CCM Data & Business Intelligence

Survey of Titanium Dioxide in China

The Tenth Edition

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Executive summary

Recent years, China's titanium dioxide (TiO_2) industry tended to develop steadily. The period of 2018–2020 saw consecutive growth of TiO_2 output in China, while fluctuation in the capacity. In 2020, domestic TiO_2 capacity grew to 4.10 million t/a and the output came to 3.52 million tonnes. With increasing concentration of the industry and manufacturers to obtain better production technology, it is estimated that TiO_2 production capacity in China will exceed 5.25 million t/a by 2025 and the output will grow to about 4.21 million tonnes.

So far, chloride process TiO_2 is at the nascent stage in China, while sulfate process still dominates. Although some major domestic manufacturers have already built or are building chloride process projects, technical barriers, product quality and high cost of related facilities make the process unreachable to most producers. The upgrading of China's TiO_2 production techniques still has a long way to go.

The domestic price curve of TiO_2 in 2018–2020 showed a "down-up" pattern; the price went down from Jan. 2018 to July 2020, then followed by a upward trend all the way to June 2021.

With high foreign demand and the continuous improvement in quality of domestic TiO_2, the exports continued to be strong in 2018–2020, while imports declined in general. China exported 1,203,975 tonnes of TiO_2 in 2020, expanding at a CAGR of 14.92% during 2018–2020, while imported 168,276 tonnes, down from 197,443 tonnes in 2018.

As one of the largest TiO_2 consumers worldwide, China sees its consumption grow year by year. In 2018–2020, domestic TiO_2 consumption increased from 2,172,896 tonnes to 2,414,878 tonnes, with a CAGR of 5.42%. Coating, plastics and papermaking industries remain the largest downstream markets for TiO_2, accounting for 60.91%, 19.01% and 11.19% of the total in 2020. It is expected that in the next five years, these three industries will continue to lead the way in TiO_2 consumption.

Methodology

Survey of Titanium Dioxide in China is CCM's tenth edition report on China's titanium dioxide industry, finished in Nov. 2021.

The report is drafted by diverse methods as follows:

1) Desk research
The sources of desk research are various, including published magazines, journals, government statistics, industrial statistics, customs statistics, association seminars as well as information from the Internet. A lot of work has gone into compilation and analysis of the obtained information. Where necessary, checks have been made with Chinese suppliers regarding market information such as key producers, key end users, production, export and demand and so on.

2) Telephone interview
CCM has carried out extensive telephone interviews in order to survey the actual market situation of titanium dioxide industry in China.

Interviewees cover:
- Key producers
- Key end users
- Key traders
- Material suppliers
- Some associations
- Experts

3) Site visit
CCM has visited some industry experts in order to obtain the experts' thorough views and investment suggestion.

4) Network
CCM adopts network to contact with players in this industry by B2B website and software.

5) Questionnaire
In order to confirm some information and obtain more experts' views for China's titanium dioxide industry development trend, CCM adopts questionnaire for some key producers, end users, traders and experts.

Data processing and presentation
The data collected and compiled were sourced from:
- CCM's ValoTracer database
- Published articles from periodicals, magazines and journals, the third database
- Statistics from governments and international institutes
- Telephone interviews with domestic producers, joint ventures, service suppliers, government
- Questionnaire
- Third-party data providers
- Custom statistics
- Comments from industrial experts
- Professional database from other sources
- Information from the Internet

The data from various sources have been combined and cross-checked to make this report as precise and scientific as possible. Throughout the process, a series of internal discussions took place in order to analyse the data and draw conclusions from it.

Unit
RMB: currency unit in China, also called Yuan
USD: currency unit in the US
tonne: ton, equals to metric ton in this report
/t: per tonne
t/a: tonne/annum or tonne/year

Glossary
CAGR: Compound Annual Growth Rate
GDP: Gross Domestic Product
TiO_2: Titanium dioxide
MIIT: Ministry of Industry and Information Technology of the People's Republic of China
CNCIA: China National Coatings Industry Association
MOFCOM: Ministry of Commerce of the People's Republic of China
IPO: Initial Public Offering
REACH: Registration, Evaluation, Authorization and Restriction of Chemicals
NDRC: National Development and Reform Commission
USGS: United States Geological Survey
SAT: State Administration of Taxation
GACC: General Administration of Customs of the People's Republic of China

Table Exchange rate USD/CNY, Jan. 2018–Nov. 2021

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
2018	6.5079	6.3045	6.3352	6.2764	6.3670	6.4078	6.6157	6.8293	6.8347	6.8957	6.9670	6.9431	**6.6070**
2019	6.8482	6.7081	6.6957	6.7193	6.7344	6.8896	6.8716	6.8938	7.0883	7.0726	7.0437	7.0262	**6.8826**
2020	6.9614	6.9249	6.9811	7.0771	7.0690	7.1315	7.0710	6.9980	6.8498	6.7796	6.7050	6.5921	**6.9284**
2021	6.5408	6.4623	6.4754	6.5584	6.4895	6.3572	6.4709	6.4660	6.4680	6.4604	6.4192	-	**-**

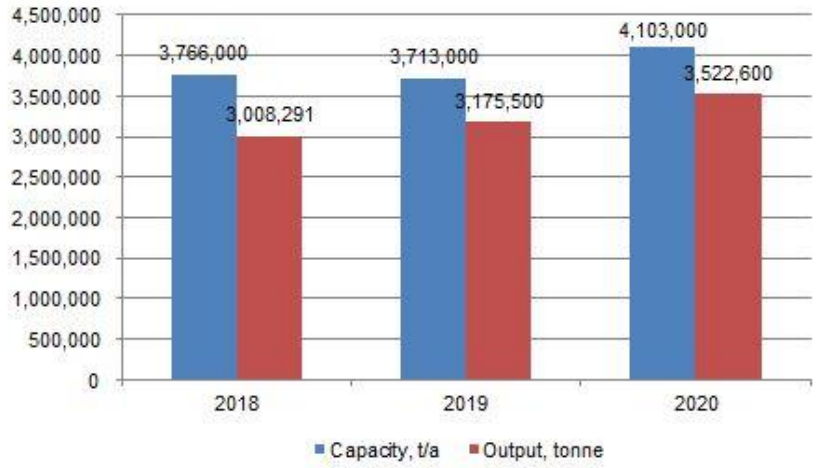
Source: The People's Bank of China

1 Titanium dioxide production in China

1.1 Titanium dioxide production information, 2018–2020

The period of 2018–2020 saw consecutive growth of TiO_2 output in China, while fluctuation in the capacity.

Figure 1.1-1 Capacity and output of titanium dioxide in China, 2018–2020



Source: CCM

In 2020, the capacity of TiO_2 in China increased to 4,103,000 t/a and the output reached 3,522,600 tonnes. The operating rate of the industry was 85.85%.

In 2018–2020, certain amount of backward capacity was phased out while some advanced production lines came into use. For example, by the end of 2018, Wuxi Haopu Titanium Co., Ltd. had fully abandoned its 100,000 t/a sulfate-process TiO_2 capacity and received considerable compensation from local government. In contrast, Yibin Tianyuan Haifeng Hetai Co., Ltd. finished a 50,000 t/a chloride-process TiO_2 project and it went into trial production in 2019.

The export volume of China's TiO_2 has expanded constantly these years and the TiO_2 products have enjoyed greater recognition and popularity for their improved quality and advantageous prices. Growing export market has not only broadened business and sales destinations for Chinese producers, but also effectively consumed their inventories, which has driven up their productivity for more engagement in international trade.

1.2 Top 40 titanium dioxide manufacturers, 2018–2020

In 2018, of all the domestic full-process TiO_2 manufacturers that maintained normal production, 11 manufacturers achieved 100,000 tonne-above output, with Yunnan Dahutong Industrial & Trade Co., Ltd. as the new comer. The output of these 11 enterprises altogether reached nearly 2.08 million tonnes, accounting for almost 70% of the total output. In particular, the output of LB Group Co., Ltd. (LB Group) was 635,000 tonnes, over one fifth of the total.

In 2019, of all the domestic full-process TiO_2 manufacturers that maintained normal production, 11 manufacturers had their output exceeding 100,000 tonnes. The output of these 11 enterprises altogether was some 2.15 million tonnes, about 68% of the total output. In particular, the output of LB Group was 629,900 tonnes, slightly below 20% of the total, and still came as the largest TiO_2 manufacturer in China.

In 2020, all the production activities worldwide were somehow affected by COVID-19. However, with China outperforming other countries in response to this public health incident, Chinese TiO_2 manufacturers were able to maintain normal production throughout the year in general, and managed to fulfill more orders from home and abroad. In 2020, of all the domestic TiO_2 manufacturers, 12 manufacturers had their output exceeding 100,000 tonnes, of which Panzhihua Taihai Technology Co., Ltd. entered this group for the first time. Output of these 12 enterprises totalled about 2.54 million tonnes, over 70% of the national total. LB Group alone achieved 817,200 tonnes, over 23% of the total, retaining the No.1 position in China.

Table 1.2-1 Titanium dioxide production of top 40 manufacturers in China, 2018–2020

No.	Producer	Location	Status, as of 2020	2020		2019		2018	
				Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne
1	LB Group Co., Ltd.	Henan	Active	1,010,000	817,200	630,000	629,900	630,000	635,000
2	CNNC Hua Yuan Titanium Dioxide Co., Ltd.	Gansu	Active	300,000	317,600	200,000	255,600	300,000	196,684
3	Pangang Group Vanadium & Titanium Resources Co., Ltd.	Sichuan	Active	235,000	235,500	235,000	233,900	235,000	228,400
4	GPRO Investment Holding Group Co., Ltd.	Jiangsu	Active	260,000	187,600	180,000	145,200	180,000	131,900
5	Shandong Doguide Group Co., Ltd.	Shandong	Active	220,000	170,000	220,000	168,000	220,000	165,000
6	China National Chemical Co., Ltd.	Beijing	Active	170,000	135,400	170,000	169,800	170,000	178,600
7	Shandong Jinhai Titanium Resources Technology Co., Ltd.	Shandong	Active	100,000	133,500	100,000	107,500	150,000	120,000
8	Shandong Dawn Titanium Industry Co., Ltd.	Shandong	Active	100,000	113,500	100,000	123,500	100,000	107,513
9	Guangxi Jinmao Titanium Co., Ltd.	Guangxi	Active	100,000	113,100	100,000	104,600	100,000	104,068
10	Yunnan Dahutong Industrial & Trade Co., Ltd.	Sichuan	Active	120,000	110,500	120,000	106,800	120,000	101,200
11	Ningbo Xinfu Titanium Dioxide Co., Ltd.	Zhejiang	Active	120,000	100,000	120,000	110,000	120,000	111,000
12	Panzhihua Taihai Technology Co., Ltd.	Sichuan	Active	80,000	108,200	80,000	87,700	80,000	79,508
13	Anhui Annada Titanium Industry Co., Ltd.	Anhui	Active	80,000	85,300	80,000	77,300	80,000	69,608
14	Guangdong Huiyun Titanium Industry Co., Ltd.	Guangdong	Active	65,000	69,200	65,000	64,300	65,000	64,000
15	CITIC Titanium Industry Co., Ltd.	Liaoning	Active	60,000	68,700	60,000	60,000	60,000	58,000

No.	Producer	Location	Status, as of 2020	2020		2019		2018	
				Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne
16	Panzhihua Haifengxin Chemical Co., Ltd.	Sichuan	Active	60,000	64,200	60,000	56,700	60,000	43,326
17	Guangxi Shunfeng Titanium Industry Co., Ltd.	Guangxi	Active	60,000	52,700	60,000	53,700	60,000	53,800
18	Panzhihua Xingzhong Titanium Industry Co., Ltd.	Sichuan	Active	50,000	52,000	50,000	45,500	50,000	33,000
19	Jiangxi Tikon Titanium Co., Ltd.	Jiangxi	Active	50,000	46,700	50,000	47,700	50,000	46,200
20	Kunming Donghao Titanium Co., Ltd.	Yunnan	Active	45,000	41,500	45,000	45,000	45,000	24,900
21	Panzhihua Hengtong Titanium Co., Ltd.	Sichuan	Active	30,000	30,500	30,000	30,000	30,000	20,000
22	Guizhou Sunward Fuquan Chemical Co., Ltd.	Guizhou	Active	50,000	30,000	50,000	5,000	0	/
23	Suzhou Hongfeng Titanium Industry Co., Ltd.	Jiangsu	Active	30,000	28,700	30,000	30,000	30,000	21,000
24	Fumin Longteng Titanium Industry Co., Ltd.	Yunnan	Active	30,000	25,800	30,000	30,000	30,000	45,000
25	Wuhan Fangyuan Titanium Dioxide Co., Ltd.	Hubei	Active	60,000	27,600	60,000	26,100	60,000	27,053
26	Alfa Full (Guangxi) Titanium Dioxide Co., Ltd.	Guangxi	Active	25,000	20,000	25,000	25,800	25,000	25,000
27	Panzhihua Tianlun Chemical Co., Ltd.	Sichuan	Active	40,000	25,000	40,000	24,000	40,000	25,000
28	Yibin Tianyuan Haifeng Hetai Co., Ltd.	Sichuan	Active	50,000	24,400	50,000	13,000	0	/
29	Panzhihua Taidu Chemical Industry Co., Ltd.	Sichuan	Active	30,000	24,000	30,000	24,300	30,000	24,000
30	Nexttech Materials Co., Ltd.	Anhui	Active	30,000	22,600	30,000	23,200	30,000	22,000
31	CNMC (Guangxi) Pgma Co., Ltd.	Guangxi	Active	25,000	21,800	25,000	21,000	25,000	22,000
32	Denox Advanced Materials Co., Ltd.	Anhui	Active	30,000	20,000	30,000	10,500	30,000	6,000
33	Shanghai Pengbo Titanium Dioxide Co., Ltd.	Shanghai	Active	50,000	19,300	50,000	19,000	50,000	19,000
34	Guangxi Detian Chemical Cycle Co., Ltd.	Guangxi	Active	20,000	18,200	20,000	18,800	20,000	18,000
35	Huai'an Feiyang Titanium Dioxide Manufacturing Co., Ltd.	Jiangsu	Active	36,000	15,800	36,000	18,000	36,000	17,161

No.	Producer	Location	Status, as of 2020	2020		2019		2018	
				Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne
36	Guangxi Xilong Chemical Co., Ltd.	Guangxi	Active	30,000	15,800	30,000	8,000	0	/
37	Hunan Chuangda Yutu Chemcial Co., Ltd.	Hunan	Active	15,000	14,500	15,000	13,600	15000	14100
38	Guangxi Baihe Chemical Co., Ltd.	Guangxi	Active	20,000	14,100	20,000	23,000	20,000	14,950
39	Panzhihua Zhengyuan Technology Co., Ltd.	Sichuan	Active	30,000	13,000	30,000	7,000	30,000	5,000
40	Yumen Jingyang Titanium Pigment Manufacturing Co., Ltd.	Gansu	Active	20,000	6,300	20,000	6,000	20,000	6,000
Others				167,000	82,800	337,000	106,500	370,000	125,320
Total				**4,103,000**	**3,522,600**	**3,713,000**	**3,175,500**	**3,766,000**	**3,008,291**

Note: Jiangsu Taibai Group Co., Ltd. was listed separately in last report, but it was acquired by GPRO Titanium Industry Co., Ltd.'s holding company GPRO Investment Holding Group Co., Ltd. by 2020. Thus the figures of Jiangsu Taibai Group Co., Ltd. in 2020 were consolidated into GPRO Investment Holding Group Co., Ltd.
Source: CCM

During 2018–2020, sulfate process TiO_2 still dominated the domestic market; at the same time, chloride process TiO_2, the future of the industry, developed steadily. Generally, current domestic chloride process technique is far from mature yet, and stable mass production waits for improvement. The next five years may see a fast growth of chloride process as it is encouraged in the course of the 14th Five-Year Period. There will be a shift to chloride process in years to come, but sulfate process would still remain the mainstream, though seeing shrinking share in the industry.

Table 1.2-2 Production information of the top 40 titanium dioxide manufacturers in China, 2020

No.	Manufacturer	Location	2020			Note
			Status	Capacity, t/a	Output, tonne	
1	LB Group Co., Ltd.	Henan	Active	1,010,000	817,200	Chloride process TiO_2 capacity: 360,000 t/a
2	CNNC Hua Yuan Titanium Dioxide Co., Ltd.	Gansu	Active	300,000	317,600	/
3	Pangang Group Vanadium & Titanium Resources Co., Ltd.	Sichuan	Active	235,000	235,500	Chloride process TiO_2 capacity: 15,000 t/a
4	GPRO Investment Holding Group Co., Ltd.	Jiangsu	Active	260,000	187,600	/
5	Shandong Doguide Group Co., Ltd.	Shandong	Active	220,000	170,000	/
6	China National Chemical Co., Ltd.	Beijing	Active	170,000	135,400	/
7	Shandong Jinhai Titanium Resources Technology Co., Ltd.	Shandong	Active	100,000	133,500	/

No.	Manufacturer	Location	2020			Note
			Status	Capacity, t/a	Output, tonne	
8	Shandong Dawn Titanium Industry Co., Ltd.	Shandong	Active	100,000	113,500	/
9	Guangxi Jinmao Titanium Co., Ltd.	Guangxi	Active	100,000	113,100	/
10	Yunnan Dahutong Industrial & Trade Co., Ltd.	Sichuan	Active	120,000	110,500	/
11	Ningbo Xinfu Titanium Dioxide Co., Ltd.	Zhejiang	Active	120,000	100,000	/
12	Panzhihua Taihai Technology Co., Ltd.	Sichuan	Active	80,000	108,200	/
13	Anhui Annada Titanium Industry Co., Ltd.	Anhui	Active	80,000	85,300	/
14	Guangdong Huiyun Titanium Industry Co., Ltd.	Guangdong	Active	65,000	69,200	/
15	CITIC Titanium Industry Co., Ltd.	Liaoning	Active	60,000	68,700	Chloride process TiO_2 capacity: 60,000 t/a
16	Panzhihua Haifengxin Chemical Co., Ltd.	Sichuan	Active	60,000	64,200	/
17	Guangxi Shunfeng Titanium Industry Co., Ltd.	Guangxi	Active	60,000	52,700	/
18	Panzhihua Xingzhong Titanium Industry Co., Ltd.	Sichuan	Active	50,000	52,000	/
19	Jiangxi Tikon Titanium Co., Ltd.	Jiangxi	Active	50,000	46,700	/
20	Kunming Donghao Titanium Co., Ltd.	Yunnan	Active	45,000	41,500	/
21	Panzhihua Hengtong Titanium Co., Ltd.	Sichuan	Active	30,000	30,500	/
22	Guizhou Sunward Fuquan Chemical Co., Ltd.	Guizhou	Active	50,000	30,000	/
23	Suzhou Hongfeng Titanium Industry Co., Ltd.	Jiangsu	Active	30,000	28,700	/
24	Fumin Longteng Titanium Industry Co., Ltd.	Yunnan	Active	30,000	25,800	/
25	Wuhan Fangyuan Titanium Dioxide Co., Ltd.	Hubei	Active	60,000	27,600	/
26	Alfa Full (Guangxi) Titanium Dioxide Co., Ltd.	Guangxi	Active	25,000	20,000	/
27	Panzhihua Tianlun Chemical Co., Ltd.	Sichuan	Active	40,000	25,000	/
28	Yibin Tianyuan Haifeng Hetai Co., Ltd.	Sichuan	Active	50,000	24,400	Chloride process TiO_2 capacity: 50,000 t/a
29	Panzhihua Taidu Chemical Industry Co., Ltd.	Sichuan	Active	30,000	24,000	/
30	Nexttech Materials Co., Ltd.	Anhui	Active	30,000	22,600	/

No.	Manufacturer	Location	2020			Note
			Status	Capacity, t/a	Output, tonne	
31	CNMC (Guangxi) Pgma Co., Ltd.	Guangxi	Active	25,000	21,800	/
32	Denox Advanced Materials Co., Ltd.	Anhui	Active	30,000	20,000	/
33	Shanghai Pengbo Titanium Dioxide Co., Ltd.	Shanghai	Active	50,000	19,300	/
34	Guangxi Detian Chemical Cycle Co., Ltd.	Guangxi	Active	20,000	18,200	/
35	Huai'an Feiyang Titanium Dioxide Manufacturing Co., Ltd.	Jiangsu	Active	36,000	15,800	/
36	GuangXi Xilong Chemical Co., Ltd.	Guangxi	Active	30,000	15,800	/
37	Hunan Chuangda Yutu Chemcial Co., Ltd.	Hunan	Active	15,000	14,500	/
38	Guangxi Baihe Chemical Co., Ltd.	Guangxi	Active	20,000	14,100	/
39	Panzhihua Zhengyuan Technology Co., Ltd.	Sichuan	Active	30,000	13,000	/
40	Yumen Jingyang Titanium Pigment Manufacturing Co., Ltd.	Gansu	Active	20,000	6,300	/
Others				167,000	82,800	/
Total				**4,103,000**	**3,522,600**	/

Source: CCM

1.3 Titanium dioxide production distribution, 2020

Domestic TiO_2 manufacturers are mainly distributed in 17 provinces, municipalities and autonomous regions. In particular, many TiO_2 manufacturers congregated in Sichuan, Guangxi, Shandong, Jiangsu and Anhui. The largest TiO_2 producer in China is headquartered in Henan Province, having production bases in both Sichuan and Hubei.

Table 1.3-1 Distribution of top 40 titanium dioxide manufacturers by province/municipality/ autonomous region in China, 2020

Province/Municipality/Autonomous Region	Capacity, t/a	Company Number
Henan	1,010,000	1
Sichuan	725,000	10
Shandong	420,000	3
Jiangsu	326,000	3
Gansu	320,000	2
Guangxi	280,000	7
Beijing	170,000	1
Anhui	140,000	3
Zhejiang	120,000	1
Yunnan	75,000	2
Guangdong	65,000	1
Liaoning	60,000	1
Hubei	60,000	1
Shanghai	50,000	1
Jiangxi	50,000	1
Guizhou	50,000	1
Hunan	15,000	1

Source: CCM

Sichuan Province is a famous TiO_2 production base in China, with 10 manufacturers concentrated there in 2020. Particularly, Panzhihua City boasts abundant titanium ore resources and the local government aims to turn the city into a renowned TiO_2 production base by granting many preferential policies regarding water and electricity, which stimulates the development of local TiO_2 industry.

The manufacturers in Guangxi Zhuang Autonomous Region are mainly located in Wuzhou City (including Tengxian County) and Liuzhou City where titanium ore resources are rich. With less strict local regulations on environmental protection there, many manufacturers adopt sulfate process to produce TiO_2. Moreover, Guangxi can easily make full use of overseas resources because it borders Vietnam, an important titanium ore import origin for China. Most manufacturers in Guangxi only produce anatase TiO_2 or non-pigment TiO_2 for ceramics, enamel and welding rod.

TiO_2 production in Shandong Province is controlled by Shandong Doguide Group Co., Ltd., Shandong Jinhai Titanium Resources Technology Co., Ltd. and Shandong Dawn Titanium Industry Co., Ltd.

In Jiangsu Province, GPRO Investment Holding Group Co., Ltd. now controls nearly 80% of the total TiO_2 production capacity there, being the controlling shareholder of both GPRO Titanium Industry Co., Ltd. and Jiangsu Taibai Group Co., Ltd.

LB Group Co., Ltd. (with 1,010,000 t/a in 2020 in total) has TiO_2 capacities in Henan Province, Yunnan Province, Sichuan Province Hubei Province, of which the latter two, with abundant ilmenite resources, provide the company with easy access to raw materials. Therefore, real capacity in Henan Province is much lower.

CNNC Hua Yuan Titanium Dioxide Co., Ltd. takes the lion's share of TiO_2 production in Gansu Province. It also has production bases in Anhui and Jiangsu provinces. It is notable that its Jiangsu base, Wuxi Haopu Titanium Dioxide Co., Ltd., was shut down in 2018 due to the local government's industrial planning adjustment and the production facilities were taken over by another subsidiary Anhui Goldstar Titanium Dioxide (Group) Co., Ltd.

1.4 Domestic titanium dioxide expansion projects

Since 2010, domestic TiO_2 capacity has been increasing at a much slower pace, which is mainly attributed to the government limitation of the production with sulfate process for the process is less clean. While restricting expansion of sulfate process, the government also encourages the advancement and application of chloride process to produce TiO_2. However, due to technical barriers and blockade of the core technology imposed by the overseas TiO_2 giants, enterprises that intend to apply chloride process can only explore by themselves and accumulate experience little by little. Only a few well-capitalised chemical enterprises with enough technology accumulation have carried out chloride process projects. Nevertheless, with all things improved in the past few years, China's TiO_2 industry is likely to see accelerating capacity expansion in both processes in the near future.

Table 1.4-1 List of projects expected to be built up and operate in the near future

No.	Company	Capacity in 2020, t/a	Expansion, t/a	Expected finish time	Technology	Note
1	Fujian Kuncai Material Technology Co., Ltd.	0	100,000	2020	Hydrochloric acid extraction process	Fujian Kuncai Material Technology Co., Ltd.'s 100,000 t/a hydrochloric acid extraction process TiO_2 production line was put into trial production in Dec. 2020. Its capacity is not included in 2020.
2	Yibin Tianyuan Haifeng Hetai Co., Ltd.	50,000	50,000	2021	Chloride	/
3	Shandong Xianghai Titanium Resources Technology Co., Ltd.	0	60,000	2021	Chloride	The company is a wholly owned subsidiary of Shandong Lubei Chemical Co., Ltd.
4	Shandong Jinhai Titanium Resources Technology Co., Ltd.	100,000	100,000	2021	Sulfate	The company is a wholly owned subsidiary of Shandong Lubei Chemical Co., Ltd.
5	Hebei Jicheng New Material Co., Ltd.	0	160,000	2021	Chloride	/

No.	Company	Capacity in 2020, t/a	Expansion, t/a	Expected finish time	Technology	Note
6	CITIC Titanium Industry Co., Ltd.	60,000	60,000	2021	Chloride	/
7	Anhui Annada Titanium Industry Co., Ltd.	80,000	50,000	2022	Sulfate	Anhui Annada Titanium Industry Co., Ltd. is building a 50,000 t/a post-processing project expected to be completed by 2022.
8	Guangdong Huiyun Titanium Industry Co., Ltd.	65,000	80,000	2022	Sulfate	Guangdong Huiyun Titanium Dioxide Co., Ltd. is building a 80,000 t/a post-processing project expected to be completed by 2022, of which the phase one (30,000 t/a) finished in early 2021 and phase two (50,000 t/a) by 2022. Meanwhile, it is planning to add 30,000 t/a crude rutile titanium capacity.
9	LB Group Co., Ltd.	1,010,000	700,000	2023 & 2024	Chloride & sulfate	1. Subsidiary Yunnan Metallurgical Xinli Titanium Industry Co., Ltd. is building a 200,000 t/a chloride process project expected to be completed by 2023. 2. Subsidiary Henan Billions New Materials Co., Ltd. is expanding a 100,000 t/a chloride process project expected to be completed by the end of 2022 and it is going to transform the original 60,000 t/a chloride process device into 30,000 t/a titanium sponge device by 2024. 3. Subsidiary Gansu Xingbai Titanium Co., Ltd. is building a 400,000 t/a sulfate process project expected to be completed by 2023.
10	CNNC Hua Yuan Titanium Dioxide Co., Ltd.	300,000	400,000	2021 & 2023	Sulfate	1. Subsidiary Anhui Goldstar Titanium Dioxide (Group) Co., Ltd. is building a 100,000 t/a post-processing project expected to be completed by the end of 2021. 2. Subsidiary Gansu Dongfang Titanium Dioxide Co., Ltd. is building a 300,000t/a sulfate process project expected to be completed by 2023.
11	Pangang Group Vanadium & Titanium Resources Co., Ltd.	235,000	60,000	2023	Chloride	Subsidiary Pangang Group Titanium Industry Co., Ltd. is going to build a 60,000 t/a chloride process project expected to be completed by 2023.
12	Panzhihua Haifengxin Chemical Co., Ltd.	60,000	30,000	2024	Sulfate	The company is going to build a 30,000 t/a post-processing project by 2024.
13	Panzhihua Taihai Technology Co., Ltd.	80,000	50,000	2024	Sulfate	The company is going to build a 50,000 t/a post-processing project by 2024.
14	Guangxi Shunfeng Titanium Industry Co., Ltd.	60,000	60,000	2025	Sulfate	The company is going to relocate its old 60,000 t/a sulfate process project and expand it to 120,000 t/a.
15	Hunan Chuangda Yutu Chemcial Co., Ltd.	15,000	100,000	2025	Sulfate	Subsidiary Hunan Yutu Titanium New Material Co., Ltd. is building a 100,000 t/a sulfate process project expected to be completed by 2025, of which the phase one (50,000 t/a) is expected by 2022.

No.	Company	Capacity in 2020, t/a	Expansion, t/a	Expected finish time	Technology	Note
16	Guangxi Xilong Chemical Co., Ltd.	30,000	30,000	/	Sulfate	In preparation

Source: CCM

Of all the projects above, it is eye-catching that Fujian Kuncai Material Technology Co., Ltd. developed a set of hydrochloric acid extraction process TiO_2 with independent intellectual property rights.

According to relevant literature, main procedures for the hydrochloric acid extraction process TiO_2 are as follows:

- Acidolysis: hydrochloric acid is added to dissolve ilmenite, and then the solid is separated to obtain the titanium oxychloride solution.
- Reduction: the titanium oxychloride solution is reduced by iron powder to remove ferric ion.
- Crystallisation: after cooling, ferrous chloride in the solution crystallises, and titanium oxychloride solution without iron is obtained.
- Extraction: add organic extractant to the iron-free solution to remove impurities.
- Hydrolysis: the titanium oxychloride solution is then sprayed and hydrolysed to obtain amorphous TiO_2.
- Salt treatment: add salt treatment agent to increase the colour and lustre and porosity of TiO_2.
- Calcining: after high-temperature dehydration and calcination, the primary product of granular TiO_2 is obtained.
- Crushing: the granular TiO_2 is rolled and milled to obtain TiO_2 powder.

The process has both advantages and disadvantages, specifically:

- Advantages: hydrochloric acid and extractant can be recycled and reused, and the by-products ferrous chloride and ferric chloride can be converted into iron oxide for reuse after hot water hydrolysis. In addition, the hydrochloric acid extraction method has not high requirements for raw materials, generates less industrial wastewater and residues, and consumes less energy.
- Disadvantages: Expensive extractant, high requirements on equipment, high conditions for hydrochloric acid dissolving ilmenite all pose some threats to the promotion of this process. Also, concentration of titanium oxychloride is difficult to guarantee.

Domestic titanium dioxide capacity expansion is mainly based on the following favourable factors:

- Firstly, demand from downstream industries is increasing, especially from the coating and plastics industries.
- Secondly, demand from overseas markets gives domestic manufacturers room to expand further.
- Thirdly, policies and regulations are helpful to the capacity expansion in regard to production through chloride process, so such projects are progressing faster than before.
- Fourthly, sulfate process has also improved in terms of pollutant disposal, so there are ongoing such projects too.

1.5 Development of chloride process

Chloride process used to develop slowly in China, with projects promoted in a steady way only by experienced big players in TiO_2 industry.

Since 2019, however, more influential companies, some even from other chemical sectors, joined in the development of chloride process. For instance, Yibin Tianyuan Haifeng Hetai Co., Ltd., a wholly-owned subsidiary of Yibin Tianyuan Group Co., Ltd., built up a 50,000 t/a chloride process

TiO_2 project and ran on trial in 2019. The company's another 50,000 t/a expansion project is scheduled to be finished by the end of 2021. Similarly, Hebei Jicheng New Material Co., Ltd., a subsidiary of Tangshan Yanshan Iron & Steel Co., Ltd., entered into this industry in 2020 by announcing that it is to build up a 500,000 t/a chloride-process project during 2021–2025, of which the first phase will deliver 160,000 t/a production capacity.

Guidance Catalogue for Industrial Structure Adjustment (2019 version) by National Development and Reform Commission (NDRC) stipulates that addition of sulfate-process TiO_2 capacity is restricted, while building chloride-process projects with capacity of 30,000 t/a per production line or above is encouraged. And this development direction of TiO_2 industry shall not change in many years to come.

Therefore, during the 14th Five-Year Plan period (2021–2025), China's TiO_2 industry is to witness fast growth in chloride-process TiO_2 capacity and welcome many new players. Often these new producers come with ambitious chloride-process projects, yet it remains unknown that how many proposed capacity can be built up and put into operation in the next few years. Generally, China's TiO_2 industry is not to expect a chloride process-dominant future in the short term.

It is also noteworthy that the faster development of chloride process in China does not mean it serves as a substitute for sulfate process as reported by the media. In fact, as long as enterprises bear in mind environmental protection and comprehensive utilisation of wastes and by-products, sulfate process would still be the mainstream for quite a long time.

1.6 Titanium dioxide feedstock situation, 2018–2020

According to the *Mineral Commodity Summaries 2021* offered by the United States Geological Survey (USGS), ilmenite consumption takes up 90% of titanium ore consumption around the world. As of the end of 2020, global titanium ore resources exceeded 2 billion tonnes (calculated by TiO_2 equivalent) and reserves were about 742 million tonnes, nearly 94% of which were ilmenite reserves (696 million tonnes). Except in Antarctica, titanium ore resources are found abundant in the other six continents, more specifically, scattering in 29 countries. Among them, Australia holds the most titanium ore resources. Reserves in the top 15 countries account for about 96% of the global total.

Table 1.6-1 Ilmenite & rutile reserves of major titanium resources suppliers

No.	Country	2020 output, '000 tonnes			Reserve, '000			Share to global total
		Ilmenite	Rutile	Total	Ilmenite	Rutile	Total	
1	Australia	800	200	1,000	150,000	27,000	177,000	23.87%
2	China	2,300	N/A	2,300	230,000	N/A	230,000	31.01%
3	India	160	11	171	85,000	7,400	92,400	12.46%
4	Brazil	25	N/A	25	43,000	N/A	43,000	5.80%
5	Norway	400	N/A	400	37,000	N/A	37,000	4.99%
6	South Africa	1,000	100	1,100	35,000	6,800	41,800	5.64%
7	Canada	680	N/A	680	31,000	N/A	31,000	4.18%

No.	Country	2020 output, '000 tonnes			Reserve, '000			Share to global total
		Ilmenite	Rutile	Total	Ilmenite	Rutile	Total	
8	Mozambique	600	6	606	26,000	890	26,890	3.63%
9	Madagascar	300	N/A	300	23,000	N/A	23,000	3.10%
10	Ukraine	470	94	564	5,900	2,500	8,400	1.13%
11	The US	100	N/A	100	2,000	N/A	2,000	0.27%
12	Vietnam	160	N/A	160	1,600	N/A	1,600	0.22%
13	Kenya	190	74	264	440	170	610	0.08%
14	Senegal	310	9	319	N/A	N/A	N/A	N/A
15	Sierra Leone	N/A	120	120	N/A	490	490	0.07%
Others		70	20	90	26,000	400	26,400	3.56%
World total		**7,565**	**634**	**8,199**	**695,940**	**45,650**	**741,590**	**100.00%**

Note: 1. Ilmenite & rutile output and reserves are calculated based on equivalence to TiO_2 content.
2. The rutile output and reserves data of the United States are included with in ilmenite data.
Source: Mineral Commodity Summaries 2021 by the USGS

According to the China Mineral Resources Report 2019 issued by the former Ministry of Land and Resources in Oct. 2019, 826 million tonnes of titanium ores (calculated by TiO_2 equivalent) had been recorded as of 2018, up by 0.9% over 2017. But high-quality ores only account for a very small proportion, about 2% of the total. Primary rutile ores of lower grade account for 86% of the domestic rutile ores, and the rest 14% is placers. The other 98% titanium reserves are ilmenites, of which primary ilmenite (magnetite) ores and ilmenite placers take up 92% and 8% respectively.

By 2020, this basic situation has rarely changed. An aggregate of 142 titanium deposits had been found in 20 provinces (regions) in China, mainly in Sichuan, Hebei, Hainan, Hubei, Guangdong, Guangxi, Shanxi, Shandong, Shaanxi and Henan provinces. Specifically, 92% of domestic titanium ores (655.21 million tonnes calculated by TiO_2 equivalent) were found in Sichuan and Hebei provinces.

Though China is rich in titanium resources, its ore grade is relatively lower than that of many other titanium-rich countries. Primary ilmenite rock ores, with average content of only 5%, are concentrated in Sichuan Province and Hebei Province; ilmenite placers are found in Guangdong Province, Guangxi Zhuang Autonomous Region, Hainan Province and Yunnan Province. Besides ilmenite, there are some other titanium resources in Henan Province, Hubei Province, and Shanxi Province, but the content of their rutile resources is even lower than 5%.

Absolute majority of associated primary rock-type ilmenite ores with low titanium content and only a tiny bit of easy-to-exploit-and-utilise rutile ores make China depend on import, at least in terms of high-quality titanium ores. At present, domestic ilmenite enterprises mostly produce low-grade products with underdeveloped purification technology and limited equipment scale.

The content of the domestic titanium concentrate ore is generally lower than 45%, while that of

the imported one is above 50% in the majority. So a number of the domestic titanium dioxide manufacturers prefer to use imported titanium concentrate ore in their production.

In 2020, the import of titanium ores experienced a significant year-on-year rise, mainly because of an increased demand for China's TiO_2 and other titanium products from home and abroad. In 2020, Mozambique, Vietnam and Australia were the major providers of titanium ores to China.

Table 1.6-2 China's import volume of ilmenite by month, 2018–2020

Month	Volume, tonne		
	2018	2019	2020
Jan.	267,879	230,248	300,342
Feb.	180,851	165,309	249,244
March	243,975	260,524	233,388
April	339,529	122,310	231,508
May	278,799	171,774	320,038
June	322,506	162,266	198,631
July	273,564	362,664	216,261
Aug.	288,121	185,255	222,934
Sept.	225,303	124,799	202,740
Oct.	313,141	270,414	285,911
Nov.	188,509	245,423	252,854
Dec.	276,791	297,619	300,547
Total	**3,198,968**	**2,598,605**	**3,014,397**

Source: China Customs

Table 1.6-3 Top 10 import origins of ilmenite to China, 2020

No.	Origin	Volume, tonne
1	Mozambique	1,069,844
2	Vietnam	420,705
3	Australia	400,060
4	Kenya	270,271
5	Norway	207,085
6	South Korea	155,224
7	India	95,000
8	South Africa	88,080
9	The US	69,157
10	Ukraine	58,033
Others		180,938
Total		**3,014,397**

Source: China Customs

Table 1.6-4 Output of titanium concentrate in China, 2018–2020

Production area(Province/Municipality/Autonomous Region)	Volume, tonne		
	2018	2019	2020
Sichuan	3,652,000	3,998,000	4,340,000
Yunnan	131,200	190,000	323,000
Hebei	83,000	166,000	320,000
Shandong	103,500	120,000	271,000
Others	575,000	541,000	493,000
Total	**4,544,700**	**5,015,000**	**5,747,000**

Source: CCM

Both the capacity and output of titanium slag in China have been increasing in recent years. In TiO_2 production, titanium slag approach has lesser pollutants emitted compared with titanium concentrate ore approach.

Table 1.6-5 Output of titanium slag (74%–76%) in China by month, 2018–2020

Month	Volume, tonne		
	2018	2019	2020
Jan.	29,100	32,860	33,800
Feb.	22,300	29,600	29,600
March	30,100	37,100	36,000
April	37,750	37,800	27,100
May	41,700	34,400	31,400
June	34,100	31,900	37,500
July	34,650	33,100	35,000
Aug.	40,180	34,050	34,960
Sept.	40,500	38,750	36,400
Oct.	38,810	33,800	44,700
Nov.	38,400	34,000	42,800
Dec.	40,100	35,500	41,400
Total	**427,690**	**412,860**	**430,660**

Source: CCM

Table 1.6-6 Output of titanium slag (90%–92%) in China by month, 2018–2020

Month	Volume, tonne		
	2018	2019	2020
Jan.	16,300	14,600	23,000
Feb.	15,900	10,900	17,950
March	15,200	15,300	24,350
April	16,300	18,050	24,700
May	15,850	18,460	20,150
June	15,300	18,960	17,550
July	13,800	21,200	22,250
Aug.	15,400	24,700	22,060
Sept.	15,600	26,300	20,840
Oct.	16,400	25,100	22,100
Nov.	16,300	26,650	19,500
Dec.	15,800	26,200	20,500
Total	**188,150**	**246,420**	**254,950**

Source: CCM

Under mounting pressure of environmental protection from the government, basically more and more enterprises chose to use acid-soluble titanium slag or mixture of acid-soluble titanium slag and titanium concentrate ore to produce TiO_2. At the same time, the growing demand for high quality TiO_2 is forcing manufacturers to use more acid-soluble titanium slag for better product quality.

Thus, the scale of titanium slag production in China has grown larger driven by the huge demand from downstream product sectors (also including $TiCl_4$, titanium sponge). However, titanium slag still does not have cost advantage compared with titanium concentrate ore in TiO_2 production, which impedes a fast growth of titanium slag consumption.

2 TiO_2 and raw material prices

2.1 Raw material price, 2018–H1 2021

- Ilmenite

In 2018–2019, the ex-works price of ilmenite was relatively stable in China, with little fluctuation, but big jumps in the price were witnessed in 2020–H1 2021.

- 2018: The price generally showed a downward trend with some fluctuations. The average price peaked at USD232.47/t in March, while in Aug., the price dipped to USD194.95/t, the lowest point.
- 2019: Ex-works price was relatively flat overall with some more obvious ups in Q4. The highest point occurred in Nov., with an average price of USD208.87/t; the lowest point came in Jan., with the average price being USD193.95/t.
- 2020: The price went dived in Q2 but then rebounded and reached for new high since June.
- H1 2021: The price stayed a bit above USD300/t in Jan. and Feb., and then quickly crossed USD350/t; the average price reached USD399.26/t in June.

Jan. 2018–April 2018

The price increased slightly, primary reasons are:

- Rising cost: the costs of logistics and packaging rose since 1 Jan., 2018.
- Small inventories in downstream producers: the ilmenite stocks in downstream enterprises decreased due to obstructed transportation over a month induced by the overhaul of the Three Gorges Dam over Yangtze River and the Spring Festival.

May 2018–Dec. 2018

The price witnessed a slightly downward trend in Q2–Q3 2018 and kept stable in Q4 2018. In Q2–Q3 2018, demand for ilmenite from TiO_2 producers was weak due to environmental protection inspections which led to limited production. In Q4 2018, domestic ilmenite transaction was extremely low though price maintained stable. Specifically, influenced by strict environmental inspections, a large number of ilmenite producers in the Panzhihua-Xichang Area suspended production; some even could not finish previous orders and had to delay delivery. Yet the downstream market was also sluggish, since the majority of downstream enterprises still had stocks, which counteracted the price hike pressure brought by tight supply. In addition, some small ilmenite producers lowered their prices based on a negative expectation towards the future market.

Jan. 2019–Aug. 2019

In Q1–Q3 2019, the market did not change significantly, despite minor ups and downs in prices. Downstream demand grew around the Spring Festival and prices rose slightly in Q1. In March, as the operating rates of ilmenite producers in Panzhihua-Xichang Area increased, the market supply of ilmenite was sufficient with slight prices increase. Starting from May, the overall market fell again, but the price only dropped a bit due to the support of its cost.

Sept. 2019–March 2020

Price went up, main reasons are:

- The supply of raw materials reduced due to transportation disruption caused by COVID-19. Starting from Oct. 2019, some ilmenite manufacturers were in routine maintenance, which caused the output reduction of ilmenite. Around the Spring Festival, downstream manufacturers increased inventories, stimulating certain price increase.
- The decline in foreign ilmenite output led to tight supply of ilmenite import, high import price, and restricted export of ilmenite in India and Vietnam.

April 2020–May 2020

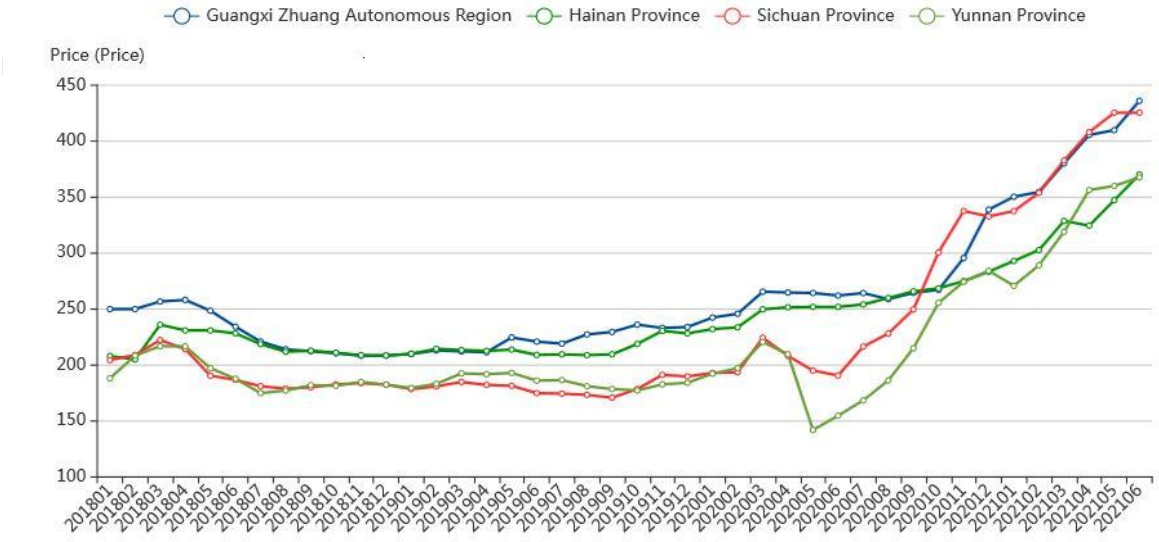
In late March, the supply of ilmenite in Panzhihua-Xichang Area returned to normal, and the

inventory in manufacturers increased. However, the operating rate of downstream manufacturers failed to come normal because of the aftermath of COVID-19, thus the downstream demand was weak, which drove the price of ilmenite down.

June 2020–June 2021
The price showed an upward trend in this period owing to shrinking supply of ilmenite.

Besides, in H2 2020, due to sharp increases in the price of domestic ilmenite, demand for imported ilmenite has increased. However, as the exchange rate of USD to RMB declined, overseas manufacturers raised their prices continuously.

Figure 2.1-1 Ex-works prices of ilmenite in China by region, Jan. 2018–June 2021



Note: Ilmenite grading: 45%–47% in Yunnan Province, 40%–46% in Sichuan Province, 45%–54% in Hainan Province and 50%–52% in Guangxi Zhuang Autonomous Region
Source: CCM

- Titanium slag

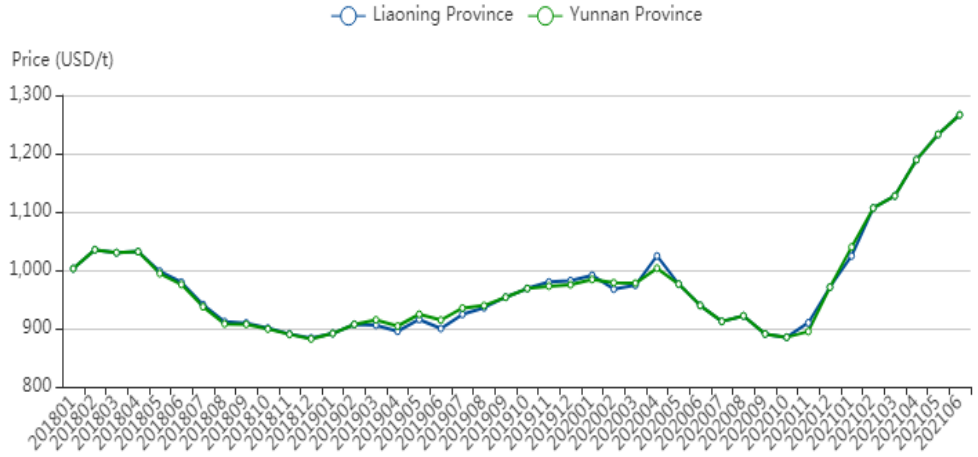
Jan. 2018–Dec. 2018
From Jan. to April 2018, titanium slag kept its trends in 2017, with prices rising continually. In May–Dec. 2018, titanium slag prices showed an overall downward trend, the reasons of which can be divided into two parts. First and foremost, the declining price of titanium ore reduced production cost, thus driving the prices of titanium slag down. Second, demand from downstream manufacturers was a little bit sluggish.

Jan. 2019–Dec. 2019
In 2019, the supply of titanium slag was relatively stable, the overall market price increased, except tax reduction in April and weak downstream demand in June driving prices down. Rising downstream demand and insufficient supply of raw materials drove the market price of titanium slag up in 2019.

Jan. 2020–Oct. 2020
In general, price of titanium slag witnessed a downward trend. Due to the aftermaths of COVID-19, the downstream demand became weak, leading the price of titanium slag down. And many titanium slag manufacturers chose to suspend production or cut production because of low profits.

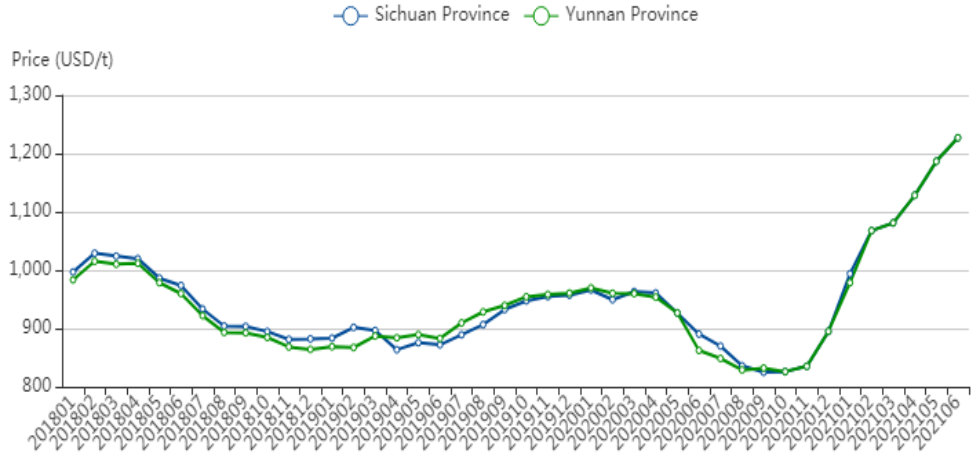
Nov. 2020–June 2021
The price of titanium slag went up significantly driven by tightened titanium slag supply and strong downstream demand.

Figure 2.1-2 Ex-works prices of titanium slag (92%) in China by region, Jan. 2018–June 2021



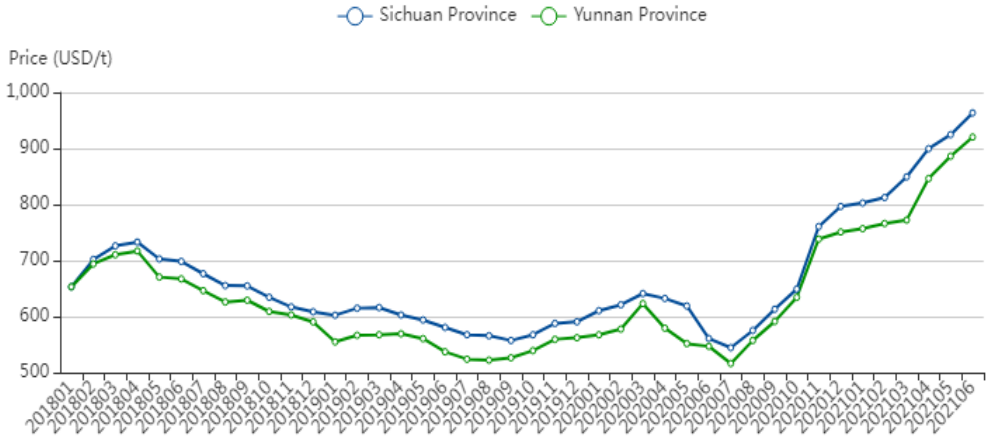
Source: CCM

Figure 2.1-3 Ex-works prices of titanium slag (90%) in China by region, Jan. 2018–June 2021



Source: CCM

Figure 2.1-4 Ex-works prices of titanium slag (74%–76%) in China by region, Jan. 2018–June 2021



Source: CCM

2.2 TiO_2 price, 2018–H1 2021

The domestic price curve of TiO_2 in 2018–H1 2021 showed a "down-up" pattern. The price generally went down from Jan. 2018 to July 2020, and then went all the way up to June 2021.

Jan. 2018–April 2018

In this period, TiO_2 price basically fluctuated at high level. The main reasons for this are:

- Output of ilmenite in Sichuan Province, the major ilmenite production site stayed unstable, largely affected by frequent environmental protection inspections, which increased the production cost of ore mining and dressing, decreased its output and finally influenced the price of TiO_2. Besides, the price of sulfuric acid, another material of TiO_2, fluctuated.
- The demand was basically good enough to maintain the TiO_2 price at high levels when it varied with seasonal factors.
- The operating rate of the whole TiO_2 industry was basically limited in a delicate balance, thus the supply side was fit to the demand side, and the price of TiO_2 could be held relatively high for a long time.

May 2018–Dec. 2019

There was a sign for year-long descent in this period. In Feb. 2018, nearly the end of last high-price period, many TiO_2 manufacturers planned to raise price, but downstream enterprises were uninterested toward buying. Thus, TiO_2 price did not go up dramatically as TiO_2 manufacturers had anticipated. Meanwhile, the hidden accumulative effect of previous stocking came to the surface.

Since May 2018, TiO_2 price fluctuated and slipped lower in China. Average price of rutile TiO_2 went down from USD2,828.67/t in May 2018 to USD2,224.06/t in Dec. 2019, down 21.37%. Average price of anatase TiO_2 went down from USD2,311.50/t to USD1,780.84/t at the same time, decreasing by 22.96%. The price decline is mainly attributed to a sluggish domestic TiO_2 market and an overstock of the whole industry. Specifically:

- On the demand side:

Downstream producers were also affected by environmental inspections. Operating rates of most downstream producers were low in H2 2018. As North China and East China were frequented by hazy days in Q4 2018, operating rates of coating and papermaking industry saw further decline, and this situation was not improved until March 2019 and was repeated in Q4 2019.

● On the supply side:

During last high-price period, an overstock trend became increasingly obvious and finally came into effect in May 2018. For the following period of time, the operating rate of the industry changed as usual without domestic demand being significantly better. Notably, operating rates of TiO_2 manufacturers in Shandong, Anhui, Sichuan, Liaoning, Hubei and Jiangsu provinces were relatively low, affected by strict environmental inspections along the Yangtze River and "Look Back" inspections by central government officials. Since the SCO Qingdao Summit was held in Shandong Province in June 2018, major TiO_2 manufacturers there such as Shandong Dawn Titanium Industry Co., Ltd., Shandong Doguide Group Co., Ltd. had to cut or suspended production. The TiO_2 industry in this period lacked vitality in demand.

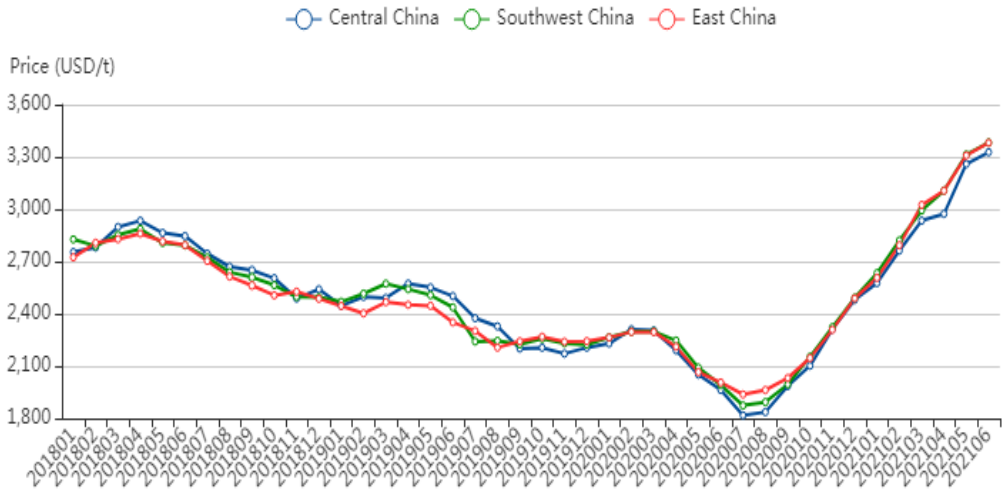
Jan. 2020–July 2020

The price of TiO_2 rose for a short while but then declined in this period. The outbreak of COVID-19 in late Jan. restricted the production of some TiO_2 manufacturers in early stage and the spot supply was tightened, which drove the prices up. In Q2 2020, the price began to drop mainly due to sluggish demand as the downstream manufacturers were affected by COVID-19, especially the foreign ones.

August 2020–June 2021

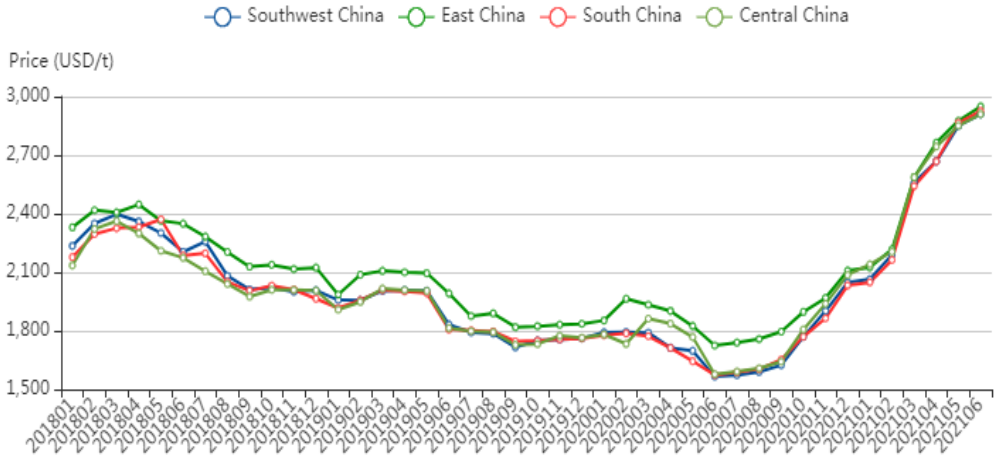
In this period, the world has been coming back on the right track under eased COVID-19 situation with recovering economy. Demand for China's TiO_2 from home and abroad was revitalised, plus rising cost of ilmenite lending support to TiO_2 price for most of the time. This two factors were strong to keep the TiO_2 price soaring.

Figure 2.2-1 Monthly ex-works prices of rutile titanium dioxide in China by region, Jan. 2018–June 2021



Source: CCM

Figure 2.2-2 Monthly ex-works prices of anatase titanium dioxide in China by region, Jan. 2018–June 2021



Source: CCM

3 Mainstream titanium dioxide manufacturer, 2018–2020

3.1 Overview

Traditional first-tier titanium dioxide manufacturers in China are LB Group Co., Ltd. (LB Group), CNNC Hua Yuan Titanium Dioxide Co., Ltd. (CNNC Hua Yuan), Pangang Group Vanadium & Titanium Resources Co., Ltd. (Pangang Group), GPRO Investment Holding Group Co., Ltd. (GPRO Group) and Anhui Annada Titanium Industry Co., Ltd. (Anhui Annada). They not only have large production scale, but also, as listed companies, enjoy more financing channels which makes them backbone forces for future development of chloride-processed TiO_2 in China. With faster development and deeper upgrading of China's TiO_2 industry, there will be more to join them.

Statistics show that in 2020, over 40 domestic large-scale full-process TiO_2 manufacturers maintained normal production, of which 12 boasted TiO_2 output exceeding 100,000 tonnes. Of these 12 enterprises, LB Group, CNNC Hua Yuan and Pangang Group are the front runners and expected to lead domestic TiO_2 industry.

Table 3.1-1 List of domestic titanium dioxide producers with more than 100,000 tonnes output, 2020

No.	Producer	Note
1	LB Group Co., Ltd.	Including Sichuan Lomon Titanium Industry Co., Ltd., Xiangyang Lomon Titanium Industry Co., Ltd., Henan Billions New Materials Co., Ltd. and Yunnan Metallurgical Xinli Titanium Industry Co., Ltd.
2	CNNC Hua Yuan Titanium Dioxide Co., Ltd.	Including Anhui Goldstar Titanium Dioxide (Group) Co., Ltd., Gansu Hecheng Titanium Dioxide Co., Ltd. and Gansu Dongfang Titanium Dioxide Co., Ltd.
3	Pangang Group Vanadium & Titanium Resources Co., Ltd.	Including Pangang Chongqing Titanium Co., Ltd., Panzhihua Dongfang Titanium Industry Co., Ltd. and Pangang Group Titanium Industry Co., Ltd.
4	GPRO Investment Holding Group Co., Ltd.	Including GPRO Titanium Industry Co., Ltd. (with subsidiaries Nanjing Titanium Dioxide Chemical Co., Ltd. and Xuzhou Titanium Dioxide Chemical Co., Ltd.) and Jiangsu Taibai Group Co., Ltd. (with subsidiaries Jiangsu Zhentai Chemical Co., Ltd. and Zhenjiang Taibai Chemical Co., Ltd.)
5	Shandong Doguide Group Co., Ltd.	Including itself and Shandong Jinhong Titanium Dioxide Chemicals Co., Ltd., Shandong Sansheng Titanium Industry Co., Ltd.
6	China National Chemical Co., Ltd.	Including Jinan Yuxing Chemical Co., Ltd. and Guangxi Bluestar Dahua Chemical Co., Ltd.
7	Shandong Jinhai Titanium Resources Technology Co., Ltd.	/
8	Shandong Dawn Titanium Industry Co., Ltd.	/
9	Guangxi Jinmao Titanium Co., Ltd.	/
10	Yunnan Dahutong Industrial & Trade Co., Ltd.	Including Yunnan Dahutong Titanium Industry Co., Ltd. and Panzhihua Dahutong Titanium Industry Co., Ltd.

No.	Producer	Note
11	Ningbo Xinfu Titanium Dioxide Co., Ltd.	/
12	Panzhihua Taihai Technology Co., Ltd.	/

Source: CCM

3.2 LB Group Co., Ltd.

- Company profile

LB Group Co., Ltd. (LB Group, 002601), previously known as Lomon Billions Group Co., Ltd. and Henan Billions Chemicals Co., Ltd., is headquartered in Jiaozuo City, Henan Province. In September 2016, it invested USD1.35 billion to acquire 100% stake of Sichuan Lomon Titanium Industry Co., Ltd. Up to now, LB Group has five titanium dioxide production bases in four provinces, including two bases in Jiaozuo City (Henan Province), and one each in Mianzhu City (Sichuan Province), Xiangyang City (Hubei Province) and Kunming City (Yunnan Province). And its titanium dioxide capacity reached 1,010,000 t/a in 2020, ranking first in Asia and third in the world. LB Group has established subsidiaries outside mainland China, such as Billions (Hong Kong) Co., Ltd., Billions Europe Ltd. and Billions America Corporation, to expand its business in export markets.

Table 3.2-1 Major subsidiaries of LB Group in titanium dioxide business, 2020

No.	Subsidiary	Business location	Shareholding ratio	Business	Obtain method
1	Henan Billions New Materials Co., Ltd.	Jiaozuo City, Henan Province	88.24%	Titanium dioxide production and sales	Establish
2	Yunnan Metallurgical Xinli Titanium Industry Co., Ltd.	Kunming City, Yunnan Province	98.39%	Titanium dioxide production and sales	Controlling shareholder
3	Lomon Billions Sichuan Titanium Industry Co., Ltd. (previously known as Sichuan Lomon Titanium Industry Co., Ltd.)	Mianzhu City, Sichuan Province	100.00%	Titanium dioxide production and sales	Purchase
4	Lomon Billions Xiangyang Titanium Industry Co., Ltd.	Xiangyang City, Hubei Province	100.00%	Titanium dioxide production and sales	Purchase
5	Billions America Corporation	Illinois, United States	100.00%	Titanium dioxide sales	Establish
6	Billions Europe Ltd.	United Kingdom	100.00%	Chemical product sales	Establish
7	Billions (Hong Kong) Corporation Limited	Hong Kong, China	100.00%	Chemical product sales	Establish

Source: CCM & LB Group Co., Ltd.

- Production

Table 3.2-2 Capacity and output of titanium dioxide in LB Group, 2018–2020

Time	Capacity, t/a	Output, tonne
2018	630,000	635,000
2019	630,000	629,900
2020	1,010,000	817,200

Source: CCM & LB Group Co., Ltd.

The capacity of TiO_2 of LB Group reached 1,010,000 t/a in 2020, with 650,000 t/a sulfate process TiO_2 and 360,000 t/a chloride process TiO_2. The output saw a big year-on-year jump this year.

Table 3.2-3 Major events of LB Group's production, 2018–2020

Time	Major event
Feb., 2018	LB Group stated in an investigation that its TiO_2 production capacity had reached 600,000 t/a and it had been constructing the chloride process TiO_2 production line with a capacity of 200,000 t/a to cultivate profits.
March, 2018	LB Group announced that it planned to acquire 100% stake in Sichuan Anning Iron and Titanium Co., Ltd. and to raise the fund through shares issuance and cash payment, in order to expand its reserve of the raw material titanium concentrate. However, the acquisition plan was eventually terminated due to the failure to reach an agreement on the core clauses.
May, 2018	LB Group announced that the company had signed the Strategic Cooperation Framework Agreement on Comprehensive Development and Deep Processing of Vanadium & Titanium Magnetite Resources in Panzhihua City with the Panzhihua Municipal People's Government, and planned to invest USD756.77 million (RMB5 billion) to deepen exploitation of titanium resources in Panzhihua-Xichang Area and to build up TiO_2 industry chain.
July, 2018	Xu Gang, Chairman of LB Group, stated in an investigation by a domestic securities institution that the company hoped to make a difference in overseas titanium concentrate business in H2 2018 or 2019, to better satisfy its increasing demand for the raw materials of chloride process TiO_2 in the future.
Dec., 2018	LB Group announced that it had signed a Framework Agreement to Expand Investment and Cooperation in the Project of TiO_2 Industry Chain with the Nanxun County Government of Hubei Province, stating that the two parties will further integrate the local TiO_2 industry chain and form a closer cooperation relationship.
Jan., 2019	Xiangyang Lomon intended to technically transform the 100,000 t/a rutile-type titanium dioxide production line to expand the capacity to 150,000 t/a, and issued the first environmental impact report.
May, 2019	LB Group announced the operating of 300,000 t/a chloride process TiO_2 production line, with main TiO_2 capacity reaching about 950,000 t/a.
June, 2019	LB Group acquired Yunnan Metallurgical Xinli Titanium Industry Co., Ltd.
Dec., 2019	LB Group acquired 15.66% equity of Guangdong Orient Zirconic Ind Sci & Tech Co., Ltd.
April, 2020	Lufeng Xinli Titanium Industry Co., Ltd.'s (Lufeng Xinli) 200,000 t/a chloride process TiO_2 project was approved by Chuxiong Ecological Environment Bureau. The project is expected to start construction in H1 2021.
May, 2020	Xiangyang Lomon issued the EIA report of the 150,000 t/a rutile titanium dioxide technological transformation and expansion project. The project plans to increase Xiangyang Lomon's TiO_2 capacity from 100,000 t/a to 150,000 t/a.
May, 2020	LB Group signed a technical cooperation contract with Ti-Cons Technology Consulting GmbH to improve its TiO_2 production technology and management. Benefiting from this, chloride process TiO_2 capacity in its subsidiary Henan Billions New Materials Co., Ltd. will gradually increase to 100,000 t/a.

Source: CCM & LB Group Co., Ltd.

As for the company's development plan in the 14th Five-Year Period (2021–2025), LB Group plans a business target of annual revenue over USD7.2 billion (RMB50 billion) by 2025 from businesses such as titanium dioxide, titanium products, mineral products, and new energy. For the titanium dioxide industry, the company will continue to focus on the TiO_2 business and try to enrich its product portfolio through technological innovation, transformation, and upgrading.

● TiO_2

LB Group has found a way to reduce production cost of chloride process TiO_2 and hence will further expand capacity. But no more new sulfate process project. Instead, it will acquire some small-sized factories, or integrate the original sulfate process TiO_2 into the industry through technological transformation and upgrades, to further strengthen its influence.

● Raw material

In order to ensure the supply of raw materials for chloride process TiO_2, in 2019, LB Group invested in an innovative upgrade and transformation project in Panzhihua City, which can convert 500,000 tonnes of ilmenite concentrate to chloride titanium slag per year. In 2020, the company also considered a titanium slag project in Yunnan to upgrade domestic ilmenite to chloride titanium slag on a large-scale basis.

● Derivatives

LB Group sticks to product diversification. The company will focus on the development of titanium tetrachloride, titanium sponge, and high-end titanium alloy. It also tries to expand to derivative businesses of zirconium, iron, and scandium products. In 2020, its capacity of sponge titanium was 10,000 t/a. In addition, the 15,000 t/a titanium sponge production line in Gansu Province was put into trial production in Dec., and the 30,000 t/a titanium sponge project in Yunnan Province was under construction.

● Industrial chain

LB Group, particularly the Jiaozuo base, has achieved co-production of sulfuric acid, TiO_2, ferrous sulfate, iron oxide black, and scandium oxide. It has built 600,000 t/a sulfuric acid, 100,000 t/a iron pigment, 100,000 t/a scandium oxide, and 600,000 t/a gypsum production lines, which maximises resources utilisation rate and cuts pollution discharge.

Table 3.2-4 Financial figures of LB Group's major businesses, 2018–2020

Category	Sales, USD			YoY change, %			Operating cost, USD			YoY change, %			Gross profit margin			YoY change, percentage point		
	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018
By industry																		
Chemicals and raw material manufacturing	1,996,467,105	1,621,242,461	1,550,388,544	23.96	8.93	1.24	1,288,135,318	936,822,991	911,643,673	38.42	7.05	9.05	35.48%	42.22%	41.20%	-6.74	1.02	-4.21
By product																		
TiO_2	1,580,588,299	1,271,368,703	1,326,622,964	25.15	-0.17	2.05	1,011,789,704	724,023,156	747,628,412	40.68	0.88	4.94	35.99%	43.05%	43.64%	-7.07	-0.59	-1.55
Mineral	275,036,662	202,143,597	109,324,331	9.43	92.62	-34.97	154,863,563	101,615,665	67,396,663	11.12	57.06	-10.26	43.69%	49.73%	38.35%	-0.86	11.38	-16.98
Zirconium products	4,008,284	9,586,794	11,617,014	-57.91	-14.03	27.33	3,526,200	7,587,731	8,630,348	-53.22	-8.41	25.32	12.03%	20.85%	25.71%	-8.83	-4.86	1.19
Sponge titanium and titanium tetrachloride	117,316,732	/	0	433.52	/	/	103,408,185	/	0	558.47	/	/	11.86%	/	0.00%	-16.73	/	/
Others	19,517,128	138,143,366	102,824,234	-69.84	39.95	90.00	14,547,666	103,596,438	87,988,251	-70.18	22.65	111.95	25.46%	25.01%	14.43%	0.85	10.58	-8.86
By region																		
Domestic	1,075,298,593	916,262,950	814,989,585	18.14	17.12	0.38	729,428,522	546,868,004	502,580,627	34.27	13.35	12.38	32.17%	40.32%	38.33%	-8.15	1.98	-6.59
Overseas	921,168,512	704,979,511	735,398,959	31.54	-0.14	2.22	558,706,796	389,954,987	409,063,047	44.23	-0.69	5.23	39.35%	44.69%	44.38%	-5.34	0.31	-1.59

Note: The financial figures of sponge titanium and titanium tetrachloride were included in "Others" in 2019.
Source: CCM & LB Group Co., Ltd.

Table 3.2-5 Operating costs of LB Group's TiO_2 business, 2018–2020

Item	2020		2019		2018	
	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %
Feedstock	646,220,875	63.87	453,467,494	62.63	473,790,155	63.37
Energy	213,362,899	21.09	135,575,702	18.73	135,697,330	18.15
Labour	46,820,704	4.63	33,611,919	4.64	34,984,855	4.68
Depreciation	65,123,327	6.44	47,762,399	6.60	50,304,985	6.73
Others	40,261,899	3.98	53,605,642	7.40	N/A	/
Total	**1,011,789,704**	**100**	**670,417,514**	**100**	**694,777,325**	**92.93**

Source: CCM & LB Group Co., Ltd.

- Export

Table 3.2-6 LB Group's TiO_2 export, 2018–2020

No.	Company	Export volume, tonne			Export price, USD/t			Main destination
		2020	2019	2018	2020	2019	2018	
1	Lomon Billions Sichuan Titanium Industry Co., Ltd.	186,219	155,224	137,667	2,026	2,250	2,586	South Korea, India, France, Brazil, Israel
2	LB Group Co., Ltd.	144,834	94,795	112,415	1,993	2,215	2,519	Canada, India, France, Turkey, Brazil
3	Henan Billions New Materials Co., Ltd.	93,232	49,673	35,314	2,238	2,376	2,516	France, United Kingdom, India, Brazil, Indonesia
4	Lomon Billions Xiangyang Titanium Industry Co., Ltd.	37,304	23,818	21,582	2,011	2,235	2,593	The Netherlands, Brazil, the Philippines, Argentina, South Africa

Source: CCM & China Customs

3.3 CNNC Hua Yuan Titanium Dioxide Co., Ltd.

- Company profile

CNNC Hua Yuan Titanium Dioxide Co., Ltd. (CNNC Hua Yuan, 002145) is headquartered in Jiayuguan City, Gansu Province. It has three TiO_2 production bases: Anhui Goldstar Titanium Dioxide (Group) Co., Ltd. (Ma'anshan City, Anhui Province), Gansu Hecheng Titanium Dioxide Co., Ltd. (Jiayuguan City, Gansu Province) and Gansu Dongfang Titanium Dioxide Co., Ltd. (Baiyin City, Gansu Province). In addition, CNNC Hua Yuan takes Jiangsu Province as the purchasing centre and Shanghai as the sales centre.

Table 3.3-1 Major subsidiaries of CNNC Hua Yuan, 2020

No.	Subsidiary	Business location	Business	Shareholding ratio	Obtain method
1	Wuxi CNNC Hua Yuan Titanium Dioxide Co., Ltd.	Wuxi City, Jiangsu Province	Procurement	100%	Establish
2	Anhui Goldstar Titanium Dioxide (Group) Co., Ltd.	Ma'anshan City, Anhui Province	Manufacturing	100%	Purchase
3	Gansu Dongfang Titanium Dioxide Co., Ltd.	Baiyin City, Gansu Province	Manufacturing	100%	Purchase
4	Gansu Hecheng Titanium Dioxide Co., Ltd.	Jiayuguan City, Gansu Province	Manufacturing	100%	Establish
5	Gold Star Titanium Dioxide (Hong Kong) Co., Ltd.	Hong Kong, China	Trading	100%	Establish
6	Shanghai Sicheng Titanium Dioxide Co., Ltd.	Shanghai Municipality	Sales	100%	Establish
7	Anhui Goldstar Titanium Dioxide Sales Co., Ltd.	Ma'anshan City, Anhui Province	Sales	100%	Establish
8	Guangzhou Tioxhua Co., Ltd.	Guangzhou City, Guangdong Province	Sales	100%	Establish

Source: CCM & CNNC Hua Yuan Titanium Dioxide Co., Ltd.

- Production

Table 3.3-2 Capacity and output of titanium dioxide in CNNC Hua Yuan, 2018–2020

Time	Capacity, t/a	Output, tonne
2018	300,000	196,684
2019	200,000	255,600
2020	300,000	317,600

Source: CCM

The TiO_2 products of CNNC Hua Yuan were all sulfate-processed. In 2020, the capacity of TiO_2 was 300,000 t/a, ranked second in China. The output of TiO_2 increased from 196,600 tonnes in 2018 to 317,600 tonnes in 2020, with a CAGR of 27.07%.

Table 3.3-3 Major events of CNNC Hua Yuan's production, 2018–2020

Time	Major event
Jan., 2018	CNNC Hua Yuan announced to raise USD181.63 million by offering convertible bonds to the public, of which about USD90.81 million was for a 200,000 t/a TiO_2 post-treatment project in Anhui Goldstar Titanium Dioxide (Group) Co., Ltd. The first phase of 100,000 t/a TiO_2 had been put into trial production in May 2020, and the second phase of 100,000 t/a TiO_2 is expected to complete at the end of 2021.
Sept., 2018	CNNC Hua Yuan announced that Wuxi Haopu Titanium Dioxide Co., Ltd. would stop production and dismantle the main TiO_2 production equipment before November 30, 2018, in response to the local government's efforts to optimize industrial structure.
Nov., 2018	CNNC Hua Yuan announced that Gansu Dongfang Titanium Dioxide Co., Ltd.'s 100,000 t/a rutile TiO_2 resources comprehensive utilization project would come to pilot production since the date of the announcement.
Nov., 2018	CNNC Hua Yuan disclosed in an interview that it would achieve the chloride process TiO_2 production in the future through self-construction or acquisition of domestic or overseas producers with the technology.
Aug., 2020	CNNC Hua Yuan signed a cooperation agreement with the People's Government of Baiyin City, Gansu. CNNC Hua Yuan will build a 500,000 t/a resources comprehensive utilisation project with clean production process in Yingdong Industrial Park of Baiyin High Tech Zone. Upon completion, it will form 200,000 t/a crude titanium dioxide and 300,000 t/a finished titanium dioxide production capacity.
Oct., 2020	Xinjiang Desheng New Material Technology Co., Ltd. (Xinjiang Desheng), a subsidiary of CNNC Hua Yuan, signed a framework agreement on investment with Xinjiang Hami Municipal People's Government. Xinjiang Desheng will invest in a 2 million t/a high-quality titanium-rich material resources deep processing project, which is divided into three phases, and the first 1 million t/a production lines are scheduled to be finished before 2026. This project will guarantee the company's raw material supply for TiO_2 production.

Source: CCM & CNNC Hua Yuan Titanium Dioxide Co., Ltd.

Regarding the future development, the 2020 Annual Report of CNNC Hua Yuan revealed that relying on two major TiO_2 production bases in Gansu and Anhui, the company will integrate the resources of the industry chain, enhance its core competitiveness, and improve the production, sales and R&D capabilities of TiO_2. At the same time, the company will orderly promote the implementation of the 500,000 t/a crude titanium dioxide and 200,000 t/a finished titanium dioxide projects of Gansu Dongfang Titanium Industry Co., Ltd.

Table 3.3-4 Financial figures of CNNC Hua Yuan's major businesses, 2018–2020

Category	Sales, USD			YoY change, %			Operating cost, USD			YoY change, %			Gross profit margin			YoY change, percentage point		
	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018
By industry																		
Fine Chemicals	532,912,942	483,541,882	445,104,206	10.94	13.17	-5.51	391,219,426	329,961,499	310,377,939	19.35	10.74	-0.76	26.59%	31.76%	30.27%	-5.17	1.49	-3.34
By Product																		
TiO_2	532,912,942	483,541,882	445,104,206	10.94	13.17	-5.51	391,219,426	329,961,499	310,377,939	19.35	10.74	-0.76	26.59%	31.76%	30.27%	-5.17	1.49	-3.34
By region																		
Domestic	313,755,798	297,949,491	270,962,028	6.01	14.55	-13.88	231,755,878	204,852,774	189,984,669	13.89	12.32	-8.23	26.13%	31.25%	29.89%	-5.12	1.36	-3.94
Overseas	219,157,144	185,592,392	174,142,179	18.87	11.02	10.04	159,463,548	125,108,726	120,393,269	28.31	8.25	13.88	27.24%	32.59%	30.86%	-5.35	1.72	-2.33

Source: CCM & CNNC Hua Yuan Titanium Dioxide Co., Ltd.

Table 3.3-5 Operating costs of CNNC Hua Yuan's TiO_2 business, 2018–2020

Item	2020		2019		2018	
	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %
Feedstock	243,472,335	62.23	207,671,779	434.80	207,865,126	66.97
Energy	69,603,026	17.79	62,019,203	129.85	55,781,892	17.97
Labour	10,318,964	2.64	9,694,418	20.30	8,879,163	2.86
Manufacturing, depreciation and others	67,825,101	17.34	50,576,099	105.89	37,851,758	12.2
Total	**391,219,426**	**100**	**329,961,499**	**100**	**310,377,939**	**100**

Source: CCM & CNNC Hua Yuan Titanium Dioxide Co., Ltd.

- Export

Table 3.3-6 CNNC Hua Yuan's TiO_2 export, 2018–2020

No.	Company	Export volume, tonne			Export price, USD/t			Main destination
		2020	2019	2018	2020	2019	2018	
1	Anhui Goldstar Titanium Dioxide Sales Co., Ltd.	82,440	48,804	12,479	2,027	2,210	2,459	Poland, Brazil, India, Turkey, Italy
2	Anhui Goldstar Titanium Dioxide (Group) Co., Ltd.	74,348	46,098	67,728	1,986	2,135	2,569	Brazil, India, Turkey, Italy, Spain

Source: CCM & China Customs

3.4 Pangang Group Vanadium & Titanium Resources Co., Ltd.

- Company profile

Pangang Group Vanadium & Titanium Resources Co., Ltd. (Pangang Group, 000629) was established in 1993 and headquarters in Panzhihua City, Sichuan Province. Its main businesses consist of vanadium, titanium and electricity. Specifically, it is the biggest vanadium products producer and a top five TiO_2 producer by production scale in China. Vanadium and titanium are Pangang Group's focuses for further development.

Table 3.4-1 Subsidiaries of Pangang Group, 2020

No.	Subsidiary	Business location	Business	Shareholding ratio	Obtain method
1	Pangang Group Titanium Industry Co., Ltd.	Panzhihua City, Sichuan Province	Titanium products production	100%	Establish
2	Pangang Chongqing Titanium Co., Ltd.	Chongqing Municipality	Titanium dioxide production	100%	Establish
3	Panzhihua Dongfang Titanium Industry Co., Ltd.	Panzhihua City, Sichuan Province	Titanium dioxide production and sales	65%	Purchase
4	Panzhihua Guotai Science & Technology Co., Ltd.	Panzhihua City, Sichuan Province	Titanium products production	51%	Purchase
5	Pangang Group Beihai Special Ferroalloy Co., Ltd.	Beihai City, Guangxi Zhuang Autonomous Region	Steel processing	100%	Establish
6	Shanghai Pangang Vanadium & Titanium Resources Development Co., Ltd.	Shanghai Municipality	Trading	100%	Establish
7	Pangang Group Chongqing Vanadium Titanium Science & Technology Co., Ltd.	Chongqing Municipality	Trading	100%	Establish
8	Pangang Group Chengdu Vanadium Titanium Source Development Co., Ltd.	Chengdu City, Sichuan Province	Trading	100%	Establish

Source: CCM & Pangang Group Vanadium & Titanium Resources Co., Ltd.

- Production

Table 3.4-2 Capacity and output of titanium dioxide in Pangang Group, 2018–2020

Time	Capacity, t/a	Output, tonne
2018	235,000	228,400
2019	235,000	233,900
2020	235,000	235,500

Source: CCM

As China's third largest producer of TiO_2 (by output), Pangang Group has a production capacity of 235,000 t/a TiO_2 and is one of the few companies in China that can produce TiO_2 through both sulfate and chloride processes. In 2018–2020, Pangang Group's TiO_2 production capacity maintained at the same level, of which the production capacity of the sulfate process TiO_2 was 220,000 t/a and 15,000 t/a for the chloride process. Its output increased year by year in this period.

Table 3.4-3 Major events of Pangang Group's production, 2018–2020

Time	Major event
May, 2018	Pangang Group announced the fused salt chloride process TiO_2 project (60,000 t/a) under Pangang Group Titanium Industry Co., Ltd. was in the stage of environmental impact assessment and was expected to be put into production in 2020. However, as of Sept. 2021, the project has not been completed.
June, 2018	Pangang Group announced it had signed a cooperation agreement with Puneng (Beijing) Energy Technology Co., Ltd. The two formed a strategic partnership in regard to purchase, sales, production, technology and capital cooperation of vanadium electrolyte.
May, 2019	Pangang Group signed a cooperation agreement with Sichuan Desheng Group Vanadium & Titanium Co., Ltd. The two sides have established a strategic partnership in the sales of vanadium products.

Source: CCM & Pangang Group Vanadium & Titanium Resources Co., Ltd.

Table 3.4-4 Financial figures of Pangang Group's major businesses, 2018–2020

Category	Sales, USD			YoY change, %			Operating cost, USD			YoY change, %			Gross profit margin			YoY change, percentage point		
	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018
By industry																		
Vanadium products	544,335,666	905,519,262	1,235,316,664	-39.49	-23.64	144.54	465,674,964	657,406,182	775,683,668	-28.69	-11.71	98.83	14.45%	27.40%	37.21%	-12.95	-9.81	14.44
Titanium products	612,152,796	632,692,776	645,016,974	-2.60	2.18	24.45	543,622,120	540,331,077	506,476,640	1.28	11.13	21.42	11.20%	14.60%	21.48%	-3.40	-6.88	1.96
Electricity	276,654,566	268,326,937	300,084,857	3.79	-6.85	-0.23	250,218,815	237,196,334	271,706,559	6.19	-9.06	0.73	9.56%	11.60%	9.46%	-2.04	2.14	-0.86
By product																		
Vanadium products	544,335,666	905,519,262	1,235,316,664	-39.49	-23.64	144.54	465,674,964	657,406,182	775,683,668	-28.69	-11.71	98.83	14.45%	27.40%	37.21%	-12.95	-9.81	14.44
Titanium slag	109,221,756	90,486,441	104,594,575	21.51	4.73	13.87	92,731,270	80,458,840	N/A	16.02	/	/	15.10%	11.08%	N/A	4.02	/	/
TiO_2	392,587,648	442,686,995	452,952,264	-10.73	1.81	18.72	352,683,286	372,296,911	338,355,370	-4.64	14.62	10.71	10.16%	15.00%	25.30%	-5.74	-9.4	5.4
Electricity	276,654,566	268,326,937	300,084,857	3.79	-6.85	-0.23	250,218,815	237,196,334	271,706,559	6.19	-9.06	0.73	9.56%	11.60%	9.46%	-2.04	2.14	-0.86
By region																		
Domestic	1,403,956,222	1,676,700,953	2,008,015,322	-15.71	-13.02	62.88	1,237,835,387	1,328,373,419	1,415,824,501	-6.20	-2.26	41.72	11.83%	20.77%	29.49%	-8.94	-8.72	10.53
Overseas (including Hong Kong, Macao and Taiwan Province)	122,934,807	235,173,880	286,732,940	-47.38	-14.56	46.81	111,379,776	205,617,238	247,518,798	-45.47	-13.46	40.87	9.40%	12.57%	13.68%	-3.17	-1.11	3.64

Source: CCM & Pangang Group Vanadium & Titanium Resources Co., Ltd.

Table 3.4-5 Operating costs of Pangang Group's TiO_2 business, 2018–2020

Item	2020		2019		2018	
	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %
Raw materials and energy	291,317,817	82.60	306,780,278	82.40	281,931,987	83.32
Others	61,365,469	17.40	65,516,634	17.60	56,423,383	16.68
Total	**352,683,286**	**100**	**372,296,911**	**100**	**338,355,370**	**100**

Source: CCM & Pangang Group Vanadium & Titanium Resources Co., Ltd.

- Export

Table 3.4-6 Pangang Group's TiO_2 export, 2018–2020

No.	Exporter	Export volume, tonne			Export price, USD/t			Main destination
		2020	2019	2018	2020	2019	2018	
1	Panzhihua Dongfang Titanium Industry Co., Ltd.	46,680	34,282	29,641	1,974	2,102	2,490	Turkey, United Arab Emirates, Indonesia, India, Brazil
2	Pangang Group Chengdu Vanadium Titanium Source Development Co., Ltd.	21,592	10,649	0	1,981	2,082	/	Russia, Egypt, Vietnam, Italy, Spain
3	Pangang Chongqing Titanium Co., Ltd.	1,631	871	2,667	1,950	2,113	2,531	Malaysia, Russia, United Arab Emirates, Australia, South Korea
4	Shanghai Pangang Vanadium & Titanium Resources Development Co., Ltd.	0	8,311	5,510	/	2,194	2,546	Argentina, the United Arab Emirates, Oman, Australia, Pakistan
5	Pangang Group Titanium Industry Co., Ltd.	0	0	1,150	/	/	3,178	India, Russia, Thailand, the UK, Italy

Source: CCM & China Customs

3.5 Shandong Doguide Group Co., Ltd.

- Company profile

Established in 2002, Shandong Doguide Group Co., Ltd. (Shandong Doguide) has a registered capital of RMB100 million. Headquartered in Zibo City, Shandong Province, Shandong Doguide is mainly dedicated to the production and sales of titanium dioxide, sulfuric acid, purifying agent, etc. And it is one of the large-scale sulfate process TiO_2 producers in China.

Table 3.5-1 Major subsidiaries of Shandong Doguide in titanium dioxide business, 2020

No.	Subsidiary	Business location	Business	Shareholding ratio	Obtain method
1	Shandong Jinhong Titanium Dioxide Chemicals Co., Ltd.	Zibo City, Shandong Province	Titanium dioxide production	58.50%	Controlling shareholder
2	Shandong Sansheng Titanium Industry Co., Ltd.	Zibo City, Shandong Province	Chemical fiber titanium dioxide	58.00%	Purchase

Source: CCM

- Production

Table 3.5-2 Capacity and output of titanium dioxide in Shandong Doguide, 2018–2020

Time	Capacity, t/a	Output, tonne
2018	220,000	165,000
2019	220,000	168,000
2020	220,000	170,000

Source: CCM

- Export

Table 3.5-3 Shandong Doguide's TiO_2 export, 2018–2020

No.	Company	Export volume, tonne			Export price, USD/t			Main destination
		2020	2019	2018	2020	2019	2018	
1	Shandong Doguide Group Co., Ltd.	52,396	32,127	33,862	2,108	2,258	2,616	Indonesia, India, Brazil, Pakistan, Vietnam
2	Shandong Jinhong Titanium Dioxide Chemicals Co., Ltd.	21,480	13,526	10,340	2,070	2,210	2,582	India, Brazil, Malaysia, South Korea, Taiwan Province

Source: CCM & China Customs

3.6 GPRO Investment Holding Group Co., Ltd.

- Company profile

Headquartered in Nanjing City, Jiangsu Province, GPRO Investment Holding Group Co., Ltd. (GPRO Group)'s main businesses involve manufacturing, real estate, financial, tourism, and food industries.

GPRO Titanium Industry Co., Ltd. (GPRO Titanium, 000545), a holding subsidiary of GPRO Group, is a listed company. It is a large-scale sulfate process TiO_2 producer in China, with rutile TiO_2 and anatase TiO_2 as main products. Its TiO_2 production bases are Nanjing Titanium Dioxide Chemical Co., Ltd. (Nanjing Titanium) and Xuzhou Titanium Dioxide Chemical Co., Ltd. (Xuzhou Titanium). Specifically, Nanjing Titanium produces rutile TiO_2 and Xuzhou Titanium produces both rutile and anatase TiO_2.

Jiangsu Taibai Group Co., Ltd. (Jiangsu Taibai), another subsidiary of GPRO Group, is also a main domestic TiO_2 manufacturer. It produces both rutile and anatase TiO_2, with rutile TiO_2 accounting for about 90%. In March 2020, 100% equity of Jiangsu Taibai was transferred to GPRO Group.

Table 3.6-1 Main subsidiaries of GPRO Group, 2020

No.	Subsidiary	Business location	Shareholding ratio	Business	Obtain method
1	GPRO Titanium Industry Co., Ltd.	Jilin City, Jilin Province	34.26%	Manufacturing and trading	Acquisition
2	Nanjing Titanium Dioxide Chemical Co., Ltd.	Nanjing City, Jiangsu Province	100%	Manufacturing	Reverse takeover
3	Xuzhou Titanium Dioxide Chemical Co., Ltd.	Xuzhou City, Jiangsu Province	100%	Manufacturing	Establish
4	Nanjing Titanium Industry International Co., Ltd.	Nanjing City, Jiangsu Province	100%	Trading	Establish
5	Nanjing GPRO Supply Chain Management Co., Ltd.	Nanjing City, Jiangsu Province	100%	Service	Establish
6	Nanjing GPRO Commercial Factoring Co., Ltd.	Nanjing City, Jiangsu Province	100%	Commercial factoring	Establish
7	GPRO (USA) Development Co., Ltd.	United States	100%	Trading	Establish
8	Jiangsu Taibai Group Co., Ltd.	Zhenjiang City, Jiangsu Province	100%	Manufacturing and trading	Acquisition
9	Jiangsu Zhentai Chemical Co., Ltd.	Zhenjiang City, Jiangsu Province	100%	Manufacturing and trading	Acquisition

Source: CCM & GPRO Investment Holding Group Co., Ltd.

- Production

Table 3.6-2 Capacity and output of titanium dioxide in GPRO Group, 2018–2020

Time	Capacity, t/a	Output, tonne
2018	180,000	131,900
2019	180,000	145,200
2020	260,000	187,600

Note: The capacity and output of Jiangsu Taibai are consolidated into GPRO Group in 2020.
Source: CCM

Table 3.6-3 Major events of GPRO Group's production, 2018–2020

Time	Major event
Jan. 2018	In order to further expand the intelligent manufacturing industry sector, GPRO Titanium successfully acquired a 51% stake of Nanjing Orientleader Technology Co., Ltd.
Oct. 2018	GPRO Titanium successfully acquired a 50.98% stake of Cangzhou Dahua Group Co., Ltd.
July 2019	GPRO Titanium's plan to acquire Zhejiang Guxiandao New Materials Co., Ltd., a leader in China's polyester filament industry, was rejected by the China Securities Regulatory Commission.
Jan. 2020	Nanjing Titanium Dioxide Chemical Co., Ltd., a subsidiary of GPRO Titanium, and Nippon Paint (China) Holdings Co., Ltd. signed a cooperation agreement on the supply and application of titanium dioxide.
March 2020	GPRO Group announced to acquire 100% shares of Jiangsu Taibai Group Co., Ltd. (Jiangsu Taibai), and would promote GPRO Titanium to acquire Jiangsu Taibai within 36 months after Jiangsu Taibai completed the industrial and commercial change registration.

Source: CCM & GPRO Investment Holding Group Co., Ltd.

- GPRO Titanium

In the next few years, GPRO Titanium plans to carry out horizontal mergers and acquisitions to expand the capacity of TiO_2, as well as to optimise its product portfolio based on the potential of its existing TiO_2 production equipment in Nanjing City and Xuzhou City. Meanwhile, it will offer financing opportunities to quality companies in the upstream and downstream to boost cooperation, laying the foundation for its industrial chain integration.

Table 3.6-4 Financial figures of GPRO Titanium's major businesses, 2018–2020

Category	Sales, USD			YoY change, %			Operating cost, USD			YoY change, %			Gross profit margin			YoY change, percentage point		
	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018
By business																		
TiO_2	251,569,343	263,715,313	273,116,638	-3.97	0.59	4.61	236,923,636	223,436,538	224,771,392	6.74	3.55	13.39	5.82%	15.27%	17.70%	-9.45	-2.43	-6.37
Supply chain	5,884,361	3,955,022	2,048,275	49.77	101.14	9.55	N/A	3,328,362	1,715,952	/	102.06	9.55	N/A	15.84%	16.22%	/	-0.38	-0.26
Commercial factoring	7,267,362	6,190,929	5,540,630	18.17	16.40	887.27	0	0	0	0	0	0	100.00%	100.00%	100.00%	0	0	0
By product																		
Rutile TiO_2	200,436,186	208,619,044	210,909,503	-4.41	3.04	9.37	187,656,037	173,995,891	172,547,318	8.57	5.05	18.74	6.38%	16.60%	18.19%	-10.22	-1.59	-6.46
Anatase TiO_2	49,137,003	52,602,700	54,265,621	-5.97	0.98	-15.35	47,700,362	47,190,304	45,396,829	1.75	8.29	-7.99	2.92%	10.29%	16.34%	-7.37	-6.05	-6.70
Commercial factoring	7,267,362	6,190,929	5,540,630	18.17	16.40	887.27	0	0	0	0	0	0	100.00%	100.00%	100.00%	0	0	0
Others	7,880,514	6,448,590	9,989,789	23.02	-32.76	66.47	N/A	5,578,706	8,543,197	/	-31.98	66.27	N/A	13.49%	14.48%	/	-0.99	0.10
By region																		
Domestic	209,375,432	233,449,504	247,887,452	-9.72	-1.90	3.31	190,224,451	193,025,896	198,483,274	-0.80	0.65	8.53	9.12%	17.32%	19.93%	-8.20	-2.09	-3.85
Overseas	55,345,634	40,411,761	32,818,091	37.87	28.28	39.29	51,920,692	33,739,005	26,712,221	54.91	31.57	58.01	6.28%	16.51%	18.61%	-10.23	-2.10	-9.68

Source: CCM & GPRO Titanium Industry Co., Ltd.

Table 3.6-5 Operating costs of GPRO Titanium's TiO_2 business, 2018–2020

Item	2020		2019		2018	
	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %
Feedstock	130,823,170	55.59	131,671,578	58.94	130,885,707	60.05
Energy	59,823,241	25.42	55,094,320	24.66	51,593,120	23.67
Labour	13,031,852	5.54	12,342,463	5.52	12,369,360	5.68
Depreciation	16,098,185	6.84	12,355,121	5.53	11,936,319	5.48
Others	15,579,952	6.62	11,934,680	5.34	11,159,641	5.12
Total	**235,356,399**	**100**	**223,398,163**	**100**	**217,944,147**	**100**

Source: CCM & GPRO Titanium Industry Co., Ltd.

- Export

Table 3.6-6 GPRO Group's TiO_2 export, 2018–2020

No.	Company	Export volume, tonne			Export price, USD/t			Main destination
		2020	2019	2018	2020	2019	2018	
1	Nanjing Titanium Industry International Co., Ltd.	32,789	20,591	15,827	1,951	2,090	2,446	South Korea, Italy, Turkey, India, Spain
2	Jiangsu Zhentai Chemical Co., Ltd.	7,343	/	/	2,013	/	/	India, Indonesia, United Arab Emirates, South Africa, Vietnam

Note: Jiangsu Zhentai Chemical Co., Ltd. is a subsidiary of Jiangsu Taibai, and its export data in 2020 is integrated into GPRO Group.
Source: CCM & China Customs

3.7 Anhui Annada Titanium Industry Co., Ltd.

- Company profile

Anhui Annada Titanium Industry Co., Ltd. (Anhui Annada, 002136), headquartered in Tongling City, Anhui Province, is also one of the large-scale sulfate process TiO_2 producers in China. Anhui Annada itself is mainly involved in the production and sales of TiO_2 and its subsidiary specialises in iron phosphare business.

Table 3.7-1 Subsidiary of Anhui Annada, 2020

Subsidiary	Business location	Business	Shareholding ratio	Obtain method
Tongling Nayuan Material Science and Technology Co., Ltd.	Tongling City, Anhui Province	Iron phosphate products production and sales	70%	Establish

Source: CCM & Anhui Annada Titanium Industry Co., Ltd.

- Production

Table 3.7-2 Capacity and output of titanium dioxide in Anhui Annada, 2018–2020

Time	Capacity, t/a	Output, tonne
2018	80,000	69,608
2019	80,000	77,300
2020	80,000	85,300

Source: CCM

TiO_2 products of Anhui Annada are all sulfate-processed. In 2018–2020, TiO_2 capacity of Anhui Annada maintained at 80,000 t/a, with about 20,000 t/a of anatase titanium dioxide and 60,000 t/a of rutile titanium dioxide. Output of its TiO_2 was in an uptrend in this period and it increased to 85,300 tonnes in 2020, up 10.35% year on year.

Table 3.7-3 Major events of Anhui Annada's production, 2018–2020

Time	Major event
Jan. 2018	Anhui Annada and its subsidiary Tongling Nayuan both were accredited as High-tech Enterprise 2017 by Anhui government, which entitled them to enjoy tax preferential policy—15% corporate income tax in 2017–2019.
Dec. 2018	Anhui Annada and Jiangsu Top Fine New Material Co., Ltd. successfully developed a rutile TiO_2 powder, ART-311, for high-end green coatings.
Sept. 2019	Anhui Annada announced that Anhui Chuang'gu New Materials Co., Ltd. and Tongling Chemical Industry Group Co., Ltd. signed a capital increase agreement. At the same time, Anhui Annada's controlling shareholder was still Tongling Chemical Industry Group Co., Ltd.
Dec. 2020	Anhui Ananda issued the EIA report of the 50,000 t/a of rutile TiO_2 for plastics and inks upgrading project. The project was scheduled to start construction in Feb. 2021 and is expected to be completed in 2023.

Source: CCM

Table 3.7-4 Financial figures of Anhui Annada's major businesses, 2018–2020

Category	Sales, USD			YoY change, %			Operating cost, USD			YoY change, %			Gross profit margin			YoY change, percentage point		
	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018	2020	2019	2018
By industry																		
Chemicals and raw material manufacturing	160,489,760	149,785,289	155,921,313	7.86	0.07	-9.32	N/A	129,646,461	131,983,350	/	2.33	-0.65	N/A	13.45%	15.35%	/	-1.90	-7.39
By product																		
TiO_2	141,790,182	138,277,831	148,805,033	3.22	-3.20	-6.80	N/A	120,120,401	126,056,070	/	-0.73	0.65	N/A	13.13%	15.29%	/	-2.16	-6.27
Iron phosphate	18,699,578	11,507,458	7,116,280	63.58	68.45	-42.09	N/A	9,526,060	5,927,280	/	67.42	-22.16	N/A	17.22%	16.71%	/	0.51	-21.32
By region																		
Domestic	126,454,046	119,769,994	117,286,482	6.28	6.38	-10.17	N/A	103,905,092	99,611,724	/	8.66	-0.75	N/A	13.25%	15.07%	/	-1.82	-8.06
Overseas	34,461,494	30,015,295	38,634,832	15.58	-19.07	-6.65	N/A	25,741,369	32,371,626	/	-17.16	-0.37	N/A	14.24%	16.21%	/	-1.97	-5.29

Note: The financial figures was applicable to industries, products or regions where the company's operating income or operating profit is more than 10%.
Source: CCM & Anhui Annada Titanium Industry Co., Ltd.

Table 3.7-5 Operating costs of Anhui Annada's chemicals and raw material manufacturing business, 2018–2020

Item	2020		2019		2018	
	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %	Value, USD	Proportion to total operating cost, %
Raw material, fuel and energy	106,765,151	75.64	95,142,549	73.39	98,565,166	74.68
Manufacturing	21,577,239	15.29	21,760,833	16.78	20,378,229	15.44
Labour	6,489,865	4.60	6,353,498	4.9	6,533,176	4.95
Depreciation	6,324,770	4.48	6,389,581	4.93	6,506,779	4.93
Total	**141,157,025**	**100**	**129,646,461**	**100**	**131,983,350**	**100**

Source: CCM & Anhui Annada Titanium Industry Co., Ltd.

- Export

Table 3.7-6 Anhui Annada's TiO_2 export, 2018–2020

No.	Company	Export volume, tonne			Export price, USD/t			Main destination
		2020	2019	2018	2020	2019	2018	
1	Anhui Annada Titanium Industry Co., Ltd.	20,152	14,771	14,396	1,961	2,094	2,477	India, Brazil, Turkey, Morocco, Thailand

Source: CCM & China Customs

4 Highlighted case

4.1 Enterprise dynamic during 2018–2020

After the sluggish market in 2012–2015, prices of China's main titanium products including titanium ore, titanium slag, titanium sponge and TiO_2 began to rise from the bottom in 2016 and reached a relatively high level in 2017; after that they generally fell by different rates and came to a lower level in 2019. Meanwhile, output of these titanium products generally showed an upward trend. It is fair to say that China's titanium industry had come to a phase where the increasing demand could be satisfied at a lower cost. As the market turned better but competition became fiercer year by year, investment in the titanium industry grew heavier. Some projects shelved due to previous market downturn started construction again at the end of 2016. What's more, there came a new wave of listing plans and M&A activities in the industry.

Domestic enterprises made restructuring and asset acquisitions mainly through the following three ways these years:

- Big enterprises acquire small ones to expand their production scale.
- Merge with another company of similar size to meet the requirements of the industry policy.
- Some enterprises acquire listed titanium dioxide companies, in order to help themselves get listed in the stock exchange.

Here is the dynamics of some enterprises which attracted much attention during 2018–2020.

Table 4.1-1 Events of titanium dioxide producers in China, 2018–2020

Time	Event	Status	Note
19 March, 2018	LB Group Co., Ltd. announced its plan to fully acquire Sichuan Anning Iron and Titanium Co., Ltd. through issuance of shares and cash. The matching funds would be raised publicly.	Failed	On May 18, 2018, LB Group announced to terminate the acquisition of Anning Iron and Titanium due to a failure to reach an agreement on key terms. Instead, LB Group signed a procurement contract with Anning Iron and Titanium for titanium concentrate.
26 April, 2018	Yunnan Xijin Mining Industry Co., Ltd. held a press conference in Jiangsu Province regarding the plan of listing in Australia.	Failed	Established in 2015, Yunnan Xijin Mining's business covers the development, processing and sales of mineral resources. It aims to integrate, develop and utilize the titanium resources in Yunnan Province.
15 Aug., 2018	GPRO Titanium Industry Co., Ltd. announced to fully acquire Zhejiang Guxiandao Green Fiber Co., Ltd. with USD820.22 million, which is recognized as a small company tries to acquire a bigger one.	Finished	Guxiandao Green Fiber is mainly involved in the R&D, production and sales of PET industrial yarn and PET chips. It is one of the leading enterprises in the PET industrial yarn sectors.
2 Nov., 2018	Sichuan Anning Iron and Titanium Co., Ltd. was successfully listed on Shenzhen Stock Exchange.	Finished	On 17 April, 2020, Sichuan Anning Iron and Titanium Co., Ltd. was successfully listed on Shenzhen Stock Exchange.
	Materials for IPO (second try) of Sichuan Anning Iron and Titanium Co., Ltd. were formally accepted by China Securities Regulatory Commission (CSRC).		
27 May, 2019	LB Group Co., Ltd. acquired Yunnan Metallurgical Xinli Titanium Industry Co., Ltd.	Finished	By the end of 2019, LB Group Co., Ltd. has acquired 98.39% shares of Yunnan Metallurgical Xinli Titanium Industry Co., Ltd., whose 60,000 t/a chloride process TiO_2 capacity was just back to production in Dec. 2019 after years of suspension.
16 Nov., 2019	Shandong Lubei Chemical Co., Ltd. announced to acquire 100% shares of both Shandong Jinhai Titanium Resources Technology Co., Ltd. and Shandong Xianghai Titanium Resources Technology Co., Ltd.	Finished	Shandong Jinhai Titanium Resources Technology Co., Ltd. has TiO_2 capacity of 100,000 t/a. Shandong Xianghai Titanium Resources Technology Co., Ltd.'s 60,000 t/a chloride process TiO_2 is expected to be finished in 2021.

Time	Event	Status	Note
21 March, 2020	GPRO Investment Holding Group Co., Ltd., controlling shareholder of GPRO Titanium Industry Co., Ltd., announced to acquire 100% shares of Jiangsu Taibai Group Co., Ltd.	Finished	There is horizontal competition between GPRO Titanium Industry Co., Ltd. and Jiangsu Taibai Group Co., Ltd. after the acquisition. GPRO Investment Holding Group Co., Ltd. has promised to fix that in 36 months.

Note: Events above mainly focus on stock exchange information
Source: CCM

4.2 Policy and legislation

Environmental protection is a basic national policy in China and it's playing an increasingly important role in Chinese industries. The establishment of the Ministry of Environmental Protection in 2008 demonstrated China's determination to reduce pollution and achieve sustainable development.

In 2018, the State Council reformed its subordinate institutions. The Ministry of Environmental Protection was revoked and replaced by the Ministry of Ecology and Environment, whose main responsibilities are to formulate and implement eco-environmental policies, plans and standards, to take the charge of ecological environment monitoring and law enforcement, to supervise and manage pollution prevention and treatment activities, as well as to organize the environmental protection inspection and etc. The establishment of the Ministry of Ecology and Environment highlights the Chinese government's commitment to environmental protection.

Recent years, with the increasing attention being paid to environmental protection by government departments, the TiO_2 industry in China faced with unprecedented pressure as an industry of high pollution, high energy consumption, and high water consumption. During this period, the most influential actions upon China's TiO_2 industry were the central environmental protection inspections starting from Dec. 2015.

Central inspection teams were formed under the leadership of the Ministry of Environmental Protection in Jan. 2016. These teams were scheduled to head altogether to 31 provinces/municipalities/autonomous regions through several batches. The inspection work had not a day off; local environmental protection authorities were also required to exercise appropriate inspection and supervise rectification work before and after the inspections by the central government. Such inspections are unprecedented in terms of both time spent and regions covered. Major TiO_2 production bases were all affected for quite a time. The majority of TiO_2 manufacturers had to suspend or cut production given the stricter requirements and meticulous inspection.

After the first round of central inspection, on 29 March, 2018, the spokesperson of Ministry of Ecology and Environment stated that the Ministry planned to carry out the second round during 2018–2021. It aims to establish a dual-inspection system with central government and provincial governmental complementing each other to improve the long-term mechanism for environmental protection.

In addition, before the official announcement of a planned second round, the first round was still ongoing in certain regions, teams of central inspection launched environmental protection reviews now and then to check the implementation of the rectification plans. At the same time, environmental protection actions against severe air pollution were conducted in Beijing-Tianjin-Hebei Region.

Major impacts of the environmental protection inspections upon domestic TiO_2 industry are:

First, environmental protection cost grows ever higher. Since 2016, environmental protection

policies have become stricter in China. Once deemed unqualified, those companies would suffer environmental protection penalties, production suspension for rectification, which involuntarily drives up the cost of pollution treatment. Currently, most domestic TiO_2 production goes through sulfate process and waste treatment cost has risen to USD455/t (RMB3,000/t) to satisfy the emission standards.

Second, the living space of small- and medium-sized producers has been narrowed. According to laws and regulations, environmental protection facilities must be designed, constructed and put into operation simultaneously with the production lines. For sulfate process TiO_2 production, however, requirements for resources utilisation and environmental protection facilities are higher than those in chloride process TiO_2 production, because of extra treatment of by-products. Therefore, the sulfate process TiO_2 producers face greater pressure on environmental protection investment and operation. Particularly, small- and medium-sized producers have greater risks of being eliminated due to their weaknesses in capital and technology.

In order to effectively utilise titanium resources, reduce pollution and energy consumption, regulate market order and upgrade the industry, a series of policies has been put forward to regulate China's titanium dioxide industry. These policies point out four orientations in future regulatory work:

- Firstly, restrain expansion of currently dominant sulfate process technology.
- Secondly, encourage the development of titanium dioxide with chloride process.
- Thirdly, push titanium dioxide producers to improve environmental protection technology.
- Fourthly, promote industry integration.

Table 4.2-1 Relevant policies & legislations on Chinese titanium dioxide industry, 2012–2020

Issue time	Document	Issued by	Content
July 2012	12th Five-Year Plan for Comprehensive Utilization of Vanadium & Titanium Resources	NDRC	Weed out backward TiO_2 production lines in 2015, including: the sulfate process production line with capacity less than 20,000 t/a; the chloride process production line with capacity less than 15,000 t/a.
April 2016	Draft of Negative List for Market Access (Pilot Version)	NDRC	Forbid the construction of new TiO_2 projects with the sulfate process. The pilot areas were Tianjin, Shanghai, Fujian and Guangdong provincial level administration regions. Full coverage across China was officially implemented in Dec. 2018.
Jan. 2017	Notice of the Ministry of Finance and the State Administration of Taxation on Comprehensively Promoting the Reform of Resource Tax	SAT	Reduce resource tax on eligible cut-and-fill mining and mines at the stage of exhaustion. Encourage the exploitation of low-grade minerals and waste slag.
Oct. 2019	Guidance Catalogue for Industrial Structure Adjustment (2019 version)	NDRC	New capacity of sulfate process TiO_2 is listed in the Restricted Catalogue, while chloride process project with a capacity of over 30,000 t/a (included) per production line is listed in the Encouraged Catalogue.
Dec. 2020	Catalogue of Prohibited Commodities in Processing Trade	MOFCOM and GACC	TiO_2 was removed from the Catalogue from 1 Dec., 2020.

Source: Above-mentioned issuing departments & CCM

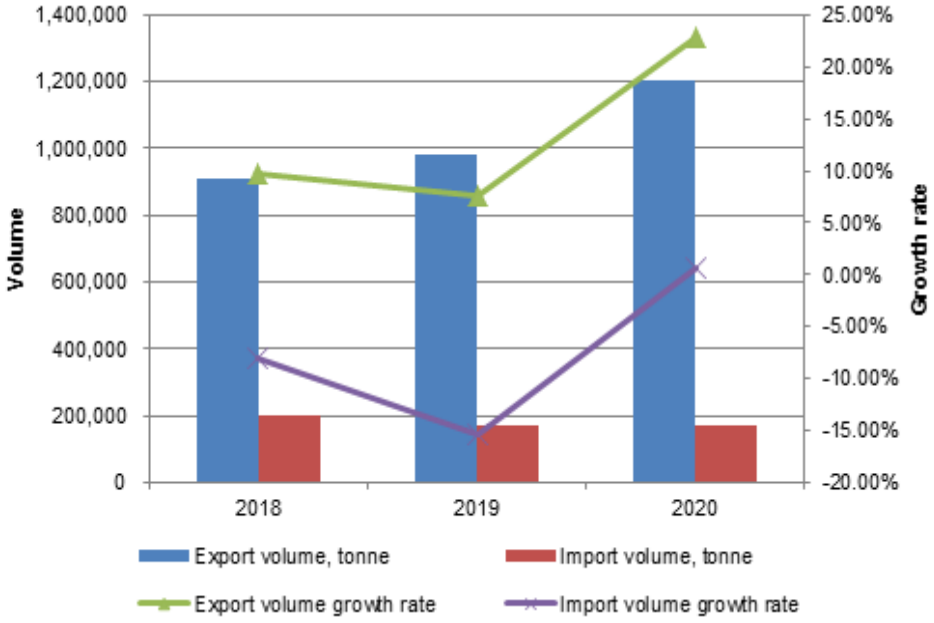
5 Import and export analysis

5.1 Overview 2018–2020

The export volume of TiO_2 from China continued to reach a new high in 2018–2020, along with improvement of product quality and contraction of TiO_2 production capacity overseas. With TiO_2 export exceeding 1,200,000 tonnes in 2020, China has been playing an increasingly important role in the international TiO_2 market.

In contrast, China's annual TiO_2 import has kept below 200,000 tonnes in this period. Although China's TiO_2 production technology has been improved and the quality elevated, China still has to rely on high-end TiO_2 import to meet domestic demand. During these three years, annual import of high-end TiO_2 to China stayed above 150,000 tonnes.

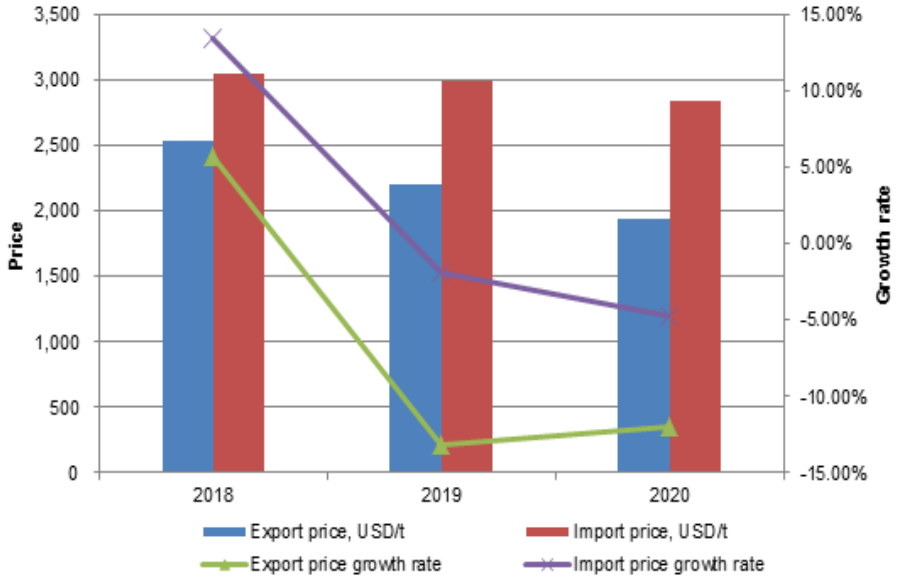
Figure 5.1-1 China's import and export volume of titanium dioxide, 2018–2020



Source: CCM & China Customs

With regard to the TiO_2 import and export prices in 2018–2020, the price gap between imported and exported TiO_2 was significant and even broadened, indicating that the majority of export products from China were just mid- to low-end ones.

Figure 5.1-2 China's import and export prices of titanium dioxide, 2018–2020



Source: CCM & China Customs

5.2 Import analysis 2018–2020

The import volume of TiO_2 to China went down in general with small fluctuation over the past three years, as the volume decreased to 167,091 tonnes in 2019 but edged up to 168,276 tonnes in 2020. The annual average import price went down to USD2,986/t in 2019 and further down to USD2,844/t in 2020.

In 2018–2020, dependency on titanium dioxide imports in China was 6.56%, 5.26%, 4.78% respectively; the downward trend mainly came from the following aspects:

Breakthrough of domestic chloride process technology

At present, there are 4 enterprises having mastered the chloride process technology. In 2020, the capacity and output of chloride process TiO_2 in China had reached 485,000 t/a and 318,900 tonnes respectively. The output of chloride process TiO_2 accounted for 9.05% of the total, an increase of 2.49 percentage points from 6.56% in 2019.

Released capacity and increasing output in China

Domestic output increased from 3,008,291 tonnes in 2018 to 3,522,600 tonnes in 2020, at a CAGR of 8.21%.

High import price

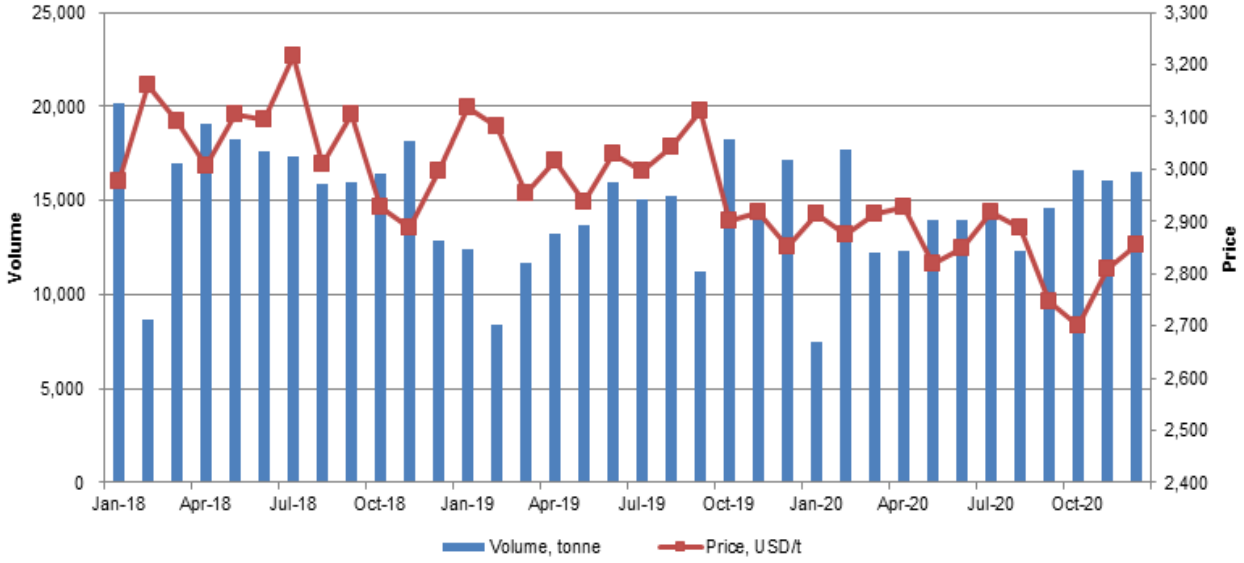
In the past three years, the exchange rate fluctuated a lot, and import price of TiO_2 was greatly affected. Since most of the imported TiO_2 is produced with chloride process, these high-end products came at high price.

In 2018, the import price remained high; the price in July reached USD3,217/t, the highest for the year. In February, the import volume fell to 8,647 tonnes, down 57.06% month on month, as the import price continued to rise and import demand thus weakened.

In 2019, the price still kept at high level, but the total import volume fell 15.37% year on year. In February, the import volume stood at 8,419 tonnes, the lowest of the year.

In 2020, the import price fell below USD3,000/t, and hit the bottom in October at USD2,701/t. China's monthly TiO_2 import remained above 12,000 tonnes all the year except January. It is fair to say that COVID-19 has barely affected the import volume of TiO_2.

Figure 5.2-1 China's import volume and price of titanium dioxide, Jan. 2018–Dec. 2020



Source: CCM & China Customs

5.3 Export analysis 2018–2020

China exported 911,635 tonnes in 2018, 980,008 tonnes in 2019 and 1,203,975 tonnes in 2020. In this period, the export volume expanded at a CAGR of 14.92%.

China's export volume of TiO_2 kept increasing mainly for the follow reasons:

- The price of TiO_2 from China is lower.
- The quality of TiO_2 has improved.
- Surging demand in overseas markets.

The top 10 export destinations in 2020 took up 52.30% of the total TiO_2 export, and the share was 52.65% in 2019 and 53.89% in 2018. China's TiO_2 export market is diverse, involving more than 140 countries. In 2018–2020, China's TiO_2 was mainly exported to some developing countries such as India, Brazil, Vietnam, Turkey, and Indonesia. It is worth noting that TiO_2 exports to India and Brazil continued to grow because of rigid demand for infrastructure there. While the exports to the US decreased significantly, affected by Sino-US trade disputes.

Table 5.3-1 China's top 10 export destinations of titanium dioxide, 2018–2020

No.	Country	2020		Country	2019		Country	2018	
		Quantity, tonne	Price, USD/t		Quantity, tonne	Price, USD/t		Quantity, tonne	Price, USD/t
1	India	135,810	1,879	India	126,936	2,172	India	94,564	2,447
2	Brazil	99,277	1,907	Brazil	72,583	2,186	The US	63,384	2,493
3	South Korea	73,149	2,008	South Korea	62,632	2,227	Brazil	56,816	2,475
4	Vietnam	62,696	1,992	Vietnam	52,767	2,238	South Korea	54,461	2,550
5	Turkey	59,377	1,916	Indonesia	49,701	2,158	Indonesia	46,855	2,476
6	Indonesia	49,657	1,940	Turkey	38,126	2,174	Vietnam	42,325	2,539
7	Malaysia	38,729	1,944	Malaysia	32,580	2,178	Turkey	40,481	2,532
8	Canada	38,324	1,852	United Arab Emirates	31,247	2,182	Iran	33,700	2,783
9	Egypt	37,525	1,996	Thailand	25,109	2,204	Italy	29,926	2,613
10	France	35,087	1,916	France	24,302	2,228	Malaysia	28,799	2,521
Others		574,346	1,938	Others	464,025	2,200	Others	420,324	2,532
Total/Average		**1,203,975**	**1,933**	**Total/Average**	**980,008**	**2,195**	**Total/Average**	**911,635**	**2,527**

Source: CCM & China Customs

Asia-Pacific region, West Europe and South America were the core regions for China's TiO_2 export in this period.

Table 5.3-2 China's titanium dioxide export volume by region, 2018–2020

Region	Export volume, tonne			Share		
	2020	2019	2018	2020	2019	2018
Africa	84,322	66,264	54,931	7.00%	6.76%	6.03%
Asia	473,320	425,224	360,712	39.31%	43.39%	39.57%
Central and Eastern Europe	127,065	92,455	84,678	10.55%	9.43%	9.29%
Middle East	103,183	79,261	84,758	8.57%	8.09%	9.30%
NAFTA	67,138	44,834	80,799	5.58%	4.57%	8.86%
Oceania	14,113	11,283	10,997	1.17%	1.15%	1.21%
South America	157,342	118,757	96,728	13.07%	12.12%	10.61%
West Europe	177,492	141,930	138,032	14.74%	14.48%	15.14%
Total	**1,203,975**	**980,008**	**911,635**	**100.00%**	**100.00%**	**100.00%**

Note: Due to rounding, the total may not equal 100.00%.
Source: CCM & China Customs

As to exporter, in 2018–2020, Lomon Billions Sichuan Titanium Industry Co., Ltd. ranked first in TiO_2 export volume, LB Group Co., Ltd. came second; their export volume accounted for some 15% and 12%% to the total export in 2020 respectively.

Table 5.3-3 Major Chinese titanium dioxide exporters, 2018–2020

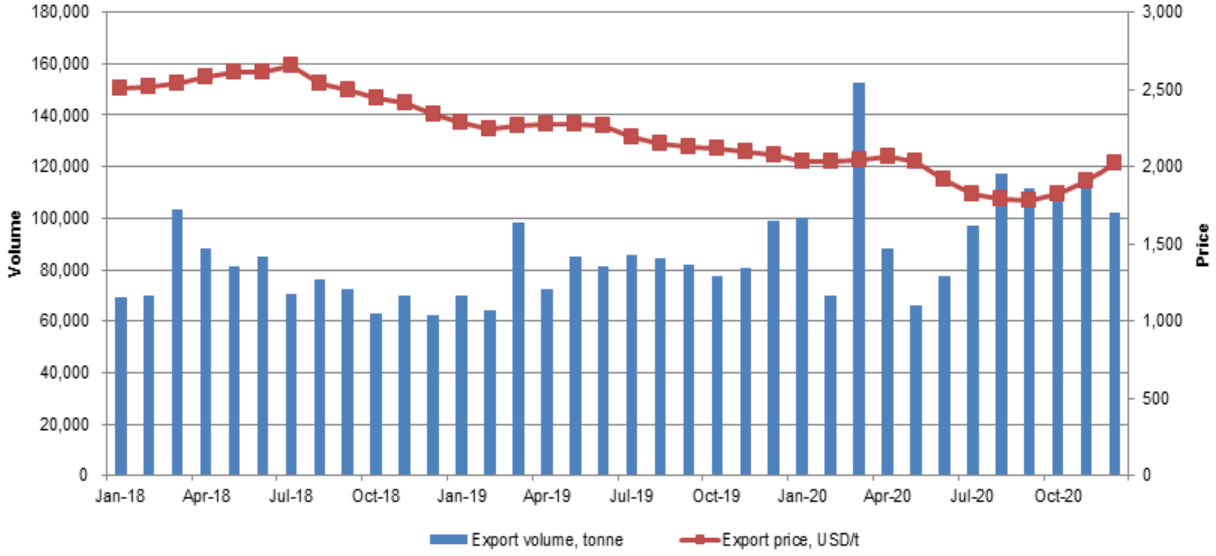
Exporter	Volume, tonne			Main destination
	2020	2019	2018	
Lomon Billions Sichuan Titanium Industry Co., Ltd.	186,219	155,224	137,667	South Korea, India, France, Brazil, Israel
LB Group Co., Ltd.	144,834	94,795	112,415	Canada, India, France, Turkey, Brazil
Henan Billions New Materials Co., Ltd.	93,232	49,673	35,314	France, United Kingdom, India, Brazil, Indonesia
Anhui Goldstar Titanium Dioxide Sales Co., Ltd.	82,440	48,804	12,479	Poland, Brazil, India, Turkey, Italy
Shandong Jinhai Titanium Resources Technology Co., Ltd.	74,795	41,091	29,236	India, Pakistan, Turkey, South Korea, Thailand
Anhui Goldstar Titanium Dioxide (Group) Co., Ltd.	74,348	46,098	67,728	Brazil, India, Turkey, Italy, Spain
Shandong Dawn International Trading Co., Ltd.	55,461	42,355	42,081	India, Egypt, South Korea, Indonesia, Brazil
Shandong Doguide Group Co., Ltd.	52,396	32,127	33,862	Indonesia, India, Brazil, Pakistan, Vietnam
Panzhihua Dongfang Titanium Industry Co., Ltd.	46,680	34,282	29,641	Turkey, United Arab Emirates, Indonesia, India, Brazil
Jinan Yuxing Chemical Co., Ltd.	46,172	49,915	58,276	India, Vietnam, Turkey, United Arab Emirates, Saudi Arabia

Source: CCM & China Customs

In general, the export price of TiO_2 in China tended to fell in 2018–2020. The export price dropped from USD2,650/t in July 2018 to USD1,785/t in September 2020, and then recovered slightly to USD2,019/t in December because of increased demand.

In 2020, the export volume of TiO_2 in China increased by 22.85% year on year. In Q1, affected by the COVID-19 outbreak in China, some overseas buyers worried that TiO_2 export would be blocked later, so they increased order. And in March the export volume of TiO_2 reached a record high at 152,766 tonnes. Overseas outbreaks led to a big dive of export volume in Q2. With the situation gradually eased abroad, monthly export volume exceeded 100,000 tonnes for the most time in H2.

Figure 5.3-1 China's export volume and price of titanium dioxide, Jan. 2018–Dec. 2020



Source: CCM & China Customs

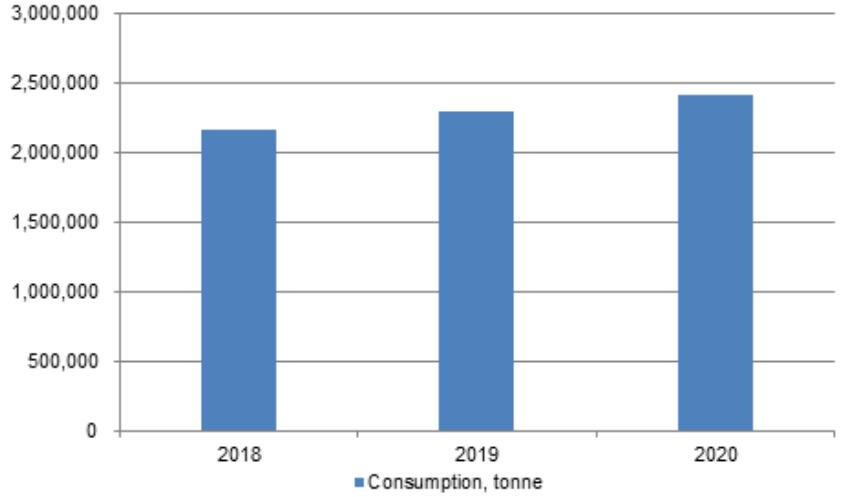
6 Consumption

6.1 Chinese titanium dioxide consumption situation, 2018–2020

China, as an industrial power, is not only a producing powerhouse, but also a big consumer of TiO_2. In 2018–2020, annual domestic consumption of titanium dioxide was 2,172,896 tonnes, 2,303,518 tonnes and 2,414,878 tonnes respectively, increasing with a CAGR of 5.42%.

Downstream application fields of TiO_2 are mainly coating, plastics, papermaking and chemical fiber, occupying the top four positions in China's TiO_2 consumption fields. In 2020, 60.91% of China's TiO_2 was used in coating, followed by plastics and papermaking, accounting for 19.01% and 11.19% of the total respectively.

Figure 6.1-1 Consumption volume of titanium dioxide in China, 2018–2020



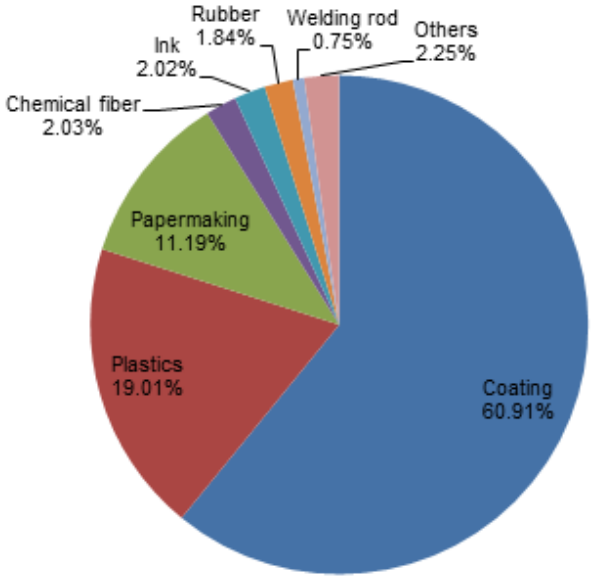
Source: CCM

Table 6.1-1 Consumption volume of titanium dioxide by major end use segment in China, 2018–2020

Industry	Consumption volume, tonne		
	2020	2019	2018
Coating	1,470,815	1,363,534	1,285,117
Plastics	459,000	502,089	477,583
Papermaking	270,240	236,830	229,570
Chemical fiber	49,012	47,622	40,089
Ink	48,900	47,400	46,080
Rubber	44,388	44,028	33,540
Welding rod	18,084	18,360	18,987
Others	54,439	43,655	41,930
Total	**2,414,878**	**2,303,518**	**2,172,896**

Source: CCM

Figure 6.1-2 Consumption pattern of titanium dioxide in China, 2020

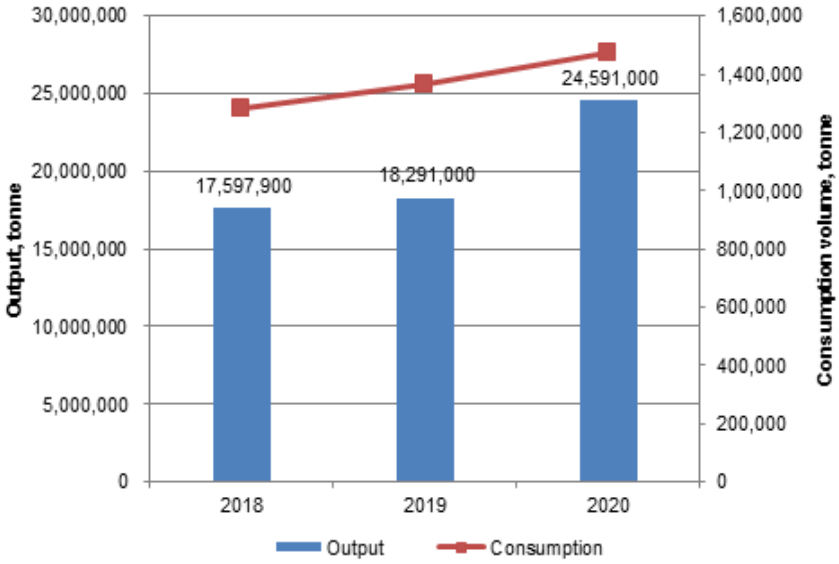


Source: CCM

6.1.1 Coating

Coating is the largest TiO_2 downstream sector in China. In 2018–2020, the TiO_2 consumption in coating was 1,285,117 tonnes, 1,363,534 tonnes and 1,470,815 tonnes respectively, with a CAGR of 6.98%. In the same period, the output of coating increased from 17,597,900 tonnes in 2018 to 24,591,000 tonne in 2020. In coating industry, architectural coating consumed about half of the TiO_2 for this sector, followed by industrial protective coating with a share of 26.68%.

Figure 6.1.1-1 Titanium dioxide consumption in the coating industry and output of coating in China, 2018–2020



Source: CCM

Architectural coating

In 2018–2020, the output of architectural coating grew steadily, mainly driven by the real estate industry and renovation of old houses. The demand for architectural coating has kept strong. For one thing, due to large number of houses in China and the advancement of renovation of old house, demand for architectural coatings increases continually; for another, growths in population and urbanisation rate, infrastructure construction and the real estate industry have brought greater market demand for architectural coatings.

● Real etsate industry

The real estate industry in China has a great demand for coating. Therefore, how the real estate industry fares greatly affects the demand for coating and thus the consumption of TiO_2. At present, the real estate market in China is still huge. In 2020, the real estate development investment increased by 7.00% year on year to USD2,041.50 billion (RMB14,144.30 billion). The housing construction area of real estate enterprises and housing completion area were about 9,268 million m^2 and 912 million m^2 respectively.

● Renovation of old house

According to the Ministry of Housing and Urabn-Rural Development of the People's Republic of China, there were about 160,000 old communities in China in 2019, involving more than 42 million households and a construction area of about 4 billion m^2 with an average construction area of 25,000 m^2 each community. If calculated on the ratio of external wall area to building area of 0.7, the external wall area of each community is 17,500 m^2. Assuming that 50% of the external wall area needs renovating with coating usage of 5 kg per square meter, and 25,000 old communities are renovated every year, there will be about 1.09 million tonnes of coating used in old house renovation each year. In 2020, 40,300 communities were renovated in China, and the coating consumption is estimated to be about 1.76 million tonnes.

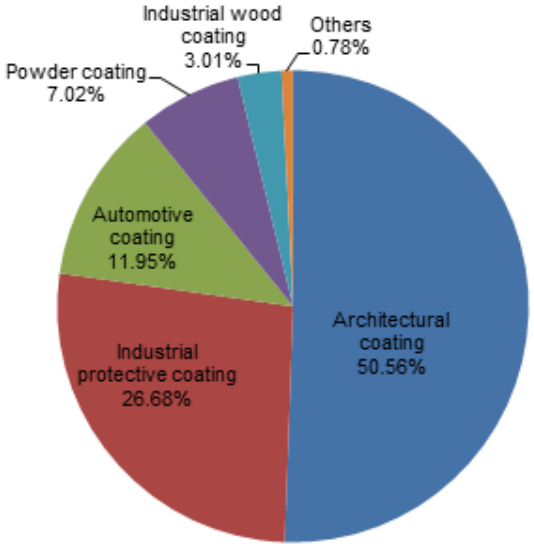
Industrial protective coating

Industrial protective coating took up the second largest proportion of TiO_2 consumption. In China, industrial protective coating includes marine, container and other anti-corrosion coating.

The booming shipbuilding and ship repair industries has increased the demand for marine coating. According to China Association of the National Shipbuilding Industry, in 2018–2020, the accomplished shipbuilding output increased from 34.71 million DWT (dead weight tonnage) in 2018 to 38.53 million DWT in 2020, with a CAGR of 5.36%. And the ships repaired by China's 19 ship repair companies rose from 4,505 in 2018 to 5,079 in 2020, with a CAGR of 6.18%.

According to the China Container Industry Association, China's container production output reached a record high in 2020, at 3.10 million TEU (twenty-feet equivalent unit). The increase in container output also drove up the market demand for container coating.

Figure 6.1.1-2 Titanium dioxide consumption pattern in the coating industry in China, 2020



Source: CCM

Titanium dioxide used in the coating industry requires good application performance in terms of chroma, hiding force, tinting strength and dispersity to ensure the quality of the coating. As a common practice, the rutile type is widely applied in architectural coating, because exterior wall coating requires excellent weatherability.

Rutile TiO_2 is also welcomed in industrial coating, which is mainly used on the surface of industrial products. And TiO_2 with better performance is required in this field. For example, the product used in automobile production must have good covering ability, anti-corrosion performance and sound weatherability. Coil coating and wood coating, used in household appliances, furniture, have looser requirements on weatherability. Powder coating requires only good covering ability and chroma, and both anatase and rutile can meet the requirement.

During the 14th Five-Year Period (2021–2025), the total output of the coating industry will keep steady growth; it is expected to reach about 30 million tonnes by 2025, with an average annual growth rate of 4%. In addition, the coating industry will witness industrial upgrading, product structure optmisation and increased proportion of environmentally friendly coating products. By 2025, environmentally friendly coating will account for 70% of the total output.

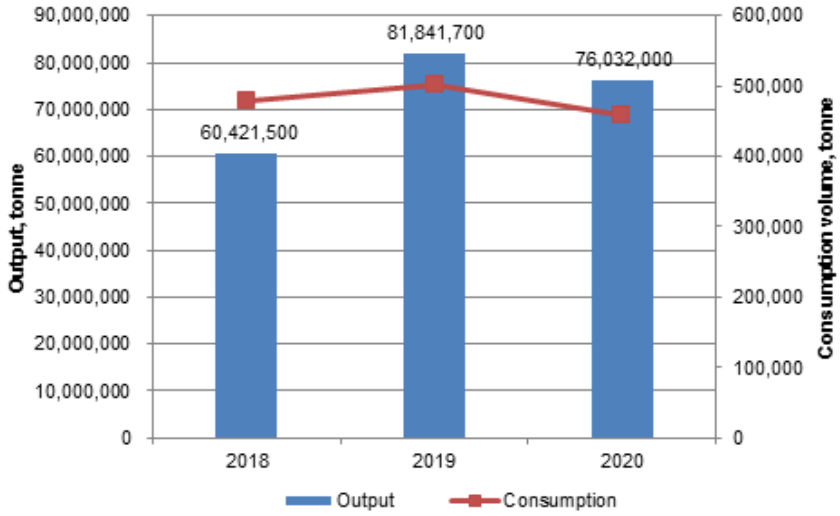
It is expected that the demand for TiO_2 from the coating industry will go up along with the increase in coating output in 2021–2025.

6.1.2 Plastics

China is the world's largest producer of plastics and plastics is China's second largest consumption field of TiO_2. In 2018–2020, China's consumption volumes of TiO_2 in plastics industry were 477,583 tonnes, 502,089 tonnes and 459,000 tonnes respectively.

In the past three years, yearly output of plastics was 60,421,500 tonnes, 81,841,700 tonnes and 76,032,000 tonnes respectively. Generally, TiO_2 consumption in plastics changes with the output of plastics. In 2020, daily plastic product and plastic pipe were the top two TiO_2 consuming sub-sectors in the plastics industry, taking up 19.15% and 17.11% respectively.

Figure 6.1.2-1 Titanium dioxide consumption in the plastic industry and output of plastics in China, 2018–2020

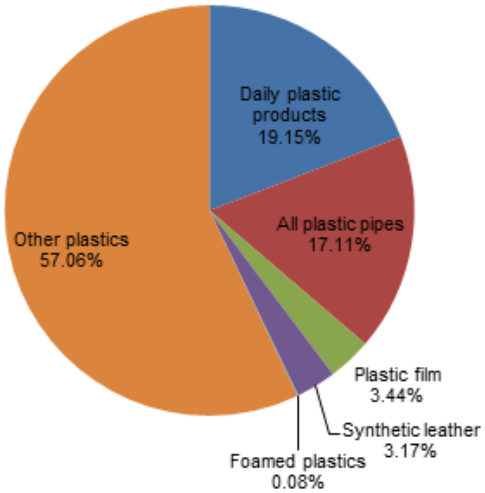


Source: CCM

The amount of titanium dioxide added in plastics varies with variety and application, generally ranging between 0.5%–5.0%. Daily plastic products consume the most of TiO_2; usually, average addition amount of TiO_2 in these products is about 30 kilograms per tonne. The output of daily plastic products saw a decrease in 2018, but rebounded sharply to 6,486,400 tonnes in 2019 and increased to 6,511,000 tonnes in 2020. Accordingly, TiO_2 consumption in this sector was 85,895 tonnes, 89,512 tonnes and 87,899 tonnes respectively.

Another big consumption sector of China's TiO_2 in the industry is all plastic pipes. In terms of consumption volume, it was 78,528 tonnes in 2020, down 20.68% from 99,003 tonnes in 2018. However, the output of all plastic pipes increased from 15,670,000 tonnes in 2018 to 16,360,000 tonnes in 2020, thanks to the development of real estate industry, old house renovation and the construction of urban pipelines.

Figure 6.1.2-2 Titanium dioxide consumption pattern in the plastics industry in China, 2020



Source: CCM

Titanium dioxide is used as colorant and reinforcer in the plastics industry, which requires high hiding power, good achromic ability, weatherability and surface-treatment effect. Rutile type is applied more widely than anatase type in plastics used in outdoor.

As to volume of titanium dioxide addition in plastic products, it varies according to type and quality. Titanium dioxide can be mixed with resin powder or plasticizer. It can also be processed into master batch first, which is a concentrated mixture of pigments and/or additives encapsulated during a heat process into a carrier resin, which is then cooled and cut into a granular shape. The master batch can be used by mixing with plastic resin in certain ratio according to different process requirements of the plastics and injection moulds.

During the 14th Five-Year Period, three development goals for the plastics processing industry have been put forward, including:

- Scale development: to keep steady growth in the output, revenue, operating profit and export value of plastic products.
- Technological innovation: R&D investment of key enterprises shall not be less than 3.20% of their revenue. Superior resources should be better integrated.
- Green development: to promote the application of new technologies for energy conservation, emission reduction and low-carbon & clean production, promote the use of new energy and adopt environment friendly new materials, processes & technologies to reduce energy consumption.

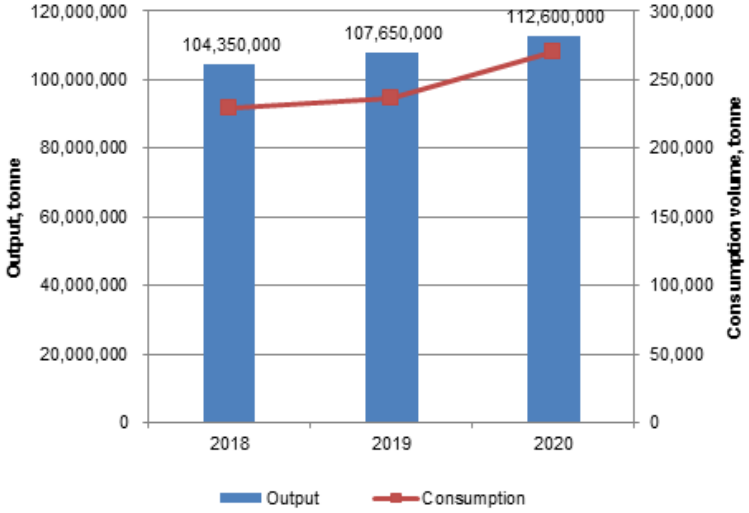
It is foreseeable that the production of and demand for plastics will continue to grow in 2021–2025. Therefore, demand for TiO_2 from this sector will also increase.

6.1.3 Papermaking

Papermaking is the third largest titanium dioxide consumption field in China, which accounted for about 11.19% of the total consumption volume in 2020.

In 2018–2020, the consumption volume of TiO_2 in the papermaking industry increased from 229,570 tonnes to 270,240 tonnes, at a CAGR of 8.50%. The output of paper increased from 104,350,000 tonnes in 2018 to 112,600,000 tonnes in 2020, at a CAGR of 3.88%.

Figure 6.1.3-1 Titanium dioxide consumption in papermaking industry and output of paper in China, 2018–2020



Source: CCM

One of the most important applications of TiO_2 in papermaking is decorative paper, which is mainly used to make furniture, floor and wallpaper. According to incomplete statistics, the TiO_2 content in decorative paper is 20%–40%, while that in other paper is 1%–5%. With the increase of domestic consumption level and the demand for house decoration & high-grade furniture, demand for decorative paper is expected to keep rising, thus driving up the consumption of TiO_2 in this field.

For different paper, the required TiO_2 addition and quality are different. In general, quality requirements for TiO_2 used in the papermaking industry are good covering force, good achromic ability, uniform granularity, good dispersity in water and high purity. TiO_2 is mainly used as fillers and colorants in papermaking industry in China.

Traditionally, anatase TiO_2 is extensively used in papermaking, which has better whiteness than the rutile type. But in recent years, the quality of rutile TiO_2 in China has improved greatly, including the whiteness property. Thus, more and more paper producers prefer to use the rutile ones to improve their products' anti-aging ability.

Besides, paper for different purposes requires different types of TiO_2. For example, rutile TiO_2 is used in decorative paper, mainly owing to its excellent oxidative stability and weather resistance. The rutile TiO_2 made through chloride process is much preferred for its better whiteness, rutile crystal content and stability. In contrast, banknote paper requires sulfate anatase TiO_2 to better satisfy its requirement of opacity.

During the 14th Five-Year Period, development goals for the papermaking industry by 2025, proposed by China Paper Association, are listed as follows:

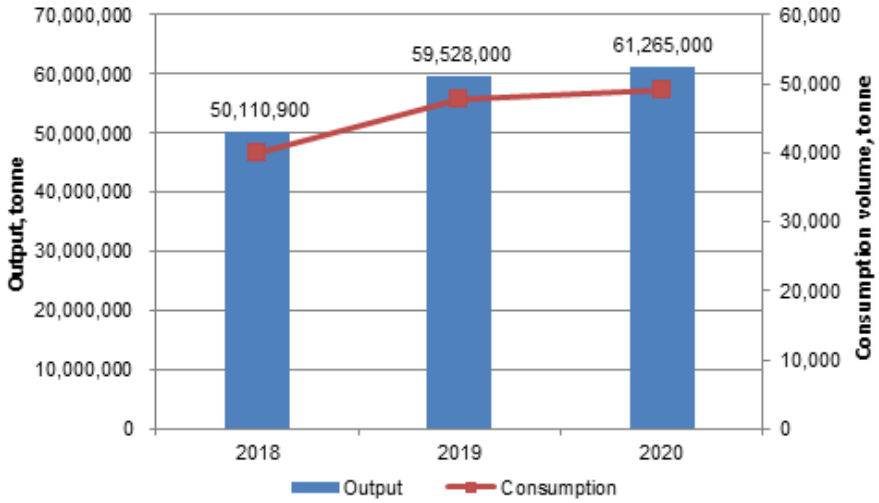
- The output of paper and paperboard will reach 140 million tonnes in China, and the annual per capita consumption will reach 100kg.
- The output of virgin pulp will reach 30 million tonnes.
- The output of paper products will reach 90 million tonnes.
- Product structure will be optimised, and product quality & variety improved.

In 2021–2025, the papermaking industry may witness rapid growth, and the demand for paper products will increase significantly, thereby driving up the demand for TiO_2 in this industry.

6.1.4 Chemical fiber

The chemical fiber industry's TiO_2 consumption accounted for 2.03% of the total, reaching 49,012 tonnes in 2020, with a CAGR of 10.57% in 2018–2020. The same growth rate is seen in the output of chemical fiber in this period, as it increased from 50,110,900 tonnes in 2018 to 61,265,000 tonnes in 2020.

Figure 6.1.4-1 Titanium dioxide consumption in chemical fiber and output of chemical fiber in China, 2018–2020



Source: CCM

Major categories using TiO_2 in chemical fiber industry are terylene, polyamide fiber, and viscose fiber. According to statistics from China Chemical Fibers Association, output of terylene in 2020 was 49,227,500 tonnes and polyamide fiber 3,842,500 tonnes, with a yearly increase of 3.89% and 3.87% respectively, while the output of viscose fiber fell to 3,954,700 tonnes, down by 4.11% year on year. Other chemical fibers have also developed quickly in China in recent years.

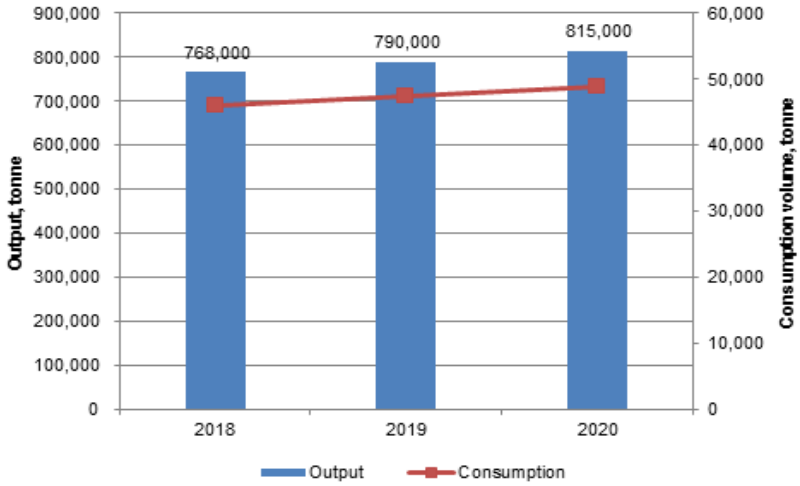
TiO_2 is usually used as a delusterant in the chemical fiber industry, with the effect generally being achieved at an addition of 2 kilograms per tonne. Requirements for TiO_2 used in the chemical fiber industry are: good whiteness, strong colouration, stable chemical properties, good dispersion, fine and uniform particles and good water dispersion. The particle size of fiber grade TiO_2 usually falls between 0.15 μm and 0.35 μm, and the process to make this kind of TiO_2 is complicated.

Compared with delustered fiber, semi-dull fiber is more popular in China. It is reported that the average TiO_2 addition is only 0.20%–0.50% in semi-dull fiber, while in delustered fiber, the application is 0.50%–1.50%.

6.1.5 Ink

In 2020, titanium dioxide consumption volume in the ink industry accounted for 2.02% of China's total, reaching 48,900 tonnes, with a CAGR of 3.01% in 2018–2020. Growing at the same pace, China's ink output increased from 768,000 tonnes in 2018 to about 815,000 tonnes in 2020.

Figure 6.1.5-1 Titanium dioxide consumption in the ink industry and output of ink in China, 2018–2020



Source: CCM

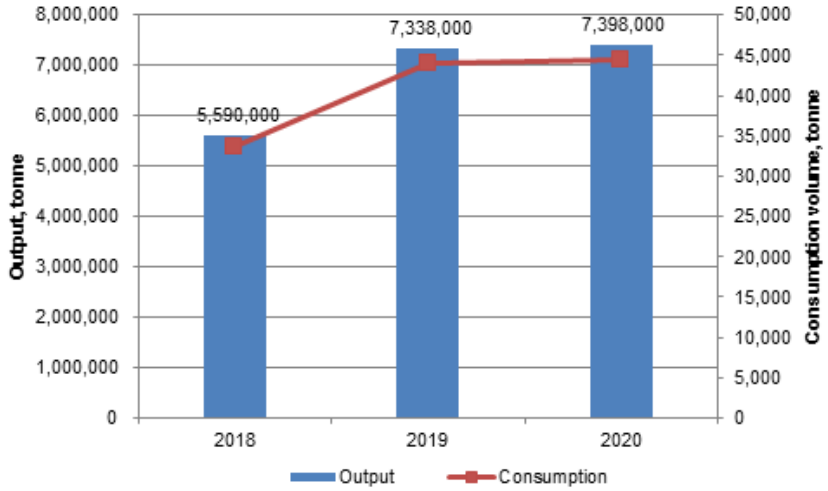
The amount of TiO_2 added to ink products is relatively large, typically between 25% and 50%. In recent years, the consumption of TiO_2 in ink has increased along with the rise of ink output. As demand for packaging in China still goes up, the consumption of TiO_2 in ink will continue to grow steadily.

In ink production, different types of ink products have different quality requirements. Generally speaking, TiO_2 used in the ink industry should have high covering ability and tinting strength, good achromic ability, moisture, chroma, dispersity. Rutile type is preferable in this field. And imported TiO_2 usually has better chroma and tinting strength than homemade one.

6.1.6 Rubber

In 2018–2020, the consumption volume of TiO_2 in the rubber industry was 33,540 tonnes, 44,028 tonnes and 44,388 tonnes respectively, with a CAGR of 15.04%. The industry accounted for 1.84% of the total TiO_2 consumption in 2020. During the same period, the output of synthetic rubber grew at a similar rate, reaching 7,398,000 tonnes in 2020.

Figure 6.1.6-1 Titanium dioxide consumption in the rubber industry and output of synthetic rubber in China, 2018–2020



Source: CCM

Titanium dioxide is used in tyre, rubber duct, rubber overshoes, texrope belt and so on.

Thereinto, tyre consumes the largest amount of TiO_2. Usually, a certain amount of rutile TiO_2 is added to tyre to enhance the resistance to ozone and ultraviolet ray.

Titanium dioxide used in rubber industry should have good heat resistance, covering ability, achromic ability and good dispersity.

In general, the anatase type is preferably used in the rubber industry. However, tyre requires good weatherability and high ultraviolet-resistance, and thus uses more rutile type.

During the 14th Five-Year Period, total output in rubber industry should follow a stable uptrend with slightly lower average annual growth rate than the current level, and the scale, influence and export share of China's rubber industry should be strengthened, according to the latest rubber industry development plan. It also sets output targets for main rubber products by 2025, including:

- Tyre: the output will be 704 million, and radialisation rate reach 96%.
- Cycle tyre: the cover tyre and inner tube of motorcycle will reach 120.70 million and 211.10 million respectively; those of bicycle will be 420 million and 550 million respectively; those of electric bicycle will be 363 million and 77 million respectively.
- Other rubber products: 4.5 billion pieces for seal products, 2.5 billion pieces for rubber damper, 6 million pieces for engineering rubber products and 1.5 billion pieces for rubber products in electronic appliances.

So in the next few years, the output of tyres and other rubber products is expected to increase steadily, and the demand for TiO_2 in the rubber industry will also increase.

6.1.7 Other consumption fields

There are also other fields using TiO_2, such as welding rod, enamel, tile, cosmetics, pharmaceutical, electronics, leather, food, alloy and glass. Generally speaking, TiO_2 consumption in these fields is relatively small.

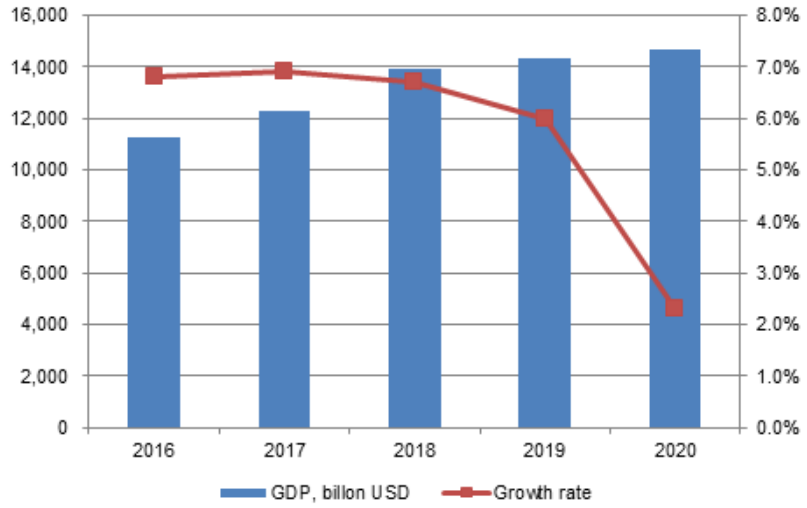
7 Forecast on Chinese titanium dioxide, 2021–2025

7.1 Drivers

Good performance of Chinese economy

China's economy has been growing steadily and its resilience continues to be highlighted. Although the GDP growth rate has slowed down since 2017, the rate stayed above 6% in 2016–2019. The decline in 2020 owed to the severe damage wrought by COVID-19.

Figure 7.1-1 GDP development and annual growth rate in China, 2016–2020



Source: National Bureau of Statistics

Stringent environmental regulations

In recent years, domestic environmental protection efforts have been gradually strengthened. Supervision teams from the central government have went through 31 provinces and municipalities since 2015, and the "look back" activities were launched to review environmental protection work nationwide in September 2018. Enterprises deemed to be environmentally unqualified would be punished by shutdowns and rectifications, which will not only increase the enterprises' pollution treatment cost, but also reduce the living space of small and medium-sized enterprises, thus leading to the collapse of sub-standard TiO_2 enterprises. There were about 60 domestic TiO_2 manufacturers before 2015, but now the number reduced to about 42. As of 2020, there were 11 domestic TiO_2 manufacturers whose capacity reached 100,000 t/a, taking up 66.66% of the total capacity, indicating a high industrial concentration. In addition, stricter environmental regulations have accelerated the development of the chloride process TiO_2.

Growing domestic demand from downstream industries

The downstream industries of TiO_2 such as coating, plastics and papermaking, will maintain a growth trend in their output during 2021–2025. Coating is the largest consumer of TiO_2, and the demand for coating in the real estate industry and the renovation of old houses is still strong. Therefore, the demand for TiO_2 in coatings will continue to grow in the next few years.

● Real estate industry: Statistics show that in 2016–2020, China saw increased investment in real estate development and housing construction area of real estate. In the next five years, it is expected that the real estate industry will continue to foster a prospering coating market. Besides, as the number of houses in China has continued growing, demand for redecoration will also keep expanding, stimulating the demand for coating. Thus, the real estate market still shows its potential to boost the demand for TiO_2.

● Renovation of old houses: With the advancement of the old house renovation project in China, the demand for coating will continue to expand.

In addition, downstream industries of TiO_2 have gradually expanded to fields like cosmetics, toys, food, and medicine. With the development of economy and broadening of application research, the demand for TiO_2 will become larger.

7.2 Barriers

Backward production process

In 2020, LB Group owned TiO_2 capacity of 1,010,000 t/a, ranking the first in China and the third worldwide, following Chemours (1,250,000 t/a) and Tronox (1,080,000 t/a). Although the capacity gap seems not large, the production techniques they use still tell the difference between domestic and overseas TiO_2 industries.

Specifically, about 88% of China's TiO_2 was produced with sulfate process, while more than 70% of TiO_2 from the top five foreign producers (Chemours, Tronox, Venator, Kronos and INEOS) was produced through chloride process. Chemours and INEOS even apply chloride process in all their TiO_2 production lines.

The quality of China's TiO_2 is still far from high-end application. China's chloride-processed TiO_2 just accounted for about 12% of the total TiO_2 capacity in 2020, which is far lower than that of overseas manufacturers. Domestic TiO_2 are mostly of lower grade that can only be used in the bottom-end products such as latex paint for building, and the export destinations are mainly underdeveloped countries like India who need low-grade TiO_2 in large amount. Only a small proportion is for developed areas such as the United States, Japan and Western Europe.

Reliance on high-quality ilmenite imports

In 2018–2020, domestic titanium concentrate output increased from 4,544,700 tonnes in 2018 to 5,747,000 tonnes in 2020. However, in 2018–2020, the dependency on ilmenite imports in China remained above 50%, with an import volume of 3,198,968 tonnes, 2,598,605 tonnes and 3,014,397 tonnes respectively. Capacity expansion of TiO_2 is obviously restricted by the supply of raw materials, and self-sufficiency of ilmenite has become a key factor in corporate competition.

Large gap between TiO_2 manufacturers

Capacity: In 2020, there were over 42 TiO_2 manufacturers in China, and only 11 manufacturers had capacity of or above 100,000 t/a. Among them, the top five held 2,025,000 t/a, occupying 49.35% of the total. This means that most TiO_2 producers are of small production scale.

Technique: So far, there are only 4 TiO_2 manufacturers whose chloride process TiO_2 projects have been built and put into production—LB Group Co., Ltd. (360,000 t/a), CITIC Titanium Industry Co., Ltd. (60,000 t/a), Yibin Tianyuan Haifeng Hetai Co., Ltd. (50,000 t/a) and Pangang Group Vanadium & Titanium Resources Co., Ltd. (15,000 t/a).

7.3 Qualitative forecast

China's titanium dioxide industry is likely to develop in the following trends.

Further integration of TiO_2 industry

As of 2020, the concentration of China's TiO_2 industry has increased: there were 11 manufacturers with capacity of 100,000 t/a and above, accounting for 66.66% of the total

capacity; 12 medium-sized enterprises with capacity in the 50,000 t/a to 100,000 t/a range, accounting for 17.43% of the total. LB Group, in particular, had TiO_2 capacity of 1.01 million t/a, ranking third in the world.

Increasing high-end application

In 2019, processed titanium products (TiO_2 as their raw material) are mainly used in the chemical industry, accounting for 51.26% of the total, followed by aerospace and metallurgy, taking up 20.85% and 5.97% respectively. Specifically, consumption in the chemical industry increased the most, by 9,238 tonnes, followed by aerospace, with an increase of 2,579 tonnes. In view of this trend, demand for TiO_2 in these industries is expected to grow rapidly over the next 3–5 years.

Tighter supply of titanium ore

Since the price fall in 2012, major titanium ore suppliers worldwide have slashed their capital expenditure; therefore, there had been hardly any new mines exploited and some existing mines getting close to exhaustion. As a big TiO_2 supplier, China will see new capacity be put into production in the future, but domestic titanium ore resources might fail to satisfy the growing demand from TiO_2 production. The supply of titanium ore will be further tightened.

Development of both production techniques

Currently in the overseas market, especially in developed countries, chloride process is the main production technique. Meanwhile in China, although there are some producers like LB Group that have built chloride process TiO_2 production lines, sulfate process still dominates. It is believed that the development of advanced chloride process will forge ahead along with the improvement of sulfate process.

Waste sulfuric acid is the main pollutant when applying sulfate process. Now it can be recycled to produce phosphate. For example, all of the waste sulfuric acid of Lomon Billions Sichuan Titanium Industry Co., Ltd. is used to produce phosphate, which reduces the pollution significantly. Other improvements to sulfate process include: using acid-soluble titanium slag instead of titanium concentrate as raw material, utilising waste heat from sulfur-based sulfuric acid production, recycling of waste acid and concentrated acid, etc.

It is worth mentioning that the technology of converting ferrous sulfate to ferric phosphate has attracted the attention of TiO_2 manufacturers. Ferrous sulfate is a by-product of TiO_2; it can react with phosphoric acid to produce ferric phosphate, a raw material for lithium iron phosphate. This by-product can be used for high-efficient and value-added purposes through the construction of iron phosphate production lines. Not only can the manufacturing cost of TiO_2 be reduced, but also the industrial chain can be extended, so as to realise a green and circular economy through comprehensive utilisation of resources.

In addition, improved sulfate process has its own advantages. It can produce both high-end rutile TiO_2 and low-end anatase TiO_2, while chloride process can only produce rutile TiO_2. Although rutile TiO_2 can be transformed into anatase TiO_2, the extra process will add production cost.

7.4 Quantitative forecast

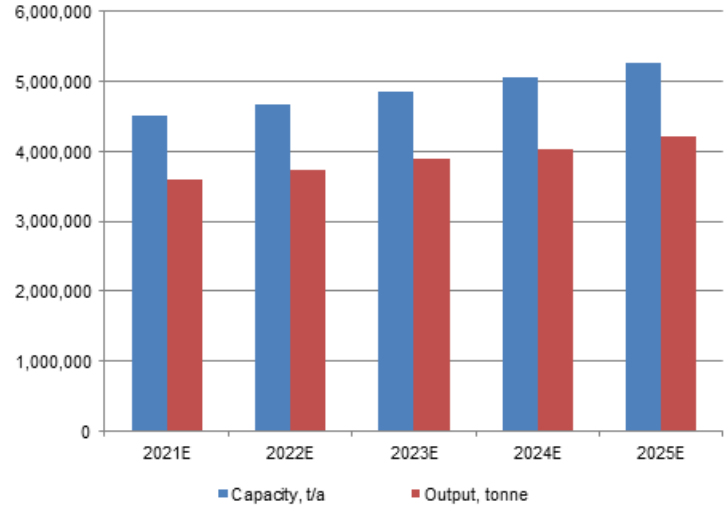
With the phase-out of backward capacity and restriction on sulfate process TiO_2 capacity expansion, domestic sulfate process TiO_2 capacity will be further concentrated in the future. If sulfate process capacity of less than 20,000 t/a should be eliminated, the total TiO_2 capacity will be cut by about 150,000 t/a, and if the elimination threshold is raised to 50,000 t/a, about 520,000 t/a production capacity will be evaporated.

As China's chloride process TiO_2 has not fully mastered the core technology so far, chloride

process TiO_2 production is still in its early stage. The TiO_2 capacity of the chloride process accounted for only 12% of the total domestic capacity in 2020, which is still miles away from foreign giants. According to the *Guidance Catalogue for Industrial Structure Adjustment (2019 Edition)*, construction of chloride process TiO_2 production lines with capacity of 30,000 t/a and above is encouraged. It is expected that in the next five years, the capacity of chloride process TiO_2 will be further increased.

In 2018–2020, there were many TiO_2 construction projects in China. With the new capacity released, domestic TiO_2 capacity and output will keep growing. It is estimated that by 2025, the total capacity will exceed 5.25 million t/a and the output will jump to about 4.21 million tonnes in China.

Figure 7.4-1 Forecast on capacity and output of titanium dioxide in China, 2021–2025



Source: CCM

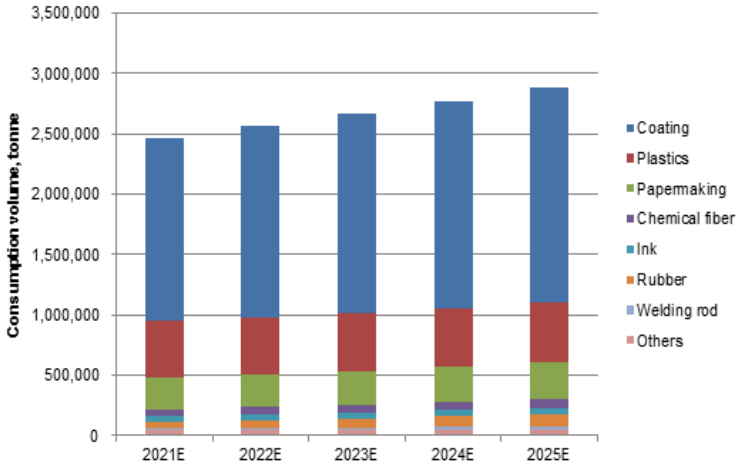
In the next five years, coating, plastics and papermaking industries will still be the three largest downstream sectors, together consuming 90% or so TiO_2 products in China.

The coating market absorbs the biggest portion of TiO_2. It is expected that the demand from coating industry will grow at a CAGR of about 4% during 2021–2025. As economy grows, the coating market will be promising with the support of major customers like real estate, renovation and automobile enterprises. Besides, coating industry will follow an environment-friendly & water-based path as the 13th Five-Year Plan promoted and the general trend in the industry demonstrated.

At present, TiO_2 demand from plastics industry accounts for about 20% of the total in China. As environmental protection requirements push the industry to upgrade and the government encourages hi-tech and light-weight products, China's plastics industry is expected to see a jump in demand and thus consume more TiO_2, growing at a CAGR of about 2% in consumption volume during 2021–2025.

Being the third largest application field of TiO_2, papermaking makes up about 10% of the total consumption. TiO_2 demand growth from this industry will slow down due to the elimination of outdated capacity as well as paperless trend in the digital age, which may be offset somewhat by surging demand for decorative paper though. It is expected that the demand for TiO_2 in papermaking industry will grow at a CAGR of about 5% in 2021–2025.

Figure 7.4-2 Forecast on consumption volume of titanium dioxide in main application industries in China, 2021–2025



Source: CCM

8 Opportunity

8.1 Raw material

Huge opportunities in China's TiO_2 market await domestic and foreign titanium mining and processing producers. Titanium ore accounts for about 60% of TiO_2 production cost. Therefore, the supply of titanium ore is decisive for the development of TiO_2 industry.

According to the USGS, China's ilmenite reserves were 230 million tonnes in 2020, accounting for 33.05% of the global total, ranking first in the world. Despite the large reserves, supply of titanium ore is still tight as the grade of titanium ore resources is low and the mining is difficult in China, so a large amount of imports is still required.

On one hand, producers have paid much attention to the integration of domestic titanium ore resources. For instance, on 19 March, 2018, LB Group announced to acquire Sichuan Anning Iron and Titanium Co., Ltd., in order to expand the reserves in the raw material titanium concentrate. However, the acquisition plan was eventually terminated due to the failure of the two enterprises to reach an agreement on the core terms. Furthermore, another leading titanium dioxide producer CNNC Hua Yuan would set integration of industrial chain as its strategic goal. Experiences show that ilmenite self-sufficiency has played an important role in improving TiO_2 quality, reducing operating cost and boosting financial results. Given that, the company will focus on expanding ilmenite capacity via M&A to build a stable ilmenite supply chain.

On the other hand, domestic chloride process TiO_2 producers have to use imported high-grade titanium ore because the technique requires higher quality and purity of titanium ore. That is why domestic chloride process TiO_2 producers and titanium ore distributors have been looking for high-quality titanium ore sources overseas. As most of the world's large-scale high-quality titanium ore resources have been controlled by large international companies, it is very necessary for Chinese chloride process TiO_2 producers to negotiate a stable supply with high-quality titanium ore suppliers.

In 2018–2020, the dependency on ilmenite import remained above 50%, but domestic demand for high-quality ilmenite was still in short supply. In this context, domestic TiO_2 manufacturers need to continuously expand its overseas reach in search of high-quality titanium ore resources. Besides, they need to introduce new technology, increase research and development and other means to improve the optimal utilisation of titanium ore resources.

8.2 Technical supporting/cooperation

In recent years, domestic TiO_2 industry leaders have begun to build facilities for chloride process TiO_2 production. Communication and cooperation between domestic and overseas technology suppliers in this sector have been increasing. It is expected that more domestic players will turn to chloride process and technological exchanges will increase further.

The cooperation between domestic TiO_2 producers and overseas technology suppliers are as follows:

On 25 Jan., 2019, LB Group announced it had signed a Strategic Cooperation Agreement with Outotec Oyj to optimise and couple the techniques and technologies of pre-reduction of ilmenite, comprehensive utilisation of vanadium-titanium magnetite resources and producing chloride process titanium slag from titanium concentrate. Achievements of such cooperation would include: on the one hand, producing chloride process titanium slag from titanium concentrate can then continue to produce chloride process TiO_2. Second, recycle valuable elements such as vanadium and niobium in an efficient way.

On 1 March, 2019, LB Group announced it had reached an accommodation through friendly negotiation with Ti-Cons Jendro, Weiland und Partner Management Consultants in regard to

the legal dispute over the Contract of Technology Transfer and Technical Service for the Design, Construction and Operation of Chloride Process TiO_2 Production Line signed before. The day before, the two sides, considering the technology and management advantages from each side, signed a Letter of Intent on Cooperation in Technology Transfer and Production Optimisation for the development of chloride process TiO_2.

On 31 May, 2020, LB Group announced it had signed a technical cooperation contract with Ti-Cons Technology Consulting GmbH. The two parties would cooperate in the fields of intelligent automatic control system, production optimisation, improvement of production organisation, new products and product quality, environmental protection issues, reduction of production costs, etc.

Table 8.2-1 Progress of China's chloride process TiO_2 project, 2021–2023

No.	Company	Expansion, t/a	Expected finish time	Progress
1	Shandong Xianghai Titanium Resources Technology Co., Ltd.	60,000	2021	Under construction
2	CITIC Titanium Industry Co., Ltd.	60,000	2021	Under construction
3	Yibin Tianyuan Haifeng Hetai Co., Ltd.	50,000	2021	Under construction
4	Hebei Jicheng New matericals Co., Ltd.	160,000	2021	Under construction
5	LB Group Co., Ltd.	100,000	2022	Under construction
6	LB Group Co., Ltd.	200,000	2023	Under construction
7	Pangang Group Vanadium & Titanium Resources Co., Ltd.	60,000	2023	In preparation

Source: CCM

However, we should notice that leaders in chloride process TiO_2 production as Chemours, Tronox Limited and Venator who have the most advanced techniques and technologies have so far never transferred the core technologies to any other company. The existing chloride process production equipment in China has been self-developed or with the help of foreign technical consultation. Since the technology adopted here in China is not complete and mature, enormous challenges and difficulties are inescapable.

8.3 Development of titanium dioxide for special purpose

Due to the stricter environmental protection policies in China recent years, the demand for TiO_2-based SCR (selective catalytic reduction) catalyst has grown strong. SCR catalyst is of importance to nitric oxide pollution reduction and is mainly composed of nanoscale TiO_2. It not only saves energy and protects the environment, but also shows good photostability and high reactivity in the reaction. With features of non-toxicity, low cost and no secondary pollution, it is a nano-functional material with wide application prospect. Currently, nanoscale TiO_2 is mainly used in wastewater treatment, air purification, sterilisation, medical technology and environmental protection material production. It is worth noting that new applications also boost the demand for nanoscale TiO_2. Such as nanoscale TiO_2 for lithium batteries, which is an excellent lithium battery material because of its good lithium intercalation capacity, low toxicity, low energy consumption, good stability, and eco-friendliness. Besides, it can also be used for some capacitor materials, solar energy materials, temperature-reducing and energy-saving materials, etc.

In addition, the booming real estate and automobile industries are in need of ever more high-end TiO_2 products. Seeing this, domestic TiO_2 producers have been hurrying up to develop higher-quality special purpose TiO_2 to fill the market gap. For example:

- In Dec., 2018, Anhui Annada Titanium Industry Co., Ltd. announced that the ART-311, a high-end green coating rutile TiO_2 product, was successfully co-developed with Jiangsu

Top Fine New Material Co., Ltd. and debuted in the market in Dec. 2018.

● In Dec. 2019, LB Group Co., Ltd. applied for a patent of a preparation method of super-weather-resistant titanium dioxide, which enables the surface of TiO_2 to form a more uniform and dense film layer by adopting a special surface treatment process. Products thus obtained also have excellent dispersity and storage stability, and has quite good formula applicability in downstream customers due to small coating amount.

● In June 2020, TiO_2 type DR-2589 developed by Kunming Donghao Titanium Co., Ltd. and Inter-China Chemical Co., Ltd. debuted. It is reported that DR-2589 is used in high weather-resistant plastics, with properties of good lightness in colouring, hiding power and dispersion, excellent processability, thermal resistance and chalking resistance.

8.4 Trading

In Nov. 2020, the Ministry of Commerce and the General Administration of Customs of the People's Republic of China issued the NO. 54 Notice on the adjustment of the Catalogue of Commodities Prohibited from Processing Trade (the Catalogue). TiO_2 was removed from the Catalogue since 1 Dec. 2020, which is propitious to TiO_2 export as manufacturers can apply for tax rebate.

With improvement in quality and broadening application, the competitiveness of China's TiO_2 has been greatly improved in recent years. China's TiO_2 export volume has maintained a rapid growth, and more and more foreign end users have turned to China in search of TiO_2. Domestic producers are actively exploring overseas markets. It would be wise for foreign companies to work with domestic producers to establish distribution networks worldwide.

9 Contact information of major producers in China

Table 9-1 Contact information of major producers in China

No.	Producer	Website	Telephone	Fax	Address
1	LB Group Co., Ltd.	www.lomonbillions.com	86-391-3126553/3126699	86-391-3126111	No. 1669 Jiaoke Road, Jiaozuo City, Henan Province, P. R. China
2	CNNC Hua Yuan Titanium Dioxide Co., Ltd.	www.zhtb.com	86-555-3501312	86-555-3501312	No. 8 Xingfu Road, Zhangjing Industrial Park, Xibei Town, Xishan District, Wuxi City, Jiangsu Province, P. R. China
3	Pangang Group Vanadium & Titanium Resources Co., Ltd.	www.pgvt.cn	86-812-3385366	86-812-3385285	Pangang Culture Square, 21 Pangang Avenue, East District, Panzhihua City, Sichuan Province, P. R. China
4	GPRO Investment Holding Group Co., Ltd.	www.nthcl.com	86-025-58366818	86-025-58366800	No. 229 East Dawei Road, Nanjing Chemical Industry Park, Jiangsu Province, P. R. China
5	Shandong Doguide Group Co., Ltd.	www.doguide.net	86-533-4161746	86-533-4167746	No. 55 Hengli River, Qiugu, Boshan District, Zibo City, Shandong Province, P. R. China
6	China National Chemical Co., Ltd.	www.chemchina.com/portal/index.htm	86-776-2994352/86-531-67612778	86-776-2993908/86-531-67612796	No. 62 North Sihuan West Road, Haidian District, Beijing Municipality, P. R. China
7	Shandong Jinhai Titanium Resources Technology Co., Ltd.	www.jinhaiti.cn	86-543-6455877	86-543-6455977	Qikou Town, Wudi County, Binzhou City, Shandong Province, P. R. China
8	Shandong Dawn Titanium Industry Co., Ltd.	www.dawntio2.com	86-535-8825068	/	New Materials, New Energy Industrial Park, Longkou Economic Development Zone, Longkou City, Shandong Province, P. R. China
9	Guangxi Jinmao Titanium Co., Ltd.	www.jinmaotaiye.cn	86-774-7301933	86-774-7290558	Chemical Industrial Park, Teng County, Wuzhou City, Guangxi Zhuang Autonomous Region, P. R. China
10	Yunnan Dahutong Industrial & Trade Co., Ltd.	www.yndht.com	86-871-68327488/86-812-6211371	86-871-68316444/86-812-6210817	20th Floor, Building A, Hecheng International, No. 1088 Haiyuan Middle Road, High-tech Zone, Kunming City, Yunnan Province, P. R. China
11	Ningbo Xinfu Titanium Dioxide Co., Ltd.	www.xinfu-tio2.com	86-574-86669696	86-574-86669818	No. 1 Yuejintang Road, Zhenhai District, Ningbo City, Zhejiang Province, P. R. China
12	Panzhihua Taihai Technology Co., Ltd.	www.tisea.cn	86-812-6210820	86-812-6210820	Vanadium Titanium Industrial Park, Panzhihua City, Sichuan Province, P. R. China
13	Anhui Annada Titanium Industry Co., Ltd.	www.andty.com	86-562-3867940	86-562-3864285	No. 1288 South Section of Tongguan Avenue, Tongling City, Anhui Province, P. R. China
14	Guangdong Huiyun Titanium Industry Co., Ltd.	www.gdtitanium.com	86-766-8611868	86-766-8613336	Fuxing Road, Liudu Town, Yunan District, Yunfu City, Guangdong Province, P. R. China
15	CITIC Titanium Industry Co., Ltd.	www.jzty.com.cn	86-416-7183439/7182822	86-416-7182388	No. 1 Jintai Road, Taihe District, Jinzhou City, Liaoning Province, P. R. China

No.	Producer	Website	Telephone	Fax	Address
16	Panzhihua Haifengxin Chemical Co., Ltd.	www.pzhhfx.com	86-812-6210138	86-812-6210199	No. 70 Taiyuan Road, Vanadium Titanium Industrial Park, Panzhihua City, Sichuan Province, P. R. China
17	Guangxi Shunfeng Titanium Industry Co., Ltd.	www.shunfeng.cc	86-774-2678099	86-774-2678080	No. 15 Longcheng East Road, Longxu Town, Longxu District, Wuzhou City, Guangxi Zhuang Autonomous Region, P. R. China
18	Panzhihua Xingzhong Titanium Industry Co., Ltd.	www.xztypt.com	86-812-621369	/	Vanadium Titanium High-tech Industrial Park, Panzhihua City, Sichuan Province, P. R. China
19	Jiangxi Tikon Titanium Co., Ltd.	/	86-794-8355555	86-794-8352555	No. 4 Antang Road, Fubei Town, Linchuan District, Fuzhou City, Jiangxi Province, P. R. China
20	Kunming Donghao Titanium Co., Ltd.	www.kmdhty.cn	86-871-68854222	/	Kunming Titanium Salt Industrial Base, Fumin County, Kunming City, Yunnan Province
21	Panzhihua Hengtong Titanium Co., Ltd.	www.hengtongty.com	86-812-3509212	86-812-3509218	No. 31 Titanium Avenue, Vanadium Titanium High-tech Industrial Development Zone, Panzhihua City, Sichuan Province, P. R. China
22	Guizhou Sunward Fuquan Chemical Co., Ltd.	www.sunwardchemical.com	86-871-63102972	/	Shuanglong Industrial Park, Niuchang Town, Fuquan City, Qiannan Prefecture, Guizhou Province, P. R. China
23	Suzhou Hongfeng Titanium Industry Co., Ltd.	www.szhongfeng.com.cn	86-512-65396890	86-512-66729852	No. 151 Bao'an Road, High-tech Zone, Suzhou City, Jiangsu Province, P. R. China
24	Fumin Longteng Titanium Industry Co., Ltd.	/	86-871-68854066	86-871-68854068	Beiying Titanium Industrial Park, Yongding Town, Fumin County, Kunming City, Yunnan Province, P. R. China
25	Wuhan Fangyuan Titanium Dioxide Co., Ltd.	www.fytb.com	86-027-83412402	86-027-83412907	HSBC Corporate Headquarters, Qiaokou District, Wuhan City, Hubei Province, P. R. China
26	Alfa Full (Guangxi) Titanium Dioxide Co., Ltd.	www.alfafull.com	86-774-7502178	86-774-7502121	Mengjiang Town, Teng County, Nanning City, Guangxi Zhuang Autonomous Region, P. R. China
27	Panzhihua Tianlun Chemical Co., Ltd.	www.pzhtl.com	86-812-3161186	86-812-3161196	An'ning Industrial Zone, Yanbian County, Panzhihua City, Sichuan Province, P. R. China
28	Yibin Tianyuan Haifeng hetai Co., Ltd.	www.ybty.com	86-831-5980821	86-831-5980823	No. 61 Port Park Road, Lingang Economic and Technological Development Zone, Yibin City, Sichuan Province, P. R. China
29	Panzhihua Taidu Chemical Industry Co., Ltd.	www.pzhtd.com.cn/index.html	86-510-83220520	86-510-83220520	Vanadium Titanium Industrial Park, Panzhihua City, Sichuan Province, P. R. China
30	Nexttech Materials Co., Ltd.	www.nexttechmat.com	86-562-5327558	/	Jincheng Industrial Park, Tongling City, Anhui Province, P. R. China
31	CNMC (Guangxi) Pgma Co., Ltd.	www.pgma.com.cn	86-774-8835566	86-774-8836098	No.1 Power Plant South Road, Pinggui District, Hezhou City,

No.	Producer	Website	Telephone	Fax	Address
					Guangxi Zhuang Autonomous Region, P. R. China
32	Denox Advanced Materials Co., Ltd.	denox.net.cn	86-562-2611727	86-562-2611099	No. 399 Changshan Avenue, Economic and Technological Development Zone, Tongling City, Anhui Province, P. R. China
33	Shanghai Pengbo Titanium Dioxide Co., Ltd.	www.pengbotio2.com	86-021-57266998	86-021-57266998	No. 55 Lane 66, Xiasheng Road, No. 2 Industrial Zone, Jinshanwei Town, Jinshan District, Shanghai Municipality, P. R. China
34	Guangxi Detian Chemical Cycle Co., Ltd.	www.gxdtchem.com	86-771-3723388	86-771-3723388	Leiping Town, Daxin County, Guangxi Zhuang Autonomous Region, P. R. China
35	Huai'an Feiyang Titanium Dioxide Manufacturing Co., Ltd.	/	86-517-85730098	86-517-85733099	Erbao Village, Shitang Town, Huaian District, Huaian City, Jiangsu Province, P. R. China
36	Guangxi Xilong Chemical Co., Ltd.	www.bb-hy.com	86-775-8736388	/	Wangmao Industrial Park, Bobai County, Yulin City, Guangxi Zhuang Autonomous Region, P. R. China
37	Hunan Chuangda Yutu Chemcial Co., Ltd.	www.hncdyt.cn	86-734-8300502	86-734-8300502	Jinjialing Village, Chashan'ao Town, Zhuhui District, Hengyang City, Hunan Province, P. R. China
38	Guangxi Baihe Chemical Co., Ltd.	/	86-771-5508881	86-771-5511380	Baihe Base of Pingguo County, Guangxi Zhuang Autonomous Region, P. R. China
39	Panzhihua Zhengyuan Technology Co., Ltd.	/	86-812-8102209	/	Baima Vanadium and Titanium Industrial Park, Miyi County, Panzhihua City, Sichuan Province, P. R. China
40	Yumen Jingyang Titanium Pigment Manufacturing Co., Ltd.	/	86-937-3272185	86-937-3272186	Jianhua Industrial Park, Yumen East Town, Yumen City, Gansu Province, P. R. China

Source: CCM

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