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FERROALLOYS [ADVANCE RELEASE]

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Ferroalloys

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U.S. production of bulk ferroalloys in 2018 increased by 3% to 408,000 metric tons (t) from 395,000 t in 2017. Estimated production of noble ferroalloys in 2018 decreased by 55% to 5,450 t from 12,000 t (revised) in 2017 (table 1). Ferroalloy exports increased by 7% to 58,300 t (gross weight) compared with 54,400 t in 2017 (table 7). Ferroalloy imports increased by 8% to 1,730,000 t (gross weight) compared with 1,610,000 t in 2017 (table 8). World production of total ferroalloys was estimated to be 51 million metric tons (Mt) (gross weight) in 2018, an 11% increase compared with 46 Mt (revised) in 2017 (table 9). Among the bulk ferroalloys, China was the leading country in the production of ferrochromium, ferromanganese, ferrosilicon, and silicomanganese; Kazakhstan was the leading country in ferrosilicon-chromium production in 2018. Among the noble ferroalloys, China was the leading country in the production of ferromolybdenum, ferronickel, and ferrovanadium; Brazil was the leading country of ferroniobium production; and Russia was estimated to be the leading country of ferrotitanium production and the only country with reported ferrophosphorus production. India was the only country that produced ferroaluminum and ferrosilicomagnesium in 2018.

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, ferrosilicon-tungsten and ferrotungsten, ferrovanadium, and ferrozirconium (including ferrosilicozirconium), among others.

Legislation and Government Programs

National Defense 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 (FY) 2018 (October 1, 2017, through September 30, 2018) Annual Materials Plan (AMP). Maximum disposal limits, which were based on the FY 2018 AMP, were set at 21,300 t of ferrochromium and 45,400 t of ferromanganese (Defense Logistics Agency Strategic Materials, 2017b). The DLA Strategic Materials administered acquisitions of ferroniobium from the NDS under the same AMP. The maximum acquisition limit was 209 t of ferroniobium (Defense Logistics Agency Strategic Materials, 2017a). As of yearend 2018, the ferroalloy inventory (gross weight) was as follows: 43,800 t of high-carbon ferrochromium, 27,400 t of low-carbon ferrochromium, 199,000 t of high-carbon ferromanganese, and 278 t of ferroniobium (table 3).

Production

In 2018, 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 2018 increased by 3% to 408,000 t from 395,000 t in 2017. Estimated production of noble ferroalloys in 2018 decreased by 55% to 5,450 t from 12,000 t (revised) in 2017 (table 1). The trend in bulk ferroalloy production increased less than that of crude steel, which increased by 6% to 86.6 Mt in 2018 from 81.6 Mt in 2017 (Tuck, 2020). World production of bulk ferroalloys, excluding the United States, increased by 11%, and global noble ferroalloys production increased by 9% in 2018 (tables 1, 9).

Consumption

Domestic reported consumption of bulk ferroalloys was 1.11 Mt in 2018, a 4% decrease from 1.15 Mt in 2017. Reported consumption of noble ferroalloys decreased slightly in 2018 compared with consumption in 2017 (table 1). Of the bulk ferroalloys, reported consumption of ferrochromium, ferromanganese, and silicomanganese was essentially unchanged in 2018 compared with consumption in 2017; consumption of ferrosilicon, however, decreased by 18% (table 4). For the noble ferroalloys, reported consumption of ferrophosphorus decreased by 25%, ferromolybdenum by 15%, and ferroniobium by 7% in 2018 compared with consumption in 2017. Reported consumption of ferrotitanium decreased slightly and ferronickel was essentially unchanged. Reported consumption of ferrotungsten increased by 33%, ferroboron by 7%, and ferrovanadium increased slightly (table 5).

Prices

The trends in prices for bulk ferroalloys varied in 2018. The annual average price for grades of low-carbon ferrochromium (less than 3% carbon) increased by an average of 8%, whereas the average price for high-carbon ferrochromium (more than 4% carbon) decreased by an average of 3% compared with those in 2017 (table 6). Compared with prices in 2017, the average U.S. spot-market prices for medium-carbon ferromanganese increased by 3%, high-carbon ferromanganese decreased slightly, and silicomanganese prices were essentially unchanged. Average prices for 50%-grade ferrosilicon and 75%-grade ferrosilicon increased by 10% and 24%, respectively, from those in 2017.

For the noble ferroalloys, the 2018 annual average prices of ferrovanadium more than doubled, ferromolybdenum increased by 37%, ferrotitanium increased by 35%, ferrotungsten increased by 23%, and ferroniobium increased by 6%. The average annual price of nickel metal, with 99.81% minimum purity, increased by 26% (table 6).

Foreign Trade

The United States was a net importer of ferroalloys in 2018. On a gross-weight basis, U.S. total bulk ferroalloy exports decreased by 4% to 38,300 t compared with exports in 2017, whereas total bulk ferroalloy imports increased by 9% to 1.62 Mt (tables 7, 8). Exports of chromium ferroalloys increased by 420 t in 2018 to 2,530 t (gross weight) compared with exports in 2017, whereas imports decreased slightly to 579,000 t (gross weight). Exports of manganese ferroalloys decreased by 2,900 t to 14,800 t (gross weight), whereas imports increased by 23% to 839,000 t (gross weight). Exports of silicon ferroalloys increased by 1,000 t (gross weight) to 21,000 t (gross weight) compared with exports in 2017, whereas imports decreased by 9% to 198,000 t (gross weight). Exports of total noble ferroalloys increased by 37% compared with exports in 2017, whereas imports of total noble ferroalloys were essentially unchanged. Specifically, exports of ferromolybdenum increased by 48% and imports increased by 40%; ferrotitanium and ferrosilicon-titanium exports increased by 29% and imports increased by 6%; and exports of ferrotungsten and ferrosilicon-tungsten as well as ferrovanadium were more than double those in 2017, whereas imports of ferrotungsten and ferrosilicon-tungsten decreased by 38% and imports of ferrovanadium increased by 8%. Ferronickel exports were unchanged in 2018 and imports decreased by 3% compared with those in 2017. Exports of ferroniobium decreased by 37% in 2018 and imports increased by 20% compared with those in 2017.

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, boron promotes 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 it 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 glass. Borate ore is converted to boric acid and then reduced in an electric arc furnace with carbon steel or along with aluminum and iron ore to produce ferroboron.

The United States did not produce ferroboron in 2018 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 no ferroboron production was reported in 2018 (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 are stainless and heat-resisting steels. No substitute exists for chromium in stainless steel; it is an essential component in all stainless-steel products. Chromium is also 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 2018, world stainless and heat-resisting steel melt shop production (ingot or slab equivalent) was 50.7 Mt, an increase of 6% from production in 2017 (International Stainless Steel Forum, 2019, p. 8). The American Iron and Steel Institute (2017, 2018) estimated U.S. stainless-steel production to be 3.18 Mt, a slight increase from that in 2017. Countries that led stainless-steel production were, listed in descending order, China, India, Japan, and the United States (International Stainless Steel Forum, 2019, p. 8).

The United States did not produce ferrochromium and imported 579,000 t (gross weight) of ferrochromium in 2018, a slight decrease from that in 2017 (table 8). The leading countries for ferrochromium production were China (40%), South Africa (29%), and Kazakhstan (12%) (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 2018, with carbon and high-strength low-alloy steels as 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 2018, imports of ferromanganese and silicomanganese were 839,000 t (gross

weight), an increase of 23% from imports in 2017 (table 8). The leading countries in manganese ferroalloy production, excluding United States production, were China (57%), India (14%) and Ukraine (5%) (table 9).

Ferromolybdenum.—Molybdenum is added to steel for a variety of uses, such as improving corrosion and wear resistance and increasing hardenability and strength at high temperatures. Ferromolybdenum is 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 from 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 known.

The United States produced ferromolybdenum at two facilities; production data were withheld to avoid disclosing company proprietary data (table 2). In 2018, 11,900 t (gross weight) of ferromolybdenum was imported, an increase of 40% compared with imports in 2017 (table 8). The leading global producer of ferromolybdenum was China with more than 90% of world production (excluding the United States). Ferromolybdenum was also produced in Armenia and India (table 9), as well as Austria, Belgium, Chile, Iran, the Republic of Korea, Russia, and the United Kingdom, but available information was inadequate to make reliable estimates of output in the latter specified countries.

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 include cryogenic steels, stainless steels, superalloys, ultrahigh-strength steels, and wrought steels, with stainless steel as the leading end use.

Nickel ore mined from laterite deposits, which contain nickel-bearing minerals such as limonite and garnierite, is smelted in electric arc furnaces to produce ferronickel. The United States did not produce ferronickel and imported 74,000 t (gross weight) of ferronickel in 2018, a 3% decrease compared with imports in 2017 (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 (American Zinc Recycling Corp., undated).

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 with 4% to 13% nickel; conventional ferronickel grades range from 18% to 80% nickel. After accounting for nickel content in the nickel pig iron, China was the leading ferronickel producer in 2018, with 54% of world production. Indonesia was estimated to account for 11% of production. Japan and New Caledonia accounted for 8% and 6% of world ferronickel 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 the leading ferroniobium products in 2018. Niobium does not occur naturally as a metal; rather, 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. The niobium concentrate is then smelted in electric arc furnaces to produce ferroniobium for metallurgical uses. The United States produced ferroniobium at one facility; production data were withheld to avoid disclosing company proprietary data (table 2). In 2018, 12,800 t (gross weight) of ferroniobium was imported, an increase of 20% from that in 2017 (table 8). Brazil, Canada, and Russia were the only other countries that produced ferroniobium in 2018, with Brazil leading world production with 88% of reported production (excluding United States production) (table 9).

Ferrophosphorus.—Phosphorus is typically considered an impurity in iron ore and 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 briquettes after the deoxidation process is complete. The leading end uses for ferrophosphorus are carbon steel, followed by full steel, electrical steel, and high-strength low-alloy steel. The United States did not produce ferrophosphorus in 2018 and imported 6,070 t (gross weight), which was a 28% decrease from imports in 2017 (table 8). Reported world production of ferrophosphorus was limited to Russia, which produced an estimated 1,500 t ferrophosphorus in 2018 (table 9). Ferrophosphorus was likely produced in other countries, 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 that are smelted in blast or submerged electric arc furnaces to produce ferrosilicon. The United States produced ferrosilicon at three facilities; production data were withheld to avoid disclosing company proprietary data (table 2). In 2018, 198,000 t (gross weight) of ferrosilicon was imported, a 9% decrease from imports in 2017 (table 8). China was estimated to be the leading silicon-ferroalloy-producing country, with 61% of world production (excluding United States production), followed by Russia (13%) and Norway (6%) (table 9).

The first ferrosilicon plant in Paraguay, owned by Elkem ASA (Norway), started production in March 2018. Capacity was reported to be 11,000 metric tons per year (t/yr) of ferrosilicon (Elkem ASA, 2018). Ferrosilicon production also

began in Bosnia and Herzegovina after Red Resources Plc (United Kingdom) agreed to recommission a plant owned by Steelmin Ltd. (Bosnia and Herzegovina) in Jajce, Bosnia. Commercial production began in August with an initial capacity of 29,000 t/yr of ferrosilicon. Full capacity was expected to be 48,720 t/yr after a second furnace was refurbished (Argus Media group—Argus Metals International, 2018; Garaca, 2018).

Ferrotitanium.—Titanium is added to steel to promote grain refinement and to act as a decarbonizing, denitrogenizing, deoxidizing, and desulfurizing agent. Ferrotitanium is produced for use 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 as a source for ferrotitanium. 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 data were withheld to avoid disclosing company proprietary data (table 2). In 2018, 2,710 t (gross weight) of ferrotitanium and ferrosilicon-titanium were imported, an increase of 6% from imports in 2017 (table 8). Russia and India also produced ferrotitanium in 2018, with an estimated 99% and 1% of global production (excluding United States production), respectively (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 are standard tool and die steels and high-speed steels. To a lesser extent, ferrotungsten may 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, containing up to 38% tungsten, or tungsten metal scrap. Specialty-steel mills equipped with argon-oxygen decarburization can accommodate scheelite ore concentrates.

The United States did not produce ferrotungsten or ferrosilicon-tungsten in 2018 and imported 170 t (gross weight) of ferrotungsten and ferrosilicon-tungsten, a 38% decrease from imports in 2017 (table 8). Although no world production of ferrotungsten was reported in 2018, China produced most of the world's ferrotungsten in previous years (Seddon, 2014, p. 10–14). Ferrotungsten also has been produced in Brazil, Germany, India, the Republic of Korea, Russia, Sweden, and Vietnam in the past, but available information was inadequate to make reliable estimates of output for 2018.

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 2018 (table 5). Vanadium is primarily recovered as a byproduct of processing titanium-bearing magnetite or from recycling vanadium-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 2018.

In the United States, ferrovanadium was produced at two facilities; production data were withheld to avoid disclosing company proprietary data (table 2). In 2018, 4,210 t (gross weight) of ferrovanadium was imported, an increase of 8% from imports in 2017 (table 8). China was the leading ferrovanadium-producing country with 67% of total world production (excluding United States production) followed by Russia (19%) and South Africa (11%) (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 are the leading end use for ferrozirconium and ferrosilicozirconium; nonferrous alloys, such as zircaloy, also include 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 2018, the United States did not produce ferrozirconium and imported 191 t (gross weight), an increase of 19% from imports in 2017 (table 8). World production of ferrozirconium was not reported in 2018 or prior, but it may have been included in the unspecified category for some countries. Although India reported ferrosilicozirconium production in the past, no production was reported in 2018, and available information was inadequate to make reliable estimates of output.

Outlook

Domestic consumption of ferroalloys is expected to closely follow the trend in U.S. steel production. Global steel production increased by 5% to 1.81 billion metric tons in 2018, and demand was expected to increase by 4% in 2019 and increase slightly in 2020 (World Steel Association, 2019a, p. 9; 2019b).

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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.
Niobium. Ch. in Minerals Yearbook, annual.
Silicon. Ch. in Minerals Yearbook, annual.
Titanium. Ch. in Minerals Yearbook, annual.
Tungsten. Ch. in Minerals Yearbook, annual.

TABLE 1
SALIENT FERROALLOYS STATISTICS[1]

(Metric tons, gross weight)

	2014	2015	2016	2017	2018
United States:					
Bulk ferroalloys:[2]					
Production	517,000	424,000	369,000	395,000	408,000
Consumption, reported	1,230,000	1,180,000	1,150,000	1,150,000 r	1,110,000
Exports	29,500	24,200	24,100	39,800	38,300
Imports for consumption	1,730,000	1,240,000	1,200,000	1,490,000	1,620,000
Noble ferroalloys:					
Production[e, 3]	15,100	21,000	19,100	12,000 r	5,450
Consumption, reported	68,600	63,200	59,400 r	61,200 r	59,900
Exports	15,700	10,800	12,800 r	14,600	20,000
Imports for consumption	115,000	76,700	69,300	118,000 r	117,000
World production:[4]					
Bulk ferroalloys	38,700,000 r	35,300,000 r	35,400,000 r	35,700,000 r	39,800,000
Noble ferroalloys	11,900,000 r	15,600,000 r	12,500,000 r	10,300,000 r	11,200,000

[e]Estimated. [r]Revised.
[1]Table includes data available through January 14, 2021. Data are rounded to no more than three significant digits.
[2]Bulk ferroalloys data for the United States include ferrochromium, ferromanganese, ferrosilicon, and silicomanganese.
[3]Noble ferroalloys production data for the United States include ferromolybdenum, ferroniobium, ferrotitanium, and ferrovanadium. Calculated as consumption minus imports plus exports; only for noble ferroalloys with production in the United States.
[4]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 2018, BY U.S. CENSUS BUREAU REGION

		Products[1]						
		Bulk ferroalloys			Noble ferroalloys			
Region and company	Plant location	FeMn	SiMn	FeSi	FeMo	FeTi	FeV	FeNb
Midwest:								
AMG Vanadium, Inc.	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[1, 2]

(Metric tons, gross weight)

Alloy	Inventory
Ferrochromium:	
High-carbon	43,800
Low-carbon	27,400
Ferromanganese, high-carbon	199,000
Ferroniobium	278

[1]Table includes data available through January 14, 2021. Data are rounded to no more than three significant digits.
[2]Inventory as of December 31, 2018.

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
2017:				
Steel:				
Carbon and high-strength low-alloy	6,970 r	271,000	102,000	34,100
Stainless and heat-resisting	371,000 r	9,820	15,600	44,300
Unspecified and other	35,900	57,200	20,700	90,300
Total steel	414,000 r	338,000	138,000	169,000 [3]
Alloys and superalloys	9,680 r	(4)	--	(4)
Cast irons	(4)	6,530	255	70,200 [5]
Miscellaneous and unspecified	5,700 r	542	2,690	272 r, 3, 5
Grand total	430,000 r	345,000	141,000 [6]	239,000
Consumer stocks, December 31	13,300 r	17,100 [7]	13,400 r, 7	11,200 r
2018:				
Steel:				
Carbon and high-strength low-alloy	7,740	W	90,100	32,100
Stainless and heat-resisting	366,000	9,820	15,600	42,600
Unspecified and other	34,900	W	30,100	41,100
Total steel	409,000	341,000	136,000	116,000 [3]
Alloys and superalloys	9,570	(4)	--	(4)
Cast irons	(4)	6,720	289	80,100 [5]
Miscellaneous and unspecified	5,580	498	2,810	370 [3, 5]
Grand total	424,000	348,000	139,000 [6]	196,000
Consumer stocks, December 31	12,900	27,400 [7]	20,900 [7]	11,300

[r]Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Table includes data available through January 14, 2021. 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
[3]Does not include silicon carbide consumption to avoid disclosing proprietary data.
[4]All or part included with "Miscellaneous and unspecified."
[5]Consumption of silvery pig iron was withheld to avoid disclosing company proprietary data.
[6]Internal evaluation indicates that silicomanganese consumption is understated.
[7]Consumer and producer stocks.

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]
2017:								
Steel:								
Carbon	(4)	1,170	--	734	(4)	(4)	(4)	5,410
High-strength low-alloy	167 r	(4) r	--	(4)	--	(4)	(4)	(4)
Stainless and heat-resisting	673	689	13,400 r	62	(4)	209	(4)	3,640 r
Unspecified and other	1,890 r	3,810 r	30	2,250 r	97	419	4,080	735 r
Total	2,730 r	5,680 r	13,400 r	3,050 r	97	628	4,080	9,790
Alloys and superalloys	(5)	1,960 r	W	2	(4) r	(5)	(6)	1,720
Cast irons	313 r	--	--	(5)	--	(5)	(5)	5
Miscellaneous and unspecified	582 r	--	W	8	--	28 r	394	81
Grand total	3,620 r	7,640 r	13,600 r	3,060 r	97	656 r	4,470	11,600
Consumer stocks, December 31	399 r	387 r	W	87	36	164	453	961
2018:								
Steel:								
Carbon	(4)	1,200	--	777	--	(4)	(4)	5,440
High-strength low-alloy	191	(4)	--	(4)	--	(4)	(4)	(4)
Stainless and heat-resisting	684	624	13,500	63	(4)	210	(4)	3,560
Unspecified and other	1,260	3,480	32	2,310	129	436	2,940	707
Total	2,130	5,310	13,500	3,150	129	646	2,940	9,700
Alloys and superalloys	(5)	1,820	W	2	(4)	(5)	(6)	1,610
Cast irons	(5)	--	--	(5)	--	(5)	(5)	7
Miscellaneous and unspecified	927	--	W	8	--	57	402	89
Grand total	3,060	7,130	13,500	3,160	129	703	3,340	11,400
Consumer stocks, December 31	377	528	W	147	35	163	424	928

rRevised. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Table includes data available through January 14, 2021. 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]	2017			2018		
		High	Low	Average[3]	High	Low	Average[3]
Bulk ferroalloys:							
Ferrochromium:							
0.05% carbon	¢/lb	228.75	208.90	217.19	245.00	226.78	238.73
0.10% carbon	do.	218.75	198.10	205.60	235.44	200.00	220.06
0.15% carbon	do.	207.00	188.00	196.62	225.00	192.00	211.75
More than 4% carbon:							
47–55% chromium	do.	137.00	124.67	133.83	137.00	132.00	134.50
60–70% chromium	do.	151.25	138.00	145.04	148.00	101.88	136.87
Manganese ferroalloys:							
85% medium-carbon ferromanganese	do.	115.00	94.00	110.46	116.00	110.00	113.31
76% high-carbon ferromanganese	$/lt	1,600.00	1,400.00	1,488.74	1,650.00	1,280.00	1,471.36
65% silicomanganese	¢/lb	72.00	60.00	65.59	70.00	60.00	64.96
Silicon ferroalloys:							
50% ferrosilicon	do.	105.00 r	89.00 r	94.47	107.00	100.00	104.24
75% ferrosilicon	do.	108.00 r	73.00 r	86.88	113.00	103.00	107.58
Nickel metal, 99.81% (minimum) purity[4]	$/lb	4.05 r	5.44 r	4.72	6.85	4.91	5.95
Noble ferroalloys:							
Ferromolybdenum	do.	10.77	8.73	9.72	14.08	12.15	13.33
Ferroniobium[5]	$/kg	XX	XX	19.83	XX	XX	21.11
Ferrotitanium, 70%-grade	$/lb	2.20	1.70	1.97	3.00	2,25	2.65
Ferrotungsten[6]	$/kg	49.00	30.00	37.28	50.00	33.00	45.91
Ferrovanadium	$/lb	21.10	12.18	15.42	55.86	24.49	39.12

rRevised. do. Ditto. XX Not applicable.
[1]Table includes data available through January 14, 2021.
[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]Nickel metal prices are reported in dollars per pound by gross weight.
[5]Weighted average value of imported plus exported materials.
[6]Ferrotungsten prices are reported as dollars per kilogram of tungsten content.

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

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

Alloy	2017 Gross weight (metric tons)	2017 Contained weight (metric tons)	2017 Value (thousands)	2018 Gross weight (metric tons)	2018 Contained weight (metric tons)	2018 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	1,240	510	$1,400	731	365	$832
Not more than 4% carbon	854	441	1,840	1,740	1,010	2,670
Ferrosilicon-chromium	15	5	31	60	21	82
Total, chromium ferroalloys	2,110	956	3,270	2,530	1,400	3,590
Manganese ferroalloys:						
Ferromanganese, all grades	9,250 r	7,300 r	14,200	10,400	8,250	14,500
Silicomanganese	8,460	5,500	11,900	4,340	2,820	6,220
Total, manganese ferroalloys	17,700	12,800	26,100	14,800	11,100	20,700
Silicon ferroalloys:						
Ferrosilicon, more than 55% silicon	11,100	6,720	15,500	12,400	7,560	18,800
Ferrosilicon, other	8,870	4,120	13,600	8,630	4,000	13,300
Total, silicon ferroalloys	20,000	10,800	29,100	21,000	11,600	32,100
Total, bulk ferroalloys	39,800	24,600	58,500	38,300	24,000	56,400
Noble ferroalloys:						
Ferromolybdenum	638 r	447 r	10,800	943	660	18,400
Ferronickel	26	15	435	26	14	437
Ferroniobium[2]	2,250 r	1,500	26,200 r	1,420	930	16,200
Ferrophosphorus	2,430	NA	2,610	2,240	NA	3,750
Ferrotitanium and ferrosilicon-titanium	2,420	NA	8,560	3,120	NA	12,300
Ferrotungsten and ferrosilicon-tungsten	90	45	673	207	104	752
Ferrovanadium	300	229	6,000	820	575	20,900
Ferrozirconium	62	NA	154	424	NA	861
Ferroalloys, other	6,410	NA	9,660	10,800	NA	18,900
Total, noble ferroalloys	14,600 r	2,240 r	65,100 r	20,000	2,280	92,600
Grand total	54,400	26,800	124,000 r	58,300	26,300	149,000

rRevised. NA Not available.
[1]Table includes data available through January 14, 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	2017 Gross weight (metric tons)	2017 Contained weight (metric tons)	2017 Value (thousands)	2018 Gross weight (metric tons)	2018 Contained weight (metric tons)	2018 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	511,000 r	275,000 r	$651,000 r	495,000	269,000	$613,000
More than 3% but not more than 4% carbon	6,740	3,370	7,140	8,610	4,560	9,560
More than 0.5% but not more than 3% carbon	2,820	1,820	6,820	4,130	2,570	9,610
Not more than 0.5% carbon	47,600 r	31,500 r	129,000 r	53,100	37,100	167,000
Ferrosilicon-chromium	21,500	7,760	32,000	18,000	6,380	31,300
Total, chromium ferroalloys	590,000	319,000	825,000 r	579,000	320,000	831,000
Manganese ferroalloys:						
Ferromanganese:						
More than 4% carbon	201,000	149,000	247,000	264,000	199,000	324,000
More than 2% but not more than 4% carbon	142	106	147	6	5	14
More than 1% but not more than 2% carbon	73,600	59,300	119,000	96,300	77,400	155,000
Not more than 1% carbon	56,100	47,400	99,500	67,100	56,300	123,000
Silicomanganese	351,000	236,000	401,000	412,000	277,000	499,000
Total, manganese ferroalloys	682,000	492,000	867,000	839,000	610,000	1,100,000
Ferrosilicon:						
55%–80% silicon, more than 3% calcium	5,690	4,040	8,900	12,300	9,220	19,200
55%–80% silicon, other	162,000	123,000	218,000	154,000	116,000	241,000
80%–90% silicon	494	419	770	237	196	278
More than 90% silicon	4,820	4,450	2,420	2,330	2,150	1,240
Magnesium ferrosilicon	16,000	6,890	26,700	17,500	7,900	29,200
Ferrosilicon, other	27,800	7,620	18,400	11,600	4,120	15,600
Total, ferrosilicon	217,000	147,000	275,000	198,000	140,000	307,000
Total, bulk ferroalloys	1,490,000	957,000	1,970,000	1,620,000	1,070,000	2,240,000
Noble ferroalloys:						
Ferromolybdenum	8,520 r	5,760 r	112,000	11,900	8,010	223,000
Ferronickel	76,500	22,700	243,000	74,000	21,700	299,000
Ferroniobium[2]	10,600 r	6,900 r	229,000 r	12,800	8,300	283,000
Ferrophosphorus	8,420	NA	3,930	6,070	NA	3,790
Ferrotitanium and ferrosilicon-titanium	2,550	NA	7,580 r	2,710	NA	8,550
Ferrotungsten and ferrosilicon-tungsten	276	209	5,800	170	143	4,800
Ferrovanadium	3,880	2,810	92,800	4,210	3,130	231,000
Ferrozirconium	161	NA	601	191	NA	682
Ferroalloys, other	6,790	NA	16,400	5,220	NA	14,000
Total, noble ferroalloys	118,000 r	38,400 r	711,000 r	117,000	41,300	1,070,000
Grand total	1,610,000	996,000 r	2,680,000	1,730,000	1,110,000	3,310,000

rRevised. NA Not available.
[1]Table includes data available through January 14, 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	2014	2015	2016	2017	2018
Albania, ferrochromium	34,897	43,669	44,551	49,000	60,000 e
Argentina:					
Ferrosilicon[e]	17,000	12,700	12,000	13,000	13,000
Silicomanganese	10,000 r	8,000 r	10,000	--	--
Total[e]	27,000 r	20,700 r	22,000	13,000	13,000
Armenia, ferromolybdenum	6,528	5,576	6,526	6,588	6,588
Australia:					
Ferromanganese	161,900	150,000	116,900	125,100	148,300
Silicomanganese	119,400	130,700	83,700	120,200	112,900
Total	281,300	280,700	200,600	245,300	261,200
Austria:[e]					
Ferronickel	2,500	2,500	2,500	2,500	2,500
Other, unspecified	12,000	12,000	12,000	12,000	12,000
Total	14,500	14,500	14,500	14,500	14,500
Bahrain, silicomanganese	6,000	6,000	5,000	--	--
Bhutan, ferrosilicon[3]	79,485	104,406	106,234	108,670 r	138,178
Bosnia and Herzegovina, ferrosilicon	--	--	--	--	12,000 e
Brazil:					
Ferrochromium[4]	285,340	173,467	150,240	171,531	175,061
Ferromanganese	110,270	84,160	83,780	123,470	117,800
Ferronickel[5]	107,243	195,000 r	245,000 r	247,251 r	233,000
Ferroniobium[6]	80,000	80,000	68,000 r	90,000 r	91,000 e
Ferrosilicon[e]	98,000	88,300	88,300 r	100,000 r	119,000
Silicomanganese	214,000	141,540	166,680	202,520	228,690
Total	894,853	762,467 r	802,000 r	934,772 r	964,551
Burma, ferronickel	59,000 e	60,000 e	64,462 r	62,366 r	58,000 e
Canada:[e]					
Ferroniobium	8,900	8,300	9,400 r	11,000	12,000
Ferrosilicon	32,000	38,000	38,000	40,000	36,000
Ferrovanadium	1,000	1,000	1,000	1,000	1,000
Total	41,900	47,300	48,400 r	52,000	49,000
China:					
Ferrochromium	4,120,000	3,940,000	4,230,000	4,940,000	5,250,000 e
Ferromanganese:[e]					
Blast furnace	457,000	446,000	340,000	220,000	270,000
Electric furnace	2,170,000	2,120,000	1,610,000	1,560,000	1,660,000
Ferromolybdenum	120,000	116,000	127,000	141,000	141,000
Ferronickel equivalent, nickel pig iron[e, 5]	2,400,000	1,900,000	1,900,000	2,100,000	2,400,000
Ferrosilicon	5,500,000	4,730,000	4,300,000	3,650,000	3,800,000 e
Ferrovanadium	44,400 r	40,900 r	34,200 r	38,400 r	40,500
Silicomanganese	7,319,000	5,870,000	7,267,000	6,610,000	9,450,000
Other, unspecified	6,970,000	11,000,000 r, e	7,700,000 e	5,200,000 r, e	5,700,000 e
Total	29,100,400 r	30,162,900 r	27,508,200 r	24,459,400 r	28,711,500
Colombia, ferronickel[e]	142,000	126,000	128,000	140,000	140,000
Dominican Republic, ferronickel	--	--	33,203	43,894	53,000 e
Egypt:					
Ferromanganese	12,000	12,000	12,000	12,000	13,000
Ferrosilicon[7]	56,794	56,093	60,477	60,500 e	60,500 e
Total	68,794	68,093	72,477	72,500 e	73,500 e
Finland, ferrochromium	441,291	457,063	469,141	416,285	492,774
France:					
Ferromanganese	116,000 e	126,000	119,000	95,400	125,400
Ferrosilicon[e]	50,000	40,000 r	50,000 r	50,000 r	50,000
Silicomanganese	64,800	65,100	58,200	58,400	56,700
Total	231,000 e	231,100 r	227,200 r	203,800 r	232,100
Gabon, silicomanganese	4,000 e	14,500	14,900	21,300	42,900
Georgia, silicomanganese	256,677	217,300	244,228	289,800 r	332,900

See footnotes at 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	2014	2015	2016	2017	2018
Germany:[e]					
Ferrochromium	17,800 [r]	17,800 [r]	17,800 [r]	17,800 [r]	17,800
Other, unspecified	8,200	8,200	8,200	8,200	8,200
Total	26,000 [r]	26,000 [r]	26,000 [r]	26,000 [r]	26,000
Greece, ferronickel	94,950	89,130	87,880	86,140	80,700
Guatemala, ferronickel[e]	15,300	32,800	26,300	37,600	44,900
Iceland, ferrosilicon	112,657	121,556	128,020 [r]	116,811	116,889
India:					
Ferroaluminum	4,596	3,010	4,140	4,337	4,337
Ferroboron	45	42	--	--	--
Ferrochromium	944,000	944,000	944,000	944,000	944,000
Ferromanganese	676,000 [r]	646,000 [r]	621,000 [r]	752,000 [r]	795,000
Ferromolybdenum	1,281	1,281	1,614	1,315	1,315
Ferrosilicomagnesium	25,788	21,887	21,140	16,724 [r]	18,436
Ferrosilicon	92,014	92,000	90,000	90,000	88,000 [e]
Ferrotitanium	760	204	231	393	125
Ferrovanadium	1,031	879	1,266	1,318	1,150
Silicomanganese	1,920,000 [r]	1,832,000 [r]	1,768,000 [r]	2,038,000 [r]	2,098,000
Total	3,665,515 [r]	3,541,303 [r]	3,451,391 [r]	3,848,087 [r]	3,950,363
Indonesia:					
Ferronickel[e]	82,600	85,700	101,000	109,000	124,000
Ferronickel equivalent, nickel pig iron[e, 5]	--	140,000 [r]	380,000 [r]	370,000 [r]	370,000
Silicomanganese	25,000	30,000	40,000	40,000	--
Total[e]	108,000	256,000 [r]	521,000 [r]	519,000 [r]	494,000
Japan:					
Ferrochromium[e]	16,000	15,000	15,000	16,000	16,000
Ferromanganese	463,345	465,952	473,740	456,460	451,700
Ferromolybdenum	4,500	4,500	4,000	--	--
Ferronickel	379,291	396,969	333,448	312,324	339,844
Ferrovanadium	4,400 [e]	4,000 [e]	4,000	-- [e]	-- [e]
Silicomanganese	26,500	22,700 [r]	22,700 [r]	24,500 [r]	21,100
Other, unspecified	79,912	73,651	77,453	79,809	73,094
Total	973,948	982,772 [r]	930,341 [r]	889,093 [r]	901,738
Kazakhstan:					
Ferrochromium	1,351,803	1,414,476	1,525,221	1,640,300	1,600,000 [e]
Ferrosilicon	395	86,984	68,779	59,926	60,000 [e]
Ferrosilicon-chromium	158,825	74,609	94,468	110,497	110,000 [e]
Silicomanganese	200,379	164,189	135,885	123,977	132,000 [e]
Other, unspecified	3,735	1,662	1,987	--	46
Total	1,715,137	1,741,920	1,826,340	1,934,700	1,900,000 [e]
Korea, Republic of:					
Ferromanganese	535,000 [r]	500,000 [r]	425,000 [r]	360,000 [r]	320,000
Ferronickel	114,000	195,000	228,000	237,000	223,000
Ferrosilicon[e]	30,000	30,000	30,000	30,000	30,000
Silicomanganese	235,000	175,000	135,000	117,000 [r]	117,000
Total	914,000 [r]	900,000 [r]	818,000 [r]	744,000 [r]	690,000
Kosovo, ferronickel[e]	38,700	56,500	12,700	38,500	30,900
Macedonia:					
Ferronickel[e]	82,100	80,500	48,200	32,600	45,900
Ferrosilicon	73,014	45,698	24,431	21	--
Total[e]	155,000	126,000	72,600	32,600 [r]	45,900
Malaysia:					
Ferromanganese	--	--	58,801	264,555	312,420
Ferrosilicon	8,641	104,554	126,261	174,540	220,515
Silicomanganese	--	--	20,975	230,535	283,414
Total	8,641	104,554	206,037	669,630	816,349

See footnotes at 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	2014	2015	2016	2017	2018
Mexico:					
Ferromanganese	67,506	67,920	84,530	90,013	95,468
Silicomanganese	164,855	139,361	134,251	148,130	152,000
Total	232,361	207,281	218,781	238,143	247,468
New Caledonia, ferronickel	224,884	228,484	261,420	269,961	260,206
Norway:					
Ferromanganese	295,400	309,200	329,100	400,800	327,600
Ferrosilicon[e]	350,000	350,000	350,000	350,000	350,000
Silicomanganese	314,300	309,900	306,100	284,500	330,000
Total	959,700	969,100	985,200	1,035,300	1,007,600
Oman, ferrochromium	44,063	63,750	90,063	79,563	77,750
Paraguay, ferrosilicon	--	--	--	--	8,000 [e]
Poland:					
Ferromanganese	549	460	450 [e]	510 [e]	510 [e]
Ferrosilicon	62,878	77,754	77,682	65,732 [r]	65,700 [e]
Silicomanganese	32 [e]	--	--	--	--
Other, unspecified	24,909	460	12,517	24,800 [r]	33,250
Total	88,368	78,674	90,649	91,042 [r]	99,500 [e]
Russia:					
Ferrochromium	439,600	363,286	268,439	436,280	400,000 [e]
Ferromanganese	178,600	155,700	124,200	253,000 [r]	281,000
Ferroniobium[e]	150 [r]	250 [r]	120 [r]	370 [r]	380
Ferrophosphorus	1,500 [e]	1,500 [e]	1,500 [e]	1,538	1,500 [e]
Ferrosilicon	1,026,190	1,057,909	935,912	840,765	841,000 [e]
Ferrosilicon-chromium	67,160	102,000 [e]	75,000 [e]	75,000 [e]	75,000 [e]
Ferrotitanium	7,500 [e]	9,961	10,741	10,200 [r]	9,000 [e]
Ferrovanadium	11,400 [e]	12,277	12,392	12,593 [r]	11,383
Silicomanganese	179,910	188,895	203,216	44,917 [r]	43,334
Other, unspecified[e]	6,500	8,000	9,000	10,000	10,000
Total	1,918,510 [r]	1,899,778 [r]	1,640,520 [r]	1,684,663 [r]	1,670,000 [e]
Saudi Arabia:					
Ferromanganese	8,000	7,000	10,000	10,000	23,000
Silicomanganese	60,000	63,000	60,000 [e]	65,000	85,400
Total	68,000 [r]	70,000 [r]	70,000 [r, e]	75,000 [r]	108,400
Slovakia:					
Ferromanganese	20,554	25,376	35,589	42,115	32,341
Ferrosilicon	47,019	45,961	38,030	52,436	52,400 [e]
Silicomanganese	29,643	27,036	35,719	40,265	37,226
Total	97,216	98,373	109,338	134,816	121,967
South Africa:					
Ferrochromium[8]	3,719,010	3,684,598	3,596,000	3,600,000 [e]	3,900,000 [e]
Ferromanganese	787,000	512,000	335,000	257,100	235,600
Ferrosilicon	87,700	91,800	73,200	34,000 [e]	34,000 [e]
Ferrovanadium[e]	19,000	15,000	7,000	7,000	6,800
Silicomanganese	228,100	210,200	144,000	160,400	164,200
Total	4,840,810	4,513,598	4,155,200	4,060,000 [e]	4,340,000 [e]
Spain:					
Ferromanganese	133,500	126,200	120,100	132,100	86,200
Ferrosilicon[e]	80,500	80,000	80,000	95,000	95,000
Silicomanganese	128,700	134,400	123,100	138,700	156,100
Total	342,700	340,600	323,200	365,800	337,300
Sweden, ferrochromium	67,000	90,480	81,900	92,390	86,910
Turkey:					
Ferrochromium	86,025	82,650	75,000	83,894	68,626
Ferrosilicon[9]	4,000 [r]	1,400	2,900 [r]	2,900 [r]	3,500
Total	90,025 [r]	84,050	77,900 [r]	86,794 [r]	72,126

See footnotes at 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	2014	2015	2016	2017	2018
Ukraine:					
Ferromanganese	102,934	87,740	104,470	114,500	79,400
Ferronickel	114,222	95,209	79,900	72,500	79,537
Ferrosilicon	142,300	90,200	101,420	92,910	75,400 e
Silicomanganese	840,433	698,400	814,970	810,670	859,600
Other, unspecified	15,326	19,360	22,219 r	12,635 r	13,150
Total	1,215,215	990,909	1,122,979 r	1,103,215 r	1,107,087
United States:[10]					
Bulk ferroalloys	517,000	424,000	369,000	395,000 r	489,000
Noble ferroalloys[e]	15,100	21,000	19,100	12,000 r	5,450
Total	532,000	445,000	388,000	407,000 r	495,000
Venezuela:					
Ferromanganese	8,000	--	--	--	--
Ferronickel	20,800 e	16,700 e	--	--	--
Ferrosilicon[e]	74,300	74,300	37,000	--	--
Silicomanganese	39,000	35,000	42,000	18,670	--
Total	142,100	126,000	79,000	18,670	--
Zimbabwe, ferrochromium	235,256	115,586	78,200	142,800	180,000 e
Grand total[10]	50,600,000 r	50,900,000 r	47,900,000 r	46,000,000 r	51,000,000
Of which:					
Ferroaluminum	4,600	3,010	4,140	4,340	4,340
Ferroboron	45	42	--	--	--
Ferrochromium	11,800,000	11,400,000	11,600,000	12,600,000	13,300,000
Ferromanganese	6,300,000 r	5,840,000 r	5,000,000 r	5,270,000 r	5,370,000
Ferromolybdenum	132,000	127,000	139,000	149,000	149,000
Ferronickel	3,880,000 r	3,700,000	3,930,000 r	4,160,000 r	4,490,000
Ferroniobium	89,100 r	88,600 r	77,500 r	101,000 r	103,000
Ferrophosphorus	1,500 e	1,500 e	1,500 e	1,540	1,500 e
Ferrosilicomagnesium	25,800	21,900	21,100	16,700	18,400
Ferrosilicon	8,020,000 r	7,420,000 r	6,820,000 r	6,030,000 r	6,270,000
Ferrosilicon-chromium	226,000	177,000	169,000	185,000	185,000
Ferrotitanium	8,260	10,200	11,000	10,600 r	9,130
Ferrovanadium	81,200 r	74,100 r	59,900 r	60,300 r	60,800
Silicomanganese	12,400,000 r	10,500,000 r	11,800,000 r	11,600,000 r	14,700,000
Other, unspecified	7,650,000 r	11,600,000 r	8,230,000 r	5,750,000 r	6,340,000

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

[1]Table includes data available through October 20, 2020. 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]Total of imports received by all countries from Bhutan. Source: UN Comtrade.

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

[5]In order to facilitate comparison with other ferronickel-producing countries and (or) localities, gross weight has been estimated using a nickel content of 20%. Although there are no formal specifications, ferronickel has historically referred to products containing a minimum of 15% nickel, but nickel pig iron may contain as little as 3% nickel.

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

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

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

[9]Exports. Source: UN Comtrade.

[10]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.