



## E. I. du Pont de Nemours and Co.: Titanium Dioxide

In May 1972 the executive committee of E. I. du Pont de Nemours and Co. convened to consider a report from the pigments department concerning the titanium dioxide market. Events had dramatically altered the economics of producing and selling titanium dioxide in the United States. Substantial excess demand had developed, causing producers to reevaluate their capacity expansion plans in this market. Du Pont's executive committee had to determine what Du Pont's response would be—and the likely reaction of its competitors—to the changed environment.

### Company Background

E. I. du Pont de Nemours and Co. (Du Pont) was a diversified manufacturer of fibers, plastics, industrial chemicals and other specialty chemical products. In 1971 it was the seventeenth largest manufacturing corporation in the United States, with reported earnings of \$357 million on sales of \$3.8 billion. It was a conservatively managed company as evidenced by its longstanding AAA bond rating and its tendency to rely on retained earnings to fund its capital expenditure programs. (A five-year financial summary for Du Pont is provided in **Exhibit 1**.)

Since its founding as an explosives manufacturer in 1802, Du Pont compiled an enviable record of growth and profitability. Historically, Du Pont competed primarily on the basis of technological innovation and tended to avoid cost competition in commodity markets. The rapid pace of technological development, however, and the consequent shortening of product life cycles in recent decades had forced it to defend some of its mature products more aggressively. This frequently meant improving costs and competing on the basis of price. Because its size and technological superiority usually afforded Du Pont a dominant position in the markets in which it competed, an aggressive defense of market share often gave rise to antitrust charges.

Du Pont was organized into 10 industrial departments. The pigments department, the second smallest with sales of approximately \$180 million in 1971, was responsible for titanium dioxide. Du Pont's involvement with titanium dioxide began with the acquisition of the Commercial Pigment Co. in 1931. By 1972 Du Pont had closed its original manufacturing facility and was operating more modern plants in Antioch, California; Edge Moor, Delaware; and New Johnsonville, Tennessee.

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## Titanium Dioxide Market

Titanium dioxide ( $\text{TiO}_2$ ) is a white chemical agent used in the manufacture of paints, paper, synthetic fibers, plastics, ink, and synthetic rubber. It acts as a whitening and opacifying agent and has no commercially satisfactory substitute.

Two principal technologies exist for manufacturing  $\text{TiO}_2$ : a sulfate process and a chloride process. The sulfate process produces  $\text{TiO}_2$  by the digestion of low grade titaniferous feedstocks with sulfuric acid. Although this technique does not require high-grade feedstock, it produces large amounts of ecologically hazardous wastes. In the chloride process, titaniferous feedstock reacts with chlorine in the presence of carbon to produce titanium tetrachloride, which is then converted to  $\text{TiO}_2$ . The chloride process can use either high-grade feedstock (rutile or synthetic rutile) or low-grade feedstock (ilmenite or lecoxene). The low-grade chloride technology (ilmenite chloride) differs from the high-grade chloride technology (rutile chloride) by requiring more chlorine per unit of output and producing more waste. However, both chloride processes produce less waste and safer waste than sulfate technology.

Domestic sales of  $\text{TiO}_2$  were projected to reach 730,000 tons by the end of 1972, with a dollar value of \$340 million. The volume of sales had been growing slowly at a 3% annual rate during the previous decade. Since  $\text{TiO}_2$  was an ingredient in many final products with cyclical demand, its demand also tended to move with the business cycle. Based upon past experience, the volume of demand could fall by as much as 10% between the peak and the trough of a business cycle. Annual sales were projected to grow to more than one million tons by 1985.

$\text{TiO}_2$  prices tended to be extremely stable. Between 1963 and 1969 selling prices remained between \$26 and \$27 per 100 lbs (This represented a 17% decline in real prices over the period.) After 1969, prices fell below \$25, but began recovering sharply in 1972.

### Capacity Expansion Decisions by $\text{TiO}_2$ Producers

The National Lead Co. built the first domestic  $\text{TiO}_2$  plant in Sayreville, New Jersey, in 1918. This plant used the sulfate process as did all subsequent plants built before the 1950s. Du Pont then introduced the ilmenite chloride technology at its Edge Moor plant in 1952. This facility took almost three years to become fully operational because of the formidable problems involved in scaling up this technology from models. As a result, although the chemical process of the ilmenite chloride method was widely known, only Du Pont possessed the operational knowledge necessary to make production economically viable.

In 1958 Du Pont again chose the ilmenite chloride process for a large plant at New Johnsonville, Tennessee. Since this plant was the largest in the industry, Du Pont realized scale economies that lowered its costs slightly below those of its competitors; however, Du Pont's decision to use the ilmenite chloride technology was based primarily on its access to ilmenite ore, not on cost savings.<sup>1</sup> Both the sulfate and the two chloride technologies had roughly identical per unit operating costs for plants of equivalent size.

In the late 1950s and early in 1960, large quantities of easily accessible rutile ore were discovered in the beach sands of eastern Australia. As a result, all plants built during the next decade used the rutile chloride technology, including a facility in Antioch, California, built by Du Pont in 1964.

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<sup>1</sup> Du Pont obtained ilmenite ore from India and later from Florida. Other sources included Australia, New Jersey, and New York.

By the early 1970s, eight U.S. firms supplied over 90% of the domestic market for  $\text{TiO}_2$  with imports supplying the remainder. All of these firms were diversified to varying degrees. (Exhibits 2 and 3 detail each firm's capacity, actual production and dollar sales during 1970 to 1972 for both types of technology.)

After Du Pont, National Lead (NL) was the second largest supplier of  $\text{TiO}_2$  by a wide margin; however, its share of the market fell steadily throughout the late 1960s. NL had total 1971 earnings of \$23 million on sales of \$925 million. It was generally less profitable than Du Pont and relied more heavily on debt to finance its growth (debt as a percentage of NL's total capital was 35% in 1971). NL was also more highly sensitive to economic fluctuations. In 1971 NL owned  $\text{TiO}_2$  plants in Sayreville, New Jersey, and St. Louis, Missouri. Pigments accounted for roughly one-quarter of NL's total sales and one-third of its total operating profit.

### **Transitions in the $\text{TiO}_2$ Market**

Between 1969 and 1972 two major events transformed the domestic  $\text{TiO}_2$  market. A sudden shortage of rutile ore developed in 1970 and 1971, and ore prices increased dramatically. When per ton prices of rutile ore rose from A\$65 (Australian dollars) in the late 1960s to A\$110 in 1972, the economics of the high-grade chloride technology were altered radically.

During the same period sulfate process plants were forced to make major capital expenditures to comply with newly enacted environmental protection legislation. The combined effect of these two disruptions was to significantly raise  $\text{TiO}_2$  mill costs for both the sulfate and rutile chloride processes. Whereas previously Du Pont's ilmenite chloride process had only a small cost-advantage over other processes, it was now significantly cheaper than the other two technologies.

Following these events, production of  $\text{TiO}_2$  declined sharply as high cost plants began to shut down. Exacerbating the supply problem, the devaluation of the U.S. dollar and the continuation of a tariff on  $\text{TiO}_2$  cut imports significantly. The reduced supply of  $\text{TiO}_2$  resulted in substantial excess demand and the rationing of production among users.

### **Du Pont's Strategic Alternatives in $\text{TiO}_2$**

Excess demand created capacity expansion opportunities for producers of  $\text{TiO}_2$ . Du Pont's rivals had two principal alternatives for expansion: upgrading marginally profitable sulfate and rutile chloride plants or building new ilmenite chloride plants. As Du Pont's Edge Moor plant demonstrated, this latter alternative required large-scale facilities and extensive experience to be made economically viable. An optimal-scale ilmenite chloride plant would require capacity of 50,000-100,000 tons per year and would cost between \$45 and \$90 million. Competitors building such plants would assume the usual risks of technical failure, delayed startups, and so forth. But a risk of declining prices and diminished cash flow from  $\text{TiO}_2$  operations also existed if many competitors simultaneously chose to add capacity and flood the market.

Du Pont recognized both the opportunities and the risks inherent in the  $\text{TiO}_2$  market and took steps to formulate a strategy for coping with the changed environment. In May 1972 A. H. Geil, vice president and general manager of Du Pont's pigments department, submitted to the executive committee a report entitled "Opportunities in the  $\text{TiO}_2$  Business." The report described two possible strategies in  $\text{TiO}_2$  that Du Pont should consider implementing: a growth strategy and a maintain strategy.

The objective of the maintain strategy was to boost Du Pont's market share in  $\text{TiO}_2$  to 45% over the next several years. The growth strategy, on the other hand, called for an aggressive response that would be designed to "provide cash for Du Pont expansion [in the  $\text{TiO}_2$  market], but limit competitors' ability to expand."<sup>2</sup> This strategy required the integration of plans for expanding capacity through 1985, pricing  $\text{TiO}_2$ , and restricting the licensing of the ilmenite chloride process to improve Du Pont's competitive position in this market. Successful implementation of this strategy required that all three of these tactics be coordinated, since each independently represented a much smaller threat to competitors' expansion moves.

Forecasts of total demand for  $\text{TiO}_2$ , capacity costs, operating expenses, selling prices, Du Pont's market share, and Du Pont's  $\text{TiO}_2$  capacity under both strategies are shown in **Exhibit 4**. Du Pont's market share in 1985 at the end of the capacity expansion program was expected to be almost 65% under the growth strategy compared with 45% under the maintain strategy. Forecast prices for  $\text{TiO}_2$  were expected to be lower at first under the growth strategy relative to the maintain strategy as Du Pont's new capacity increased industry supply.<sup>3</sup> But they were expected to be relatively higher in future years due to more orderly capacity expansion. Forecast operating expenses were expected to be the same under either strategy.

The cost of new capacity was expected to be \$900 per ton in 1973 and to increase as shown in **Exhibit 4**. Further investment in net working capital amounting to 20% of the increased sales level would also have to be made. The capital investment (other than additions to net working capital) would be eligible for a 10% investment tax credit.<sup>4</sup> Ongoing capital expenditure for maintenance and replacement were expected to approximate depreciation allowances over time. Thus, should  $\text{TiO}_2$  production terminate at any point in the future, it was believed that Du Pont's investment in working capital and the book value of other assets could be completely recovered.

Du Pont's pretax operating profit margin before interest expense, but after depreciation on the new capacity, was expected to average 40% under both strategies. This was more than twice the margin that competitors building new ilmenite chloride capacity would realize at the outset. The difference resulted from Du Pont's extensive experience with this production technology and could be expected to erode over time as competitors gained similar experience.

In light of the long-term benefits and other competitive advantages associated with the growth strategy, the pigments department recommended its adoption. It noted that "a combination of factors [put] Du Pont in the unique position [of being able] to increase its share of the market by a substantial amount,"<sup>5</sup> and argued that such a unique set of circumstances should not go unexploited.

If accepted, the  $\text{TiO}_2$  growth strategy would commit Du Pont to a massive capital expenditure program that would reach half a billion dollars by 1985. Before reaching a decision, the executive committee had to be convinced that the relative merits of the growth strategy truly justified such an extended period of high capital expenditure.

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<sup>2</sup> Federal Trade Commission, In the Matter of E. I. du Pont de Nemours & Co., Docket No. 9108, Initial Decision, September 4, 1979, p. 23.

<sup>3</sup>  $\text{TiO}_2$  prices forecast under the maintain strategy were essentially the same as those that would be expected to prevail even if Du Pont undertook no capacity expansion.

<sup>4</sup> Du Pont's marginal tax rate in 1972 was 48%.

<sup>5</sup> Federal Trade Commission, p. 16.

**Exhibit 1** Five-year Financial Summary, 1967-1971 (\$ millions, except per share and ratio data)

	1971	1970	1969	1968	1967
<b>Income Statement</b>					
Sales	\$3,848	\$3,618	\$3,632	\$3,455	\$3,079
Net income	357	334	356	372	314
Cash flow from operations	727	684	677	659	583
Earnings per share	7.33	6.86	7.62	7.99	6.73
Dividends per share	5.00	5.00	5.25	5.50	5.00
Average shares outstanding (000)	47,281	47,257	47,076	46,285	46,158
<b>Balance Sheet</b>					
Net working capital	\$1,221	\$1,100	\$1,107	\$ 996	\$ 874
Net property, plant and equipment	2,002	1,923	1,803	1,738	1,724
Total assets	3,999	3,740	3,453	3,289	3,071
Total debt	307	216	186	162	125
Shareholders' equity	3,095	2,964	2,854	2,697	2,557
Total capital	3,402	3,180	3,040	2,859	2,682
Book value per share	60.23	57.67	55.53	53.09	50.22
Market value per share <sup>a</sup>	143.75	113.38	133.38	162.75	163.25
<b>Capital Sources</b>					
Cash flow retained	\$ 480	\$ 438	\$ 423	\$ 394	\$ 308
External equity financing (net)	21	37	35	23	19
Debt financing (net)	<u>91</u>	<u>30</u>	<u>24</u>	<u>37</u>	<u>67</u>
Total capital added	\$ 592	\$ 505	\$ 482	\$ 454	\$ 394
<b>Capital Expenditures</b>	\$ 454	\$ 471	\$ 391	\$ 332	\$ 454
<b>Key Financial Ratios</b>					
Growth rate (%)					
Sales	6.4	(0.4)	5.1	12.2	(2.5)
Profits	6.9	(6.2)	(4.3)	18.5	(19.3)
Return on sales (%)	9.3	9.2	9.8	10.8	10.2
Return on equity (%)	11.5	11.3	12.5	11.3	12.3
Current ratio	3.5	3.6	3.6	3.6	3.2
Debt and total capital (%)	9.0	6.8	6.1	5.7	4.7
Price earnings ratio <sup>a</sup>	19.6	16.5	17.5	20.4	24.2
Market value/Book value <sup>a</sup>	2.4	2.0	2.4	3.1	3.3

<sup>a</sup> Based on midpoint of the year's trading range for Du Pont's common shares.

Exhibit 2

Domestic TiO <sub>2</sub> Production Capacity by Firm										Total Domestic TiO <sub>2</sub> Shipments by Firm, Including Imports <sup>a</sup>									
1972 est.		1971		1970		1972 est.		1971		1970		1972 est.		1971		1970			
000 tons	%	000 tons	%	000 tons	%	000 tons <sup>b</sup>	%	000 tons <sup>b</sup>	%	000 tons <sup>b</sup>	%	000 tons <sup>b</sup>	%	\$ millions <sup>c</sup>	%	\$ millions <sup>c</sup>	%		
Du Pont	38	277	33	252	30	220	30	222	31	206	30	100	29	98	31	100	31		
NL Industries	27	268	32	268	32	180	25	209	30	210	31	95	28	102	33	112	35		
American Cyanamid	10	82	10	90	11	80	11	72	10	53	8	40	12	30	10	24	7		
SCM	9	78	9	78	9	65	9	64	9	58	9	25	7	26	9	27	8		
Gulf & Western	8	70	8	70	8	60	8	26	4	30	4	30	9	11	3	13	4		
Kerr-McGee	5	39	5	37	5	45	6	37	5	31	5	20	6	12	4	16	5		
Sherwin-Williams	3	27	3	27	3	30	4	26	4	21	3	10	3	12	4	8	2		
PPG	—	—	—	18	2	—	—	10	1	9	1	—	—	4	1	4	1		
Total (U.S. firms)	100	841	100	840	100	680	93	666	94	618	91	320	94	296	95	304	93		
Imports	—	—	—	—	—	50	7	41	6	58	9	20	6	15	5	21	7		
Total	100	841	100	840	100	730	100	707	100	676	100	340	100	311	100	325	100		

Source: Federal Trade Commission, In the Matter of E. I. du Pont de Nemours & Co., Docket No. 9108, Compliant Counsel's Exhibits Nos. CX121A, B; CX223A, B; and CX222.

<sup>a</sup> Excluded exports.

<sup>b</sup> Thousands of tons shipped.

<sup>c</sup> Dollar value of shipments.

Exhibit 3 TiO<sub>2</sub> Production by Firm and Type of Process, 1970 (tons 000)

	Total Production <sup>a</sup>	Sulfate Process	Chloride Process
Du Pont <sup>b</sup>	211	43	168
NL Industries	229	193	36
American Cyanamid	56	47	9
SCM	51	48	3
Gulf & Western	33	33	—
Kerr-McGee	35	—	35
Sherwin-Williams	19	—	19
PPG	10	—	10
Total	644	364	280

Source: Federal Trade Commission, In the Matter of E. I. du Pont de Nemours & Co., Docket No. 9108, Initial Decision, p. 11.

<sup>a</sup> Differences between total production and total shipments (see Exhibit 2) represent adjustments to TiO<sub>2</sub> inventory.

<sup>b</sup> Only Du Pont had chloride process production using low-grade feedstock; all others used high-grade feedstock.

Exhibit 4 TiO<sub>2</sub> Market Forecasts under Alternative Strategies for Du Pont, 1973-1985

	Size of Market <sup>a</sup> (tons 000)	Cost of New Capacity (\$ per ton)	Pretax Operating Expenses <sup>b</sup> (\$ per ton)	Growth Strategy			Maintain Strategy		
				Average Gross Selling Price (\$ per ton)	Du Pont Market Share (%)	Du Pont Capacity (tons 000)	Average Gross Selling Price (\$ per ton)	Du Pont Market Share (%)	Du Pont Capacity (tons 000)
1973	752	900	330	540	35	350	555	35	340
1974	774	927	390	640	40	375	665	40	350
1975	798	955	460	750	47	400	760	45	360
1976	822	983	540	880	47	421	890	45	370
1977	846	1,013	580	950	51	443	955	45	381
1978	872	1,043	620	1,010	52	475	1,015	45	392
1979	898	1,075	660	1,070	52	505	1,070	45	404
1980	925	1,107	690	1,130	55	530	1,120	45	416
1981	952	1,140	710	1,190	58	552	1,170	45	428
1982	981	1,174	740	1,250	59	579	1,210	45	441
1983	1,010	1,210	770	1,310	61	616	1,270	45	455
1984	1,041	1,246	810	1,370	62	645	1,320	45	468
1985	1,072	1,283	850	1,430	64	685	1,370	45	482

<sup>a</sup> Total demand for TiO<sub>2</sub> is forecast to grow at 3% annually and is not considered to be very sensitive to price.

<sup>b</sup> Pretax operating expense per ton includes depreciation allowances but excludes interest expense.