

IRON OXIDE PIGMENTS

By Michael J. Potter

Iron oxide materials yield pigments that are nontoxic, nonbleeding, relatively inert, weather resistant, and light fast. Natural iron oxides include a combination of one or more ferrous or ferric oxides and impurities such as manganese, clay, or organics. Synthetic iron oxides can be produced in various ways, including: thermal decomposition of iron salts such as ferrous sulfate to produce reds; precipitation to produce yellows, reds, browns, and blacks (e.g., the Penniman-Zoph process); and reduction of organic compounds by iron (e.g., nitrobenzene reduced to aniline in the presence of particular chemicals) (Harben, 1995, p. 85).

Production

U.S. sold or used crude iron oxide pigment (IOP) materials were 44,700 metric tons, or 14% less than in 1995, according to the U.S. Geological Survey (USGS). Shipments of finished natural IOP were 74,100 tons, or about the same as in 1995. Output of finished synthetic IOP sold by processors in the United States was 88,400 tons, or 16% higher than in 1995.

Sold-or-used data for crude IOP material were developed by the USGS by means of a voluntary survey. Data were obtained from all six known companies, representing a 100% response rate. In a second voluntary survey, data were received from all 17 known operations, or 100%, which produced finished IOP.

Pea Ridge Iron Co. was expanding production at its plant near Sullivan, MO. Pea Ridge makes iron oxides for ferrite, pigment, densification and other markets (Chemical Marketing Reporter, 1996b, p. 20). Bayer Corp. acquired the iron oxide business of Landers Segal Color Inc., Passaic, NJ. Included were blending, marketing and distribution operations for synthetic and natural iron oxide products (Concrete Products, 1996, p. 12). Harcros Pigments Inc. received ISO 9002 certification at its plants in Easton, PA; East St. Louis, IL; and Fairview Heights, IL (Chemical Marketing Reporter, 1996c, p. 31).

A subcategory of synthetic iron oxide is regenerated iron oxide. This is a material which has been recovered from a steel industry waste product, pickle liquor, which itself comes from rust removal of steel. Traditionally, pickle liquor has either been disposed of by deepwelling or recycled into ferric chloride or regenerated. U.S. Environmental Protection Agency regulations aimed at deepwelling have led to more steel companies making arrangements with third party acid regenerators (Chemical Marketing Reporter, 1996a, p. 3). Bailey Engineers Inc. and PVS Chemicals Inc. formed a company, Bailey-PVS Oxides LLC, which will own and operate regeneration facilities. The new company initially will run Bailey's existing regeneration operation at USX Corp.'s steel

plant in Fairfield, AL. Bailey-PVS also signed a worldwide cooperation agreement with the Ruthner division of Andritz, a Vienna, Austria, regeneration company. Andritz will supply technology, engineering support and equipment for all new acid regeneration plants built by Bailey-PVS (Chemical Marketing Reporter, 1996b, p. 20).

Prices

Yearend 1996 prices from Chemical Market Reporter, converted to dollars per kilogram, in bags, per truckload, f.o.b. warehouse, were black, synthetic—\$1.80 to \$1.94; brown, synthetic—\$1.83 to \$1.94; red, natural—\$0.65 to \$1.10; ochre, natural—\$0.81; and yellow, synthetic—\$1.76 to \$1.89.

Foreign Trade

Because of a change in code numbers in some iron oxide trade data categories, the total of "other grade" exports for 1996 in table 5 is believed to be at least 84,000 tons with a value of \$102 million instead of 27,200 tons with a value of \$41.7 million.

World Review

Brazil.—Sherwin-Williams Co. and Bayer SA, the Brazilian subsidiary of Bayer AG, jointly acquired Globo SA Tintas e Pigmentos of Sao Paulo from Reckitt & Colman PLC and other shareholders for \$93.5 million. Globo's annual sales were \$85 million. Sherwin-Williams was to take over Globo's paint business, and Bayer was to take the synthetic iron oxide pigment business with a capacity of about 15,000 tons per year (Chemical and Engineering News, 1996, p. 18).

Canada.—A paper described the use of specular hematite (micaceous iron oxide) as a blast cleaning abrasive, especially for the surface preparation of steel, prior to coating. Specular hematite is supplied from Quebec Cartier Mining Co.'s deposit in northern Quebec. Processed concentrate is shipped to various locations, including Barnes Environmental International, Waterdown, Ontario, and other licensees of Crystalgrit Inc., Montreal, Quebec. The paper included comparison data of specular hematite, which is recyclable, with other recyclable and nonrecyclable abrasives such as silica, coal slag, garnet, staurolite, etc. After use, the spent specular hematite can be supplied to the cement industry as a source of iron for the production of portland cement. It can also be provided to sintering plants which supply iron oxide in the form of pellets or briquettes for the production of blast furnace iron (Hunt, 1996, p. 19).

China.—There has been a long history of developing hard ferrite magnetic materials in China, according to a paper given at “China Magnetic Materials Conference” in Beijing. Hard ferrite factories are scattered widely around the country and labor costs are said to be fairly low. Because mill scale or refined pulverized iron ore is used as raw material, most hard ferrites are not of a high grade. About 60% of the hard ferrites was being used for loud speakers and 20% for electric motors. Substantial effort was being put into improving process and quality control toward increasing the output of high grade ferrites (Interaction, 1996, p. 2-3).

Outlook

The three largest Western iron oxide producers, Bayer, Harcros, and Laporte, have been active during the past few years in acquisitions, expanding capacity and undertaking joint ventures. Bayer and Laporte were focusing on granulated pigments that ease handling while reducing dusting. Harcros was focusing on surface-coated iron oxides that significantly reduce mixing and preparation times. Each of these producers announced a Chinese project: Laporte’s joint venture in Fuyang, Huangdong Province was already exporting; Bayer Shanghai Pigments 20,000-ton-per-year plant was due on-stream in the second half of 1996; and Harcros was in the early stages of building a plant in Shenzhen, Quandong Province.

There have been increased Chinese exports in an already full market. One Chinese exporter estimated that Chinese material can run as low as \$550 per metric ton, f.o.b. China, compared with \$1,600 per metric ton for some U.S.-made material. This exporter estimated Chinese iron oxide pigment exports to be 85,000 to 100,000 tons per year. According to one U.S. company source, Chinese pigments were gaining especially in the low-value construction product markets, but had not penetrated the coatings or plastics markets (Fattah, 1996, p. 23).

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TABLE 1
SALIENT U.S. IRON OXIDE PIGMENTS STATISTICS 1/

(Metric tons, unless otherwise noted)

	1992	1993	1994	1995	1996
Mine production	W	W	W	W	W
Crude pigments sold or used	39,300	35,800	46,400	51,700	44,700
Value	thousands \$4,670	\$5,020	\$6,010	\$6,720	\$6,990
Finished pigments sold	121,000	126,000	139,000	151,000 r/	162,000
Value	thousands \$136,000	\$140,000	\$143,000	\$160,000 r/	\$183,000
Exports	21,100	22,400	21,300	17,500	16,000
Value	thousands \$32,200	\$32,000	\$30,700	\$24,900	\$23,200
Imports for consumption	45,100	43,600	51,400	59,300	62,600
Value	thousands \$49,900	\$57,300	\$61,400	\$77,600	\$74,000

r/ Revised. W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits.

TABLE 2
FINISHED IRON OXIDE PIGMENTS SOLD BY PROCESSORS IN THE UNITED STATES, BY KIND 1/

Kind	1995		1996	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Natural:				
Black: Magnetite	13,200 r/	\$2,330 r/	12,700	\$2,140
Brown: Iron oxide	W	W	--	--
Umbers:				
Burnt	1,740 r/	2,640 r/	W	W
Raw	W	W	W	W
Red:				
Iron oxide 2/	49,300	9,600	49,100	9,640
Sienna, burnt	W	W	W	W
Yellow:				
Ocher	W	W	W	W
Sienna, raw	W	W	W	W
Undistributed	10,300 r/	6,510 r/	12,200	9,680
Total	74,500 r/	21,100 r/	74,100	21,500
Synthetic:				
Black: Iron oxide	18,700 r/	32,100 r/	21,000	37,800
Brown: Iron oxide	W	W	7,700	14,700
Red: Iron oxide	W	W	W	W
Yellow: Iron oxide	20,100 r/	35,300 r/	23,600	42,400
Mixtures of natural and synthetic:				
Iron oxides	W	W	W	W
Other: Specialty oxides	W	W	W	W
Undistributed	37,400 r/	71,100 r/	36,100	66,500
Total	76,200 r/	138,000 r/	88,400	161,000
Grand total	151,000 r/	160,000 r/	162,000	183,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

1/ Data are rounded to three significant digits; may not add to totals shown.

TABLE 3
 PRODUCERS OF IRON OXIDE PIGMENTS, REGENERATOR IRON OXIDES,
 AND STEEL-PLANT WASTE IRON OXIDES IN THE UNITED STATES IN 1996

Producers	Plant location
Finished pigments:	
Alabama Pigments Co.	Greenpond, AL
Bayer Corp.	New Martinsville, WV
Blue Ridge Talc Co., Inc.	Henry, VA
Dynamic Color Solutions, Inc.	Milwaukee, WI
Harcros Pigments Inc.	Emeryville, CA; East St. Louis, IL; Easton, PA
Hilton-Davis Co.	Newark, NJ
Hoover Color Corp.	Hiwassee, VA
Mapico, Inc.	St. Louis, MO
New Riverside Ochre Co., Inc.	Cartersville, GA
Pea Ridge Iron Ore Co.	Sullivan, MO
Prince Manufacturing Co.	Quincy, IL and Bowmanstown, PA
Rockwood Pigments	Beltsville, MD
Solomon Grind-Chem Services Inc.	Springfield, IL
Swansea Minerals Inc.	Tempe, AZ
Crude pigments:	
Cleveland-Cliffs Iron Co., Mather Mine and Pioneer plant (closed July 31, 1979; shipping from stockpile.)	Negaunee, MI
Hoover Color Corp.	Hiwassee, VA
New Riverside Ochre Co., Inc.	Cartersville, GA
Pea Ridge Iron Ore Co.	Sullivan, MO
Swansea Minerals Inc.	Tempe, AZ
Virginia Earth Pigments Co.	Hillsville, VA
Regenerator and steel plant waste iron oxides:	
Bailey Engineers, Inc.	Fairfield, AL
International Steel Services	Allenport, PA
Weirton Steel Corp.	Weirton, WV

TABLE 4
 ESTIMATED IRON OXIDE PIGMENT CONSUMPTION, BY END USE, AS A PERCENTAGE OF REPORTED SHIPMENTS

End use	All iron oxides		Natural iron oxides		Synthetic iron oxides	
	1995	1996	1995	1996	1995	1996
Coatings (industrial finishes, trade sales: lacquers, paints, varnishes)	20	22	13 r/	13	26 r/	30
Construction materials (cement, mortar, preformed concrete, roofing granules)	W	31	18	20	W	39
Colorants for ceramics, glass, paper, plastics, rubber, textiles	W	W	W	W	13 r/	9
Foundry sands	8 r/	8	16	16	--	--
Industrial chemicals (such as catalysts)	9	9	W	W	W	W
Ferrites	W	W	W	W	W	W
Animal feed and fertilizers	W	W	W	W	W	2
Other (also includes cosmetics, magnetic ink and toner, and polishing agents)	63 r/	30	53 r/	51	61 r/	20
Total	100	100	100	100	100	100

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."

TABLE 5
U.S. EXPORTS OF IRON OXIDES AND HYDROXIDES, BY COUNTRY 1/

Country	1995				1996			
	Pigment grade		Other grade		Pigment grade		Other grade	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Argentina	--	--	581	\$380	(2/)	\$3	785	\$493
Australia	179	\$229	1,030	2,090	34	126	544	1,370
Austria	--	--	1,950	4,930	19	19	20	25
Belgium	167	497	758	800	289	529	95	193
Brazil	143	687	13,500	5,820	15	108	175	340
Canada	246	230	102,000	20,800	19	15	10,700	13,400
Ecuador	--	--	1,860	456	16	39	1	4
Germany	366	417	1,030	4,190	288	1,220	263	983
Hong Kong	829	2,450	932	477	1,040	2,780	70	197
Indonesia	919	1,570	81	135	808	1,380	88	60
Italy	23	66	392	1,130	1	4	231	476
Japan	3,020	3,070	7,700	28,000	4,030	3,390	2,850	4,080
Korea, Republic of	2,630	6,590	2,080	6,710	989	3,830	1,300	4,280
Malaysia	763	820	239	274	42	182	155	236
Mexico	3,750	873	5,450	6,630	4,950	1,560	1,700	4,020
Netherlands	310	696	4,040	5,830	78	309	1,340	2,210
Singapore	59	15	2,180	2,770	1	3	881	1,660
South Africa	1,220	2,020	359	468	828	1,210	70	83
Spain	--	--	40	92	55	113	39	84
Taiwan	58	49	1,750	2,520	3	8	746	702
Thailand	515	805	421	760	313	570	274	547
Trinidad and Tobago	--	--	682	25	--	--	--	--
United Kingdom	521	1,500	1,760	3,430	607	2,080	2,250	3,890
Venezuela	823	267	1,840	1,640	1	4	407	57
Other	1,000	2,110	6,640	7,390	1,540	3,760	2,180	2,300
Total	17,500	24,900	159,000	108,000	16,000	23,200	27,200	41,700

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF SELECTED IRON OXIDE PIGMENTS, BY TYPE 1/

Type	1995		1996		Source, 1996 (metric tons)
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
Natural:					
Earth colors 2/	382	\$258	3,060	\$1,200	Cyprus 2,560; Germany 205; Spain 179; India 60; Italy 20; United Kingdom 20; France 18; South Africa 4; Japan 1; Taiwan (3/); Poland (3/); Denmark (3/).
Micaceous	3,240	1,250	6,330	2,170	Canada 3,940; Netherlands 2,010; United Kingdom 187; France 130; Austria 38; Japan 21; South Africa 5; Mexico 4.
Umber	3,020	957	--	--	
Vandyke brown	165	183	--	--	
Total	6,800	2,650	9,390	3,370	
Synthetic:					
Black	11,000	30,700	8,780	25,600	Japan 3,910; India 2,460; Germany 1,410; Italy 370; Mexico 352; China 243; Hong Kong 18; Netherlands 10; Belgium 5; Canada 3; United Kingdom 1; France (3/).
Red	21,800	20,900	24,200	22,200	China 11,400; Canada 4,890; Germany 4,760; Japan 1,060; Spain 602; Mexico 440; Hong Kong 382; Brazil 367; Italy 98; United Kingdom 81; Belgium 49; Philippines 2; Switzerland 1; France 1.
Yellow	14,700	15,900	15,800	16,100	China 4,800; Germany 4,290; United Kingdom 2,840; Brazil 1,230; Italy 945; Mexico 732; Hong Kong 419; Spain 370; Japan 71; Belgium 30; India 20; Hungary 17; Canada 11; Switzerland 2; France 1.
Other 4/	4,950	7,500	4,410	6,670	Germany 1,750; Canada 1,350; India 539; Japan 469; Sweden 175; China 79; Mexico 34; Belgium 15; United Kingdom 4; Italy 3.
Total	52,500	75,000	53,200	70,600	
Grand total	59,300	77,600	62,600	74,000	

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes those earth colors not elsewhere specified or included.

3/ Less than 1/2 unit.

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

Source: Bureau of the Census.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF IRON OXIDE AND IRON HYDROXIDE PIGMENTS, BY COUNTRY 1/

Country	Natural				Synthetic			
	1995		1996		1995		1996	
	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)
Austria	72	\$106	38	\$47	--	--	--	--
Belgium	--	--	--	--	34	\$638	99	\$439
Brazil	--	--	--	--	1,210	1,170	1,600	1,570
Canada	946	145	3,940	511	6,380	1,560	6,260	1,510
China	--	--	--	--	12,900	7,710	16,600	10,700
Cyprus	2,960	894	2,560	768	--	--	--	--
France	2,160	795	148	149	42	64	2	60
Germany	203	237	206	259	14,100	22,400	12,200	19,900
Hong Kong	--	--	--	--	747	559	820	644
Hungary	--	--	--	--	--	--	17	28
India	--	--	60	14	1,190	734	3,020	2,380
Italy	--	--	20	6	826	1,050	1,420	1,640
Japan	6	148	22	98	8,270	33,900	5,510	26,500
Mexico	2	13	4	30	1,380	1,120	1,560	1,370
Netherlands	342	185	2,010	1,190	68	92	10	78
Spain	34	16	179	77	840	666	972	719
Sweden	--	--	--	--	360	94	175	58
United Kingdom	80	87	207	179	3,170	2,830	2,920	2,920
Other	(2/)	19	9	38	1,030	301	4	88
Total	6,800	2,650	9,390	3,370	52,500	75,000	53,200	70,600

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 8
NATURAL IRON OXIDE PIGMENTS: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1992	1993	1994	1995	1996 e/
Argentina (ocher)	40	28	35 e/	30 e/	30
Austria	9,475	8,398	8,000 e/	8,000 e/	7,500
Bosnia and Herzegovina e/	200	--	--	--	--
Brazil e/	5,500	5,500	5,500	5,500	5,500
Chile	22,945	7,106	3,283	3,000 e/	3,000
Cyprus (umber)	5,000	6,000	9,000	9,000 e/	9,000
France e/	12,000	1,000	1,000	1,000	1,000
Germany 4/	10,100	7,712	7,475	7,500 e/	7,500
India (ocher)	142,478	138,210	170,761 r/	234,098 r/	225,000
Iran e/	2,307 5/	2,500	2,500	2,500	2,500
Italy e/	700	700	600	600	500
Pakistan (ocher)	5,126	6,196	6,000 e/	6,000 e/	6,100
Paraguay (ocher) e/	330	330	330	300 r/ e/	300
South Africa	1,114	1,186	2,084 r/	5,256	643 5/
Spain: e/					
Ocher	8,200	8,000	7,000	8,000	7,000
Red iron oxide	18,000	16,000	15,000	16,000	15,000
United States	W	W	W	W	W
Zimbabwe	538	390	438	585 r/	600

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

1/ Estimated data are rounded to three significant digits.

2/ Table includes data available through June 4, 1997.

3/ In addition to the countries listed, a considerable 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, but are not limited to, Azerbaijan, China, Kazakhstan, Russia, and Ukraine. Because unreported output is probably substantial, this table is not summed to provide a world total.

4/ Includes Vandyke brown.

5/ Reported figure.