

Survey of Inorganic Fluoride in China

The Sixth Edition

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Researched & Prepared by:

Kcomber Inc.

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Executive summary

Fluorine chemical industry has been one of the fastest developing and most promising chemical industries in China. China has become a major fluorine chemical producer as well as a big consumer. At present, great progress has been made in the research and development of inorganic fluorides in China. Inorganic fluorides have been widely used in chemical, mechanical, optical instrument, electronic and medical fields and become important chemical products in the national economy.

As the largest producer of anhydrous hydrogen fluoride (AHF) in the world, China had total capacity of 2,542,000 t/a in 2021, and achieved an output of 1,580,000 tonnes. AHF is vital to the development of fluorine industry, and the demand for AHF will be bolstered by improved demand in the future.

China is also the largest producer of aluminum fluoride and cryolite in the world. In 2021, the domestic capacity of aluminum fluoride and cryolite were 1,460,000 t/a and 573,000 t/a respectively. At present, aluminum fluoride and cryolite industries have been affected by the supply-side reform in electrolytic aluminum industry, and the capacity and output have been on the decline.

Production of lithium hexafluorophosphate developed fast in the past five years. In 2021, the total capacity in China increased to 104,360 t/a, and the output jumped to 54,300 tonnes. It is expected that the growth momentum will continue with promising new energy vehicle market.

Methodology

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, seminars as well as information from the internet. A lot of work has gone into the compilation and analysis of the obtained information. When necessary, checks have been made with Chinese suppliers regarding production information.

2. Telephone interviews

CCM has carried out extensive telephone interviews to compile this report. Interviewees cover the following:

- Key producers
- Key traders
- Material suppliers
- Associations
- Experts

3. Network search

CCM employs a network to contact industry participants by using B2B website and software. CCM also obtains registration information via network.

4. Data processing and presentation

The data collected and compiled are variously sourced from:

- CCM's database
- Published articles from periodicals, magazines, journals and third party databases
- Statistics from governments and international institutes
- Telephone interviews with domestic producers, joint ventures, service suppliers and government agencies
- Third-party data providers
- Customs statistics
- Comments from industrial experts
- Professional databases
- Information from the Internet

The data have been combined and cross-checked to ensure that this report is as accurate and methodologically sound as possible. Throughout the process, a series of discussions have been held within CCM to systematically analyse the data and draw appropriate conclusions.

- Glossary

CAGR: compound annual growth rate

GDP: gross domestic product

AHF: anhydrous hydrogen fluoride (AHF is equivalent to hydrogen fluoride in the report)

- Unit

CNY: currency unit in China, also called Yuan

USD: currency unit in the US, also called US Dollar

Tonne: ton, equals to metric ton in this report

/t: per tonne

t/a: tonne per year, tonne per annum

kg: kilogram

Table Exchange rate of USD/CNY, Jan. 2017–Aug. 2022

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
2017	6.8918	6.8713	6.8932	6.8845	6.8827	6.8019	6.7772	6.7148	6.5909	6.6493	6.6300	6.6067	6.7662
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	6.3693	6.4615
2022	6.3794	6.3580	6.3014	6.3509	6.5672	6.6651	6.6863	6.7467	-	-	-	-	-

Source: The People's Bank of China

1 Brief introduction of inorganic fluorides in China

Inorganic fluorides include anhydrous hydrogen fluoride (AHF), aluminum fluoride, cryolite, lithium hexafluorophosphate and etc.

- AHF: it is a basic raw material in fluorine industry, mainly used to produce inorganic and organic fluorides.
- Aluminum fluoride: it is a sandy powder, which is mainly used in aluminum smelting to reduce the melting point and improve conductivity of the electrolyte. It is also used as a fluxing agent for ceramic glaze and enamel glaze.
- Cryolite (Na_3AlF_6): it is a fluxing agent, mainly used in the electrolytic production of aluminum. It is also used as a wear-resistant additive for rubber products and grinding wheels, as a whitening agent for enamel, etc.

With the development of new energy, electronic information, and pharmaceutical industries, inorganic fluorides, including fluorine electronic chemicals, fluorine-containing special gases, and fluorine-containing fine chemicals, have a bigger market.

2 Production and market situation of major products

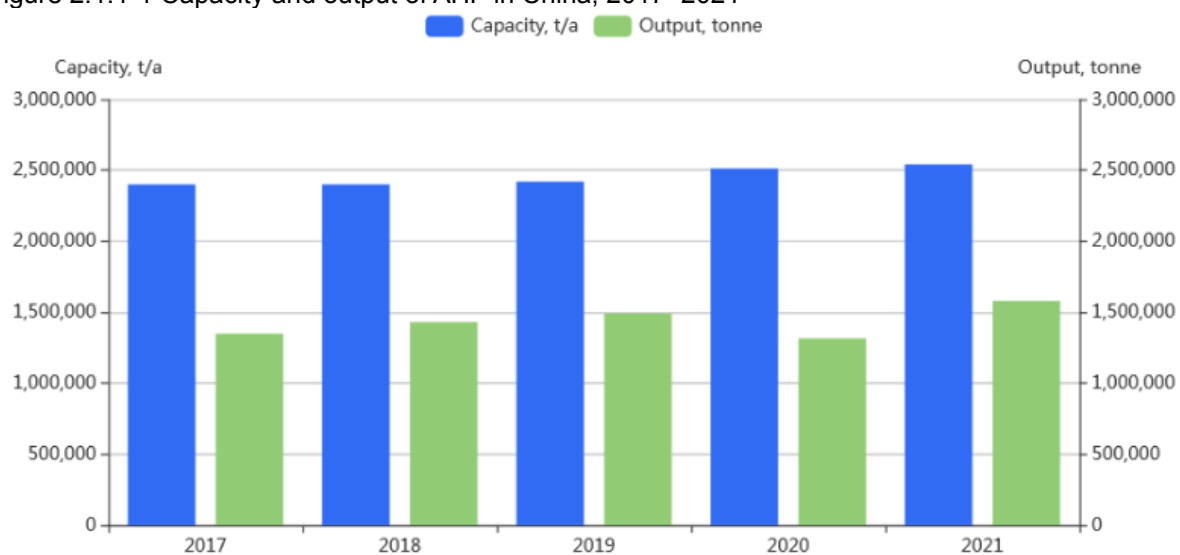
2.1 Anhydrous hydrogen fluoride

2.1.1 Production situation

China is the largest anhydrous hydrogen fluoride (AHF) manufacturer in the world. Domestic AHF manufacturers concentrate in Zhejiang, Fujian and Jiangxi provinces, where there are abundant fluorite resources and many downstream users of AHF.

In 2017–2021, China's AHF capacity witnessed a slight upward momentum, increasing to 2,542,000 t/a in 2021. The output also maintained an overall growth trend, except that the figure in 2020 slipped to 1,316,000 tonnes, due to delayed production resumption and thus decreased operating rate under the COVID-19 pandemic. In 2021, thanks to effectively eased COVID-19 situation at home and rising demand from downstream industries, the AHF output rebounded to 1,580,000 tonnes, up by 20.1% year on year.

Figure 2.1.1-1 Capacity and output of AHF in China, 2017–2021



Source: CCM

Table 2.1.1-1 Main active AHF manufacturers in China, 2020–2021

No.	Producer	Location	Capacity, t/a		Output, tonne	
			2021	2020	2021	2020
1	Dongyue Group Ltd.	Shandong	210,000	180,000	150,000	121,000
2	Do-Fluoride New Materials Co., Ltd. (formerly known as Do-fluoride Chemicals Co., Ltd.)	Henan	200,000	150,000	160,000	135,000
3	Zhejiang Sanmei Chemical Industry Co., Ltd.	Zhejiang	131,000	131,000	129,200	130,700
4	Zhejiang Juhua Co., Ltd.	Zhejiang	115,000	80,000	60,000	60,000
5	Qinghai Western Mining Tongxin Chemicals Co., Ltd.	Qinghai	100,000	100,000	80,000	31,000
6	Zhejiang Yonghe Refrigerant Co., Ltd.	Zhejiang	85,000	85,000	73,100	70,300
7	Shaowu Huaxin Chemical Industry Co., Ltd.	Fujian	50,000	50,000	45,000	25,000
8	Jiangsu Meilan Chemical Co., Ltd.	Jiangsu	50,000	50,000	40,000	35,000
9	Jiangxi Dongyan Pharmaceutical Co., Ltd.	Jiangxi	50,000	50,000	30,000	27,500
10	Jiangxi Shilei Fluorine Chemicals Co., Ltd.	Jiangxi	50,000	50,000	32,000	18,800
11	Hunan Nonferrous Chenzhou Fluoride Chemical Co., Ltd.	Hunan	40,000	40,000	36,000	36,000
12	Shaanxi Yanchang Petroleum Group Fluorosilicon Chemical Co., Ltd.	Shaanxi	40,000	40,000	30,000	24,000
13	Jiangxi Tianxing Chemical Co., Ltd.	Jiangxi	40,000	40,000	25,000	22,000
14	Fujian Shunchang Fubao Tengda Chemical Industry Co., Ltd.	Fujian	35,000	35,000	28,000	33,000
15	Jiangxi Chinafluorine Chemical Co., Ltd.	Jiangxi	35,000	35,000	21,000	15,800
16	Guizhou Wengfu Kailin Fluorosilicon New Material Co., Ltd.	Guizhou	30,000	30,000	25,000	25,000
17	Changshu 3F Fluorochemical Industry Co., Ltd.	Jiangsu	30,000	30,000	23,000	21,000
18	Fujian Yongfu Chemical Co., Ltd.	Fujian	30,000	30,000	21,000	10,500
19	Yantai Zhongrui Chemical Co., Ltd.	Shandong	30,000	30,000	18,000	11,600
20	Luoyang Fluoride Potassium Technology Co., Ltd.	Henan	30,000	30,000	18,000	7,500
Others			1,161,000	1,246,000	535,700	455,300
Total			2,542,000	2,512,000	1,580,000	1,316,000

Source: CCM

Capacity in most AHF producers scarcely changed in the past two years, but the capacity in leading enterprises such as Dongyue Group Ltd., Do-Fluoride New Materials Co., Ltd. and Zhejiang Juhua Co., Ltd. increased, because they need more AHF to sustain large-scale production of downstream products.

From 2020 to 2021, the share of top ten Chinese AHF producers by capacity to the national total increased, yet the share of top ten by output to the total declined.

Table 2.1.1-2 Capacity and share of main AHF manufacturers in China, 2020–2021

Item	Capacity, 2021		Capacity, 2020	
	Volume, t/a	Share	Volume, t/a	Share
Top five	756,000	29.7%	646,000	25.7%
Top ten	1,041,000	41.0%	926,000	36.9%
Total	2,542,000	/	2,512,000	/

Source: CCM

Table 2.1.1-3 Output and share of main AHF manufacturers in China, 2020–2021

Item	Output, 2021		Output, 2020	
	Volume, tonne	Share	Volume, tonne	Share
Top five	592,300	37.5%	517,000	39.3%
Top ten	805,300	51.0%	679,500	51.6%
Total	1,580,000	/	1,316,000	/

Source: CCM

2.1.2 Price

In H1 2017, the ex-works price of AHF (99.95%) rose sharply from USD1,073/t to USD1,736/t, up by 61.7%. The main reasons for that are as follow:

- The price of fluorite, the key raw material of AHF, rose greatly.
- There was a short supply of AHF due to environmental protection pressures, routine maintenance and other factors which resulted in a low operating rate.
- The demand for AHF for the production of downstream refrigerants (like R22) increased greatly.

After a short time of adjustment in July–Aug. 2017, the price went up again and rocketed to USD2,371/t in March 2018, the highest price in the past six years. The shortage of fluorite was the main reason for this round of surge.

In 2019, the price fluctuated between USD1,349/t and USD1,868/t. It was deeply affected by the Sino-US trade dispute. With news on the phase-one trade deal between the two countries coming, the price finally stabilized at around USD1,400/t in Q4. In general, the AHF price trend in 2019 can be divided into four stages:

- From Jan. to early April: AHF market price fell sharply. Three things contributed to the decline. The first is the restart of the AHF devices after maintenance. The supply of AHF was sufficient in the market and the price decreased. Meanwhile, operating rate of upstream raw material fluorite rose slightly, especially in Inner Mongolia and Hebei. On the whole, the supply of fluorite increased, and the falling price of fluorite dragged down AHF price significantly. In addition, declining market conditions in downstream refrigerant market also affected the price.
- From mid-April to mid-July: The price rebounded. During this period, operating rate of domestic refrigerant industry rose slightly. Demand for AHF from the refrigerant sector increased, so the AHF price rebounded. On the other hand, supply of fluorite was slightly tight. The price of fluorite went up, which strongly supported AHF price.
- From late July to mid-Nov.: The price of AHF fluctuated a bit. The operating rate of AHF was about 60%. Spot AHF was sufficient while downstream refrigerant production was at a low level. Demand for upstream fluorite and AHF was poor. Specifically, operating rate of refrigerant R22 was around 50%. The operating rate of R134a remained low. Market demand for refrigerants was moderate and mainly for export.
- From the end of Nov. to the end of the year: AHF price rose slightly. Fluorite mining and flotation operated normally. As automotive industry was active in stocking, the supply of R22 was tight.

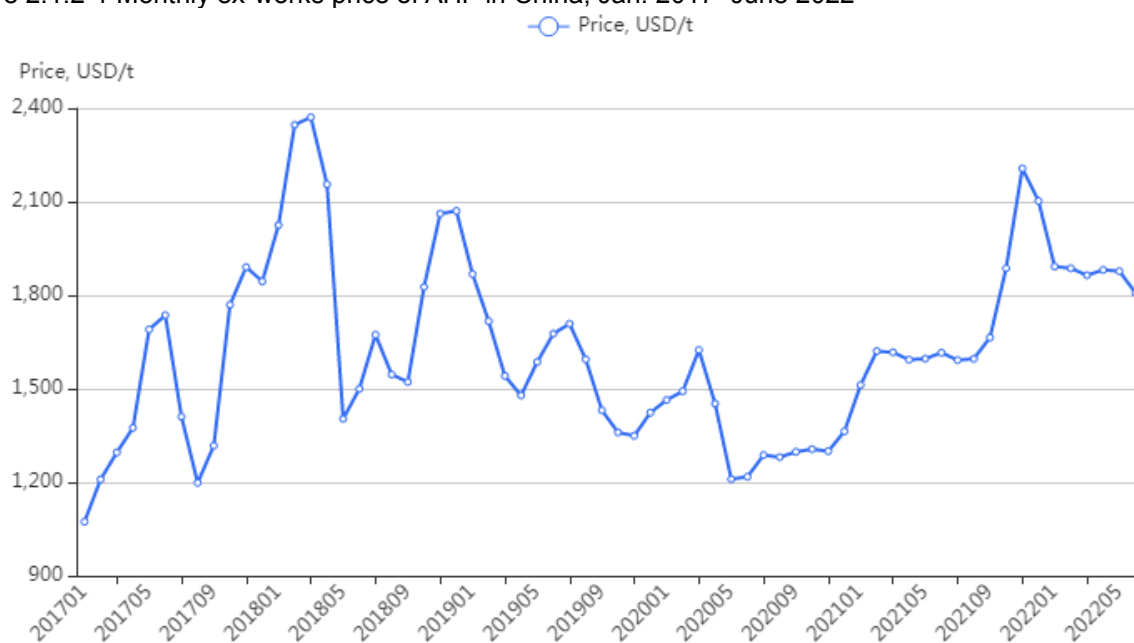
In H1 2020, the price first climbed to USD1,625/t in March, but dropped to USD1,210/t in May. The price rise in Q1 was mainly influenced by the COVID-19, as raw material supply was tight then due to impeded production, restricted transportation, as well as lack of available human resources. The AHF price followed the rising trend shown in prices of the raw materials. As domestic condition eased, production gradually resumed and AHF supply recovered, so the price began to fall. In H2 2020, the price stayed at a low level and rebounded within a narrow range, reaching USD1,363/t in Dec. 2020. The price was affected by sluggish downstream demand, especially a weak demand from refrigerant industry.

In 2021, AHF price started from USD1,512/t in Jan. and climbed to USD2,103/t in Dec., up by 39.1%. Specifically:

- In Jan.–Feb.: AHF price increased, driven by a mismatch between supply and demand and the increasing price of raw material fluorite.
- In March–Aug.: AHF price fluctuated slightly, influenced either by cost or by demand.
- In Sept.–Dec.: The rose rapidly, and peaked at USD2,207/t in Nov., mainly because prices of both the upstream material fluorite and downstream refrigerants rose.

In H1 2022, AHF price followed a downward trend, but it was still at a high level, above USD1,800/t, supported by costs.

Figure 2.1.2-1 Monthly ex-works price of AHF in China, Jan. 2017–June 2022

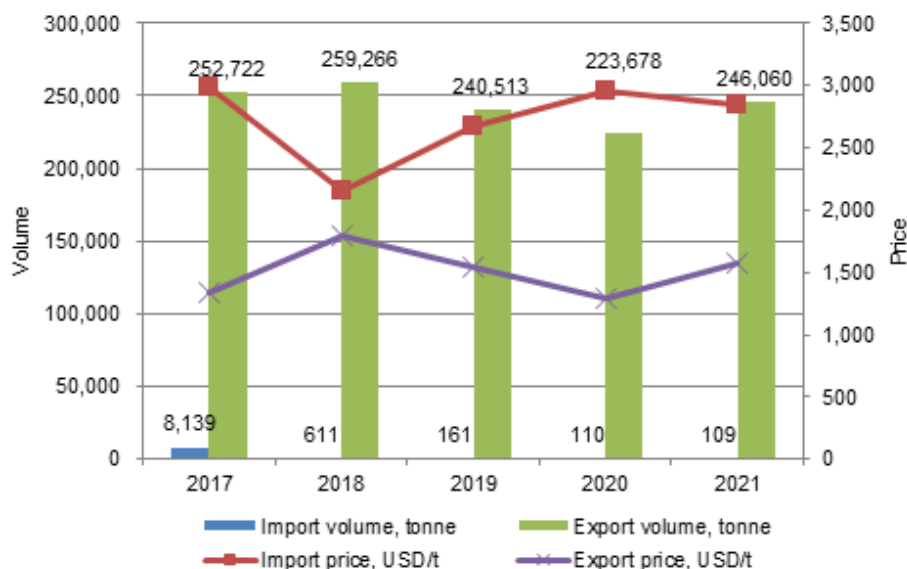


Source: CCM

2.1.3 Import and export

China AHF import is quite small. As to AHF export, the volume fluctuated in 2017–2021. The export volume increased to 259,266 tonnes in 2018, the highest in the past five years. It kept decreasing in 2019 and 2020, but recovered to 246,060 tonnes in 2021 as overseas demand for AHF improved.

Figure 2.1.3-1 Import and export of AHF in China, 2017–2021



Source: China Customs & CCM

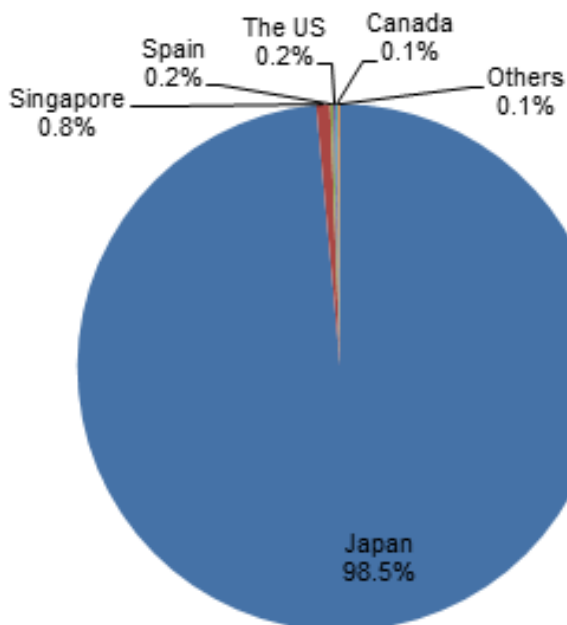
Table 2.1.3-1 Imports and exports of AHF in China, 2017–2021

Year	Import			Export		
	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t
2017	8,139	24,328,750	2,989	252,722	338,330,085	1,339
2018	611	1,316,003	2,155	259,266	463,492,030	1,788
2019	161	429,883	2,666	240,513	369,441,548	1,536
2020	110	325,255	2,957	223,678	288,553,356	1,290
2021	109	309,241	2,847	246,060	388,422,726	1,579

Source: China Customs & CCM

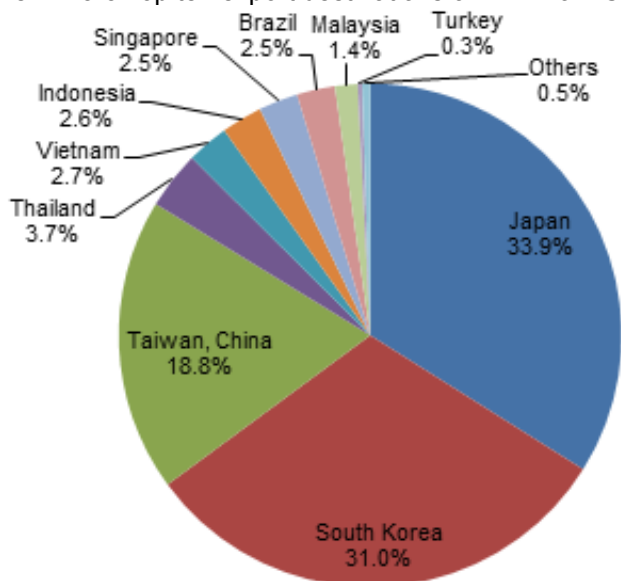
China mainly exports AHF to Asian countries and regions. In 2021, Japan was the largest export destination of China's AHF by volume, followed by South Korea, Taiwan Province, Thailand and Vietnam. Japan was also the largest import origin of AHF to China the same year, the volume making up 98.5% of total import volume.

Figure 2.1.3-2 Top import origins of AHF to China by volume, 2021



Note: Due to rounding, the total may not equal 100.0%.
Source: China Customs & CCM

Figure 2.1.3-3 Top ten export destinations of AHF from China by volume, 2021



Note: Due to rounding, the total may not equal 100.0%.
Source: China Customs & CCM

2.1.4 Future trends

AHF is vital to the development of fluorine industry. In the next few years, the development of AHF industry will be decided by the following three factors:

- Transformation and upgrading

Under so far the strictest environmental protection policies and supervision, enterprises in pursuit of capacity expansion must first upgrade production process, optimize devices, or further develop and utilize low-quality fluorine-containing resources to achieve transformation and upgrading.

- Raw materials

In recent years, China has had greater control over strategic resources and curbed ill-planned or unplanned exploitation of fluorite resources at home. China's fluorite output is expected to increase steadily in the near future. However, cost of obtaining mining rights and fluorite resources exploitation will be on the rise.

- Demand from related industries

The demand for AHF will be bolstered by improved demand from the downstream sectors like organic fluorine industry, inorganic fluorides, high-energy battery materials.

The price of AHF is usually affected by supply and price of its raw material fluorite. Driven by growing demand, the price of AHF is expected to fluctuate at a high level in the future.

Currently, some Chinese enterprises have ongoing AHF capacity expansion projects, and it is expected that China's AHF capacity will increase in the next two to three years.

Table 2.1.4-1 List of projects expected to be built up and operate in the near future

No.	Enterprise	Expansion, t/a	Expected finish time
1	Chifeng Pengfeng Chemical Co., Ltd.	100,000	2022
2	Zhejiang Quhua Fluor-chemistry Co., Ltd. (a subsidiary of Zhejiang Juhua Co., Ltd.)	40,000	2022
3	Luoyang Fengrui Fluorine Co., Ltd.	25,000	2022
4	Jiangxi Xingfu Zhonglan New Material Co., Ltd.	120,000	2023
5	Ulanqab Yingke Technology Development Co., Ltd.	50,000	2023
6	Jinchang Shuangyi Chemical Technology Co., Ltd.	30,000	2023
7	Fujian Wengfu Lantian Fluorchem Co., Ltd.	10,000	2023
8	Jiangxi Xingfu Zhonglan New Material Co., Ltd.	70,000	2024
9	Quzhou NGF Chemical Co., Ltd.	40,000	2024
10	Guizhou Chanhen Chemical Corporation	30,000	2024
11	Yunnan Wengfu Yuntianhua Fluorchem Technology Co., Ltd.	10,000	2024
12	Zhejiang Sanmei Chemical Industry Co., Ltd.	159,000	2025
13	Guizhou Chanhen Chemical Corporation	30,000	2025

Source: CCM

2.2 Aluminum fluoride

2.2.1 Production situation

Aluminum fluoride is an important material used in electrolytic aluminum industry and nearly 90% of aluminum fluoride is used in this area.

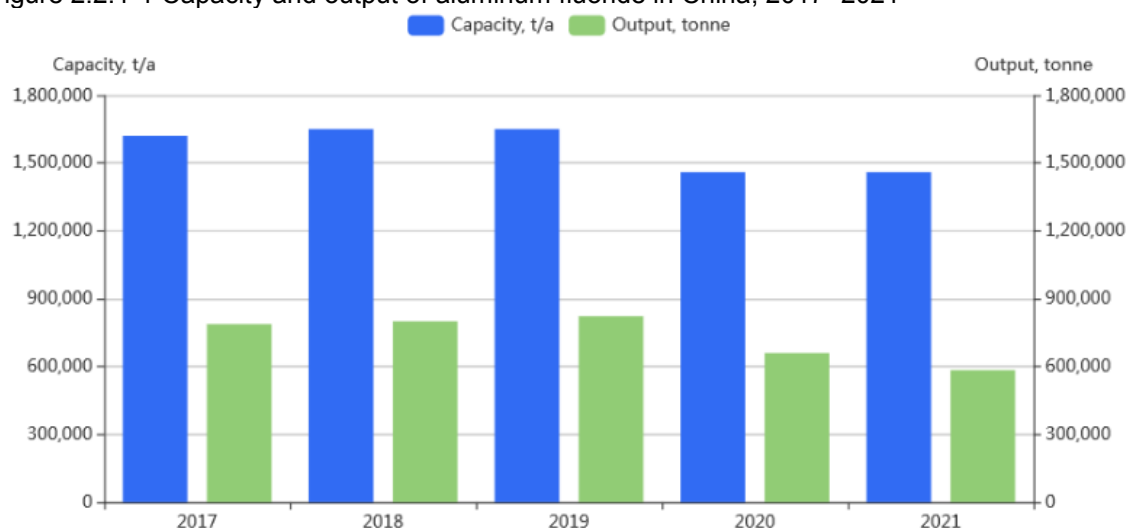
According to the China Inorganic Salt Industry Association, China's aluminum fluoride industry presents the following characteristics:

- The industry is in serious overcapacity, with large inventory and low operating rate;
- With improved aluminum fluoride quality, unit consumption of aluminum fluoride for electrolytic aluminum decreases.

As the largest aluminum fluoride provider in the world, China had above 1,600,000 t/a capacity of aluminum fluoride in 2017–2019. However, the capacity decreased to 1,460,000 t/a in 2020–2021, as some manufacturers cut down their capacity or switched to AHF production.

In 2017–2019, the output of aluminum fluoride increased slightly, reaching 823,000 tonnes in 2019. Hit by the COVID-19 pandemic and the policy of de-inventory, operating rate of aluminum fluoride in China lowered in the past two years. As a result, China's aluminum fluoride output fell in 2020 and further decreased to 584,000 tonnes in 2021.

Figure 2.2.1-1 Capacity and output of aluminum fluoride in China, 2017–2021



Source: CCM

In China, the production of aluminum fluoride is mainly concentrated in Henan Province and Shandong Province. Do-Fluoride Chemicals Co., Ltd. was the largest aluminum fluoride manufacturer in 2021, with the capacity of 300,000 t/a. Its capacity increased from 250,000 t/a in 2019 to 300,000 t/a in 2020. The second largest producer was Shandong Bofeng Lizhong Chemical Co., Ltd., with 90,000 t/a capacity, but its operating rate declined a lot in 2021, mainly affected by weak demand. Yizhang Hongyuan Chemical Co., Ltd. ranked third with 80,000 t/a capacity.

Table 2.2.1-1 Main active aluminum fluoride manufacturers in China, 2020–2021

No.	Producer	Location	Capacity, t/a		Output, tonne	
			2021	2020	2021	2020
1	Do-Fluoride New Materials Co., Ltd.	Henan	300,000	300,000	146,400	195,000
2	Shandong Bofeng Lizhong Chemical Co., Ltd.	Shandong	90,000	90,000	7,000	46,000
3	Yizhang Hongyuan Chemical Co., Ltd.	Hunan	80,000	80,000	28,000	31,000
4	Jiaozuo Jinruida Aluminum Industry Co., Ltd.	Henan	78,000	78,000	36,000	44,000
5	Hunan Nonferrous Hengdong Fluorin Chemical Co., Ltd.	Hunan	70,000	70,000	37,000	43,000
6	Guangxi Pingguo Hetai Technology Co., Ltd.	Guangxi	60,000	60,000	35,000	1,000
7	Henan Zhongse Dongfang Shaoxing Industrial Co., Ltd.	Henan	60,000	60,000	32,000	29,000
8	Jiangxi Fufeng New Material Technology Co., Ltd.	Jiangxi	60,000	15,000	5,000	13,000
9	Shandong Zhaohe New Materials Technology Co., Ltd.	Shandong	45,000	45,000	21,000	20,000
10	Jinyang Advanced Materials Co., Ltd.	Anhui	40,000	40,000	16,000	18,000
11	Yunnan Yuntianhua Fluorine Chemical Co., Ltd.	Yunnan	35,000	35,000	23,000	31,000
12	Zhangye Sanyi Chemical & Trading Co., Ltd.	Gansu	30,000	30,000	18,000	20,000
13	Shaanxi Yanchang Petroleum Group Fluorosilicon Chemical Co., Ltd.	Shaanxi	30,000	30,000	15,000	18,000
14	Chengde Yingke Fine Chemical Co., Ltd.	Hebei	30,000	30,000	15,000	13,000
15	Zibo Nanhan Chemicals Co., Ltd.	Shandong	25,000	25,000	10,000	10,000
16	Jiaozuo Minli Industrial Co., Ltd.	Henan	10,000	10,000	6,000	4,000
Others			417,000	462,000	133,600	124,000
Total			1,460,000	1,460,000	584,000	660,000

Source: CCM

2.2.2 Price

The price of aluminum fluoride mainly fluctuates along with the price of raw material AHF.

In 2017, the price kept going up; it began at USD1,006/t in Jan. and rocketed to USD1,918/t in Dec., up by 90.7%. Two big increases were seen: the first in Feb.–March, with the price up 15.31%, and the second in Oct.–Nov., up 26.66%. There were two main reasons for this surge: one was a supply shortage of aluminum fluoride in the market, and the other was the increasing price of upstream raw materials.

In 2018, a V shape can be identified in the price change. In H1 2018, the price fell all the way to USD1,431/t from USD1,989/t, mainly due to aluminum fluoride glut. But in H2, with shrinking aluminum fluoride inventories and rising raw material prices, the price of aluminum fluoride bounced back. Yet in 2019, the ex-works price aluminum fluoride was on a general downward trend.

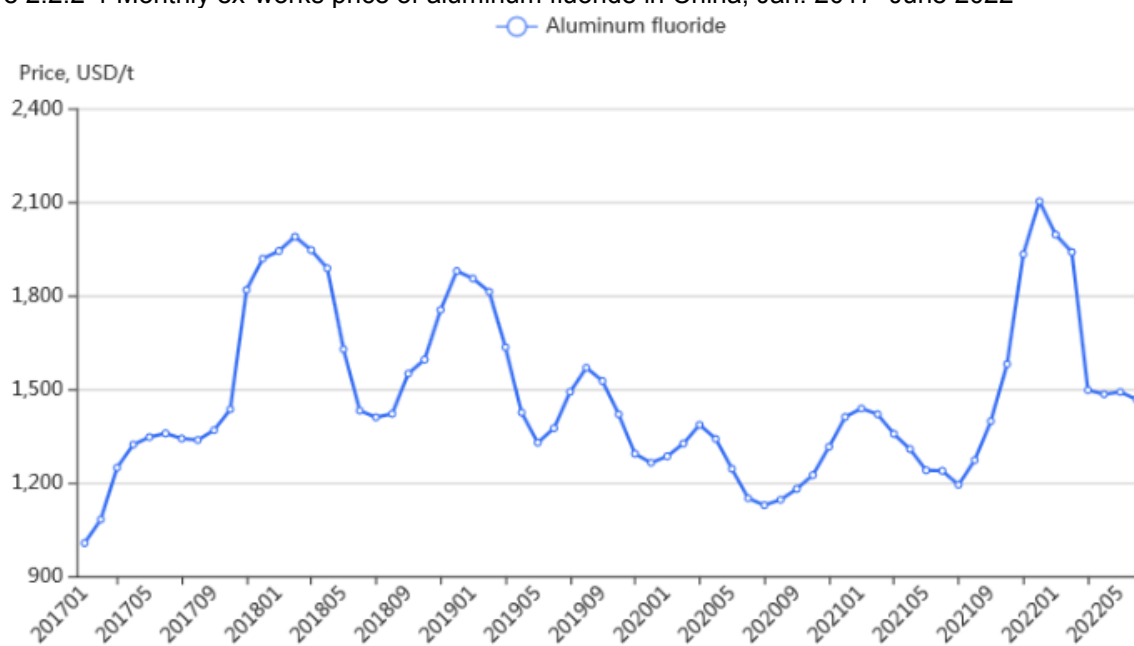
In 2020, China's aluminum fluoride price experienced two rounds of rising:

- Jan.–March: affected by the COVID-19 pandemic, downstream enterprises resumed production slowly, so the price of aluminum fluoride was at a low level compared with H1 2019. In March, the price climbed to USD1,385/t, the highest in this period. This peak came mainly due to tight raw material supply and thus higher cost, as well as blocked transportation in some parts of China.
- July–Dec.: aluminum fluoride price increased from USD1,128/t in July to USD1,411/t in Dec., driven by strong growth in downstream industries.

In 2021, aluminum fluoride price fell first and then shot up. In H1, the operating rate of the industry continued to run at a high level, and the inventories in manufacturers climbed. Consequently, the huge inventory dragged down the price of aluminum fluoride. However, the price trend reversed in H2. Supported by increasing costs and high downstream product prices, aluminum fluoride price soared and hit a high record in Dec. at USD2,102/t, up by 49.0% year on year.

In H1 2022, due to lowered raw material prices, the price of aluminum fluoride fell back from the peak of Dec. 2021.

Figure 2.2.2-1 Monthly ex-works price of aluminum fluoride in China, Jan. 2017–June 2022



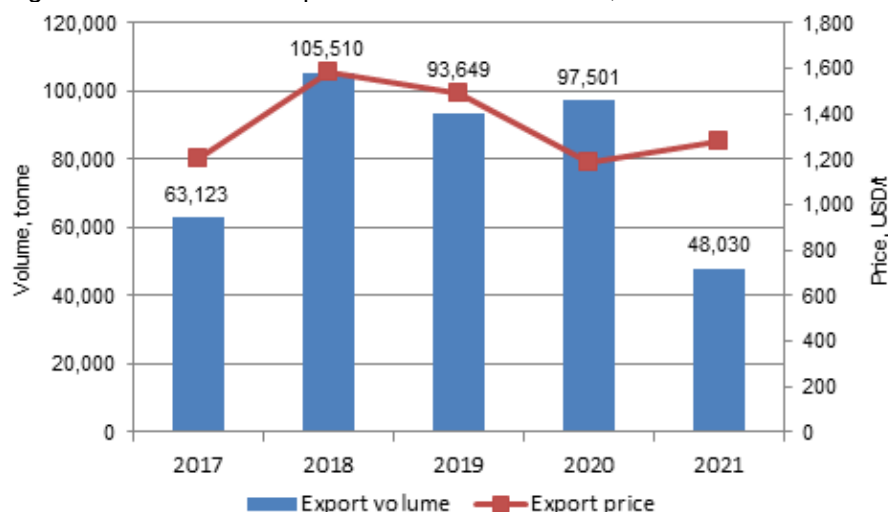
Source: CCM

2.2.3 Import and export

China's aluminum fluoride imports are quite small, while the exports are kept at a high level.

In 2017–2021, the export of aluminum fluoride in China showed marked fluctuations. It increased to 105,510 tonnes in 2018, up by 67.1% year on year, since manufacturers focused more on the export market due to weak domestic demand. In 2019, aluminum fluoride exports slightly slipped to 93,649 tonnes. In 2020, as overseas supply went down due to the COVID-19 pandemic, China's export of aluminum fluoride increased. In 2021, the recurring rounds of pandemic dampened overseas demand and pushed up transportation cost, which directly impacted the export of aluminum fluoride. Therefore, the volume of aluminum fluoride exported from China slumped to 48,030 tonnes in 2021.

Figure 2.2.3-1 China's exports of aluminum fluoride, 2017–2021



Note: Anhydrous aluminum fluoride and other aluminum fluoride are included.

Source: China Customs & CCM

Table 2.2.3-1 China's imports and exports of aluminum fluoride (anhydrous), 2017–2021

Year	Import			Export		
	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t
2017	109	964,712	8,813	63,118	76,095,432	1,206
2018	155	1,315,414	8,491	104,816	165,792,535	1,582
2019	203	1,184,017	5,822	89,901	134,225,814	1,493
2020	163	1,183,366	7,264	86,284	103,083,351	1,195
2021	175	1,299,265	7,437	39,476	51,400,760	1,302

Source: China Customs & CCM

Table 2.2.3-2 China's imports and exports of other aluminum fluoride, 2017–2021

Year	Import			Export		
	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t
2017	0	5,514	1,378,500	5	59,343	12,001
2018	40	42,764	1,069	694	823,097	1,185
2019	2	3,577	1,807	3,748	4,971,569	1,326
2020	0	/	/	11,218	12,389,312	1,104
2021	0	/	/	8,555	9,883,848	1,155

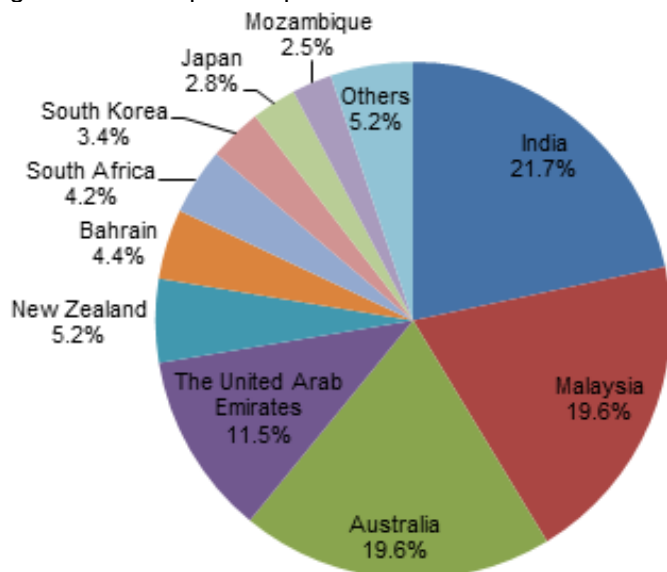
Note: Import volume in 2017 was 4 kg.

Source: China Customs & CCM

In 2021, China's aluminum fluoride was mainly exported to India, Malaysia, Australia, and the United Arab Emirates; combined volume of the top three export destinations was 29,259 tonnes, accounting for about 60.9% of the total.

In contrast, China's aluminum fluoride import was quite small and mainly came from Sweden.

Figure 2.2.3-2 Top ten export destinations of aluminum fluoride from China by volume, 2021



Note: Anhydrous aluminum fluoride and other aluminum fluoride are included.
Source: China Customs & CCM

2.2.4 Future trends

The development of aluminum fluoride industry is closely linked to the development and prosperity of the downstream industries such as electrolytic aluminum, abrasives, glass manufacturing, and electronics.

Aluminum fluoride is an indispensable flux in the production of electrolytic aluminum. A healthy and sustainable development of the electrolytic aluminum industry will support the demand for aluminum fluoride. Given policy restrictions to facilitate the supply-side reform, further expansion of electrolytic aluminum capacity will be suppressed. It is expected that the output of electrolytic aluminum will approach the upper limit, and the consumption of aluminum fluoride will also reach a peak.

Moreover, rapid development of abrasives, glass manufacturing, electronics and other industries provides new development space for the aluminum fluoride industry.

Overall, demand for aluminum fluoride is expected to increase slightly in the next three years.

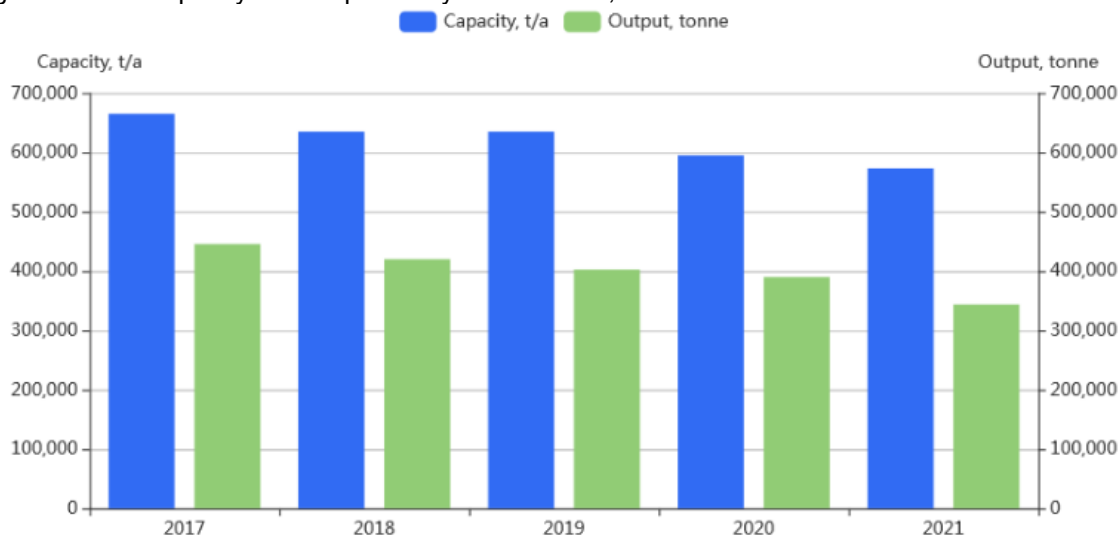
2.3 Cryolite

2.3.1 Production situation

Most cryolite is consumed in the production of electrolytic aluminum, while a small part is consumed in welding electrodes, enamels and ceramics.

In the past five years, few manufacturers announced plans to expand production capacity, and some got out of the business. As a result, the capacity of cryolite in China decreased slightly from 665,000 t/a to 573,000 t/a in 2017–2021. At the same time, the output of cryolite dropped from 445,500 tonnes in 2017 to 343,800 tonnes in 2021, influenced by supply-side reform in electrolytic aluminum industry. Besides, new technologies of electrolytic aluminum production such as "use of electrolytes instead of cryolite" and "obtaining cryolite from aluminum electrolytic waste residue", have also contributed to the decrease.

Figure 2.3.1-1 Capacity and output of cryolite in China, 2017–2021



Source: CCM

In China, the production of cryolite is mainly concentrated in Henan Province and Shandong Province, since electrolytic aluminum industry, which consumes the highest volume of cryolite, is more developed there.

Table 2.3.1-1 Main active manufacturers of cryolite in China, 2020–2021

No.	Producer	Location	Capacity, t/a		Output, tonne	
			2021	2020	2021	2020
1	Do-Fluoride New Materials Co., Ltd.	Henan	80,000	80,000	52,000	56,200
2	Shandong Bofeng Lizhong Chemical Co., Ltd.	Shandong	60,000	60,000	38,000	39,000
3	Zibo Kunyu Industry and Trading Co., Ltd.	Shandong	40,000	40,000	25,000	28,800
4	Zhuzhou Guangcheng Chemical Co., Ltd.	Hunan	30,000	30,000	22,000	21,000
5	Zhengzhou Tianrui Grain Technology Co., Ltd.	Henan	30,000	30,000	20,000	19,500
6	Fluorine Industry Environmental Protection Technology (Yunnan) Co., Ltd.	Yunnan	30,000	30,000	20,000	18,000
7	Jiaozuo Jinkaiyuan Aluminum Co., Ltd.	Henan	30,000	30,000	18,000	18,000
8	Jiaozuo Minli Industrial Co., Ltd.	Henan	30,000	30,000	18,000	15,000
9	Shandong Rich Billows Group Limited	Shandong	20,000	20,000	17,000	16,000
10	Hunan Nonferrous Hengdong Fluoride Chemical Co., Ltd.	Hunan	20,000	20,000	13,000	12,600
11	Zhengzhou Hengtai Fluoride Salt Factory	Henan	20,000	20,000	12,000	14,000
12	Zibo Nanhan Chemical Co., Ltd.	Shandong	15,000	15,000	9,000	9,700
13	Changshu Hongjia Fluorine Technology Co., Ltd.	Jiangsu	15,000	15,000	8,500	8,000
14	Zibo Beidouxing Chemical Co., Ltd.	Shandong	10,000	10,000	8,000	7,000
15	Shandong Hairun New Material Technology Co., Ltd.	Shandong	10,000	10,000	6,000	7,000
16	Shaanxi Yanchang Petroleum Group Fluorosilicone Chemical Co., Ltd.	Shaanxi	5,000	5,000	2,500	2,000
17	Dazhou Lizhi Environmental Protection Technology Co., Ltd.	Sichuan	3,500	6,000	1,500	2,500
Others			124,500	144,000	53,300	95,700
Total			573,000	595,000	343,800	390,000

Source: CCM

2.3.2 Price

Cryolite and AHF prices displayed somewhat similar price fluctuations and trends.

In 2017, the price of cryolite soared. It was USD675/t in Jan. but ended at USD1,016/t in Dec., up by 50.7%.

In 2018, demand for cryolite was sluggish and the price was on a downward trend. It headed all the way south from USD1,050/t in Feb. to USD812/t in Oct. In 2019, though an overall weak operation was seen, the price of cryolite did not fluctuate much as the demand was also slack. The supply-demand balance continued in H1 2020 and the price fell within the range of USD761/t and USD787/t.

From H2 2020 to June 2022, increasing raw material prices and improving downstream demand pushed cryolite price higher. The price increased from USD806/t in July 2020 to USD1,077/t in June 2022, up by 33.6%.

Figure 2.3.2-1 Monthly ex-works price of cryolite in China, Jan. 2017–June 2022



Source: CCM

2.3.3 Future trends

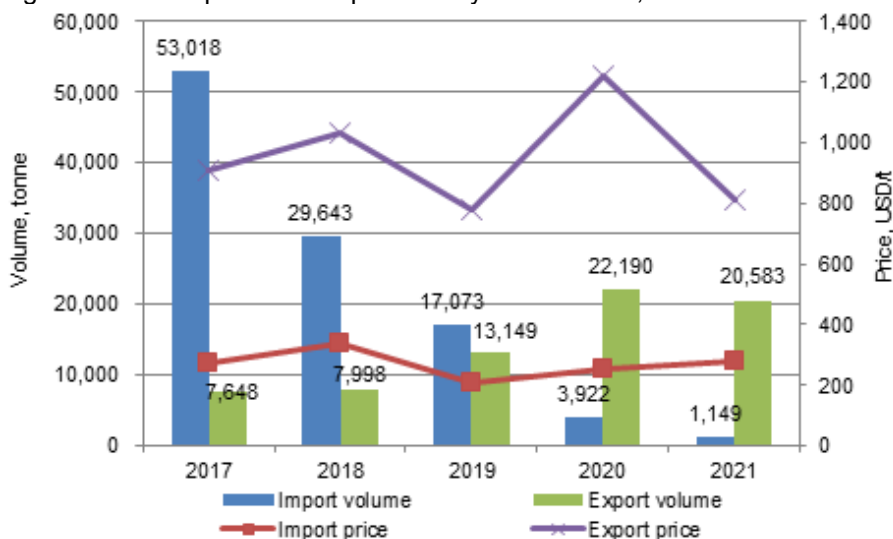
Cryolite is mainly used as an auxiliary material in the production of electrolytic aluminum. Cryolite market relies highly on the development of China's aluminum industry. Due to supply-side reform in electrolytic aluminum industry, the capacity expansion of electrolytic aluminum has slowed down. Besides, further development of recycled electrolyte use in electrolysis process has weakened the demand for cryolite, and thus cryolite production will continue to decline.

2.3.4 Import and export

In 2017–2021, the import of cryolite in China saw a significant decline trends, went down from the peak 53,018 tonnes in 2017 to 1,149 tonnes in 2021, with a CAGR of -61.6%. Mainly because the production technology of domestic cryolite manufacturers gradually mature, and the quality of the products they produce can be comparable to that of foreign products.

Cryolite exports have shown a growth trend in 2017–2021, from 7,648 tonnes to 20,583 tonnes, even though the export volume of cryolite fell by 7.2% year-on-year in 2021.

Figure 2.3.4-1 Imports and exports of cryolite in China, 2017–2021



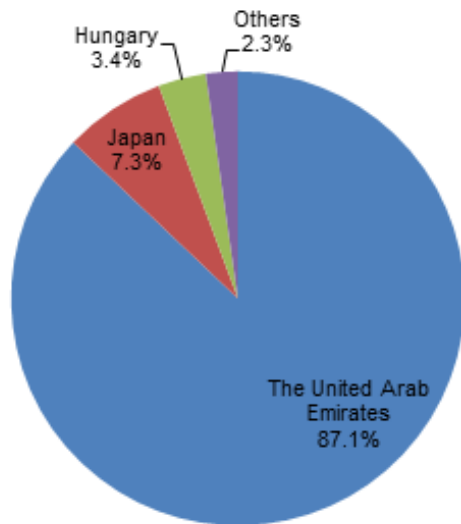
Source: China Customs & CCM

Table 2.3.4-1 Imports and exports of cryolite in China, 2017–2021

Year	Import			Export		
	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t
2017	53,018	14,541,449	274	7,648	6,968,089	911
2018	29,643	9,941,360	335	7,998	8,248,917	1,031
2019	17,073	3,589,543	210	13,149	10,253,044	780
2020	3,922	1,004,733	256	22,190	27,028,200	1,218
2021	1,149	323,334	281	20,583	16,689,242	811

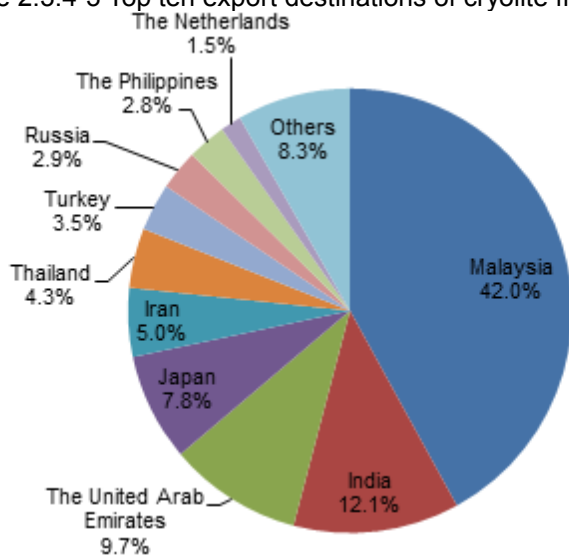
Source: China Customs & CCM

Figure 2.3.4-2 Top three import origins of cryolite in China by volume, 2021



Source: China Customs & CCM

Figure 2.3.4-3 Top ten export destinations of cryolite from China by volume, 2021



Note: Due to rounding, the total may not equal 100.0%.

Source: China Customs & CCM

2.4 Lithium hexafluorophosphate

2.4.1 Production situation

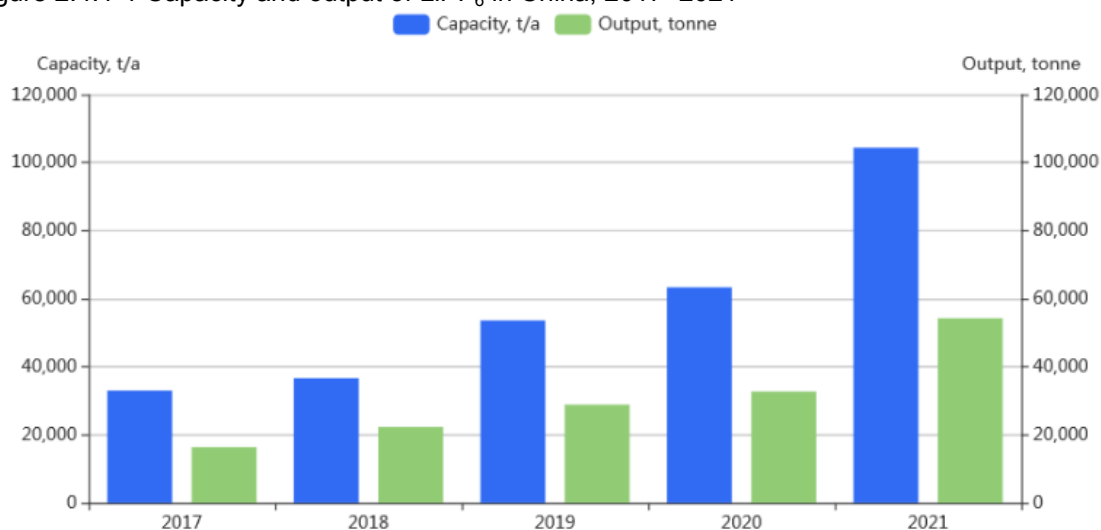
Lithium hexafluorophosphate (LiPF_6) is the main raw material for the manufacture of lithium-ion battery electrolytes. Because of its good ionic conductivity and electrochemical stability, it is currently the most commonly used electrolyte lithium salt.

Along with the boom of lithium-ion battery industry, LiPF_6 also developed apace. In 2017–2021, both capacity and output of LiPF_6 in China increased. The capacity rocketed to 104,360 t/a in 2021 from 33,000 t/a in 2017, with a CAGR of 33.4%. The output increased steadily in 2017–2020 and witnessed a steep upward momentum in 2021, supported by demand from lithium-ion battery industry.

Since 2020, the supply of LiPF_6 in China lagged behind the demand, for the main reasons as follows:

- Surge in demand: as China introduced policies to encourage the development of new energy vehicles under the COVID-19 pandemic in H1 2020, large need for electrolytes in new energy vehicles industry brought a rapid surge in the demand for LiPF_6 .
- Low operating rate: despite that capacity of LiPF_6 increased rapidly in 2020–2021, it took time for the release of the new capacity.

Figure 2.4.1-1 Capacity and output of LiPF_6 in China, 2017–2021



Source: CCM

In recent two years, many companies have expanded capacity. In 2021, there were eighteen major LiPF_6 manufacturers in China, and six of them had production capacity of more than 5,000 t/a. The output of LiPF_6 was mainly concentrated in top producers, mainly because these enterprises have large capacity, advanced technology, excellent product quality and stable customer base, which could prompt producers to gain more market share.

Table 2.4.1-1 Main active manufacturers of LiPF₆ in China, 2020–2021

No.	Producer	Location	Capacity, t/a		Output, tonne	
			2021	2020	2021	2020
1	Guangzhou Tinci Materials Technology Co., Ltd.	Guangdong	32,000	12,000	9,400	4,800
2	Do-Fluoride New Materials Co., Ltd.	Henan	20,000	10,000	16,100	6,500
3	Jiangsu Xintai Material Technology Co., Ltd.	Jiangsu	8,160	8,160	9,400	4,600
4	Zhejiang Yongtai Technology Co., Ltd.	Zhejiang	8,000	2,000	1,300	1,200
5	Morita new energy materials (Zhangjiagang) Co., Ltd.	Jiangsu	7,000	5,000	3,800	3,800
6	Jiangsu Jiujiujiu Technology Co., Ltd.	Jiangsu	6,400	6,400	5,400	5,300
7	Hubei Zhonglan Hongyuan New Energy Materials Co., Ltd.	Hubei	4,000	4,000	1,500	1,500
8	Foosung Technologies (Nantong) Co., Ltd.	Jiangsu	3,800	3,800	1,200	1,200
9	Fujian Longde New Energy Co., Ltd.	Fujian	3,000	2,000	800	500
10	Shandong Shida Shenghua Chemical Group Co., Ltd.	Shandong	2,000	2,000	1,100	1,000
11	Shanshan Advanced Materials (Quzhou) Co., Ltd.	Zhejiang	2,000	2,000	800	100
12	Qinghai JZY New Material Co., Ltd.	Qinghai	2,000	0	200	0
13	Quzhou Beidouxing New Chemical Materials Co., Ltd.	Zhejiang	1,300	1,300	1,200	500
14	Jiangxi Shilei Fluorine Materials Co., Ltd.	Jiangxi	1,200	1,200	500	300
15	Tianjin Jinniu Power Sources Material Co., Ltd.	Tianjin	1,000	1,000	500	400
16	Hubei Hongyuan Pharmaceutical Technology Co., Ltd.	Hubei	1,000	1,000	500	600
17	Befar Group Co., Ltd.	Shandong	1,000	1,000	400	180
18	Guangdong Jinguang High-Tech Co., Ltd.	Guangdong	500	500	200	220
Total			104,360	63,360	54,300	32,700

Source: CCM

Table 2.4.1-2 Production and share of top five LiPF₆ manufacturers in China, 2020–2021

Item	2021	2020	Share	
			2021	2020
Capacity, t/a	75,160	41,560	72.0%	65.6%
Output, tonne	44,100	25,000	81.2%	76.5%

Source: CCM

2.4.2 Price

Subjected to the release of new capacity of LiPF₆ and slower growth in downstream demand, LiPF₆ price underwent a sharp correction in 2017. Specifically:

- Supply: new capacity of LiPF₆ released, which intensified competition among LiPF₆ enterprises.
- Demand: due to fewer subsidies in the new energy vehicle industry and the higher price for some raw materials of electrolytes, the demand for electrolytes from domestic lithium-ion battery decreased rapidly.

In 2018–H1 2020, LiPF₆ prices hit bottom and remained at a low level. LiPF₆ market was in a continued oversupply, sending the price of LiPF₆ to the bottom. The situation was hard to pick up, and continued until H1 2020.

In H2 2020–Feb. 2022, LiPF₆ price soared and peaked in Feb. 2022. This surge was backed by improvement in demand. Since H2 2020, the demand for new energy vehicles experienced explosive growth, resulting in a boost in lithium-ion battery demand. The strong growth of demand for LiPF₆ outran supply increase, and LiPF₆ industry entered a new boom cycle. As a result, the price of LiPF₆ continued to rise.

From March to June 2022, the price declined from the peak, mainly due to the suppression of downstream demand. Continuous high price of LiPF₆ dampened the purchasing desire in downstream enterprises, resulting in fewer new transactions. On the other hand, as some regions were hit by COVID-19 resurgences, downstream industry had lower operating rates and thus lowered the consumption of LiPF₆. In addition, the release of new LiPF₆ capacity led to an increase in market supply, which also contributed to the decline in the price of LiPF₆.

Figure 2.4.2-1 Monthly ex-works price of LiPF₆ in China, Jan. 2017–June 2022



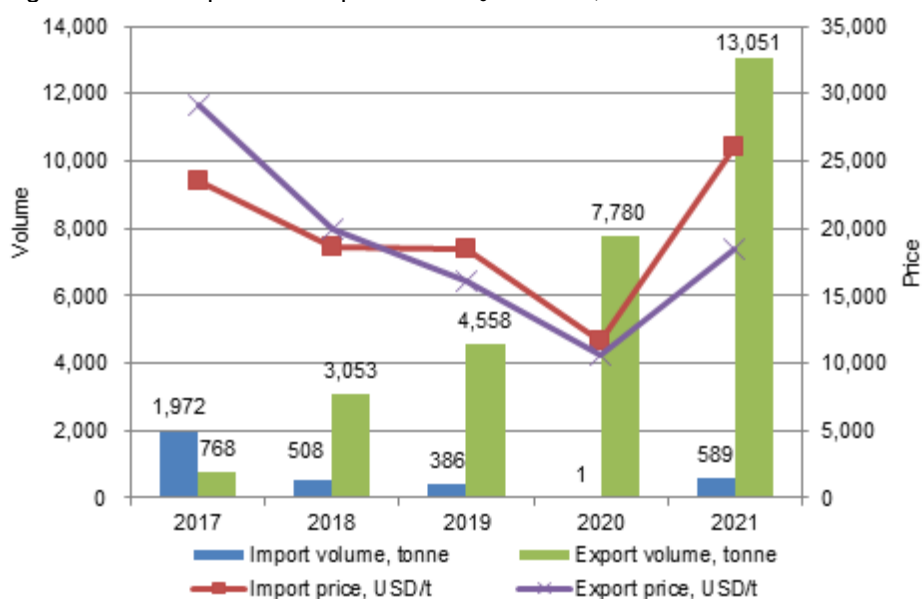
Source: CCM

2.4.3 Import and export

In 2017–2021, the export volume of LiPF₆ from China continued to increase, jumping from 768 tonnes in 2017 to 13,051 tonnes in 2021, with a CAGR of 103.0%. With the maturity of LiPF₆ production technology in China, both LiPF₆ capacity and output increased, China has become the largest production base in the world. Since 2018, China LiPF₆ exports have exceeded its imports.

LiPF₆ import volume was relatively small in China, because of high self-sufficiency rate of LiPF₆. Except 2021, 2017–2020 period witnessed a downward trend in the imports.

Figure 2.4.3-1 Import and export of LiPF₆ in China, 2017–2021



Source: China Customs & CCM

Table 2.4.3-1 Imports and exports of LiPF₆ in China, 2017–2021

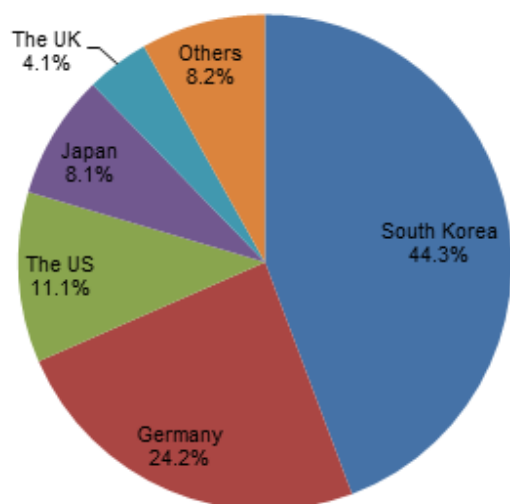
Year	Import			Export		
	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t
2017	1,972	46,419,332	23,542	768	22,417,915	29,194
2018	508	9,436,345	18,579	3,053	61,044,093	19,997
2019	386	7,161,616	18,530	4,558	73,317,505	16,085
2020	1	14,303	11,666	7,780	82,790,481	10,641
2021	589	15,336,601	26,019	13,051	240,227,139	18,407

Source: China Customs

In 2021, China imported 589 tonnes LiPF₆. Main import origins were Japan and South Korea, the two taking up 96.5% of the total import volume.

South Korea was the largest export destination of China's LiPF₆ by volume, accounting for 44.3% of total export volume, followed by Germany, the US, Japan and the UK.

Figure 2.4.3-2 Top five export destinations of LiPF₆ from China by volume, 2021



Source: China Customs & CCM

2.4.4 Future trends

Increasing demand for lithium-ion battery from various sectors, including consumer electronics and automotive, is pushing the demand for LiPF₆. It is expected that the demand for lithium-ion battery will increase in the coming five years, and LiPF₆, with huge market potential, will have its capacity exceed 400,000 t/a in China by 2025.

In the short term, LiPF₆ may remain in tight supply and high price. However, along with new capacity gradually coming into operation, the increase in supply will drive LiPF₆ price to a more reasonable level.

At present, domestic LiPF₆ capacity expansion projects are mainly seen in top enterprises that possess sophisticated technology, produce quality products and have stable customer base. Industry concentration is predicted to improve as leading manufacturers expand their production capacity.

Table 2.4.4-1 Capacity expansion of LiPF₆ in China in the near future

No.	Producer	Expanded capacity, t/a	Expected launch time
1	Guangzhou Tinci Materials Technology Co., Ltd.	97,000	30,000 t/a: 2022
			Total: 2025
2	Do-Fluoride New Materials Co., Ltd.	80,000	35,000 t/a: 2022
			45,000 t/a 2023
3	Songyan Metallurgical Materials (Quannan) Co., Ltd.	15,000	2022
4	Hubei Zhonglan Hongyuan New Energy Materials Co., Ltd.	2,000	2022
5	Jiangsu Tairui Lianteng Material Technology Co., Ltd.	30,000	Phase 1: 2022
			Total: 2025
6	Lizhong Sitong Light Alloys Group Co., Ltd.	18,000	Phase 1: 2023
			Total: 2024
7	Qinghai Fudi Lithium-Energy Technology Co., Ltd.	10,000	Phase 1: 2022
			Total: 2023

No.	Producer	Expanded capacity, t/a	Expected launch time
8	Shandong Shida Shenghua Chemical Group Co., Ltd.	3,000	2023
9	Zhejiang Yongtai Technology Co., Ltd.	20,000	2024
10	Fujian Longde New Energy Co., Ltd.	10,000	2024
11	Changshu Xinhua Chemical Co., Ltd.	10,000	2024
12	Fujian Qingliu Dongying Chemical Co., Ltd.	6,000	2024
13	China Kings Resources Group Co., Ltd.	25,000	N/A
14	Guangdong Jinguang High-Tech Co., Ltd.	10,000	N/A
15	Yangfeng Chuyuan New Energy Technology Co., Ltd.	10,000	N/A
16	Hubei Hongyuan Pharmaceutical Technology Co., Ltd.	6,000	N/A
17	Jiangxi Shilei Fluorine Materials Co., Ltd.	4,800	N/A
18	Qinghai JZY New Material Co., Ltd.	4,000	N/A
19	Shanshan Advanced Materials (Quzhou) Co., Ltd.	2,000	N/A
20	Quzhou Beidouxing New Chemical Materials CO., Ltd.	1,300	N/A

Source: CCM

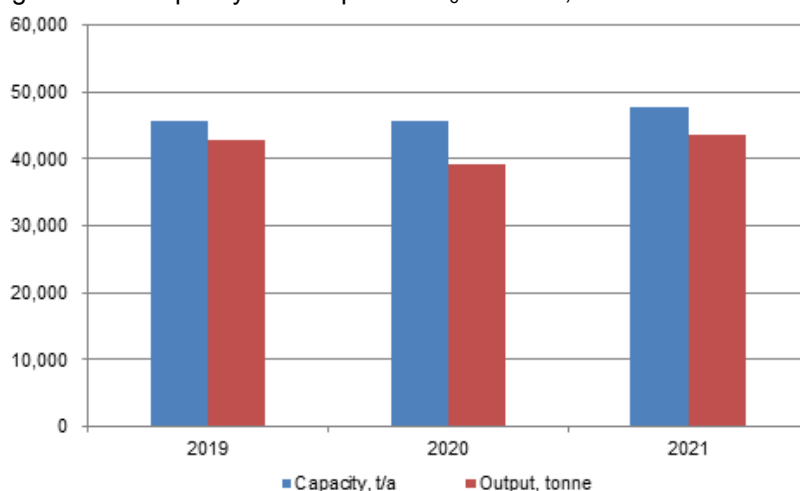
2.5 Others

- Sulfur hexafluoride

As an important fluorinated gas, sulfur hexafluoride (SF₆) is widely used in power equipment, metal smelting, aviation, medical and other industries. It is also an ideal etching gas, mainly used in the manufacture of semiconductor devices, flat panels and photovoltaic panels.

As of 2021, there were about 12 SF₆ manufacturers in China. During 2019–2021, there was no new entrant in the industry, and some manufacturers quit the market. But the total capacity increased slightly from 45,700 t/a in 2019 to 47,700 t/a in 2021, after one manufacturer expanded its capacity.

Figure 2.5-1 Capacity and output of SF₆ in China, 2019–2021



Source: CCM

In China, capacity and output of SF₆ are mainly concentrated in some large companies, such as Chengdu Kemeite Special Gas Co., Ltd., Fujian Deer Technology Co., Ltd., Shandong Feiyuan Gas Co., Ltd., and Liming Research & Design Institute of Chemical Industry Co., Ltd.

Table 2.5-1 Main active SF₆ manufacturers in China, 2020–2021

No.	Producer	Location	Capacity, t/a		Output, tonne	
			2021	2020	2021	2020
1	Chengdu Kemeite Special Gas Co., Ltd.	Sichuan	22,000	18,500	20,000	17,290
2	Fujian Deer Technology Co., Ltd.	Fujian	10,000	10,000	8,850	8,400
3	Shandong Feiyuan Gas Co., Ltd.	Shandong	5,500	5,500	5,780	4,500
4	Liming Research & Design Institute of Chemical Industry Co., Ltd.	Henan	3,500	3,500	3,260	3,100
5	Shandong Ruihua Fluoride Industry Co., Ltd.	Shandong	2,500	2,500	2,050	1,800
6	Fujian Yongjing Technology Co., Ltd.	Fujian	1,600	1,600	1,450	1,250
7	Shouguang Longhao Chemical Co., Ltd.	Shandong	500	500	400	400
8	Xinxiang Lifan Fluoride Industry Co., Ltd.	Henan	500	500	450	400
Others			1,600	3,100	1,360	2,160
Total			47,700	45,700	43,600	39,300

Source: CCM

- Lithium bis(fluorosulfonyl)imide

Lithium bis(fluorosulfonyl)imide (LiFSI) can be used as an electrolyte additive for lithium-ion battery and used in the electrolyte of rechargeable lithium-ion battery.

LiFSI is a new type of lithium salt with excellent performance. Compared with LiPF_6 , it has better electrochemical properties, hydrolysis resistance, thermal stability and electrical conductivity. It can also be used as an additive, or as an electrolyte individually. Therefore, LiFSI is expected to be the next generation major electrolyte in lithium-ion battery taking the place of LiPF_6 and has a very large market in the future.

Due to high technical barriers of LiFSI, only a few domestic manufacturers produce it and the output is small. In 2020 and 2021, the output of LiFSI was 552 tonnes and 2,640 tonnes respectively.

Table 2.5-2 Main active LiFSI manufacturers in China, 2020–2021

No.	Producer	Location	Capacity, t/a		Output, tonne	
			2021	2020	2021	2020
1	Guangzhou Tinci Materials Technology Co., Ltd.	Guangdong	2,300	300	380	150
2	Shanghai Chemspec Corporation	Zhejiang	1,700	1,700	770	277
3	Do-Fluoride New Materials Co., Ltd.	Henan	1,600	1,600	410	10
4	Rolechem (Shandong) New Material Co., Ltd.	Shandong	1,000	/	400	/
5	Zhejiang Yongtai Technology Co., Ltd.	Fujian	900	100	450	40
6	Suzhou Fluolyte Co., Ltd.	Jiangsu	300	300	80	10
7	Shenzhen Capchem Technology Co., Ltd.	Hunan	200	200	90	15
8	Jiangsu HSC New Energy Materials Co., Ltd.	Jiangsu	100	100	60	50
Total			8,100	4,300	2,640	552

Source: CCM

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17th Floor, Huihua Commercial & Trade Building, No. 80 Xianlie Zhong Road Guangzhou,
510070, P.R.China

Website: <http://www.cnchemicals.com>

Tel: +86-20-37616606

Fax: +86-20-37616968

Email: econtact@cnchemicals.com