

IRON OXIDE PIGMENTS

By Michael 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.)¹

The largest end use categories of iron oxide pigments (IOP) in 1995 continued to be construction materials (such as cement, concrete, paving, and brick) and coatings. Chemical uses of iron oxides included magnetic storage media, with applications in audio and video tapes, magnetic ink character recognition (MICR) and computer diskettes; in toners for copiers and printers; in pyrotechnical components of vehicle air bag restraint systems; and catalysts (such as for making ammonia and styrene).²

Production

U.S. sold or used crude IOP materials were 51,700 metric tons, or 11% higher than in 1994, according to the U.S. Geological Survey (USGS). Shipments of finished natural IOP were 76,200 tons, also 11% more than in 1994. Output of finished synthetic IOP sold by processors in the United States was 68,800 tons, or similar to that of 1994.

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 by the close-out date for 14 of the 17 known operations, or 82%, which produced finished IOP. Estimates for the remaining three operations were derived from the previous year's production levels and trends.

Bayer Corp. planned to increase capacity, by an unspecified amount through debottlenecking, at its 45,000-ton-per-year plant at New Martinsville, WV. The company developed a technology for manufacturing granulated pigments, which helps to lower production costs and makes transportation and use by customers easier because of their lack of dust.³

Harcros Pigments Inc. expanded its synthetic iron oxide facility in East St. Louis, IL. The expansion was designed to produce an additional 6,800 tons per year of yellow and black iron oxides. Most of the increase was said to be for yellow iron oxide production, with the rest for black iron oxide.⁴

Mapico, Inc., in St. Louis, MO, was purchased from

Columbian Chemical Co. for \$44 million by Laporte PLC, headquartered in Luton, England. Laporte is a major British producer of specialty chemicals. Mapico's market segments included reprographic toners, cosmetics, and chemical catalysts.⁵

World Review

Bayer and Shanghai Coatings Corp. of Shanghai, China, formed a joint venture, Bayer Shanghai Pigments, which was 67% owned by Bayer. The new company was to build an iron oxide grinding and mixing plant costing about \$18 million, with initial capacity of 20,000 tons per year. Startup was targeted for 1996, with much of the output planned for export markets.⁶

Bayer was expanding capacity for granulated pigments for building materials to 60,000 tons per year at Krefeld-Uerdingen, Germany. The company also planned to introduce new technology designed to expand the product range of its pigments.⁷

Laporte PLC acquired Chemische Werke Brockheus AG of Germany for approximately \$54 million. Brockheus was the first to develop an iron oxide granules process. (Alternatives to granules are powders and slurries.) The company's output of IOP was approximately 17,000 tons per year, with the majority going to Europe, especially Germany. However, a significant quantity was being exported to North America.⁸

Outlook

According to Bayer AG, world demand for synthetic iron oxides could reach as much as 600,000 tons by the year 2005. Demand in 1994 was some 500,000 tons, with 53% used in pigments for construction, 33% in coatings, and 14% in colorants for plastics, rubber, etc., toners, catalysts, ferrites, cosmetics, and other uses. Analyzing world demand over the next 12 years, Bayer projected Western Europe as the largest market, consuming 35% of total output, but showing almost no growth. North America may grow at 4% per year and Asia at 3.5% per year. North America could account for 25% of the world market in 2005 and Asia 30%.⁹

¹Harben, P. W. Iron Oxide. The Industrial Minerals Handybook II, 2d ed., 1995, p. 85.

²Richards, D. Iron Oxides Markets Expected to Reach 600,000 Metric Tons. Chem. Mktg. Rep., v. 248, No. 25, Dec. 18, 1995, p. 37.

³Chemical Marketing Reporter. Bayer Invests in its Iron Oxides. V. 248, No. 2, July 10, 1995, p. 9.

⁴———. Harcros to Expand Synthetic Iron Oxide. V. 247, No. 6,

Feb. 6, 1995, p. 4.

⁵Industrial Minerals (London). World of Minerals. No. 332, May 1995, p. 17.

⁶Chemical & Engineering News. Business Concentrates. V. 73, No. 11, Mar. 13, 1995, p. 12.

⁷Work cited in footnote 3.

⁸Industrial Minerals (London). World of Minerals. No. 337, Oct. 1995, p. 13.

⁹Page 7 of work cited in footnote 2.

OTHER SOURCES OF INFORMATION

U.S. Geological Survey Publication

Pigments and Fillers. Ch. In USGS Prof. Paper 820, 1973.

Other Source

Pigments, Iron Oxide. Ch. in Industrial Minerals and Rocks, SME, 1994.

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

(Metric tons, unless otherwise noted)

	1991	1992	1993	1994	1995
Mine production	W	W	W	W	W
Crude pigments sold or used	36,500 r/	39,300	35,800	46,400	51,700
Value	thousands \$4,480	\$4,670	\$5,020	\$6,010	\$6,720
Finished pigments sold	117,000	121,000	126,000	139,000	145,000
Value	thousands \$133,000	\$136,000	\$140,000	\$143,000	\$147,000
Exports	20,600	21,100	22,400	21,300	17,500
Value	thousands \$33,800	\$32,200	\$32,000	\$30,700	\$24,900
Imports for consumption	34,700	45,100	43,600	51,400	59,300
Value	thousands \$39,400	\$49,900	\$57,300	\$61,400	\$77,600

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	1994		1995	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Natural:				
Black, magnetite	W	W	13,300	\$2,500
Brown, iron oxide	W	W	W	W
Umbers:				
Burnt	W	W	2,030	3,070
Raw	W	W	W	2,170
Red:				
Iron oxide 2/	32,000 r/	\$6,200 r/	49,300	9,600
Sienna, burnt	W	W	W	W
Yellow:				
Ocher	W	W	W	W
Sienna, raw	W	W	W	W
Undistributed	36,700 r/	13,400 r/	11,500	5,250
Total	68,700 r/	19,600 r/	76,200	22,600
Synthetic:				
Black, iron oxide	17,000 r/	27,500 r/	16,300	27,400
Brown, iron oxide 3/	6,130 r/	11,600 r/	W	W
Red, iron oxide	W	W	W	W
Yellow, iron oxide	W	W	18,800	32,600
Mixtures of natural and synthetic,				
iron oxides	(4/)	(4/)	(4/)	(4/)
Other, specialty oxides	(4/)	(4/)	(4/)	(4/)
Undistributed	47,000 r/	83,800 r/	33,600	64,000
Total	70,200 r/	123,000 r/	68,800	124,000
Grand total	139,000	143,000	145,000	147,000

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.

2/ Includes pyrite cinder.

3/ Includes "Other, specialty oxides" and "Mixtures of natural and synthetic, iron oxides."

4/ Included with "Synthetic: Brown, iron oxide" to avoid disclosing company proprietary data.

TABLE 3
PRODUCERS OF IRON OXIDE PIGMENTS, REGENERATOR IRON OXIDES,
AND STEEL-PLANT WASTE IRON OXIDES IN THE UNITED STATES IN 1995

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
Mineral Pigments Corp.	Beltsville, MD
New Riverside Ochre Co., Inc.	Cartersville, GA
Pea Ridge Iron Ore Co.	Sullivan, MO
Prince Manufacturing Co.	Quincy, IL and Bowmanstown, PA
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	
	1994	1995	1994	1995	1994	1995
Coatings (industrial finishes, trade sales, lacquers, paints, varnishes)	21 r/	20	17 r/	14	24 r/	24
Construction materials (cement, mortar, preformed concrete, roofing granules)	33 r/	W	W	18	W	W
Colorants for ceramics, glass, paper, plastics, rubber, textiles	12	W	12	W	11 r/	13
Foundry sands	8	9	17	16	--	--
Industrial chemicals (such as catalysts)	6 r/	W	2	6	9	W
Ferrites	W	W	W	W	W	W
Animal feed and fertilizers	W	6	W	W	W	W
Other (also includes cosmetics, magnetic ink and toner, polishing agents)	20 r/	65	52 r/	46	56 r/	63
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 or Territory	1994				1995			
	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	3	\$10	513	\$284	--	--	581	\$380
Australia	1,570	1,940	1,290	2,250	179	\$229	1,030	2,090
Austria	--	--	39,200	3,430	--	--	1,950	4,930
Belgium	13	73	1,330	2,680	167	497	758	800
Brazil	147	868	1,060	1,730	143	687	13,500	5,820
Canada	213	247	104,000	24,000	246	230	102,000	20,800
Ecuador	--	--	1,330	208	--	--	1,860	456
Germany	543	820	1,330	4,040	366	417	1,030	4,190
Hong Kong	1,240	3,060	881	448	829	2,450	932	477
Indonesia	1,080	1,730	80	118	919	1,570	81	135
Italy	19	23	638	431	23	66	392	1,130
Japan	4,380	4,440	5,660	18,900	3,020	3,070	7,700	28,000
Korea, Republic of	3,130	8,610	1,290	4,660	2,630	6,590	2,080	6,710
Malaysia	1,000	721	215	238	763	820	239	274
Mexico	3,640	1,060	8,790	6,830	3,750	873	5,450	6,630
Netherlands	324	677	17,400	2,610	310	696	4,040	5,830
Singapore	129	21	2,490	3,320	59	15	2,180	2,770
South Africa	915	1,270	214	384	1,220	2,020	359	468
Spain	--	--	24,900	451	--	--	40	92
Taiwan	231	265	2,190	1,910	58	49	1,750	2,520
Thailand	943	1,350	279	642	515	805	421	760
Trinidad and Tobago	20	4	733	77	--	--	682	25
United Kingdom	890	1,740	6,720	6,580	521	1,500	1,760	3,430
Venezuela	14	21	2,000	1,160	823	267	1,840	1,640
Other	862	1,740	3,900	7,390 r/	1,000	2,110	6,640	7,390
Total	21,300	30,700	229,000	94,800	17,500	24,900	159,000	108,000

r/ Revised.

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

Source: Bureau of the Census.

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

Type	1994		1995		Source, 1995 (metric tons)
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	
Natural:					
Earth colors 2/	185	\$185	382	\$258	France 343; United Kingdom 35; Germany 3; Japan (3/).
Micaceous	2,660	796	3,240	1,250	France 1,810; Canada 946; Netherlands 342; Austria 72; Spain 34; United Kingdom 16; Germany 9; Japan 6; Mexico 2.
Umber	3,500	1,080	3,020	957	Cyprus 2,960; United Kingdom 30; Germany 26; Poland (3/).
Vandyke brown	76	73	165	183	Germany 165.
Total	6,420	2,140	6,800	2,650	
Synthetic:					
Black	9,190	26,100	11,000	30,700	Japan 6,090; Germany 1,550; India 1,090; Venezuela 984; Sweden 360; Italy 270; China 260; Mexico 171; Hong Kong 164; United Kingdom 69; Jordan 18; Canada 13; Colombia 2; France (3/).
Red	16,400	10,900	21,800	20,900	China 8,630; Canada 4,690; Germany 4,620; Japan 1,860; Mexico 573; Spain 478; Hong Kong 386; Brazil 230; United Kingdom 198; Netherlands 68; France 39; Italy 35; Belgium 17; Colombia 14; Denmark 6; Switzerland (3/).
Yellow	15,800	16,200	14,700	15,900	Germany 5,250; China 3,840; United Kingdom 2,890; Brazil 983; Mexico 564; Italy 520; Spain 362; Hong Kong 193; India 63; Canada 18; Belgium 15; France 3; Colombia 3; Switzerland 2; Japan (3/).
Other 4/	3,690	6,010	4,950	7,500	Germany 2,710; Canada 1,660; Japan 324; China 130; Mexico 66; India 32; United Kingdom 16; Hong Kong 5; Colombia 4; Belgium 2.
Total	45,000	59,300	52,500	75,000	
Grand total	51,400	61,400	59,300	77,600	

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 or Territory	Natural				Synthetic			
	1994		1995		1994		1995	
	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)
Australia	17	\$25	--	--	6	\$11	--	--
Austria	77	63	72	\$106	19	18	--	--
Belgium	--	--	--	--	175	560	34	\$638
Brazil	--	--	--	--	870	831	1,210	1,170
Canada	360	29	946	145	5,970	1,280	6,380	1,560
China	--	--	--	--	13,500	7,840	12,900	7,710
Cyprus	3,430	996	2,960	894	--	--	--	--
France	2,310	685	2,160	795	57	123	42	64
Germany	152	197	203	237	10,600	16,300	14,100	22,400
Hong Kong	--	--	--	--	407	290	747	559
Hungary	--	--	--	--	34	52	--	--
India	--	--	--	--	441	212	1,190	734
Italy	--	--	--	--	1,050	1,130	826	1,050
Japan	1	9	6	148	5,690	26,000	8,270	33,900
Mexico	--	--	2	13	895	820	1,380	1,120
Netherlands	20	8	342	185	55	75	68	92
Russia	1	32	--	--	--	--	--	--
Spain	16	8	34	16	871	594	840	666
Sweden	--	--	--	--	1,190	335	360	94
United Kingdom	39	60	80	87	3,240	2,720	3,170	2,830
Other	(2/)	26	(2/)	19	12	97	1,030	301
Total	6,420	2,140	6,800	2,650	45,000	59,300	52,500	75,000

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/	1991	1992	1993	1994	1995 e/
Argentina (ocher)	77	40	28	35 e/	30
Austria	10,200	9,475	8,398	8,000 e/	8,000
Bosnia and Herzegovina e/	XX	200	--	--	--
Brazil e/	5,500	5,500	5,500	5,500	5,500
Chile	6,761	22,945	7,106	3,283 r/	3,000
Cyprus (umber)	5,800	5,000	6,000	9,000	9,000
France e/	14,000	12,000	1,000	1,000	1,000
Germany 4/	7,043	10,100	7,712	7,475 r/	7,500
India (ocher)	155,563	142,478 r/	138,210 r/	152,900 r/	160,000
Iran	3,753	2,307	2,500 e/	2,500 e/	2,500
Italy e/	800	700	700	600	600
Pakistan (ocher)	1,889	5,126	6,196	6,000 e/	6,000
Paraguay (ocher) e/	330	330	330	330	330
South Africa	1,122	1,114	1,186	12,672 r/	5,256 5/
Spain: e/					
Ocher	8,600	8,200	8,000	7,000	8,000
Red iron oxide	20,000	18,000	16,000	15,000	16,000
United States	W	W	W	W	W
Yugoslavia 6/	800	XX	XX	XX	XX
Zimbabwe	400 e/	538	390 r/	438 r/	500

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

1/ U.S. data and estimated data are rounded to three significant digits.

2/ Table includes data available through July 9, 1996.

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/ Reported figure.

5/ Includes Vandyke brown.

6/ Dissolved in Apr. 1992. All production for Yugoslavia in 1991 came from Bosnia and Herzegovina.