



2009 Minerals Yearbook

IRON OXIDE PIGMENTS

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In 2009, natural iron oxide pigment (IOP) production in the United States decreased compared with that of 2008. U.S. production data are withheld to avoid revealing company proprietary data. Finished natural and synthetic IOPs sold by processors decreased to 50,800 metric tons (t) valued at \$74 million in 2009 from 83,300 t valued at \$116 million in 2008. Exports of all grades of IOPs and hydroxides decreased to 17,000 t valued at \$34 million in 2009 compared with 51,600 t valued at \$43.9 million in 2008. Imports of natural and synthetic IOPs decreased to 106,000 t valued at \$127 million in 2009 compared with 155,000 t valued at \$164 million in 2008 (table 1).

Production

Natural IOPs are derived from hematite, which is a red iron oxide mineral; limonite, which varies from yellow to brown, such as ochers, siennas, and umbers; and magnetite, which is black iron oxide. Synthetic IOPs 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 (Podolsky and Reid, 2006, p. 1458).

U.S. production data for crude (natural) IOPs sold or used in 2009 were developed by the U.S. Geological Survey (USGS) from a voluntary survey of three companies, of which all responded. Domestic production data collected through the USGS survey are withheld to avoid disclosing company proprietary data, but sales were less than 50,000 t in 2009. Production declined in 2009 compared with that of 2008.

In a second voluntary USGS survey, data were received from seven of eight known processing operations for finished (natural and synthetic) IOPs. These seven operations represented 74% of the tonnage shown in table 1. Data for the nonrespondent was estimated on the basis of prior-year levels of output and industry trends. Sales of finished pigments were 50,800 t valued at \$74 million in 2009 compared with 83,300 t valued at \$116 million in 2008.

Production data for finished IOPs are collected only from operations that process material, such as the crushing and grinding of natural IOPs or synthesize IOPs. Canvass data are not collected from operations that simply blend, mix, repackage, and (or) resell IOP material.

At least three U.S. companies 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. The spent pickle liquor is treated to recycle the acid, resulting in the formation of iron oxide. Regenerated iron oxide data were not included in table 1 because it must be processed before it is suitable for use in typical iron oxide pigment applications.

Alabama Pigments Co. completed construction of a new production facility at its McCalla, AL, site to process natural black iron oxide, specialty blended products, and agricultural products. The company also began to install three new blenders and four 100-ton dry bulk silos at the site (Alabama Pigments Co., 2009).

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 was 167,000 t and 1.13 million metric tons (Mt), respectively, in 2006. More recent data are unavailable, but the global economic downturn since 2008 likely resulted in decreased consumption of IOP in 2008 and 2009. Uses for natural IOPs were estimated to be construction materials (48%), coatings (42%), other unspecified applications (7%), and ceramic, glass, paint, paper, and plastic applications (3%). Uses for synthetic IOPs were estimated to be construction materials (48%), coatings (24%), other unspecified applications (21%), and ceramic, glass, paint, paper, and plastic applications (7%).

Construction materials included such concrete products 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, with the tinted concrete often being stamped so that it resembles brick, slate, stone, and many more shapes and forms found in nature, including wood (Pinto, 2008, p. 4, 6).

Sales of IOP in these construction markets were negatively affected by the sharp decline in domestic and foreign construction activity. In the United States, construction starts for new privately owned housing decreased to 555,000 units in 2009 from 905,000 units in 2008 (U.S. Census Bureau, 2010b). The value of all residential and commercial construction, both of which use tinted brick and concrete products, decreased to \$937 billion in 2009 from \$1.07 trillion in 2008 (U.S. Census Bureau, 2010a).

The second largest market for IOP is as a tint in paints and coatings. The paint and coatings market experienced a significant decline in shipments in 2009 owing to decreased construction and manufacturing activity during the economic recession. Shipments of total paint and allied products (comprising architectural coatings, original equipment manufacture product coatings, special-purpose coatings, and miscellaneous allied paint products) were 3.74 billion liters (988 million gallons) in 2009 compared with 4.62 billion liters (1.22 billion gallons) in 2008 (U.S. Census Bureau, 2010c).

Other end uses of IOPs included colorants for ceramics, glass, paper, plastics, rubber, and textiles; in foundry sands; and

industrial chemicals, such as catalysts. Other applications were animal feed, cosmetics, ferrites, fertilizers, and magnetic ink and toner.

A major end use for regenerator iron oxides was ferrite ceramic magnets. There are two types of ferrites—soft, which do not retain magnetism permanently, and hard, which retain magnetism permanently. The latter are also referred to as permanent magnets. Uses of soft ferrites include computers, cores for radio frequency coils, inverter cores, memory cores, microwave communication systems, microwave ferrites for telecommunications, pot cores, rectangular modulus cores, television deflection yokes, and other industrial applications. Hard ferrites are used in flexible magnets, generators, loudspeakers, and motors.

Prices

The average annual producer price index (PPI) for IOPs under North American Industry Classification System code 325131–72 was 200.2 in 2009 (1983=100) compared with 209.8 in 2008. The PPI ranged between 197.7 and 201.2 in 2009 with the high being reached in August and the low in October. The PPI measured the average change in the selling prices charged by domestic producers of IOPs over time (U.S. Bureau of Labor Statistics, 2010).

LANXESS AG raised prices for several of its IOP products by as much as \$250 per metric ton because of increases in costs for raw materials (LANXESS AG, 2009b).

Unit values for finished natural and synthetic IOP sold by domestic producers ranged from \$0.36 to \$3.24 per kilogram, with an average unit value of \$1.46 per kilogram.

The average unit value of exports of pigment-grade IOP and hydroxides was \$2.74 per kilogram in 2009 compared with \$2.56 per kilogram in 2008. The average unit value of exports of other grades of IOP and hydroxides was \$1.63 per kilogram in 2009 compared with \$0.68 per kilogram in 2008. Unit values increased for export shipments to nearly all countries.

Unit values of imports of IOP and hydroxides ranged from \$0.51 to \$2.22 per kilogram, depending on the grade. The average unit value of all IOP imports combined was \$1.19 per kilogram in 2009 compared with \$1.05 per kilogram in 2008. The unit value of imported micaceous IOP declined and those for all other import grades either remained unchanged or increased.

Imports of natural IOP grades averaged \$0.56 per kilogram in 2009, unchanged from 2008. The average value of U.S. imports of natural IOPs from Cyprus, the leading source, increased to \$0.48 per kilogram in 2009 from \$0.47 per kilogram in 2008. The value of natural IOP imports from Spain, the second leading source, decreased to \$0.36 per kilogram from \$0.59 per kilogram during the same period.

Synthetic IOP import grades averaged \$1.20 per kilogram in 2009 compared with \$1.07 per kilogram in 2008. The average value of U.S. imports of synthetic IOPs from China, the leading source, decreased to \$0.91 per kilogram in 2009 from \$0.93 per kilogram in 2008. The value of synthetic IOP imports from Germany, the second leading source, increased to \$1.28 per kilogram from \$1.20 per kilogram.

Foreign Trade

U.S. exports of pigment-grade IOPs and hydroxides in 2009 totaled 5,640 t valued at \$15.5 million compared with 4,740 t valued at \$12.1 million in 2008. China was the leading destination for exports of pigment-grade IOPs, accounting for 40% of the export tonnage. Exports of pigment-grade IOP increased to Asian markets.

Exports of other grades of IOPs and hydroxides were 11,300 t valued at \$18.5 million in 2009 compared with 46,900 t valued at \$31.8 million in 2008. Canada and Mexico were the major destinations for exports of other grades of IOPs and hydroxides, accounting for 79% of the export tonnage. Canada, China, and Mexico accounted for 94% of the decline in exports of other grades of IOP (table 3). The global recession resulted in decreased exports to Canada, Mexico, and European countries. In addition, China increased its IOP production in the past 4 to 5 years, resulting in lesser dependence on imports of IOP from the United States.

U.S. imports of IOPs were 106,000 t valued at \$127 million in 2009 compared with 155,000 t valued at \$164 million in 2008 (tables 1, 4). By tonnage, the leading sources of natural IOP imports were Spain with 41% of the tonnage and Cyprus with 36% of the tonnage. The leading sources of synthetic IOP imports were China with 46% of the tonnage; Germany, 28%; Brazil, 8%; and Italy, 7%. Imports decreased significantly because of the large decline in construction activity in the United States in 2009 (table 5).

World Review

Sixteen countries reported production of natural IOP in 2009 (table 6). Production increased in India, decreased in Germany and Turkey, and remained unchanged in most other countries. China and several eastern European countries are not included in table 6 because production data were not available. Production in Germany shown in table 6 included synthetic IOP.

China.—LANXESS began construction of a new plant to manufacture black iron oxide pigments in Jinshan, Shanghai Province. The plant was to have a capacity of 10,000 metric tons per year and was expected to be operational in late 2010. LANXESS also began making modifications to increase efficiency and reduce emissions at its adjacent yellow iron oxide pigment plant. The company planned to reduce emissions by at least 15% by 2011. Both plants serve Asian markets (LANXESS AG, 2009a).

Italy.—Rockwood Pigments NA, Inc. commissioned a high-purity synthetic iron oxide pigment plant in Turin. The plant, operated by Rockwood Italia S.p.A., was certified under the Good Manufacturing Practice regulations issued by the Food and Drug Administration in the United States. The certification ensured Rockwood's pharmaceutical customers that the iron oxide pigments used for such applications as coloring and marking pharmaceuticals were manufactured according to the pharmaceutical industry rules (Rockwood Pigments NA, Inc., 2009).

United Kingdom.—Prince Mineral Holding Corp. purchased Castle Colours Ltd., a leading supplier of colorants for the

European brick and tile industry. Prince Mineral Holding, through its subsidiary Prince Minerals, Inc., already was a global supplier of iron oxide pigments. The purchase of Castle Colours, however, gives Prince Minerals even greater access to European ceramic brick markets (O'Driscoll, 2009; Prince Minerals, Inc., undated).

Outlook

IOP mining declined worldwide in 2009 because of the negative effect of the global economic recession. The recession resulted in decreased construction activity and lower demand for IOPs for coloring concrete and paint, the two major markets for IOPs.

One major global IOP producer, Rockwood Pigments, indicated that its sales declined in 2008 and 2009 in North America and Europe (Rockwood Holdings, Inc., 2010, p. 40). LANXESS, a leading world producer of synthetic IOP, indicated that sales of its pigment products declined in 2009, although price increases partially offset the decline in volume sales (LANXESS AG, 2010, p. 75). Despite the travails of 2008 and 2009, the International Monetary Fund (IMF) predicted a slightly better economy in 2010. Economic stimulus packages, low interest rates, and low inflation were helping to stimulate a global recovery. IMF expected global output to increase by 4% in 2010. The fastest growth was expected in countries with emerging and developing economies. In particular, the IMF predicted 4% to 10% growth in Asian markets. In Europe and North America, however, the IMF predicted growth of 1% to 3% (International Monetary Fund, 2010). Improvement in the global economy may result in increased activity in IOP markets. In Europe and North America, IOP markets may increase 2% or 3% while those in Asia may increase 4% to 5%.

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TABLE 1
SALIENT U.S. IRON OXIDE PIGMENTS STATISTICS¹

		2005	2006	2007	2008	2009
<u>Crude pigments sold or used:²</u>						
Quantity	metric tons	W	W	W	W	W
Value	thousands	W	W	W	W	W
<u>Finished pigments sold:^{6, 3}</u>						
Quantity	metric tons	90,300 [†]	70,300	88,100	83,300 [†]	50,800
Value	thousands	\$93,400	\$69,300	\$122,000	\$116,000 [†]	\$74,000
<u>Exports:⁴</u>						
Quantity	metric tons	2,220	3,100	5,410	4,740	5,640
Value	thousands	\$6,170	\$8,090	\$15,900	\$12,100	\$15,500
<u>Imports for consumption:³</u>						
Quantity	metric tons	193,000	199,000	178,000	155,000	106,000
Value	thousands	\$140,000	\$159,000	\$154,000	\$164,000	\$127,000

⁶Estimated. [†]Revised. W Withheld to avoid disclosing company proprietary data.

¹Data are rounded to no more than three significant digits.

²Mined.

³Natural (mined) and synthetic.

⁴Pigment grade.

TABLE 2
PRODUCERS OF IRON OXIDE PIGMENTS AND REGENERATED IRON OXIDES IN THE UNITED STATES IN 2009

Producers	Plant location
<u>Crude pigments:</u>	
Alabama Pigments Co.	Green Pond, AL.
Hoover Color Corp.	Hiwassee, VA.
New Riverside Ochre Co., Inc.	Cartersville, GA.
<u>Finished pigments:</u>	
Alabama Pigments Co.	Green Pond, AL.
Dynamic Color Solutions, Inc.	Milwaukee, WI.
Hoover Color Corp.	Hiwassee, VA.
LANXESS Corp.	New Martinsville, WV.
New Riverside Ochre Co., Inc.	Cartersville, GA.
Prince Minerals, Inc.	Quincy, IL; and Bowmanstown, PA.
Rockwood Pigments NA, Inc.	Beltsville, MD; Easton, PA; and St. Louis, MO.
<u>Regenerator iron oxides:</u>	
ArcelorMittal Weirton Inc.	Weirton, WV.
Bailey-PVS Oxides, L.L.C.	Decatur, AL; Fairfield, AL; and Delta, OH.
International Steel Services, Inc.	Allenport, PA.

TABLE 3
U.S. EXPORTS OF IRON OXIDES AND HYDROXIDES, BY COUNTRY¹

Country	Pigment grade				Other grade			
	2008		2009		2008		2009	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Australia	232	\$573	166	\$512	158	\$485	5	\$39
Belgium	1,760	4,820	700	3,360	36	165	54	389
Brazil	230	1,250	235	1,210	161	293	105	222
Canada	144	157	61	81	11,500	17,100	6,800	11,800
China	176	453	2,280	2,360	27,100	5,390	190	436
Germany	--	--	54	140	391	1,070	79	547
Hong Kong	176	380	165	517	12	15	44	131
India	38	102	30	154	53	80	21	74
Italy	96	236	42	144	861	726	520	441
Japan	54	142	60	82	40	32	19	161
Korea, Republic of	353	1,070	662	3,910	87	542	138	437
Mexico	595	474	472	420	3,880	1,780	2,130	1,310
Taiwan	33	106	44	217	108	464	23	193
Thailand	3	15	20	116	820	256	27	80
United Kingdom	352	1,150	112	493	292	1,040	285	745
Other	495 ^r	1,210 ^r	534	1,760	1,350 ^r	2,330 ^r	889	1,450
Total	4,740	12,100	5,640	15,500	46,900	31,800	11,300	18,500

^rRevised. -- Zero.

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

Source: U.S. Census Bureau.

TABLE 4
U.S. IMPORTS FOR CONSUMPTION OF SELECTED IRON OXIDE AND HYDROXIDE PIGMENTS, BY TYPE¹

Type	2008		2009		Principal sources, 2009 (metric tons)
	Quantity (metric tons)	Value ² (thousands)	Quantity (metric tons)	Value ² (thousands)	
Natural:					
Earth colors ³	3,130	\$1,580	862	\$440	Cyprus, 686; Spain, 174.
Micaceous	1,570	1,060	1,040	633	Spain, 612; Austria, 208; France, 162.
Total	4,700	2,640	1,900	1,070	
Synthetic:					
Black	36,200	40,800	25,100	36,600	Germany, 11,600; China, 5,800; Italy, 3,430; Japan, 3,380.
Red	58,000	58,300	40,700	41,200	China, 24,700; Germany, 9,880; Belgium, 2,250; Italy, 1,350.
Yellow	53,700	57,200	37,500	45,300	China, 17,600; Germany, 8,150; Brazil, 7,920; Italy, 2,710.
Other ⁴	2,770	4,790	1,250	2,770	Canada, 641; China, 377; France, 105.
Total	151,000	161,000	105,000	126,000	
Grand total	155,000	164,000	106,000	127,000	

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

²Customs value.

³Includes those earth colors not elsewhere specified or included.

⁴Includes synthetic brown oxides, transparent oxides, and magnetic and precursor oxides.

Source: U.S. Census Bureau and the U.S. International Trade Commission.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF IRON OXIDE AND IRON HYDROXIDE PIGMENTS, BY COUNTRY¹

Country	Natural				Synthetic			
	2008		2009		2008		2009	
	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	95	\$117	208	\$247	--	--	3	\$52
Belgium	--	--	--	--	2,010	\$1,470	2,340	1,640
Brazil	10	29	--	--	8,010	7,850	7,970	8,810
Canada	--	--	--	--	2,910	4,550	1,520	3,260
China	--	--	20	14	85,400	79,000	48,400	44,300
Colombia	--	--	--	--	1,670	2,620	1,400	1,880
Cyprus	2,870	1,350	686	332	--	--	--	--
France	446	320	163	127	322	1,130	148	520
Germany	50	69	37	42	37,300	44,600	29,600	38,100
Italy	2	8	(3)	2	6,490	8,240	7,510	13,000
Japan	9	38	--	--	3,340	8,720	3,870	12,600
Spain	1,180	694	786	285	264	249	241	192
Sweden	--	--	--	--	1,370	281	356	76
Other	44 ^r	19 ^r	2	24	1,620 ^r	2,460 ^r	1,100	1,550
Total	4,700	2,640	1,900	1,070	151,000	161,000	105,000	126,000

^rRevised. -- Zero.

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

²Customs value.

³Less than ½ unit.

Source: U.S. Census Bureau and the U.S. International Trade Commission.

TABLE 6
NATURAL IRON OXIDE PIGMENTS: ESTIMATED WORLD PRODUCTION, BY COUNTRY^{1,2}

(Metric tons)

Country ³	2005	2006	2007	2008	2009
Austria	5,000 ^r	5,000 ^r	5,000 ^r	5,000 ^r	5,000
Brazil	2,000	2,000	2,000	2,000	2,000
Cyprus, umber	12,000	12,000	12,000	12,000	12,000
France	2,500	2,791 ⁴	2,800	2,800	2,800
Germany ⁵	231,585 ⁴	242,264 ⁴	240,310 ⁴	251,412 ⁴	209,172 ⁴
Guatemala	-- ^r	-- ^r	--	--	--
Honduras	17,000	17,000	17,000	17,000	17,000
India, ocher	360,000	370,000 ^r	375,000 ^r	380,000 ^r	385,000
Iran	2,500	2,600	2,600	2,600	2,600
Italy	500	500	500	500	500
Lithuania	--	4	4	4	4
Pakistan, ocher	5,500	5,500	6,000	6,000	6,000
Paraguay, ocher	250	250	250	250	250
South Africa	510 ⁴	590 ⁴	232 ⁴	39 ⁴	--
Spain, ocher	140,000	140,000	140,000	140,000	140,000
Turkey ⁶	280,000	206,000	260,000	220,000	100,000
United Kingdom, iron oxides and hydroxides ⁷	12,000	8,913 ⁴	8,000	8,000	8,000
United States	W	W	W	W	W

^rRevised. W Withheld to avoid disclosing company proprietary data. -- Zero.

¹Estimated data are rounded to no more than three significant digits.

²Table includes data available through July 26, 2010.

³In addition to the countries listed, a number of others undoubtedly produce iron oxide pigments, but output is not reported and no basis is available for formulating estimates of output levels. Such countries include Azerbaijan, China, Kazakhstan, Russia, and Ukraine. Unreported output is probably substantial.

⁴Reported figure.

⁵Production includes natural and synthetic iron oxide pigments.

⁶Production includes micaceous iron oxide pigment and earth paints.