

# IRON OXIDE PIGMENTS

By Michael J. Potter

Iron oxide materials yield pigments that are nontoxic, nonbleeding, relatively inert, weather resistant, and lightfast. 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).

## Production

U.S. finished natural iron oxide pigments (IOP) were 81,500 metric tons in 1997, or 9% higher than in 1996. Finished synthetic IOP sold by processors in the United States were 94,600 tons, an increase of 7%. (See table 1.)

Production data for crude IOP were developed by means of a voluntary survey. Of eight known companies, data were obtained from seven, or an 87% response rate. By tonnage, the seven companies represented 70% of the output. In a second voluntary survey, data were received from 16 of 17 known operations which produced finished IOP, a response rate of 94%. By tonnage, the 16 companies comprised 90% of the output.

Bayer Corp. continued in its efforts to complete the takeover of distribution for all its iron oxide products. In so doing, the company is working to streamline its operations, to cut costs, and to allow it to have a larger role in the natural iron oxides market (Denton, 1997).

## Consumption

Synthetic IOP consumption in coatings shows a sudden increase, from 30% in 1996 to 42% in 1997. (See table 4.) This is believed to reflect more accurate data for 1997 than for 1996, and not a sudden change in market conditions. In the manufacture of colored concrete products, IOP are stable under exposure to sunlight and ultraviolet radiation and are highly weather resistant. IOP are used in paints and coatings for primer, architectural, and industrial applications. They are used extensively in house and marine paints. Red iron oxides are used in primers for automobiles and steel structures (McCormack, 1997).

## Prices

Yearend 1997 prices 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 (Chemical Market Reporter, 1997).

## Foreign Trade

Total U.S. imports of synthetic IOP increased by 14% in 1997 to 60,400 tons. (See table 7.) This largely reflected an increase in imports from China from 16,600 tons in 1996 to 24,100 tons in 1997. The average value of Chinese material was \$581 per ton in 1997, compared with \$1,579 per ton for imports from Germany and \$1,447 per ton for material from the United Kingdom.

## Outlook

According to a company source, an area which was quite active for IOP in the United States in 1997 was in plastics, which were displacing metal and glass in automotive applications (Denton, 1997). U.S. imports of IOP have been increasing, especially synthetic material from China, although the imports from that country have been largely for noncoatings applications. IOP should continue to have a favorable outlook because of their properties, including durability and light and heat stability.

Iron oxides were said to account for two-thirds of world colored pigments volume in 1996 (latest available). Because of their low cost, IOP made up 17% of the market value. Although the United States is an important producer and consumer of IOP, Europe is the largest producer and user, especially because of the popularity of colored concrete products in the construction industry. Growth is projected to be most rapid in the developing Asian markets, averaging 5% per year over the next 5 years (McCormack, 1997).

## References Cited

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## SOURCES OF INFORMATION

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

(Metric tons, unless otherwise noted)

	1993	1994	1995	1996	1997	
Mine production	W	W	W	W	W	
Crude pigments sold or used	35,800	46,400	51,700	44,700	58,200	
Value	thousands	\$5,020	\$6,010	\$6,720	\$6,990	\$7,580
Finished pigments sold	126,000	139,000	151,000	163,000 r/	176,000	
Value	thousands	\$140,000	\$143,000	\$160,000	\$183,000	\$193,000
Exports	22,400	21,300	17,500	16,000	16,600	
Value	thousands	\$32,000	\$30,700	\$24,900	\$23,200	\$20,600
Imports for consumption	43,600	51,400	59,300	62,600	70,600	
Value	thousands	\$57,300	\$61,400	\$77,600	\$74,000	\$76,900

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	1996		1997	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Natural:				
Black: Magnetite	12,700	\$2,140	15,400	\$2,950
Umbers:				
Burnt	W	W	2,060	2,810
Raw	W	W	W	W
Red:				
Iron oxide 2/	49,600 r/	9,700 r/	53,600	11,200
Sienna, burnt	W	W	W	W
Yellow:				
Ocher	W	W	W	W
Sienna, raw	W	W	W	W
Undistributed	12,200	9,680	10,500	6,700
Total	74,500 r/	21,500	81,500	23,700
Synthetic:				
Black: Iron oxide	21,000	37,800	20,100	34,500
Brown: Iron oxide	7,770	14,700	10,000	18,900
Red: Iron oxide	W	W	W	W
Yellow: Iron oxide	23,600	42,400	25,700	44,400
Mixtures of natural and synthetic:				
Iron oxides	W	W	1,880	W
Other: Specialty oxides	W	W	W	W
Undistributed	36,000 r/	66,100 r/	36,900	71,200
Total	88,400	161,000	94,600	169,000
Grand total	163,000 r/	183,000	176,000	193,000

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.

TABLE 3  
PRODUCERS OF IRON OXIDE PIGMENTS, REGENERATOR IRON OXIDES,  
AND STEEL-PLANT WASTE IRON OXIDES IN THE UNITED STATES IN 1997

Producers	Plant location
<b>Finished pigments:</b>	
Alabama Pigments Co.	Greenpond, AL.
Arizona Oxides L.L.C.	El Mirage, AZ.
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.
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.
<b>Crude pigments:</b>	
Alabama Pigments Co.	Greenpond, AL.
Arizona Oxides L.L.C.	El Mirage, AZ.
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.
<b>Regenerator and steel plant waste iron oxides:</b>	
Bailey - PVS Oxides, L.L.C.	Fairfield, AL.
International Steel Services, Inc.	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	
	1996	1997	1996	1997	1996	1997
Coatings (industrial finishes, trade sales: lacquers, paints, varnishes)	22	28	13	12	30	42
Construction materials (cement, mortar, preformed concrete, roofing granules)	30 r/	29	20	19	39	38
Colorants for ceramics, glass, paper, plastics, rubber, textiles	W	W	W	W	9	8
Foundry sands	8	9	17 r/	19	--	--
Industrial chemicals (such as catalysts)	9	4	W	W	W	W
Ferrites	W	W	W	W	W	W
Animal feed and fertilizers	W	W	W	W	2	W
Other (also includes cosmetics, magnetic ink and toner, and polishing agents)	31 r/	30	50 r/	50	20	12
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	1996				1997			
	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	(2/)	\$3	785	\$493	30	\$44	331	\$256
Australia	34	126	544	1,370	18	31	650	1,440
Austria	19	19	20	25	--	--	--	--
Belgium	289	529	95	193	352	511	517	608
Brazil	15	108	175	340	22	102	181	432
Canada	19	15	10,700	13,400	152	131	9,560	11,900
Ecuador	16	39	1	4	3	7	2	7
Germany	288	1,220	263	983	306	1,180	337	1,520
Hong Kong	1,040	2,780	70	197	579	1,710	35	151
Indonesia	808	1,380	88	60	597	1,050	27	75
Italy	1	4	231	476	--	--	280	505
Japan	4,030	3,390	2,850	4,080	4,130	3,280	3,290	9,760
Korea, Republic of	989	3,830	1,300	4,280	1,260	3,300	885	3,710
Malaysia	42	182	155	236	23	63	51	62
Mexico	4,950	1,560	1,700	4,020	7,050	3,710	1,970	4,850
Netherlands	78	309	1,340	2,210	104	234	1,580	2,760
Singapore	1	3	881	1,660	52	62	390	748
South Africa	828	1,210	70	83	156	185	90	227
Spain	55	113	39	84	4	12	--	--
Taiwan	3	8	746	702	82	102	1,410	1,150
Thailand	313	570	274	547	74	214	115	194
United Kingdom	607	2,080	2,250	3,890	721	2,370	2,370	3,660
Venezuela	1	4	407	57	15	16	250	99
Other	1,540	3,760	2,180	2,300	853	2,260	1,970	2,230
Total	16,000	23,200	27,200	41,700	16,600	20,600	26,300	46,400

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	1996		1997		Source, 1997 (metric tons)
	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	
Natural:					
Earth colors 3/	3,060	\$1,200	4,410	\$1,820	Cyprus 3,720; France 250; Germany 154; Spain 153; Colombia 92; Morocco 20; Japan 17; South Africa 1; Canada (4/); Estonia (4/); Poland (4/).
Micaceous	6,330	2,170	5,720	2,670	Canada 2,600; Netherlands 2,290; Italy 204; Austria 202; France 132; China 128; Morocco 78; Spain 23; United Kingdom 21; Mozambique 20; Australia 10; Japan 9; Mexico 7; Republic of Korea (4/).
Total	9,390	3,370	10,100	4,490	
Synthetic:					
Black	8,780	25,600	9,960	23,800	Japan 3,830; India 2,760; China 1,310; Germany 1,010; Italy 461; Mexico 443; Hong Kong 128; Canada 20; Sweden 2; France 1.
Red	24,200	22,200	25,900	20,400	China 14,600; Canada 4,510; Germany 4,450; Spain 846; Italy 446; Japan 351; Brazil 240; United Kingdom 177; Mexico 159; Hong Kong 64; Norway 47; Morocco 22; Belgium 20; France 11; Switzerland 10; Czech Republic 3.
Yellow	15,800	16,100	19,200	19,500	China 7,960; Germany 4,560; United Kingdom 3,470; Italy 1,250; Brazil 1,050; Mexico 623; Spain 200; Hong Kong 196; Netherlands 61; Belgium 40; Japan 30; Canada 24; Poland 19; Hungary 15; Switzerland 12; France 6; South Africa (4/).
Other 5/	4,410	6,670	5,340	8,730	Germany 2,570; Canada 1,480; China 532; Japan 351; India 227; Mexico 101; United Kingdom 41; Poland 17; Italy 14; Belgium 2; Hong Kong 1.
Total	53,200	70,600	60,400	72,400	
Grand total	62,600	74,000	70,600	76,900	

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

2/ Customs value.

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

4/ Less than 1/2 unit.

5/ 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			
	1996		1997		1996		1997	
	Quantity (metric tons)	Value 2/ (thou- sands)	Quantity (metric tons)	Value 2/ (thou- sands)	Quantity (metric tons)	Value 2/ (thou- sands)	Quantity (metric tons)	Value 2/ (thou- sands)
Austria	38	\$47.00	202	\$199	--	--	--	--
Belgium	--	--	--	--	99	\$439	62	\$573
Brazil	--	--	--	--	1,600	1,570	1,290	1,260
Canada	3,940	511	2,600	308	6,260	1,510	6,030	1,820
China	--	--	128	68	16,600	10,700	24,100	14,000
Cyprus	2,560	768	3,720	1,190	--	--	--	--
France	148	149	382	280	2	60	18	255
Germany	206	259	154	175	12,200	19,900	12,600	19,900
Hong Kong	--	--	--	--	820	644	389	309
Hungary	--	--	--	--	17	28	15	28
India	60	14	--	--	3,020	2,380	2,990	2,240
Italy	20	6	204	156	1,420	1,640	2,170	2,450
Japan	22	98	26	205	5,510	26,500	4,570	21,700
Mexico	4	30	7	27	1,560	1,370	1,330	1,320
Netherlands	2,010	1,190	2,290	1,480	10	78	61	68
Spain	179	77	176	108	972	719	1,050	557
Sweden	--	--	--	--	175	58	2	10
United Kingdom	207	179	21	25	2,920	2,920	3,690	5,340
Other	9	38	222	264	4	88	131	584
Total	9,390	3,370	10,100	4,490	53,200	70,600	60,400	72,400

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

2/ Customs value.

Source: Bureau of the Census.

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

(Metric tons)

Country 3/	1993	1994	1995	1996	1997 e/
Argentina (ocher)	28	-- r/	-- r/	-- r/	--
Austria e/	8,398 4/	8,000	8,000	7,500	7,500
Brazil e/	5,500	5,500	5,500	5,500	5,500
Chile	7,106	3,283	16,451 r/	18,821 r/	16,000
Cyprus (umber)	6,000	9,000	5,415 r/	4,604 r/	5,000
France e/	1,000	1,000	1,000	1,000	1,000
Germany 5/	7,712	7,475	7,500 e/	7,500 e/	7,500
India (ocher)	138,210	170,761	254,166 r/	284,546 r/	285,000
Iran e/	2,500	2,500	2,500	2,500	2,500
Italy e/	700	600	600	500	500
Pakistan (ocher) e/	6,196 4/	6,000	6,000	6,100	6,200
Paraguay (ocher) e/	330	330	300	300	300
South Africa	1,186	2,084	5,256	643	464
Spain: e/					
Ocher	8,000	7,000	8,000	7,000	7,000
Red iron oxide	16,000	15,000	16,000	15,000	15,000
United States	W	W	W	W	W
Zimbabwe	390	438	585	400 r/ e/	400

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, 1998.

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, Kazakstan, 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.