



2012 Minerals Yearbook

CHROMIUM

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By John F. Papp

Domestic survey data and tables were prepared by Mahbood Mahdavi, statistical assistant, and the world production tables were prepared by Glenn J. Wallace, international data coordinator.

In 2012, the U.S. chromium supply (measured in contained chromium) was 146,000 metric tons (t) from recycled stainless steel scrap, 554,000 t from imports, and 119,000 t from Government and industry stocks. Supply distribution was 234,000 t to exports, 114,000 t to Government and industry stocks, and 470,000 t to apparent consumption. Chromium apparent consumption increased by 4.6% compared with that of 2011. Historically, chromium ferroalloys have replaced chromite ore as the leading source of chromium to U.S. industry. Stainless steel mill products have been accounting for an increasing share of chromium supply to domestic industry, now rivaling that of ferrochromium. Because stainless steel mill products have contributed a significant amount of chromium to domestic industry since 1960, trade in these products has been incorporated into chromium trade statistics, and their contribution has been accounted for in chromium apparent consumption since 2007. Recycled material was the leading domestic commercial supply source for chromium in 2012. Chromium has a wide range of uses in chemicals, metals, and refractory materials. Its use in iron, nonferrous alloys, and steel is for enhancing hardenability or resistance to corrosion and oxidation. Production of stainless steel and nonferrous alloys are two of its more critical applications. Other applications are in other alloy steels, catalysts, leather processing, pigments, plating of metals, refractories, and surface treatments.

Because the United States has small chromite ore reserves, domestic supply has been a concern during every national military emergency since World War I. World chromite ore resources, mining capacity, and ferrochromium production capacity are concentrated in the Eastern Hemisphere. In recognition of the vulnerability of long supply routes during a military emergency, chromium (in various forms, including chromite ore, chromium ferroalloys, and chromium metal) has been held in the National Defense Stockpile (NDS) since before World War II. Since 1991, as a result of changed national security considerations, stockpile goals have been reduced and inventory has been sold.

Legislation and Government Programs

The Defense Logistics Agency (DLA), Strategic Materials, U.S. Department of Defense, disposed of chromium materials under its fiscal year 2012 (October 1, 2011, through September 30, 2012) Annual Materials Plan (AMP) and announced that the fiscal year 2013 AMP set maximum disposal goals for chromium materials at 59,152 t of chromium ferroalloys and 454 t of chromium metal (Defense Logistics Agency, Strategic Materials, 2012).

Production

Domestic data for chromium materials were developed by the U.S. Geological Survey (USGS) by means of the monthly “Chromite Ores and Chromium Products” and “Consolidated Consumers” surveys. Stainless and heat-resisting steel producers were the leading chromium consumers, and high-carbon ferrochromium was the leading chromium-containing material consumed.

The major marketplaces for chromium-containing materials are chromite ore and foundry sand; chromium chemicals, ferroalloys, and metal; and stainless steel. In 2012, the United States produced chromite ore, chromium chemicals, and stainless steel. The United States is a major world producer of chromium chemicals and stainless steel. The United States does not produce ferrochromium or industrial grade chromium metal; however, chromite foundry sand was domestically produced.

Oregon Resources Corp. Ltd. (ORC), owned by IDM International Ltd. (Australia), commissioned its Coos Bay chromite ore processing facility to produce chromite foundry sand in September 2011 and continued to improve efficiency and productivity in 2012. ORC reached its nameplate capacity of 70,000 metric tons per year (t/yr) of chromite (IDM International Limited, 2012, p. 4). Elementis Chromium, a subsidiary of Elementis plc (United Kingdom), produced sodium dichromate from chromite ore at Castle Haynes, North Carolina.

Consumption

The U.S. stainless steel industry produced more than 2 million metric tons per year (Mt/yr) of stainless steel and imported and exported stainless steel mill products and scrap in 2012, making it the leading consumer of chromium materials. AK Steel Corp. (AK), Allegheny Technologies Incorporated (ATI), and North American Steel Co. (NAS) were the leading U.S. stainless steel producers.

AK produced stainless steel at Butler, PA, and Mansfield, OH. AK reported shipments of 770,000 t of stainless and electrical steel in 2012 compared with 817,000 t in 2011 (AK Steel Corp., 2012, p. 10–11, 17). ATI produced stainless steel at Brackenridge, Midland, and Latrobe, PA (Allegheny Technologies Incorporated, 2013, p. F15).

NAS [a subsidiary of Acerinox, S.A. (Spain)] produced stainless steel at Ghent, KY. NAS reported melt shop production at 1.01 million metric tons (Mt) in 2012 compared with 0.937 Mt in 2011, an 8% increase. Acerinox considered the Ghent plant its most efficient stainless steel plant worldwide (Acerinox S.A., 2013, p. 170–171).

ThyssenKrupp Stainless USA [a subsidiary of ThyssenKrupp AG (Germany)] continued development of a 1 Mt/yr stainless steel melt shop and rolling mill at Calvert City, AL (ThyssenKrupp AG, 2012, p. 75).

Environment

Chromium is an essential trace element for human health. Some chromium compounds, however, are acutely toxic, chronically toxic, and (or) carcinogenic. The U.S. Environmental Protection Agency (EPA) regulates chromium releases into the environment and the Occupational Safety and Health Administration (OSHA) regulates workplace exposure.

Prices

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

Foreign Trade

Chromium-containing material exports from and imports into the United States included chromite ore; chromium chemicals, ferroalloys, metal, and pigments; and stainless steel. Based on foreign trade statistics reported by the U.S. Department of Commerce for calendar year 2012, the value of foreign trade of these chromium materials excluding stainless steel mill products and scrap was \$145 million for exports and \$1,097 million for imports. A significant amount of chromium exits and enters the U.S. economy via stainless steel mill product and scrap trade. The value of foreign trade of chromium materials including stainless steel mill products and scrap was \$3,330 million for exports and \$4,022 million for imports.

World Industry Structure

The chromium industry comprises chromite ore, chromium chemicals and metal, ferrochromium, stainless steel, and chromite refractory material and foundry sand producers. Several long-term trends are simultaneously taking place in the chromium industry. The chromium chemical industry has eliminated excess production capacity and has concentrated on increasing production in remaining plants. Chromite refractory use has been declining, however, foundry use has been increasing slowly. The use of chromite refractories and chromium chemicals has been reduced owing to environmental concerns. The fraction of chromite ore being supplied by independent producers is declining, while that being supplied by vertically integrated producers is increasing. In other words, chromite ore mines now tend to be owned and operated by chromite refractory, chromium chemical, or ferrochromium producers. This trend is associated with the migration of ferrochromium production capacity from stainless-steel-producing countries to chromite-ore-producing countries, a trend that has been interrupted with the emergence of China

as a significant ferrochromium and leading stainless steel producer. While ferrochromium production capacity was closed in historically producing countries, which usually have been stainless-steel-producing countries, new furnaces or plants were constructed in chromite ore producing areas. The electrical power and submerged-arc electric-furnace production capacities used to produce ferrochromium have been increasing. Furnaces built recently have an electrical capacity in the tens of megavoltamperes (MVA) whereas, when ferrochromium plants were first built, furnaces rated in the low kilovoltampere (kVA) range were common.

Production process improvements, such as agglomeration of chromite ore, preheating and prereluction of furnace feed, and closed-furnace technology, have been retrofitted at the plants of major producers, and are being incorporated in newly constructed plants. Since the introduction of post-melting refining processes in the steel industry after 1960, there has been a shift in production to high-carbon ferrochromium from low-carbon ferrochromium. After years of ferrochromium production, slag stockpiles have grown. Recently developed processes have efficiently recovered ferrochromium from that slag, and those processes have been or are being installed at existing plant sites. In South Africa, the leading chromite-ore- and ferrochromium-producing country, three trends are emerging—ferrochromium plants are being developed in the western belt of the Bushveld Complex, ferrochromium plants are being built in association with chromite ore mines, and ferrochromium production processes have been developed to accommodate chromite ore byproduct recovered from platinum operations.

The geographic distribution of mineral production has increased over the past 150 years. Europe, along with the United States, accounted for nearly all mineral production in the mid-nineteenth century, but together now account for less than one-fifth of world mineral production. The world share of mineral production from the United States and Europe has been decreasing, while the share from Australia, Canada, China, the Confederation of Independent States, and a collection of developing countries has been increasing. Although minerals and metals are not being mined to extinction, mineral scarcity will likely become an issue in coming decades. The displacement of Western countries by developing countries as the leading mineral producers has major geopolitical implications because Europe is dependent on foreign suppliers to satisfy its industrial demand for minerals and metals. It was of concern that scarce-minerals markets could be transformed from equal access, competitive bidding markets (that is, open markets) to markets with long-term supply agreements negotiated between major corporations with substantial government involvement resulting in a politicized mineral supply (that is, politically controlled closed markets).

Capacity.—Rated capacity (table 7) is defined as the maximum quantity of product that can be produced in a period of time at a normally sustainable long-term operating rate, based on the physical equipment of the plant and given acceptable routine operating procedures involving labor, energy, materials, and maintenance. Capacity includes both operating plants and plants temporarily closed that can be brought into production

within a short period of time with minimum capital expenditure. Because all countries and producers do not provide information about production capacity, historical chromium trade data have been used to estimate national production capacities. Reported production capacity changes result from both facility changes and increased knowledge about facilities. Production capacities have been estimated for the chromite ore, chromium chemicals, chromium metal, ferrochromium, and stainless steel industries (table 7).

Production.—In 2012, world chromite ore gross production was 25.6 Mt, a 0.6% decrease from that of the previous year (table 8); ferrochromium gross production was 8.98 Mt, a 3.6% decrease from that of the previous year (table 9); and stainless steel gross production was 35 Mt, a 5.7% increase from that of the previous year (as estimated by the author).

Chromite Ore.—India, Kazakhstan, and South Africa were the leading chromite-ore-producing countries (table 8).

Chromium Chemicals.—Major chromium chemical producers included China, Kazakhstan, Russia, South Africa, and the United States. Leading chromium-chemical-producing countries where large sodium dichromate plants (production capacity in excess of 100,000 t/yr) operate included Kazakhstan, Russia, and the United States. Moderate-sized production facilities were located in China, India, Japan, South Africa, and Turkey. Small-scale local producers operated in China and India.

Chromium Metal.—Major chromium metal producers included Russia (by the electrolytic process), Japan (by the silicothermic process), and China, France, Kazakhstan, Russia, and the United Kingdom (by the aluminothermic process).

Ferrochromium.—In 2012, China, Kazakhstan, and South Africa were the leading ferrochromium producers (table 9). Ferrochromium is the leading end use of chromite ore, and ferrochromium production is an electrical energy intensive process. Charge-grade ferrochromium requires 2,900 to 4,100 kilowatt-hours of electrical energy per metric ton of product, with efficiency varying by ore grade, operating conditions, and production process. Thus, the location of ferrochromium plants reflects a cost balance between raw materials and electrical energy supply.

Stainless Steel.—Stainless steel is the leading end use of ferrochromium. The International Stainless Steel Forum reported 2012 world crude stainless steel production was 35.363 Mt compared with 33.621 Mt in 2011 (International Stainless Steel Forum, 2013).

Stainless Steel Scrap.—Stainless steel scrap is an important source of chromium to the stainless steel industry. Stainless steel scrap is produced in proportion to stainless steel mill product production. Stainless steel scrap consumption is proportional to raw stainless steel production. The proportion of scrap generated and (or) consumed varies among producers and consumers.

World Review

Albania.—Albania produced 26,000 t of high-carbon ferrochromium in 2012 compared with 32,000 t in 2011 and consumed 12,000 t in 2012 compared with 9,000 t in 2011 (CRU, 2014a, b).

Australia.—The Government of Western Australia reported chromite ore sales [in contained chromic oxide (Cr_2O_3)] of

186,635 t of Cr_2O_3 in 2012 and 96,573 t of Cr_2O_3 in 2011 (Government of Western Australia, 2013, p. 20).

Consolidated Minerals Limited (Consmim) (2013a, p. 9; 2013b) reported chromite production of 452,300 t in 2012 compared with 323,800 t in 2011. Consmim planned to cease chromite ore production in 2013 owing to declining ore grade.

Austria.—Austria produced 0.066 Mt of stainless steel in 2012 compared with 0.070 Mt in 2011, and consumed 26,000 t of high-carbon ferrochromium in 2012 compared with 32,000 t in 2011 (CRU, 2014a, b).

Belgium.—Belgium produced 1.241 Mt of stainless steel in 2011 compared with 1.241 Mt in 2011 and consumed 228,000 t of high-carbon ferrochromium in 2012 compared with 227,000 t in 2011 (CRU, 2014a, b).

Brazil.—Brazil produced chromite ore, ferrochromium, and stainless steel. Brazil reported 2011 chromite ore production of 542,512 t (217,198 t Cr_2O_3 content), exports of 60,818 t, and imports of 23,733 t. Brazil produced from a chromite ore reserve of 2.51 Mt Cr_2O_3 content, mostly in Bahia State. In 2011, Brazil produced 145,112 t of chromium ferroalloys, exported 11,972 t, and imported 16,901 t. Chromite ore was mined in the States of Amapa and Bahia. Leading chromite ore producers were Cia. Ferro-Ligas da Bahia S/A, Magnesita S/A, and Mineração Vila Nova Ltda. (Ramos, 2012). Brazil produced 0.390 Mt of stainless steel in 2012 compared with 0.413 Mt in 2011 and 161,000 t of high-carbon ferrochromium in 2012 compared with 131,000 t in 2011, and consumed 136,000 t in 2012 compared with 142,000 t in 2011 (CRU, 2014a, b).

Canada.—Canada consumed 19,000 t of high-carbon ferrochromium in 2012 compared with 16,000 t in 2011. Cliffs Natural Resources Inc. (Cliffs) (United States) (2011; 2012, p. 6) reported that its chromite ore properties, Black Thor and Black Label (each 100% owned) and Big Daddy (72% owned), in Ontario, Canada, were in the prefeasibility stage of development. Cliffs reported inferred mineral resources of 69.5 Mt at 31.9% Cr_2O_3 . Cliffs was conducting a prefeasibility study of a planned open pit mine that would transition to underground after 10 to 15 years; ore processing and shipping facilities were planned at the mine site; and a brownfield ferrochromium smelter was planned at Greater Sudbury with electrical power capacity of 300 megawatts.

Azimut Exploration Inc. explored the Eastmain West property in the James Bay region of Quebec for chromite. Azimut reported chromite grading 36.8% Cr_2O_3 at the Sledgehammer Prospect and 39.1% Cr_2O_3 at the Dominic Prospect (Azimut Exploration Inc., 2012, p. 17).

Noront Resources Ltd. (2012, p. 1) explored for chromite ore. Noront reported Blackbird property chromite measured resources of 9.3 Mt at 37.44% Cr_2O_3 , indicated resources of 11.2 Mt at 34.36% Cr_2O_3 , and inferred resources of 23.5 Mt at 33.14% Cr_2O_3 .

China.—China produced chromite ore, ferrochromium, chromium chemicals and metal, and stainless steel. China produced a small amount of chromite ore, was the second leading producer of ferrochromium (mostly from imported chromite ore), and was the leading producer of stainless steel. China produced 16.087 Mt of stainless steel in 2012 compared with 14.091 Mt in 2011, and 3.104 Mt of high-

carbon ferrochromium in 2012 compared with 2.653 Mt in 2011, and consumed 4,667 t in 2012 compared with 4,129 t in 2011. In 2012, China accounted for 45% of world stainless steel production, 53% of world high-carbon ferrochromium production, and 51% of world high-carbon ferrochromium consumption (CRU, 2014a, b).

Finland.—Finland produced chromite ore (Kemi Mine), ferrochromium (Tornio Works), and stainless steel (Tornio Works). Finland produced 1.078 Mt of stainless steel in 2012 compared with 1.003 Mt in 2011, 230,000 t of high-carbon ferrochromium in 2012 compared with 231,000 t in 2011, and consumed 171,000 t of high-carbon ferrochromium in 2012 compared with 153,000 t in 2011 (CRU, 2014a, b).

In 2012, Outokumpu produced 452,000 t of marketable chromite ore from 0.8 Mt of run-of-mine ore, 229,000 t of ferrochromium, and 1.692 Mt of stainless steel compared with 693,000 t of chromite ore from 1.4 Mt of run-of-mine ore, 231,000 t of ferrochromium, and 1.707 Mt of stainless steel in 2011. The company reported reserves of 33 Mt of chromite ore at 26.1% Cr₂O₃ and resources of 105 Mt chromite ore at 29.5% Cr₂O₃. Outokumpu produced stainless steel at melt shops in Tornio, Avesta (Sweden), and Sheffield (Britain). Outokumpu planned to increase its ferrochromium production capacity to 530,000 t/yr starting in 2015 (Outokumpu Oyj, 2013, p. 26, 110–111).

Afarak Group Plc (formerly Ruukki Group) comprised chromite ore mining [Stellite Mine (South Africa), Turk Maadin Sirketi (Turkey)] and ferrochromium production facilities {Mogale Alloys [Pty.] Ltd. (South Africa), Eschweiler-Weisweiler [EWW] (Germany)}.

France.—France produced chromium metal and stainless steel. France produced 0.285 Mt of stainless steel in 2012 compared with 0.300 Mt in 2011, and consumed 77,000 t of high-carbon ferrochromium in 2012 compared with 79,000 t in 2011 (CRU, 2014a, b). Delachaux Group's Metals Operations produced chromium metal by aluminothermic reduction of chromic oxide. Delachaux produced about 9,000 t of chromium metal in 2011 and anticipated producing 9,800 t in 2012 from an operation with production capacity of 12,000 t/yr (Steelguru, 2012).

Germany.—Germany produced ferrochromium and stainless steel. Elektrowerke Weisweiler GmbH [owned by Afarak Group (Finland)] produced low-carbon ferrochromium. Germany produced 1.313 Mt of stainless steel in 2012 compared with 1.502 Mt in 2011, and consumed 340,000 t of high-carbon ferrochromium in 2012 compared with 377,000 t in 2011 (CRU, 2014a, b).

India.—India produced chromite ore, chromium chemicals, ferrochromium, and stainless steel. India exported lumpy and friable chromite ore and chromite ore concentrates. India produced 2.470 Mt of stainless steel in 2012 compared with 2.271 Mt in 2011, produced 1.003 Mt of high-carbon ferrochromium in 2012 compared with 0.940 Mt in 2011, and consumed 418,000 t of high-carbon ferrochromium in 2012 compared with 350,000 t in 2011 (CRU, 2014a, b).

India reported that 20 mines in the States of Karnataka and Odisha collectively produced 3,764,120 t of chromite ore in fiscal year 2011–12 (April 1, 2011, through March 31,

2012) compared with 4,325,699 t from 21 mines in fiscal year 2010–11. India's chromite ore reserves were estimated at a provisional 53.970 Mt as of January 4, 2010. India reported chromite ore exports of 225,089 t and imports of 136,204 t in fiscal year 2011–12, compared with exports of 172,866 t and imports of 86,456 t in fiscal year 2010–11. The leading chromite ore mining companies, all located in Odisha, were Balashore Alloys Ltd., Ferro Alloys Corporation Ltd., Indian Metal & Ferro Alloys Ltd., Misrilall Mines Pvt. Ltd., Orissa Mining Corporation Ltd., and Tata Steel Ltd. Krebs & Cei (India) Ltd., Tamil Nadu Chromates and Chemicals Ltd., and Vishnu Chemicals Ltd. produced chromium chemicals. India produced 1.595 t of chromium metal in fiscal year 2010–11 (Indian Bureau of Mines, 2013).

From an installed production capacity of 1.69 Mt/yr, India produced 904,556 t of ferrochromium in fiscal year 2011–12 compared with 1,003,598 t in fiscal year 2010–11. India exported 567,660 t and imported 32,064 t of ferrochromium in fiscal year 2011–12 compared with 774,429 t of exports and 22,412 t of imports in fiscal year 2010–11. Chromium ferroalloys were produced at plants in the States of Andhar Pradesh, Odisha, Gujarat, and West Bengal. The leading chromium ferroalloy producers were Balasore Alloys Ltd., FACOR Alloys Ltd., GMR Technologies & Ind. Ltd., IDCOL Ferro Chrome Plant, Indian Charge Chrome Ltd., Indian Metals & Ferro Alloys Ltd., Jindal Stainless Ltd., Jindal Steel & Power Ltd., Nava Bharat Ferro Alloys Ltd., Sri Vasavi Ind. Ltd., Rawat Ferro Alloys, Rohit Ferro Tech. P. Ltd., SAL Steel, Standard Chrome Ltd., Tata Steel Ltd., and Utkal Manufacturing Services Ltd. (Indian Bureau of Mines, 2013).

Italy.—Cogne Acciai Speciali and ThyssenKrupp Accai Speciali produced stainless steel. Italy produced 1.702 Mt of stainless steel in 2012 compared with 1.602 Mt in 2011, and consumed 392 t of high-carbon ferrochromium in 2012 compared with 376 t in 2011 (CRU, 2014a, b).

Japan.—Japan was a major stainless steel-producing country. Japan produced 3.132 Mt of stainless steel in 2012 compared with 3.256 Mt in 2011, and consumed 691,000 t of high-carbon ferrochromium in 2012 compared with 835,000 t in 2011 (CRU, 2014a, b).

Kazakhstan.—Kazakhstan produced chromite ore and ferrochromium. Eurasian Natural Resources Corporation PLC (ENRC) (United Kingdom) produced chromite ore and ferrochromium. Kazakhstan produced 1.005 Mt of high-carbon ferrochromium in 2012 compared with 0.999 Mt in 2011, and consumed 92 t of high-carbon ferrochromium in 2012 compared with 87 t in 2011 (CRU, 2014a, b). Production capacity at ENRC's Donskoy Mine was 3.5 Mt/yr. ENRC reported salable chromite ore production of 3.730 Mt in 2012 compared with 3.567 Mt in 2011. ENRC's principal chromite-ore-producing subsidiary Donskoy GOK produced 4.5 Mt run-of-mine chromite ore. As of December 31, 2012, ENRC chromite ore reserves were 206.7 Mt at 41.3% Cr₂O₃; resources were 308.3 Mt at 49.4% Cr₂O₃. ENRC reported ferrochromium production of 1.199 Mt in 2012, compared with 1.185 Mt in 2011. At Aktobe, ENRC continued construction of four direct current furnaces with collective ferrochromium production capacity of 440,000 t/yr. Completion was anticipated in 2013

at an estimated cost of \$750 M (Eurasian Natural Resources Corporation PLC, 2013, p. 22, 24–27, 170, 174–176).

Mechel OAO (Russia) owned Oriol Resources (United Kingdom), which produced chromite ore at the Voskhod Mine and chromium ferroalloys at the Tikhvin Ferroalloy Plant. Voskhod chromite ore feeds the Tikhvin Ferroalloy Plant. Voskhod production capacity was 1.3 Mt/yr chromite ore plus 0.65 Mt/yr of chromite ore fines. Production in 2012 was 736,100 t of chromite ore and 379,000 t of chromite ore concentrate compared with 691,500 t of chromite ore and 295,100 t of chromite ore concentrate in 2011. Tikhvin produced 140,000 t of high-carbon ferrochromium in 2011 containing 60% chromium. Mechel reported Joint Ore Reserves Committee (JORC) and National Instrument (NI) 43–101-compliant chromite ore reserves of 20.3 Mt at an average grade of 30.4% Cr₂O₃ as of December 31, 2012 (Mechel OAO, 2013, p. 2, 121, 125–127).

Korea, Republic of.—Korea produced 2.131 Mt of stainless steel in 2012 compared with 2.116 Mt in 2011, and consumed 499 t of high-carbon ferrochromium in 2012 compared with 486 t in 2011 (CRU, 2014a, b).

Oman.—Oman produced chromite ore and was preparing to produce ferrochromium. Oman Chromite Company S.A.O.G. produced chromite ore in the mountains near Sohar (Oman Chromite Company S.A.O.G., undated). Gulf Mining Materials Company, a Gulf Mining Group company, produced chromite ore (Gulf Mining Group, undated).

Four ferrochromium plants were planned or under construction in the Sohar Free Zone. Al Tamman Indsil Ferro Chrome, a joint venture of Muscat Overseas Group and Indsil Group (India), planned to start up a 150,000-t/yr ferrochromium plant with 75,000-t/yr production capacity by 2013 and an additional 75,000-t/yr capacity by 2014. Bahar Oman Metals planned a 100,000-t/yr ferrochromium plant, and Gulf Mining Materials planned a ferrochromium smelter. Metkore Alloys & Industries Ltd. was building a 165,000-t/yr ferrochromium plant that was expected to be operational in 2014 (James, 2013; Bahar Metals Metals LLC, undated).

Russia.—Russia produced 0.099 Mt of stainless steel in 2012 compared with 0.102 Mt in 2011. Russia produced 260,000 t of high-carbon ferrochromium in 2012 compared with 252,000 t in 2011, and consumed 99,000 t of high-carbon ferrochromium in 2012 compared with 347,123 t in 2011 (CRU, 2014a, b). Russia exported 367,594 t of ferrochromium in 2012 compared with 347,123 t in 2011 and imported 63 t in 2012 compared with 102 t in 2011 (TEX Report, The, 2013). Mechel produced ferrochromium at the Tikhvin Ferroalloy Plant (see Kazakhstan).

South Africa.—South Africa produced chromite ore, chromium chemicals, ferrochromium, and stainless steel. In 2012, South Africa was the leading producer of chromite ore and ferrochromium. South Africa reported chromite ore production of 10.824 Mt in 2011 compared with 10.871 Mt in 2010 and exported 2.063 Mt in 2011 compared with 1.929 Mt in 2010. South Africa reported ferrochromium production of 3.422 Mt in 2011 compared with 3.607 Mt in 2010, and exported 3.037 Mt in 2011 compared with 3.116 Mt in 2010 (Ntshobane, 2012, p. 156–162). The South African Department of Minerals and Energy reported that 13 companies operated

27 chromite ore mines and that 7 companies produced ferrochromium at 14 plants having a collective production capacity of 3.697 Mt/yr of ferrochromium in 2011 (Moisane, 2011, p. 1–12). South Africa produced 0.505 Mt of stainless steel in 2012 compared with 0.444 Mt in 2011, produced 2,891 t of high-carbon ferrochromium in 2012 compared with 3,255 t in 2011, and consumed 140,000 t of high-carbon ferrochromium in 2012 compared with 125,000 t in 2011 (CRU, 2014a, b).

Afarak (Finland) was developing the Mecklenburg Mine and Waylox Mine and was expanding the Stellite Mine and Mogale Alloys. Afarak commissioned the Mecklenburg Mine (Afarak Group Plc, 2013a, b).

Spain.—Spain produced 0.844 Mt of stainless steel in 2012 compared with 0.807 Mt in 2011, and consumed 156,000 t of high-carbon ferrochromium in 2012 compared with 150,000 t in 2011 (CRU, 2014a, b).

Sweden.—Sweden produced ferrochromium and stainless steel. Sweden produced 0.510 Mt of stainless steel in 2012 compared with 0.586 Mt in 2011, produced 40,000 t of high-carbon ferrochromium in 2012 compared with 82,000 t in 2011, and consumed 110,000 t in 2012 compared with 119,000 t in 2011 (CRU, 2014a, b). Vargön Alloys AB, a Yildirim Group (Turkey) company, produced ferrochromium from a ferrochromium operation with a production capacity of about 220,000 t/yr.

Taiwan.—Taiwan produced 1.106 Mt of stainless steel in 2012 compared with 1.203 Mt in 2011, and consumed 291,000 t of high-carbon ferrochromium in 2012 compared with 316,000 t in 2011 (CRU, 2014a, b).

Turkey.—Turkey produced chromite ore and ferrochromium. Turkey produced 70,000 t of high-carbon ferrochromium in 2012 compared with 76,000 t in 2011, and consumed 10,000 t in 2012 compared with 18,000 t in 2011. Eti Krom Inc., a Yildirim Group company, mined chromite ore and produced ferrochromium. Eti Krom operated 79, mostly underground, chromite ore mines producing about 1 Mt/yr. Eti Krom also produced high-carbon ferrochromium at Elazig from a high-carbon ferrochromium operation with a production capacity of 160,000 t/yr (Ozdirek, 2013). Eti Elektrometalurji A.Ş. produced chromite ore, ferrosilicochromium, and low-carbon ferrochromium. Eti Elektrometalurji produced about 100,000 t of chromite ore from 12 mines, low-carbon ferrochromium from an operation with a production capacity of 36,000 t/yr, and ferrosilicochromium from an operation with a production capacity of 16,000 t/yr (Eti Elektrometalurji A.Ş., undated). Dedeman Madencilik (undated) mined chromite ore.

United Kingdom.—The United Kingdom produced chromium metal and stainless steel. London & Scandinavian Metallurgical Co. Ltd. produced chromium metal. The United Kingdom produced 0.290 Mt of stainless steel in 2012 compared to 0.330 Mt in 2011, and consumed 49,000 t of high-carbon ferrochromium in 2012 compared with 55,000 t in 2011 (CRU, 2014a, b).

The British Geological Survey reported that the United Kingdom had apparent consumption of chromium contained in ferrochromium of 49,300 t in 2011 and iron and steel industry consumption of 38,210 t (Bride and others, 2013, p. 29).

Zimbabwe.—Zimbabwe produced chromite ore and ferrochromium. Zimbabwe produced 155,000 t of high-carbon ferrochromium in 2012 compared with 196,000 t in 2011, and consumed 8,000 t in 2012 compared with 7,000 t in 2011 (CRU, 2014a, b).

Outlook

The outlook for chromium consumption in the United States and the rest of the world is about the same as that for stainless steel, which is the leading end use for chromium worldwide. In 2012, China was the leading stainless steel producer.

The practice of supplying chromium in the form of ferrochromium by countries that mine chromite ore was interrupted as China became a major consumer of chromite ore to produce ferrochromium, and South Africa experienced limited electrical power supply. The trend was expected to continue as China closed small, inefficient, environmentally unfriendly ferroalloy production facilities. The increasing price of ferrochromium sustained independent ferrochromium producers in China; however, other factors being equal, ferrochromium production is most cost-effective when the ferrochromium plant is located close to the chromite mine. With new, efficient, and reliable ferrochromium production facilities in chromite-ore-producing countries, ferrochromium production capacity and production are expected to diminish in countries where ferrochromium production facilities are not located near chromite ore resources. Other factors of production, such as electrical energy or labor costs, can offset chromite ore transportation costs. Further vertical integration of the chromium industry is expected as countries that produce chromite ore expand ferrochromium or stainless steel production capacity.

Chromite Ore.—Chromite ore is predominantly used to make ferrochromium that is used to make metal alloys. Lesser amounts of chromite ore are used to make chromium chemicals or refractory products. Chromite ore production capacity was expected to remain in balance with average consumption. To improve chromite ore availability and to stabilize feed material prices, ferrochromium producers have invested in mines that produce chromite ore. Most chromite ore is produced under vertically integrated mine-smelter or mine-plant ownership. As platinum mining moves to chromite-bearing seams in South Africa, a greater portion of chromite is likely to be supplied as byproduct from such operations. Platinum may become a byproduct of some chromite operations when efficient recovery of platinum from chromite ore tailings is developed. In addition to increased production from the leading chromite ore producers (India, Kazakhstan, and South Africa), chromite ore production in the Middle East (Oman, Turkey, and United Arab Emirates) is expected to increase to meet increasing demand.

Ferrochromium.—Ferrochromium is predominantly used to make stainless steel. Lesser amounts of ferrochromium are used to make alloy steel or superalloys. The outlook for ferrochromium is the same as that for metal alloys.

Chromium Metal.—The Delachaux Group reported 2011 world chromium metal production to have been 41,000 t and projected production of 43,000 t in 2012 and 44,000 to 45,000 t in 2013 (Steelguru, 2012).

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TABLE 1
SALIENT CHROMIUM STATISTICS¹

	2008	2009	2010	2011	2012	
World, production, contained chromium:						
Chromite ore (mine) ²	metric tons	7,320,000	6,010,000 ^r	7,530,000 ^r	7,940,000 ^r	7,890,000
Ferrochromium (smelter) ³	do.	4,590,000	4,000,000 ^r	5,300,000	5,310,000 ^r	5,120,000
Stainless steel ⁴	do.	4,540,000	4,440,000	5,370,000	5,610,000 ^r	5,930,000
U.S. supply:						
Components of U.S. supply, contained chromium:						
Domestic mines	do.	--	--	--	--	--
Secondary ⁵	do.	146,000	141,000	144,000	147,000	146,000
Imports:						
Chromite ore ²	do.	64,300	23,000	43,800 ^r	70,300	90,800
Chromium chemicals	do.	18,000	10,600	5,120	4,270	5,880
Chromium ferroalloys	do.	307,000	140,000	305,000	311,000	302,000
Chromium metal	do.	13,100	7,570	13,000	13,600	15,300
Stainless steel mill products and scrap	do.	157,000	91,800	133,000	132,000	140,000
Stocks, January 1:						
Government	do.	115,000	155,000 ⁶	129,000	115,000	111,000
Industry ⁷	do.	9,940	7,290	6,820	7,300	7,770
Total	do.	831,000	576,000	779,000	800,000	819,000
Distribution of U.S. supply, contained chromium:						
Exports:						
Chromite ore ²	do.	2,280	743	1,390	1,930	6,930
Chromium chemicals	do.	22,600	13,500	21,600	20,600	17,700
Chromium ferroalloys and metal	do.	11,300	2,900	4,850	3,060	3,070
Stainless steel mill products and scrap	do.	250,000	263,000	246,000	206,000	206,000
Stocks, January 1:						
Government	do.	105,000 ⁸	129,000	115,000	111,000	107,000
Industry ⁷	do.	7,290	6,820	7,300	7,770 ^r	7,670
Total	do.	399,000	416,000	396,000	351,000 ^r	348,000
Production, reported, chromium ferroalloy and metal net production ⁹		W	W	--	--	--
Consumption						
Apparent, contained chromium	do.	432,000	160,000	384,000	450,000 ^r	470,000
Reported:						
Chromite ore and concentrates, gross quantity	do.	W	W	W	W	W
Chromium ferroalloys: ¹⁰						
Gross weight	do.	427,000	383,000	423,000	429,000 ^r	436,000
Contained chromium	do.	251,000	224,000	248,000	248,000 ^r	251,000
Chromium metal, gross quantity	do.	4,740	4,190	4,540	4,490 ^r	4,940
Stocks, December 31, gross quantity:						
Government						
Chromite ore	do.	--	--	--	--	--
Chromium ferroalloys	do.	140,000 ⁸	175,000	154,000	150,000	144,000
Chromium metal	do.	4,820	4,670	4,430	4,230	4,090
Industry:						
Producer ¹¹	do.	W	W	W	W	W
Consumer:						
Chromium ferroalloys ¹²	do.	11,700	10,900	11,500	12,600 ^r	12,500
Chromium metal	do.	235	149	284	186 ^r	228
Other	do.	271 ^r	263	244 ^r	239 ^r	211
Prices, average annual:						
Chromite ore ¹³	dollars per metric ton	346	159	208	216	168
Ferrochromium, chromium content ¹⁴	dollars per pound	1.79	0.81	1.17	1.15	1.08
Aluminothermic chromium metal, gross quantity ¹⁵	do.	5.30	4.08	5.23	6.56	5.87
Value of trade: ¹⁶						
Exports	thousands	\$149,000	\$86,600	\$131,000	\$124,000	\$145,000
Imports	do.	\$1,430,000	\$444,000	\$1,010,000	\$1,130,000	\$1,100,000
Net imports ¹⁷	do.	-1,280,000	-358,000	-884,000	-1,010,000	-952,000

See footnotes at end of table.

TABLE 1—Continued
SALIENT CHROMIUM STATISTICS¹

	2008	2009	2010	2011	2012	
U.S. supply:—Continued						
Stainless steel:						
Production:						
Gross quantity ¹⁸	metric tons	1,930,000	1,620,000	2,200,000	2,070,000	1,980,000
Contained chromium ¹⁹	do.	324,000	276,000	383,000	353,000	NA
Average grade, dimensionless ²⁰		0.1684	0.1703	0.1738	0.1703	NA
Shipments, gross quantity ²¹		1,380,000	1,200,000	1,510,000	1,890,000	1,900,000
Exports, gross quantity		471,000	414,000	508,000	558,000	590,000
Imports, gross quantity		783,000	416,000	585,000	605,000	668,000
Scrap, gross quantity:						
Receipts		858,000	832,000	846,000	866,000	858,000
Consumption		1,330,000	1,260,000	1,280,000	1,300,000	1,300,000
Exports		1,000,000	1,130,000	937,000	656,000	624,000
Imports		140,000	124,000	195,000	169,000	155,000
Value of trade:						
Exports	thousands	\$2,300,000	\$1,450,000	\$2,120,000	\$2,510,000	\$2,380,000
Imports	do.	\$4,040,000	\$1,710,000	\$2,310,000	\$2,650,000	\$2,690,000
Scrap exports	do.	\$1,190,000	\$777,000	\$936,000	\$958,000	\$804,000
Scrap imports	do.	\$217,000	\$138,000	\$305,000	\$295,000	\$236,000
Net imports ^{17, 22}	do.	-\$773,000	\$384,000	\$433,000	\$523,000	\$260,000

¹Revised. do. Ditto. NA Not Available. W Withheld to avoid disclosing company proprietary data. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Calculated assuming chromite ore to average 45% Cr₂O₃, which is 68.42% chromium.

³Calculated assuming chromium content of ferrochromium to average 57% chromium.

⁴Calculated from American Iron and Steel Institute reported stainless steel production assuming chromium content of stainless steel to average 16.7% chromium.

⁵Calculated assuming chromium content of stainless steel to average 17% chromium.

⁶From January 1, 2009, to December 31, 2009, the Defense Logistics Agency (DLA) made an accounting adjustment to low-carbon ferrochromium stocks making A35them (the stocks for those months) incompatible for the purpose of computing stock change for that year. January stocks were estimated.

⁷Includes consumer stocks of chromium ferroalloys and metal and other chromium-containing materials.

⁸From January 1, 2008, to December 31, 2008, the DLA changed its high-carbon and low-carbon ferrochromium stocks accounting method making them (the stocks for those months) incompatible for the purpose of computing stock change for that year. December stocks were estimated based on monthly stock changes excluding the accounting-change month.

⁹Includes chromium ferroalloys and metal and other chromium materials in the United States.

¹⁰Chromium ferroalloys, chromite ore, and other chromium-containing materials excluding chromium metal.

¹¹Chromium ferroalloys and metal producer stocks of chromium ferroalloys and metal.

¹²Consumer stocks of high- and low-carbon ferrochromium and ferrochromium-silicon.

¹³Time-weighted average price of South African chromite ore that contains 44% Cr₂O₃ free on board (f.o.b.) South Africa as reported in Ryan's Notes.

¹⁴Time-weighted average U.S. price of imported high-carbon chromium that contains 49% to 51% chromium as reported in Ryan's Notes.

¹⁵Annual average U.S. price of imported aluminothermic chromium metal as reported by Ryan's Notes.

¹⁶Includes chromite ore and chromium ferroalloys, metal, and chemicals.

¹⁷Negative data indicate that imports are greater than exports.

¹⁸Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel production and shipments.

¹⁹Estimated mass-weighted average of the mean chromium content of stainless steel production by grade. Uncertainty is approximately ±0.01, owing to the range of chromium chemical specification limits by stainless steel grade.

²⁰Ratio of estimated mass-weighted average chromium content of stainless steel production by grade to production. Expressed as a fraction.

²¹Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel shipments.

²²Includes stainless steel and stainless steel scrap.

TABLE 2
U.S. REPORTED CONSUMPTION AND STOCKS OF CHROMIUM PRODUCTS¹

(Metric tons)

	2011		2012		Change ²	
	Gross quantity	Chromium content	Gross quantity	Chromium content	Quantity	Percent
Consumption by end use:						
Alloy uses:						
Steel:						
Carbon steel	7,430 ^r	4,570 ^r	6,730	4,310	-696	-9
High-strength low-alloy steel	3,150 ^r	2,070 ^r	2,730	1,790	-419	-13
Stainless and heat-resisting steel	363,000 ^r	209,000 ^r	374,000	213,000	11,000	3
Fully alloy steel	21,300 ^r	12,800 ^r	16,900	10,100	-4,400	-21
Unspecified steel ³	23,500 ^r	13,800 ^r	23,600	13,900	122	1
Superalloys	10,400 ^r	7,700 ^r	12,600	9,450	2,280	22
Other alloys and uses ⁴	4,740 ^r	3,400 ^r	4,860	3,420	123	3
Total	433,000^r	253,000^r	441,000	256,000	8,050	2
Consumption by material:						
Low-carbon ferrochromium	26,700 ^r	18,200 ^r	26,600	18,200	-78	(6)
High-carbon ferrochromium	373,000 ^r	219,000 ^r	380,000	221,000	6,820	2
Ferrochromium silicon	(5)	(5)	(5)	(5)	(5)	W
Chromium metal	4,490 ^r	4,490 ^r	4,940	4,940	452	10
Chromium-aluminum alloy	366 ^r	267 ^r	371	257	5	1
Other chromium materials	28,200 ^r	11,200 ^r	29,100	11,400	852	3
Total	433,000^r	253,000^r	441,000	256,000	8,050	2
Consumer stocks:						
Low-carbon ferrochromium	1,900 ^r	1,300 ^r	1,770	1,210	-133	-7
High-carbon ferrochromium	10,100 ^r	5,930 ^r	10,100	5,870	-38	(6)
Ferrochromium silicon	(5)	(5)	(5)	(5)	(5)	(5)
Chromium metal	186 ^r	186 ^r	228	228	42	22
Chromium-aluminum alloy	(5)	(5)	(5)	(5)	(5)	(5)
Other chromium materials	820 ^r	361 ^r	863	366	43	5
Total	13,000^r	7,770^r	12,900	7,670	-87	-1
National Defense Stockpile stocks:^{7,8}						
Chromium ferroalloys:⁹						
High-carbon ferrochromium	95,200	68,000	94,300	67,300	-902	-1
Low-carbon ferrochromium	54,300	38,800	49,400	35,200	-4,990	-9
Chromium metal ¹⁰	4,230	4,230	4,090	4,090	-136	-3

W Withheld to avoid disclosing company proprietary data; included in "Total."

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Change based on gross quantity of unrounded data of current year compared with that of previous year.

³Includes electrical, tool, and unspecified steel end uses.

⁴Includes cast irons, welding and alloy hard-facing rods and materials, wear- and corrosion-resistant alloys, and aluminum, copper, magnetic, nickel, and other alloys.

⁵Withheld to avoid disclosing company proprietary data; included in "Other chromium materials."

⁶Less than ½ unit.

⁷The source for stockpile information is the Defense Logistics Agency, DLA Strategic Materials.

⁸The DLA data are based on the "Total Uncommitted Inventory" of stockpile material D-1 report.

⁹Chromium content estimated using 71.4% chromium.

¹⁰Chromium content estimated using 100% chromium.

TABLE 3
VALUE OF IMPORTS AND U.S. PRICE QUOTATIONS FOR CHROMIUM MATERIALS¹

Material	2011		2012		
	Contained chromium	Gross quantity	Contained chromium	Gross quantity	
Value: ^{2,3}					
Chromite ore:					
Not more than 40% chromic oxide	dollars per metric ton	1,490	528	XX	XX
More than 40% but less than 46% chromic oxide	do.	814	252	781	238
46% or more chromic oxide	do.	986	372	1,240	410
Average	do.	965	355	1,200	392
Ferrochromium:					
Not more than 0.5% carbon	do.	5,000	3,460	4,820	3,330
More than 0.5% but not more than 3% carbon	do.	4,080	2,320	3,580	2,440
More than 3% but not more than 4% carbon	do.	1,400	794	992	536
Average (not more than 4% carbon)	do.	4,920	3,380	4,620	3,180
More than 4% carbon	do.	2,270	1,300	2,050	1,170
Average (all grades)	do.	2,600	1,530	2,360	1,380
Chromium metal ⁴	do.	XX	14,100	XX	13,300
Price: ⁵					
Chromite ore:					
Turkey					
36% to 38% Cr ₂ O ₃	do.	1,250 ⁶	317	959 ⁶	243
40% to 42% Cr ₂ O ₃	do.	1,190 ⁶	334	930 ⁶	261
South Africa					
39% Cr ₂ O ₃	do.	779	208	575	153
44% Cr ₂ O ₃	do.	718	216	558	168
High-carbon ferrochromium:					
49% to 51% chromium	cents per pound	115	XX	108	XX
60% to 65% chromium	do.	122	XX	110	XX
Low-carbon ferrochromium					
0.05% carbon	do.	246	XX	234	XX
0.10% carbon	do.	228	XX	217	XX
0.15% carbon	do.	219	XX	210	XX
Chromium metal:					
Imported, aluminothermic	do.	XX	656	XX	587

do. Ditto. XX Not applicable.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Mass-weighted average based on customs value and quantity of imported material.

³Reported by the U.S. Census Bureau.

⁴Average for all grades.

⁵Source: Ryan's Notes.

⁶Based on average Cr₂O₃ content.

TABLE 4
U.S. EXPORTS OF CHROMIUM METAL, BY TYPE¹

HTS ² code	Type	2011		2012		Principal destinations in 2012 (Quantity in metric tons, value in thousands)
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
2610.00.0000	Chromite ore and concentrates, gross quantity	5,250	\$3,520	21,200	\$9,870	China (12,000, \$4,480); Mexico (2,970, \$1,860); Canada (2,920, \$1,580).
	Metal and alloy, gross quantity:					
8112.21.0000	Unwrought chromium powders	345	8,020	326	8,130	Brazil (54, \$844); Japan (47, \$714); Germany (40, \$1,850); Mexico (33, \$561); Taiwan (26, \$810); China (19, \$513); United Kingdom (18, \$439); Venezuela (16, \$116); India (15, \$515).
8112.22.0000	Chromium metal waste and scrap	18	428	3	53	Malaysia (2, \$31); Philippines (1, \$13).
8112.29.0000	Chromium metal other than unwrought powders and waste and scrap	194	5,360	134	4,820	France (20, \$493); Mexico (15, \$397); United Kingdom (15, \$352); Japan (14, \$767); Brazil (13, \$496); Taiwan (12, \$414); Canada (9, \$148); Ireland (7, \$176); Hong Kong (4, \$161).
	Total chromium metal	557	13,800	462	13,000	
	Chromium ferroalloys:					
7202.41.0000	High-carbon ferrochromium: ³					
	Gross quantity	4,260	5,360	4,460	5,790	Brazil (1,940, \$2,460); Argentina (592, \$527); Mexico (356, \$470); Thailand (337, \$465); Chile (242, \$351); Canada (216, \$298).
	Contained chromium	1,940	XX	2,240	XX	
7202.49.0000	Low-carbon ferrochromium: ⁴					
	Gross quantity	1,030	2,250	768	1,350	Canada (338, \$668); Mexico (300, \$462); Peru (104, \$176); Brazil (19, \$26); Colombia (4, \$16); Indonesia (2, \$3).
	Contained chromium	549	XX	347	XX	
7202.49.0000	Ferrochromium-silicon:					
	Gross quantity	28	64	64	105	Canada (all).
	Contained chromium	10	XX	22	XX	
	Total chromium ferroalloys:					
	Gross quantity	5,330	7,670	5,300	7,250	
	Contained chromium	2,500	XX	2,610	XX	
	Chemicals, gross quantity:					
	Chromium oxides:					
2819.10.0000	Chromium trioxide	13,000	22,000	17,300	48,600	Japan (3,710, \$10,300); Brazil (2,340, \$6,010); China (1,990, \$6,090); Republic of Korea (1,170, \$3,540); United Kingdom (1,080, \$2,590); India (1,010, \$2,570); Chile (661, \$1,380); Indonesia (524, \$1,780); Mexico (470, \$1,940); Germany (461, \$1,490); Italy (414, \$1,100); Colombia (394, \$1,090).
2819.90.0000	Other	4,800	32,800	5,480	39,600	Spain (1,460, \$8,370); Belgium (1,250, \$8,600); United Kingdom (1,100, \$9,140); Canada (304, \$2,250); Brazil (216, \$1,380); Germany (146, \$1,570).
	Total chromium oxides	17,800	54,800	22,800	88,200	Mexico (14, \$96); Republic of Korea (14, \$94); Taiwan (9, \$42); Vietnam (3, \$15).
2833.29.4000	Chromium sulfates	53	263	40	254	
	Salts of oxometallic or peroxometallic acids:					
2841.90.4500	Zinc and lead chromate	4	396	3	227	South Africa (2, \$181); Jamaica (1, \$3).
2841.30.0000	Sodium dichromate	30,100	28,900	14,000	18,600	Mexico (5,360, \$7,320); Japan (4,520, \$3,800); Canada (3,200, \$4,650); Republic of Korea (164, \$408); Brazil (151, \$149); Taiwan (129, \$259); Thailand (113, \$90); India (108, \$1,568); Peru (76, \$42); Malaysia (57, \$64); Colombia (55, \$127); Chile (38, \$21); Indonesia (37, \$33); Singapore (19, \$43); China (19, \$10); Australia (2, \$31).
2841.50.1000	Potassium dichromate	72	152	103	188	Mexico (64, \$76); Taiwan (16, \$61); Netherlands (10, \$12); Venezuela (9, \$8); Australia (2, \$7); Colombia (1, \$7); France (1, \$9).

See footnotes at end of table.

TABLE 4—Continued
U.S. EXPORTS OF CHROMIUM METAL, BY TYPE¹

HTS ² code	Type	2011		2012		Principal destinations in 2012 (Quantity in metric tons, value in thousands)
		Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
	Chemicals, gross quantity—Continued:					
	Salts of oxometallic or peroxometallic acids—Continued:					
2841.50.9100	Other	928	3,940	388	1,710	Republic of Korea (126, \$569); Canada (51, \$245); China (44, \$159); Mexico (35, \$80); Vietnam (23, \$84); Indonesia (19, \$37); Thailand (12, \$49); Turkey (11, \$31).
	Total salts	31,100	33,400	14,500	20,700	
3206.20.0000	Pigments and preparations, gross quantity	1,810	10,600	791	5,480	Mexico (509, \$3,000); Canada (110, \$837); Brazil (42, \$130).
	XXX Not applicable.					

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States of America.

³More than 4% carbon.

⁴Not more than 4% carbon.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY¹

Country	Not more than 0.5% carbon (HTS ² code 7202.49.5090)			More than 0.5% carbon, but not more than 3% carbon (HTS ² code 7202.49.5010)			More than 3% carbon, but not more than 4% carbon (HTS ² code 7202.49.1000)			More than 4% carbon (HTS ² code 7202.41.0000)			Total all grades		
	Gross quantity (metric tons)	Cr content (metric tons)	Value (thousands)	Gross quantity (metric tons)	Cr content (metric tons)	Value (thousands)	Gross quantity (metric tons)	Cr content (metric tons)	Value (thousands)	Gross quantity (metric tons)	Cr content (metric tons)	Value (thousands)	Gross quantity (metric tons)	Cr content (metric tons)	Value (thousands)
2011:															
Albania	284	197	\$593	--	--	--	--	--	--	8,520	5,440	\$12,500	8,800	5,630	\$13,100
Belgium	61	41	266	--	--	(3)	(3)	\$4	--	--	--	--	61	41	269
Brazil	1,220	729	3,170	--	--	--	--	--	--	--	--	--	1,220	729	3,170
China	708	466	2,460	--	--	--	3	2	9	214	111	212	711	468	2,470
Finland	--	--	--	--	--	--	--	--	--	214	111	212	214	111	212
Germany	6,540	4,580	31,600	--	--	--	--	--	--	--	--	--	6,540	4,580	31,600
India	--	--	--	95	54	105	13,400	8,080	19,300	--	--	--	13,500	8,140	19,400
Japan	2,660	1,860	13,500	--	--	--	--	--	--	--	--	--	2,660	1,860	13,500
Kazakhstan	8,070	5,660	23,200	--	--	--	120,000	83,000	190,000	--	--	--	128,000	88,700	213,000
Netherlands	17	11	61	--	--	--	--	--	--	--	--	--	17	11	61
Portugal	--	--	--	--	--	--	501	323	719	--	--	--	501	323	719
Russia	31,400	21,600	101,000	40	31	\$150	1,390	786	1,020	33,000	21,900	56,500	65,800	44,300	159,000
South Africa	20	11	61	353	193	762	--	--	--	243,000	119,000	248,000	244,000	120,000	249,000
Sweden	20	14	103	--	--	--	--	--	--	11,100	7,370	22,300	11,100	7,390	22,400
Turkey	2,770	1,970	9,410	--	--	--	20	14	64	8,690	5,680	16,000	11,500	7,660	25,500
Vietnam	--	--	--	--	--	--	--	--	--	150	90	360	150	90	360
Zimbabwe	--	--	--	--	--	--	23,800	13,900	37,000	23,800	13,900	37,000	23,800	13,900	37,000
Total	53,700	37,100	186,000	393	224	912	1,510	855	1,200	462,000	265,000	602,000	518,000	304,000	790,000
2012:															
Albania	--	--	--	--	--	--	--	--	--	3,440	2,240	5,080	3,440	2,240	5,080
Belgium	35	23	128	--	--	--	40	22	22	--	--	--	75	46	151
Brazil	316	179	855	--	--	--	--	--	--	--	--	--	316	179	855
China	60	38	295	144	95	205	--	--	--	197	137	347	401	270	847
France	1	1	3	--	--	--	--	--	--	--	--	--	1	1	3
Germany	5,760	4,000	25,800	1,340	886	1,960	--	--	--	13,400	8,150	17,300	7,100	4,890	27,800
India	--	--	--	--	--	--	--	--	--	--	--	--	13,400	8,150	17,300
Japan	1,790	1,250	8,770	--	--	--	--	--	--	--	--	--	1,790	1,250	8,770
Kazakhstan	3,830	2,680	10,400	3,070	2,130	8,090	--	--	--	92,700	64,200	126,000	99,600	69,000	144,000
Russia	27,800	19,100	85,600	2,600	1,810	7,320	371	200	198	29,400	19,300	41,000	60,200	40,400	134,000
South Africa	500	338	1,530	442	242	898	--	--	--	235,000	116,000	228,000	236,000	117,000	231,000
Spain	--	--	--	--	--	--	20	13	33	20	13	33	20	13	33
Sweden	--	--	--	--	--	--	12,800	8,550	23,000	12,800	8,550	23,000	12,800	8,550	23,000
Switzerland	--	--	--	--	--	--	16	8	28	16	8	28	16	8	28
Turkey	3,810	2,730	12,800	--	--	--	32,000	21,100	49,600	32,000	21,100	49,600	35,800	23,800	62,300
Zimbabwe	--	--	--	--	--	--	29,400	16,900	35,700	29,400	16,900	35,700	29,400	16,900	35,700
Total	43,900	30,300	146,000	7,580	5,150	18,500	411	222	221	449,000	257,000	526,000	500,000	293,000	691,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 5—Continued
U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY¹

²Harmonized Tariff Schedule of the United States of America.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE¹

HTS ² code	Type	2011			2012			Sources in 2012 (Quantity in metric tons, value in thousands)
		Quantity (metric tons)	Value ³ (thousands)	Quantity (metric tons)	Value ³ (thousands)	Quantity in metric tons, value in thousands		
Chromite ore:								
2610.00.0020	Not more than 40% Cr ₂ O ₃ :							
	Gross quantity	151	\$80	--	--			
	Cr ₂ O ₃ content	78	XX	--	XX			
2610.00.0040	More than 40%, but less than 46% Cr ₂ O ₃ :							
	Gross quantity	27,900	7,040	29,000	6,910	South Africa (29,000, \$6,910); Canada (24, \$4).		
	Cr ₂ O ₃ content	12,600	XX	12,900	XX			
2610.00.0060	46% or more Cr ₂ O ₃ :							
	Gross quantity	163,000	60,700	248,000	102,000	South Africa (248,000, \$102,000); Turkey (69, \$40); Belgium (16, \$22); Russia (1, \$3); Canada (1, \$2).		
	Cr ₂ O ₃ content	90,000	XX	120,000	XX			
Total chromite ore:								
	Gross quantity	191,000	67,900	277,000	109,000			
	Cr ₂ O ₃ content	103,000	XX	133,000	XX			
Chromium ferroalloys:								
Ferrochromium:								
7202.49.5090	Not more than 0.5% carbon:							
	Gross quantity	53,700	186,000	43,900	146,000	Russia (27,800, \$85,600); Germany (5,760, \$25,800); Kazakhstan (3,830, \$10,400); Turkey (3,810, \$12,800); Japan (1,790, \$8,770); South Africa (500, \$1,530); Brazil (316, \$855); China (60, \$295); Belgium (35, \$128); France (1, \$3).		
	Cr content	37,100	XX	30,300	XX			
7202.49.5010	More than 0.5%, but less than 3% carbon:							
	Gross quantity	393	912	7,580	18,500	Kazakhstan (3,070, \$8,090); Russia (2,600, \$7,320); Germany (1,340, \$1,960); South Africa (442, \$898); China (144, \$205).		
	Cr content	224	XX	5,150	XX			
	More than 3%, but less than 4% carbon:							
	Gross quantity	1,510	1,200	411	221	Russia (371, \$198); Belgium (40, \$22).		
	Cr content	855	XX	222	XX			
	More than 4% carbon:							
	Gross quantity	462,000	602,000	449,000	526,000	South Africa (235,000, \$228,000); Kazakhstan (92,700, \$126,000); Turkey (32,000, \$49,600); Russia (29,400, \$41,000); Zimbabwe (29,400, \$35,700); India (13,400, \$17,300); Sweden (12,800, \$23,000); Albania (3,440, \$5,080); China (197, \$347); Spain (20, \$33); Switzerland (16, \$28).		
	Cr content	265,000	XX	257,000	XX			
7202.50.0000	Ferrochromium-silicon:							
	Gross quantity	20,000	33,600	25,800	36,500	Kazakhstan (22,800, \$31,600); Russia (3,040, \$4,930).		
	Cr content	7,820	XX	9,730	XX			
Total chromium ferroalloys:								
	Gross quantity	538,000	824,000	526,000	728,000			
	Cr content	311,000	XX	302,000	XX			
Chromium metal, gross quantity:								
8112.21.0000	Unwrought chromium powders	2,720	40,000	3,060	43,000	China (915, \$13,500); Russia (782, \$8,590); France (690, \$11,500); United Kingdom (536, \$7,270); Belgium (57, \$889); Spain (48, \$456); Germany (22, \$763); Japan (5, \$105).		

See footnotes at end of table.

TABLE 6—Continued
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE¹

HTS ² code	Type	2011		2012		Sources in 2012 (Quantity in metric tons, value in thousands)
		Quantity (metric tons)	Value ³ (thousands)	Quantity (metric tons)	Value ³ (thousands)	
8112.22.0000	Chromium metal, gross quantity—Continued: Waste and scrap	574	2,090	415	1,950	Mexico (374, \$1,020); Singapore (20, \$566); Japan (12, \$197); Taiwan (3, \$35); Germany (2, \$99); Canada (2, \$12); China (1, \$27).
8112.29.0000	Other than waste and scrap	10,300	150,000	11,800	159,000	Russia (4,620, \$55,800); United Kingdom (3,190, \$43,800); France (2,320, \$36,300); China (1,500, \$19,700); Germany (70, \$1,530); Spain (60, \$652); Netherlands (20, \$186); Japan (7, \$434); Canada (2, \$29); Liechtenstein (1, \$75).
	Total chromium metal	13,600	192,000	15,300	203,000	
	Chemicals, gross quantity:					
	Chromium oxides and hydroxides:					
2819.10.0000	Chromium trioxides	5,770	18,700	8,170	27,800	Turkey (5,380, \$16,400); Kazakhstan (2,030, \$7,090); China (358, \$2,330); South Africa (211, \$745); Spain (54, \$409); Colombia (49, \$378); Russia (40, \$136); Germany (18, \$70); Japan (17, \$123); Canada (11, \$36); France (3, \$17); Mexico (1, \$7).
2819.90.0000	Other	1,330	8,550	1,790	10,500	China (741, \$5,040); Germany (545, \$3,810); Canada (286, \$315); India (69, \$344); Kazakhstan (57, \$335); France (38, \$220); Colombia (27, \$237); Pakistan (10, \$71); Japan (6, \$38); Netherlands (5, \$34); Russia (2, \$8).
	Total oxides	7,100	27,300	9,960	38,200	
2833.29.4000	Sulfates of chromium	308	368	346	376	Turkey (288, \$318); India (39, \$36); Uruguay (19, \$22).
2841.90.4500	Salts of oxometallic or peroxometallic acids: Chromates of lead and zinc	144	628	69	351	Colombia (51, \$253); Japan (13, \$57); China (5, \$25).
2841.30.0000	Sodium dichromate	268	772	267	681	India (120, \$264); China (111, \$334); Turkey (36, \$83).
	Other chromates and dichromates:					
	Peroxo-chromates:					
2841.50.1000	Potassium dichromate	18	71	399	698	United Kingdom (all).
2841.50.9100	Other	243	936	597	2,230	Austria (439, \$1,510); Brazil (58, \$163); Colombia (34, \$144); Italy (30, \$105); Taiwan (16, \$72); Germany (9, \$163); China (6, \$42); France (6, \$23).
	Total salts	673	2,410	1,330	3,960	
2849.90.2000	Chromium carbide	276	5,690	171	3,600	China (81, \$1,230); Canada (43, \$1,200); United Kingdom (36, \$576); Germany (5, \$250); Austria (3, \$282); Japan (2, \$38); Russia (1, \$28).
	Total chromium chemicals	8,350	35,700	11,800	46,200	
	Pigments and preparations based on chromium, gross quantity:					
3206.20.0010	Chrome yellow	1,990	8,980	1,190	6,500	Canada (543, \$3,740); China (426, \$1,800); Colombia (162, \$687); Mexico (30, \$125); Germany (28, \$153).
3206.20.0020	Molybdenum orange	328	2,790	355	2,910	Canada (225, \$2,180); Colombia (108, \$618); Germany (18, \$83); China (4, \$28).
3206.20.0030	Zinc yellow	25	80	43	134	China (37, \$110); Mexico (6, \$24).

See footnotes at end of table.

TABLE 6—Continued
 U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE¹

HTS ² code	Type	2011		2012		Sources in 2012 (Quantity in metric tons, value in thousands)
		Quantity (metric tons)	Value ³ (thousands)	Quantity (metric tons)	Value ³ (thousands)	
	Pigments and preparations based on chromium, gross quantity—Continued:					
3206.20.0050	Other	306	1,740	267	1,840	France (119, \$539); Germany (51, \$511); Japan (45, \$259); India (22, \$153); Poland (19, \$136); Canada (4, \$29); China (4, \$176); Colombia (2, \$10).
	Total pigments	2,650	13,600	1,850	11,400	

XX Not applicable. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Harmonized Tariff Schedule of the United States of America.

³Customs import value generally represents a value in the foreign country, and therefore, excludes U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise into the United States.

TABLE 7
WORLD PRODUCTION CAPACITY AND CONSUMPTION OF CHROMITE ORE,
FERROCHROMIUM, CHROMIUM METAL, CHROMIUM CHEMICALS, AND STAINLESS STEEL^{5, 1}

(Thousand metric tons of contained chromium)

Country	Production capacity in 2012					Consumption ²		
	Ore	Ferro-chromium	Metal	Chemicals	Stainless steel	2010	2011	2012
Afghanistan	2	--	--	--	--	--	--	--
Albania	87	18	--	--	--	18	2	-14
Argentina	--	--	--	13	--	19	22	15
Australia	136	--	--	--	--	-45	-54	-139
Austria	--	--	--	--	11	84	124	159
Belgium	--	--	--	--	236	128	118	126
Brazil	193	72	--	--	76	207	163	170
Canada	--	--	--	--	--	18	15	16
China	60	1,490	15	140	2,520	3,500	3,730	3,520
Czech Republic	--	--	--	--	3	9	7	1
Finland	208	121	--	--	175	133	154	113
France	--	--	10	--	51	53	46	50
Germany	--	18	--	--	263	245	190	187
Greece	(3)	--	--	--	--	(3)	1	1
India	1,170	480	(3)	31	404	476	491	705
Indonesia	--	--	--	--	NA	-2	-2	-3
Iran	81	--	--	2	--	--	--	--
Italy	--	--	--	--	279	208	225	201
Japan	--	11	1	17	584	448	446	403
Kazakhstan	1,070	852	--	37	--	205	300	323
Korea, Republic of	--	--	--	--	329	279	271	282
Madagascar	40	--	--	--	--	(3)	37	3
Oman	259	--	--	--	--	-2	11	15
Pakistan	76	--	--	3	--	9	-5	26
Philippines	7	--	--	--	--	(3)	-2	(3)
Poland	--	--	--	--	--	8	12	12
Russia	275	353	25	31	30	129	277	274
Slovenia	--	--	--	--	20	10	16	16
South Africa	3,270	1,880	--	23	91	-11	-227	-103
Spain	--	--	--	--	161	88	83	89
Sudan	19	--	--	--	--	(3)	(3)	(3)
Sweden	--	74	--	--	100	50	29	36
Taiwan	--	--	--	--	237	224	158	147
Turkey	873	50	--	17	--	64	-29	185
Ukraine	--	--	--	--	37	--	28	20
United Arab Emirates	10	--	--	--	--	(3)	-6	--
United Kingdom	--	--	8	--	57	29	35	34
United States	--	--	--	38	360	294	345	342
Vietnam	17	--	--	--	--	--	--	-9
Zimbabwe	180	93	--	--	--	1	66	45
Total	8,040	5,500	58	352	6,020	XX	XX	XX

⁰Estimated. NA Not Available. XX Not applicable. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Estimated based on U.S. Geological Survey reported chromite ore production and United Nations trade statistics (COMTRADE) assuming that chromite ore imports are reported in contained Cr₂O₃; chromium ferroalloys, contained chromium; and exports, gross quantity.

³Less than ½ unit.

TABLE 8
CHROMITE: WORLD PRODUCTION, BY COUNTRY^{1,2,3}

(Metric tons, gross weight)

Country	2008	2009	2010	2011	2012 ^e
Afghanistan ^{e,4}	6,500	6,700 ^r	5,727 ^{r,5}	6,204 ^{r,5}	6,000
Albania ⁶	225,373 ^r	283,558 ^r	328,322 ^r	330,938 ^r	330,000
Australia	224,809	119,314	180,000 ^r	323,800 ^r	452,300 ⁵
Brazil ⁷	664,347	365,210	520,129	542,512 ^r	543,000 ^p
China ^e	200,000	200,000	200,000	200,000	200,000
Finland	613,543	246,817	598,000 ^r	692,527 ^r	425,217 ⁵
Greece ^{e,4}	1,400	1,400	1,400	1,600	1,600
India	3,900,000	3,760,000	3,800,000	3,850,000 ^e	3,900,000
Iran	268,586	268,586 ^r	45,000 ^r	100,000 ^{r,e}	100,000
Kazakhstan	3,552,000	3,544,000	3,760,000 ^e	3,800,000 ^e	4,000,000
Madagascar	112,613 ^r	133,000 ^r	134,500	66,700 ^r	67,000
Oman	859,748	636,482	801,856	616,700	554,800 ⁵
Pakistan	104,000	133,000 ^r	252,000 ^r	250,000 ^{r,e}	260,000
Philippines	15,268	14,322	14,807	22,794 ^r	23,890 ⁵
Russia	913,000	416,194	400,000 ^e	662,000 ^r	660,000
South Africa	9,682,640	7,560,938	10,871,095	10,721,360 ^r	11,000,000
Sudan	27,094	14,087	56,823	64,128 ^r	18,300 ⁵
Turkey	1,885,712	1,573,993	1,904,461	2,901,027 ^r	2,500,000
United Arab Emirates	34,350	23,770	25,000	--	--
Vietnam	55,880	37,105	40,000	40,000 ^e	40,000
Zimbabwe	442,584	193,673	510,000	599,079 ^r	550,000
Total	23,800,000	19,500,000 ^r	24,400,000 ^r	25,800,000 ^r	25,600,000

^eEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through February 25, 2014.

³Figures for all countries represent marketable output.

⁴Gross weight estimated assuming an average grade of 44% chromic oxide (Cr₂O₃).

⁵Reported figure.

⁶Ore grade was 18% to 42% chromic oxide (Cr₂O₃).

⁷Average chromic oxide (Cr₂O₃) content was as follows: 2008—42.5%; 2009—40.0%; 2010—49.7%; 2011—45.2% (revised); and 2012—45.0% (estimated).

TABLE 9
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Metric tons, gross weight)

Country ³	2008	2009	2010	2011	2012 ^c
Albania	11,916	7,556	23,233 ^r	28,694 ^r	29,000
Brazil ⁴	194,324	131,048	277,114	145,122 ^r	150,000 ^p
China ^c	1,500,000	1,810,000	2,400,000	2,700,000 ^r	2,800,000
Finland ^c	233,550 ⁵	123,310 ⁵	125,000	125,000	125,000
Germany ^c	26,960 ⁵	13,667 ⁵	17,300	17,800	17,500
India ^{c, 6}	750,000	873,385 ⁵	850,000	830,000	800,000
Iran	NA	NA	NA	NA	NA
Japan ⁴	13,888	7,698	16,208	17,217 ^r	18,000
Kazakhstan	1,220,315	1,173,286	1,311,302	1,289,917 ^r	1,305,566 ⁵
Romania	6,000	15,000	14,000	--	--
Russia	490,000 ^e	378,000	414,288 ^r	501,700 ^r	500,000
South Africa ⁷	3,268,659	2,346,132	3,607,132	3,425,911 ^r	3,000,000
Sweden ^c	117,053 ⁵	31,345 ⁵	36,000	36,000	36,000
Turkey ^c	79,840 ⁵	41,028 ⁵	60,000	60,000	60,000
United States ⁸	W	W	--	--	--
Zimbabwe	145,430	72,223	146,000	140,000 ^e	137,534 ^{p, 5}
Total	8,060,000 ^r	7,020,000 ^r	9,300,000 ^r	9,320,000 ^r	8,980,000

^cEstimated. ^pPreliminary. ^rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

¹World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through February 25, 2014.

³In addition to the countries listed, Iran is known to have produced ferrochromium, but information is inadequate to make reliable estimates of output levels.

⁴Includes high- and low-carbon ferrochromium.

⁵Reported figure.

⁶Reported on a fiscal year basis, which is from April 1 to March 31. Includes ferrochrome and charge chrome.

⁷Includes high- and low-carbon ferrochromium and ferrochromium-silicon.

⁸Includes chromium metal, high- and low-carbon ferrochromium, ferrochromium-silicon, and other chromium materials.