USGS
science for a changing world

2019 Minerals Yearbook

FERROALLOYS [ADVANCE RELEASE]

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

February 2025

Ferroalloys

By Ruth F. Schulte

Amanda S. Brioche contributed data for ferroboron, Chad A. Friedline for ferroniobium, Joseph Gambogi for ferrotitanium, Michele E. McRae for ferronickel, Désirée E. Polyak for ferromolybdenum and ferrovanadium, Emily K. Schnebele for ferromanganese, ferrosilicon, and silicomanganese, and Kim B. Shedd for ferrotungsten. Domestic survey data and tables were prepared by Hodan A. Fatah, statistical assistant.

Ferroalloys are alloys of iron with one or more other elements, which are added to metal melts during the production of steel or other alloys. The alloying elements delivered by ferroalloys impart distinctive qualities to steel and cast iron or serve important functions during steel refining, such as control of inclusions, corrosion resistance, desulfurization, and heat strength.

Ferroalloys can be classified as either bulk ferroalloys or noble ferroalloys (also referred to as special or specialty ferroalloys). Bulk ferroalloys are produced in large quantities and include ferrochromium (including ferrosilicon-chromium), ferromanganese, ferrosilicon, and silicomanganese (also known as ferrosilicomanganese or ferrosilicon-manganese). Noble ferroalloys are produced in smaller quantities and typically include ferroaluminum, ferroboron, ferromolybdenum, ferronickel, ferroniobium, ferrophosphorus, ferrosilicomagnesium, ferrosilicon-titanium and ferrotitanium, ferrotungsten (including ferrosilicon-tungsten), ferrovanadium, and ferrozirconium (including ferrosilicozirconium).

U.S. production of bulk ferroalloys in 2019 increased slightly to 412,000 metric tons (t) from 408,000 t in 2018. Estimated production of noble ferroalloys in 2019 increased by 40% to 910 t from 650 t (revised) in 2018 (table 1). Total ferroalloy exports decreased by 34% to 38,600 t (gross weight) compared with 58,300 t in 2018 (table 7). Ferroalloy imports decreased by 19% to 1,400,000 t (gross weight) compared with 1,730,000 t in 2018 (table 8). World production of total ferroalloys was estimated to be 58.7 million metric tons (Mt) (gross weight) in 2019, an 11% increase compared with 52.7 Mt (revised) in 2018 (table 9). Among the bulk ferroalloys, China was the leading country in the production of ferrochromium, ferromanganese, ferrosilicon, and silicomanganese, and Kazakhstan was the leading country in ferrosilicon-chromium in 2019. Among the noble ferroalloys, China was the leading country in the production of ferromolybdenum, ferronickel, and ferrovanadium; Brazil was the leading country in the production of ferroniobium; and Russia was estimated to be the leading country in the production of ferrotitanium and the only country with reported ferrophosphorus production. India was the only country with reported ferroaluminum and ferrosilicomagnesium production in 2019.

Legislation and Government Programs

Stockpile.—The Defense Logistics Agency Strategic Materials (DLA Strategic Materials), U.S. Department of Defense, administered disposals of ferrochromium and ferromanganese materials from the National Defense Stockpile (NDS) under its fiscal year 2019 (October 1, 2018, through September 30, 2019) Annual Materials Plan (AMP). Maximum disposal limits were based on the fiscal year 2019 AMP, which were set at 45,400 t of ferromanganese and 21,300 t of ferrochromium (Defense Logistics Agency Strategic Materials, 2018b). The DLA Strategic Materials administered acquisitions of ferroniobium for the NDS under the same AMP. Maximum acquisition limits were 209 t of ferroniobium (Defense Logistics Agency Strategic Materials, 2018a). As of yearend 2019, the ferroalloy inventory (gross weight) was as follows: 189,000 t of high-carbon ferromanganese, 38,700 t of high-carbon ferrochromium, 27,400 t of low-carbon ferrochromium, and 407 t of ferroniobium (table 3).

Production

In 2019, 11 companies in the United States produced ferroalloys (table 2). Domestic data for ferroalloy materials were collected by the U.S. Geological Survey by means of the "Consolidated Consumers' Report," "Manganese Ore and Products," "Nickel Stocks, Purchases, and Consumption," "Silicon Alloys," "Specialty Ferroalloys," and "Vanadium" surveys.

U.S. production of bulk ferroalloys in 2019 increased slightly to 412,000 t from 408,000 t in 2018. Estimated production of noble ferroalloys in 2019 increased by 40% to 910 t from 650 t (revised) in 2018 (table 1). The trend in bulk ferroalloy production followed closely that of crude steel, where domestic production of raw steel increased slightly to 87.8 Mt in 2019 from 86.6 Mt in 2018 (Tuck, 2022). World production, excluding the United States, of bulk ferroalloys increased by 9%, and world production of noble ferroalloys increased by 22% in 2019 (tables 1, 9).

Consumption

Domestic bulk ferroalloy reported consumption was 1.17 Mt in 2019, unchanged from 1.17 Mt (revised) in 2018. Noble ferroalloy reported consumption decreased by 6% in 2019 compared with consumption in 2018 (table 1).

Prices

The prices for bulk ferroalloys varied in 2019. The annual average prices for grades of low-carbon ferrochromium (less than 3% carbon) and the average prices for high-carbon ferrochromium (more than 4% carbon) in 2019 decreased by an average of 13% each compared with those in 2018 (table 6). Compared with prices in 2018, the average U.S. spot-market prices for high-carbon ferromanganese decreased by 11%, silicomanganese decreased by 4%, and medium-carbon

ferromanganese decreased by 3%. Average prices for 75%-grade ferrosilicon and 50%-grade ferrosilicon decreased by 17% and slightly, respectively, from those in 2018.

For the noble ferroalloys, the 2019 annual average prices of ferrovanadium decreased by 43%, ferrotungsten by 30%, and ferromolybdenum by 4% compared with those in 2018. The annual average price of ferrotitanium in 2019 increased by 13% and ferroniobium increased by 8% from those in 2018. The average annual price of nickel metal, with 99.81% minimum purity, increased by 6% (table 6).

Foreign Trade

The United States was a net importer of ferroalloys in 2019. On a gross-weight basis, U.S. total bulk ferroalloy exports decreased by 38% to 23,800 t compared with exports in 2018, whereas total bulk ferroalloy imports decreased by 18% to 1.32 Mt (tables 1, 7, 8). Exports of chromium ferroalloys decreased by 30% in 2019 to 1,760 t (gross weight) compared with exports in 2018 and imports decreased by 21% to 458,000 t (gross weight). Exports of manganese ferroalloys decreased by 56% to 6,560 t (gross weight) and imports decreased by 19% to 683,000 t (gross weight). Exports of silicon ferroalloys decreased by 26% to 15,500 t (gross weight) compared with exports in 2018, and imports decreased by 10% to 178,000 t (gross weight) (tables 7, 8). Exports of total noble ferroalloys (gross weight) decreased by 26% compared with exports in 2018, and imports of total noble ferroalloys decreased by 30% (tables 1, 7, 8). Specifically, exports of ferromolybdenum decreased by 41%, and imports decreased by 12%; ferronickel exports decreased by 24%, and imports decreased by 40%; ferroniobium exports decreased by 29%, and imports decreased by 12%; ferrotitanium and ferrosilicon-titanium exports decreased by 51%, but imports increased by 25%; exports of ferrotungsten and ferrosilicon-tungsten decreased by 65%, and imports decreased by 26%; exports of ferrovanadium decreased by 47%, and imports decreased by 15% (tables 7, 8).

Ferroalloy Review

Ferroboron.—Boron is added to steel to increase hardenability (the depth to which steel is hardened upon quenching at high temperatures). Boron is also added to some stainless steels to improve creep resistance; control hot shortness (the propensity for some alloys to separate along grain boundaries when stressed or deformed at near melting-point temperatures); and, in some cases, promote neutron absorption, which is critical in advanced technological fields such as nuclear power. Ferroboron is typically added to alloy steels, high-strength low-alloy steels, structure steels, and stainless steels. Ferroboron also increases the magnetic susceptibility of alloys, enabling them to be used in magnetic applications such as neodymium-iron-boron magnets.

Boron occurs in nature as borate minerals, such as borax, and is used mostly to produce borosilicate, a type of glass with silica and boron trioxide. To produce ferroboron, borate ore is converted to boric acid and then reduced in an electric arc furnace with carbon steel or with aluminum and iron ore.

The United States did not produce ferroboron in 2019 and relied on imports. There are no Harmonized Tariff Schedule of the United States codes specific to ferroboron; thus, exact import quantities were not available. India reported ferroboron production in previous years, but there was no ferroboron production reported in 2019 (table 9).

Ferrochromium.—Chromium is added to steel to impart corrosion and oxidation resistance, increase hardenability, improve wear resistance, and bolster strength at elevated temperatures. The primary end uses for ferrochromium were stainless and heat-resisting steels. There is no substitute for chromium in stainless steel; it is an essential component in all stainless-steel products. Chromium also was used in tool steels, superalloys, and other specialty metals. Chromite ore is the mineral source of chromium. The ore can be smelted in electric arc furnaces to produce ferrochromium for the metallurgical industry.

In 2019, world stainless and heat-resisting steel melt shop production (ingot or slab equivalent) was 52.2 Mt, a 3% increase from production in 2018 (International Stainless Steel Forum, 2020, p. 7). The American Iron and Steel Institute (2018, 2019) estimated U.S. stainless-steel production to be 2.86 Mt, an 8% decrease from production in 2018. Leading stainless-steel-producing countries, listed in descending order of production, were China, India, Japan, and the United States (International Stainless Steel Forum, 2020, p. 7).

The United States did not produce ferrochromium and imported 458,000 t (gross weight) of ferrochromium in 2019, a 21% decrease from that in 2018 (table 8). The leading countries for ferrochromium production were China (43%), South Africa (26%), and Kazakhstan (13%) (table 9).

Ferromanganese and Silicomanganese.—Manganese ferroalloys include ferromanganese and silicomanganese, which are essential for desulfurization and deoxidation in steelmaking. Ferromanganese and silicomanganese also increase the hardenability of steel. Steelmaking was the leading end use of manganese ferroalloys in the United States in 2019; carbon and high-strength low-alloy steels were the primary end products (table 4). Ferromanganese is produced by mixing manganese ore, specifically the mineral pyrolusite, and iron ore with carbon in electric arc furnaces or, less frequently, blast furnaces. Silicomanganese is similarly produced but includes silicon in the melt to increase the deoxidation properties of the steel.

The United States produced manganese ferroalloys at two facilities; production data were withheld to avoid disclosing company proprietary data (table 2). In 2019, imports of ferromanganese and silicomanganese were 683,000 t (gross weight), a decrease of 19% from imports in 2018 (table 8). The leading countries in manganese ferroalloy production, excluding the United States, were China (65%), India (10%), and Ukraine (4%) (table 9).

Ferromolybdenum.—Molybdenum is added to steel for a variety of different uses, such as improving corrosion and wear resistance and increasing hardenability and strength at high temperatures. Ferromolybdenum was used to produce alloy and stainless steels, alloy cast irons, full steel, carbon steel, high-strength low-alloy steel, tool steel, and superalloys. The mineral

molybdenite is mined from primary ores, such as low-grade porphyry molybdenum deposits, or obtained as a byproduct from the production of other metals, typically low-grade copper porphyry deposits. The molybdenite ore is then concentrated and roasted to form molybdic oxide, which can then be converted into ferromolybdenum, molybdenum chemicals, or molybdenum metal. Molybdic oxide is easily reduced in an electric arc furnace or by argon oxygen decarburization processes. Molybdenum can also be recovered from alloy scrap if the molybdenum content of the scrap is well known.

The United States produced ferromolybdenum at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2019, 10,400 t (gross weight) of ferromolybdenum was imported, a decrease of 12% compared with imports in 2018 (table 8). Exports of ferromolybdenum in 2019 were 552 t (gross weight), a 41% decrease from exports in 2018 (table 7). The leading global producer of ferromolybdenum was China, accounting for more than 90% of world production, excluding the United States. Ferromolybdenum was also produced in Armenia (5%), Japan (2%), and India (<1%) (table 9). Austria, Belgium, Chile, Iran, the Republic of Korea, Russia, and the United Kingdom may have produced ferromolybdenum, but available information was inadequate to make reliable estimates of output.

Ferronickel.—Nickel is added to steel to promote solid-solution strengthening, toughness at low temperatures, and hardenability. Nickel can also be used to improve resistance to corrosion and oxidation. The primary end uses for ferronickel included cryogenic steels, stainless steels, superalloys, ultrahigh-strength steels, and wrought steels; stainless steel was the leading end use.

Ferronickel and nickel pig iron (a form of ferronickel with lower nickel content, typically less than 15%) are produced from laterite ores, most often from the smelting of hydrous-magnesium-silicate ores, also called saprolite. The United States did not produce ferronickel and imported 44,500 t (gross weight) of ferronickel in 2019, a decrease of 40% compared with imports in 2018 (table 8). American Zinc Recycling Corp. recovered chromium-, molybdenum-, and nickel-bearing waste and scrap at its secondary smelter in Ellwood City, PA, to produce an iron-base remelt alloy with an average nickel content of 10%. Stainless-steel producers used the remelt as a substitute for ferrochromium, ferromolybdenum, and ferronickel (Befesa S.A., 2022, p. 123).

China and Indonesia were the only countries that produced nickel pig iron, a type of nickel-iron alloy containing less than 15% nickel. Nickel pig iron is a low-grade product containing 4% to 15% nickel relative to conventional ferronickel grades, which range from 18% to 80% nickel. After accounting for nickel content in the nickel pig iron, China was the leading ferronickel producer in 2019, accounting for 46% of world production. Indonesia was estimated to account for 30% of world production. Japan and New Caledonia were the next leading ferronickel producers, accounting for 5% and 4% of world production, respectively (table 9).

Ferroniobium.—Niobium is added to steel as a microalloying element and improves toughness and wear resistance, increases yield strength, and enables retention of grain size at elevated temperatures. Carbon steels, high-strength low-alloy steels, stainless steels, and superalloys were ferroniobium products in 2019. Niobium does not occur naturally as a metal; however, it is contained in the mineral structure of the mineral pyrochlore, typically found in carbonatite deposits in zoned alkaline igneous complexes. Carbonatite ores can be concentrated to produce a niobium mineral (pyrochlore) concentrate. Niobium concentrate is then smelted in electric arc furnaces to produce ferroniobium for metallurgical uses. The United States produced ferroniobium at one facility; production was withheld to avoid disclosing company proprietary data (table 2). In 2019, 11,300 t (gross weight) of ferroniobium was imported, a decrease of 12% from that in 2018 (table 8). Exports of ferroniobium were 1,000 t (gross weight), a 29% decrease from exports in 2018 (table 7). Brazil, Canada, and Russia were the only other countries that produced ferroniobium in 2019; Brazil led world production, accounting for 90% of reported production, excluding production in the United States (table 9).

Ferrophosphorus.—Phosphorus is typically considered an impurity in iron ore and is eliminated in the early stages of the steelmaking process. However, phosphorus is sometimes added to steel as ferrophosphorus to improve strength and machinability and to increase resistance to atmospheric corrosion. Ferrophosphorus is produced from iron ore slag as a byproduct during steel manufacturing and then added to steel melts as briquets after the deoxidation process is complete. The leading end uses for ferrophosphorus were carbon steel, followed by cast iron, full steel, electrical steel, and high-strength low-alloy steel. The United States did not produce ferrophosphorus in 2019 and imported 4,120 t (gross weight), which was a 32% decrease from imports in 2018 (table 8). World production of ferrophosphorus was limited to Russia, which produced an estimated 1,500 t of ferrophosphorus in 2019 (table 9). Ferrophosphorus may have been produced in other countries, such as China, but available information was inadequate to make reliable estimates of output.

Ferrosilicon.—Silicon is added to steel to increase resistance to oxidation at high temperatures, improve hardenability, and promote solid-solution strengthening. Steel and cast-iron alloys were the primary products for ferrosilicon use. High-purity quartz sand and quartzite are sources for silica, which are smelted in blast or submerged electric arc furnaces to produce ferrosilicon. The United States produced ferrosilicon at three facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2019, 178,000 t (gross weight) of ferrosilicon was imported, a 10% decrease from imports in 2018 (table 8). Exports of ferrosilicon were 15,500 t (gross weight), a decrease of 26% from exports in 2018 (table 7). China was estimated to be the leading silicon-ferroalloy-producing country, accounting for 67% of world production, excluding the United States production, followed by Russia (11%) and Norway (4%) (table 9).

Ferrotitanium.—Titanium is added to steel to promote grain refinement and to act as a decarbonizing, denitrogenizing, deoxidizing, and desulfurizing agent. Ferrotitanium was used in carbon steels, high-strength low-alloy steels, maraging steels, and stainless steels. Titanium scrap that contains iron or steel is the primary source for ferrotitanium. Commercial-

purity titanium scrap can also be used. Typically, titanium scrap is smelted in an electric induction furnace to produce ferrotitanium. However, ferrotitanium can also be produced by aluminothermic reduction of ilmenite or rutile, which are the main mineral sources for titanium. The most common ferrotitanium grades are 30% titanium and 70% titanium.

The United States produced ferrotitanium at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2019, 3,390 t (gross weight) of ferrotitanium and ferrosilicon-titanium was imported, an increase of 25% from imports in 2018 (table 8). Exports of ferrotitanium and ferrosilicon-titanium were 1,520 t (gross weight), a 51% decrease from exports in 2018. Russia and India also produced ferrotitanium in 2019, accounting for an estimated 99% and 1%, respectively, of global production, excluding United States production (table 9).

Ferrotungsten.—The addition of tungsten to steel improves its hardness, wear resistance, and strength at high temperatures. It promotes a higher toughness for a given hardness level and improves cutting efficiency and cutting speeds. As a result, the primary end uses for ferrotungsten were standard tool and die steels and high-speed steels. To a lesser extent, ferrotungsten can also be added to some stainless and structural steels (Lassner and Schubert, 1999, p. 307–312; Sarna, 2014).

Ferrotungsten can be produced from high-grade tungsten ore or concentrates of the tungsten oxide minerals scheelite or wolframite, calcium tungstate (an artificial scheelite), or soft scrap. To produce ferrotungsten, tungsten materials are reduced by either a carbothermic process in an electric arc furnace, a metallothermic process using silicon and (or) aluminum, or a combination of carbothermic and metallothermic processes (Lassner and Schubert, 1999, p. 307–312).

Tungsten is added to steel melts as ferrotungsten, a master alloy typically containing between 75% and 85% tungsten. Tungsten can also be added as a master alloy, known as tungsten melting base, that contains up to 38% tungsten or as tungsten-bearing scrap. Specialty-steel mills equipped with argon-oxygen decarburization can accommodate scheelite ore concentrates (Lassner and Schubert, 1999, p. 307–312; Sarna, 2014).

The United States did not produce ferrotungsten or ferrosilicon-tungsten in 2019 and imported 126 t (gross weight) of ferrotungsten and ferrosilicon-tungsten, a 26% decrease from imports in 2018 (table 8). Although there was no reported world production of ferrotungsten in 2019, China has produced most of the world's ferrotungsten in recent years (Seddon, 2014, p. 10–14). Ferrotungsten has also been produced in Brazil, Germany, India, the Republic of Korea, Russia, Sweden, and Vietnam, but available information was inadequate to make reliable estimates of output.

Ferrovanadium.—Vanadium is added to steel to promote fine grain size and inhibit grain growth at high temperatures, increase hardenability in steel, and improve wear resistance. Structural and engineering alloy steels (such as carbon steels), full alloy and high-strength low-alloy steels, and tool and die steels were the leading end uses for ferrovanadium in 2019. Vanadium is primarily recovered as a byproduct of processing titanium-bearing magnetite or from recycling titanium-bearing materials. Secondary vanadium can also be produced from various industrial waste materials, such as vanadium-bearing coal ash, petroleum residues, pig iron slag, and spent catalysts. To produce ferrovanadium, the recovered vanadium slag is smelted with iron oxides in electric arc furnaces. Secondary vanadium was the main source of U.S. ferrovanadium production in 2019.

In the United States, ferrovanadium was produced at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2019, 3,400 t (gross weight) of ferrovanadium was imported, a decrease of 15% from imports in 2018 (table 8). Exports of ferrovanadium were 436 t (gross weight), a decrease of 47% from exports in 2018 (table 7). Excluding the United States, China (65%) was the leading ferrovanadium-producing country, and Russia (16%) and South Africa (10%) were the next leading ferrovanadium-producing countries (table 9).

Ferrozirconium.—Zirconium is added to steel to control sulfide inclusions and fix nitrogen, particularly in boron steels. In addition, zirconium can act as a deoxidizing agent and inhibit grain growth and strain aging. High-strength low-alloy steels were the leading end use for ferrozirconium and ferrosilicozirconium; nonferrous alloys, such as zircaloy, also included some ferrozirconium. Zirconium is most commonly obtained from the mineral zircon, which is recovered as a byproduct or coproduct of heavy-mineral-sand mining and processing. The zirconium ore is then added to the ladle or as ingot molds during the steel manufacturing process.

In 2019, the United States did not produce ferrozirconium and imported 170 t (gross weight), a decrease of 11% from imports in 2018 (table 8). World production of ferrozirconium was not reported in 2019, but it may have been included in the unspecified category for some countries. India reported ferrosilicozirconium production in the past, but no production was reported in 2019 and available information was inadequate to make reliable estimates of output.

Outlook

Domestic consumption of ferroalloys is expected to closely follow trends in U.S. steel production. Global steel production increased by 3% to 1.87 billion metric tons in 2019, and demand was expected to decrease by 2% in 2020 owing to the global coronavirus disease 2019 (COVID-19) pandemic but increase by 4% in 2021 as COVID-19 lockdowns were lifted (World Steel Association, 2020a, p. 7; 2020b).

References Cited

American Iron and Steel Institute, 2018, AIS 104 report—Quarterly production of stainless and heat resisting raw steel (4th quarter): Washington, DC, American Iron and Steel Institute, undated. (Accessed August 8, 2019, via http://www.steel.org/.)

American Iron and Steel Institute, 2019, AIS 104 report—Quarterly production of stainless and heat resisting raw steel (4th quarter): Washington, DC, American Iron and Steel Institute, undated. (Accessed May 5, 2020, via http://www.steel.org/.)

Befesa S.A., 2022, Annual report 2021: Luxembourg City, Luxembourg, Befesa S.A., 209 p. (Accessed April 22, 2022, at https://images.befesa.com/media/2022/04/Befesa-AR-2021.pdf.)

Defense Logistics Agency Strategic Materials, 2018a, Annual Materials Plan for FY 2019 (Potential acquisitions): Fort Belvoir, VA, Defense Logistics Agency Strategic Materials news release DLA–SM–18–3152, October 3, 1 p. (Accessed November 29, 2021, via https://www.dla.mil/HQ/Acquisition/StrategicMaterials/Reports/.)
Defense Logistics Agency Strategic Materials, 2018b, Annual Materials Plan for FY 2019 (Potential disposals): Fort Belvoir, VA, Defense Logistics Agency Strategic Materials news release DLA–SM–19–3151, October 3, 1 p. (Accessed November 29, 2021, via https://www.dla.mil/HQ/Acquisition/StrategicMaterials/Reports/.)
International Stainless Steel Forum, 2020, Stainless steel in figures 2020: Brussels, Belgium, International Stainless Steel Forum, 22 p. (Accessed July 7, 2020, via https://www.worldstainless.org/statistics/stainless-steel-meltshop-production/stainless-steel-meltshop-production-2014-2020/.)
Lassner, Erik, and Schubert, W.D., 1999, Tungsten—Properties, chemistry, technology of the element, alloys, and chemical compounds: New York, NY, Plenum Publishers, 422 p.
Sarna, S.K., 2014, Tungsten in steels: IspatGuru. (Accessed December 2, 2021, at https://www.ispatguru.com/tungsten-in-steels/#.)
Seddon, Mark, 2014, Ferro-tungsten applications, production (primary and from scrap) and market: International Tungsten Industry Association Annual General Meeting, 27th, Toronto, Ontario, Canada, September 22–24, presentation, 32 p.
Tuck, C.C., 2022, Iron and steel: U.S. Geological Survey Mineral Commodity Summaries 2022, p. 82–83. (Accessed April 22, 2022, at https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-iron-steel.pdf.)
World Steel Association, 2020a, World steel in figures 2020: Brussels, Belgium, World Steel Association, 30 p. (Accessed January 21, 2025, at https://worldsteel.org/wp-content/uploads/2020-World-Steel-in-Figures.pdf.)
World Steel Association, 2020b, World steel short range outlook October 2020: Brussels, Belgium, World Steel Association press release, October 15. (Accessed January 21, 2025, at https://worldsteel.org/media/press-releases/2020/worldsteel-short-range-outlook-october-2020/.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Boron. Ch. in Minerals Yearbook, annual.
Chromium. Ch. in Minerals Yearbook, annual.
Manganese. Ch. in Minerals Yearbook, annual.
Molybdenum. Ch. in Minerals Yearbook, annual.
Nickel. Ch. in Minerals Yearbook, annual.
Niobium. Ch. in Minerals Yearbook, annual.
Silicon. Ch. in Minerals Yearbook, annual.
Titanium. Ch. in Minerals Yearbook, annual.
Tungsten. Ch. in Minerals Yearbook, annual.
Vanadium. Ch. in Minerals Yearbook, annual.
Zirconium. Ch. in Minerals Yearbook, annual.

TABLE 1
SALIENT FERROALLOYS STATISTICS[1]

(Metric tons, gross weight)

	2015	2016	2017	2018	2019
United States:					
Bulk ferroalloys:[2]					
Production	424,000	369,000	395,000	408,000	412,000
Consumption, reported	1,180,000	1,150,000	1,150,000	1,170,000 r	1,170,000
Exports	23,000 r	21,800 r	34,800 r	38,300	23,800
Imports for consumption	1,240,000	1,200,000	1,490,000	1,620,000	1,320,000
Noble ferroalloys:					
Production[e, 3]	21,000	19,000 r	13,000 r	650 r	910
Consumption, reported[4]	63,200	59,400	61,200	55,100 r	52,000
Exports	10,800	12,800	14,600	20,000	14,700
Imports for consumption	76,700	69,300	117,000 r	116,000 r	82,300
World production:[5]					
Bulk ferroalloys	35,400,000 r	35,500,000 r	35,900,000 r	41,200,000 r	44,700,000
Noble ferroalloys	15,700,000 r	12,900,000 r	10,600,000 r	11,500,000 r	14,000,000

[e]Estimated. [r]Revised.
[1]Table includes data available through January 31, 2022. Data are rounded to no more than three significant digits.
[2]Bulk ferroalloys data for the United States include ferromanganese, ferrosilicon, and silicomanganese.
[3]Noble ferroalloys production data for the United States include ferromolybdenum, ferroniobium, ferrotitanium, and ferrovanadium. Production was calculated as consumption minus imports plus exports.
[4]Reported consumption of noble ferroalloys includes ferroboron, ferromolybdenum, ferronickel, ferroniobium, ferrophosphorus, ferrotitanium, ferrotungsten, and ferrovanadium.
[5]World production data for bulk ferroalloys includes ferrochromium, ferromanganese, ferrosilicon, ferrosilicon chromium, and silicomanganese. World production data for noble ferroalloys includes ferroaluminum, ferroboron, ferromolybdenum, ferronickel, ferroniobium, ferrophosphorus, ferrosilicomagnesium, ferrosilicozirconium, ferrotitanium, ferrovanadium, and unspecified ferroalloys. Production data for the United States are included in the noble ferroalloys total.

TABLE 2
DOMESTIC PRODUCERS OF FERROALLOYS IN 2019, BY U.S. CENSUS BUREAU REGION

		Products[1]						
		Bulk ferroalloys			Noble ferroalloys			
Company and region	Plant location	FeMn	SiMn	FeSi	FeMo	FeTi	FeV	FeNb
Midwest:								
AMG Vanadium, LLC	Cambridge, OH						X	
Arconic Inc.	Canton, OH					X		
Eramet Marietta Inc.	Marietta, OH	X	X					
Global Titanium Inc.	Detroit, MI					X		
Globe Metallurgical, Inc.	Beverly, OH			X				
Northeast:								
Centerra Gold Inc.	Langeloth, PA				X			
Reading Alloys Inc.	Robesonia, PA							X
Yilmaden Holding Inc.	Butler, PA				X		X	
South:								
CC Metals & Alloys, LLC	Calvert City, KY			X				
Core Metals Group, LLC	Bridgeport, AL			X				
Felman Production, LLC	Letart, WV		X					

[1]Abbreviations are as follows: FeMn, ferromanganese; SiMn, silicomanganese; FeSi, ferrosilicon; FeMo, ferromolybdenum; FeTi, ferrotitanium; FeV, ferrovanadium; FeNb, ferroniobium.

TABLE 3
GOVERNMENT INVENTORY OF FERROALLOYS AS OF DECEMBER 31, 2019[1]

(Metric tons, gross weight)

Alloy	Inventory
Ferrochromium:	
High-carbon	38,700
Low-carbon	27,400
Ferromanganese, high-carbon	189,000
Ferroniobium	407

[1]Table includes data available through January 31, 2022. Data are rounded to no more than three significant digits.

Source: Defense Logistics Agency Strategic Materials.

TABLE 4
REPORTED U.S. CONSUMPTION OF BULK FERROALLOYS BY END USE[1, 2]

(Metric tons, gross weight)

End use	FeCr	FeMn	SiMn	FeSi
2018:				
Steel:				
Carbon and high-strength low-alloy	7,620 r	W	90,100	32,100
Stainless and heat-resisting	448,000 r	9,820	15,600	42,600
Unspecified and other steels	43,900 r	W	30,100	41,100
Total steel	499,000 r	341,000	136,000	116,000
Alloys and superalloys	6,540 r	(3)	(3) r	(3)
Cast irons	(3)	6,720	289	54,800 r
Miscellaneous and unspecified	6,220 r	487 r	2,810	370
Grand total	512,000 r	348,000	139,000 [4]	171,000 r
Consumer stocks, December 31	9,740 r	27,400 [5]	20,900 [5]	10,100 r
2019:				
Steel:				
Carbon and high-strength low-alloy	5,810	W	95,000	28,800 [6]
Stainless and heat-resisting	409,000	9,810	15,500	43,200 [6]
Unspecified and other steels	42,700	W	29,100	W
Total steel	457,000	329,000 [7]	139,000	113,000 [8]
Alloys and superalloys	6,260	(3)	--	(9)
Cast irons	(3)	6,430	W	57,100
Miscellaneous and unspecified	6,860	866	W	(9)
Grand total	470,000	336,000 [7]	143,000 [4, 7]	217,000
Consumer stocks, December 31	9,450	28,300 [5]	28,200 [5]	11,100

rRevised. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Table includes data available through January 31, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Abbreviations and the forms of material included are as follows: FeCr, ferrochromium, including chromium metal; FeMn, ferromanganese; SiMn, silicomanganese; and FeSi, ferrosilicon, silvery pig iron, silicon carbide, and inoculant alloys.
[3]All or part included with "Miscellaneous and unspecified" to avoid disclosing proprietary data.
[4]Internal evaluation indicates that silicomanganese consumption is understated.
[5]Consumer and producer stocks.
[6]Only includes 75% FeSi.
[7]Includes withheld data.
[8]Does not include 50% FeSi.
[9]Included with "Cast irons."

TABLE 5
REPORTED U.S. CONSUMPTION OF NOBLE FERROALLOYS BY END USE[1, 2]

(Metric tons, contained weight, unless otherwise noted)

End use	FeMo	FeNb	FeNi	FeV	FeW	FeB[3]	FeP[3]	FeTi[3]
2018:								
Steel:								
Carbon	(4)	1,200	--	777	--	(4)	(4)	5,420 r
High-strength low-alloy	191	(4)	--	(4)	--	(4)	(4)	(4)
Stainless and heat-resisting	682 r	623 r	W	63	(4)	210	(4)	(4) r
Unspecified and other steels	1,260	3,480	W	2,290 r	126 r	436	2,940	1,450 r
Total steel	2,130	5,310	W	3,130 r	126 r	646	2,940	6,870 r
Alloys and superalloys	(5)	1,550 r	W	2	(4)	(5)	(6)	(6) r
Cast irons	(5)	--	--	(5)	--	(5)	383 r	3 r
Miscellaneous and unspecified	925 r	--	W	8	--	57	19 r	129 r
Grand total	3,060	6,850 r	13,500	3,140 r	126 r	703	3,340	7,000 r
Consumer stocks, December 31	377	528	W	188 r	35	163	424	928
2019:								
Steel:								
Carbon	(4)	1,120	--	741	--	(4)	(4)	5,340
High-strength low-alloy	191	(4)	--	(4)	--	(4)	(4)	(4)
Stainless and heat-resisting	692	617	W	63	(4)	210	(4)	(4)
Unspecified and other steels	1,050	3,370	W	2,270	111	465	2,640	1,320
Total steel	1,930	5,100	W	3,070	111	675	2,640	6,660
Alloys and superalloys	(5)	1,580	W	4	(4)	(5)	(6)	1
Cast irons	(5)	--	--	(5)	--	(5)	348	3
Miscellaneous and unspecified	937	--	W	8	--	29	19	128
Grand total	2,870	6,880	13,200	3,090	111	704	3,010	6,790
Consumer stocks, December 31	390	537	322	197	20	115	376	764

r Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1] Table includes data available through January 31, 2022. Data are rounded to no more than three significant digits; may not add to totals shown.

[2] Abbreviations and the forms of material included are as follows: FeMo, ferromolybdenum, including calcium molybdate; FeNb, ferroniobium, including nickel niobium; FeNi, ferronickel; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; FeW, ferrotungsten; FeB, ferroboron, including other boron materials; FeP, ferrophosphorus, including other phosphorus materials; and FeTi, ferrotitanium, including titanium scrap and other titanium materials.

[3] Gross weight.

[4] Withheld to avoid disclosing company proprietary data; included with "Steel: Unspecified and other steels."

[5] Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."

[6] Less than ½ unit.

TABLE 6
SELECTED DOMESTIC FERROALLOY PRICES[1]

Alloy	Unit[2]	2018			2019		
		High	Low	Average[3]	High	Low	Average[3]
Bulk ferroalloys:							
Ferrochromium:							
0.05% carbon	¢/lb	245.00	226.78	238.73	231.00	205.00	216.31
0.10% carbon	do.	235.44	200.00	220.06	205.00	171.00	187.42
0.15% carbon	do.	225.00	192.00	211.75	198.00	169.00	183.32
More than 4% carbon:							
47–55% chromium[4]	do.	137.00	132.00	134.50	137.00	132.00	134.50
62–70% chromium	do.	148.00	101.88	136.87	122.00	74.88	100.29
Manganese ferroalloys:							
85% medium-carbon ferromanganese	¢/lb	116.00	110.00	113.31	114.00	85.00	109.70
76% high-carbon ferromanganese	$/lt	1,650.00	1,280.00	1,471.36	1,440.00	1,050.00	1,311.14
65% silicomanganese	¢/lb	70.00	60.00	64.96	49.50	69.00	62.36
Silicon ferroalloys:							
50% ferrosilicon	do.	106.63 r	101.85 r	104.24	103.35	101.35	102.35
75% ferrosilicon	do.	113.00	103.00	107.58	105.00	74.00	89.15
Nickel metal, 99.81% (minimum) purity[5]	$/lb	6.85	4.91	5.95	7.12	5.19	6.27
Noble ferroalloys:							
Ferromolybdenum	do.	14.08	12.15	13.33	13.50	11.25	12.86
Ferroniobium[6]	$/kg	NA	NA	21.11	NA	NA	22.71
Ferrotitanium, 70%-grade	$/lb	3.00	2.25	2.65	3.10	2.90	3.00
Ferrotungsten[7]	$/kg	50.00	33.00	45.91	35.00	24.00	32.27
Ferrovanadium	$/lb	55.86	24.49	39.12	43.10	10.78	22.31

rRevised. do. Ditto. NA Not available.
[1]Table includes data available through January 31, 2022.
[2]Abbreviations are as follows: ¢/lb, cents per pound; $/kg, dollars per kilogram; $/lt, dollars per long ton; and $/lb, dollars per pound.
[3]Arithmetic mean of high and low prices, weekly prices, or monthly prices.
[4]Price for this category was discontinued in March 2019.
[5]Nickel metal prices are reported in gross weight.
[6]Weighted average value of imported plus exported materials.
[7]Ferrotungsten prices are reported as dollars per kilogram of contained tungsten.

Sources: CRU Group, London Metal Exchange Ltd., S&P Global Platts Metals Week, and U.S. Census Bureau.

TABLE 7
U.S. EXPORTS OF FERROALLOYS[1]

Alloy	2018 Gross weight (metric tons)	2018 Contained weight (metric tons)	2018 Value (thousands)	2019 Gross weight (metric tons)	2019 Contained weight (metric tons)	2019 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	731	365	$832	1,300	679	$1,870
Not more than 4% carbon	1,740	1,010	2,670	437	254	911
Ferrosilicon-chromium	60	21	82	22	8	26
Total, chromium ferroalloys	2,530	1,400	3,590	1,760	942	2,810
Manganese ferroalloys:						
Ferromanganese, all grades	10,400	8,250	14,500	4,950	3,910	7,130
Silicomanganese	4,340	2,820	6,220	1,610	1,040	1,860
Total, manganese ferroalloys	14,800	11,100	20,700	6,560	4,960	8,990
Silicon ferroalloys:						
Ferrosilicon, more than 55% silicon	12,400	7,560	18,800	9,850	5,960	12,700
Ferrosilicon, other	8,630	4,000	13,300	5,650	2,520	9,020
Total, silicon ferroalloys	21,000	11,600	32,100	15,500	8,480	21,700
Total, bulk ferroalloys	38,300	24,000	56,400	23,800	14,400	33,500
Noble ferroalloys:						
Ferromolybdenum	943	678 r	18,400	552	387	10,800
Ferronickel	26	14	437	20	12	334
Ferroniobium[2]	1,420	930	16,200	1,010	650	11,200
Ferrophosphorus	2,240	NA	3,750	1,760	NA	3,130
Ferrotitanium and ferrosilicon-titanium	3,120	NA	12,300	1,520	NA	6,310
Ferrotungsten and ferrosilicon-tungsten	207	104	752	72	43	859
Ferrovanadium	820	575	20,900	436	295	10,600
Ferrozirconium	424	NA	861	359	NA	732
Ferroalloys, other	10,800	NA	18,900	9,000	NA	15,800
Total, noble ferroalloys	20,000	2,300 r	92,600	14,700	1,390	59,800
Grand total	58,300	26,300	149,000	38,600	15,800	93,300

rRevised. NA Not available.
[1]Table includes data available through December 2, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Contained weight calculated assuming 65% niobium content for ferroniobium.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF FERROALLOYS[1]

Alloy	2018 Gross weight (metric tons)	2018 Contained weight (metric tons)	2018 Value (thousands)	2019 Gross weight (metric tons)	2019 Contained weight (metric tons)	2019 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	495,000	269,000	$613,000	393,000	215,000	$390,000
More than 3% but not more than 4% carbon	8,020 r	4,190 r	8,730 r	1,210	802	1,220
More than 0.5% but not more than 3% carbon	4,130	2,570	9,610	2,090	1,330	4,610
Not more than 0.5% carbon	53,100	37,100	167,000	44,300	30,900	123,000
Ferrosilicon-chromium	18,000	6,380	31,300	17,600	6,360	27,300
Total, chromium ferroalloys	578,000 r	320,000	830,000 r	458,000	254,000	546,000
Manganese ferroalloys:						
Ferromanganese:						
More than 4% carbon	264,000	199,000	324,000	208,000	158,000	212,000
More than 2% but not more than 4% carbon	6	5	14	--	--	--
More than 1% but not more than 2% carbon	96,300	77,400	155,000	59,700	47,800	97,800
Not more than 1% carbon	67,100	56,300	123,000	64,800	53,400	113,000
Silicomanganese	412,000	277,000	499,000	351,000	236,000	409,000
Total, manganese ferroalloys	839,000	610,000	1,100,000	683,000	495,000	832,000
Ferrosilicon:						
55%–80% silicon, more than 3% calcium	12,300	9,220	19,200	1,720	1,170	3,440
55%-80% silicon, other	154,000	116,000	241,000	152,000	115,000	211,000
80%–90% silicon	237	196	278	566	484	727
More than 90% silicon	2,330	2,150	1,240	222	210	449
Magnesium ferrosilicon	17,500	7,900	29,200	13,000	5,930	22,900
Ferrosilicon, other	11,600	4,120	15,600	11,100	3,850	14,000
Total, ferrosilicon	198,000	140,000	307,000	178,000	127,000	252,000
Total, bulk ferroalloys	1,620,000	1,070,000	2,240,000	1,320,000	876,000	1,630,000
Noble ferroalloys:						
Ferromolybdenum	11,900	8,010	223,000	10,400	6,990	196,000
Ferronickel	74,000	21,700	299,000	44,500	11,900	153,000
Ferroniobium[2]	12,800	8,290 r	283,000	11,300	7,330	268,000
Ferrophosphorus	6,070	NA	3,790	4,120	NA	3,470
Ferrotitanium and ferrosilicon-titanium	2,710	NA	8,550	3,390	NA	11,300
Ferrotungsten and ferrosilicon-tungsten	170	143	4,800	126	96	2,930
Ferrovanadium	4,010 r	2,970 r	233,000 r	3,400	2,280	168,000
Ferrozirconium	191	NA	682	170	NA	432
Ferroalloys, other	5,220	NA	14,000	4,740	NA	13,500
Total, noble ferroalloys	117,000	41,100 r	1,070,000	82,100	28,600	816,000
Grand total	1,730,000	1,110,000	3,310,000	1,400,000	904,000	2,450,000

rRevised. NA Not available. -- Zero.
[1]Table includes data available through December 2, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Contained weight calculated assuming 65% niobium content for ferroniobium.

Source: U.S. Census Bureau.

TABLE 9
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality and alloy type	2015	2016	2017	2018	2019
Albania, ferrochromium	43,669	44,551	59,199 r	68,998 r	69,000 e
Argentina:					
Ferrosilicon[e]	12,700	12,000	13,000	13,000	13,000
Silicomanganese[3]	8,000	10,000	--	--	--
Total	20,700	22,000	13,000	13,000	13,000
Armenia, ferromolybdenum	5,576	6,526	6,588	7,292 r	7,712
Australia:[3]					
Ferromanganese	150,000	116,900	125,100	148,300	114,000
Silicomanganese	130,700	83,700	120,200	112,900	95,000
Total	280,700	200,600	245,300	261,200	209,000
Austria:[e]					
Ferronickel	2,500	2,500	2,500	2,500	2,500
Other, unspecified	12,000	12,000	12,000	11,000 r	11,000
Total	14,500	14,500	14,500	13,500 r	13,500
Bahrain, silicomanganese[3]	6,000	5,000	--	--	--
Bhutan, ferrosilicon[4]	104,406	106,234	108,410 r	120,857 r	138,616
Bosnia and Herzegovina, ferrosilicon	--	--	--	10,000 r, e	5,000 e
Brazil:					
Ferrochromium[5]	173,467	150,240	171,531	175,061	136,780
Ferromanganese[3]	84,160	83,780	123,470	117,800	102,000
Ferronickel	195,357 r	245,000 e	245,725 r	233,050 r	187,000 e
Ferroniobium[6]	80,000 e	68,000 e	90,000	91,000	92,000
Ferrosilicon[e]	119,000 r	226,000 r	185,000 r	221,000 r	225,000
Silicomanganese[3]	141,540	166,680	202,520	228,690	216,000
Total	793,524 r	939,700 r	1,018,246 r	1,066,601 r	958,780
Burma, ferronickel	60,000 e	64,615 r	62,308 r	61,000 r, e	59,615
Canada:[e]					
Ferroniobium[6]	8,300	9,400	11,000	11,000 r	9,200
Ferrosilicon	38,000	38,000	40,000	36,000	37,000
Ferrovanadium	1,000	1,000	1,000	1,000	1,000
Total	47,300	48,400	52,000	48,000 r	47,200
China:					
Ferrochromium	3,940,000	4,230,000	4,940,000	5,280,000 r	6,030,000
Ferromanganese:[e]					
Blast furnace	446,000	340,000	220,000	270,000	290,000
Electric furnace	2,120,000	1,610,000	1,560,000	1,660,000	1,770,000
Ferromolybdenum	116,000	127,000	138,000 r	144,000 r	144,000
Ferronickel equivalent, nickel pig iron[e, 7]	1,900,000	1,900,000	2,100,000	2,400,000	3,000,000
Ferrosilicon	4,730,000	4,300,000	3,650,000	4,500,000 r	5,300,000 e
Ferrovanadium	40,900	34,200	38,400	40,500	43,600
Silicomanganese	5,870,000	7,267,000	6,610,000	9,450,000	12,600,000
Other, unspecified[e]	11,000,000	7,700,000	5,200,000	5,700,000	6,600,000
Total	30,162,900	27,508,200	24,456,400 r	29,444,500 r	35,777,600
Colombia, ferronickel[e]	126,000	128,000	140,000	143,000 r	130,000
Dominican Republic, ferronickel	--	33,203	43,894	53,697 r	78,661
Egypt:					
Ferromanganese[3]	12,000	12,000	12,000	13,000	12,000
Ferrosilicon[8]	56,093	60,477	60,500 e	60,500 e	60,500 e
Total	68,093	72,477	72,500	73,500	72,500
Finland, ferrochromium	457,063	469,141	416,285	492,774	505,000
France:					
Ferromanganese[3]	126,229 r	119,008 r	95,442 r	125,383 r	115,000
Ferrosilicon[e]	40,000	50,000	50,000	50,000	48,000
Silicomanganese[3]	65,124 r	58,223 r	58,443 r	56,652 r	68,000
Total	231,353 r	227,231 r	203,885 r	232,035 r	231,000
Gabon, silicomanganese[3]	14,500	14,900	21,300	42,900	43,000
Georgia, silicomanganese[3]	217,300	244,228	289,800	335,000 r	284,200

See footnotes at the end of table.

TABLE 9—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality and alloy type	2015	2016	2017	2018	2019
Germany:[e]					
Ferrochromium	17,000 [r]	17,000 [r]	17,000 [r]	17,000 [r]	17,000
Other, unspecified	8,200	8,200	8,200	8,200	8,200
Total	25,200 [r]	25,200 [r]	25,200 [r]	25,200 [r]	25,200
Greece, ferronickel	89,130	87,880	86,140	80,700	61,500
Guatemala, ferronickel[e]	32,800	26,300	37,600	44,900	45,000
Iceland, ferrosilicon	121,556	128,020	116,811	116,889	117,000
India:					
Ferroaluminum	3,010	4,140	4,337	3,221 [r]	1,962
Ferroboron	42	--	--	--	--
Ferrochromium	944,000	944,000	944,000	944,000	930,000
Ferromanganese[3]	646,000	621,000	753,000 [r]	811,000 [r]	598,000
Ferromolybdenum	1,281	1,614	1,315	1,086 [r]	631
Ferrosilicomagnesium	21,887	21,140	16,724	18,436	15,445
Ferrosilicon	92,000	90,000	90,000	90,000 [r]	93,000 [e]
Ferrotitanium	204	231	389 [r]	125	92
Ferrovanadium	879	1,266	1,318	1,150	587
Silicomanganese[3]	1,832,000	1,768,000	2,038,000	2,133,000 [r]	1,588,000
Total	3,541,303	3,451,391	3,849,083 [r]	4,002,018 [r]	3,227,717
Indonesia:					
Ferronickel[e]	86,100 [r]	101,000	109,000	124,000	129,000
Ferronickel, nickel pig iron[e]	272,000 [r]	759,000 [r]	748,000 [r]	733,000 [r]	1,790,000
Silicomanganese[3]	30,000	40,000	40,000	4,000 [r]	4,000
Total	388,100 [r]	900,000 [r]	897,000 [r]	861,000 [r]	1,923,000
Japan:					
Ferrochromium[e]	16,000 [r]	16,000 [r]	16,000	15,000 [r]	13,000
Ferromanganese	465,952	473,740	456,460	456,518 [r]	462,740
Ferromolybdenum	2,864 [r]	2,972 [r]	3,094 [r]	3,042 [r]	3,000
Ferronickel	396,969	333,448	312,324	339,844	337,790
Ferrovanadium	4,350 [r]	4,420 [r]	4,390 [r]	4,390 [r]	4,400 [e]
Silicomanganese[3]	22,700	22,700	24,500	21,100	31,000
Other, unspecified	73,651	77,453	79,809	73,094	65,675
Total	982,486 [r]	930,733 [r]	896,577 [r]	912,988 [r]	917,605
Kazakhstan:					
Ferrochromium	1,414,476	1,525,221	1,640,300	1,700,000 [r, e]	1,800,000 [e]
Ferrosilicon	86,984	68,779	60,001 [r]	65,405 [r]	65,400 [e]
Ferrosilicon-chromium	74,609	94,468	110,497	110,000 [e]	114,000 [e]
Silicomanganese[3]	164,189	135,885	123,977	137,710 [r]	123,464
Other, unspecified	1,662	1,987	--	46	--
Total	1,741,920	1,826,340	1,934,775 [r]	2,013,161 [r]	2,102,864
Korea, Republic of:					
Ferromanganese[3]	500,000	425,000	360,000	374,000 [r]	366,000
Ferronickel	195,000	228,000	237,000	228,000 [r]	230,000
Ferrosilicon[e]	30,000	30,000	30,000	30,000	30,000
Silicomanganese[3]	175,000	135,000	117,000	164,000 [r]	162,000
Total	900,000	818,000	744,000	796,000 [r]	788,000
Kosovo, ferronickel[e]	56,500	12,700	38,500	30,900	21,100
Macedonia:					
Ferronickel[e]	80,500	48,200	32,600	45,900	83,000
Ferrosilicon	45,698	24,431	21	--	--
Total	126,198	72,631	32,621	45,900	83,000
Malaysia:					
Ferromanganese[3]	--	58,801	264,555	312,420	266,000
Ferrosilicon	104,554	126,261	174,540	220,515	230,735
Silicomanganese[3]	--	20,975	230,535	283,414	312,000
Total	104,554	206,037	669,630	816,349	808,735

See footnotes at the end of table.

TABLE 9—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality and alloy type	2015	2016	2017	2018	2019
Mexico:[3]					
Ferromanganese	67,920	84,530	90,013	95,468	73,000
Silicomanganese	139,361	134,251	148,130	152,000	154,000
Total	207,281	218,781	238,143	247,468	227,000
New Caledonia, ferronickel	228,484	261,420	269,961	260,206	247,746
Norway:					
Ferromanganese[3]	309,200	329,100	400,800	327,600	337,000
Ferrosilicon[e]	350,000	350,000	350,000	350,000	350,000
Silicomanganese[3]	309,900	306,100	284,500	330,000	287,000
Total	969,100	985,200	1,035,300	1,007,600	974,000
Oman, ferrochromium	63,750	90,063	79,563	70,000 [r]	85,125
Paraguay, ferrosilicon	--	--	--	8,000 [e]	10,000 [e]
Poland:					
Ferrosilicon	77,754	77,682	65,732	63,618 [r]	37,500 [e]
Other, unspecified	460	12,517	24,800	33,250	30,000 [e]
Total	78,214 [r]	90,199 [r]	90,532 [r]	96,868 [r]	67,500 [e]
Russia:					
Ferrochromium	363,286	268,439	434,452 [r]	332,261 [r]	384,089
Ferromanganese	155,700	124,200	253,000	281,000	273,000
Ferroniobium[e, 6]	250	120	370	380	380
Ferrophosphorus	1,500 [e]	1,500 [e]	1,538	1,500 [e]	1,500 [e]
Ferrosilicon	1,057,909	935,912	840,352 [r]	928,797 [r]	846,579
Ferrosilicon-chromium[e]	102,000	75,000	75,000	75,000	75,000
Ferrotitanium	9,961	10,741	10,200	9,000 [e]	9,000 [e]
Ferrovanadium	12,277	12,392	12,593	11,383	10,894
Silicomanganese	188,895	203,216	44,917	43,334	51,774
Other, unspecified[e]	8,000	9,000	10,000	10,000	10,000
Total	1,899,778	1,640,520	1,682,422 [r]	1,692,655 [r]	1,662,216
Saudi Arabia:[3]					
Ferromanganese	7,000	10,000	10,000	23,000	39,000
Silicomanganese	63,000	55,000 [r]	65,000	85,400	103,000
Total	70,000	65,000 [r]	75,000	108,400	142,000
Slovakia:					
Ferromanganese	25,376	35,589	42,115	32,364 [r]	46,513
Ferrosilicon	45,961	38,030	52,436	50,392 [r]	50,400 [e]
Silicomanganese	27,036	35,719	40,265	37,225 [r]	26,187
Total	98,373	109,338	134,816	119,981 [r]	123,100
South Africa:					
Ferrochromium[9]	3,684,598	3,596,000	3,700,000 [r, e]	3,900,000 [e]	3,600,000 [e]
Ferromanganese	512,000	335,000	257,100 [3]	235,600 [3]	232,000 [3]
Ferrosilicon	91,800	73,200	48,200 [r]	98,000 [r, e]	98,000 [e]
Ferrovanadium[e]	15,000	7,000	7,000	6,800	6,800
Silicomanganese[3]	210,200	144,000	160,400	164,200	172,000
Total	4,513,598	4,155,200	4,172,700 [r]	4,404,600 [r]	4,108,800
Spain:					
Ferromanganese[3]	126,200	120,100	132,100	86,200	55,500
Ferrosilicon[e]	80,000	80,000	95,000	95,000	90,000
Silicomanganese[3]	134,400	123,100	138,700	156,100	98,400
Total	340,600	323,200	365,800	337,300	243,900
Sweden, ferrochromium	90,480	81,900	92,390	101,370 [r]	118,198
Turkey:					
Ferrochromium	82,650	75,000	83,894	91,799 [r]	81,743
Ferrosilicon[10]	1,400	2,900	2,900	3,500	3,000
Total	84,050	77,900	86,794	95,299 [r]	84,743

See footnotes at the end of table.

TABLE 9—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality and alloy type	2015	2016	2017	2018	2019
Ukraine:					
Ferromanganese	87,740	104,470	114,500	79,480 r	151,090
Ferronickel	95,209	79,900	72,500	79,537	74,400
Ferrosilicon	90,200	101,420	92,910	97,084 r	97,100 e
Silicomanganese	698,400	814,970	810,670	859,640 r	804,680
Other, unspecified	19,360	22,219	12,635	13,150	20,670
Total	990,909	1,122,979	1,103,215	1,128,891 r	1,147,940
United States:[11]					
Bulk ferroalloys	424,000	369,000	395,000	408,000 r	412,000
Noble ferroalloys[e]	21,000	19,000 r	13,000 r	650 r	910
Total	445,000	388,000	408,000 r	409,000 r	413,000
Venezuela:					
Ferronickel	16,700 e	--	--	--	--
Ferrosilicon[e]	74,300	37,000	--	--	--
Silicomanganese[3]	35,000	42,000	18,670	--	--
Total	126,000	79,000	18,670	--	--
Zimbabwe, ferrochromium	115,586	78,200	142,800	365,000 r	308,593
Grand total[11]	51,100,000 r	48,400,000 r	46,500,000 r	52,700,000 r	58,700,000
Of which:					
Ferroaluminum	3,010	4,140	4,340	3,220 r	1,960
Ferroboron	42	--	--	--	--
Ferrochromium	11,400,000	11,600,000	12,700,000 r	13,600,000 r	14,100,000
Ferromanganese	5,840,000	5,000,000	5,270,000	5,450,000 r	5,300,000
Ferromolybdenum	126,000 r	138,000 r	149,000	155,000 r	155,000
Ferronickel	3,830,000 r	4,310,000 r	4,540,000 r	4,860,000 r	6,480,000
Ferroniobium	88,600	77,500	101,000	102,000 r	102,000
Ferrophosphorus	1,500 e	1,500 e	1,540	1,500 e	1,500 e
Ferrosilicomagnesium	21,900	21,100	16,700	18,400	15,400
Ferrosilicon	7,450,000 r	6,960,000 r	6,130,000 r	7,230,000 r	7,950,000
Ferrosilicon-chromium	177,000	169,000	185,000	185,000	189,000
Ferrotitanium	10,200	11,000	10,600	9,130	9,090
Ferrovanadium	74,400 r	60,300 r	64,700 r	65,200 r	67,300
Silicomanganese	10,500,000	11,800,000	11,600,000	14,800,000 r	17,200,000
Other, unspecified	11,600,000	8,230,000	5,760,000 r	6,260,000 r	7,160,000

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

[1]Table includes data available through October 5, 2021. All data are reported unless otherwise noted. Grand totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Ferroalloys may have been produced in other countries and (or) localities, but production information was inadequate to make reliable estimates of output.

[3]Reported by the International Manganese Institute.

[4]Total of imports received by all countries from Bhutan. Source: UN Comtrade.

[5]Includes high- and low-carbon ferrochromium.

[6]Reported by countries in niobium content and converted to gross weight assuming 65% niobium.

[7]China's nickel pig iron is estimated to have a nickel content of 4% based on reported data. Because most ferronickel produced globally contains more than 15% nickel, China's production has been scaled using a nickel content of 20% in order to facilitate comparison with other ferronickel-producing countries and (or) localities.

[8]Production is based on fiscal year, with a starting date of July 1 of the year shown.

[9]Includes high- and low-carbon ferrochromium and ferrosilicon-chromium.

[10]Exports. Source: UN Comtrade.

[11]Data for the United States are included in the "Other, unspecified" category and "Grand total" only. These data are not included in any commodity-specific subtotals.