared with that in 2018 (China Molybdenum Co., Ltd., 2020, p. 23).

Russia.—LLC Lovozero GOK operated the Lovozero Mine in the Murmansk region. The company produced loparite mineral concentrates that were consumed by JSC Solikamsk Magnesium Works to produce niobium compounds at its facility in the Perm region. Solikamsk reported 659 t of niobium oxide contained in shipments of niobium compounds in 2019, a slight decrease compared with that in 2018. More than 90% of shipments were sent to consumers in Russia, with most of the remaining amount sent to the Americas followed by Europe (JSC Solikamsk Magnesium Works, 2020, p. 10, 12).

Venezuela.—The Government of Venezuela exported columbite-tantalite ore from artisanal mining. In addition, state-owned CVG Ferrominera Orinoco C.A. operated a mill in Bolivar State that processed columbite-tantalite ore. The mill had a daily ore-processing capacity of 160 t (Depablos, 2018a, b).

Outlook

Currently, operating niobium mines have adequate reserves to meet global demand for the foreseeable future. The steel industry is the largest consumer of niobium (mainly in HSLA steel) and niobium content of HSLA steel is greatest in developed countries, indicating that niobium use in steel could increase in developing nations. Potential new sources of niobium are typically associated with the production of other mineral deposits, niobium being a byproduct. Several potential new niobium sources were in development during 2019, mostly in Australia and Canada.

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TABLE 1
SALIENT NIOBIUM STATISTICS[1]

		2015	2016	2017	2018	2019
United States:						
Exports:						
Niobium (Nb) ores and concentrates, gross weight	metric tons	73	14	7	5	27
Synthetic concentrates, gross weight	do.	138	379	113	198	40
Tantalum ores and concentrates, gross weight	do.	98	162	109	48	28
Niobium-containing ores and concentrates,[2] niobium (Nb) content[e]	do.	42	64	26	28	13
Ferroniobium, Nb content	do.	1,390	1,410	1,460	926	655
Total exports, Nb content	do.	1,430	1,480	1,490	955	668
Imports for consumption:						
Niobium ores and concentrates, gross weight	do.	--	1	1	31	3
Synthetic concentrates, gross weight	do.	--	9	15	12	6
Tantalum ores and concentrates, gross weight	do.	730	675	1,010	1,050	840
Niobium-containing ores and concentrates,[2] Nb content[e]	do.	82	77	115	126	95
Niobium metal, Nb content[3]	do.	886	1,240	1,410	1,800	1,700
Niobium oxide, Nb content[e]	do.	983	855	895	964	994
Ferroniobium, Nb content[e]	do.	6,570	6,080	6,910	8,290	7,330
Total exports, Nb content	do.	8,520	8,250	9,330	11,200	10,100
Reported consumption, Nb content:						
Raw materials	do.	W	W	W	W	W
Ferroniobium and nickel niobium	do.	7,510	7,370	7,640	6,850 [r]	6,680
Apparent consumption, Nb content[4]	do.	7,080	6,730	7,780	10,100	9,370
Value,[5] gross weight:						
Niobium ores and concentrates	dollars per kilogram	7.59	7.81	20.69	15.08	11.33
Niobium oxide	do.	36.19	33.66	31.20	35.03	35.42
Ferroniobium	do.	24.27	20.56	19.83	21.11	22.71
World, production of niobium concentrates, Nb content	metric tons	65,700	58,400	66,800	78,800 [r]	97,000 [e]

[e]Estimated. [r]Revised. do. Ditto. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Table includes data available through August 27, 2020. Data are rounded to no more than three significant digits, except values; may not add to totals shown.
[2]Includes natural and synthetic niobium-containing ores and concentrates. Nb content of ores and concentrates was estimated assuming the following niobium oxide (Nb_2O_5) contents: 30% in niobium ore, 16% in synthetic concentrates, and 16% in tantalum ore. The Nb content of Nb_2O_5 is 69.904%.
[3]Includes niobium and articles made of niobium.
[4]Defined as imports minus exports plus adjustments for Government stock changes.
[5]Weighted average value of imported plus exported materials.

Sources: U.S. Census Bureau and U.S. Geological Survey.

TABLE 2
REPORTED CONSUMPTION, BY END USE, INDUSTRY STOCKS OF FERRONIOBIUM AND NICKEL NIOBIUM, AND GOVERNMENT STOCKS BY MATERIAL IN THE UNITED STATES[1]

(Metric tons, niobium content)

	2018	2019
End use:		
Steel:		
Carbon	1,200	1,120
Stainless and heat-resisting	623 r	617
Full alloy	289	285
High-strength low-alloy	(2)	(2)
Electric	(2)	(2)
Tool	(2)	(2)
Unspecified	3,190	3,080
Total	5,310	5,100
Superalloys	1,530 r	1,560
Alloys (excluding steels and superalloys)	21	21
Grand total	6,850 r	6,680
Stocks, December 31:		
Consumer	528	537
Producer[3]	W	W
Total	528	537
National Defense Stockpile, total uncommitted inventory by material:		
Ferroniobium	181	265
Niobium metal ingots	10	10

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through August 27, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Included with "Steel, unspecified."
[3]Ferroniobium only.

TABLE 3
U.S. FOREIGN TRADE IN NIOBIUM, BY CLASS[1]

HTS[2] code	Class	2018 Gross weight (kilograms)	2018 Value (thousands)	2019 Gross weight (kilograms)	2019 Value (thousands)	Principal destinations and sources in 2019 (gross weight in kilograms and values in thousand dollars)
	Exports:					
2615.90.3000	Synthetic concentrates	198,000	$3,020	40,100	$975	China 24,000, $869; United Kingdom 16,000, $107.
2615.90.6030	Niobium ores and concentrates	4,510	133	26,900	163	India 24,800, $104; Russia 759, $22; United Kingdom 630, $18; France 322, $9.
2615.90.6060	Tantalum ores and concentrates[3]	48,000	316	27,800	168	United Kingdom 27,800, $168.
7202.93.0000	Ferroniobium	1,420,000	16,200	1,010,000	11,200	Mexico 759,000, $8,360; Netherlands 122,000, $1,340; Taiwan 84,100, $924.
	Total exports	XX	19,700	XX	12,500	
	Imports for consumption:[4]					
2615.90.3000	Synthetic concentrates	11,800	186	5,810	31	Brazil 5,670, $27; Canada 141, $5.
2615.90.6030	Niobium ores and concentrates	30,700	398	3,370	179	Canada 2,770, $126; Hong Kong 284, $28; China 162, $9.
2615.90.6060	Tantalum ores and concentrates[3]	1,050,000	62,600	840,000	43,100	Australia 454,000, $21,500; Rwanda 238,000, $14,200; United Arab Emirates 73,100, $2,080.
2825.90.1500	Niobium oxide	1,380,000	48,300	1,420,000	50,400	Brazil 1,000,000, $35,000; Thailand 210,000, $6,920; Russia 76,300, $2,530.
	Total ores, concentrates, and oxides	XX	111,000	XX	93,700	
	Ferroniobium:					
7202.93.4000	Silicon <0.4%	537,000	21,500	217,000	8,790	Germany 127,000, $5,210; Brazil 82,220, $3,440.
7202.93.8000	Other	12,200,000	262,000	11,100,000	259,000	Brazil 7,100,000, $156,000; Canada 3,950,000, $103,000.
	Total ferroniobium	12,800,000	283,000	11,300,000	268,000	
8112.92.4000	Unwrought, powders	1,800,000	82,100	1,700,000	79,400	Brazil 1,350,000, $61,700; Russia 243,000, $10,600; Germany 47,300, $3,960.
	Total imports	XX	477,000	XX	441,000	

XX Not applicable.

[1]Table includes data available through August 27, 2020. 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]Tantalum ores and concentrates may contain niobium.

[4]Includes niobium waste and scrap, as well as other materials, which are included in HTS code 8112.92.0600, and niobium other than powders, unwrought, and waste and scrap, as well as other materials, which are included in HTS code 8112.99.9000.

Sources: U.S. Census Bureau and U.S. Geological Survey.

TABLE 4

NIOBIUM: WORLD PRODUCTION OF MINERAL CONCENTRATES, BY COUNTRY OR LOCALITY[1, 2]

(Kilograms, niobium content)

Country or locality[3]	2015	2016	2017	2018	2019
Brazil, mineral concentrates[4]	58,852,000	50,752,000	58,137,000	69,593,000 r	88,932,000
Burundi, ore and concentrates[e]	10,000	6,200	28,000 r	43,000 r	38,000
Canada, pyrochlore concentrates	5,600,000	6,300,000	7,200,000	7,700,000 e	6,800,000 e
China, mineral concentrates	30,100 e	37,000 r	45,000 r	45,000 r	45,000 e
Congo (Kinshasa):[e]					
Cassiterite concentrates	84,000	120,000	190,000	160,000	200,000
Columbite-tantalite concentrates	370,000	420,000	380,000	400,000	220,000
Total	454,000	540,000	570,000	560,000	420,000
Ethiopia, columbite-tantalite concentrates[e]	15,000	16,000	22,000	26,000	7,000
Mozambique, columbite-tantalite concentrates	2,735	4,005	3,700 e	5,000 r, e	6,000 e
Nigeria, columbite-tantalite concentrates[e]	53,000	73,000	63,000 r	63,000 r	63,000
Russia, loparite concentrates	439,140	439,209	452,771	467,451 r	461,880
Rwanda:[e]					
Cassiterite concentrates	34,000	32,000	42,000	42,000	34,000
Columbite-tantalite concentrates	210,000	160,000	220,000	210,000	170,000
Total	244,000	192,000	262,000	252,000	204,000
Uganda, ore and concentrates[e]	190	530	470	300 r	300
Grand total	65,700,000	58,400,000	66,800,000	78,800,000 r	97,000,000 e

[e]Estimated. [r]Revised.

[1]Table includes data available through October 6, 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]Figures for all countries and (or) localities represent marketable output.

[3]In addition to the countries and (or) localities listed, Australia, French Guiana, Malaysia, and Venezuela may have produced niobium mineral concentrates, but available information was inadequate to make reliable estimates of output.

[4]Includes columbite-tantalite and pyrochlore.

TABLE 5

FERRONIOBIUM (FERROCOLUMBIUM): WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons, niobium content)

Country or locality[2]	2015	2016	2017	2018[e]	2019[e]
Brazil	51,874	44,390	58,690	59,000	60,000
Canada	5,385	6,099	6,981	7,400 r	6,000
Russia[e]	160	80	240	250	250
Total	57,400	50,600	65,900	66,700 r	66,300

[e]Estimated. [r]Revised.

[1]Table includes data available through February 5, 2021. 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, Austria, China, and Germany may have produced ferroniobium (ferrocolumbium), but available information was inadequate to make reliable estimates of output.