USGS
science for a changing world

2012 Minerals Yearbook

IRON OXIDE PIGMENTS

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

August 2016

Iron Oxide Pigments

By Arnold O. Tanner

Domestic survey data were prepared by Hoa P. Phamdang, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

In 2012, natural iron oxide pigment (IOP) production in the United States was virtually unchanged compared with that of 2011. U.S. production data are withheld to avoid disclosing company proprietary data. Finished natural and synthetic IOPs sold by processors increased to about 48,400 metric tons (t) valued at $77.7 million in 2012 from 48,000 t valued at $73.9 million in 2011 (table 1). Exports of all grades of IOPs and hydroxides decreased to 60,300 t valued at about $55.4 million in 2012 compared with 62,000 t valued at $51.7 million in 2011 (table 3). Imports of natural and synthetic IOPs decreased to 151,000 t valued at $182 million in 2012 compared with 158,000 t valued at $188 million in 2011 (tables 1, 4, 5).

Production

Natural IOPs are inorganic compounds that are suitable for use as pigments after milling and relatively minimal processing as compared with synthetic IOPs or various other natural pigments. They commonly are the most advantageous choice of the natural minerals for pigmentation because they are low cost, inherently color stable, and nontoxic. Typically, they are derived from hematite, which is a red iron oxide mineral; goethite or limonite, minerals that vary from yellow to brown, which include ochers and siennas (yellow) and umbers (brown); and magnetite, a black iron oxide mineral. A wider variety of colors can be produced from natural IOPs either by blends of different IOPs or calcination of hydrated natural IOPs. Synthetic IOPs are widely used as colorants and compete with natural IOPs in many color applications. They are manufactured using three methods: thermal decomposition of iron salts or iron compounds; precipitation of iron salts, usually accompanied by oxidation; and reduction of organic compounds by iron. Organic colorants can be used for some colorant applications but several organic compounds fade over time from exposure to sunlight.

A U.S. Geological Survey (USGS) voluntary survey was sent to three domestic producers of crude (natural) IOPs. U.S. production data for crude (natural) IOPs sold or used in 2012 were estimated based on the data of one company and estimated for two nonrespondents based on previously reported data adjusted according to assumed consuming industry trends. These data collected through the USGS survey are withheld to avoid disclosing company proprietary data. With virtually no change in production of crude pigment in 2012, sales increased slightly.

In a second voluntary USGS survey, production data for finished (natural and synthetic) IOPs received from five of eight known processing operations, represented nearly 75% of the tonnage shown in table 1. Data for the nonrespondents were estimated based on prior-year output levels and industry trends. Sales of finished pigments were 48,400 t in 2012, up slightly from 48,000 t in 2011. Production data for finished IOPs are collected only from operations that process material, such as the crushing and grinding of natural IOPs, or that synthesize IOPs, not operations that simply blend, mix, repackage, and (or) resell IOP material.

At least four U.S. companies, operating nine plants, produced regenerated iron oxide during steelmaking (table 2). Iron oxide is obtained during steelmaking when steel is treated with hydrochloric acid to remove surface oxides. Iron oxide is formed when the spent pickle liquor is treated to recycle the acid. Regenerated iron oxide data were not included in table 1 because it must undergo additional processing before it is suitable for use in typical IOP applications.

During 2012, Prince Minerals Inc. purchased natural IOP supplier Densimix, Inc. and its subsidiary, E&B, Inc., including a two-plant complex in Houston, TX. Densimix processes hematite into IOPs and other iron oxide products; the majority of the company's shipments are used in the coatings and paint, glass, oil and gas, and plastics industries and other chemical and filler markets (Densimix, Inc., 2013). This purchase supplemented Prince Mineral's existing natural and synthetic IOP products that are used to color brick, cement and masonry, and ceramics and glass, and in various color applications for the foundry and welding industries and other industrial markets (Ollett, 2012; Prince Minerals, Inc., 2012).

Applied Minerals, Inc. reported IOP resources at two project areas of the company's Dragon Mine in Utah. The Western Mine ore samples averaged 76% hematite and 19% goethite and the Dragon Pit ore samples averaged 83% goethite and amorphous oxide and 12% hematite. Applied Minerals broke ground on a new halloysite plant for the production of halloysite-based flame retardant product scheduled to begin production by mid-2013. Upon completion of the new plant, the company planned to produce its IOP products at the existing processing plant with approximately 10,000 metric tons per year (t/yr) of IOP (Zeitoun, 2012).

Consumption

End-use data for IOPs are not surveyed by the USGS or other organizations. Will (2008, p. 12) estimated that world consumption of natural IOPs and synthetic IOPs in 2006 was 167,000 t and 1.13 million metric tons (Mt), respectively. About 90% of natural IOPs was used in construction materials and coatings and nearly 75% of synthetic IOPs was used in the same. More recent data are unavailable, but the global economic downturn of 2008–09 likely resulted in decreased consumption of IOPs in those years. This may be inferred by the significant decreases in reported world production of natural IOPs in 2009 and the slow recovery from 2010 through 2012, based on reported and estimated increases in world production (table 6).

Construction materials included concrete products such as block, brick, or segmental retaining wall units; mortar;

paving stones; precast products of various sizes or dimensions; ready-mixed concrete; and roofing tiles. IOPs are used almost exclusively to color decorative concrete. The tinted concrete is often stamped to resemble brick, slate, stone, and many more shapes and forms found in nature, including wood (Pinto, 2008, p. 4, 6).

The second largest market for IOPs is as a tint in paints and coatings. The last year for which shipments of total paint and allied products (comprising architectural coatings, original equipment manufacture product coatings, special-purpose coatings, and miscellaneous allied paint products) were available was 2011, during which an estimated 4.26 billion gallons were shipped, unchanged from that of 2010. The U.S. Census Bureau discontinued paint, varnish, and lacquer reports as of the third quarter of 2011 (U.S. Census Bureau, 2011a, b). Other IOP end uses included colorants for ceramics, glass, paper, plastics, rubber, and textiles; in foundry sands; industrial chemicals, such as catalysts; animal feed; cosmetics; ferrites; fertilizers; and magnetic ink and toner.

A major end use for regenerator iron oxides was ferrite ceramic magnets. Two types of ferrites are used—hard, which retain magnetism permanently, and soft, which do not. Hard ferrites are used in flexible magnets, generators, loudspeakers, and motors. Uses of soft ferrites include computers, cores for radio frequency coils, microwave communication systems, microwave ferrites for telecommunications, and other industrial applications.

Prices

The annual average producer price index (PPI) for IOPs under North American Industry Classification System code PCU325130325130132 (U.S. Bureau of Labor Statistics Series ID WPU06220206) was 220.7 in 2012 (1983=100) compared with 211.6 in 2011. The PPI ranged between 218.4 and 223.1 in 2012, the high being reached in December and the low in February. The PPI measured the average change in the selling prices charged by domestic producers of IOPs over time (U.S. Bureau of Labor Statistics, 2013). Unit values for finished natural and synthetic IOP sold by domestic producers ranged from $0.33 to $3.74 per kilogram, with an average unit value of $1.60 per kilogram.

At midyear, U.S. pigment manufacturer Rockwood Color Pigments and Services announced global price increases on all of its synthetic IOP products, effective August 1; the company did not announce the levels of increase, stating that the customers would be contacted separately. Rockwood Pigments cited "ongoing investment to upgrade infrastructure, address regional regulatory requirements, and support ongoing activities in new product development and innovation" as the reasons for the increases (Patel, 2012).

In January, Karntner Montanindustrie GmbH (KMI), the world's leading micaceous iron oxide pigment (MIO) producer, announced price increases of 3% to 4% on its standard grade MIOs, citing increasing labor costs along with increasing demand for higher quality products. Prices on micronized MIO grades were unchanged (O'Driscoll, 2012).

Foreign Trade

In 2012, U.S. exports of IOPs and hydroxides decreased. Forty-three percent of total IOP exports went to China, which was twice that of the next highest country, Spain, with 19% of the total (table 3).

U.S. exports of pigment-grade IOPs and hydroxides increased slightly to 8,950 t valued at $13.5 million in 2012 with the average unit value decreasing by about 13% compared with that of 2011. Mexico was the leading destination of pigment-grade IOPs, accounting for nearly 44% of U.S. exports, and China was second with 30% (tables 1, 3). Exports of other grades of IOPs and hydroxides decreased by nearly 4% to 51,400 t valued at $41.9 million. China, Spain, and Canada, in descending order, were the major destinations for export of other grades of IOPs and hydroxides, accounting for 45%, 23%, and 14% of the export tonnage, respectively (table 3).

U.S. imports of all IOPs and hydroxides decreased by about 4% in 2012 from that of 2011 and yet they were significantly higher, by 42%, than the recent import low of 2009 (tables 1, 4).

Imports of natural IOP grades decreased slightly. The leading source was Cyprus, with about 57% of the tonnage, followed by France with nearly 15%. Imports of synthetic IOP grades decreased by about 4%. The leading sources of synthetic IOP imports were China with 51% of the tonnage; Germany, 26%; Canada, 7%; and Brazil and Italy, about 6% each (table 5).

World Review

Natural IOPs were produced in at least 10 countries in 2012 (table 6). Several other countries were thought to produce iron oxide pigments, but output, which may have been substantial, was not reported, and no basis was available for estimating output levels.

Because much of Europe's IOP production supplied external markets, those producers were not expected to be significantly affected by sluggish European construction markets. In general, IOP companies with a global customer base were less vulnerable to regional economic fluctuations. Consumption of pigment minerals were expanding significantly for certain emerging markets, such as Latin America and Asia, especially China (Ollett, 2013c).

Austria.—In 2012, KMI continued production of MIO from its underground mine in Waldenstein, Austria, accounting for up to 90% of the global MIO supply market. MIOs have a horizontal layering of flaky, lamellar, "micaceous" particles that overlap like scales on a fish and give strength and corrosion resistance to paints and coatings. Standard grade MIOs are used on bridges, oil rigs, and other structural steel and as protective coatings on electrical and industrial equipment. Micronized grades are used in anticorrosive decorative coatings, including water-based coatings, improvement of prime coatings, and as partial replacement of zinc dust in prime coatings (O'Driscoll, 2012).

Brazil.—Lanxess AG produced synthetic yellow IOPs at its plant in Porto Feliz. At midyear, the company expanded the Porto Feliz sales beyond its traditional North American and South American customers to markets worldwide (Lanxess AG, 2012). The Porto Feliz operation is unusual because of a nearly

$11 million cogeneration facility that Lanxess constructed in 2010. The plant burned bagasse, crushed sugar cane fibers readily available from the region's sugar cane industry, to generate steam providing the plant's heat and for powering a turbine to produce its own electricity while reducing carbon dioxide emissions. Lanxess proceeded with plans to build co-generation plants at its other IOP plant sites in Belgium and India (Lanxess AG, 2010).

China.—China likely increased its IOP production beginning in about 2006, as partly evidenced by a steady and substantial decrease in IOP imports from the United States to a negligible quantity in 2009, in spite of the country's ongoing urbanization. In 2010 through 2012, IOP imports from the United States, increased returning to about 60% the annual levels of 2005–07 (U.S. International Trade Commission, undated). A rising demand for IOPs in China mainly was driven by continued rising levels of construction activity and economic recovery from the global recession (table 3).

Hong Kong-based Cathay Industries Group and the Tonghua Group, announced construction of a new synthetic iron oxide plant for the production of black, red, and yellow IOPs in Anhui Province in eastern China. When completed, the joint-venture plant, to be known as Rely Science & Technology Co., Ltd., will produce 100,000 t/yr with a planned expansion to 150,000 t/yr. The companies intend to sell the IOP products in the Chinese market, which Cathay Industries indicated has been increasing at a rate of 7% to 8% per year in most IOP consuming industries. The new plant will use a direct precipitation process, in which an all-liquid phase method is expected to significantly reduce liquid and solid waste. This will be Cathay Industries' eighth plant of similar IOP capacity in China. Its other major plants are in Shenzhen, Guangdong Province, and Shanghai and Wuxi, Anhui Province, with a total capacity of 80,000 t/yr (Cathay Industries Group, 2013; Ollett, 2013a).

Lanxess AG announced plans to build a 25,000-t/yr red iron oxide plant in Ningbo, Zhejiang Province, at an estimated cost of $74 million. Construction of the plant was scheduled to begin in the second quarter of 2013 with production beginning in early 2015. Synthetic yellow-shaded red IOPs will be produced using an improved Penniman process in which metallic iron is oxidized to iron oxide using acids as catalysts in the presence of atmospheric oxygen. Lanxess continued production at its 38,000-t/yr IOP plant in Jinshan, Shanghai Province, where it produced yellow and black iron oxide pigments (Ollett, 2013b, c).

Spain.—Promindsa SA, the country's leading producer of IOPs, produced and sold about 16,000 t of IOPs in 2012, up from 15,000 t in 2011, about 85% of which it annually exports to more than 50 countries. The company anticipated production and sales to remain at or slightly below the same level in 2013, but expected an increase of about 15% in 2014. About 80% of Promindsa's IOP output and sales was red hematite, much of that from its Tierga mines, principally the underground Santa Rosa Mine, outside Zaragoza. The Santa Rosa operation follows a seam of hematite with an average purity of 85% to 90% iron (III) oxide at depths of up to 250 meters. Promindsa sold its Santa Rosa iron oxide as a red pigment for use in asphalt, brick, glass and ceramics, paints, and roof tile. Promindsa also mined black (magnetite), brown (oolitic iron ore), and yellow (goethite) IOPs in Spain (Fernando Prada, President, Promindsa SA, written commun., July 16, 2013; Moores, 2010).

Outlook

IOP production was estimated to have increased slightly worldwide in 2012 from that of 2011, as the result of growth in construction activity in Asia, Latin America, and the United States. Although the global economic situation was improving in some regions, construction activity and consequent consumption of IOPs for coloring concrete and paint remained sluggish. On a world scale, growth in the IOP market is expected to continue to increase, mostly because IOP's largest end market, construction, is increasing in China, Latin America, and the United States. In Europe, because of economic uncertainties that have continued following the regional debt crisis, capital spending on construction projects that use IOPs is expected to be limited (Ollett, 2013b).

The International Monetary Fund expected the global economy to increase by about 3.1% in 2013 and 3.8% in 2014, with emerging and developing economies increasing by more than twice the percentage as that of the advanced economies (International Monetary Fund, 2013). Continued improvement in the global economy may result in increased activity in IOP markets in 2013–14, especially in regions where the construction industry is expanding.

References Cited

Cathay Industries Group, 2013, New Cathay plant in China: Hong Kong SAR, Cathay Industries Group news release, February 4. (Accessed June 2, 2012, at http://www.cathayindustries.eu/index.php/en/news/53-new-cathay-plant-in-china.)

Densimix, Inc., 2013, Products: Houston, TX, Densimix, Inc. (Accessed April 21, 2013, at http://www.densimix-eb.com/products/index.asp.)

International Monetary Fund, 2013, Growing pains: Washington, DC, International Monetary Fund, World Economic Outlook Update, July 9, 3 p. (Accessed July 11, 2013, at http://www.imf.org/external/pubs/ft/weo/2013/update/02/.)

Lanxess AG, 2010, LANXESS restructures its iron oxide production in Brazil: Leverkusen, Germany, LANXESS AG WebMagazine Newsletter, March. (Accessed March 25, 2012, via http://webmagazine.lanxess.com/brazils-green-boom/green-chemistry.html.)

Lanxess AG, 2012, Yellow specialties for the worldwide market: Leverkusen, Germany, LANXESS AG global press release, May 7. (Accessed February 22, 2013, at http://lanxess.us/en/us-media/global-press-releases/yellow-specialties-for-the-worldwide-market/.)

Moores, Simon, 2010, Spanish iron oxide demand defies domestic trend: Industrial Minerals, July, no. 514, p. 17.

O'Driscoll, Mike, 2012, Labour costs push up micaceous iron oxide prices: Industrial Minerals, January 16. (Accessed June 13, 2013, via http://www.indmin.com/.)

Ollett, John, 2012, Prince Minerals buys iron oxide producer Densimix: Industrial Minerals, September 11. (Accessed June 13, 2013, via http://www.indmin.com/.)

Ollett, John, 2013a, Cathay to construct new Chinese synthetic iron oxide plant: Industrial Minerals, February 6. (Accessed February 28, 2013, via http://www.indmin.com/.)

Ollett, John, 2013b, Iron oxide—Back in the black: Industrial Minerals, April, no. 547, p. 40–45.

Ollett, John, 2013c, Lanxess to construct 25,000 tpa iron oxide plant in China: Industrial Minerals, January 29. (Accessed January 30, 2013, via http://www.indmin.com/.)

Patel, Kasia, 2012, Rockwood Pigments announces global price increase: Industrial Minerals, July 4. (Accessed June 13, 2013, via http://www.indmin.com.)

Pinto, Art, 2008, The use of iron oxides in decorative concrete, *in* Proceedings of Iron Oxide for Colorant and Chemical Applications, New Orleans, LA, February 12–13, 2008: Portland, ME, IntertechPira Corp., p. 1–32 [separately paginated].
Prince Minerals, Inc., 2012, Prince Minerals announces the acquisition of Densimix and E&B Inc.: New York. NY, Prince Minerals, Inc. press release, August 31. (Accessed August 5, 2013, at http://www.princeminerals.com/img/frontend/upload/Densimix Prince Press Release 082712.pdf.)
U.S. Bureau of Labor Statistics, 2013, Producer price index—Industry data: U.S. Bureau of Labor Statistics. (Accessed July 8, 2013, via http://data.bls.gov/cgi-bin/srgate.)
U.S. Census Bureau, 2011a, Paint, varnish, and lacquer—Fourth quarter 2010: U.S. Census Bureau MQ325F(10)–4, March, 6 p. (Accessed July 14, 2011, at http://www.census.gov/manufacturing/cir/historical_data/mq325f/mq325f104.xls.)
U.S. Census Bureau, 2011b, Paint, varnish, and lacquer—Second quarter 2011: U.S. Census Bureau MQ325F(11)–02, September. (Accessed July 3, 2012, via http://www.census.gov/manufacturing/cir/historical_data/mq325f/.)
U.S. International Trade Commission, [undated], Interactive tariff and trade dataweb: U.S. International Trade Commission. (Accessed April 10, 2012, at http://dataweb.usitc.gov/.)
Will, Raymond, 2008, Iron oxide pigments global overview, *in* Proceedings of Iron Oxides for Colorant and Chemical Applications, New Orleans, LA, February 11–13, 2008: Portland, ME, IntertechPira Corp., p. 1–30, [separately paginated].
Zeitoun, A. M., 2012, Applied Minerals Inc. issues letter to shareholders: New York, NY, Applied Minerals, Inc. news release, November 20. (Accessed July 11, 2013, at http://appliedminerals.com/news/article/applied-minerals-inc.-issues-letter-to-shareholders.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Historical Statistics for Mineral and Material Commodities in the United States, Data Series 140.
Pigments and Fillers. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

Other

CEH Marketing Research Report: Pigments. SRI Consulting, 2004.
IntertechPira Corp. proceedings of conferences.
Iron Oxide Pigments—Pt. 1.—Fine-Particle Iron Oxides for Pigment, Electronic, and Chemical Use. U.S. Bureau of Mines Information Circular 8771, 1978.
Iron Oxide Pigments—Pt. 2.—Natural Iron Oxide Pigments—Location, Production, and Geological Description. U.S. Bureau of Mines Information Circular 8813, 1980.
Manufacture of Different Grades of Iron Oxide—A New Experience. Iron Oxides ’91 Proceedings, Falmouth Associates, Inc., 1991.
Pigment Handbook (2d ed.). John Wiley & Sons, 1988.

TABLE 1
SALIENT U.S. IRON OXIDE PIGMENTS STATISTICS[1]

		2008	2009	2010	2011	2012
Crude pigments sold or used:[2]						
Quantity	metric tons	W	W	W	W	W
Value	thousands	W	W	W	W	W
Finished pigments sold:[3]						
Quantity	metric tons	83,300	50,800	54,700	48,000	48,400
Value	thousands	$116,000	$74,000	$80,700	$73,900	$77,700
Exports:[4]						
Quantity	metric tons	4,740	5,640	8,750	8,660 r	8,950
Value	thousands	$12,100	$15,500	$15,700	$15,000 r	$13,500
Imports for consumption:[3]						
Quantity	metric tons	155,000	106,000	151,000	158,000	151,000
Value	thousands	$164,000	$127,000	$167,000	$188,000	$182,000

rRevised. W Withheld to avoid disclosing company proprietary data.
[1]Data are rounded to no more than three significant digits.
[2]Mined.
[3]Natural (mined) and synthetic.
[4]Pigment grade.

TABLE 2
PRODUCERS OF IRON OXIDE PIGMENTS AND REGENERATED IRON OXIDES
IN THE UNITED STATES IN 2012

Producers	Plant location
Crude pigments:	
Alabama Pigments Co., LLC	Green Pond, AL.
Hoover Color Corp.	Hiwassee, VA.
New Riverside Ochre Co., Inc.	Cartersville, GA.
Finished pigments:	
Alabama Pigments Co., LLC	Green Pond, AL.
Dynamic Color Solutions, Inc.	Milwaukee, WI.
Hoover Color Corp.	Hiwassee, VA.
New Riverside Ochre Co., Inc.	Cartersville, GA.
Prince Minerals, Inc.	Quincy, IL; and Bowmanstown, PA.
Rockwood Pigments NA, Inc.	Beltsville, MD; Cartersville, GA; King of Prussia, PA; Los Angeles, CA; and St. Louis, MO.
Regenerator iron oxides:	
American Iron Oxide Co.[1]	Allenport, PA; Portage, IN; and Rockport, IN.
ArcelorMittal Weirton Inc.	Weirton, WV.
Bailey-PVS Oxides, L.L.C.	Decatur, AL; Fairfield, AL; and Delta, OH.
International Steel Services, Inc.	Burns Harbor, IN; and Warren, OH.

[1]Division of International Steel Services, Inc.

TABLE 3
U.S. EXPORTS OF IRON OXIDES AND HYDROXIDES, BY COUNTRY[1]

	Pigment grade				Other grade			
	2011		2012		2011		2012	
Country	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Argentina	6	$41	19	$15	--	--	5	$60
Australia	74	220	89	238	82	$179	400	297
Belgium	1,240	4,410	765	3,090	117	503	396	935
Brazil	182	898	100	421	252	749	197	316
Canada	39	69	19	40	12,600	13,900	7,350	12,900
Chile	85	587	334	641	--	--	41	65
China	2,350	2,460	2,640	2,900	23,200	7,260	23,300	10,900
Colombia	121	506	45	304	81	203	489	522
France	31	118	16	77	115	654	36	632
Germany	48	68	3	7	45	291	2,050	1,280
Haiti	9	33	7	26	5	17	5	22
Hong Kong	225	809	44	163	760	777	65	106
India	86	341	92	292	27	109	102	404
Indonesia	3	12	3	23	95	98	76	117
Israel	4	10	19	61	122	55	802	272
Italy	9	59	11	77	102	100	--	--
Jamaica	9	34	15	41	--	--	4	10
Japan	11	31	21	89	14	16	25	19
Korea, Republic of	17	51	39	243	58	638	36	628
Mexico	3,560	2,450	3,900	2,590	1,970	1,550	2,790	3,960
New Zealand	8	25	--	--	38	93	70	74
Singapore	6	29	11	71	99	509	68	374
Spain	45	106	21	85	12,200	3,060	11,700	4,060
Taiwan	62	169	146	263	211	2,420	134	813
Thailand	28	111	9	61	21	16	22	794
United Kingdom	105	369	287	967	718	1,810	531	1,340
Venezuela	113	254	15	48	176	353	246	140
Other	179 r	698 r	278	680	328 r	1,320 r	407	833
Total	8,660 r	15,000 r	8,950	13,500	53,400	36,700	51,400	41,900

rRevised. -- Zero.

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

Source: U.S. Census Bureau; data adjusted by the U.S. Geological Survey.

TABLE 4
U.S. IMPORTS FOR CONSUMPTION OF SELECTED IRON OXIDE AND HYDROXIDE PIGMENTS, BY TYPE[1]

Type	2011 Quantity (metric tons)	2011 Value[2] (thousands)	2012 Quantity (metric tons)	2012 Value[2] (thousands)	Principal sources, 2012 (metric tons)
Natural:					
Earth colors[3]	2,280	$1,190	1,930	$984	Cyprus, 1,800; Italy, 121.
Micaceous	1,020	1,130	1,340	1,420	France, 477; Germany, 277; Spain, 275; Austria, 196.
Total	3,310	2,310	3,280	2,400	
Synthetic:					
Black	44,200	47,500	40,500	41,900	Germany, 13,500; China, 10,800; Canada, 9,180.
Red	58,600	69,900	59,600	72,500	China, 40,800; Germany, 14,800.
Yellow	49,800	64,800	46,200	62,600	China, 23,700; Germany, 9,250; Brazil, 8,890.
Other[4]	1,810	3,320	1,350	2,390	China, 1,350.
Total	154,000	186,000	148,000	179,000	
Grand total	158,000	188,000	151,000	182,000	

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Customs value.
[3]Includes those earth colors not elsewhere specified or included.
[4]Includes synthetic brown oxides, transparent oxides, and magnetic and precursor oxides.

Sources: U.S. Census Bureau.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF IRON OXIDE AND IRON HYDROXIDE PIGMENTS, BY COUNTRY[1]

	Natural				Synthetic			
	2011		2012		2011		2012	
Country	Quantity (metric tons)	Value[2] (thousands)	Quantity (metric tons)	Value[2] (thousands)	Quantity (metric tons)	Value[2] (thousands)	Quantity (metric tons)	Value[2] (thousands)
Austria	117	$217	196	$303	13	$33	16	$42
Belgium	--	--	--	--	10	22	7	4
Brazil	--	--	--	--	11,000	14,700	9,160	12,700
Canada	--	--	--	--	12,600	3,730	9,810	3,440
China	39	25	28	25	77,800	87,400	75,800	86,300
Colombia	--	--	--	--	1,750	2,700	2,440	3,690
Cyprus	1,980	935	1,880	886	--	--	--	--
France	417	379	478	388	190	1,100	114	682
Germany	259	324	277	316	39,700	48,900	37,900	48,400
Italy	203	113	121	86	6,250	12,300	9,310	17,400
Japan	1	58	3	35	3,500	13,300	1,630	4,930
Spain	268	236	275	314	274	190	309	198
Sweden	--	--	--	--	285	44	30	52
Other	19	24	19	53	1,040	1,130	1,140	1,580
Total	3,310	2,310	3,280	2,410	154,000	186,000	148,000	179,000

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

Sources: U.S. Census Bureau.

TABLE 6
NATURAL IRON OXIDE PIGMENTS: ESTIMATED WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country[3]	2008	2009	2010	2011	2012
Austria, micaeous iron oxide	5,000 r	4,000 r	4,000 r	4,000 r	4,000
Brazil	NA r	NA r	NA r	NA r	NA
Cyprus, umber	4,471 r, 4	4,363 r, 4	4,500 r	4,000 r	4,000
France	2,800	2,800	2,800	2,800	3,000
Germany[4, 5, 6]	251,412	209,172	233,909	223,288 r	204,198
India, ocher	1,117,000 r, 4	890,000 r, 4	1,237,000 r, 4	1,100,000 r	1,200,000
Iran	NA r	NA r	NA r	NA r	NA
Italy	500	105 r, 4	117 r, 4	112 r	100
Lithuania	NA r	NA r	NA r	NA r	NA
Pakistan, ocher	51,417 r, 4	55,985 r, 4	50,220 r, 4	40,932 r, 4	40,000
Paraguay, ocher	NA r	NA r	NA r	NA r	NA
South Africa	39 4	183 4	244 4	266 r, 4	270
Spain, ocher and red iron oxide	18,000 r	17,000 r	15,500 r, 4	15,000 r, 4	16,500 4
Turkey	NA r	NA r	NA r	NA r	NA
United Kingdom	NA r	NA r	NA r	NA r	NA
United States	W	W	W	W	W

rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Estimated data are rounded to no more than three significant digits.
[2]Table includes data available through September 26, 2013.
[3]In addition to the countries listed, a number of others produce iron oxide pigments, but output is not reported and no basis is available for formulating estimates of output levels. Such countries include Azerbaijan, Brazil, China, Honduras, Iran, Kazakhstan, Lithuania, Paraguay, Russia, Turkey, Ukraine, and the United Kingdom. Unreported output is probably substantial.
[4]Reported figure.
[5]Accurate information concerning exactly how much of this production translates into iron oxide pigments is not available.
[6]Production includes natural and synthetic iron oxide pigments.