USGS
science for a changing world

2011 Minerals Yearbook

CHROMIUM

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

December 2013

Chromium

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 2011, the U.S. chromium supply (measured in contained chromium) was 147,000 metric tons (t) from domestically recycled stainless steel scrap, 531,000 t from imports, and 122,000 t from Government and industry stocks. Supply distribution was 232,000 t to exports, 117,000 t to Government and industry stocks, and 451,000 t to apparent consumption. Chromium apparent consumption increased by 18% compared with that of 2010. Historically, chromium ferroalloys have replaced chromite ore as the leading source of chromium to the U.S. economy. Stainless steel mill products have been accounting for an increasing share of chromium supply to the domestic economy, now rivaling that of ferrochromium. Because stainless steel mill products contribute a significant amount of chromium to the domestic economy, trade in these products has been incorporated into chromium trade statistics, and their contribution has been accounted for in chromium apparent consumption. Compared with that of 2010, world chromite ore production decreased and ferrochromium production increased in 2011.

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 alloy steel, catalysts, leather processing, pigments, plating of metals, refractories, and surface treatments.

Legislation and Government Programs

The Defense Logistics Agency, Strategic Materials (DLA) disposed of chromium materials from the National Defense Stockpile under its fiscal year 2011 (October 1, 2010, through September 30, 2011) Annual Materials Plan (AMP) and announced the fiscal year 2012 plan. The DLA's fiscal year 2011 AMP set maximum disposal goals for chromium materials at 90,700 t of chromium ferroalloys and 454 t of chromium metal (Defense Logistics Agency, Strategic Materials, 2011).

Production

The major marketplaces for chromium-containing materials are chromite ore and foundry sand; chromium chemicals, ferroalloys, and metal; and stainless steel. In 2011, 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.

In 2011, Oregon Resources Corp. (ORC) [a subsidiary of IDM International Ltd., formerly Industrial Minerals Corp. Ltd. (Australia)] started recovering chromite from its Coos County, OR, paleo-beach placer (heavy-mineral sand) deposits. In doing so, ORC became the sole producer of foundry-grade chromite ore in the United States. ORC chromite ore shipments were 5,142 t in fiscal year (FY) 2011 (July 1, 2010, through June 30, 2011). The company planned to increase production to 49,500 t in FY 2012 and 95,000 t in FY 2013–15 (Industrial Minerals Corp. Ltd., 2011; IDM International Limited, 2012a, b). The combined proved and probable reserves for the Coos County heavy-minerals sands project was 9.1 million metric tons (Mt) averaging 7.4% chromic oxide (Cr_2O_3).

Elementis Chromium [a subsidiary of Elementis plc (United Kingdom)] produced sodium dichromate from chromite ore at Castle Haynes, North Carolina.

Consumption

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" consumer surveys. Stainless and heat-resisting steel producers are the leading chromium consumers, and high-carbon ferrochromium is the leading chromium-containing material consumed.

The U.S. stainless steel industry produces more than 2 million metric tons per year (Mt/yr) of stainless steel and imports and exports stainless steel mill products and scrap, which account for a significant amount of chromium in U.S. trade. AK Steel Corp., ATI, and North American Steel Co. were the leading U.S. stainless steel producers.

AK Steel Corp. produced stainless steel at Butler, PA, and Mansfield, OH. AK reported shipments of 817,000 t stainless and electrical steel in 2011 compared with 756,000 t in 2010 (AK Steel Corp., 2012, p. 10, 15). Allegheny Technologies Incorporated (ATI) produced stainless steel at Brackenridge, Midland, and Latrobe, PA. ATI reported production of 492,000 t of high value and standard products in 2011 compared with 498,000 t in 2010 (Allegheny Technologies Incorporated, 2012, p. F14, F29).

North American Stainless (NAS) [a subsidiary of Acerinox, S.A. (Spain)] produced stainless steel in Ghent, KY. NAS reported melt shop production at 937,087 t in 2011 compared with 899,150 t in 2010, a 4.2% increase. Acerinox considered the Ghent plant its most efficient stainless steel plant worldwide (Acerinox S.A., 2012, p. 186).

ThyssenKrupp Stainless USA [a subsidiary of ThyssenKrupp AG (Germany)] produced stainless steel at Calvert, AL. ThyssenKrupp continued development of a 1-Mt/yr-stainless steel melt shop and rolling mill in Calvert (ThyssenKrupp AG, 2012, p. 20).

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

The United States imported and exported 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 2011, the value of foreign trade of these chromium materials excluding stainless steel mill products and scrap was $124 million for exports and $1.13 billion for imports. The value of foreign trade of chromium materials including stainless steel mill products and scrap was $3.60 billion for exports and $4.08 billion for imports (table 1).

World Industry Structure

The chromium industry comprises chromite ore, chromium chemical and metal, ferrochromium, stainless steel, and chromite refractory material and foundry sand producers. Several trends are simultaneously taking place in the chromium industry. The chromium chemical industry has eliminated excess production capacity, concentrating on production growth in surviving plants. Chromite refractory use has been declining; however, foundry use has been increasing slowly. Environmental concerns have reduced the use of chromite refractories and chromium chemicals. The fraction of chromite ore from independent producers is declining, while that from vertically integrated producers is increasing. In other words, chromite ore mines tend now 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 prereduction 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 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.

Mineral production became more geographically diverse during the past 150 years. Europe, along with the United States, accounted for nearly all of mineral production in the mid-19th 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 had been decreasing while the share from Australia, Canada, China, Confederation of Independent States, and a collection of developing countries has been increasing. While 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 supplies to satisfy its industrial demand. It was of concern that scarce minerals markets could be transformed from equal access competitive bidding markets to markets where trade is conducted by long-term supply agreements between major corporations with heavy government involvement resulting in a politicized mineral supply.

Capacity.—Production capacities have been rated for the chromite ore, chromium chemical, chromium metal, ferrochromium, and stainless steel industries (table 7). Rated capacity 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 not all countries or producers provide information about production capacity, historical chromium trade data also have been used to estimate national production capacities. Changes in reported production capacity result from both facility changes and increased knowledge about facilities. New information about a facility may result in the reevaluation of production capacity for that facility.

Degel and others (2011, p. 53–55) compared alternating current (AC) and direct current (DC) arc furnace technology and described energy recovery. A benefit of DC furnaces is the use of fine run-of-mine material, eliminating the need for costly agglomerations process. ETI-Krom revamped two 30-MVA furnaces at Elazig, Turkey, and added an energy recovery system. Samancor operated two DC furnaces [40 megawatts (MW) and 60 MW]; Mogale Alloys operated two smaller DC furnaces; and Kazchrome installed four 72 MW DC furnaces expected to produce 440,000 metric tons per year (t/yr) of ferrochromium.

Production.—World 2011chromite ore production was 23.3 Mt gross weight, a 3% decrease compared with that of 2010 (table 8); ferrochromium production was 9.5 Mt gross weight, a slight increase compared with that of 2010 (table 9); stainless steel production was 33 Mt gross weight, a 4% increase compared with that of 2010.

Chromite ore.—Alexander (2011a, b) reported the recovery of chromite sand from landfilled foundry sand. Waste foundry sand has been used as a fill material, landfill cover, road base, or asphalt mix. Alexander estimated that chromite sand comprised about one-third (116,400 cubic yards) of landfill foundry sand (338,000 cubic yards) from a hazardous waste site used by a steel foundry. Alexander Mill Services International developed a process to recover the chromite sand and other materials from that waste. The chromite sand recovered met the Steel Founders' Society of America tentative specifications for chromite sand and flour.

McEwan (2011, p. 5, 15–17, 20) reported that chromite ore for refractory use should have more than 45% Cr_2O_3, a chromium-to-iron ratio of more than 2 to 1, a large aggregate size, and low silica (SiO_2) content. Chromite-containing refractories were used in copper, nickel, and platinum pyrometallurical extraction processes, steel industry vacuum degassers, foundry industry electric arc furnaces, and ferroalloy Creusot Loire Uddeholm converters. Stötzel and others (2011) described the thermal expansion and bulk density of chromite ore for refractory use by comparing them to other foundry sand.

Chromium Chemicals.—Leading chromium-chemical-producing countries where large sodium dichromate plants (production capacity in excess of 100,000 t/yr) operated 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.—Ferrochromium is the leading end use of chromite ore. Ferrochromium production is electrical energy intensive. Charge-grade ferrochromium requires 2,900 to 4,100 kilowatthours of electrical energy per metric ton of product, with efficiency varying by ore grade, operating conditions, and production process. Thus, ferrochromium plant location will reflect a cost balance between raw materials and electrical energy supply.

Chitambira and others (2011) reported that Zimbabwe's deteriorated power supply is a major limiting factor in ferrochromium growth. In addition, Zimbabwe is landlocked and far from consuming markets making transportation costs higher compared with those of the leading ferrochromium producers—South Africa and Kazakhstan.

Stainless Steel.—Stainless steel is the leading end use of ferrochromium. The International Stainless Steel Forum (ISSF) reported 2011 world crude stainless steel production to have been 33.621 Mt compared with 31.094 Mt in 2010. ISSF reported world stainless steel trade to have been 15.7452 Mt in 2011 compared with 14.3721 Mt in 2010 (International Stainless Steel Forum, 2012).

Stainless Steel Scrap.—Stainless steel scrap is an important source of chromium to the stainless steel industry. The ISSF reported 2011 world stainless steel scrap trade to have been 5.0201 Mt compared with 5.1976 Mt in 2010.

World Review

Albania.—Empire Mining Corporation (Canada) explored for chromite ore in the Bulqiza chromite mining district near the town of Bulqiza. Empire started a drilling program in the area. Empire sued the Albanian Ministry of Economy, Trade, and Energy because of a new restriction on Empire's mining license; the litigation was expected to be resolved in 2012 (Empire Mining Corporation, 2012).

Illyria Minerals Industry Sh. a. (IMI) [a joint venture between Kurum Energy, Resources and Metallurgy Sh. a., a subsidiary of Kurum Holding A.S. (Turkey) and Sichuan Jiannanchun International Group Ltd. (China)], contracted with the Ministry of Economy, Trade and Energy (Government of Albania) to explore and exploit Kalimash and Vlahne zone chromite deposits in northern Albania. IMI planned to produce 80,000 t/yr of lumpy ore and 90,000 t/yr of concentrate from 300,000 t/yr of run-of-mine ore for export to China. IMI also planned to install a high-carbon ferrochromium smelter nearby (Illyria Minerals Industry Sh. a., undated).

Australia.—The Government of Western Australia reported chromite ore sales by calendar year in contained Cr_2O_3: 2011—96,573 t of contained Cr_2O_3; 2010—73,535 t of contained Cr_2O_3 (Government of Western Australia, 2012, p. 20). Consolidated Minerals Limited (2012, p. 10) (Consmin) reported chromite production of 323,800 t in 2011 compared with 181,200 t in 2010, and chromite ore reserves of 0.3 Mt at 23% chromium (Cr) and resources of 1.5 Mt at 29% Cr.

Belgium.—Belgium produced 1.2143 Mt of stainless steel in 2011 compared with 1.3061 Mt in 2010.

Brazil.—Brazil produced chromite ore, ferrochromium, and stainless steel. Brazil reported 2010 chromite ore production of 520,129 t (258,308 t Cr_2O_3-content), exports of 77,131 t, and imports of 23,238 t. Brazil produced from a chromite ore reserve of 2.17 Mt Cr_2O_3-content, mostly in Bahia State. In 2010, Brazil produced 277,114 t of chromium ferroalloys, exported 9,568 t and imported 11,390 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, 2011). Brazil produced 0.4133 Mt of stainless steel in 2011 compared with 0.4072 Mt in 2010.

Canada.—Cliffs Natural Resources Inc. (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, had inferred mineral resources of 69.5 Mt at 31.9% Cr_2O_3. Cliffs conducted a prefeasibility study that looked at open pit followed by underground mining, ore processing and shipping facilities at the mine site, and a brownfield ferrochromium smelter at Greater Sudbury with 300 MW electrical power capacity.

Azimut Exploration Inc. explored for chromite in the James Bay region of Quebec (Azimut Exploration Inc., 2011).

KWG Resources Inc. (2010, p. 92) explored the Big Daddy chromite deposit (about 86°14'11" W, 52°45'32" N) and found,

to a cutoff grade of 15% Cr_2O_3, chromite ore indicated resources of 26.4 Mt at 39.37% Cr_2O_3, and inferred resources of 20.5 Mt at 37.47% Cr_2O_3.

Noront Resources Ltd. (2011, p. 6) explored for chromite ore at its Blackbird and Eagle Two properties. The combined properties had measured resources of 5.187 Mt at 34.43% Cr_2O_3, indicated resources of 3.678 Mt at 35.14% Cr_2O_3, and inferred resources of 6.124 Mt at 25.87% Cr_2O_3.

Ressources Minières Pro-Or Inc. explored for chromite at its Menarik property in northwestern Quebec (Ressources Minières Pro-Or Inc., 2012). Ressources patented a method to increase the chromium to iron ratio of chromite ore via a carbochlorination process that selectively removes iron (Ressources Minières Pro-Or Inc., 2010).

Diamond Discoveries International Corp. (United States) explored its Caribou Property near Thetford Mines, Quebec, Canada, which hosts historical chromite ore mines and chromite mineralization (Bassard, 2011). Diamond planned to prove resources and prepare scoping and feasibility studies by 2014.

China.—China produced chromite ore, ferrochromium, chromium chemicals and metal, and stainless steel. China was the leading producer of stainless steel, which also made it the leading market for ferrochromium. China produced a small amount of chromite ore and large amounts of ferrochromium and stainless steel. China imported 9.4 Mt of chromite ore and 1.8 Mt of ferrochromium in 2011. China produced 2.477 Mt of ferrochromium in 2011 compared with 2.090 Mt in 2010. China produced 13.786 Mt of stainless steel in 2011 compared with 12.415 Mt in 2010.

Eurasian Natural Resources Corp. plc (ENRC) (United Kingdom) suspended ferrochromium production at its Tuoli plant in 2011 (Eurasian Natural Resources Corporation plc, 2012, p. 10).

Tharisa plc planned to construct Tharisa Ferrochrome Smelter at Luoyuan Bay, Fujian Province, China. The plant was to be located near Baosteel Desheng Stainless Steel Plant and Fujian Wuhang Stainless Steel Products Company, Ltd. The plant was to start production in 2014 with a capacity of 600,000 t/yr of ferrochromium (Tharisa plc, 2011).

Cuba.—Cuba produced chromite ore. The Bolivarian Alliance for the Peoples of Our America (ALBA) funded a chromite ore processing plant in Altagracia, Camaguey Province (Gutiérrez, 2011).

Finland.—Finland produced chromite ore (Kemi Mine), ferrochromium (Tornio Works), and stainless steel (Tornio Works). Outokumpu produced 693,000 t of marketable 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 compared with 598,000 t of chromite ore from 1.3 Mt of run-of-mine ore, 238,000 t of ferrochromium, and 1.610 Mt of stainless steel in 2010. The company reported proven reserves of chromite ore at 35 Mt graded at 26% Cr_2O_3, indicated resources of chromite ore at 13 Mt graded at 30% Cr_2O_3, and inferred resources of chromite ore at 78 Mt graded at 29% Cr_2O_3. 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 2013 and to reach full production capacity in 2015 (Outokumpu Ojy, 2012, p. 50–51, 85).

Ruukki Group comprised chromite ore mining [Stellite Mine (South Africa), Turk Maadin Sirketi (Turkey)] and ferrochromium production facilities [Mogale Alloys (Pty.) Ltd. (South Africa), EWW (Germany)]. Ruuki was developing Mecklenburg Mine (South Africa), Waylox mine project (Zimbabwe), and expanding Stellite Mine and Mogale Alloys. Ruukki reported Stellite Mine chromite ore production capacity of 360,000 t/yr and Mogale ferrochromium production capacity of 280,000 t/yr. Ruukki reported production of 82,200 t of chromite ore and 354,000 t of ferrochromium compared with 20,000 t of chromite ore and 6,880 t of ferrochromium in 2010. Ruukki planned to complete the Mecklenburg Mine feasibility study in 2012 and to increase ferrochromium production capacity by adding two DC furnaces (Ruukki Group plc, 2012, p. 7–8, 41).

France.—France produced 0.2996 Mt of stainless steel in 2011 compared with 0.2756 Mt in 2010.

Germany.—Germany produced chromium metal, ferrochromium, and stainless steel. Elektrowerke Weisweiler GmbH [owned by Ruukki Group (Finland)] produced 25,908 t of low-carbon ferrochromium in 2011 compared with 17,994 t in 2010 from a production capacity of 30,000 t/yr from chromite ore produced by Turk Maadin Sirketi (Turkey) (Ruukki Group plc, 2012, p. 40). Advanced Metals Group, N.V. produced chromium metal. Germany produced 1.5016 Mt of stainless steel in 2011 compared with 1.5093 Mt in 2010.

India.—India produced chromite ore, chromium chemicals, ferrochromium, and stainless steel. India exported lumpy and friable chromite ore and chromite ore concentrates. India reported that 21 mines collectively produced 4,262,207 t of chromite ore in fiscal year 2010–11 (April 1, 2010, through March 31, 2011) compared with 3,425,580 t from 22 mines in fiscal year 2009–10. India's chromite ore reserves were estimated to be 53.970 Mt as of January 4, 2010. India reported chromite ore exports of 172,866 t and imports of 80,573 t in fiscal year 2010–11, compared with exports of 689,081 t and imports of 89,050 t in fiscal year 2009–10. Chromite ore was mined in Karnataka and Odisha States. The leading chromite ore mining companies, all in Odisha, were Balashore Alloys Ltd., Ferro Alloys Corporation Ltd., IDCOL Ferro Chrome & Alloys Ltd., Indian Metals & Ferro Alloys 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 (Indian Bureau of Mines, 2012a). Vishnu reported chromite ore consumption of 45,404 t (Vishnu Chemicals Limited, 2012, p. 44).

From an installed production capacity of 1.60 Mt/yr, India produced 1,032,100 t of ferrochromium in fiscal year 2010–11 compared with 892,923 t in fiscal year 2009–10. India exported 1,305,855 t and imported 22,412 t of ferrochromium in fiscal year 2010–11 compared with 471,953 t of exports and 17,726 t of imports in fiscal year 2009–10. Chromium ferroalloys were produced at plants in Andhar Pradesh, Odisha, Gujarat, and West Bengal States. 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., Rawat Ferro Alloys, Rohit Ferro Tech. P. Ltd., SAL Steel, Sri Vasavi Ind. Ltd., Standard Chrome Ltd., Tata Steel Ltd., and Utkal Manufacturing Services Ltd. were the leading chromium ferroalloy producers (Indian Bureau of Mines, 2012b). India produced 2.2711 Mt of stainless steel in 2011 compared with 2.1195 Mt in 2010.

Cronimet Alloys India Limited produced high carbon ferrochromium for use in the stainless steel industry from an installed capacity of 25,000 t/yr. The company planned to change its name to Metkore Alloys & Industries Limited (Cronimet Alloys India Limited, 2011, p. 24).

Iraq.—Chromite was found to be associated with the Mawat ophiolite complex in Kurdistan region (Mirza, 2008, p. II–IV, 67–102, 161–162; 2011, p. II–IV, 67–102, 161–162).

Italy.—Cogne Acciai Speciali and ThyssenKrupp Accai Speciali produced stainless steel. Italy produced 1.602(5) Mt of stainless steel in 2011 compared with 1.584(9) Mt in 2010.

Ivory Coast.—Sama Resources Inc. (Vancouver, British Columbia, Canada) reported finding massive chromite occurrences (about 7°40' N, 7°56' W) while geologically mapping and collecting rock samples (Sama Resources Inc, 2012, p. 50, 79–80, 85–86, 88).

Japan.—Japan produced 3.2559 Mt of stainless steel in 2011 compared with 3.4269 Mt in 2010.

Kazakhstan.—Kazakhstan produced chromite ore and ferrochromium. ENRC (United Kingdom) produced chromite ore and ferrochromium. ENRC produced chromite ore at Donskoy Mining Complex and Saranovskaya Mine 'Rudnaya' JSC (Russia). Production capacity at Donskoy was 3.5 Mt/yr. ENRC reported salable chromite ore production of 3.567 Mt in 2011 compared with 3.574 Mt in 2010. ENRC's principal chromite ore producing subsidiary TNC Kazchrome JSC produced 4.4 Mt run-of-mine chromite ore, which it planned to increase to 4.9 Mt in 2031. As of December 31, 2011, ENRC's chromite ore reserves were 212.4 Mt at 41.4 % Cr_2O_3 and resources were 313.6 Mt at 49.4% Cr_2O_3. ENRC principal ferrochromium producing subsidiaries were TNC Kazchrome JSC, Serov Ferroalloy Plant JSC (Russian Federation), and Xinjiang Tuoli ENRC Taihang Chrome Co. Ltd. (China). ENRC reported ferrochromium production of 1.226 Mt in 2011, compared with 1.258 Mt in 2010. At Aktobe, where ENRC operated a gas fired electrical powerplant, ENRC continued construction of four DC furnaces with a collective ferrochromium production capacity of 440,000 t/yr at an estimated cost of $750 million; completion was estimated for 2013 (Eurasian Natural Resources Corporation plc, 2012, p. 22, 24–27, 141–142).

Oriel Resources (United Kingdom), a subsidiary of Mechel OAO (Russia), produced chromite ore at the Voskhod Mine and chromium ferroalloys at the Tikhivin Ferroalloy Plant. Voskhod chromite ore feeds the Tikhivin Ferroalloy Plant. Voskhod production capacity was 1.3 Mt/yr chromite ore plus 0.65 Mt/yr of chromite ore fines. Production was 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 containing 60% chromium. Mechel reported proven (14.5 Mt) plus probable (2.3 Mt) chromite ore reserves of 16.8 Mt at an average grade of 42.2% Cr_2O_3 as of December 31, 2011 (Mechel OAO, 2012, p. 122–3, 129).

Korea, Republic of.—Korea produced 2.116 Mt of stainless steel in 2011 compared with 2.0122 Mt in 2010.

Oman.—Gulf Mining Materials Company and Sohar Free Zone agreed to set up a ferrochromium smelter that would have two furnaces each with electrical capacity of 16,500 kVA and ferrochromium production capacity of 50,000 t/yr. The construction of the project was expected to take 12 to 14 months for completion (Oman News Agency, 2012).

Gambhir (2011) reported that Oman was the third leading supplier of chromite ore to China after South Africa and India in 2008–10. Leading Omani chromite ore producers were Oman Chromite Company and Gulf Mining Group (GMM). Omani chromite ore grade is about 30% to 42% Cr_2O_3 with chromium-to-iron ratio of 1.9 to 2.6. GMM had a chromite ore production capacity of about 300,000 t/yr. Omani chromite ore production was estimated to have been about 1 Mt/yr all of which is exported with most (about 85%) going to China.

Chromite ore producer Al Tamman Trading Establishment LLC (a wholly owned subsidiary of Muscat Overseas Group) formed a joint-venture agreement with Indsil Group to build a ferrochromium plant in Freezone Sohar with a production capacity of 75,000 t/yr to become operational in 2013. The plant's production capacity would eventually be expanded to 150,000 t/yr (Indsil Group, 2012).

Metkore Alloys and Industries Ltd. planned to build a 165,000-t/yr ferrochromium smelter in Freezone Sohar by 2014 (James, 2012).

South Africa.—South Africa produced chromite ore, chromium chemicals, ferrochromium, and stainless steel. In 2011, South Africa was the leading producer of chromite ore and ferrochromium. South Africa reported chromite ore production of 6.865 Mt of which it exported 1.035 Mt and ferrochromium production of 2.346 Mt of which it exported 2.621 Mt in 2009 compared with chromite ore production of 9.683 Mt of which it exported 0.762 Mt and ferrochromium production of 3.269 Mt of which it exported 2.525 Mt in 2008 (Mosiane, 2010, p. 112–117). South Africa reported that 13 companies mined chromite ore from 27 mines, and 7 companies produced ferrochromium at 14 plants with collective production capacity of 3.697 Mt/yr in 2011 (Moisane, 2011, p. 1–12). South Africa produced 0.444 Mt of stainless steel in 2011 compared with 0.478 Mt in 2010.

Marico Chrome Corporation, a 50–50 joint venture between Vereeniging Refractories and Samancor Chrome SA, operated the Marico Chrome Mine, which produced 40,000 t/yr of metallurgical- and refractory-grade chromite ore from 9 Mt of run-of-mine reserves. Marico chromite seams are associated with the lower group seams of the Bushveld Complex. These typically have higher Cr_2O_3 content (up to 49%), lower SiO_2 (less than 1%), higher chromium-to-iron ratios (about 2:1), and lower magnetite content than upper or middle group seams (McEwan and others, 2011).

The Ruukki Group (Finland) operated the Stellite Mine, which had 300,000-t/yr run-of-mine chromite ore production capacity, and Mogale Alloys, a ferrochromium producer.

Ruukki held 5.7 Mt of chromite ore reserves in South Africa at Mecklenburg Project (Lillja, 2011, p. 5, 15-17, 20).

Spain.—Spain produced 0.807 Mt of stainless steel in 2011 compared with 0.8442 Mt in 2010.

Sweden.—Sweden produced ferrochromium and stainless steel. Sweden produced 0.5856 Mt of stainless steel in 2011 compared with 0.5461 Mt in 2010. Vargön Alloys AB, a Yildirim Group (Turkey) company, produced ferrochromium from a 220,000 t/yr production capacity. At Vargön (Sweden), Yildrim produced high-carbon ferrochromium from two 24 MVA furnaces, one 48 MVA furnace, one 105 MVA furnace, and a recovery-from-slag operation, which had a collective production capacity of 240,000 t/yr (Onal, 2011, p. 11, 13, 23–39).

Taiwan.—Taiwan produced 1.2026 Mt of stainless steel in 2011 compared with 1.5231 Mt in 2010.

Turkey.—Turkey produced chromite ore and ferrochromium. Eti Krom Inc., a Yildirim Group company, mined chromite ore and produced ferrochromium. Eti Krom produced about 1 Mt/yr of chromite ore in 2011 from 20 mines, mostly underground, and planned to increase production capacity to 1.5 Mt/yr by 2015. Eti Krom also produced high-carbon ferrochromium at Elazig.

Dedeman Madencilik mined chromite ore in the Pinarbaşi and Toruntepe regions. Eti Elektrometalurji A.S. mined chromite ore from 12 mines in the Mugla-Fethiy region and produced ferrochromium at Antalya.

Onal (2011, p. 11, 13, 23–39) reported that Yildirim Mining and Ferroalloys Division was the second leading high-quality high-carbon ferrochromium producer after ENRC with production capacity of 400,000 t/yr from eight furnaces (four in Turkey and four in Sweden). Yildrim held 100 Mt of chromite ore proven reserves, which it expected to increase to 150 Mt. At Elazig, Yildrim produced high-carbon ferrochromium from two 17 MVA furnaces, two 30 MVA furnaces, and a recovery-from-slag operation; total production capacity was 160,000 t/yr.

United Kingdom.—The United Kingdom produced chromium metal and stainless steel. London & Scandinavian Metallurgical Co. Ltd. produced chromium metal. The United Kingdom produced 0.3298 Mt of stainless steel in 2011 compared with 0.2694 Mt in 2010.

The British Geological Survey (2011) determined the chromium relative supply risk index to be 3.5 based on chromium abundance in the Earth's crust, the location of production and reserves, and the political stability of those locations. The index ranged from very high risk, 10, to very low risk, 1.

Zimbabwe.—Zimbabwe produced chromite ore and ferrochromium. On July 20, 2011, the Ministry of Mines banned exports of raw chrome ore, chrome ore fines, and alluvial chrome concentrates from the country.

Zimbabwe Alloys Chrome (Pvt.) Ltd. (Zim Alloys) restarted chromite ore production in 2011 after stopping ferrochromium production in 2008, owing to a lack of capital. Zimasco (Pvt.) Ltd. also produced chromite ore in 2011. Kalenjeka (2011) reported that Zimasco planned to increase its chromite ore production capacity to 1.1 Mt/yr from 0.6 Mt/yr by 2015, with more than 90% of the ore extracted underground from stratiform deposits in the Great Dyke.

Chirasha (2011) reported Zimbabwe's ferrochromium production capacity to be 490,350 t/yr. Zimasco's production capacity was 220,000 t/yr, followed by Zim Alloys with 215,350 t/yr. The remaining 55,000-t/yr of ferrochromium production capacity was held by four other companies. Actual production in 2011, however, was greatly limited by the country's deteriorating electrical supply (Chitambira and others, 2011; Miso-Mbele and others, 2011).

Zim Alloys planned to convert two high-carbon ferrochromium furnaces to low-carbon ferrochromium production in 2012 at a cost of about $20 million. The refurbished furnaces were expected to have a production capacity of 80,000 t/yr. Zimasco planned to increase its ferrochromium production capacity to 320,000 t/yr by 2015 (Njini, 2011; Metmar Ltd., 2012, p. 29).

Outlook

A variety of countries and regions were concerned about the mineral supply in 2011. Chromium supply was the subject of concern by China, India, South Africa, the United States, and Zimbabwe. China and the United States, as consumers, were concerned about supply. India, South Africa, and Zimbabwe, as suppliers, were concerned about maximizing domestic benefit from their national resources. Mineral supply interventions included taxing exports, limiting production and exploration licenses, national control of exports by suppliers, investment in development of new supply sources, and stockpiling by consumers. India's Steel Ministry called for extending restricted chromite ore exports to a total ban on chromite ore exports. South Africa's National Union of Mine Workers and some chromite ore producers that also produce ferrochromium called for restrictions on chromite ore exports. Zimbabwe banned the export of chromite ore. Those concerned with depletion appear to neglect the continual proving of new reserves and the economically dynamic nature of those reserves (that is, current resources can be converted to reserves as prices and cost of production change). Historically, South Africa took a leading position in the processing of chromite ore (ferrochromium production), because it had large reserves of chromite ore, developed processes to accommodate that ore, and made electrical power abundant and inexpensive. China has addressed its potential shortages by investing in chromite ore and ferrochromium production facilities, both in and out of China. The United States has stockpiled chromite ore and ferrochromium, a position that was being reevaluated in 2011.

The outlook for chromium consumption in the United States and the rest of the world is about the same as that for stainless steel production, which is the leading end use for chromium worldwide. In 2011, economic expansion in China and India resulted in increased need for chromium to produce stainless steel.

The practice of supplying chromium in the form of ferrochromium by countries that mine chromite ore was interrupted as China became a major importer of chromite ore to produce ferrochromium and South Africa, the leading ferrochromium producer, experienced limited electrical power

supply; however, that trend was not expected to continue as China closed small, inefficient, environmentally unfriendly ferroalloy production facilities. Generally, ferrochromium production is most cost effective when the ferrochromium plant is 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 market-driven economies that produce ferrochromium without nearby resources of chromite ore. Other factors of production, such as electrical energy or labor costs, can offset chromite ore transportation costs. Further vertical integration of the chromium industry was expected in countries that produce chromite ore as they expand ferrochromium or stainless steel production capacity.

Chromite Ore.—Chromite ore production capacity was expected to remain in balance with average consumption. To improve chromite ore availability and to stabilize feed material price, ferrochromium producers were expected to invest in mines that produce chromite ore; or, as chromite ore prices rise, new chromite ore resources will be brought into production. As platinum mining moves into chromite-bearing seams in South Africa, a greater portion of chromite is likely to be supplied as byproduct from such operations. In addition, platinum may become a byproduct of some chromite operations when efficient recovery of platinum from chromite ore tailings is developed. To meet chromite ore demand, chromite ore production was expected to increase in the leading chromite ore regions (India, Kazakhstan, and South Africa) and in the Middle East (Oman, Turkey, and United Arab Emirates).

References Cited

Acerinox S.A., 2012, Annual report 2011: Madrid, Spain, Acerinox S.A., February 28, 203 p. (Accessed September 25, 2012, at http://www.acerinox.es/opencms/export/system/modules/org.opencms.acerinox.module/elements/Galerias/Galeria_documentos/Annual_Report_2011.pdf.)

AK Steel Corp., 2012, Annual report and form 10–K 2011: West Chester, OH, AK Steel Corp., February 27, 95 p. (Accessed September 24, 2012, at http://www.aksteel.com/data/financial_stmts/AK Steel 10-K web_April9_2012.pdf.)

Alexander, J.S., 2011a, Foraging for foundry sands: Minerals, no. 531, December, p. 52–55. (Accessed October 18, 2012, at http://www.alexandermillservices.com/PDF_files/AMS_Processing_Metals_Article.pdf.)

Alexander, J.S., 2011b, Recycling chrome ore—An alternative for buyers to mined minerals?: Chromite Conference 2011, Johannesburg, South Africa, September 13–14, [unpaginated]. (Accessed September 20, 2011, via http://www.metalbulletin.com/EventConferencePapers/0/4189/Events/Chromite-Conference-2011.html.)

Allegheny Technologies Incorporated, 2012, ATI annual report 2012: Pittsburgh, PA, Allegheny Technologies Incorporated, February 28, 91 p. (Accessed September 24, 2012, at http://media.corporate-ir.net/media_files/IROL/98/98187/ATI_AR_2011.pdf.)

Azimut Exploration Inc., 2011, James Bay Region: Longueuil, Quebec, Canada, Azimut Exploration Inc., [unpaginated]. (Accessed June 12, 2012, at http://www.azimut-exploration.com/en-prop-jamesbaychromium.html.)

Bassard, Bertrand, 2011, Potential to develop chromium (pge) mines in Quebec: New York, New York, presentation at Annual Global Investment Conference 2011 Metals & Mining Track, September 13, [unpaginated]. (Accessed June 14, 2012, at http://quebecdiscoveries.com/wp-content/uploads/2011/09/Presentation-NYC-Rodman-2011-Web.pdf.)

British Geological Survey, 2011, Risk list 2011: Keyworth, United Kingdom, British Geological Survey, April, [unpaginated]. (Accessed March 27, 2012, at http://www.bgs.ac.uk/downloads/start.cfm?id=2063.)

Chirasha, Jabulani, 2011, Ferrochrome smelting and smelting capacity investment in Zimbabwe: Southern African Pyrometallurgy 2011 International Conference, Cradle of Humankind, South Africa, March 6–9, p. 79–82. (Accessed August 31, 2011, at http://www.pyrometallurgy.co.za/Pyro2011/Papers/077-Chirasha.pdf.)

Chitambira, B., Miso-Mbele, D., and Gumbie, M., 2011, Ferrochrome smelting in Zimbabwe: Bulawayo, Zimbabwe, Zimbabwe School of Mines, SAIMM Zimbabwe Branch Conference, July 19, 7 p. (Accessed September 25, 2012, at http://www.saimm.co.za/download/saimmbranches/zimbabwe/FERROCHROME SMELTING IN ZIMBABWE.pdf.)

Cliffs Natural Resources Inc., 2011, Cliffs Natural Resources releases northern Ontario chromite project information to facilitate stakeholder discussions: Cleveland, OH, Cliffs Natural Resources Inc., [unpaginated]. (Accessed June 13, 2012, at http://files.shareholder.com/downloads/ABEA-5Y0QTL/1922379256x0x457987/4d7d1399-8ceb-4e8f-a1ca-245df7772488/CLF_News_2011_2_3_General_Releases.pdf.)

Cliffs Natural Resources Inc., 2012, Annual report 2011: Cleveland, OH, Cliffs Natural Resources Inc., 199 p. (Accessed June 13, 2012, at http://files.shareholder.com/downloads/ABEA-5Y0QTL/1922379256x0x554836/8AC8B653-2BAD-4803-9270-12E0FEF2B19C/Cliffs_NR_2011_Form_10K_Wrap.pdf.)

Consolidated Minerals Limited, 2012, 2011 annual report: West Perth, Western Australia, Australia, Consolidated Minerals Limited, April 26, 59 p. (Accessed June 9, 2012, at http://www.consminerals.com.au/m/files/ar/CML-consolidated-accounts-FY11.pdf.)

Cronimet Alloys India Limited, 2011, 2010–11 annual report: Bangalore, India, Cronimet Alloys India Limited, August 12, 31 p. (Accessed October 29, 2012, at http://www.cronimetalloys.com/5th Ann Rpt - 2010-11.pdf.)

Defense Logistics Agency, Strategic Materials, 2011, Annual materials plan for FY 2012: Fort Belvoir, VA, Defense National Stockpile Center news release DLA–SM–11–3028, 1 p. (Accessed July 23, 2012, at https://www.dnsc.dla.mil/Uploads/NewsRelease/bberuete_10-6-2011_11-9-18_3028 FY12 AMP.pdf.)

Degel, R., Schmale, K., Köneke, M., and Schmieden, H., 2011, Application potential of SMS DC smelter technology for the pyrometallurgical industry in South Africa: Cradle of Humankind, South Africa, March 6–9, Southern African Pyrometallurgy 2011 International Conference, p. 47–62. (Accessed August 31, 2011, at http://www.saimm.co.za/Conferences/Pyro2011/047-Degel.pdf.)

Empire Mining Corporation, 2012, Empire provides update on Albanian chromite project—Legal action restores Empire's rights, but Albanian Ministry has appealed: Vancouver, British Columbia, Canada, Empire Mining Corporation news release, May 29, [unpaginated]. (Accessed June 8, 2012, at http://www.empireminingcorp.com/s/NewsReleases.asp?ReportID=527450&_Type=News-Releases&_Title=Empire-Provides-Update-on-Albanian-Chromite-Project-Legal-Action-Restores-E....)

Eurasian Natural Resources Corporation plc, 2012, Annual report and accounts 2011: London, United Kingdom, Eurasian Natural Resources Corporation plc, April 16, 128 p. (Accessed July 5, 2012, at http://www.enrc.com/Documents/Reports/ENRC_ARA 2011_Final.pdf.)

Gambhir, Kanwal, 2011, Oman chrome ores: Johannesburg, South Africa, Chromite Conference 2011, September 13–14, [unpaginated]. (Accessed September 20, 2011, via http://www.metalbulletin.com/EventConferencePapers/0/4189/Events/Chromite-Conference-2011.html.)

Government of Western Australia, 2012, Mineral and petroleum statistics digest 2011: Perth, Western Australia, Australia, Government of Western Australia, 45 p. (Accessed July 16, 2012, at http://www.dmp.wa.gov.au/documents/121857_Stats_Digest_2011.pdf.)

Gutiérrez, R.M., 2011, ALBA provides financial injections into Cuba's mining project: Camagüey, Cuba, Radio Cadena Agramonte, August 10, [unpaginated]. (Accessed June 8, 2012, at http://www.cadenagramonte.cu/english/index.php?option=com_content&view=article&id=6625:alba-provides-financial-injections-into-cubas-mining-project-&catid=1:camaguey&Itemid=14.)

IDM International Limited, 2012a, Mines and money 2012 presentation: West Perth, Western Australia, Australia, IDM International Limited, March 21, [unpaginated]. (Accessed September 24, 2012, via http://www.idminternational.net/investors/asx-annoucements/.)

IDM International Limited, 2012b, Quarterly activities report for the period ended 31 December 2011: West Perth, Western Australia, Australia, IDM International Limited, January 3, [unpaginated]. (Accessed September 18, 2012, via http://www.idminternational.net/investors/asx-annoucements/.)

Illyria Minerals Industry Sh. a., [Undated], Illyria Minerals Industry: Tirana, Albania Illyria Minerals Industry Sh. a. (Accessed June 8, 2012, via http://imi.al/.)
Indian Bureau of Mines, 2012a, Chromite, *in* Indian Minerals Year Book 2011, Part–II—Mineral Reviews: Nagpur, India, Indian Bureau of Mines, October, p. 23–1—23–20. (Accessed October 29, 2012, at http://ibm.nic.in/IMYB 2011_Chromite.pdf.)
Indian Bureau of Mines, 2012b, Ferro-alloys, *in* Indian Minerals Year Book 2011, Part–II—Mineral Reviews: Nagpur, India, Indian Bureau of Mines, December, p. 63–1—63–23. (Accessed October 29, 2012, at http://ibm.nic.in/IMYB 2011_Ferro-Alloys.pdf.)
Indsil Group, 2012, News & events: Coimbatore, India, Indsil Group. (Accessed October 29, 2012, at http://www.indsil.com/newsoman.html.)
Industrial Minerals Corp. Ltd., 2011, Annual report 2011: West Perth, Western Australia, Australia, Industrial Minerals Corp. Ltd., September 30, 95 p. (Accessed November 9, 2011, at http://www.idminternational.net/wp-content/uploads/2011/03/IMC-Limited-2011-Annual-Report.pdf.)
International Stainless Steel Forum, 2012, Stainless and heat resisting steel crude steel production (ingot/slab equivalent)—Year 2011 in '000 metric tons: Brussels, Belgium, International Stainless Steel Forum, January 7. (Accessed March 12, 2013, at http://www.worldstainless.org/Statistics/.)
James, A.E., 2012, Indian firm to invest RO30m in Sohar plant: Times of Oman, October 29, [unpaginated]. (Accessed October 29, 2012, at http://www.timesofoman.com/innercat.asp?detail=6120).
Kalenjeka, S., 2011, Dyke chrome mining mechanization—Opportunities and dilemmas: SAIMM Zimbabwe Branch Conference, Bulawayo, Zimbabwe, Zimbabwe School of Mines, July 19, 23 p. (Accessed September 25, 2012, at http://www.saimm.co.za/download/saimmbranches/zimbabwe/DYKE CHROME MINING MECHANIZATION VER 2.pdf.)
KWG Resources Inc., 2010, Spider Resources Inc. and KWG Resources Inc. technical report on the mineral resource estimate for the Big Daddy chromite deposit: Toronto, Ontario, Canada, KWG Resources Inc., 170 p. (Accessed July 28, 2011, at http://kwgresources.com/_resources/Micon43_101_july15_10.pdf.)
Lillja, M.W., 2011, New player in the chromite business: Chromite Conference 2011, Johannesburg, South Africa, September 13–14, 22 p. (Accessed September 20, 2011, via http://www.metalbulletin.com/EventConferencePapers/0/4189/Events/Chromite-Conference-2011.html.)
McEwan, N., Courtney, T., Parry, R.A., and Knupfer, P., 2011, Chromite—A cost-effective refractory raw material for refractories in various metallurgical applications: Southern African Pyrometallurgy 2011 International Conference, Cradle of Humankind, South Africa, March 6–9, 5 p. (Accessed August 31, 2011, at http://www.saimm.co.za/Conferences/Pyro2011/359-McEwan.pdf.)
McEwan, Niell, 2011, Chrome containing refractories: Chromite Conference 2011, Johannesburg, South Africa, September 13–14, [unpaginated]. (Accessed September 20, 2011, via http://www.metalbulletin.com/EventConferencePapers/0/4189/Events/Chromite-Conference-2011.html.)
Mechel OAO, 2012, United States Securities and Exchange Commission Form 20–F—December 31, 2011: Moscow, Russian Federation, Mechel OAO, May 10, 421 p. (Accessed October 12, 2012, at http://www.sec.gov/Archives/edgar/data/1302362/000119312512225462/d332495d20f.htm.)
Metmar Ltd., 2012, Integrated annual report: Sandton, South Africa, Metmar Ltd., 94 p. (Accessed October 25, 2012, via http://www.metmartrading.com/annualreport.html.)
Mirza, T.A., 2008, Petrogenesis of the Mawat ophiolite complex and the associated chromitite, Kurdistan region, NE Iraq: College of Science, Department of Geology, University of Sulaimani, Sulaimani, Iraq, 189 p. (Accessed September 28, 2012, at http://www.kurdistangeology.com/UserFiles/File/All Chapters Tola Ph D Thesis 2008.pdf.)
Mirza, Tola, 2011, Chromitite of Mawat ophiolite complex, Kurdistan region, NE Iraq: Lambert Academic Publishing GmbH & Co., Saarbrücken, Germany, 189 p.
Miso-Mbele, D., Chitambira, B., and Gumbie, M., 2011, Ferrochromium smelting in Zimbabwe: SAIMM Zimbabwe Branch Conference, Bulawayo, Zimbabwe, Zimbabwe School of Mines, July 19, 22 p. (Accessed September 25, 2012, at http://www.saimm.co.za/download/saimmbranches/zimbabwe/FERROCHROME SMELTING PRESENTATION.pdf.)
Moisane, Charlotte, 2011, Ferrous mineral commodities produced in the Republic of South Africa 2011: Pretoria, South Africa, Director of Mineral Economics, Directory D8/2011, March, 32 p. (Accessed November 1, 2012, at http://www.dmr.gov.za/publications/summary/121-directories/242-d8-ferrous-mineral-commodities-2011.html.)
Mosiane, M.C., 2010, Chromium in South Africa's Mineral Industry: Pretoria, South Africa, Director of Mineral Economics, December, 198 p. (Accessed November 1, 2012, at http://www.dmr.gov.za/publications/south-africas-mineral-industry-sami/summary/112-south-africas-mineral-industry-sami/137-sami-2009-2010.html.)
Njini, Felix, 2011, Zim Alloys furnaces upgrade in 2012: The Southern Times, November 28, [unpaginated]. (Accessed November 5, 2012, at http://www.southerntimesafrica.com/news_article.php?id=6383&title=Zim Alloys furnaces upgrade in 2012&type=69.)
Noront Resources Ltd., 2011, 2011 annual report: Toronto, Ontario, Canada, Noront Resources Ltd., October, 52 p. (Accessed June 14, 2012, at http://www.norontresources.com/Investors/getDocument/norontannualreport2011.pdf/174.)
Oman News Agency, 2012, Sohar Free Zone inks agreement to set up smelter: Oman News Agency, October 24, [unpaginated]. (Accessed October 24, 2012, at http://www.omantribune.com/index.php?page=news&&id=119294&heading=Business.)
Onal, Cengiz, 2011, Supply and demand—Are you looking at a growing shortage of material?: Chromite Conference 2011, Johannesburg, South Africa, September 13–14, [unpaginated]. (Accessed September 20, 2011, via http://www.metalbulletin.com/EventConferencePapers/0/4189/Events/Chromite-Conference-2011.html.)
Outokumpu Ojy, 2012, Annual report 2011: Helsinki, Finland, Outokumpu Ojy, February 8, 323 p. (Accessed June 20, 2012, at http://ar2011.outokumpu.com/files/outokumpu2011/pdf/Annual_Report.pdf.)
Ramos, Marco Antonio Freire, 2011, Cromo in Sumário Mineral 2011: Brasília, Brazil, Departamento Nacional de Produção Mineral, v. 31, [unpaginated]. (Accessed February 15, 2012, at https://sistemas.dnpm.gov.br/publicacao/mostra_imagem.asp?IDBancoArquivoArquivo=6369.)
Ressources Minières Pro-Or Inc., 2010, Method for increasing the chrome to iron ratio of chromites products: Montreal, Quebec, Canada, Ressources Minières Pro-Or Inc., February 9, 16 p. (Accessed June 15, 2012, at http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=15&ved=0CFUQFjAEOAo&url=http://www.google.com/patents/US7658894.pdf&ei=yETbT5OKBeLF6gHp-4XECw&usg=AFQjCNG-YsxFpyQinA5r3-gKTqIZJV99EQ&sig2=FRR7fGm2cPo2HlJvII-fRQ.)
Ressources Minières Pro-Or Inc., 2012, Menarik Project (Baie-James): Montreal, Quebec, Canada, Ressources Minières Pro-Or Inc., June 12, [unpaginated]. (Accessed June 12, 2012, at http://www.pro-or.com/en/index.php?page=rightbox&section=10.)
Ruukki Group plc, 2012, 2011 annual report: Espoo, Finland, Ruukki Group plc, March 29, 126 p. (Accessed June 19, 2012, at http://www.ruukkigroup.fi/~/media/Files/R/Ruukki-Group/Attachments/financial-report/annual-report/Annual-Report-2011.pdf.)
Sama Resources Inc, 2012, NI 43–101 technical report on the Samapleu nickel copper deposits: Côte d'Ivoire, West Africa: Vancouver, British Columbia, Canada, July 20, 246 p. (Accessed September 27, 2012, at http://www.samaresources.com/i/pdf/43_101_Technical_Report.pdf.)
Stötzel, Reinhard, Koch, Christian, Schreckenberg, Stefan, Brotzki, Jörg, 2011, Chromite sand in foundries market, requirement, challenges: Johannesburg, South Africa, Chromite Conference 2011, September 13–14, [unpaginated]. (Accessed September 20, 2011, via http://www.metalbulletin.com/EventConferencePapers/0/4189/Events/Chromite-Conference-2011.html.)
Tharisa plc, 2011, Tharisa—A vertically integrated company: Tharisa plc Web site. (Accessed June 15, 2012, via http://www.tharisa.com/.)
ThyssenKrupp AG, 2012, Interim report 11/12: Düsseldorf, Germany, ThyssenKrupp AG, August 10, 47 p. (Accessed November 9, 2012, at http://www.thyssenkrupp.com/documents/investor/Finanzberichte/eng/ThyssenKrupp_2011_2012_Q3.pdf.)
Vishnu Chemicals Limited, 2012, Annual report 2011–12: Hyderabad, India, July 30, 47 p. (Accessed October 29, 2012, at http://www.vishnuchemicals.com/downloads/annualreport_1112.pdf.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Chromium. Ch. in Mineral Commodity Summaries, annual.
Chromium. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Chromium. International Strategic Minerals Inventory Summary Report, Circular 930–B, 1984.
Chromium. Mineral Industry Surveys, monthly.

Other

Chromite. Ch. in Industrial Minerals and Rocks (7th ed.) Society for Mining, Metallurgy, and Exploration, Inc., 2006.
Chromium. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
International Chromium Development Association.
Strategic and Critical Materials Report to the Congress. U.S. Department of Defense, multiple years.

TABLE 1
SALIENT CHROMIUM STATISTICS[1]

		2007	2008	2009	2010	2011
World, production, contained chromium:						
Chromite ore (mine)[2]	metric tons	6,930,000 r	7,320,000 r	6,020,000 r	7,370,000 r	7,180,000
Ferrochromium (smelter)[3]	do.	4,790,000	4,770,000 r	4,010,000 r	5,300,000 r	5,440,000
Stainless steel[4]	do.	4,790,000 r	4,540,000 r	4,420,000 r	5,370,000 r	5,560,000
U.S. supply:						
Components of U.S. supply, contained chromium:						
Domestic mines	do.	--	--	--	--	--
Secondary[5]	do.	162,000	146,000	141,000	144,000	147,000
Imports:						
Chromite ore[2]	do.	46,400	64,300	23,000	43,900	70,300
Chromium chemicals	do.	10,600	18,000	10,600	5,120	4,270
Chromium ferroalloys	do.	259,000	307,000	140,000	305,000	311,000
Chromium metal	do.	11,700	13,100	7,570	13,000	13,600
Stainless steel mill products and scrap	do.	158,000	157,000	91,800	133,000	132,000
Stocks, January 1:						
Government	do.	253,000	115,000	155,000 [6]	129,000	115,000
Industry[7]	do.	9,620	9,940	7,290	6,820	7,300
Total	do.	910,000	831,000	576,000	779,000	800,000
Distribution of U.S. supply, contained chromium:						
Exports:						
Chromite ore[2]	do.	12,000	2,280	743	1,390	1,930
Chromium chemicals	do.	21,000	22,600	13,500	21,600	20,600
Chromium ferroalloys and metal	do.	27,000	11,300	2,900	4,850	3,060
Stainless steel mill products and scrap	do.	231,000	250,000	263,000	246,000	206,000
Stocks, January 1:						
Government	do.	115,000	105,000 [8]	129,000	115,000 r	111,000
Industry[7]	do.	9,940	7,290	6,820	7,300	6,150
Total	do.	416,000	399,000	416,000	396,000 r	349,000
Production, reported, chromium ferroalloy and metal net production[9]		W	W	W	--	--
Consumption						
Apparent, contained chromium	do.	493,000	432,000	160,000	384,000 r	451,000
Reported:						
Chromite ore and concentrates, gross weight	do.	W	W	W	W	W
Chromium ferroalloys:[10]						
Gross weight	do.	469,000	427,000	383,000	423,000 r	428,000
Contained chromium	do.	275,000	251,000	224,000	248,000	250,000
Chromium metal, gross weight	do.	5,410	4,740	4,190	4,540	3,080
Stocks, December 31, gross weight:						
Government						
Chromite ore	do.	--	--	--	--	--
Chromium ferroalloys	do.	155,000	140,000 [8]	175,000	154,000	150,000
Chromium metal	do.	4,970	4,820	4,670	4,430 r	4,230
Industry:						
Producer[11]	do.	W	W	W	W	W
Consumer:						
Chromium ferroalloys[12]	do.	16,300	11,700	10,900 r	11,500	9,900
Chromium metal	do.	221	235	149 r	284	162
Other	do.	216	272	263	243	92
Prices, average annual:						
Chromite ore[13]	dollars per metric ton	244	346	159	208	216
Ferrochromium, chromium content[14]	dollars per pound	1.01 r	1.79 r	0.81	1.17 r	1.15
Aluminothermic chromium metal, gross weight[15]	do.	3.66	5.30	4.08	5.23	6.56
Value of trade:[16]						
Exports	thousands	$150,000	$149,000	$86,600	$131,000	$124,000
Imports	do.	$699,000	$1,430,000	$444,000	$1,010,000	$1,130,000
Net imports[17]	do.	-548,000	-1,280,000	-358,000	-884,000 r	-1,010,000

See footnotes at end of table.

TABLE 1—Continued
SALIENT CHROMIUM STATISTICS[1]

		2007	2008	2009	2010	2011
Stainless steel:						
Production:						
Gross weight[18]	metric tons	2,170,000 r	1,930,000 r	1,620,000 r	2,200,000 r	2,070,000
Contained chromium[19]	do.	360,000	324,000	276,000	383,000	353,000
Average grade, dimensionless[20]		0.1656	0.1684	0.1703	0.1738	0.1703
Shipments, gross weight[21]		1,700,000	1,380,000	1,200,000	1,510,000	1,890,000
Exports, gross weight		476,000	471,000	414,000	508,000	558,000
Imports, gross weight		809,000	783,000	416,000	585,000	605,000
Scrap, gross weight:						
Receipts		953,000	858,000	832,000	846,000	866,000
Consumption		1,430,000	1,330,000	1,260,000	1,280,000	1,300,000
Exports		882,000	1,000,000	1,130,000	937,000	656,000
Imports		118,000	140,000	124,000	195,000	169,000
Value of trade:						
Exports	thousands	$2,110,000	$2,300,000	$1,450,000	$2,120,000	$2,510,000
Imports	do.	$4,300,000	$4,040,000	$1,710,000	$2,310,000 r	$2,650,000
Scrap exports	do.	$1,620,000	$1,190,000	$777,000	$936,000	$958,000
Scrap imports	do.	$198,000	$217,000	$138,000	$305,000	$295,000
Net imports[17, 22]	do.	-$770,000	-$773,000	$384,000	$433,000 r	$523,000

rRevised. do. Ditto. W Withheld to avoid disclosing company proprietary data. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Calculated assuming chromite ore to average 44% Cr_2O_3, which is 68.42% chromium.
[3]Calculated assuming chromium content of ferrochromium to average 57% chromium.
[4]Calculated from American Iron and Steel Institute reported stainless steel production assuming chromium content of stainless steel to average 16.7% chromium.
[5]Calculated assuming chromium content of stainless steel to average 17% chromium.
[6]From January 1, 2009 to December 31, 2009, the DLA made an accounting adjustment to low-carbon ferrochromium stocks making them (the stocks for those months) incompatible for the purpose of computing stock change for that year. January stocks were estimated.
[7]Includes consumer stocks of chromium ferroalloys and metal and other chromium-containing materials.
[8]From 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.
[9]Includes chromium ferroalloys and metal and other chromium materials in the United States.
[10]Chromium ferroalloys, chromite ore, and other chromium-containing materials excluding chromium metal.
[11]Chromium ferroalloys and metal producer stocks of chromium ferroalloys and metal.
[12]Consumer stocks of high- and low-carbon ferrochromium and ferrochromium-silicon.
[13]Time-weighted average price of South African chromite ore that contains 44% Cr_2O_3 f.o.b. South Africa as reported in Ryan's Notes.
[14]Time-weighted average U.S. price of imported high-carbon chromium that contains 49% to 51% chromium as reported in Ryan's Notes.
[15]Annual average U.S. price of imported aluminothermic chromium metal as reported by Ryan's Notes.
[16]Includes chromite ore and chromium ferroalloys, metal, and chemicals.
[17]Negative data indicate that imports are greater than exports.
[18]Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel production and shipments.
[19]Estimated 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.
[20]Ratio of estimated mass-weighted average chromium content of stainless steel production by grade to production. Expressed as a fraction.
[21]Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel shipments.
[22]Includes stainless steel and stainless steel scrap.

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

(Metric tons)

	2010		2011		Change[2]	
	Gross weight	Chromium content	Gross weight	Chromium content	Quantity	Percentage
Consumption by end use:						
Alloy uses:						
Steel:						
Carbon steel	7,210	4,430	5,420	3,570	-1,790	-25
High-strength low-alloy steel	2,800	1,840	2,890	1,930	91	3
Stainless and heat-resisting steel	358,000	207,000	364,000	209,000	5,790	2
Fully alloy steel	17,900	10,900	20,300	12,100	2,400	13
Unspecified steel[3]	27,800	17,400	27,000	16,900	-756	-3
Superalloys	9,390	7,480	8,310	6,110	-1,080	-12
Other alloys and uses[4]	4,690	3,180	3,160	2,260	-1,530	-33
Total	428,000	252,000	431,000	252,000	3,110	1
Consumption by material:						
Low-carbon ferrochromium	32,000	21,900	31,200	21,400	-735	-2
High-carbon ferrochromium	364,000	215,000	370,000	217,000	6,080	2
Ferrochromium silicon	(5)	(5)	(5)	(5)	(5)	W
Chromium metal	4,540	4,540	3,080	3,080	-1,460	-32
Chromium-aluminum alloy	371	256	179	135	-192	-52
Other chromium materials	27,100	10,700	26,500	10,600	-581	-2
Total	428,000	252,000	431,000	252,000	3,110	1
Consumer stocks:						
Low-carbon ferrochromium	1,810	1,240	1,850	1,270	43	2
High-carbon ferrochromium	9,210	5,450	7,390	4,340	-1,820	-20
Ferrochromium silicon	(5)	(5)	W	W	W	W
Chromium metal	284	283	162	162	-122	-43
Chromium-aluminum alloy	124	86	W	W	W	W
Other chromium materials	618	246	685	296	67	-11
Total	12,000	7,300	10,100	6,070	-1,960	-16
National Defense Stockpile stocks:[6,7]						
Chromium ferroalloys:[8]						
High-carbon ferrochromium	95,400	68,100	95,200	68,000	-190	--
Low-carbon ferrochromium	59,000	42,200	54,300	38,800	-4,690	-8
Chromium metal[9]	4,430 r	4,430 r	4,230	4,230	-203	-5

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

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

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

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

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

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

[6]The source for stockpile information is the Defense Logistics Agency, DLA Strategic Materials.

[7]The DLA data is based on the "Total Uncommitted Inventory" of stockpile material D–1 report.

[8]Chromium content estimated using 71.4% chromium.

[9]Chromium content estimated using 100% chromium.

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

Material		2010		2011	
		Contained chromium	Gross weight	Contained chromium	Gross weight
Value:[2, 3]					
Chromite ore:					
Not more than 40% chromic oxide	dollars per metric ton	XX	XX	1,490	528
More than 40% but less than 46% chromic oxide	do.	537	168	814	252
46% or more chromic oxide	do.	793	252	986	372
Average	do.	674	212	965	355
Ferrochromium:					
Not more than 0.5% carbon	do.	4,630	3,180	5,000	3,460
More than 0.5% but not more than 3% carbon	do.	3,660	2,240	4,080	2,320
More than 3% but not more than 4% carbon	do.	1,850	1,100	1,400	794
Average (not more than 4%)	do.	4,540	3,090	4,920	3,380
More than 4% carbon	do.	2,290	1,320	2,270	1,300
Average (all grades)	do.	2,560	1,500	2,600	1,530
Chromium metal[4]	do.	XX	11,300	XX	14,100
Price:[5]					
Chromite ore:					
Turkey					
36% to 38% Cr_2O_3	do.	1,340 [6]	339	1,250 [6]	317
40% to 42% Cr_2O_3	do.	1,270 [6]	357	1,190 [6]	334
South Africa					
39% Cr_2O_3	do.	778 [r]	208	779	208
44% Cr_2O_3	do.	690	208	718	216
High-carbon ferrochromium:					
49% to 51% chromium	cents per pound	117	XX	115	XX
60% to 65% chromium	do.	126	XX	122	XX
Low-carbon ferrochromium					
0.05% carbon	do.	240	XX	246	XX
0.10% carbon	do.	216	XX	228	XX
0.15% carbon	do.	200	XX	219	XX
Chromium metal:					
Imported, aluminothermic	do.	XX	523	XX	656

[r]Revised. do. Ditto. XX Not applicable.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Mass-weighted average based on customs value and weight of imported material.
[3]Reported by the U.S. Census Bureau.
[4]Average for all grades.
[5]Source: Ryan's Notes.
[6]Based on average Cr_2O_3 content.

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

HTS[2] code	Type	2010 Quantity (metric tons)	2010 Value (thousands)	2011 Quantity (metric tons)	2011 Value (thousands)	Principal destinations in 2011 (Quantity in metric tons, value in thousands)
2610.00.0000	Chromite ore and concentrates, gross weight	4,420	$2,620	5,250	$3,520	Canada (2,550, $1,580); Mexico (1,030, $743); Netherlands (864, $497); China (269, $214); Australia (118, $59).
	Metal and alloy, gross weight:					
8112.21.0000	Unwrought chromium powders	291	6,570	345	8,020	Japan (94, $1,060); Germany (63, $2,410); Mexico (55, $920); Brazil (30, $488); China (24, $710); Canada (22, $440).
8112.22.0000	Chromium metal waste and scrap	41	734	18	428	Philippines (6, $106); Germany (4, $138); Taiwan (3, $61); Japan (3, $59); United Kingdom (1, $40); Mexico (1, $20).
8112.29.0000	Chromium metal other than unwrought powders and waste and scrap	265	11,100	194	5,360	Belgium (62, $560); Japan (19, $707); Hong Kong (17, $579); Taiwan (15, $490); Canada (11, $218); Ireland (8, $159); United Kingdom (8, $186); Brazil (7, $336); Mexico (5, $264); France (5, $267).
	Total chromium metal	597	18,400	557	13,800	
	Chromium ferroalloys:					
7202.41.0000	High-carbon ferrochromium:[3]					
	Gross weight	6,530	7,810	4,260	5,360	Brazil (940, $1,200); Canada (850, $1,059); Mexico (530, $860); Peru (360, $329); Thailand (359, $508); Italy (291, $262); Argentina (265, $234).
	Contained weight	3,150	XX	1,940	XX	
7202.49.0000	Low-carbon ferrochromium:[4]					
	Gross weight	2,490	4,820	1,030	2,250	Canada (387, $894); Mexico (328, $736); Argentina (96, $159); Netherlands (61, $144); Brazil (44, $101); India (42, $105); Australia (40, $53); Peru (27, $44); Colombia (9, $16).
	Contained weight	1,060	XX	549	XX	
7202.49.0000	Ferrochromium-silicon:					
	Gross weight	106	225	28	64	Canada (24, $40); Brazil (3, $16); Colombia (1, $8).
	Contained weight	37	XX	10	XX	
	Total chromium ferroalloys:					
	Gross weight	9,130	12,900	5,330	7,670	
	Contained weight	4,250	XX	2,500	XX	
	Chemicals, gross weight:					
	Chromium oxides:					
2819.10.0000	Chromium trioxide	14,700	30,700	13,000	22,000	Brazil (2,580, $3,240); Republic of Korea (1,190, $1,520); United Kingdom (1,160, $1,450); India (1,030, $1,280); France (729, $911); Indonesia (614, $768); Chile (606, $1,000); Germany (535, $863); Spain (526, $1,790); Belgium (495, $628); Mexico (492, $1,890); Italy (473, $807).
2819.90.0000	Other	5,250	26,000	4,800	32,800	Belgium (999, $7,040); Spain (945, $5,780); United Kingdom (501, $2,910); Canada (423, $2,870); China (348, $1,680); Brazil (249, $1,740); Mexico (247, $1,340); Germany (232, $2,020).
	Total chromium oxides	19,900	56,700	17,800	54,800	
2833.29.4000	Chromium sulfates	60	306	53	263	Brazil (16, $79); Taiwan (15, $74); China (8, $40); Turkey (3, $13); Sweden (2, $12); Hong Kong (2, $10); United Kingdom (2, $10); Vietnam (1, $7); Germany (1, $6); Australia (1, $8); South Africa (1, $3).
	Salts of oxometallic or peroxometallic acids:					
2841.90.4500	Zinc and lead chromate	35	362	4	396	South Africa (3, $359); Mexico (1, $27).

See footnotes at end of table.

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

HTS[2] code	Type	2010 Quantity (metric tons)	2010 Value (thousands)	2011 Quantity (metric tons)	2011 Value (thousands)	Principal destinations in 2011 (Quantity in metric tons, value in thousands)
2841.30.0000	Sodium dichromate	29,400	27,500	30,100	28,900	Japan (20,200, $18,300); Mexico (4,880, $4,960); Canada (2,590, $3,970); India (1,130, $853); China (321, $261); Peru (246, $135); Republic of Korea (149, $82); Taiwan (113, $62); Indonesia (94, $64); Philippines (76, $42); Brazil (76, $42); South Africa (38, $21); Thailand (38, $21); Malaysia (38, $21); Chile (19, $24); Singapore (11, $6).
2841.50.1000	Potassium dichromate	48	131	72	152	
2841.50.9100	Other	929	3,570	928	3,940	Republic of Korea (160, $599); China (108, $419); Indonesia (103, $161); Canada (94, $391); Vietnam (89, $365); Thailand (61, $222); India (53, $115); South Africa (37, $772); Russia (34, $89); Lithuania (31, $83).
	Total salts	30,500	31,500	31,100	33,400	
3206.20.0000	Pigments and preparations, gross weight	2,540	8,640	1,810	10,600	Mexico (1,480, $5,910); Canada (89, $499); Colombia (40, $568); Brazil (32, $475); Germany (32, $375).

XX Not applicable.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States of America.
[3]More than 4% carbon.
[4]Not more than 4% carbon.

Source: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY[1]

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 weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)
2010:															
Albania	1,370	903	$3,280	--	--	--	--	--	--	11,600	7,610	$16,700	13,000	8,510	$20,000
Belgium	500	351	2,020	--	--	--	20	15	$79	--	--	--	520	367	2,100
Brazil	--	--	--	--	--	--	--	--	--	19	12	49	19	12	49
China	2,570	1,520	6,860	140	92	$371	40	40	123	960	667	1,770	3,710	2,320	9,130
Finland	--	--	--	--	--	--	--	--	--	429	217	415	429	217	415
France	--	--	--	--	--	--	--	--	--	(3)	(3)	3	(3)	(3)	3
Germany	5,240	3,670	21,800	--	--	--	--	--	--	50	35	176	5,290	3,710	21,900
India	--	--	--	--	--	--	475	292	611	13,300	8,170	18,900	13,800	8,470	19,500
Japan	2,050	1,420	9,010	--	--	--	--	--	--	--	--	--	2,050	1,420	9,010
Kazakhstan	2,920	1,860	8,150	--	--	--	--	--	--	112,000	77,900	194,000	115,000	79,700	203,000
Latvia	--	--	--	--	--	--	--	--	--	200	140	375	200	140	375
Netherlands	81	60	298	--	--	--	--	--	--	--	--	--	81	60	298
Romania	--	--	--	--	--	--	--	--	--	3,030	1,710	3,410	3,030	1,710	3,410
Russia	32,400	22,600	98,500	1,050	720	2,840	636	350	473	33,500	21,300	53,300	67,600	45,000	155,000
Slovenia	--	--	--	--	--	--	--	--	--	100	62	139	100	62	139
South Africa	1,000	608	3,080	1,180	640	2,110	--	--	--	243,000	121,000	250,000	245,000	122,000	255,000
Sweden	23	16	138	--	--	--	--	--	--	8,050	5,190	14,200	8,070	5,210	14,300
Switzerland	--	--	--	--	--	--	--	--	--	96	67	124	96	67	124
Turkey	1,700	1,210	5,450	--	--	--	--	--	--	11,000	7,280	20,000	12,700	8,480	25,400
United Kingdom	--	--	--	--	--	--	--	--	--	24	19	68	24	19	68
Zimbabwe	--	--	--	--	--	--	--	--	--	16,500	9,550	23,400	16,500	9,550	23,400
Total	49,900	34,300	159,000	2,370	1,450	5,320	1,170	697	1,290	454,000	261,000	597,000	507,000	297,000	763,000
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	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

See footnotes at end of table.

TABLE 5—Continued
U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY[1]

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 weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)
2011—Continued:															
Vietnam	--	--	--	--	--	--	--	--	--	150	90	360	150	90	360
Zimbabwe	--	--	--	--	--	--	--	--	--	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

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Harmonized Tariff Schedule of the United States of America.
[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2010 Quantity (metric tons)	2010 Value[3] (thousands)	2011 Quantity (metric tons)	2011 Value[3] (thousands)	Sources in 2011 (Quantity in metric tons, value in thousands)
	Chromite ore:					
2610.00.0020	Not more than 40% Cr_2O_3:					
	Gross weight	--	--	151	$80	South Africa (71, $44); India (54, $3); Canada (25, $22), Germany (1, $11).
	Cr_2O_3 content	--	XX	78	XX	
2610.00.0040	More than 40%, but less than 46% Cr_2O_3:					
	Gross weight	65,400	$11,000	27,900	7,040	South Africa (all).
	Cr_2O_3 content	29,900	XX	12,600	XX	
2610.00.0060	46% or more Cr_2O_3:					
	Gross weight	73,600 r	18,600	163,000	60,700	South Africa (163,000, $60,700); Germany (1, $10); Netherlands (1, $8).
	Cr_2O_3 content	34,200 r	XX	90,000	XX	
	Total chromite ore:					
	Gross weight	139,000	29,500 r	191,000	67,900	
	Cr_2O_3 content	64,000 r	XX	103,000	XX	
	Chromium ferroalloys:					
	Ferrochromium:					
7202.49.5090	Not more than 0.5% carbon:					
	Gross weight	49,900	159,000	53,700	186,000	Russia (31,400, $101,000); Kazakhstan (8,070, $23,200); Germany (6,540, $31,600); Turkey (2,770, $9,410); Japan (2,660, $13,500); Brazil (1,220, $3,170); China (708, $2,460); Albania (284, $593); Belgium (61, $266); South Africa (20, $61); Sweden (20, $103); Netherlands (17, $61).
	Cr content	34,300	XX	37,100	XX	
7202.49.5010	More than 0.5%, but less than 3% carbon:					
	Gross weight	2,370	5,320	393	912	South Africa (353, $762); Russia (40, $150).
	Cr content	1,450	XX	224	XX	
	More than 3%, but less than 4% carbon:					
	Gross weight	1,170	1,290	1,510	1,200	Russia (1,390, $1,020); India (95, $105); Turkey (20, $64).
	Cr content	697	XX	855	XX	
	More than 4% carbon:					
	Gross weight	454,000	597,000	462,000	602,000	South Africa (243,000, $248,000); Kazakhstan (120,000, $190,000); Russia (33,000, $56,500); Zimbabwe (23,800, $37,000); India (13,400, $19,300); Sweden (11,100, $22,300); Turkey (8,690, $16,000); Albania (8,520, $12,500); Portugal (501, $719); Finland (214, $212); Vietnam (150, $360); China (3, $9).
	Cr content	261,000	XX	265,000	XX	
7202.50.0000	Ferrochromium-silicon:					
	Gross weight	17,000	28,200	20,000	33,600	Kazakhstan (17,100, $28,258); Russia (2,880, $5,337).
	Cr content	7,210	XX	7,820	XX	
	Total Chromium ferroalloys:					
	Gross weight	524,000	791,000	538,000	824,000	
	Cr content	305,000	XX	311,000	XX	
	Chromium metal, gross weight:					
8112.21.1000	Unwrought chromium powders	1,860	22,800	2,720	40,000	China (1,660, $23,500); Russia (435, $5,510); United Kingdom (323, $4,840); France (279, $5,190); Germany (14, $613); Japan (5, $214); India (4, $55).
8112.22.0000	Waste and scrap	544	2,260	574	2,090	Mexico (545, $1,620); United Kingdom (13, $121); Germany (12, $200); Singapore (3, $54); Japan (1, $100).

See footnotes at end of table.

TABLE 6—Continued
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2010 Quantity (metric tons)	2010 Value[3] (thousands)	2011 Quantity (metric tons)	2011 Value[3] (thousands)	Sources in 2011 (Quantity in metric tons, value in thousands)
8112.29.0000	Other than waste and scrap	10,600	123,000 r	10,300	150,000	Russia (3,580, $49,200); United Kingdom (2,850, $41,300); France (2,210, $35,200); China (1,530, $21,000); Germany (99, $2,020); Netherlands (57, $784); Japan (16, $360).
	Total chromium metal	13,000	148,000	13,600	192,000	
	Chemicals, gross weight:					
	Chromium oxides and hydroxides:					
2819.10.0000	Chromium trioxides	5,050	14,100	5,770	18,700	Turkey (4,460, $12,300); China (445, $2,950); Kazakhstan (427, $1,580); South Africa (245, $831); Colombia (82, $592); Canada (40, $131); Netherlands (36, $140); Spain (20, $143); Mexico (6, $18); France (4, $17); Germany (1, $13).
2819.90.0000	Other	3,200	13,800	1,330	8,550	China (859, $5,530); Germany (202, $1,650); India (80, $400); Kazakhstan (57, $373); Canada (47, $60); France (38, $250); Finland (21, $103); Japan (17, $113); Colombia (9, $70).
	Total oxides	8,240	27,900	7,100	27,300	
2833.29.4000	Sulfates of chromium	325	351	308	368	Turkey (234, $263); China (40, $50); India (17, $20); Mexico (17, $29).
	Salts of oxometallic or peroxometallic acids:					
2841.90.4500	Chromates of lead and zinc	168	701	144	628	China (44, $203); Japan (37, $163); Austria (36, $127); Colombia (26, $128).
2841.30.0000	Sodium dichromate	150	438	268	772	China (201, $602); Turkey (54, $110); Colombia (13, $57).
	Other chromates and dichromates; Peroxochromates:					
2841.50.1000	Potassium dichromate	12	59	18	71	Austria (all).
2841.50.9100	Other	439	1,530	243	936	Austria (185, $613); Brazil (19, $54); Germany (16, $139); France (10, $41); Colombia (7, $24); China (3, $19); Canada (2, $8); Taiwan (1, $25).
	Total salts	769	2,730	673	2,410	
2849.90.2000	Chromium carbide	242	4,370	276	5,690	China (114, $1,990); United Kingdom (95, $1,540); Canada (47, $1,230); Austria (10, $541); Germany (5, $228); Hong Kong (3, $57); Mexico (1, $90); Japan (1, $19).
	Total chromium chemicals	9,580	35,400	8,350	35,700	
	Pigments and preparations based on chromium, gross weight:					
3206.20.0010	Chrome yellow	1,550	7,030	1,990	8,980	China (1,150, $3,990); Canada (605, $4,020); Colombia (128, $536); Mexico (65, $274); Germany (41, $152).
3206.20.0020	Molybdenum orange	349	2,730	328	2,790	Canada (237, $2,230); Colombia (65, $386); Mexico (19, $112); China (4, $27); Germany (3, $29).
3206.20.0030	Zinc yellow	92	282	25	80	China (19, $56); Mexico (5, $21); Canada (1, $3).
3206.20.0050	Other	292	1,540	306	1,740	France (143, $507); China (46, $334); Poland (38, $275); Germany (32, $266); Japan (19, $142); India (14, $135); Canada (9, $39); Italy (5, $23); United Kingdom (1, $9).
	Total pigments	2,280	11,600	2,650	13,600	

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

TABLE 7
WORLD PRODUCTION CAPACITY AND APPARENT CONSUMPTION OF CHROMITE ORE, FERROCHROMIUM, CHROMIUM METAL, CHROMIUM CHEMICALS, AND STAINLESS STEEL[e, 1]

(Thousand metric tons of contained chromium)

	Production capacity in 2011					Apparent consumption[2]					
Country	Ore	Ferro-chromium	Metal	Chemicals	Stainless steel	2009	2010	2011	LPI[3]	PPI[4]	CMP[5]
Afghanistan	2	--	--	--	--	2	2	2	NA	NA	NA
Albania	87	8	--	--	--	7	-49	-29	2.77	NA	NA
Argentina	--	--	--	13	--	20	43	36	3.05	NA	NA
Austria	--	--	--	--	11	39	67	-9	3.89	NA	NA
Belgium	--	--	--	--	259	177	243	266	3.98	NA	NA
Brazil	193	72	--	--	83	98	155	165	3.13	43.3	0.54
Canada	--	--	--	--	--	16	30	27	3.85	79.4 [6]	0.56 [6]
China	60	1,430	6	70	2,210	6,740	7,690	8,260	3.52	43.1	0.30
Czech Republic	--	--	--	--	3	18	24	16	3.14	NA	NA
Finland	185	126	--	--	170	48	15	41	4.05	92.4	0.59
France	--	--	7	--	52	77	117	107	3.85	NA	NA
Germany	--	18	1	--	267	325	514	550	4.03	NA	NA
Greece	(7)	--	--	--	--	1	1	2	2.83	NA	NA
India	1,170	480	(7)	31	330	732	587	900	3.08	12.4	0.25
Iran	81	5	--	2	--	77	75	75	2.49	NA	NA
Italy	--	--	--	--	271	308	402	432	3.67	NA	NA
Japan	--	11	1	17	655	509	877	872	3.93	NA	NA
Kazakhstan	1,140	852	2	37	--	330	1,130	1,140	2.69	17.0	0.32
Korea, Republic of	--	--	--	--	361	385	526	504	3.70	NA	NA
Madagascar	42	--	--	--	--	(7)	NA	42	2.72	42.0	0.38
Oman	259	--	--	--	--	192	54	186	2.89	NA	NA
Pakistan	52	--	--	3	--	6	-90	-56	2.83	NA	NA
Philippines	5	--	--	--	--	4	4	5	3.02	13.0	0.33
Poland	--	--	--	--	1	13	27	27	3.43	51.2	0.45
Russia	275	353	16	31	31	497	275	23	2.58	24.6	0.30
Slovenia	--	--	--	--	20	14	22	17	3.29	NA	NA
South Africa	3,270	1,920	--	23	112	-856	77	-391	3.67	44.5	0.33
Spain	--	--	--	--	189	115	169	NA	3.70	57.6	0.34
Sudan	17	--	--	--	--	-3	17	17	2.10	NA	NA
Sweden	--	78	--	--	116	78	73	78	3.85	85.5	0.59
Taiwan	--	--	--	--	257	NA	NA	NA	3.71	NA	NA
Turkey	572	50	--	17	--	-13	-61	-29	3.51	41.0	0.50
Ukraine	--	--	--	--	21	NA	NA	27	2.85	NA	NA
United Arab Emirates	10	--	--	--	--	7	8	NA	3.78	NA	NA
United Kingdom	--	--	7	--	60	43	37	45	3.90	NA	NA
United States	--	--	--	38	420	165	335	393	3.93	65.1 [8]	0.43 [8]
Vietnam	31	--	--	--	--	NA	NA	12	3.00	14.4	0.30
Zimbabwe	185	120	--	--	--	29	349	181	2.55	21.8	0.21
Total	7,650	5,530	40	282	5,900	XX	XX	XX	XX	XX	XX

[e]Estimated. NA Not Available. XX Not applicable. -- Zero.

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

[2]Estimated 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 Cr_2O_3; chromium ferroalloys, contained chromium; and exports, gross weight.

[3]Logistics Performance Index from Connecting to Compete 2012, The World Bank.

[4]Policy Potential Index from Survey of Mining Industries 2011–12, Frasier Institute.

[5]Current Mineral Potential from Survey of Mining Industries 2011–12, Frasier Institute.

[6]Ontario.

[7]Less than ½ unit.

[8]Average over multiple States.

TABLE 8
CHROMITE: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	2007	2008	2009	2010	2011[e]
Afghanistan[e, 4]	6,491 [5]	6,500 [r]	6,000	6,000	6,500
Albania[6]	199,771	207,104	288,759	289,687	290,000
Australia	253,400	224,809	119,314	--	--
Brazil[7]	627,772	664,347	365,210	520,129 [r]	520,200 [p, 5]
China[e]	200,000	200,000	200,000	200,000	200,000
Finland	556,100	613,543	246,817	245,000	245,000
Greece[e, 4]	1,400 [5]	1,400	1,400	1,400	1,600
India	3,320,000	3,900,000	3,760,000	3,800,000	3,850,000
Iran	185,760	268,586	255,129	250,000 [e]	250,000
Kazakhstan	3,687,200	3,552,000	3,544,000	3,760,000 [r, e]	3,800,000
Madagascar	77,700 [r]	112,600 [r]	131,800 [r]	134,500 [r]	140,000
Oman	407,822	859,748	636,482	801,856	616,700 [5]
Pakistan	108,000 [r]	104,000 [r]	174,000 [r]	120,000 [r]	130,000
Philippines	31,592	15,268	14,322 [r]	14,807 [r]	15,000
Russia	776,681	913,000	416,194	400,000 [e]	450,000
South Africa	9,646,958	9,682,640	7,560,938	10,871,095	10,200,000
Sudan	15,476	27,094	14,087	56,823	57,000
Turkey	1,678,932	1,885,712	1,573,993	1,904,461 [r]	1,900,000
United Arab Emirates	19,000	34,350	23,770	25,000	--
Vietnam	103,830	55,880	37,105	40,000 [r]	40,000
Zimbabwe	614,559 [r]	442,584 [r]	193,673 [r]	510,000 [r]	600,000
Total	22,500,000 [r]	23,800,000 [r]	19,600,000 [r]	24,000,000 [r]	23,300,000

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

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

[2]Table includes data available through August 22, 2012.

[3]Figures for all countries represent marketable output unless otherwise noted.

[4]Gross weight estimated assuming an average grade of 44% chromic oxide (Cr_2O_3).

[5]Reported figure.

[6]Ore grade was 18% to 42% chromic oxide (Cr_2O_3).

[7]Average chromic oxide (Cr_2O_3) content was as follows: 2007—40.3%; 2008—42.5%; 2009—40.0%; 2010—49.7% (revised); and 2011—49.7% (estimated).

TABLE 9
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country	2007	2008	2009	2010	2011[e]
Albania	--	11,916	7,556	8,000 [e]	8,000
Brazil[3]	195,890	194,324	131,048	277,114 [r]	277,000 [p]
China[e]	1,300,000	1,500,000	1,810,000	2,400,000 [r]	2,600,000
Finland	241,760	233,550	123,310	125,000 [e]	125,000
Germany	22,030	26,960	13,667	17,300 [r, e]	17,800
India[e, 4]	820,000	750,000	873,385 [5]	850,000	830,000
Iran[e]	8,000	8,000	8,000	8,000	8,000
Japan[6]	12,016	13,888	7,698	16,208	16,000
Kazakhstan	1,307,536	1,220,315	1,173,286	1,311,302	1,300,000
Romania[e]	--	6,000 [r]	15,000 [r]	14,000 [r]	--
Russia[e]	570,000	490,000	378,000 [5]	414,000	430,000
South Africa	3,551,983	3,268,659	2,346,132 [r]	3,607,132	3,700,000
Sweden	124,403	117,053	31,345	36,000 [e]	36,000
Turkey	69,730	79,840	41,028	60,000 [e]	60,000
United States[7]	W	W	W	-- [r]	--
Zimbabwe	187,327	145,430	72,223	146,000 [r, e]	140,000
Total	8,410,000	8,070,000 [r]	7,030,000 [r]	9,290,000 [r]	9,550,000

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.
[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Table includes data available through August 22, 2012.
[3]Includes high- and low-carbon ferrochromium.
[4]Reported on a fiscal year basis, which is from April 1 to March 31. Includes ferrochrome and charge chrome.
[5]Reported figure.
[6]Includes high- and low-carbon ferrochromium and ferrochromium-silicon.
[7]Includes chromium metal, high- and low-carbon ferrochromium, ferrochromium-silicon, and other chromium materials.