CCM Data & Business Intelligence

Production and Market of Paraformaldehyde in China

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Executive summary

In the past decade, China's paraformaldehyde industry has steadily developed. The capacity and output of PF increased at a CAGR of 3.2% and 2.2% from 2014 to 2023, respectively.

Production

Domestic PF production is mainly distributed in Hebei, Jiangsu, and Shandong with sufficient methanol supply.

From 2018 to 2023, a total of 11 new PF enterprises were added in China. At the same time, due to stricter environmental policies or unsatisfactory performance, a total of 18 companies stopped producing PF and withdrew from the market. During this period, China's PF capacity expanded from 541,000 t/a to 717,000 t/a. At present, there are 28 PF producers in China. Compared with foreign markets where capacity growth has largely stopped, the Chinese PF market is full of vitality and energy.

Import and Export

In 2020, China's export volume of PF exceeded its import volume for the first time, gradually transforming from a net importer of PF to a major exporter of PF. In 2023, China imported 19,443 tonnes of PF. The top three import sources are Taiwan Province, Spain, and Indonesia, the volume combined accounting for 93.7% of the total.

From 2014 to 2018, China's PF export volume continued to decline. In 2019, the downward trend reversed as Taiwan's PF supply declined, leading to a year-on-year increase of 63.8% in China's PF exports. From 2019 to 2023, China's PF export volume maintained growth for five consecutive years. In 2023, China exported a total of 50,085 tonnes of PF, with the top three destinations (Nigeria, Djibouti, and South Korea) accounting for 53.8% of the total export volume.

Technology

The main technologies for PF production in China are rake drying method and spray drying method. Although the rake drying method still lags behind the spray drying method in terms of quality and environmental friendliness, it is adopted by most Chinese PF manufacturers due to low investment. In 2023, a total of 20 PF manufacturers adopted the rake drying method, their capacity combined accounting for 70.7% of national total.

Price

Generally speaking, the price fluctuations of PF in China are largely influenced by raw materials, methanol or formaldehyde. In 2023, PF price showed a V-shaped trend, following fluctuations in formaldehyde and methanol prices.

Consumption

In China, PF is mainly consumed in industries such as agrochemical, resin, and pharmaceutical. The agrochemical industry is the largest downstream sector of PF, accounting for 75.5% of the total domestic PF consumption in 2023. Glyphosate (AEA pathway) is the largest end-use market, with the PF consumption accounting for 71.6% of the national total in 2023. The second largest downstream sector in China is the resin industry. In 2023, PF consumption in the resin industry accounted for 20.7% of the national total.

Methodology

Introduction

This report is the 20th edition, based on the former one finished in finished in April 2023, focusing on the situation of China's paraformaldehyde (PF) industry in 2023 and Q1 2024, as well as forecasting its future development trend. The report is formulated in April 2024 and aims to disclose the latest production and market information of China's PF industry. The data for 2023 and before are based on CCM's database and other various sources as mentioned in the section of methodology below.

The report is based on data sourced by diverse methods, which are listed as follows:

- Desk research

Desk research includes access to published magazines, journals, government statistics, industry statistics, customs statistics, association seminars as well as information on the Internet. Much work has gone into the compilation and analysis of the information obtained. Where necessary, information has been checked and discussed internally related to market structure and performance characteristics as key producers, key end users, production levels, end user demand and so on.

- Telephone interview

CCM carried out extensive telephone interviews with almost all producers to get detailed information about production, market, competition, future plan, etc.

Interviewees include producers, end users, traders, material suppliers, associations involved, industry experts.

- Network search

CCM employs a network to contact industry participants by using B2B websites and software.

- Data processing and presentation

The data collected and compiled was 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 has 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 were held within CCM to systematically analyse the data and draw appropriate conclusions.

Abbreviation

YoY: year on year
CAGR: compound annual growth rate
PF: paraformaldehyde
AEA: aminoethanoic acid (glycine)
HCN: hydrogen cyanide
IDA: iminodiacetic acid
IDAN: iminodiacetonitrile
DEA: diethanolamine
POM: polyformaldehyde

N/A: not available
MDI: methylene diphenyl diisocyanate
BDO: 1,4-butanediol
CAS: Chemical Abstracts Service
COVID-19: Coronavirus Disease 2019

Note: Apparent consumption = output + import – export

Unit

t: tonne, equals to metric tonne in this report
/t: per tonne
t/a: tonne per year, tonne per annum
kg: kilogram
USD: currency unit in the US, also called US dollar

Table 1 Regions covered

Region (Chinese mainland)	Name
Province (22)	Heilongjiang, Jilin, Anhui, Fujian, Liaoning, Hebei, Shandong, Gansu, Qinghai, Henan, Sichuan, Jiangsu, Hubei, Hunan, Jiangxi, Zhejiang, Guangdong, Shaanxi, Hainan, Shanxi, Guizhou, Yunnan
Autonomous region (5)	Guangxi, Inner Mongolia, Tibet, Xinjiang, Ningxia
Municipality (4)	Beijing, Shanghai, Tianjin, Chongqing

Source:CCM

Table 2 Exchange rate USD/CNY, Jan. 2013–March 2024

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
2013	6.2787	6.2842	6.2743	6.2471	6.1970	6.1718	6.1725	6.1708	6.1588	6.1393	6.1372	6.1160	6.1920
2014	6.1043	6.1128	6.1358	6.1553	6.1636	6.1557	6.1569	6.1606	6.1528	6.1441	6.1432	6.1238	6.1428
2015	6.1272	6.1339	6.1507	6.1302	6.1143	6.1161	6.1167	6.3056	6.3691	6.3486	6.3666	6.4476	6.2288
2016	6.5527	6.5311	6.5064	6.4762	6.5315	6.5874	6.6774	6.6474	6.6715	6.7442	6.8375	6.9182	6.6425
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	6.8821	7.0992	7.2081	7.1225	6.6972
2023	6.9475	6.7492	6.9400	6.8805	6.9054	7.0965	7.2157	7.1283	7.1788	7.1789	7.1778	7.1104	7.0424
2024	7.0770	7.1049	7.1059	-	-	-	-	-	-	-	-	-	-

Source:People's Bank of China

1 Market information of paraformaldehyde (PF)

1.1 Global overview of PF

Worldwide PF production is mainly distributed in China, Spain, the US, Germany, etc. Mainland China is the largest PF producing area with 717,000 t/a production capacity, and PF capacity beyond Mainland China was over 290,000 t/a in 2023.

The top three PF producers beyond Mainland China in 2023 were Ercros S.A., Celanese Corporation and Chang Chun Plastics Co., Ltd. (CCP), with capacity of 115,000 t/a, 50,000 t/a and 35,000 t/a respectively. The capacity of PF of CCP remained unchanged in 2019–2023.

Table 1.1-1 PF producers beyond Mainland China, 2023

No.	Company	Country/region	Specification	PF capacity, t/a
1	Ercros S.A.	Spain	89%–98%	115,000
2	Celanese Corporation	The US	91%–97%	50,000
3	Chang Chun Plastics Co., Ltd.	Taiwan Province	88%, 92%±1%	35,000
4	Prefere Resins Holding GmbH	Germany	89%–97%	30,000
5	Mitsubishi Gas Chemical Company, Inc.	Japan	86%, 92%	11,000
6	U-JIN Chemical Co., Ltd.	South Korea	N/A	10,000
7	PT Dover Chemical	Indonesia	92±1%, 96±1%	10,000
8	Sina Chemical Industries Company	Iran	96%	10,000
9	Methanol Chemicals Company	Saudi Arabia	93±1%, 96±1%	7,000
10	Venlon Enterprises Ltd.	India	93±1%, 96±1%	5,000
11	Allied Resins & Chemicals Ltd.	India	N/A	N/A
12	Adhesivos S.A. de C.V.	Mexico	90%–92%	N/A
13	Synthite Limited	The UK	82%–97%	N/A
14	Uralchimplast	Russia	94%–98%	N/A

Note:INEOS Paraform GmbH & Co. KG completed the sale of its melamines and paraformaldehyde businesses to Prefere Resins Holding GmbH in 2019.
Source:CCM

1.2 PF development in China

In the early 1970s, Shanghai Solvent Plant began to produce PF. 37% formaldehyde was concentrated into 70% solvent, and then PF was synthesized on the existence of catalyst concentrated sulfuric acid. The earliest producers included Shanghai Solvent Plant and Jilin Petrochemical Company. At that time, they only produced solid formaldehyde with poor quality.

Till 1992, the PF with low polymerization degree was exploited and produced by Jilin Petrochemical Company. The producing technology and quality of PF had been improved a lot. After the technical improvement, the PF capacity in Jilin Petrochemical Company reached 2,000 t/a in 1995, but it could only produce low content (90%) instead of high content (95%).

In 1996, there were a few companies producing PF, including Xinle Dongyuan Jinhua Co., Ltd. (PF capacity: 1,000 t/a), Jilin Petrochemical Company (PF capacity: 1,000 t/a), Shanghai Solvent Plant (PF capacity: 500 t/a), Wuxi Pesticide Factory (PF capacity: 500 t/a) and Taiyuan Organic Chemical Factory (PF capacity: 500

t/a). There were also two companies under construction, including Jiamusi Chemical Factory (PF capacity: 2,000 t/a) and one company in Henan Province.

In 1998 Jilin Petrochemical Company stopped producing 95% PF due to immature technology. Since 1998, the import volume of PF had increased a lot, greatly impacting the domestic producers whose technology was immature. As a result, some small ones such as Wuxi Pesticide Factory had to stop production.

The active producers of PF in 1998 included Shanghai Solvent Plant (PF capacity: 2,500 t/a), Heilongjiang Jiamusi No. 5 Chemical Factory (PF capacity: 2,000 t/a), Anhui Chuzhou Fertilizer Factory (PF capacity: 1,000 t/a), Xinle Dongyuan Jinhua Co., Ltd. (PF capacity: 1,000 t/a), Jilin Shijinggou United Chemical Factory (PF capacity: 500 t/a) and Zhejiang Haiyan Pesticide Plant (PF capacity: 500 t/a).

In July 1999, Jiangsu Nantong Jiangshan Co., Ltd. introduced technology from Eurotecnica, and it launched PF production with a capacity of 10,000 t/a in 2003.

In 2001, the capacity of PF was around 14,000 t/a in China. However, the annual output of PF was only 3,000 tonnes–4,000 tonnes. The low production in China was attributed to the high production cost and the inefficient production technology. Some domestic producers claimed to produce PF with content of 95%, yet its water solubility was poor, needing 30 minutes to dissolve. In contrast, the imported ones could dissolve in water in 10 minutes.

In 2002, the capacity of PF in China was around 27,200 t/a, and the output was up to 16,540 tonnes. By early 2002, there had been only four active PF producers in China, including Hebei Xinhua Co., Ltd., Shanghai Solvent Plant, Anhui Chuzhou Fertilizer Factory and Jiangsu Jinghuang Chemical Co., Ltd. Some companies planned to install PF production lines, including Guangxi Liuzhou Chemical Industry Group Co., Ltd. and Shanghai Shenxing Chemical Co., Ltd.

In 2003, the average production cost of PF was about USD725/t among domestic producers, while the average market price of PF was much lower—USD469/t. Thus, producers in China were less competitive than overseas companies in PF price.

In 2004–2005, 18 companies had been engaged in the production of PF. Among them, 9 were active in the PF production; 9 had stopped the production. In addition, 4 companies had been confirmed to be potential producers. There was a new PF producer in 2005, namely Zhejiang Jiarun Chemical Co., Ltd.

In 2006, there were about 11 active PF producers in China with a total capacity of 90,500 t/a. The number of active PF producers increased to 14 in 2007 and the capacity rose to 232,000 t/a, up by about 156% over the previous year, mainly attributed to great capacity expansion of some manufacturers.

Stimulated by the flourishing glyphosate market, China began to expand PF production since 2007. Many companies, especially those formalin producers, entered into the PF production, and many former PF producers expanded their PF production. This upsurge of PF new projects and expansion projects greatly expanded PF capacity from 232,000 t/a in 2007 to 347,000 t/a in 2008, increasing by nearly 50%. In 2008, there were 24 active PF producers in China, and the total PF output was about 122,671 tonnes, increasing by about 54.6% over the previous year.

In 2009, though the global financial crisis heavily struck the glyphosate industry, which led to the demand downturn and price fall of glyphosate and then greatly impacted the PF industry, there were still many new producers engaged in PF production, and production expansions were still going on. In 2009, there were 28 PF producers in China, including 26 active producers and 2 idle ones. The total capacity and output of these 28 PF producers were 418,000 t/a and 126,100 tonnes, increasing by 20.5% and 2.8% year on year respectively. And there were two potential PF producers at that time.

In 2010, there were 27 companies in China which had been confirmed to be engaged in PF production. 22 of them were active in PF production; 5 were idle. China owned a total PF capacity of 459,000 t/a and output of 132,000 tonnes that year. And there were 3 potential companies during this period.

In 2011, the total capacity of PF reached 467,000 t/a, 1.7% higher than that in 2010. Six companies stopped PF production after a long time of idle situation in 2011. This mainly resulted from the overcapacity of PF, the downturn of glyphosate market and their lack of competitiveness.

In 2012, the domestic PF capacity decreased to 413,000 t/a, but the output increased greatly to 184,000 tonnes with a year on year growth rate of 31.4%, which was mainly caused by the increasing demand from the domestic glyphosate industry.

In 2013, the PF capacity increased along with the launch of some new PF production lines and the output increased to 212,500 tonnes, driven by the increasing demand from the domestic glyphosate industry.

In 2014, the capacity of PF increased to 538,000 t/a with the launch of Jiangsu Sanmu Group Co., Ltd.'s new PF production line with a capacity of 20,000 t/a, and the national output increased to 235,000 tonnes.

In 2015, the capacity of PF increased to 642,000 t/a because several new producers have finished their construction of PF projects and put them into operation. The output of PF also increased to 248,500 tonnes due to the increasing domestic demand.

In 2016, the capacity and output of PF increased to 670,000 t/a and 270,000 tonnes, respectively. Due to the increasing domestic demand, the apparent consumption of PF increased by 12.4%.

In 2017 and 2018, the domestic PF capacity decreased to 589,000 t/a and 541,000 t/a respectively, since some producers stopped PF production due to stricter environmental protection policies or poor performance.

In 2019–2022, the capacity of PF increased from 560,000 t/a to 667,000 t/a in China. During this period, there were some new entrants and expansion projects. In 2019, Nantong Jiangtian's 35,000 t/a expansion project was built up and put into production. Shijiazhuang Yaze Chemical Co., Ltd.'s 25,000 t/a project and Shandong Zhengxin New Energy Co., Ltd.'s 40,000 t/a project were completed and put into operation in 2020. And at the end of 2020, Ningxia Huaye Fine Chemical Co., Ltd.'s 30,000 t/a project was built up. However, some producers chose to exit the industry in this period. For instance, Hebei Xinhua Co., Ltd. ceased production in 2020 for failing to meet the conditions of relocation and development. In late Dec., 2022, Zhenjiang LCY Performance Materials Co., Ltd. terminated the production due to the policy to protect the ecological environment in the Yangtze River Economic Belt.

In 2023, China's PF capacity expanded further to 717,000 t/a. The going into operation or commissioning of three PF projects (30,000 t/a each at Qinyang Yongrun Chemical Industry Co., Ltd., Yacoo Technology (Anqing) Co., Ltd. and Hutubi Ruiyuantong Chemical Co., Ltd.) increased China's PF capacity by 90,000 t/a. The year also witnessed 40,000 t/a PF capacity withdrawn from the domestic market, including 30,000 t/a in Zhenjiang LCY Performance Materials Co., Ltd. with its shutdown in Dec. 2022 and 10,000 t/a in Nanhe Huayang Silicon Industry Co., Ltd. with its company cancellation in May 2023.

1.3 Properties of PF

- Physical properties

Table 1.3-1 Basic information of paraformaldehyde

CAS number	30525-89-4
Molecular formula	OH(CH2O)nH (n = 8-100)
Appearance	white crystalline solid
Density	1.42 g·cm-3 (25 °C)
Melting point	120 °C–170 °C
Flash point	70 °C
Self-ignition point	300 °C

Source:CCM

PF can dissolve in water and turn into formaldehyde. It also dissolves in sodium hydroxide solution. It is insoluble in ethanol and aether.

It is easy to be decomposed into formaldehyde when meeting strong acids, strong alkali or in high temperatures.

The species of PF include low concentration (91%–93%) and high concentration (95%–97%).

- Technology in brief

PF can be obtained via dehydration and fasculation of formaldehyde solvent. It is a kind of solid grain, with the content of 92%–97%.

The pathways for PF production include catalyst process and spraying drying process (without catalyst). Apart from 91%–92% PF, catalyst process can produce 95% PF, but spraying drying process can only produce 91%–92% PF.

The process steps of PF production include vacuum concentration, polymerization, drying, sieving and packaging.

Table 1.3-2 Unit consumption of PF (per tonne) through the catalyst process of production

Item	Unit	Unit consumption
37% Formaldehyde	tonne	3.7
Catalyst	kilogram	10
Ammonia	kilogram	100
Electricity	kWh	400
Steam	tonne	5

Source:CCM

2 Production situation of PF in China

2.1 Producers of PF in China

42 companies related to PF were studied. As of March 2024, CCM finds,
- 26 of them were active producers;
- 2 of them suspended production;
- 14 of them were potential producers.

The new entrants, Qinyang Yongrun Chemical Industry Co., Ltd. (formerly the Qinyang Yongrun Technology Development Co., Ltd.) and Yacoo Technology (Anqing) Co., Ltd. started production in March 2023. Hutubi Ruiyuantong Chemical Co., Ltd.'s 30,000 t/a PF project was put into trial production in late 2023 and officially launched the product into the market in early 2024. All PF that they produce are granular: Qinyang Yongrun and Hutubi Ruiyuantong produce 92% and 96% granule, and Anqing Yacoo can only produce 92% granule at present. It should be noted that another 30,000 t/a PF project (96% granule) of Anqing Yacoo is under construction and the new line is expected to be put into operation in late 2024.

Zhenjiang LCY Performance Materials Co., Ltd., since its shutdown in late 2022, transferred its facilities and production technology to Anhui Ruibai New Material Co., Ltd. in June 2023. Currently, Anhui Ruibai is demolishing and installing the facilities, and it disclosed that the work could be completed by May 2024 at the earliest.

Table 2.1-1 Location and technology source of PF producers in China, as of March 2024

No.	Producer	Abbreviation	Location	Status, as of March 2024	Launch time	Technology source	Specification
1	Fuhua Tongda Agro-chemical Technology Co., Ltd. (Fuhua Tongda Chemical Co., Ltd.)	Fuhua Tongda	Sichuan Province	Active	2014	Domestic	96%
2	Hebei Jintaida Chemical Co., Ltd.	Hebei Jintaida	Hebei Province	Active	2013	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
3	Hebei Yuhang Chemical Co., Ltd.	Hebei Yuhang	Hebei Province	Active	1999	Wuxi Suyang Chemicals Equipment Co., Ltd.	95%–97%
4	Nantong Jiangtian Chemical Co., Ltd.	Nantong Jiangtian	Jiangsu Province	Active	Aug. 2003	GEA Niro	96%, 98%
5	Hengshui Yinhe Chemical Co., Ltd.	Hengshui Yinhe	Hebei Province	Active	May 2002	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%±1%
6	Weifang Xudong Chemical Co., Ltd.	Weifang Xudong	Shandong Province	Active	March 2007	Wuxi Suyang Chemicals Equipment Co., Ltd.	>95%
7	Anhui Denuo Chemical Co., Ltd.	Anhui Denuo	Anhui Province	Active	2004	Hebei Xinhua	96%
8	Jiangsu Sanmu Group Co., Ltd.	Jiangsu Sanmu	Jiangsu Province	Active	2014	Jiangsu Kaimao Chemical Technology Co., Ltd.	92%
9	Zibo Qixing Chemical Technology Co., Ltd.	Zibo Qixing	Shandong Province	Active	2014	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%

10	Linqu Outai Chemical Co., Ltd.	Linqu Outai	Shandong Province	Active	2008	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
11	Linyi Shengyang Chemical Co., Ltd.	Linyi Shengyang	Shandong Province	Active	2008	Domestic	96%
12	Inner Mongolia Jiaquan Chemical Technology Co., Ltd.	Inner Mongolia Jiaquan	Inner Mongolia Autonomous Region	Active	2015	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
13	Qingzhou Hengxing Chemical Co., Ltd.	Qingzhou Hengxing	Shandong Province	Active	2006	Domestic	96%±1%
14	Xinjiang Dearsun Chemical Co., Ltd.	Xinjiang Dearsun	Xinjiang Uygur Autonomous Region	Active	2016	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
15	Weifang Huifeng Chemical Co., Ltd.	Weifang Huifeng	Shandong Province	Active	2017	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
16	Hubei Trisun Chemicals Co., Ltd.	Hubei Trisun	Hubei Province	Active	2018	Domestic	96%
17	Xinjiang Wanchang New Energy Co., Ltd.	Xinjiang Wanchang	Xinjiang Uygur Autonomous Region	Active	2018	Domestic	92%, 96%
18	Dongying Fangzheng Chemical Co., Ltd.	Dongying Fangzheng	Shandong Province	Active	2018	Domestic	96%
19	Ningxia Jinhai Xinning Chemical Co., Ltd.	Ningxia Xinning	Ningxia Hui Autonomous Region	Active	2018	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
20	Shandong Zhengxin New Energy Co., Ltd.	Shandong Zhengxin	Shandong Province	Active	Jan. 2020	Domestic	96%
21	Gansu Taier Fine Chemical Co., Ltd. (Gansu Tailu Technology Chemical Co., Ltd.)	Gansu Taier	Gansu Province	Active	2020	Linyi Taier	95%±1%
22	Shijiazhuang Yaze Chemical Co., Ltd.	Shijiazhuang Yaze	Hebei Province	Active	2020	Domestic	96%
23	Ningxia Huaye Fine Chemical Co., Ltd.	Ningxia Huaye	Ningxia Hui Autonomous Region	Active	2021	Hebei Yuhang Chemcial Co., Ltd.	96%
24	Qinyang Yongrun Technology Development Co., Ltd. (Qinyang Yongrun Chemical Industry Co., Ltd.)	Qinyang Yongrun	Henan Province	Active	March 2023	N/A	92%, 96%
25	Yacoo Technology (Anqing) Co., Ltd.	Anqing Yacoo	Anhui Province	Active	March 2023	Jiangsu Huda Chemical Technology Co., Ltd.	92%
26	Hutubi Ruiyuantong Chemical Co., Ltd.	Hutubi Ruiyuantong	Xinjiang Uygur Autonomous Region	Active	2023	Domestic	92%, 96%

27	Anhui Hongyuan Chemical Technology Co., Ltd.	Anhui Hongyuan	Anhui Province	Suspended	2017	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
28	Hubei Yihua Chemical Industry Co., Ltd.	Hubei Yihua	Hubei Province	Suspended	2017	Wuxi Suyang Chemicals Equipment Co., Ltd.	96%
29	Anhui Ruibai New Material Co., Ltd.	Anhui Ruibai	Anhui Province	Potential	/	N/A	92%
30	Jining Huiquan Chemical Co., Ltd.	Jining Huicui	Shandong Province	Potential	/	N/A	N/A
31	Dingyuan County Linxing Chemical Co., Ltd.	Dingyuan Linxing	Anhui Province	Potential	/	N/A	N/A
32	Juancheng County Zhanbang Chemical Co., Ltd.	Juancheng Zhanbang	Shandong Province	Potential	/	Domestic	97%±2%
33	Ningxia Ningshun New Material Co., Ltd.	Ningxia Ningshun	Ningxia Hui Autonomous Region	Potential	/	N/A	96%
34	Xinjiang Shunyuan Chemical Technology Co., Ltd.	Xinjiang Shunyuan	Xinjiang Uygur Autonomous Region	Potential	/	N/A	N/A
35	Qinzhou Juli New Energy Technology Co., Ltd.	Qinzhou Juli	Guangxi Autonomous Region	Potential	/	N/A	N/A
36	Anhui Hehong Chemical Co., Ltd.	Anhui Hehong	Anhui Province	Potential	/	N/A	95%
37	Wen'an County Decheng New Material Technology Co., Ltd.	Decheng New Material	Hebei Province	Potential	/	N/A	N/A
38	Shandong Linfeng New Material Technology Co., Ltd.	Shandong Linfeng	Shandong Province	Potential	/	N/A	95%
39	Guangxi Guifulin Technology Co., Ltd.	Guangxi Guifulin	Guangxi Zhuang Autonomous Region	Potential	/	N/A	95%
40	Shanshan Shenglian New Energy Technology Co., Ltd.	Shanshan Shenglian	Xinjiang Uygur Autonomous Region	Potential	/	N/A	N/A
41	Gansu Hongfu Weiye Technology Co., Ltd	Hongfu Weiye	Gansu Province	Potential	/	N/A	N/A
42	Hebei Yuanlu Chemical Co., Ltd	Hebei Yuanlu	Hebei Province	Potential	/	N/A	N/A

Note:Hubei Trisun Chemicals Co., Ltd. merged its wholly-owned subsidiary Hubei Xingxin Materials Co., Ltd. After the merger, Hubei Trisun continues to operate, while Hubei Xingxin was cancelled on 1 March, 2021.
Source:CCM

Table 2.1-2 Capacity and output of major PF producers in China, 2021–Q1 2024E

No.	Producer	2021		2022		2023		Q1 2024E	
		Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne	Capacity, t/a	Output, tonne
1	Fuhua Tongda	60,000	58,000	60,000	57,000	60,000	58,000	60,000	13,200
2	Hebei Jintaida	40,000	26,000	40,000	25,000	40,000	22,300	40,000	5,600
3	Hebei Yuhang	30,000	18,200	30,000	17,800	30,000	15,500	30,000	2,500
4	Nantong Jiangtian	80,000	59,000	80,000	62,000	80,000	69,200	80,000	15,500
5	Hengshui Yinhe	30,000	8,000	30,000	8,000	30,000	7,200	30,000	1,600
6	Weifang Xudong	10,000	4,200	10,000	3,800	10,000	2,800	10,000	700
7	Anhui Denuo	20,000	3,000	20,000	2,000	20,000	1,500	20,000	400
8	Jiangsu Sanmu	20,000	5,400	20,000	6,000	20,000	8,600	20,000	800
9	Zibo Qixing	20,000	5,000	20,000	5,000	20,000	5,400	20,000	900
10	Linqu Outai	6,000	600	6,000	500	6,000	500	6,000	0
11	Linyi Shengyang	6,000	1,000	6,000	1,000	6,000	1,000	6,000	500
12	Inner Mongolia Jiaquan	15,000	6,000	15,000	7,000	15,000	6,000	15,000	1,300
13	Qingzhou Hengxing	6,000	2,000	6,000	1,800	6,000	1,600	6,000	400
14	Xinjiang Dearsun	40,000	14,000	40,000	10,000	40,000	9,500	40,000	2,400
15	Weifang Huifeng	10,000	3,200	10,000	3,000	10,000	2,400	10,000	500
16	Hubei Trisun	33,000	32,400	33,000	32,000	33,000	32,400	33,000	5,400
17	Xinjiang Wanchang	20,000	6,000	20,000	8,000	20,000	11,400	20,000	3,000
18	Dongying Fangzheng	6,000	2,000	6,000	3,000	6,000	2,100	6,000	500
19	Ningxia Xinning	30,000	8,000	30,000	7,000	30,000	5,600	30,000	1,400
20	Shandong Zhengxin	40,000	5,000	40,000	6,000	40,000	5,300	40,000	900
21	Gansu Taier	20,000	2,000	20,000	5,000	20,000	4,200	20,000	1,200
22	Shijiazhuang Yaze	25,000	3,000	25,000	3,000	25,000	2,200	25,000	400
23	Ningxia Huaye	30,000	3,000	30,000	4,000	30,000	3,400	30,000	1,400
24	Qinyang	/	/	/	/	30,000	3,200	30,000	100

	Yongrun								
25	Anqing Yacoo	/	/	/	/	30,000	4,100	30,000	1,500
26	Hutubi Ruiyuantong	/	/	/	/	30,000	100	30,000	700
27	Anhui Hongyuan	10,000	0	10,000	0	10,000	0	10,000	0
28	Hubei Yihua	20,000	0	20,000	0	20,000	0	20,000	0
Others		40,000	33,600	40,000	24,800	0	0	0	0
Total		**667,000**	**308,600**	**667,000**	**302,700**	**717,000**	**285,500**	**717,000**	**62,800**

Note:"E" means estimated.
Source:CCM

Table 2.1-3 Operating rate and output share of major PF producers in China, 2021–Q1 2024E

No.	Producer	Operating rate				Output share			
		2021	2022	2023	Q1 2024E	2021	2022	2023	Q1 2024E
1	Fuhua Tongda	96.7%	95.0%	96.7%	88.0%	18.8%	18.8%	20.3%	21.0%
2	Hebei Jintaida	65.0%	62.5%	55.8%	56.0%	8.4%	8.3%	7.8%	8.9%
3	Hebei Yuhang	60.7%	59.3%	51.7%	33.3%	5.9%	5.9%	5.4%	4.0%
4	Nantong Jiangtian	73.8%	77.5%	86.5%	77.5%	19.1%	20.5%	24.2%	24.7%
5	Hengshui Yinhe	26.7%	26.7%	24.0%	21.3%	2.6%	2.6%	2.5%	2.5%
6	Weifang Xudong	42.0%	38.0%	28.0%	28.0%	1.4%	1.3%	1.0%	1.1%
7	Anhui Denuo	15.0%	10.0%	7.5%	8.0%	1.0%	0.7%	0.5%	0.6%
8	Jiangsu Sanmu	27.0%	30.0%	43.0%	16.0%	1.7%	2.0%	3.0%	1.3%
9	Zibo Qixing	25.0%	25.0%	27.0%	18.0%	1.6%	1.7%	1.9%	1.4%
10	Linqu Outai	10.0%	8.3%	8.3%	0.0%	0.2%	0.2%	0.2%	0.0%
11	Linyi Shengyang	16.7%	16.7%	16.7%	33.3%	0.3%	0.3%	0.4%	0.8%
12	Inner Mongolia Jiaquan	40.0%	46.7%	40.0%	34.7%	1.9%	2.3%	2.1%	2.1%
13	Qingzhou Hengxing	33.3%	30.0%	26.7%	26.7%	0.6%	0.6%	0.6%	0.6%
14	Xinjiang Dearsun	35.0%	25.0%	23.8%	24.0%	4.5%	3.3%	3.3%	3.8%
15	Weifang Huifeng	32.0%	30.0%	24.0%	20.0%	1.0%	1.0%	0.8%	0.8%
16	Hubei Trisun	98.2%	97.0%	98.2%	65.5%	10.5%	10.6%	11.3%	8.6%
17	Xinjiang Wanchang	30.0%	40.0%	57.0%	60.0%	1.9%	2.6%	4.0%	4.8%
18	Dongying Fangzheng	33.3%	50.0%	35.0%	33.3%	0.6%	1.0%	0.7%	0.8%

19	Ningxia Xinning	26.7%	23.3%	18.7%	18.7%	2.6%	2.3%	2.0%	2.2%
20	Shandong Zhengxin	12.5%	15.0%	13.3%	9.0%	1.6%	2.0%	1.9%	1.4%
21	Gansu Taier	10.0%	25.0%	21.0%	24.0%	0.6%	1.7%	1.5%	1.9%
22	Shijiazhuang Yaze	12.0%	12.0%	8.8%	6.4%	1.0%	1.0%	0.8%	0.6%
23	Ningxia Huaye	10.0%	13.3%	11.3%	18.7%	1.0%	1.3%	1.2%	2.2%
24	Qinyang Yongrun	/	/	10.7%	1.3%	/	/	1.1%	0.2%
25	Anqing Yacoo	/	/	13.7%	20.0%	/	/	1.4%	2.4%
26	Hutubi Ruiyuantong	/	/	0.3%	9.3%	/	/	0.0%	1.1%
27	Anhui Hongyuan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
28	Hubei Yihua	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Others		**84.0%**	**62.0%**	**0.0%**	**0.0%**	**10.9%**	**8.2%**	**0.0%**	**0.0%**
Total		**46.3%**	**45.4%**	**39.8%**	**35.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Note:1. Due to rounding, the total may not equal 100.0%. 2. "E" means estimated.
Source:CCM

Table 2.1-4 List of producers having stopped PF production in China, 2020–Q1 2024

No.	Producer	Location	Starting year	Closed year	Specification	Capacity, t/a
1	Nanhe Huayang Silicon Industry Co., Ltd.	Hebei Province	2014	2023	96%	10,000
2	Zhenjiang LCY Performance Materials Co., Ltd.	Jiangsu Province	2002	2022	92%	30,000
3	Hebei Xinhua Co., Ltd.	Hebei Province	1993	2020	96%	5,000
4	Linyi Liheng Chemical Co., Ltd.	Shandong Province	2005	2020	96%±1%	3,000

Source:CCM

2.2 Capacity and output of PF

After years of rapid growth, China's PF capacity kept increasing from 90,500 t/a in 2006 to 467,000 t/a in 2011, but it decreased to 413,000 t/a in 2012 because several small PF producers, which had weak competitiveness under the circumstances of overcapacity and sluggish PF market, stopped PF production. The PF capacity increased sharply in 2013 along with the launch of some new PF production lines and had a slight increase to 538,000 t/a in 2014 because Jiangsu Sanmu launched its 20,000 t/a PF project.

In 2015, four PF producers stopped production, but five companies started commercial production of PF, namely Fuhua Tongda (the former Leshan Hongya Chemical Co., Ltd.) with capacity of 60,000 t/a, Zibo Qixing with capacity of 20,000 t/a, Nanhe Huayang with capacity of 10,000 t/a, Shandong Linsen with capacity of 12,000 t/a, and Inner Mongolia Jiaquan with capacity of 15,000 t/a.

In 2016, it was found that there were three more enterprises producing PF as well, namely Linyi Ruisheng with capacity of 10,000 t/a, Qingzhou Hengxing with capacity of 6,000 t/a, and Linyi Liheng with capacity of 3,000 t/a. In addition, Xinjiang Dearsun's 20,000 t/a PF project (1st phase of 40,000 t/a PF project) was finished and put into production in 2016. The capacity of PF increased to 670,000 t/a in 2016, up by 4.4% year on year.

In 2017, China's PF capacity decreased to 589,000 t/a, though three companies (Weifang Huifeng, Anhui Hongyuan, Hubei Yihua) finished construction of their PF production lines with total capacity of 40,000 t/a. Yet the same year saw five companies (Chengdu Weite, Jinan Xiangrui, Hebei Hongchen, Linyi Yongda, Taizhou Zhongrong) with total capacity of 81,000 t/a stop PF production completely and two companies (Hengshui Yinhe, Linyi Taier) dismantle a part of their production units.

In 2018, China's PF capacity kept decreasing to 541,000 t/a, and 11 companies stopped PF production completely because of stricter environmental protection policies or poor performance, though 4 companies (Hubei Xingxin, Xinjiang Wanchang, Dongying Fangzheng, Ningxia Xinning) started PF production.

In 2019, China's PF capacity increased to 560,000 t/a, along with the launch of Nantong Jiangtian's 35,000 t/a production unit, though 2 companies stopped PF production completely.

Along with stably increasing domestic demand, China's PF output kept stable in 2016–2018, ranging between 267,000 tonnes and 273,000 tonnes. It increased to 283,800 tonnes in 2019, driven by increasing demand at home and abroad.

In 2020, China's PF capacity kept increasing to 637,000 t/a, along with the launch of three projects (Shandong Zhengxin with 40,000 t/a, Gansu Taier 20,000 t/a and Shijiazhuang Yaze 25,000 t/a), and the output increased to over 295,000 tonnes, though two companies stopped PF production.

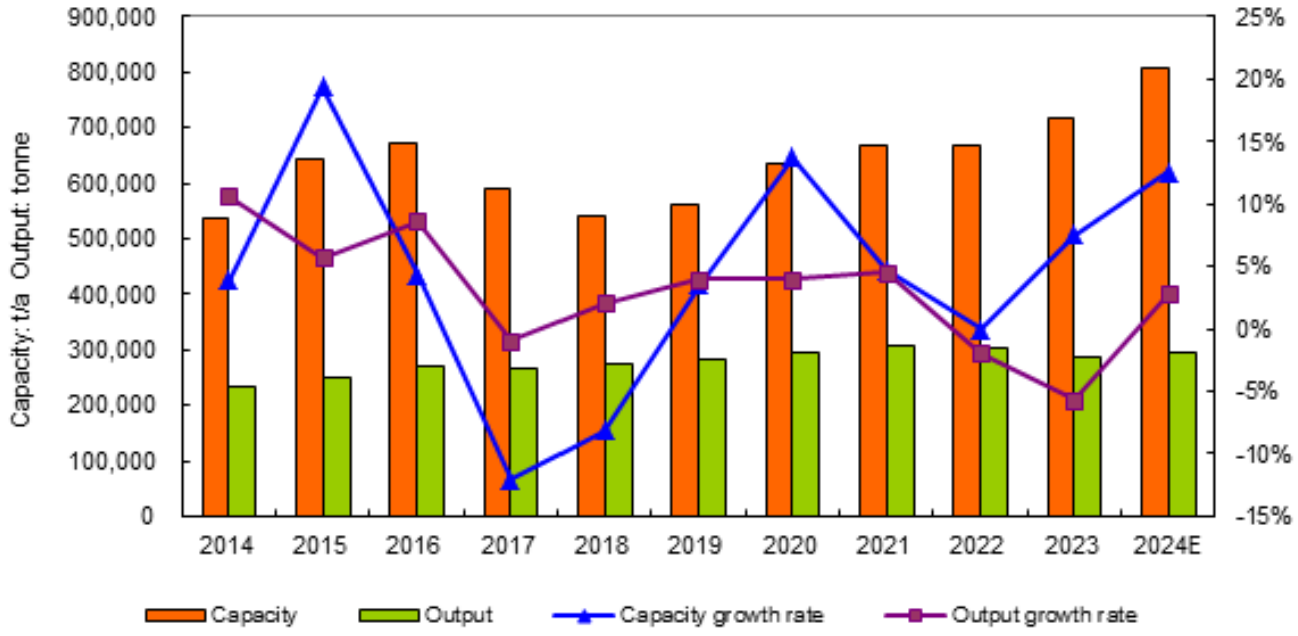
In 2021, both the capacity and output of PF went up in China, reaching 667,000 t/a and 308,600 tonnes respectively. There came a new entrant, Ningxia Huaye; its 30,000 t/a production line was built up at the end of 2020. No producer chose to exit the industry this year.

In 2022, the capacity of PF in China remained at 667,000 t/a, while the output dropped slightly to 302,700 tonnes. It should be noted that Zhenjiang LCY stopped the 30,000 t/a production line late this year.

In 2023, capacity of PF in China increased to 717,000 t/a, but the output of PF in 2023 decreased to 285,500 tonnes. Almost all enterprises producing powder PF saw a decline in output. Due to Zhenjiang LCY's withdrawal from the market, five other granular PF producers (Nantong Jiangtian, Xinjiang Wanchang, Jiangsu Sanmu, Qinyang Yongrun and Anqing Yacoo) seized a larger share in domestic granular PF market in 2023; there were obvious increases in their output.

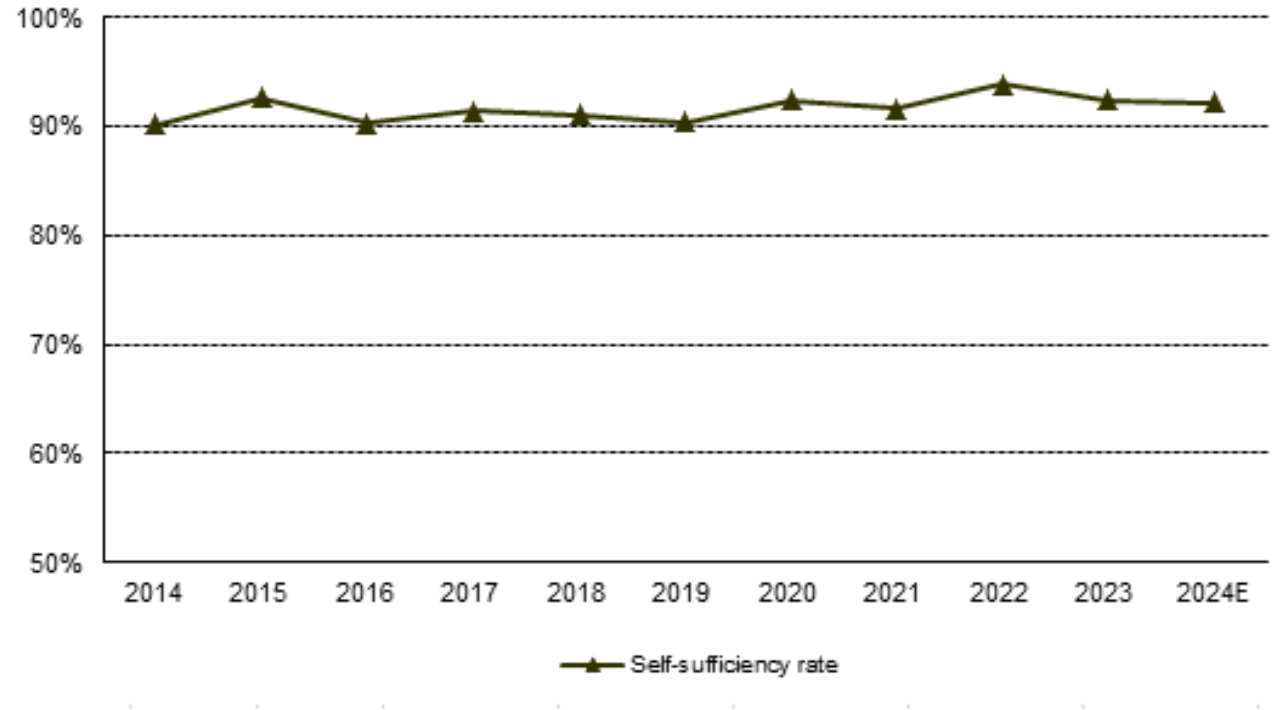
In 2024, it is expected that Anhui Ruibai's 60,000 t/a PF project and Anqing Yacoo's another 30,000 t/a PF project will be put into operation. China's PF production capacity will further increase to 807,000 t/a.

Figure 2.2-1 Capacity and output of PF in China, 2014–2024E



Note:"E" means estimated.
Source:CCM

Figure 2.2-2 Self-sufficiency rate of PF in China, 2014–2024E

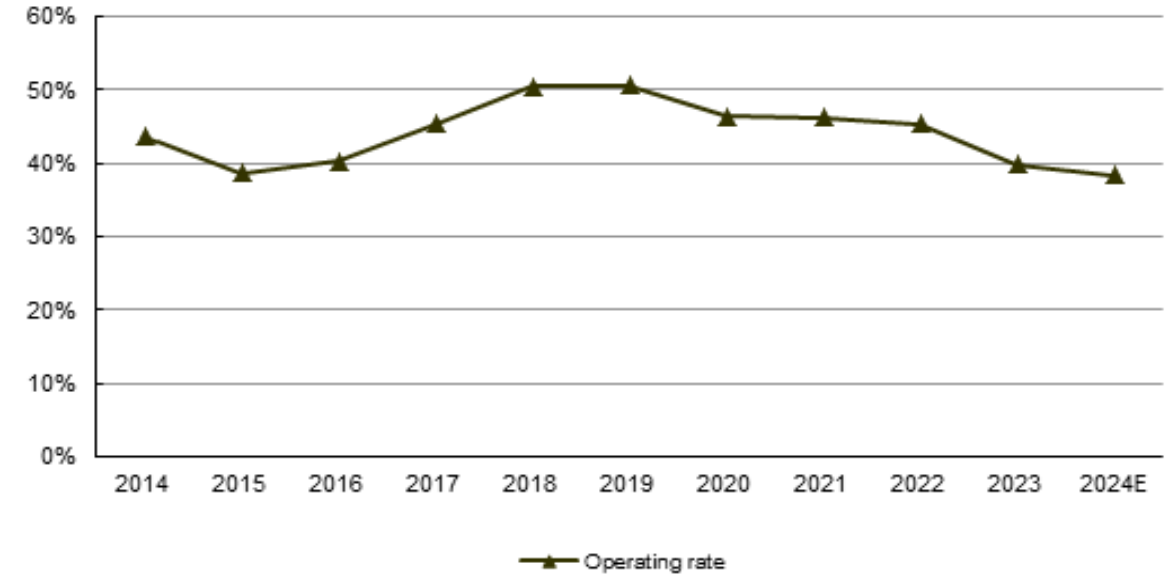


Note:"E" means estimated.
Source:CCM

The operating rate of China's PF industry was relatively low in 2010–2017, below 50%, because of serious overcapacity. The rate increased to 51% in 2018, because a number of producers stopped PF production completely and the output rose slightly driven by increased domestic demand. It kept going up in 2019, even though the capacity also increased. It declined in 2020, along with the launch of three projects.

Given reduced demand caused by the COVID-19 pandemic, the operating rate of China's PF industry maintained at around 46% in 2020–2022. In 2023, dragged by weak demand from the glyphosate industry, China's PF output saw a year-on-year decrease. It is expected that downtrend of the operating rate will continue in 2024.

Figure 2.2-3 Operating rate of PF in China, 2014–2024E



Note:"E" means estimated.
Source:CCM

2.3 Price of PF

China's PF capacity has been growing so rapidly that the demand growth could not catch up with it. Overcapacity has remained serious in recent years. As a result, PF producers' bargaining power became weaker. Meanwhile, the profit rate in PF industry has been decreasing. Now the ex-works price of PF quoted by most domestic producers is affected by the following factors:
- The price of imported PF
- The profit rate of downstream products, especially glyphosate
- The price of methanol, an important raw material of PF

The main factor affecting PF price is the raw material. Monthly ex-works prices of PF and methanol in China from 2013 to 2022 showed that PF price fluctuated along with methanol price.

The ex-works price of PF kept increasing in 2013, and it reached a new high in Dec. at about USD941/t. The rise was mainly driven by the increasing price of methanol and increasing demand for PF from the domestic glyphosate industry. However, a reverse trend was witnessed in 2014, the price of PF decreasing from USD900/t in Jan. to USD799/t in Dec., which was mainly affected by the falling price of methanol and the overcapacity of PF from the domestic glyphosate industry.

At the beginning of 2015, the ex-works price of PF in China had a sharp decrease, and hit USD617/t in March 2015. After a temporary recovery in April, the ex-works price of PF started to decrease from USD783/t in April to USD675/t in Dec. As the price of methanol and imported PF kept decreasing, the domestic ex-works price of PF decreased as well.

In 2016, the overall ex-works price of PF was lower than that in 2015. In Q1–Q3 2016, the price declined from USD704/t in Jan. to USD559/t in Sept. The ex-works price fluctuation of PF was mainly affected by its upstream raw materials' price fall (especially methanol). However, the ex-works price began to increase in Q4 2016, due to the recovery of demand for glyphosate.

In 2017, the ex-works price of PF followed an upward trend on the whole thanks to increasing raw material price and recovery of glyphosate market.

In 2018, the annual average ex-works price of PF continued to increase, reaching about USD897/t. Major reasons are increasing prices of formaldehyde and methanol, and production cuts of some PF producers triggered by stringent environmental protection inspections, especially in Shandong and Hebei.

In Q1 2019, the ex-works price of PF increased a little. Then in Q2–Q4, it showed a general downward trend, following falls in the prices of formaldehyde and methanol.

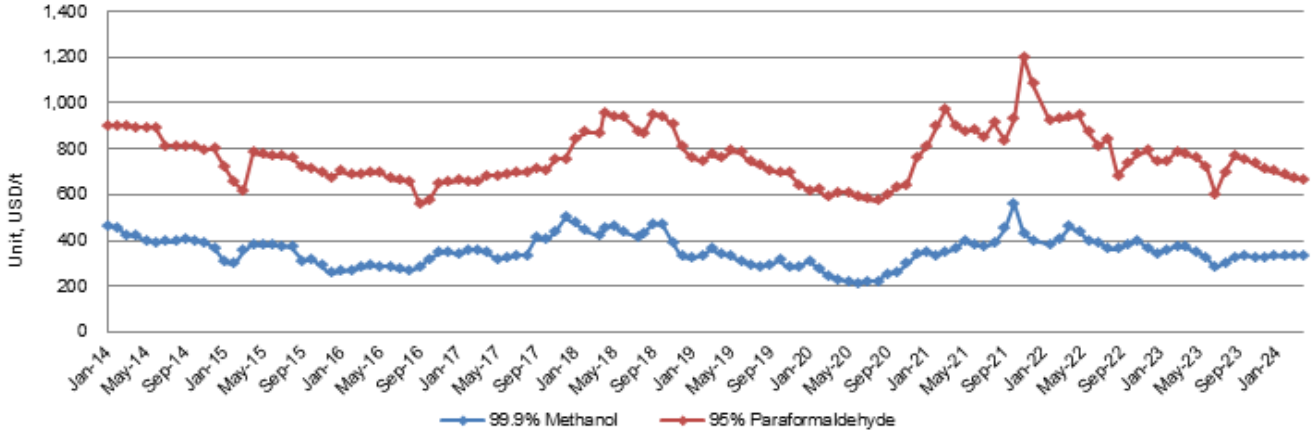
In 2020, due to the impact of COVID-19, and capacity release of new PF projects, especially in West China and North China (cost advantage, less influence from environmental protection), the price of PF dropped to the lowest at USD571/t in Aug. Later, with rising raw material prices and increasing demand for PF, the price has kept rising. Especially at the end of 2020, amid continuous rise of methanol price, environmental protection restrictions in winter, high demand from downstream wood-based panel industry, and decreased supply of formaldehyde and the rising price, PF price jumped.

In 2021, the ex-works price of PF rebounded strongly, peaking at about USD1,200/t in Nov., mainly affected by a sharp rise in methanol price. Production cost of methanol increased, since the price of coal was kept at a high level. In addition, prices of PF downstream products kept going up in 2021, especially the price of glyphosate, which also supported PF price rise to some extent.

In 2022, the ex-works price of PF saw a decline in general with some fluctuations. Due to shrinking methanol prices and sluggish demand, the market confidence was dampened to some extent.

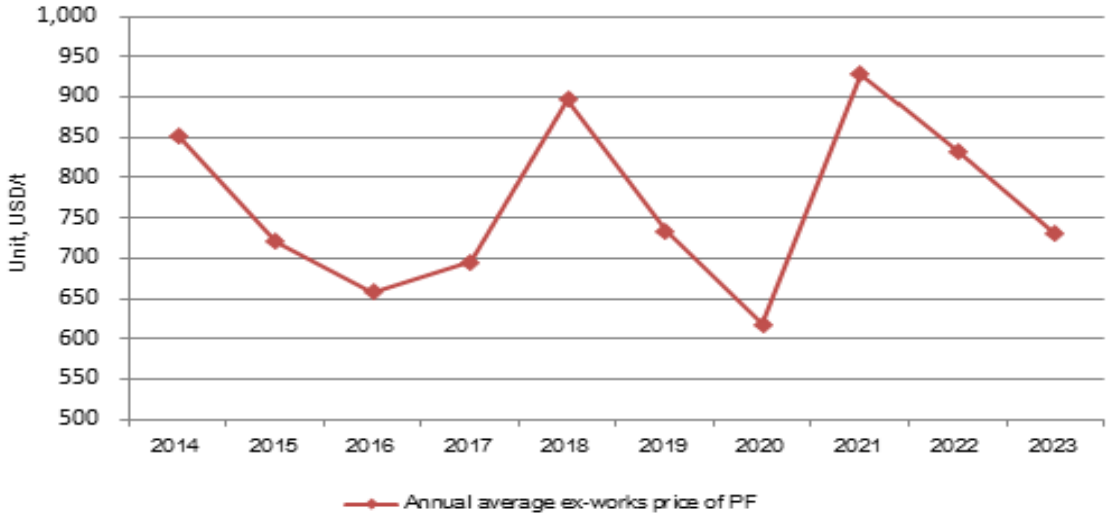
In 2023, the monthly ex-works price of PF fluctuated significantly, showing a V-shaped trend overall, which is basically consistent with the price trend of methanol. In June, due to poor downstream market demand, the ex-works price of PF dropped to its lowest point in nearly two years, at USD602/t.

Figure 2.3-1 Monthly ex-works price of 95% PF and 99.9% methanol in China, Jan. 2014–March 2024



Source:CCM

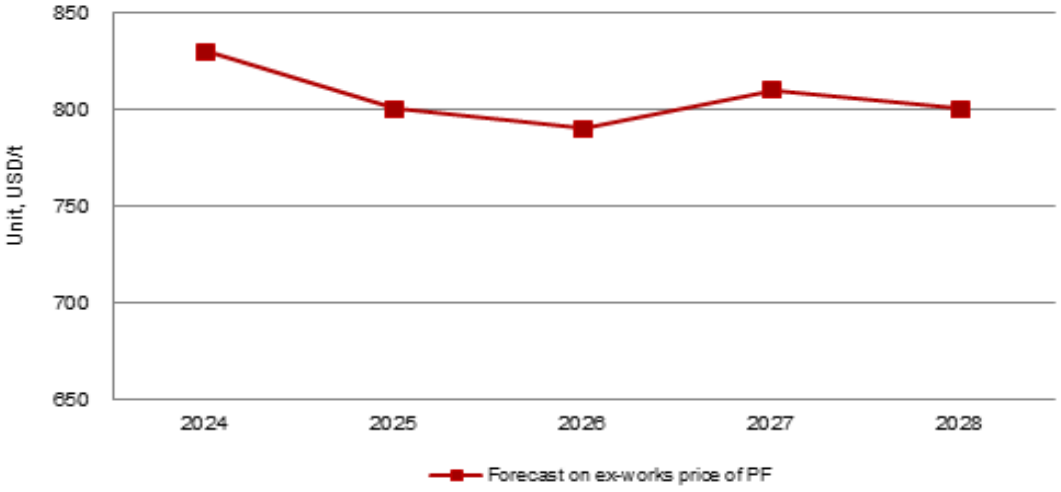
Figure 2.3-2 Annual average ex-works price of PF in China, 2014–2023



Source:CCM

On the whole, after 2015, annual average price of PF bounced up in 2018 and reached a new peak in 2021 from the 2020 trough. However, in 2022 and 2023, due to the unstable prices of methanol and formaldehyde, as well as poor downstream demand, China's PF prices fell for two consecutive years. After taking production costs, profits and demand into consideration, it is projected that the ex-works price of PF in China will fluctuate around USD800/t in 2024–2028.

Figure 2.3-3 Forecast on ex-works price of PF in China, 2024–2028



Source:CCM

Table 2.3-1 Quotation of PF in China by producer, March 2024

No.	Producer	Ex-works price in March 2024, USD/t
1	Fuhua Tongda	N/A
2	Hebei Jintaida	96% powder: 675
3	Hebei Yuhang	N/A
4	Nantong Jiangtian	96% granule: 957; 92% granule: 873
5	Hengshui Yinhe	96% powder: 633
6	Weifang Xudong	96% powder: 675
7	Anhui Denuo	N/A
8	Jiangsu Sanmu	N/A
9	Zibo Qixing	96% powder: 690
10	Linqu Outai	N/A
11	Linyi Shengyang	96% powder: 760
12	Inner Mongolia Jiaquan	96% powder: 605
13	Qingzhou Hengxing	96% powder: 647
14	Xinjiang Dearsun	96% powder: 830
15	Weifang Huifeng	96% powder: 704
16	Hubei Trisun	N/A
17	Xinjiang Wanchang	92% granule: 718
18	Dongying Fangzheng	N/A
19	Ningxia Xinning	96% powder: 605
20	Shandong Zhengxin	N/A
21	Gansu Taier	96% powder: 563
22	Shijiazhuang Yaze	N/A
23	Ningxia Huaye	96% powder: 591
24	Qinyang Yongrun	92% and 96% granule: 704
25	Anqing Yacoo	N/A
26	Hutubi Ruiyuantong	92% and 96% granule: 675

Source:CCM

2.4 New dynamics of raw material of PF—formaldehyde

Chinese PF producers use 37% or 50% formaldehyde to produce PF, depending on their production technologies. Generally speaking, production with rake drying method adopts 37% or 50% formaldehyde, and that with spray drying method uses 50% formaldehyde.

Table 2.4-1 Information on formaldehyde by major PF producers in China, as of March 2024

No.	Producer	Technology source of formaldehyde production	Source of formaldehyde	Concentration of formaldehyde
1	Fuhua Tongda	Domestic	Captive production	50%
2	Hebei Jintaida	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	45%–50%
3	Hebei Yuhang	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%
4	Nantong Jiangtian	GEA Niro	Captive production	37%–55%
5	Hengshui Yinhe	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%
6	Weifang Xudong	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%, 50%
7	Anhui Denuo	Hebei Xinhua	Captive production	37%
8	Jiangsu Sanmu	Jiangsu Kaimao Chemical Technology Co., Ltd.	Captive production	37%
9	Zibo Qixing	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	50%
10	Linqu Outai	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%
11	Linyi Shengyang	Domestic	Captive production	37%
12	Inner Mongolia Jiaquan	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	50%
13	Qingzhou Hengxing	Domestic	Captive production	37%
14	Xinjiang Dearsun	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	50%
15	Weifang Huifeng	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%
16	Hubei Trisun	Domestic	Captive production	52%
17	Xinjiang Wanchang	Domestic	Captive production	37%
18	Dongying Fangzheng	Domestic	Captive production	37%
19	Ningxia Xinning	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%
20	Shandong Zhengxin	Domestic	Captive production	37%
21	Gansu Taier	Linyi Taier	Captive production	50%
22	Shijiazhuang Yaze	Domestic	Captive production	50%

23	Ningxia Huaye	Wuxi Suyang Chemicals Equipment Co., Ltd.	Captive production	37%
24	Qinyang Yongrun	Johnson Matthey	Captive production	37%
25	Anqing Yacoo	Domestic	Captive production	55%
26	Hutubi Ruiyuantong	Domestic	Captive production	50%–55%

Source:CCM

2.4.1 Supply of formaldehyde in China

Table 2.4.1-1 Production, import, export and apparent consumption of formaldehyde in China, 2014–2023

Year	Capacity, t/a	Output, tonne	Growth rate of output	Import volume, tonne	Export volume, tonne	Apparent consumption, tonne
2014	34,000,000	18,590,000	28.9%	47	11,101	18,578,946
2015	35,000,000	14,556,000	-21.7%	13	10,334	14,545,679
2016	35,000,000	15,866,000	9.0%	1	8,902	15,857,099
2017	36,000,000	12,851,000	-19.0%	1	8,466	12,842,535
2018	36,000,000	12,500,000	-2.7%	1	8,300	12,491,701
2019	36,000,000	13,100,000	4.8%	3	11,768	13,088,234
2020	36,160,000	11,900,000	-9.2%	5	12,537	11,887,468
2021	37,010,000	14,580,000	22.5%	2	4,243	14,575,759
2022	39,770,000	15,908,000	9.1%	16	1,347	15,906,670
2023	43,670,000	16,310,000	2.5%	2	1,598	16,308,404

Source:CCM

Formaldehyde is a basic and low value-added chemical. As liquid formaldehyde is inconvenient to transport, formaldehyde is usually consumed in the surrounding areas close to the producing area to reduce freight charges. And both the import and export volume of the product in China are quite small.

In China, formaldehyde is mainly consumed in the production of adhesive, polyformaldehyde (POM), pentaerythritol, MDI, BDO, etc.

In 2013–2014, the output of formaldehyde in China kept an uptrend, but in 2015 the formaldehyde industry suffered a severe downturn, at a year-on-year decrease of 21.7% in formaldehyde output.

Although formaldehyde output edged up in 2016, operating rates of formaldehyde producers dropped in 2017 triggered by plummeting downstream consumption. This was because major downstream wood flooring factories suspended or reduced production during central and provincial environmental protection inspections. The output kept decreasing in 2018, influenced by environmental protection inspections, industrial park relocation, decreasing demand, etc., but it rebounded in 2019.

In 2020, affected by the COVID-19 pandemic, the demand from downstream real estate and other industries reduced, and the operating rate of formaldehyde industry was lower than that in 2019.

In 2021, the output of formaldehyde increased by 22.5% year on year to 14,580,000 tonnes. Main reasons for the significant increase in output are as follows:

- Due to strong demand from downstream industries, the operating rate of formaldehyde industry went

up.
● Some new production capacity went into operation.

Thanks to accelerated formaldehyde project relocation to industrial parks, about 2.8 million t/a new formaldehyde capacity was released in 2022; the capacity and output of formaldehyde in China both saw growth.

In 2023, the capacity of formaldehyde in China continued to expand, reaching 43,670,000 t/a and the output grew by 2.5% year on year. As China's chemical enterprises have been paying increasing attention to the construction of upstream and downstream industry chain support to reduce production costs, more and more enterprises have been equipped with formaldehyde production lines for downstream products, resulting in an increase in formaldehyde capacity.

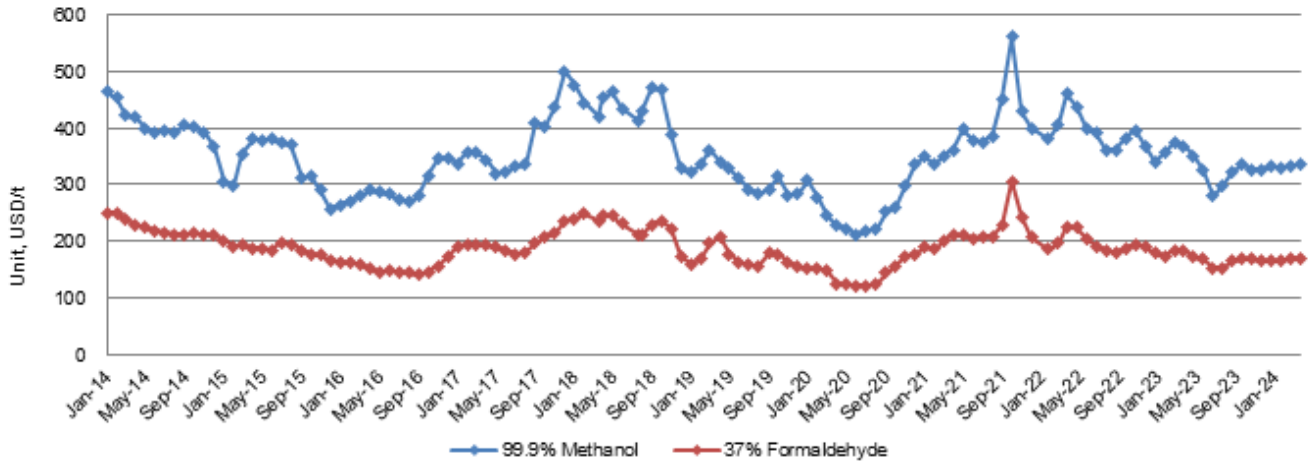
2.4.2 Price of formaldehyde in China

Methanol is the main raw material of formaldehyde. At present, the production of one tonne of formaldehyde needs about 0.43 tonne of refined methanol. The raw material cost accounts for around 90% of the total production cost of formaldehyde in China. The price of formaldehyde is primarily decided by methanol price.

During 2014–2015, the ex-works price of 99.9% purified methanol fluctuated amid a decline on the whole, being USD258/t in Dec. 2015; then it rebounded, coming up to USD499/t in Dec. 2017. Starting from 2018, the price saw another downward trend, with several fluctuations though; it decreased from USD476/t in Jan. 2018 to USD210/t in June 2020, a new low since 2010. However, in 2021, the price rebounded because of rising coal prices, peaking in Oct. at USD561/t, a new high since 2009. In 2022, driven by high prices of coal and natural gas, the methanol price remained high and fluctuating. The overall methanol price in 2023 showed a V-shaped trend. In H1 2023, coal was in a low season, so coal price declined, which drove down the production cost and price of methanol. In H2, methanol price briefly increased and remained stable after Sept., following coal price changes due to coal mine safety inspections and production restrictions in Q3 and stable supply-demand relation in Q4.

The ex-works price of 37% formaldehyde usually fluctuates with the price of methanol. From Jan. 2014 to Sept. 2016, the price in China decreased almost continuously, ending at USD141/t. Then it rebounded and reached USD245/t in May 2018. It entered another round of downtrend with fluctuations though, decreasing from USD231/t in June 2018 to USD122/t in July 2020. During Aug. 2020–Oct. 2021, the ex-works price of 37% formaldehyde in China was on an overall uptrend; it soared to USD307/t in Oct. 2021. In 2022, the formaldehyde price hovered around USD200/t. The price of formaldehyde slightly increased at the beginning of 2023, but since April, the price went down quickly and after a rebound in Aug. the price remained relatively stable from Sept. 2023 to March 2024.

Figure 2.4.2-1 Monthly ex-works prices of 37% formaldehyde and 99.9% purified methanol in China, Jan. 2014–March 2024



Source:CCM

2.5 Industrial affairs of PF in China

In Jan. 2013, Jiangsu Sanmu's 20,000 t/a PF project was determined, and Jiangsu Kaimao Chemical

Technology Co., Ltd. (formed by the technical team of Jiangsu Hengmao Machinery Manufacture Co., Ltd.) was the appointed company that took charge of the project.

On 26 May, 2013, the environmental impact assessment of Hebei Jintaida Chemical Co., Ltd.'s methanol project (250,000 t/a of formaldehyde, 135,000 t/a of methylal, 60,000 t/a of chloromethane, 40,000 t/a of PF, 10,000 t/a of urtropine, etc.), was published for the second time.

On 27 May, 2013, a 30,000 t/a PF project of Nanhe Huayang was approved by the local government.

In June 2013, the environmental impact assessment of Leshan Hongya's PF project (60,000 t/a of PF, 150,000 t/a of formaldehyde and 10,000 t/a of urotropine) was published for the first time. In Aug. 2013, the environmental impact assessment of this project was published for the second time.

In July 2013, the environmental impact assessment of Guang'an Haochuan Chemical Co., Ltd.'s PF project (100,000 t/a of formaldehyde, 6,000 t/a of PF and 2 million pieces of impregnated paper) was published for the second time.

In Oct. 2013, 20,000 t/a PF production lines of Jiangsu Sanmu, adopting spray drying method, were built up by Jiangsu Kaomao Chemical Technology Co., Ltd.

In Dec. 2013, Zibo Qixing's PF project (40,000 t/a of PF, 200,000 t/a of formaldehyde and 30,000 t/a of methylal) was approved.

In June 2015, the environmental impact assessment of Xinjiang Wanchang's PF project with a capacity of 40,000 t/a was approved.

On 4 Aug., 2015, the environmental impact assessment of Xinjiang Dearsun's PF project (200,000 t/a of formaldehyde, 100,000 t/a of methylal and 40,000 t/a of PF) was approved. The PF capacity of the project's first phase was 20,000 t/a.

In Dec. 2015, Dongying Fangzheng finished the construction of its PF project with a capacity of 6,000 t/a.

On 13 Jan., 2016, the environmental impact assessment of Ningxia Duoli's PF project with a capacity of 20,000 t/a was published for the first time.

On 21 March 2016, the environmental impact assessment of Qinyang Yongrun's PF expansion with a capacity of 30,000 t/a was published for the first time.

In March 2016, Xinjiang Dearsun's PF project was completed and put into production.

In 2016, Nantong Jiangtian reconstructed and upgraded its PF production line, changing its technology from rake drying to spray drying and increasing the capacity from 10,000 t/a to 25,000 t/a.

On 4 Feb., 2017, the assessment report on the control effect of occupational risks resulted from the 50% formaldehyde and PF projects (with a capacity of 50,000 t/a and 10,000 t/a respectively) in Anhui Hongyuan was released.

In March 2017, Qinyang Yongrun and Kingland Energy and Technology Co., Ltd. signed an investment contract that Qinyang Yongrun constructed a PF project with a capacity of 30,000 t/a for Kingland Energy and Technology Co., Ltd.

In July 2017, land pre-examination of Qinzhou Juli New Energy Technology Co., Ltd.'s polyoxymethylene dimethyl ether project (1st phase include: 80,000 t/a formaldehyde, 20,000 t/a methylal, 20,000 t/a PF, etc.) was approved.

In November 2017, the environmental impact assessment information of Ningxia Huaye Fine Chemical Co., Ltd.'s project of formaldehyde and its downstream products (450,000 t/a formaldehyde, 80,000 t/a methylal, 90,000 t/a PF, 30,000 t/a urotropine, etc.) was posted.

In January 2018, the environmental impact assessment of Anhui Dafeng Chemical Co., Ltd. project (80,000 t/a formaldehyde, 30,000 t/a PF, 50,000 t/a urea-formaldehyde resin, 15,000 t/a urotropine) was published

for the first time. However, the company was closed in Aug. 2022.

In Novermber 2018, the environment impact report of Anhui Quansheng Chemical Co., Ltd.'s PF project with a capacity of 30,000 t/a was approved. Besides, the environment impact report of Shijiazhuang Yaze Chemical Co., Ltd.'s project (160,000 t/a formaldehyde, 25,000 t/a PF, 10,000 t/a urotropine, 20,000 t/a liquid ammonia) t/a was published, and the environment impact report of Gansu Taier Fine Chemical Co., Ltd.'s project (400,000 t/a formaldehyde, 100,000 t/a methylal, 60,000 t/a PF, 60,000 t/a urotropine) was also published.

Sixteen companies stopped PF production completely in 2017–2018, caused by stricter environmental protection policy, poor performance, etc.

In January 2019, the environment impact report of Jining Huiquan Chemical Co., Ltd.'s relocation project (1st phase: 100,000 t/a formaldehyde, 50,000 t/a adhensive; 2nd phase: 100,000 t/a formaldehyde, 30,000 t/a PF) was published.

In January 2019, the 2,320,000 t/a formaldehyde and resin environment-friendly new material project of Wen'an County Decheng New Material Technology Co., Ltd. was announced (1st phase: 960,000 t/a formaldehyde; 2nd phase: 960,000 t/a formaldehyde, 60,000 t/a PF, and 500,000 t/a melamine formaldehyde resin, etc.).

In April 2019, the environmental impact assessment information of Juancheng County Zhanbang Chemical Co., Ltd.'s 480,000 t/a formaldehyde (1st phase) and deep-processing project (600,000 t/a urea-formaldehyde resin, 30,000 t/a PF, etc.) was published. However, in July 2021, the project was adjusted, and the capacity for PF was changed to 10,000 t/a.

In August 2019, the environmental impact assessment information of Hubei Xingxin Materials Co., Ltd.'s 65,000 t/a PF project was published for the first time.

In Jan. 2020, the environment impact report of Ningxia Ningshun New Material Co., Ltd.'s formaldehyde, polyol as well as downstream deep-processing project (1st phase: 200,000 t/a formaldehyde, 20,000 t/a pentaerythritol; 2nd phase: 10,000 t/a neopentyl glycol; 3rd phase: 100,000 t/a formaldehyde, 20,000 t/a PF, etc.; 4th phase: 10,000 t/a calcium formate, etc.) was published for the first time.

In March 2020, the environmental impact assessment information of Dingyuan County Linxing Chemical Co., Ltd.'s 70,000 t/a urea-formaldehyde resin technical transformation project (1st phase) and 10,000 t/a PF (2nd phase) was published.

In Aug. 2020, in accordance with the resolutions of the shareholders meeting of Hubei Trisun Chemicals Co., Ltd. and the shareholders' decision of Hubei Xingxin Materials Co., Ltd., Hubei Trisun planned to merge its wholly-owned subsidiary Hubei Xingxin. After the merger, Hubei Trisun continued to operate, while Hubei Xingxin was cancelled on 1 March, 2021.

In Oct. 2020, the environment impact report of Anhui Hehong Chemical Co., Ltd. 's project (90,000 t/a PF, etc.) was published for the first time.

In Nov. 2020, the environment impact report of Hutubi Ruiyuantong Chemical Co., Ltd.'s 30,000 t/a PF and 50,000 t/a methylal expansion project was published for the first time.

In Feb. 2021, the environment impact report of Xinjiang Shunyuan Chemical Technology Co., Ltd.'s project (1st phase: 200,000 t/a formaldehyde, 200,000 t/a urea-formaldehyde resin and 50,000 t/a PF; 2nd phase: 50,000 t/a urotropine and 300,000 t/a formaldehyde) was published for the first time.

In June 2021, the environment impact report of Yake Technology (Anqing) Co., Ltd.'s project (1st phase: 240,000 t/a formaldehyde, 60,000 t/a PF, etc.) was published.

In July 2021, the environment impact report of Shandong Linfeng New Material Technology Co., Ltd.'s project (1st phase: 400,000 t/a formaldehyde solution, ect.; 2nd phase: 60,000 t/a PF, 200,000 t/a urea formaldehyde concentrate (UFC), ect.) was published.

In Nov. 2021, Nantong Jiangtian Chemical Co., Ltd. decided to launch a relocation project, in response to

government's call to withdraw chemical enterprises from 1km-range to the Yangtze River. This project will build production lines for 100,000 t/a PF, 20,000 t/a modified engineering plastics polyformaldehyde and 9,000 t/a green environment-friendly textile auxiliary series, and set up a green intelligent factory. The construction started in March 2022, and is expected to be completed in Dec. 2025. Before the project is finished and the lines are put into operation, the company would maintain production in the existing plant, in order to ensure sound production and operation.

In Nov. 2021, the environment impact report of Guangxi Guifulin Technology Co., Ltd.'s project (720,000 t/a formaldehyde, 100,000 t/a PF, ect.) was published.

In Feb. 2022, the environment impact report of Anhui Ruibai New Materical Co., Ltd.'s project (50,000 t/a propyl acetate, 50,000 t/a butyl acetate, 360,000 t/a formaldhyde and 60,000 t/a PF) was published.

In June 2022, a 30,000 t/a PF project of Hebei Yuanlu Chemical Co., Ltd. was approved by the Ecology and Environment Bureau of Xingtai City, Hebei province.

In Dec. 2022, Zhenjiang LCY Performance Materials Co., Ltd. closed its 30,000 t/a PF production line in Zhenjiang City, Jiangsu Province, in a response to government's call to withdraw chemical enterprises from 1km-range to the Yangtze River and thus protect the eco-environment along the Yangtze River Economic Belt.

In Feb. 2023, the environment impact report of Shanshan Shenglian New Energy Technology Co., Ltd.'s project (60,000 t/a PF and 100,000 t/a sodium methoxide) was published.

In March 2023, Qinyang Yongrun Technology Development Co., Ltd.'s 30,000 t/a production line was put into production, and Yacoo Technology (Anqing) Co., Ltd.'s 30,000 t/a production line was put into trial production. At the same time, Gansu Hongfu Weiye Technology Co., Ltd.'s project (20,000 t/a PF, etc.) was approved by the Ecology and Environment Bureau of Jiuquan City, Gansu province.

In June 2023, Zhenjiang LCY Performance Materials Co., Ltd. transferred its facilities and production technology to Anhui Ruibai New Material Co., Ltd.

At the end of 2023, Hutubi Ruiyuantong Chemical Co., Ltd.'s 30,000 t/a PF production line was put into operation.

2.6 Cost structure of PF producers in China

Table 2.6-1 Production cost of granular PF produced by spray drying technology, March 2024

Production cost, USD/t	Item	Proportion, %
673	Raw material	74.7
	Labor	2.8
	Energy	2.7
	Manufacturing and management	19.8

Source:CCM

Table 2.6-2 Production cost of powder PF produced by rake drying technology, March 2024

Production cost, USD/t	Item	Proportion, %
599	Raw material	72.8
	Labor	3.0
	Energy	3.5
	Manufacturing and management	20.7

Source:CCM

3 Import & export analysis of PF

3.1 Overall situation of PF trading

The domestic PF is more and more popular with customers at home and abroad, because of its high quality and low price in recent years. From 2010 to 2014, the export volume of PF in China kept increasing, while the import volume of PF fluctuated.

In 2015, both export volume and import volume of PF in China decreased, down by 2.0% and 22.6% respectively compared with those in 2014.

In 2016, the export volume of PF in China continued to decrease while the import volume rebounded. Specifically, the PF export volume decreased by 2.2% year on year; the import volume increased by 48.4%, from 18,351 tonnes in 2015 to 27,228 tonnes in 2016.

In 2017, both export and import volumes of PF in China decreased, down by 10.5% and 13.0% year on year respectively.

In 2018, the export volume of PF kept declining, down by 11.6% year on year, while the import volume of PF increased, up by 6.5% year on year.

In 2019, both export volume and import volume of PF in China increased, up by 63.8% and 10.0% respectively compared with those in 2018.

In 2020, the export volume of PF continued to grow, up by 24.3% year on year, while the import volume of PF fell by 20.9%. At the same time, the export volume of PF exceeded the import volume for the first time since 2001, by about 6,000 tonnes.

In 2021, both import and export volumes of PF in China increased, up by 10.9% and 49.5% respectively year on year.

In 2022, China's import volume of PF saw a sharp decrease compared with previous years, plunging to the lowest level in the past decade. Given insufficient downstream demand, high import price and improved quality of domestic products, the domestic imports witnessed a decline. In contrast, the export volume kept on rising, thanks to strong demand amidst inadequate product availability overseas due to low production activities.

In 2023, the import volume and export volume of PF in China increased by 16.3% and 6.6% year on year, respectively. At the same time, annual average import price and export price decreased by 18.5% and 14.6% year on year, respectively.

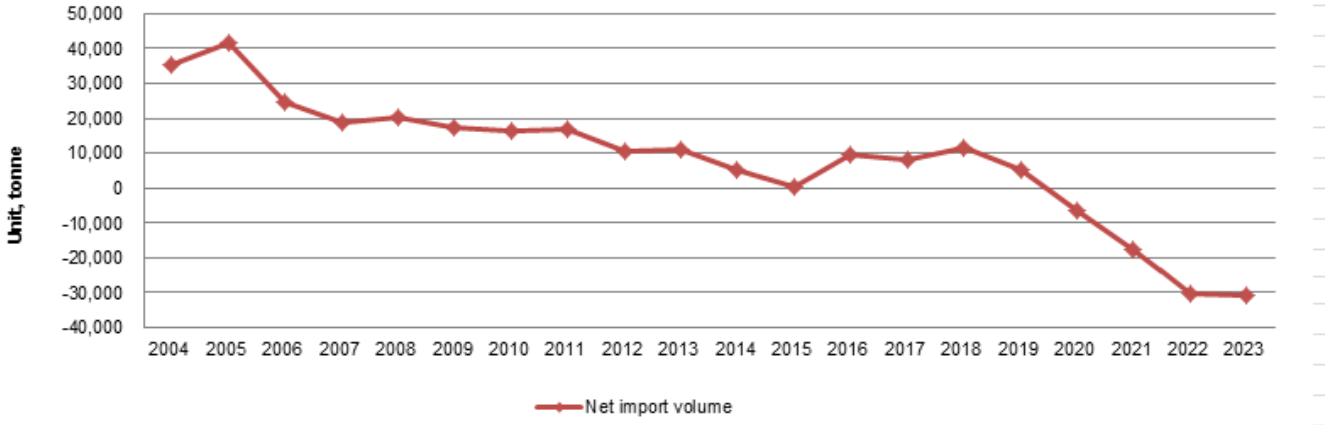
Table 3.1-1 China's imports and exports of PF, 2004–2023

Year	Import			Export		
	Volume, tonne	Value, USD	Average price, USD/t	Volume, tonne	Value, USD	Average price, USD/t
2004	36,418	17,413,685	478	1,035	519,427	502
2005	41,963	24,355,821	580	287	364,806	1,269
2006	27,337	15,128,357	553	2,673	1,752,222	656
2007	23,255	17,535,251	754	4,620	3,926,334	850
2008	21,324	19,152,962	898	1,091	1,247,598	1,144
2009	19,651	11,174,350	569	2,485	1,351,392	544
2010	23,123	15,326,157	663	6,844	3,958,553	578

2011	25,840	19,885,472	770	9,173	6,805,720	742
2012	22,882	18,082,675	790	12,196	9,325,042	765
2013	28,098	24,315,107	865	17,144	14,539,425	848
2014	23,695	21,321,657	900	18,244	16,440,267	901
2015	18,351	14,242,131	776	17,877	13,033,631	729
2016	27,228	16,693,127	613	17,478	10,253,062	587
2017	23,682	16,169,213	683	15,644	10,702,508	684
2018	25,216	19,396,069	769	13,837	11,752,717	849
2019	27,747	19,721,149	711	22,660	16,120,527	711
2020	21,952	13,785,257	628	28,157	16,271,518	578
2021	24,339	20,254,740	832	42,084	35,485,792	843
2022	16,718	17,202,637	1,029	46,989	39,715,532	845
2023	19,443	16,309,286	839	50,085	36,145,723	722

Source:China Customs & CCM

Figure 3.1-1 Net import volume of PF in China, 2004–2023



Source:China Customs & CCM

3.2 Import analysis of PF 2023

- Import volume

Annual import volume of PF was 36,000 tonnes–48,000 tonnes during 2000–2005 in China, and a historical high, 47,281 tonnes, was witnessed in 2003. After 2005, the annual import volume fell below 30,000 tonnes, and its share in apparent consumption decreased sharply to less than 20% in 2008–2013 and further to less than 10% since 2014, because of the stably increasing output of homemade PF.

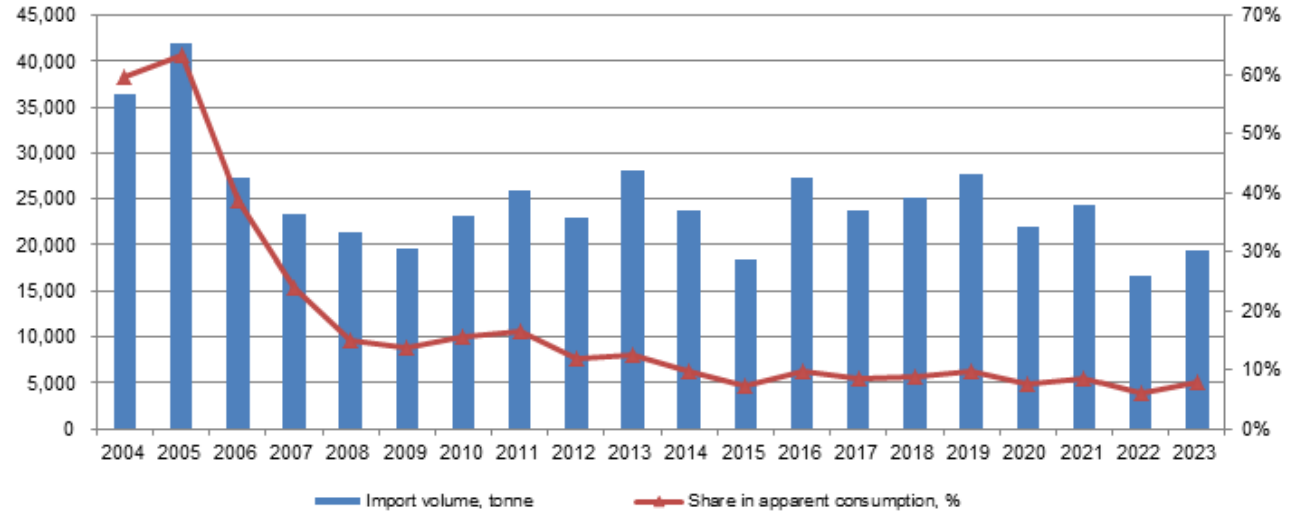
In 2013, the import volume of PF rebounded to 28,098 tonnes, driven by the fast demand growth from the domestic resin industry. Yet the import volume of PF kept decreasing during 2014–2015 because of the sufficient supply of domestic PF, and the import volume was only 18,351 tonnes in 2015, the lowest in 2000–2021.

In 2016–2021, affected by the imbalance between supply and demand, the import volume of PF fluctuated between 21,500 tonnes–28,000 tonnes. In 2022, under limited trading activities, China's import volume of PF

saw a significant decline, slashed by 31.3% year on year to 16,718 tonnes.

In 2023, the import volume of PF in China significantly increased, mainly due to the withdrawal of Zhenjiang LCY from the market and the shift of some granular PF consumers to import PF from abroad.

Figure 3.2-1 Import volume of PF and its share in PF apparent consumption in China, 2004–2023



Source:China Customs & CCM

- Import origin

Spain, Taiwan Province and the US were the top three PF origins for China in 2010–2018, during which China's PF import volume from these three regions took up almost 93.1%–99.9% of the total.

Spain has always been the top import origin before 2016. However, the share from Spain decreased from 55.9% in 2010 to 40.3% in 2016 and 41.8% in 2017, while that from Taiwan Province rose from 26.0% in 2010 to 50.3% in 2016 and 46.2% in 2017. The main reason was the narrowing gap between the PF import prices of Spain and Taiwan Province and later the PF price of Taiwan Province has been less than that of Spain since 2013.

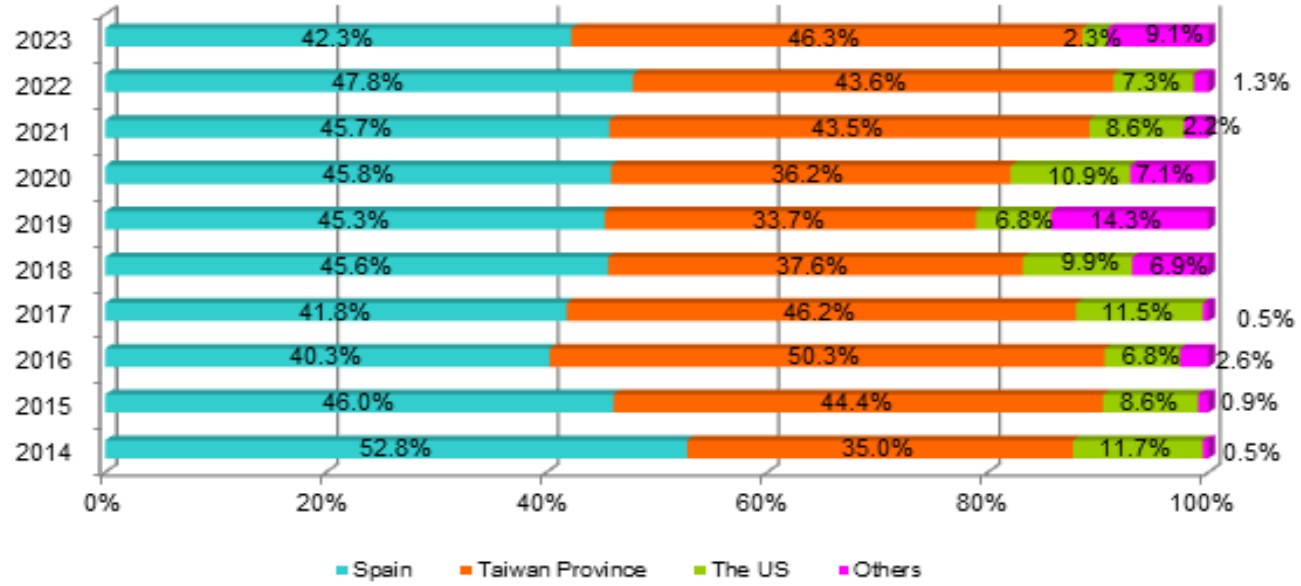
In 2018, Spain won back the No. 1 position, and China imported 1,620 tonnes of PF from Indonesia, a new but vigorous comer.

In 2019, the top three PF origins for China were Spain, Taiwan Province and Indonesia. And the PF import volume from these three regions took up 91.4% of the total.

In 2020, the US returned to the third largest PF origin. In 2020–2022, the top three PF origins remained unchanged: Spain, Taiwan Province and the US; their combined share of the total import volume climbed from 92.9% to 98.7%. Though Indonesia ranked fourth in this period, its volume and share had decreased greatly from the 2019 levels since 2020.

In 2023, Taiwan Province overtook Spain as the largest source of PF imports into China, with the import reaching 9,001 tonnes, accounting for 46.3% of China's total import volume. In addition, China's import of PF from Indonesia increased by 354.6% year on year, reaching 1,000 tonnes. However, the volume imported from the US decreased by 63.2% year on year to only 448 tonnes.

Figure 3.2-2 Share of imported PF volume to China by origin, 2014–2023



Source:China Customs & CCM

Table 3.2-1 Origins of China's imported PF, 2019–2023

Country/origin	2019			2020			2021			2022			2023		
	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t	Volume, tonne	Value, USD	Price, USD/t
Spain	12,560	9,260,199	737	10,064	6,266,063	623	11,121	9,251,155	832	7,997	8,790,482	1,099	8,218	7,109,760	865
Taiwan Province	9,345	6,161,531	659	7,947	4,604,826	579	10,589	8,453,506	798	7,283	6,663,276	915	9,001	7,221,522	802
The US	1,877	1,671,151	890	2,384	1,984,230	832	2,096	2,024,950	966	1,216	1,460,875	1,201	448	524,022	1,170
Indonesia	3,460	2,242,081	648	1,540	875,320	568	532	479,220	901	220	228,400	1,038	1,000	924,103	924
Others	505	386,187	765	17	54,818	3,322	1	45,909	41,547	2	59,604	33,169	776	529,879	683
Total	**27,747**	**19,721,149**	**711**	**21,952**	**13,785,257**	**628**	**24,339**	**20,254,740**	**832**	**16,718**	**17,202,637**	**1,029**	**19,443**	**16,309,286**	**839**

Source:China Customs & CCM

- Import price

The major factors influencing PF's import price are the supply-demand dynamics of PF in the market and the price of crude oil.

With the price increase of raw materials thanks to the recovery of global economy, the import price of PF in China kept an uptrend since Dec. 2009, reaching USD965/t in April 2014, a peak after the global financial crisis.

Crude oil was in overcapacity and its price still kept a downtrend in 2015. The overcapacity and low price of crude oil almost affected the global macroeconomic environment. The import price of PF had much to do with the crude oil price. The import price of PF in China was down to USD673/t in Dec. 2015 from USD853/t at the end of 2014. In 2016, the overall import price was lower than that in 2015, with monthly price going down from USD672/t in Jan. to USD579/t in Dec.

The general trend changed in 2017, the import price went higher with an annual average price of USD683/t. In 2018, the price kept increasing with an annual average price of USD769/t.

In 2019, the import price of PF averaged USD711/t, down some 7% year on year. In 2020, the annual average price continued to decrease, down about 12% over the previous year.

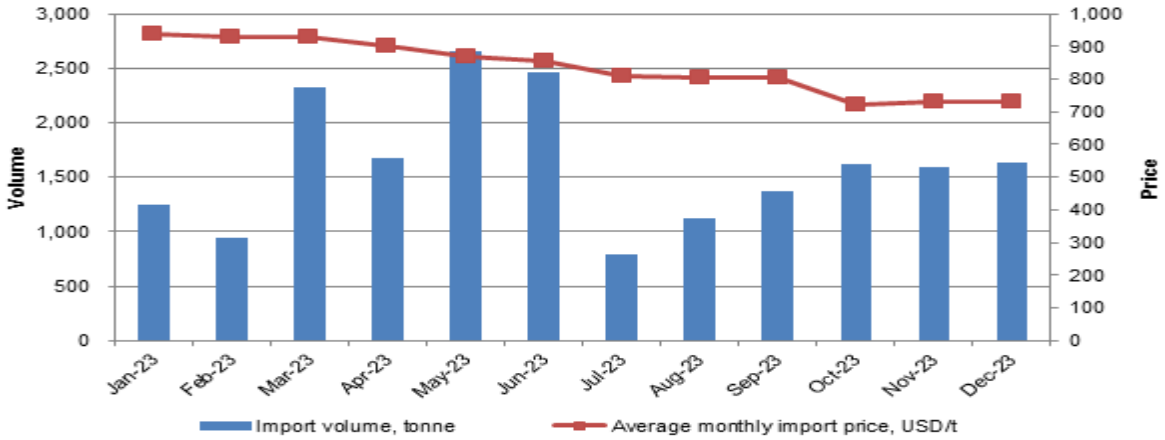
The annual average import price of PF jumped to USD832/t in 2021 from USD628/t in 2020, up by 32.5% year on year. In 2022, the annual average price further increased to USD1,029/t, since prices of methanol and natural gas were high in the international market.

In 2023, the annual average import price of PF was USD839/t, down by 18.5% year on year. In May, the unit price for importing 170 tonnes of PF from Russia was USD497/t, which was the lowest import price for the year. The highest import price for the year occurred in Jan., when 48 tonnes of PF were imported from the US at a price of USD1,267/t.

Figure 3.2-3 China's import price of PF by month, 2014–2023

Source:China Customs & CCM

Figure 3.2-4 China's imports of PF by month, 2023



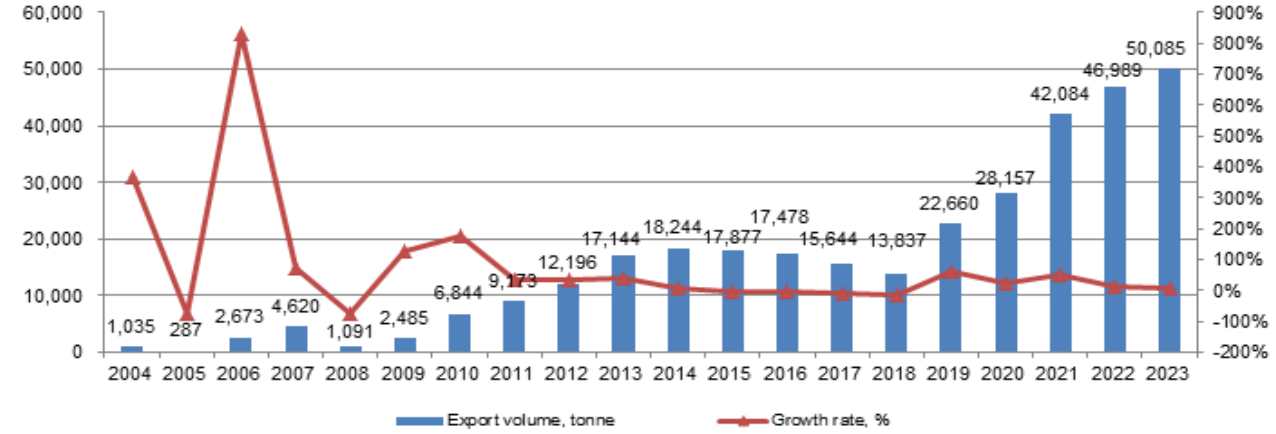
Source:China Customs & CCM

3.3 Export analysis of PF 2023

From 2012 to 2014, the export volume of PF from China kept increasing. However, it kept decreasing in 2015–2018, due to the decline in demand from resin production abroad. In 2019–2023, PF export from China saw significant year-on-year increases, the volume reaching 50,085 tonnes in 2023.

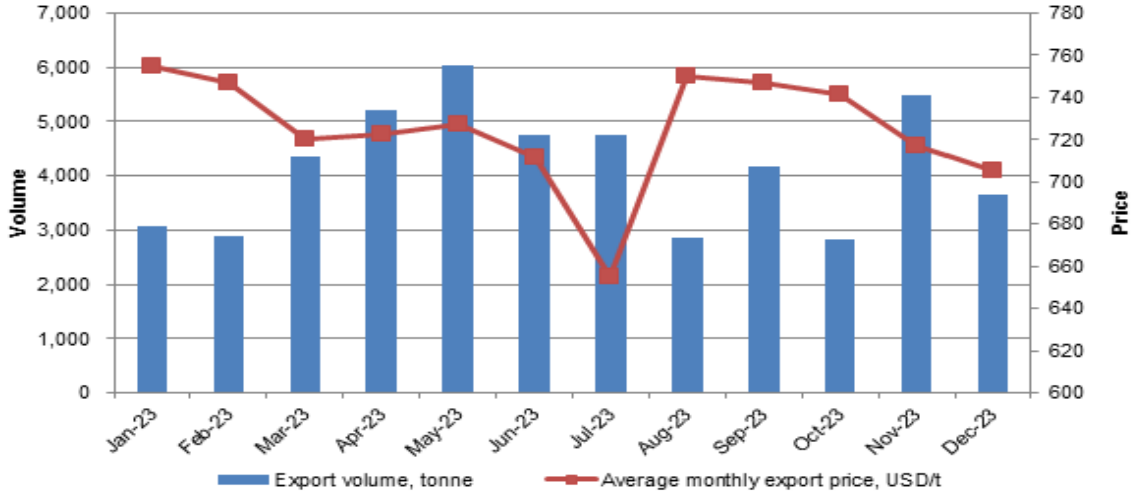
In 2021–2022, the top five export destinations of China's PF with a volume over 3,000 tonnes were Djibouti, South Korea, Nigeria, Kenya and Myanmar. In 2023, Nigeria was the largest export destination of China's PF, the amount reaching 10,161 tonnes, a year-on-year increase of 50.8%.

Figure 3.3-1 China's export volume of PF, 2004–2023



Source:China Customs & CCM

Figure 3.3-2 China's exports of PF by month, 2023



Source:China Customs & CCM

Table 3.3-1 Export destinations of China's PF, 2019–2023

No.	2019			2020			2021			2022			2023		
	Country/ region	**Volume, tonne**	**Price, USD/t**	**Country/ region**	**Volume, tonne**	**Price, USD/t**	**Country/ region**	**Volume, tonne**	**Price, USD/t**	**Country/ region**	**Volume , tonne**	**Price, USD/t**	**Country/ region**	**Volume, tonne**	**Price, USD/t**
1	South Korea	7,632	711	South Korea	6,711	586	Djibouti	7,965	798	Djibouti	9,680	791	Nigeria	10,161	672
2	Ethiopia	1,995	686	Djibouti	3,797	541	South Korea	7,654	836	South Korea	9,423	911	Djibouti	8,625	713
3	Kenya	1,789	757	Ethiopia	3,758	577	Nigeria	7,464	876	Nigeria	6,736	865	South Korea	8,159	801
4	Djibouti	1,563	762	Nigeria	3,248	579	Kenya	4,077	854	Kenya	5,295	835	Kenya	5,441	695
5	Angola	1,363	752	Kenya	2,300	613	Myanmar	3,968	865	Myanmar	3,850	853	Tanzania	4,316	716
6	Tanzania	1,258	747	Tanzania	1,588	643	Bangladesh	2,482	779	Bangladesh	2,448	775	Myanmar	4,004	687
7	Thailand	959	750	Bangladesh	1,513	440	Tanzania	2,020	850	Tanzania	2,043	847	Taiwan Province	1,413	785
8	Myanmar	945	683	Taiwan Province	1,391	631	Angola	1,257	871	Cameroon	1,346	786	South Africa	1,300	758
9	Taiwan Province	913	693	Angola	581	560	Thailand	1,135	882	Angola	1,170	795	Angola	1,299	688
10	Nigeria	866	729	Cameroon	570	578	Taiwan Province	1,123	828	India	889	768	Cambodia	828	830
11	Bangladesh	789	649	Thailand	529	592	Ethiopia	725	862	Taiwan Province	763	891	Cameroon	717	653
Sub-total		**20,072**	**709**	**Sub-total**	**25,986**	**576**	**Sub-total**	**39,868**	**841**	**Sub-total**	**43,642**	**842**	**Sub-total**	**46,262**	**719**
Others		2,588	728	Others	2,171	596	Others	2,216	892	Others	3,347	887	Others	3,823	750
Total		**22,660**	**711**	**Total**	**28,157**	**578**	**Total**	**42,084**	**843**	**Total**	**46,989**	**845**	**Total**	**50,085**	**722**

Source:China Customs & CCM

3.4 Export levy of PF (VAT & tax rebate)

Table 3.4-1 Export tax rate of PF in China

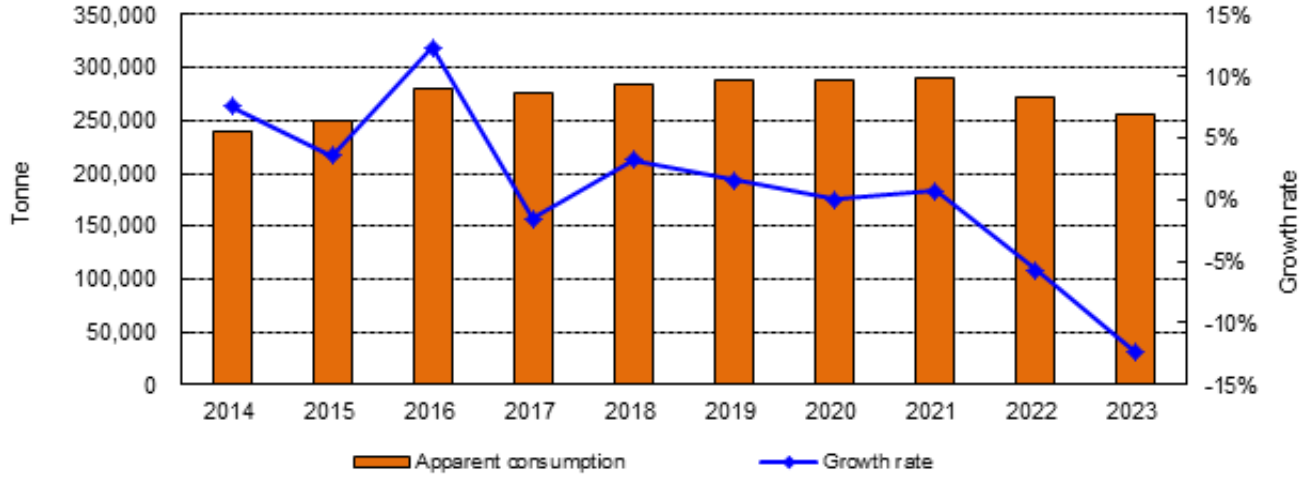
Starting date	Expiry date	VAT rate, %	Export rebate rate, %
2004/1/1	2004/12/31	17	13
2005/1/1	2005/12/31	17	13
2006/1/1	2007/6/30	17	13
2007/7/1	2008/11/30	17	5
2008/12/1	2012/12/31	17	9
2013/1/1	2018/4/30	17	9
2018/5/1	2018/10/31	16	9
2018/11/1	2019/3/31	16	10
2019/4/1	2020/3/19	13	10
2020/3/20	2100/12/31	13	13

Note:1. Export rebate refers to refunds of the value-added tax (VAT) and consumption tax (CT) actually paid by the exporting enterprises on exported goods during the production and circulation process. 2. VAT is a consumption tax on goods and services that is levied at each stage of the supply chain where value is added, from initial production to the point of sale.
Source:China Customs

4 End use segments of PF in China

On the whole, the apparent consumption of PF in China has increased at a CAGR of 0.6% during 2014–2023, though the consumption in 2023 saw a year-on-year decline.

Figure 4-1 Apparent consumption of PF and its growth rate in China, 2014–2023



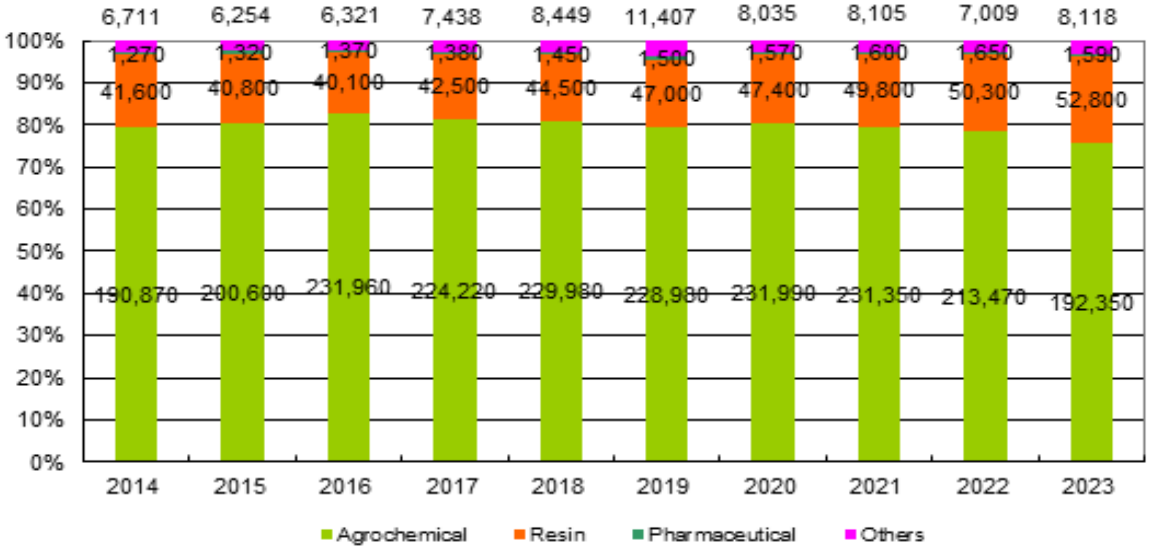
Source:CCM

Agrochemical has kept being the largest end use segment for PF in China, with the consumption of PF in this sector accounting for 75.5% of the national total in 2023, slashed by 2.9 percentage points year on year though. In this segment, PF is mainly consumed in glyphosate and amide herbicides, including acetochlor, butachlor, alachlor, propisochlor.

The second largest downstream industry of PF is resin, including phenolic resin, urea-formaldehyde resin, melamine resin. The consumption of PF in resin increased to 52,800 tonnes in 2023. Most resins are still made from formaldehyde solution (37%) at present, and only a small portion of resins, mainly used in automobile coatings/paints and inks, are made from PF. The PF applied in resin is limited because the technology adopted by domestic companies is not advanced enough and the companies also need to reduce their production cost. Resin producers using PF as the raw material are mostly foreign enterprises or Sino-foreign joint ventures. But with the increasing concern on environmental protection and excellent characteristics of PF (easily shipped and stored), PF would substitute more formaldehyde solution (37%) for resin production, which accounts for quite a large portion of the overall demand for formaldehyde solution.

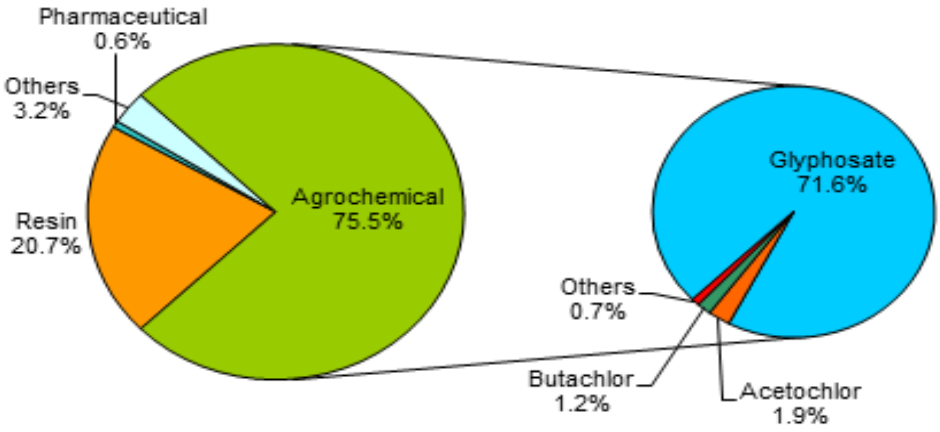
The consumption in pharmaceutical decreased to 1,590 tonnes, while the consumption in other applications including organic ingredients, additives, etc. reached 8,118 tonnes in 2023.

Figure 4-2 Consumption pattern of PF in China by downstream industry, 2014–2023



Source:CCM

Figure 4-3 PF consumption breakdown by end use segment in China, 2023



Source:CCM

4.1 Consumption of PF in glyphosate

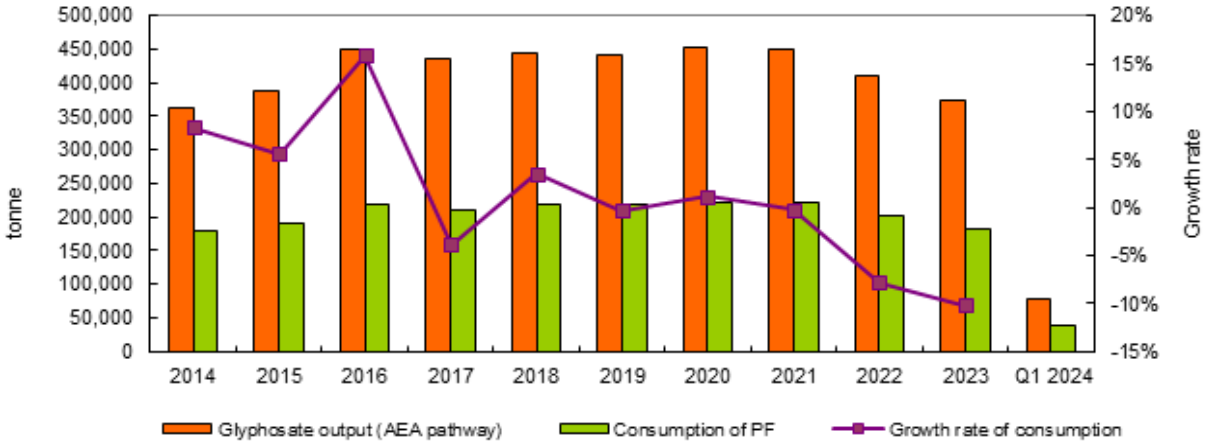
Glyphosate is the largest PF consumption sector in China. Glyphosate production (AEA pathway) uses PF with the content of 95%–97% as raw material, and about 0.49 tonne of PF is needed to produce one tonne of glyphosate technical. In the past five years, the consumption of PF in glyphosate accounted for approximately three quarters of the total PF consumption.

From 2009 to 2016, PF consumption volume in glyphosate increased fast, with a CAGR of about 12.0%, mainly driven by the increasing output of glyphosate technical (AEA pathway) in China. In 2017, PF consumption volume in glyphosate decreased, because Zhejiang Wynca Chemical Group Co., Ltd.'s output of glyphosate technical decreased a lot from 30,000 tonnes in 2016 to only 5,000 tonnes in 2017 caused by production line removal. From 2018 to 2020, PF consumption volume in glyphosate increased in general because of the increasing output of glyphosate technical (AEA pathway) in China.

In 2021, China's PF consumption volume in glyphosate declined slightly to 220,500 tonnes as the operating rate of glyphosate technical (AEA pathway) decreased a bit. In 2022, affected by efforts to pursue dual-controls over energy intensity and gross energy consumption as well as to inch closer to "double carbon" goals, inspections on production safety and poor market performance of glyphosate, the consumption volume of PF went down to 203,200 tonnes.

In H1 2023, glyphosate inventories were at a high level and the industry operating rate declined. It was not until the second half of the year that the glyphosate market experienced a brief recovery. But in Q4 2023, glyphosate industry entered the off-season and the market performed poorly. In general, the glyphosate market underperformed in 2023, and the consumption of PF in glyphosate further decreased to 182,500 tonnes.

Figure 4.1-1 Consumption of PF in glyphosate production (AEA pathway) in China, 2014–Q1 2024



Source:CCM

4.1.1 Dynamic of glyphosate development in China

Stimulated by the fat profit and large demand for glyphosate at the end of 2007 and H1 2008, domestic companies competing with each other by expanding their capacity of glyphosate or constructing new production lines of glyphosate technical, thus the capacity of China's glyphosate technical (statistical results from the companies whose status were active or idle) kept increasing fast from 202,800 t/a in 2006 to 826,900 t/a in 2010. Along with the sluggish market, poor profit, stricter requirements for waste treatment, etc., some small- and medium-sized producers have been eliminated or have stopped the production of glyphosate technical, and the domestic capacity declined to 777,500 t/a in 2011. Along with the expansion of some key producers such as Hubei Trisun Chemical Co., Ltd. (Hubei Trisun), Jiangsu Good Harvest-Weien Agrochemical Co., Ltd. (Jiangsu Good Harvest-Weien), Inner Mongolia Tenglong Fine Chemical Co., Ltd. (Inner Mongolia Tenglong), Henan HDF Chemical Co., Ltd. (Henan HDF) and Sichuan Hebang Corporation Limited (Sichuan Hebang), the capacity of glyphosate technical in China increased to 906,500 t/a in 2013, 909,500 t/a in 2014 and 998,500 t/a in 2015.

The oversupply of glyphosate since 2008 resulted in stable production of glyphosate technical in China, and from 2008 to 2011, the domestic output of glyphosate technical fluctuated between 320,000 tonnes and 340,000 tonnes (glyphosate technical 95% equivalent, similarly hereinafter). From 2009 to 2011, the operating rate of glyphosate technical was kept below 50%. Stimulated by the increasing overseas demand, the domestic output of glyphosate technical increased rapidly to 430,000 tonnes and 512,000 tonnes in 2012 and 2013 respectively, and it kept increasing in 2014 with an output of 534,000 tonnes.

As the crude oil price stayed at low level, which affected the macroeconomy, the agricultural industry ran weak in 2015. The glyphosate market was sluggish afterwards. Although the capacity of glyphosate technical increased, the output decreased to 520,000 tonnes in 2015.

In 2016, the capacity of glyphosate technical was 999,000 t/a; the output was 600,000 tonnes, up by 15.4% year on year.

In 2017, glyphosate was in short supply and demand for glyphosate in China was still on the rise. However, due to the nationwide centralized environmental inspection and the inspection of production safety, the production of glyphosate had been restricted and its output kept stable.

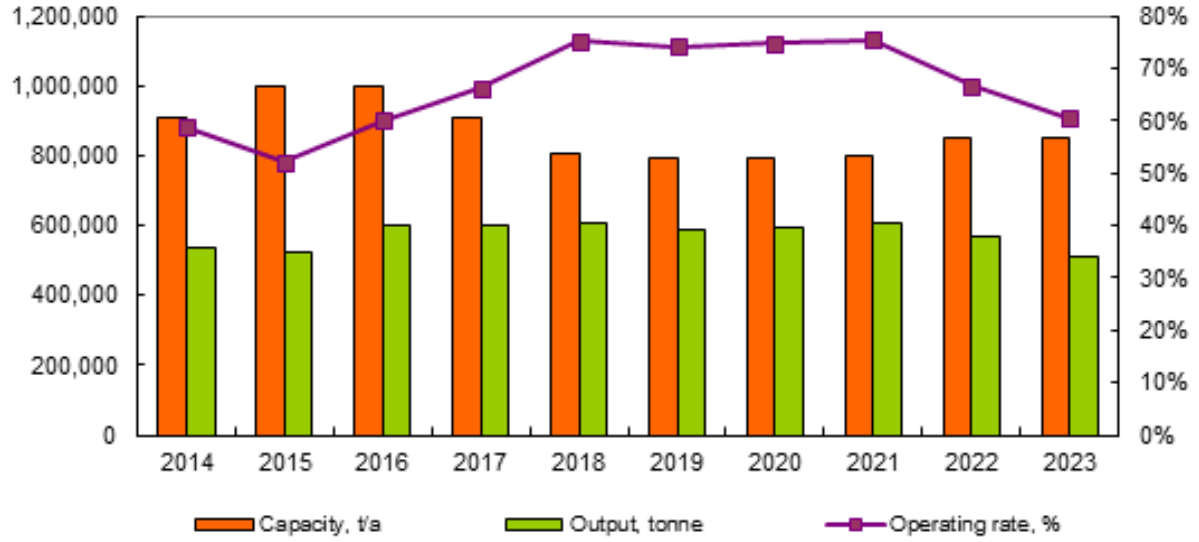
In 2018, the capacity of glyphosate in China decreased to 805,000 t/a because of stricter environmental protection policies, while the output increased to 605,000 tonnes driven by increasing demand at home and abroad.

The capacity of glyphosate technical decreased to 795,000 t/a in 2019, and the output also decreased to 590,000 tonnes. In 2020, the capacity remained unchanged, but due to the increase in agricultural product prices and the increased enthusiasm of farmers for planting, the demand for glyphosate increased, and the annual glyphosate output increased slightly. In 2021, China's glyphosate capacity reached 800,000 t/a and the output climbed up to 604,000 tonnes.

In 2022, China's production capacity of glyphosate technical increased to 850,000 t/a, along with the operation of Inner Mongolia Xingfa Technology Co., Ltd.'s 50,000 t/a glyphosate project. However, due to the peak-time power limiting and inspections on production safety, China's glyphosate technical output slipped by 6.3% year on year.

In 2023, the total capacity of glyphosate in China remained unchanged, but due to weak market demand, the total output decreased by 9.4% year on year to 513,000 tonnes. Specifically, the glyphosate output of AEA pathway decreased by 8.6% year on year to 375,000 tonnes.

Figure 4.1.1-1 Capacity and output of glyphosate technical in China, 2014–2023



Source:CCM

The controversy on glyphosate's carcinogenicity

In late March 2015, the World Health Organization (WHO) stated that the glyphosate contained in Roundup, one of Monsanto's herbicide, may be linked to cancer, which drew high attention and controversy in the scientific field.

Besides, in Feb. 2019, researchers from the University of Washington evaluated existing studies into the chemical found in glyphosate-based herbicides and concluded that it significantly increased the risk of non-Hodgkin's lymphoma (NHL), a cancer of the immune system.

However, the conclusion is quite different from those made by other mainstream authorities that participated in the risk assessment of glyphosate:

- In Jan. 2014, the Federal Institute for Risk Assessment (BfR) concluded in the glyphosate assessment that glyphosate is unlikely to pose a carcinogenic risk to humans.
- In Nov. 2015, the European Food Safety Authority (EFSA) and the EU member states finalized the reassessment of glyphosate and released a report stating that glyphosate is unlikely to pose a carcinogenic threat to humans.
- From 9 to 13 May, 2016, the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) confirmed that glyphosate is unlikely to pose a carcinogenic risk to humans from exposure through the diet.
- In Aug. 2016, independent toxicologists commissioned by the New Zealand Environmental Protection Agency (EPA) assessed the evidence of glyphosate's carcinogenicity. And the result showed that glyphosate is unlikely to cause cancer.
- In November 2017, a large study in the Journal of the National Cancer Institute looked at nearly 45,000 glyphosate users. That study concluded that no association was apparent between glyphosate and any solid tumors or lymphoid malignancies overall, including non-Hodgkin lymphoma (NHL).
- In 2018, the Agricultural Health Study, which followed more than 50,000 people in the US for over ten years, was published. This world study in the population with the highest exposure to glyphosate showed that if there was any risk of cancer from glyphosate preparations, it was exceedingly small.

To sum up, CCM believes that the performance of glyphosate in the market won't be greatly influenced in the short term, given that no substantial scientific evidence relating to the carcinogenicity of glyphosate has been introduced.

As one of the main raw materials of glyphosate, the paraformaldehyde market is directly related to the glyphosate market. Currently, glyphosate is the premier pesticide variety in China, ranking first among all varieties in terms of output, consumption, output value and sales. It's estimated that the Chinese government will keep an eye on the potential carcinogenicity of glyphosate for a long time, but won't issue related policies to ban its use domestically in the short run. Accordingly, the paraformaldehyde business won't be affected.

However, the main process route of glyphosate (glycine route) has generated more wastewater and stricter

environmental policies have been implemented in China in recent years. If the glyphosate producers limit or even suspend their production due to environmental pressure, domestic paraformaldehyde market is likely to face oversupply, leading to an increase in market risks.

Trends in glyphosate restrictions across the world

According to incomplete statistics, glyphosate products have been banned or restricted in more than 30 countries worldwide.

The European Union (EU), the US and Brazil are the world's largest markets for pesticide sales. Among them, the EU and the US have high and harsh pesticide registration requirements, and their bans on pesticide use have always been regarded as a bellwether. In this part, CCM will discuss the restrictions on glyphosate from these two regions.

- The EU
With the ongoing controversy over the impact of glyphosate on human and animal health and the environment, the EU only granted glyphosate a 5-year substance approval renewal period in 2017, which was valid until 15 Dec., 2022. This means glyphosate can be used as an active substance in plant protection products (PPPs) until that date, as long as the related products were authorized by national authorities following a safety evaluation. Only after the successful renewal of approval, glyphosate can be re-authorized in each member state for its intended uses.

On 30 May 2022, the European Chemicals Agency (ECHA) confirmed glyphosate's current hazard classification as causing serious eye damage and being toxic to aquatic life. Based on the scientific evidence available, ECHA's Committee for Risk Assessment (RAC) also concluded that classifying glyphosate as a carcinogenic, mutagenic or reprotoxic substance was not justified. On 2 Dec. of the same year, the European Commission issued a notice announcing the extension of approval for the use of glyphosate by one year, until 15 Dec., 2023.

Significant progress has been made in the research and evaluation of glyphosate by the EU in 2023. On 6 July, 2023, the European Food Safety Agency (EFSA) announced the completion of the peer review of the glyphosate re-evaluation report and issued a conclusion that no significant areas of concern were identified in the assessment of the impact of glyphosate on human health, animals, and environment. This means that based on the current evaluation results and corresponding usage scenarios, the use of glyphosate can be considered safe.

On 29 Nov., 2023, the EU issued an official announcement, authorizing the approval period of glyphosate to be extended for another 10 years (until Dec. 2033) based on the joint safety assessment results of EFSA and ECHA, which found no critical area of concern in the active ingredients of glyphosate. The renewal of glyphosate approval took effect on 16 Dec., 2023.

Although the EU currently allows the use of glyphosate, several European countries have legislated to prohibit or restrict the private sale of glyphosate products, or restrict the spraying of glyphosate in public places.

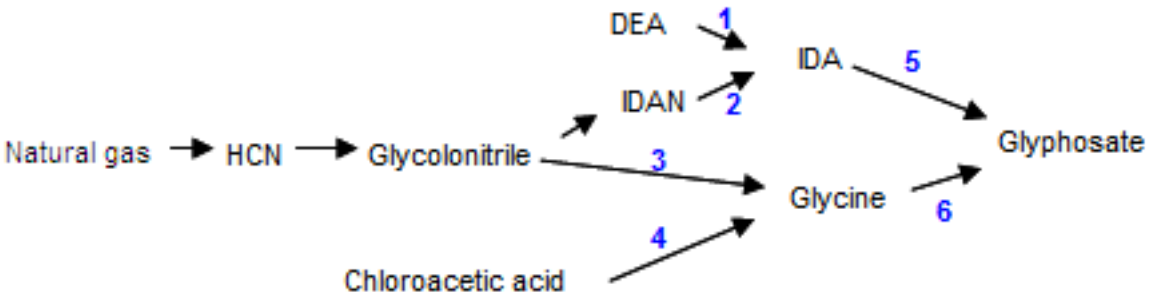
- The US
Although the International Agency for Research on Cancer (IARC) concluded in 2015 that glyphosate was a probable carcinogen, the U.S. Environmental Protection Agency (EPA) considers glyphosate unlikely to cause cancer in humans. Therefore, the US government does not ban glyphosate; Roundup and other glyphosate herbicides are sold throughout the US.

However, many municipalities in the US have already restricted or banned glyphosate. As the US federal government is slow to issue restrictions on glyphosate, to date, there has been no statewide legislation on reducing or restricting the use of glyphosate.

On the whole, although there is a strong international voice for banning glyphosate, only a few countries have actually issued a ban on it. The experience in the EU and the US in general suggests that glyphosate is not likely to be banned in the short term. Despite potential impacts on biodiversity, there is no good alternative to glyphosate at present. Thus glyphosate will remain a popular herbicide and maintain a steady growth rate in the near future.

4.1.2 Routes for glyphosate production

Figure 4.1.2-1 Production pathways of glyphosate technical in China



Note:1) DEA route; 2) IDAN route; 3) HCN route (enterprise in China has stopped this route since 2010); 4) Glycine route; 5) IDA pathway; 6) AEA pathway.
Source:CCM

Currently, there are two production pathways of glyphosate technical in China, namely aminoethanoic acid (AEA) pathway (also glycine route) and iminodiacetic acid (IDA) pathway. The latter includes two routes: DEA (diethanolamine) route and IDAN (iminodiacetonitrile) route.

IDA pathway is popular in western countries, while most glyphosate producers in China adopt AEA pathway for its mature technology, low cost, sufficient supply of raw materials and complete industrial chain, etc.

During the past decade, the Chinese government took a series of measures to strengthen environmental protection, such as the ban on glyphosate SL with a content less than 30% and the launch of environmental protection verification (EPV) by the Ministry of Environmental Protection of the People's Republic of China in 2013. The stricter environmental protection policies have dramatically driven up the cost of disposing glyphosate mother liquor. As the impurity of mother liquor waste generated from AEA pathway is the most difficult to be disposed of among three routes, the treatment cost for AEA pathway is also the highest. However, the cost of AEA pathway has advantage over IDAN route and DEA route if by-product recovery is included.

Table 4.1.2-1 Comparison of three production routes of glyphosate technical in China, 2023

Item	AEA	DEA	IDAN
Strength	Simple process, mature technology, easily available raw materials, small investment, low technology barrier	High yield, good product quality, relatively safe production process, mature technology	High yield, good product quality, easily available raw materials, low production cost
Shortcoming	Low quality and severe pollution to the environment	High dependence on imported DEA, high investment resulted from high requirement on equipment	High technology barrier, high equipment cost, high investment resulted from high requirement on equipment, raw material cost may rise sharply if the price of natural gas catches up with the international level
Raw material supply	Sufficient	High dependence on imported DEA	Sufficient
Wastewater	There are nearly saturated inorganic salt, organophosphorus (OP) compounds of high concentration and glyphosate isomer in the wastewater.	PMIDA wastewater from condensation process: There are OP compounds of high concentration in the wastewater; 3% formaldehyde contained in wastewater becomes a biological inhibitor; the intermediate, DEA or IDAN, and its derivatives are refractory; it contains 18%–22% NaCl which is nearly saturated saline solution.	
		PMIDA oxidation: There are OP compounds of high concentration in the wastewater; the wastewater contains 3% formaldehyde, 2.5% glyphosate products, unspent PMIDA and other by-	

		products.		
Major recyclable by-products		Chloromethane, HCl, methanol, methylal, triethylamine, NaCl, etc.	Urotropine, methylal, PMIDA, etc.	Urotropine, methylal, PMIDA, etc.
Initial application time in China		1986	1995	2005
Production situation in 2023	**Capacity, t/a**	598,000	35,000	217,000
	Capacity share	70.4%	4.1%	25.5%
	Output, tonne	375,000	28,000	110,000
	Operating rate	62.7%	80.0%	50.7%
	Number of producer	11	1	7
Typical company		Hubei Trisun Chemicals Co., Ltd.; Fuhua Tongda Agro-chemical Technology Co., Ltd.	Jiangsu Yangnong Chemical Co., Ltd.	Nantong Jiangshan Agrochemical & Chemical Co., Ltd.; Jiangsu Good Harvest-Weien Agrochemical Co., Ltd.

Source:CCM

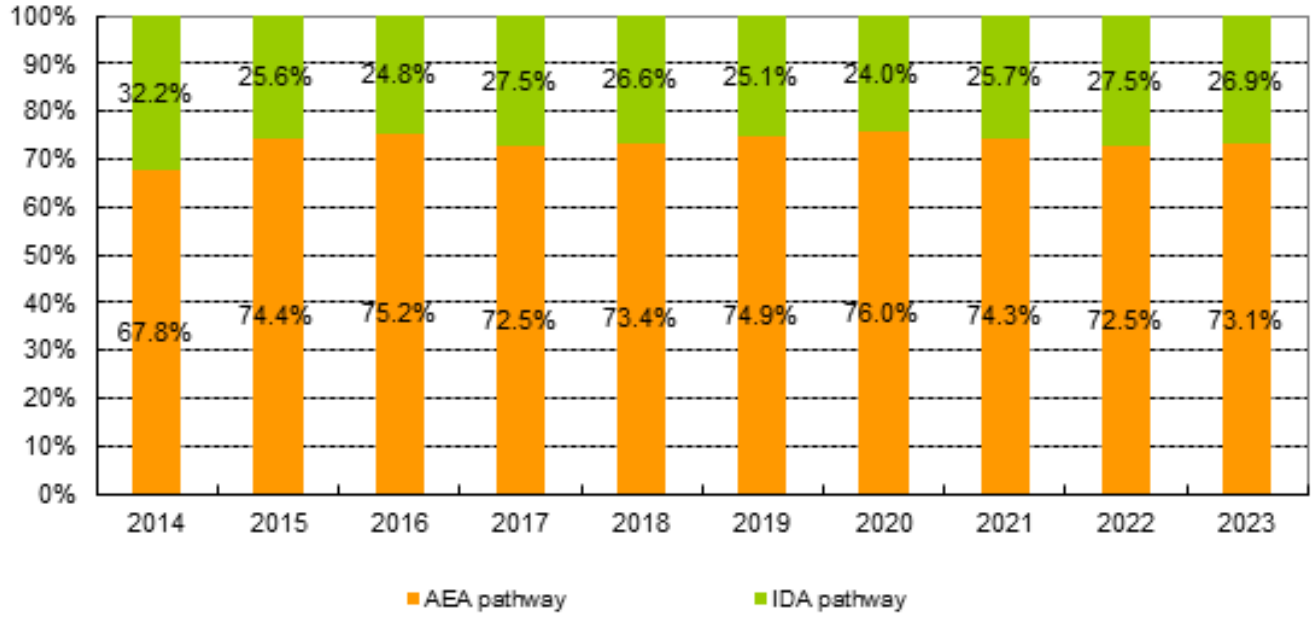
Table 4.1.2-2 Capacity and output of glyphosate technical by pathway in China, 2014–2023

Pathway		**2023**	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**
AEA	Capacity, t/a	598,000	598,000	548,000	548,000	548,000	558,000	603,000	648,000	645,000	550,000
	Output, tonne	375,000	410,500	449,000	452,000	442,000	444,000	434,900	451,000	387,100	361,800
	Growth rate of output	-8.6%	-8.6%	-0.7%	2.3%	-0.5%	2.1%	-3.6%	16.5%	7.0%	7.6%
	Operating rate	62.7%	68.6%	81.9%	82.5%	80.7%	79.6%	72.1%	69.6%	60.0%	65.8%
IDA	Capacity, t/a	252,000	252,000	252,000	247,000	247,000	247,000	302,000	351,000	353,500	359,500
	Output, tonne	138,000	155,500	155,000	143,000	148,000	161,000	165,100	149,000	132,900	172,200
	Growth rate of output	-11.3%	0.3%	8.4%	-3.4%	-8.1%	-2.5%	10.8%	12.1%	-22.8%	-2.0%
	Operating rate	54.8%	61.7%	61.5%	57.9%	59.9%	65.2%	54.7%	42.5%	37.6%	47.9%
Total	**Capacity, t/a**	**850,000**	**850,000**	**800,000**	**795,000**	**795,000**	**805,000**	**905,000**	**999,000**	**998,500**	**909,500**
	Output, tonne	**513,000**	**566,000**	**604,000**	**595,000**	**590,000**	**605,000**	**600,000**	**600,000**	**520,000**	**534,000**
	Growth rate of output	**-9.4%**	**-6.3%**	**1.5%**	**0.8%**	**-2.5%**	**0.8%**	**0.0%**	**15.4%**	**-2.6%**	**4.3%**
	Operating rate	**60.4%**	**66.6%**	**75.5%**	**74.8%**	**74.2%**	**75.2%**	**66.3%**	**60.1%**	**52.1%**	**58.7%**

Note:Total capacity (output) = Capacity (output) of AEA pathway + Capacity (output) of IDA pathway; Total growth rate of output = (Total

output this year / Total output last year) - 1; Total operating rate = Total output / Total capacity
Source:CCM

Figure 4.1.2-2 Output share of glyphosate technical in China by pathway, 2014–2023



Source:CCM

Table 4.1.2-3 Glyphosate technical (AEA pathway) producers in China, 2023

No.	Producer	Abbreviation	Location	Pathway	Status	Capacity, t/a	Output, tonne
1	Fuhua Tongda Agro-chemical Technology Co., Ltd.	Fuhua Tongda	Sichuan Province	AEA	Active	153,000	115,000
	Nantong Jiangshan Agrochemical & Chemical Co., Ltd.	Nantong Jiangshan	Jiangsu Province	AEA	Active	30,000	19,000
2	Hubei Trisun Chemicals Co., Ltd.	Hubei Trisun	Hubei Province	AEA	Active	130,000	75,000
	Inner Mongolia Xingfa Technology Co., Ltd.	Inner Mongolia Xingfa	Inner Mongolia Autonomous Region	AEA	Active	100,000	49,000
3	Zhejiang Wynca Chemical Group Co., Ltd.	Zhejiang Wynca	Zhejiang Province	AEA	Active	30,000	25,000
	Zhenjiang Jiangnan Chemical Co., Ltd.	Zhenjiang Jiangnan	Jiangsu Province	AEA	Active	50,000	42,000
4	Henan HDF Chemical Co., Ltd.	Henan HDF	Henan Province	AEA	Active	30,000	21,000
5	Jiangxi Jinlong Chemical Co., Ltd.	Jiangxi Jinlong	Jiangxi Province	AEA	Active	20,000	16,000
6	Anhui Dongzhi Guangxin Agrochemical Co., Ltd.	Anhui Guangxin	Anhui Province	AEA	Active	20,000	13,000
7	CAC Nantong Chemical Co., Ltd.	Nantong CAC	Jiangsu Province	AEA	Idle	20,000	0
8	Shandong Weifang Rainbow Chemical Co., Ltd.	Shandong Rainbow	Shandong Province	AEA	Idle	15,000	0
Total						**598,000**	**375,000**

Source:CCM

Impact of raw material on production pathways of glyphosate

- AEA pathway

The key raw materials include glycine, dimethyl phosphite (DMP) and paraformaldehyde (PF). DMP is mainly produced by glyphosate producers themselves.

- Glycine

Currently, the domestic supply of glycine greatly exceeds the domestic demand. Some glyphosate producers have achieved self-supply of glycine, and some others have planned to construct glycine production lines for their production of glyphosate technical, which further weakens the bargaining power of glycine producers.

Nowadays, domestic glycine industry only has small impact on domestic glyphosate industry in terms of supply and price. In fact, the former is largely governed by the latter.

However, during some specific periods when the requirements for environmental protection are especially higher (for instance, the time when state-level congresses are held in Beijing, and frequent severe atmospheric haze in winter), the supply of glycine will be tight and its price will be higher, which may raise the price of glyphosate technical to some extent.

- IDA pathway

For the DEA route, the most important material is DEA. As for the IDAN route, the most important material is IDAN produced by the natural gas route.

IDA is used both in the DEA route and the IDAN route. Many Chinese producers adopting the IDA pathway have DEA production lines as well as IDAN production lines; they can switch between the raw materials DEA and IDAN, depending on their supply and price.

In the IDA pathway, N-phosphonomethyl aminodiacetic acid (PMIDA) is the most important intermediate. Some companies purchase PMIDA to produce glyphosate technical.

- IDAN

Domestic glyphosate technical producers prefer purchasing PMIDA instead of purchasing IDAN, along with the launch of Sichuan Hebang Biotechnology Co., Ltd. (Hebang Biotechnology)'s 135,000 t/a PMIDA installations since 2014. It is not surprising that the volume of IDAN circulating in the domestic market has declined.

The industrial concentration of IDAN is relatively high (only three producers), and Hebang Biotechnology has played the absolutely dominant role in IDAN & PMIDA industrial chain. Moreover, Hebang Biotechnology now has a 500,000 t/a PMIDA expansion project under construction.

IDAN will have only a small impact on domestic glyphosate industry in terms of supply and price in the future.

- DEA

There is only one company adopting DEA to produce PMIDA and then glyphosate technical in China currently. Only the imported DEA, most of which is imported with the shipment mode of Processing with Imported Materials, is consumed in PMIDA & glyphosate technical. Therefore, the supply of homemade DEA has no influence on the domestic glyphosate production. DEA will have little impact on domestic glyphosate industry in the future.

Future trends

The three production routes will still coexist in China in the future, and competitiveness of the three routes is determined by technology maturity level, production cost and raw material accessibility, etc.

It is estimated that the AEA pathway will maintain its dominant position in China in the coming few years

because of mature technology, abundant supply of raw materials, complete industrial layout, and huge market of by-products.

The IDAN route will keep competitive in China because the supply of raw materials (mainly IDAN and PMIDA) is sufficient and more producers tend to directly purchase PMIDA to produce glyphosate and the overall production cost of the IDAN route is still relatively low.

The DEA route will be less advantageous in the future competition, and the only one company adopting DEA route in China has no expansion plan. Compared with the other two routes, DEA route is of high cost and weak accessibility of raw materials. Some producers previously adopting this route have switched to homemade PMIDA as the starting material to produce glyphosate technical.

4.1.3 Anti-dumping issues

Glyphosate, invented by Monsanto and first introduced to the market in 1974, now is the most widely used herbicide in the world. Roundup, Monsanto's flagship herbicide, has made the company a leader in the global glyphosate market. Following the expiry of Monsanto's patent in the early 1990s, competition from other glyphosate producers has made herbicide market virtually unrecognizable. To maintain its original leading position, Monsanto once intended to seek for cooperation with Chinese glyphosate producers, but failed ultimately. In October 1995, Monsanto launched the first anti-dumping charge in Europe against glyphosate originated from China. After that, Monsanto launched nine similar charges either by itself or in alliance with the EU, Brazil, Australia and Argentina. Except Monsanto, some other overseas glyphosate players, including Albaugh, LLC and Nufarm Limited, have also launched anti-dumping investigation into China glyphosate products.

Overall, Chinese glyphosate industry has basically overcome obstacles from anti-dumping tax, and Chinese-made glyphosate will maintain competitive in the global glyphosate market in the future.

- The EU

Monsanto lodged a charge to the European Union (EU) in October 1995 about the dumping of glyphosate originated from China. The EU regarded China as a non-market economy and treated China with Brazil as referential country. The final ruling was made in Feb. 1998 and Monsanto won the case. The EU imposed a 24% anti-dumping tax on glyphosate originated from China.

In Aug. 1998, Monsanto again facilitated the anti-absorption procedures in Europe. The final ruling was made in Feb. 2002, which was still in favor of Monsanto. The anti-dumping tax was increased from 24% to 48%.

In May 2001, Monsanto raised the anti-evading procedure for the third time in Europe against glyphosate exported from Taiwan and Malaysia, and the final ruling was made in Nov. 2001. A 48% anti-dumping tax was therefore extended to glyphosate export companies in Taiwan and Malaysia. Glyphosate became the only product exported by China to the EU market that suffered from anti-dumping, anti-absorption and anti-evading verdicts at the same time.

On 15 Feb., 2003, upon the application of Glyphosate Association of Europe, the EU started the investigation of sunset review and expiry review on glyphosate originated from China. During this investigation, the European Committee chose Brazil as the substitute country to evaluate the actual value of Chinese glyphosate. At that time, Zhejiang Wynca appealed to the EU alone. On 30 Sept., 2004, the European Committee proclaimed the final verdict of sunset review and expiry review. As a result of the investigation, all glyphosate producers of China were levied an anti-dumping tax of 29.9%, and the effective period was extended to 2008.

The EU once cancelled anti-dumping duties on Chinese glyphosate for a period of nine months from May 2009, mainly because the glyphosate market in the EU underwent a change in 2009, especially the high market price resulting in fat profits.

In order to enter the EU market, Chinese glyphosate producers, such as Zhejiang Wynca, have kept fighting with Monsanto and other companies in the EU, and finally won the case in June 2009. The EU then cancelled the 29.9% anti-dumping duty on Zhejiang Wynca's glyphosate. Zhejiang Wynca has become the only winner among all Chinese producers since 1995 when the EU started an anti-dumping investigation into Chinese glyphosate.

On 16 Dec., 2010, the EU announced that European Commission had decided to terminate the anti-dumping measures on glyphosate originated from China since 13 Dec., 2010.

On 19 July, 2012, the EU Court of Justice (ECJ) released its final judgment on the glyphosate anti-dumping case against Zhejiang Wynca. The ECJ ruled that the EU's anti-dumping measure on Zhejiang Wynca was invalid, and dismissed the EU Council's appeal entirely. Zhejiang Wynca got the final victory of the case.

- Australia

In March 1996, Monsanto lodged an anti-dumping charge in 1996 against glyphosate exported by China. 13 Chinese enterprises responded to the suit. The Australian government treated China as a country in economic transition. The final ruling was made on 12 March, 1997 and Chinese enterprises won the case. The Chinese glyphosate was not levied any addition tariff.

On 14 May, 2001, the subsidiary of Monsanto in Australia again raised the dumping charge and the amount involved was RMB23 million. The Australian Customs launched investigation into the dumping case on 12 June, 2001. After losing the markets in the EU and Brazil, pesticide producers in China already realized the risk and therefore reached agreement on protecting the market in Australia. Seven major glyphosate producers including Zhejiang Wynca, Zhenjiang Jiangnan Chemical Co., Ltd., Sinochem Hebei Import & Export Co., Ltd., Hebei Golhil Chemicals Co., Ltd., Nantong Jiangshan Agrochemical & Chemical Co., Ltd., Jiangsu Weien and Suzhou Jiahui made a collective response. On 26 Feb., 2002, the Australian Customs decided not to adopt any antidumping measures to glyphosate from China to Australia. Nevertheless, after the completion of the case, Monsanto and other Australian companies successfully persuaded the Australian Government to revise the anti-dumping provisions in the new law.

On 6 Feb., 2012, two Australian glyphosate formulators, Nufarm Limited and Accensi Pty, applied for anti-dumping investigation against Chinese-made glyphosate formulations, and the Australian Customs and Border Protection Service (ACBPS) had initiated this investigation. The investigation was concerned with imported glyphosate based herbicides including 360g/L IPA, 450g/L IPA, 570g/L IPA and 680g/L WSG. The goods was classified to the tariff code of 38089300. The current rate of duty applicable to the goods imported from China is 5%.

The investigation period was from 1 Jan., 2011 to 31 Dec., 2011. In 2011, Chinese-made glyphosate based herbicides exported to Australia took up about 5% (glyphosate 95% technical equivalent) of total Chinese-made glyphosate export number, thus, this investigation has limited effect on Chinese glyphosate industry.

On 2 Aug., 2012, ACBPS issued Notice No. 2012/37 that it decided to terminate the anti-dumping investigation against glyphosate based herbicides exported from China on the grounds that no dumping evidence was shown in the investigation results.

On 28 Aug., 2012, Nufarm Limited lodged an application with the Review Officer for a review of the decision on terminating the investigation. On 23 Oct., 2012, the Review Officer revoked the decision that to terminate the dumping investigation. On 16 Nov., 2012, ACBPS announced the resumption of anti-dumping investigation in relation to glyphosate based herbicides exported to Australia from China.

On 24 June, 2013, ACBPS released Notice No. 2013/51, saying that the three companies, namely Jiangsu Weien, Shandong Rainbow and Zhejiang Wynca, were judged that they had not dumped formulated glyphosate products into Australia, and ACBPS decided to terminate the resumed investigation.

- Brazil

Brazil launched an anti-dumping investigation on glyphosate originated from China in Aug. 2001. The main accuser was the subsidiary of Monsanto in Brazil. Ten glyphosate producing and exporting companies in China responded to the charge. On 7 Feb., 2003, the Brazilian Foreign Trade Commission (CAMEX) issued the No. 5 Notice to levy a 35.8% anti-dumping duty on glyphosate originated from China since 12 Feb., 2003, which lasted for 5 years.

The 35.8% anti-dumping duty on glyphosate originated from China expired in Feb. 2008. Brazil started a sunset review investigation and decided to reduce the anti-dumping duty from 35.8% to 11.7% for one year.

In July 2008, the CAMEX decided to reduce the anti-dumping duty from 11.7% to 2.9% for eight months.

In Feb. 2009, the CAMEX reduced the anti-dumping duty further to 2.1%, which would be valid in the following five years.

On 19 May, 2011, Monsanto renewed a request for an anti-dumping investigation on glyphosate originated from China, and in Aug. 2011 the company withdrew its anti-dumping petition with the CAMEX in term of the uncertainty and unpredictability under the international economic situation.

- Argentina

In Nov. 2001, the subsidiary of Monsanto in Argentina lodged an anti-dumping charge against glyphosate originated from China. The Argentine government launched an investigation in April 2002. Duration of the investigation was one year and seven months from 1 Aug., 2000 to 31 March, 2002 and the value involved was USD58 million. Argentina is the second country in South America after Brazil who launched an anti-dumping investigation on glyphosate originated from China. Zhenjiang Jiangnan, Zhejiang Wynca and Sinochem Shanghai Import & Export Co., Ltd. responded to the investigation. With the support from various parties in Argentina including farm owners, Chinese companies finally won the dumping case. The Argentine government made a final judgment on 4 Feb., 2004, deciding to terminate the anti-dumping investigation on glyphosate originated from China (tariff code 29310032, 29310039, 38083023, and 38083029) and not to impose anti-dumping tax. The case was finally in Chinese glyphosate producers' favor.

- The US

On 31 March, 2010, US-based Albaugh Inc. appealed to the US Department of Commerce (USDC) and United States International Trade Commission (USITC) to open an anti-dumping investigation on glyphosate originated in China, but the investigation had never been started since the company withdrew its anti-dumping petition on 29 April, 2010 when the case hadn't been filed yet.

4.1.4 Technology trend and its influence to PF consumption

Technologies for the three production routes of glyphosate have matured in China, and these three routes will coexist in China in the near future. Competitiveness of the three routes is determined by production cost, raw material accessibility, waste treatment cost, etc., under the keen competition and stricter environmental protection policy.

The AEA pathway generates a large amount of wastewater rich in ammonium chloride and formaldehyde, which requires further environmental protection treatment processes. With China's increasingly stricter environmental supervision, AEA pathway glyphosate production enterprises will intensify their research and development efforts on a series of clean production technologies, such as technologies for the utilization of phosphorus containing by-product resources and comprehensive wastewater recovery technologies.

Compared to the AEA pathway, the IDA pathway is more environmentally friendly, producing glyphosate with higher purity and better quality. The key raw material for the IDA pathway is PMIDA. Currently, Hebang Biotechnology is constructing a 500,000 t/a PMIDA project, which is expected to be completed and put into operation in 2025. After this project is completed, Hebang Biotechnology's total PMIDA capacity will reach 700,000 t/a. The company has also mastered the technology of IDA pathway glyphosate production. After the project is put into operation, it will undoubtedly reduce the market competitiveness of AEA pathway glyphosate, resulting in a decrease in the market share of AEA pathway glyphosate. This will indirectly lead to slower growth of PF consumption in the glyphosate field.

4.2 Consumption of PF in other pesticides

Besides used in glyphosate production, PF is also consumed in production of amide herbicides including acetochlor, butachlor, alachlor, propisochlor, and insecticides such as tricyclazole.

- Acetochlor

Acetochlor, a traditional herbicide, had witnessed severe oversupply for many years, resulting in a low operating rate, seldom surpassing 30% since 2012.

It's worth mentioning that acetochlor has been included in the restricted list in the European Union (the EU) since 2012, as its metabolite is harmful to humans. As a result, China's export volume of acetochlor technical

to the Eurozone has decreased. If other overseas countries and regions follow suit, the export volume of acetochlor technical would further decline.

In 2016–2019, the domestic output of acetochlor technical was on constant decline, because of the decreasing demand at home and abroad, so the PF consumption in this sector kept shrinking. However, the consumption of PF in the acetochlor technical production increased slightly to 5,700 tonnes in 2020.

In 2021, due to the high cost of raw materials, the operating rate of acetochlor industry dropped and the output decreased to 26,700 tonnes in China. Accordingly, the industry's PF consumption declined to about 5,340 tonnes. In 2022, affected by high cost of raw materials, environmental protection policy, greater COVID-19 impact in China, power outage, etc., the operating rate of acetochlor industry remained low, resulting in further output decrease of acetochlor technical. Therefore, PF consumption in this field reduced to 5,120 tonnes.

The pesticide market was sluggish in 2023, and acetochlor is no exception. The output of acetochlor in China had a decrease of 1,100 tonnes from the 2022 level, and thus the consumption of PF in acetochlor industry decreased by 4.3% year on year.

Table 4.2-1 Capacity and output of acetochlor technical and consumption of PF in China, 2014–2023

Year	Capacity, t/a	Output, tonne	Consumption of PF, tonne
2014	144,000	35,300	7,060
2015	136,000	31,600	6,320
2016	136,000	36,000	7,200
2017	136,000	35,700	7,140
2018	101,000	30,400	6,080
2019	101,000	26,900	5,380
2020	87,000	28,500	5,700
2021	87,000	26,700	5,340
2022	89,000	25,600	5,120
2023	89,000	24,500	4,900

Source:CCM

- Butachlor

Similar to acetochlor, butachlor is also a traditional herbicide. Due to its toxicity, butachlor has been forbidden for use and sale in the EU since 1 Jan., 2004, according to the law of EU/2076/2002. However, the demand for butachlor from other regions including Asia, South America and Africa increased stably in 2015–2017, echoing the increasing output of butachlor in China during the same period.

In 2018, demand for butachlor beyond China decreased, and China's output of butachlor decreased correspondingly. In 2019–2021, both the overseas demand and domestic output of butachlor saw a rebound, but in 2022–2023, the output in China diminished year on year.

Table 4.2-2 Capacity and output of butachlor technical and consumption of PF in China, 2014–2023

Year	Capacity, t/a	Output, tonne	Consumption of PF, tonne
2014	38,500	13,800	2,760

2015	38,500	15,900	3,180
2016	38,500	17,700	3,540
2017	38,500	21,500	4,300
2018	38,500	17,000	3,400
2019	38,500	17,500	3,500
2020	29,500	17,700	3,540
2021	29,500	17,800	3,560
2022	29,500	16,500	3,300
2023	29,500	15,900	3,180

Source:CCM

- Tricyclazole

The production of tricyclazole in China also uses PF as its raw material, and about 200 kg of PF is consumed to produce one tonne of tricyclazole.

The consumption volume of PF in tricyclazole technical witnessed a downward trend in 2013–2016, as the output of tricyclazole technical slipped because of shrinking demand. In 2019–2022, the consumption of PF for tricyclazole increased, but the consumption declined in 2023 following a decrease in tricyclazole output.

Table 4.2-3 Capacity and output of tricyclazole technical and consumption of PF in China, 2014–2023

Year	Capacity, t/a	Output, tonne	Consumption of PF, tonne
2014	11,900	4,155	831
2015	12,400	4,050	810
2016	12,400	4,000	800
2017	12,400	4,100	820
2018	12,400	4,000	800
2019	12,400	4,200	840
2020	12,400	4,300	850
2021	12,400	4,650	930
2022	12,400	4,700	940
2023	12,400	4,300	860

Source:CCM

- 1-Naphthylacetic acid

In China, 1-naphthylacetic acid is not produced by PF, but obtained by the reaction of naphthalene and chloroacetic acid.

As a plant growth regulator, the current capacity of 1-naphthylacetic acid in China is relatively small. There are a few 1-naphthylacetic acid producers in China, with an annual output of 1,000 tonnes–1,500 tonnes.

- List of some end users in agrochemical industry

● Nantong Jiangshan Agrochemical & Chemicals Co., Ltd. (Nantong Jiangshan)

Nantong Jiangshan uses domestic PF to produce acetochlor and butachlor with the capacity of 22,000 t/a and 15,000 t/a respectively. Its output of acetochlor technical and butachlor technical in 2023 was about 9,000 tonnes and 12,600 tonnes respectively.

● Jiangsu Changlong Agrochemical Co., Ltd. (Jiangsu Changlong)

Jiangsu Changlong has capacity of 10,000 t/a acetochlor technical and 3,000 t/a butachlor technical. Its output of these two products in 2023 was about 6,900 tonnes and about 1,600 tonnes respectively.

Previously, Jiangsu Changlong chose the cheaper one between domestic and imported PF as its raw material. Now the company consumes homemade PF only.

● Shandong Binnong Technology Co., Ltd. (Shandong Binnong)

Shandong Binnong is a major amide herbicide producer in China with capacity of 9,000 t/a in 2023; its amide herbicide technical mainly includes acetochlor, metolachlor, butachlor, alachlor. The output of acetochlor technical and butachlor technical in 2023 was about 1,400 tonnes and 1,000 tonnes respectively.

4.3 Consumption situation of PF in resin industry

PF can be a substitute for formaldehyde solution (37%) to produce resins, including phenolic resins, urea-formaldehyde resins and melamine resins. The advantages of using PF as the raw material are listed as follows:
- Shortening reaction time;
- Improving the reaction yield and decreasing the consumption of formaldehyde by 7%–17%;
- Significantly reducing wastewater discharge.

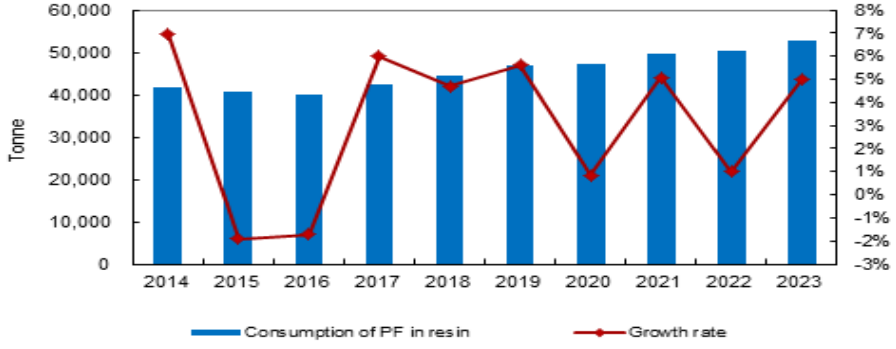
Producers possessing advanced technologies for producing urea-formaldehyde resins, phenolic resins, melamine resins, etc. tend to take PF as the raw material, which is beneficial to product quality improvement and cost reduction.

At present, resins taking PF as the raw material are mainly used in inks and coatings, and the producers using PF are mostly foreign enterprises and Sino-foreign joint ventures, who generally master advanced production technologies and have high requirements on their raw materials in order to produce high-quality products. More and more domestic private producers use PF to produce resins for high quality.

Such production usually demands PF with good water solubility. Therefore, most resin producers purchase PF produced by spray drying method.

China's PF consumption in resin industry was about 50,300 tonnes in 2022 with a year-on-year growth rate of 1.0%, taking up about 18.5% of the total domestic PF consumption. In 2023, thanks to the increase in production capacity in the resin industry and the growing demand from downstream coatings, PF's consumption in the resin industry increased by 5.0% year on year, reaching 52,800 tonnes.

Figure 4.3-1 Consumption of PF in resin industry in China, 2014–2023



Source:CCM

Drivers of PF application in resins

The growth of PF application in resins is mainly driven by stricter environmental protection requirements. China is paying more and more attention to environmental protection, and resin production using PF instead of formaldehyde can reduce pollution to a great extent. Now, in Jiangsu Province, most of the resin manufacturers use PF to produce resins instead of formaldehyde.

The constant development of automobile industry in China has driven up output of resins, which has promoted demand for PF in resin production. And it is estimated that the demand for phenolic resins will increase in the next few years in automobile market.

Barriers of PF application in resins

- The price of PF is commonly higher than that of formaldehyde, resin manufacturers chasing low production cost would prefer formaldehyde.
- Some production technologies of resins in China are traditional, which mainly use formaldehyde as the raw material. Therefore, advanced technologies adopted in resin production with PF as the raw material are needed and resin manufacturers need to improve their technologies.

Considering the drivers and barriers, as well as the development of PF, PF's consumption volume in resin industry is expected to grow steadily in China in the future.

Table 4.3-1 List of some key end users of PF in resin industry in China, 2023

No.	Producer	Location	PF consumption, tonne	Product consuming PF	Type of company	Telephone
1	Chang Chun Chemical (Jiangsu) Co., Ltd.	Jiangsu	5,800	Epoxy resin	Taiwan-funded	86-512-52648000
2	Shandong Shengquan New Materials Co., Ltd.	Shandong	3,300	Phenolic resin	Private	86-531-83511608
3	Sumitomo Bakelite (Nantong) Co., Ltd.	Jiangsu	1,500	Phenolic resin	Japan-funded	86-513-85927822
4	Sino Legend (China) Chemical Co., Ltd.	Jiangsu	1,400	Phenolic resin	Hong Kong-funded	86-512-58326999
5	Asahi Organic Chemicals (Nantong) Co., Ltd.	Jiangsu	1,300	Phenolic resin	Japan-funded	86-513-83592400
6	Cardolite Chemical (Zhuhai) Co., Ltd.	Guangdong	1,200	Epoxy resin hardener	The US-funded	86-756-7269567, 7269115
7	Eternal Chemical (China) Co., Ltd.	Jiangsu	1,000	Urea-formaldehyde resin	Taiwan-funded	86-512-57626927
8	Rianlon Corporation	Tianjin	1,000	Antioxidant 1520/1726/3114	Listed	86-22-83718817
9	Sinopec Baling Branch	Hunan	900	Epoxy resins	Listed	86-730-8492355
10	Liaoning Jincheng Chemical Refractory Co., Ltd.	Liaoning	900	Phenolic resin	Private	86-417-6957257
11	Allnex Resins (China) Co., Ltd.	Jiangsu	700	Urea-formaldehyde resin	Germany-funded	86-512-66655355
12	Fujian Nanping Lawter Chemical Co., Ltd.	Fujian	600	Phenolic resin	Japan-funded	86-599-8469500
13	Shandong Dongrun New Materials Co., Ltd.	Shandong	600	Phenolic resin	Private	86-546-7730988

14	Jiangsu Senbo New Materials Co., Ltd.	Jiangsu	500	Phenolic resin	Private	86-513-69925888
15	Laton Rosin Nanning Co., Ltd.	Guangxi	300	Disproportion rosin	South Korea-funded	86-771-4518960
16	Changle Hengchang Chemical Co., Ltd.	Shandong	200	Phenolic resin	Private	86-536-6731165
17	Xinyi Rihong Plastic Chemical Co., Ltd.	Guangdong	200	Rosin modified phenolic resin	Japan-funded	86-668-8887766 ext. 808
18	Nanning Lawter Chemical Co., Ltd.	Guangxi	200	Rosin modified phenolic resin	Japan-funded	86-771-5752172
Total			**21,600**	**/**	**/**	**/**

Source:CCM

- Chang Chun Chemical (Jiangsu) Co., Ltd. (Chang Chun Chemical)

Chang Chun Chemical produces epoxy resins from PF, with capacity of 100,000 t/a, and it consumed about 5,800 tonnes of PF in 2023, which was mainly purchased from its parent company, Chang Chun Plastics Co., Ltd.

-
Shandong Shengquan New Materials Co., Ltd. (Shandong Shengquan)

Shandong Shengquan uses PF as the raw material to produce phenolic resins. The consumption of PF in this company was about 3,300 tonnes in 2023.

It uses domestic or imported PF as raw material, and chooses the one with lower price. If the price of PF becomes high, it will switch to formaldehyde instead. The company mainly purchases PF from Jiangsu Sanmu Group Co., Ltd.

- Sumitomo Bakelite (Nantong) Co., Ltd. (Sumitomo Bakelite)

Sumitomo Bakelite mainly uses PF imported from Spain to produce phenolic resins, and it can produce 29,000 tonnes of phenolic resins annually.

Its PF consumption was about 1,500 tonnes in 2023.

- Eternal Chemical (China) Co., Ltd. (Eternal Chemical)

Eternal Chemical uses PF to produce urea-formaldehyde resins. This company used to purchase imported PF before 2017, but now switches to the domestic ones. It prefers PF produced by Taiwan-funded companies because of the high quality and relatively lower price. It consumed 1,000 tonnes of PF in 2023.

- Fujian Nanping Lawter Chemical Co., Ltd. (Nanping Lawter)

Nanping Lawter uses PF as the raw material to produce phenolic resins. It can produce 10,000 tonnes of resins annually, and its PF consumption was about 600 tonnes in 2023.

It uses either domestic or imported PF as the raw material and chooses the one with lower price.

- Liaoning Jincheng Chemical Refractory Co., Ltd. (Liaoning Jincheng)

Liaoning Jincheng uses PF as the raw material to produce phenolic resins, with capacity of 12,000 t/a. Its PF consumption volume was about 900 tonnes in 2023.

- Jiangsu Senbo New Materials Co., Ltd. (Jiangsu Senbo)

Jiangsu Senbo uses domestic PF to produce phenolic resins. Its Phase I phenolic resin production line was put into production in 2020. Its PF consumption volume was about 500 tonnes in 2023. According to the company's previous assessment, after the completion of the Phase II phenolic resin production line, its annual PF consumption may reach about 2,500 tonnes.

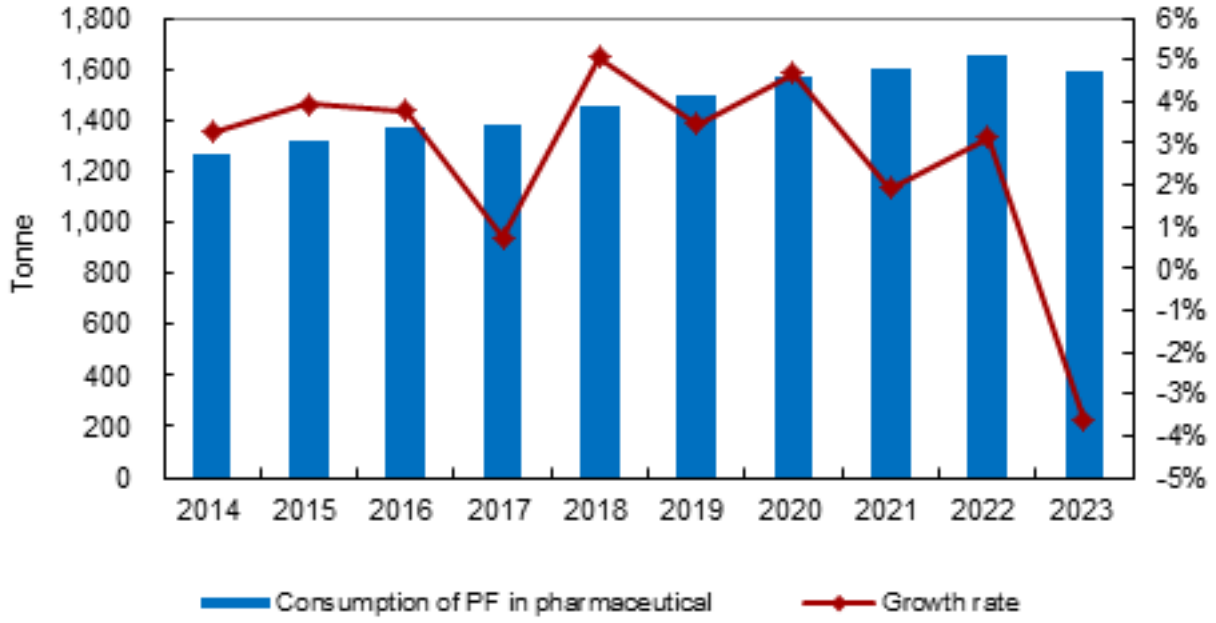
- Shandong Dongrun New Materials Co., Ltd. (Dongrun New Materials)
Its 160,000 t/a high-performance resin and formaldehyde project was put into production in March 2023. The company mainly uses PF to produce benzoxazine resins. Its annual consumption of PF can reach 1,200 tonnes at maximum.

4.4 Consumption situation of PF in pharmaceutical industry

The consumption volume of PF in pharmaceutical industry in China is small. PF is used to produce disinfectant, pharmaceutical intermediates and some medicines like stomach medicines. PF consumers from this industry prefer to purchase imported PF because of its high quality and stability. For example, Wenzhou Opal Chemical Industry Co., Ltd. purchases about 10 tonnes of imported PF to produce glycerol formal every year.

In 2014–2023, the PF consumption in pharmaceutical industry displayed a slight upward trend, with a CAGR of 2.5%. In 2023, the consumption of PF in the pharmaceutical industry ended its long-term growth and had a 3.6% year-on-year decline to 1,590 tonnes from the 1,650 tonnes in 2022. According to data released by National Bureau of Statistics of China, in 2023, Chinese pharmaceutical industry enterprises above designated size (each with annual main business revenue of at least RMB20 million) produced a total of 3.9 million tonnes of chemical active pharmaceutical ingredients, the volume shrinking by 7.0% year on year. The output of pharmaceutical intermediates also experienced a 4.3% year-on-year decrease.

Figure 4.4-1 Consumption of PF in pharmaceutical industry in China, 2014–2023



Source:CCM

4.5 Consumption situation of PF in other industries

Apart from agrochemicals, resins and pharmaceuticals, PF can also be used in organic ingredients, textiles, castings as parting medium and adhesive, livestock breeding as disinfectant, etc., the consumption in which took up around 3.2% of the total in 2023.

Table 4.5-1 List of some PF end users in other industries in China, 2023

No.	End user	Category	Application	PF consumption, tonne	Telephone
1	Anhui Jinpeng Flavours &	Additives	Salicylaldehyde (spice)	1,500	+86-18912958995

	Fragrances Co., Ltd.				
2	Zibo Zhangdian Oriental Chemical Co., Ltd.	Intermediates	2-(2-Hydroxyethyl)pyridine	1,100	+86-533-2081494
3	Zhejiang NHU Co., Ltd.	Additives	Methyl dihydrojasmonate & linalol	1,100	+86-575-85211969
4	Jilin Zhongxin Chemical Group Co., Ltd.	Chemicals	Isopentenyl alcohol	800	+86-432-65119664
5	Yingyang (China) Aroma Chemical Group	Additives	Salicylaldehyde (spice)	700	+86-22-58399303-832

Source:CCM

5 Forecast on PF industry in China

5.1 Factors influencing future development of PF

5.1.1 Driving forces

Growing demand from the domestic downstream industries

- Glyphosate

The glyphosate industry, taking up the great majority of PF's consumption in China, is decisive to the demand trend for PF. In 2023, with overall sluggish demand, glyphosate prices saw a significant decline; glyphosate producers made efforts to deplete inventories and adjusted operating rates downwards. Still, the consumption of PF in the glyphosate field accounted for over 70% of the total consumption in 2023.

In the first quarter of 2024, the price of glyphosate continued to decline, and glyphosate production enterprises were still busy reducing inventory. It is expected that after long-term destocking in 2023 and Q1 2024, operating rates of glyphosate enterprises will increase in Q2 2024. It is thus projected that the consumption of PF in the glyphosate field will slightly increase in 2024.

In the long run, the global glyphosate market is largely influenced by the cultivation of genetically modified (GM) crops, which has been steadily growing over the past 20 years. In recent years, China has also accelerated the promotion of GM crops. Driven by the continuous development of GM crops and increasing planting area, the output of glyphosate (AEA pathway) in China is estimated to increase at a CAGR of 2.7% from 2024 to 2028. Its growth may slow down after 2026, as Hebang Biotechnology's 500,000 t/a PMIDA project is expected to be put into production in 2025, after which the output of IDA pathway glyphosate will increase, capturing the market share of AEA pathway glyphosate.

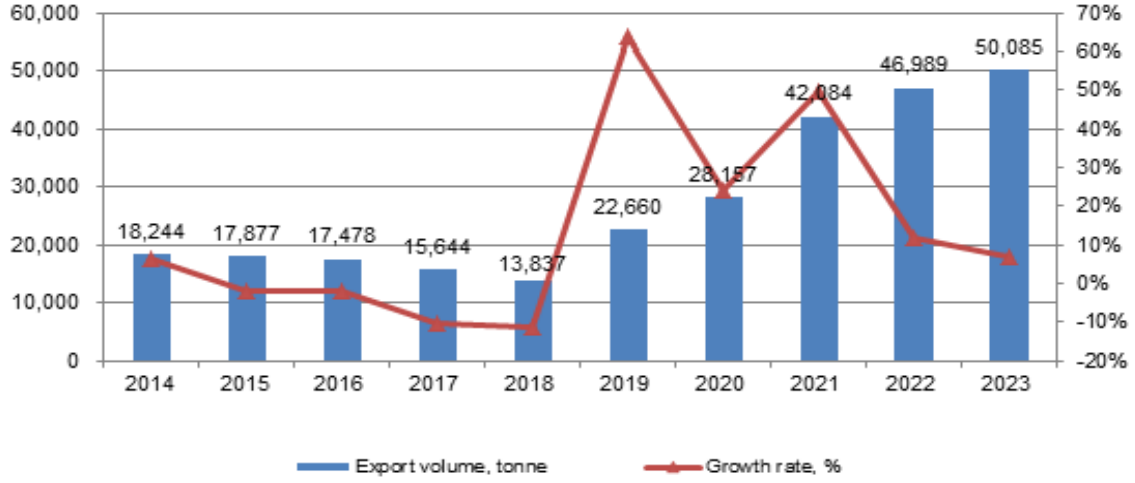
- Resin

Resin, the second largest consumption field of PF by consumption volume, took up 20.7% of domestic PF consumption in 2023. In China, the demand for PF from resin industry is estimated to increase stably in the next few years. For one thing, automobile needs to use phenolic resins to improve fire safety and strengthen fuel efficiency. Urea-formaldehyde resins are widely used in fiber boards and molding compounds and the demand for urea-formaldehyde resins will increase in the next few years. For another, related environmental departments limit the emission from formaldehyde production, so more resin producers use PF instead of liquid formaldehyde.

Growing demand from the overseas market

The Chinese PF industry is becoming increasingly competitive in the world. From 2019 to 2023, China's PF export volume maintained growth for five consecutive years. With the expansion of China's PF capacity and the increasing emphasis of Chinese PF enterprises on exploring overseas markets, it is predicted that the export volume of China's PF will continue to grow in the coming years.

Figure 5.1.1-1 Export volume of PF in China, 2014–2023



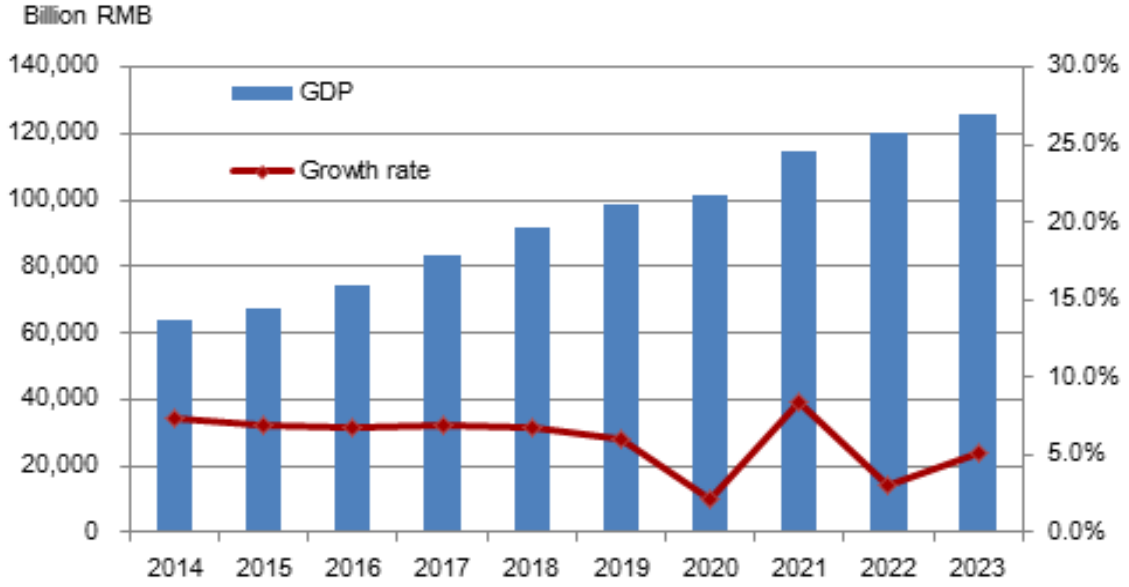
Source:China Customs

Stable macro-economic environment in China

China's economy transition has shifted from rapid growth phase to a stage of high-quality development; national economy has maintained a relatively stable growth in recent years, with yearly GDP growth rate above 5%, except 2.2% in 2020 and 3.0% in 2022. According to the Government Work Report delivered at the Second Session of the 14th National People's Congress on March 5, 2024, China's GDP growth target for 2024 is projected at around 5%.

CCM believes that the fundamentals for China's long-term and high-quality economic growth will not change. The growth target maintained at this level is conducive to guiding people in all sectors to focus on accelerating the transformation of the economic development mode and adjustment of economic structure, and improving the quality and performance of economic growth, so as to promote sustainable and healthy economic development.

Figure 5.1.1-2 China's GDP growth, 2014–2023



Note:Data for 2023 is preliminarily calculated.
Source:National Bureau of Statistics of the People's Republic of China

Good product performance of PF

PF is convenient for shipping and storage because of its granular form. PF contains high content of formaldehyde. It is a good substitute for formaldehyde, because formaldehyde is hard to transport and store. Furthermore, using PF to substitute for formaldehyde solution will reduce the volume of wastewater during the production process.

The excellent properties of PF decide that it can be used in various fields in which formaldehyde cannot be applied.

5.1.2 Barriers

Production technology needed to be improved

PF products produced by rake drying method have poor water solubility, which inhibits their application in resins. Meanwhile, a large quantity of wastewater is discharged from PF production.

In 2023, a total of 20 PF producers adopted the rake drying method in PF production in China, with combined capacity of 507,000 t/a, accounting for 70.7% of the national total.

Increased global economic uncertainty

The global economy has entered stagflation, with growth slowing down and inflation remaining high. On the one hand, geopolitical events have led to an increase in global uncertainty, and the accompanying energy

and food crises also limited the economic growth. On the other hand, many economies are further falling into stagflation due to the impact of high inflation and monetary tightening.

Challenge from glyphosate development

Since 2016, the government has issued a series of green policies, forcing some glyphosate enterprises to stop production due to environmental inspections, resulting in a decrease in national glyphosate production from 2016 to 2019. At the beginning of 2024, the Chinese government released the Guiding Catalogue for Industrial Structure Adjustment (2024 Edition), which clearly limits the expansion of glyphosate production facilities and eliminates glyphosate AS products (with glyphosate content less than 30%). This undoubtedly has a negative impact on the future growth of glyphosate production in China.

In addition, the 500,000 t/a PMIDA project of Hebang Biotechnology is expected to be put into operation in 2025. At that time, glyphosate from the IDA pathway will seize some of the glyphosate market from the AEA pathway, and the consumption growth rate of PF in the field of glyphosate will slow down.

Overcapacity of PF

In general, China's PF capacity expanded with a CAGR of 3.2% in 2014–2023. However, the operating rate of PF industry kept at a low level. Meanwhile, there are still some potential PF production lines under construction in China, even though the estimated demand grows not so fast as capacity enlarges.

5.2 Supply and demand forecast on PF 2024–2028

Demand forecast to 2028

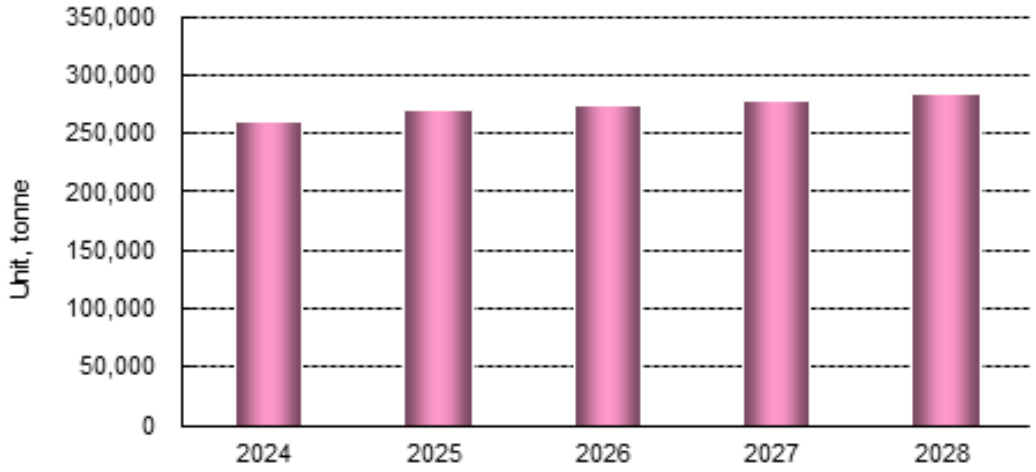
In 2023, the domestic glyphosate industry accounted for approximately 71.6% of the domestic PF demand. The future trend of PF demand in China will be similar to the development trend of glyphosate production in China.

From 2024 to 2028, China's demand for PF is expected to continue to grow. However, from 2026, due to changes in the shares of glyphosate production via different pathways, PF demand growth in China will slow down. By 2028, China's demand for PF will reach 284,200 tonnes, with a CAGR of 2.2% from 2024 to 2028.

It is estimated that by 2028, PF consumption in glyphosate industry will reach 207,600 tonnes. In addition, considering improvement of resin production technology in China, it is expected that PF consumption in resin will reach 57,600 tonnes in 2028, increasing at a CAGR of 2.0% from 2024 to 2028.

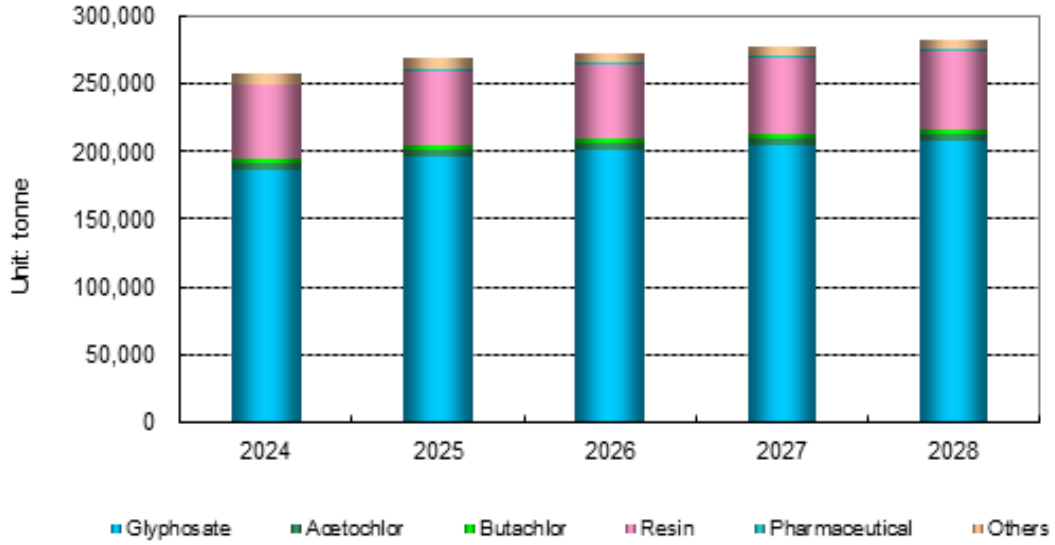
With the improvement of production technology, the quality of domestic PF is getting better and better, which enables more and more domestic PF to be applied in other industries. In addition, it is expected that the export volume of PF will continue to expand.

Figure 5.2-1 Forecast on demand for PF in China, 2024–2028



Source:CCM

Figure 5.2-2 Forecast on PF consumption by product in China, 2024–2028



Source:CCM

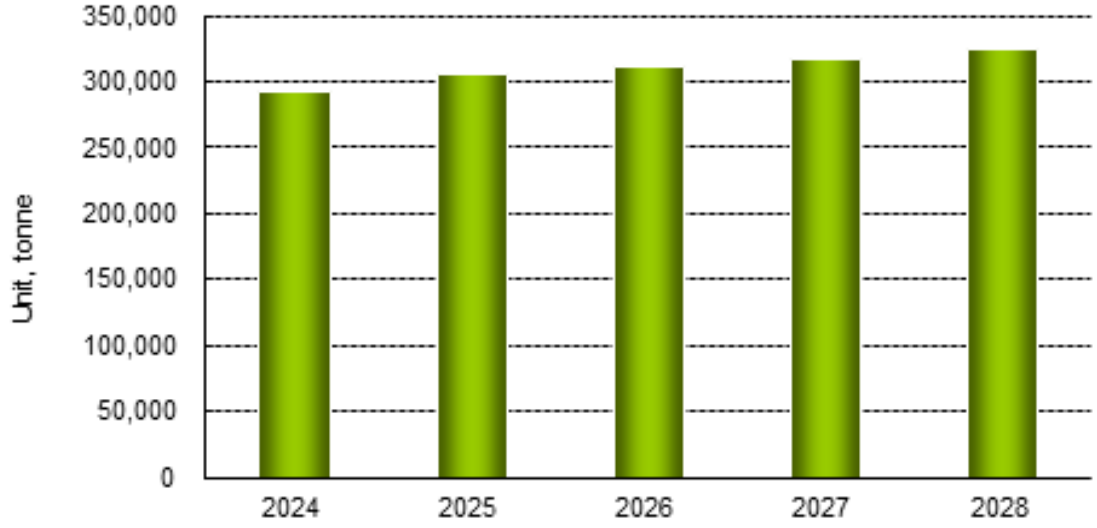
Supply forecast to 2028

The future trend of PF production in China is almost the same as the development trend of the domestic demand for PF. Both the increasing domestic demand and the overseas demand (export) for PF will be the drivers for increasing PF production in China.

In 2024–2028, the output of PF in China will keep a slow growth, and it is predicted to reach 325,600 tonnes in China in 2028, expanding with a CAGR of 2.6% in 2024–2028.

For 2024, PF output in China is predicted at 293,600 tonnes, and import and export volume may stand at about 21,500 tonnes and 54,800 tonnes respectively.

Figure 5.2-3 Forecast on PF output in China, 2024–2028



Source:CCM

Figure 5.2-4 Overview of paraformaldehyde report 2024

Categories 2023	2019 act.			2020 act.			2021 act.			2022 act.			2023 act.			2024 est.			2025 est.		
	Quantity	Share	Growth	Quantity	Share	Growth	Quantity	Share	Growth	Quantity	Share	Growth	Quantity	Share	Growth	Quantity	Share	Growth	Quantity	Share	Growth
Manufacturers 28																					
Capacity	560,000			637,000			667,000			667,000			717,000			807,000			857,000		
Production	283,800	/	4%	295,200	/	4%	308,600	/	5%	302,700	/	-2%	285,500	/	-6%	293,600	/	3%	307,000	/	5%
DEMAND																					
Glyphosate 11	218,400	76%	0%	221,000	76%	1%	220,500	76%	0%	203,200	75%	-8%	182,500	72%	-10%	187,000	72%	2%	196,500	72%	5%
Acetochlor 12	5,380	2%	-12%	5,700	2%	6%	5,340	2%	-6%	5,120	2%	-4%	4,900	2%	-4%	5,100	2%	4%	5,160	2%	1%
Butachlor 9	3,500	1%	3%	3,540	1%	1%	3,560	1%	1%	3,300	1%	-7%	3,180	1%	-4%	3,300	1%	4%	3,320	1%	1%
Other agrochemica >10	1,700	1%	13%	1,750	1%	3%	1,950	1%	11%	1,850	1%	-5%	1,770	1%	-4%	1,900	1%	7%	1,920	1%	1%
Resin >20	47,000	16%	6%	47,400	16%	1%	49,800	17%	5%	50,300	18%	1%	52,800	21%	5%	53,300	20%	1%	54,000	20%	1%
Pharmaceutical >6	1,500	1%	3%	1,570	1%	5%	1,600	1%	2%	1,650	1%	3%	1,590	1%	-4%	1,500	1%	-6%	1,520	1%	1%
Other Applications >100	11,407	4%	35%	8,035	3%	-30%	8,105	3%	1%	7,009	3%	-14%	8,118	3%	16%	8,200	3%	1%	9,180	3%	12%
Total	288,887	100%	2%	288,995	100%	0%	290,855	100%	1%	272,429	100%	-6%	254,858	100%	-6%	260,300	100%	2%	271,600	100%	4%
IMPORT																					
Spain	12,560	45%	9%	10,064	46%	-20%	11,121	46%	11%	7,997	48%	-28%	8,218	42%	3%	8,700	40%	6%	8,900	36%	2%
Taiwan Province	9,345	34%	-1%	7,947	36%	-15%	10,589	44%	33%	7,283	44%	-31%	9,001	46%	24%	9,400	44%	4%	9,500	39%	1%
The US	1,877	7%	-25%	2,384	11%	27%	2,096	9%	-12%	1,216	7%	-42%	448	2%	-63%	600	3%	34%	800	3%	33%
Indonesia	3,460	12%	114%	1,540	7%	-55%	532	2%	-65%	220	1%	-59%	1,000	5%	355%	290	1%	-71%	195	1%	-33%
Others	505	2%	311%	17	0%	-97%	1	0%	-93%	2	0%	69%	775	4%	38673%	2,510	12%	224%	5,005	21%	99%
Total	27,747	100%	10%	21,952	100%	-21%	24,339	100%	11%	16,718	100%	-31%	19,443	100%	16%	21,500	100%	11%	24,400	100%	13%
EXPORT	22,660	/	64%	28,157	/	24%	42,084	/	49%	46,989	/	12%	50,085	/	7%	54,800	/	9%	59,800	/	9%

Source:CCM

Table 5.2-1 New/expansion projects of PF in China, as of March 2024

No.	Producer	Location	Technology source	Technology	Capacity, t/a	PF line construction status	Remark
1	Hubei Trisun Chemicals Co., Ltd.	Hubei	Domestic	Rake drying	30,000	Not started	2nd phase: 30,000 t/a PF and 85,400 t/a formaldehyde
2	Jining Huiquan Chemical Co., Ltd.	Shandong	N/A	Spray drying	30,000	Not started	1st phase: 100,000 t/a formaldehyde (accepted in Feb. 2023), 50,000 t/a adhesive; 2nd phase: 100,000 t/a formaldehyde, 30,000 t/a PF.
3	Dingyuan County Linxing Chemical Co., Ltd.	Anhui	N/A	N/A	10,000	Not started	1st phase: 70,000 t/a modified urea-formaldehyde resin; 2nd phase: 10,000 t/a PF.
4	Juancheng County Zhanbang Chemical Co., Ltd.	Shandong	Domestic	Rake drying	10,000	Not started	1st phase: 240,000 t/a formaldehyde, 10,000 t/a PF.
5	Ningxia Ningshun New Material Co., Ltd.	Ningxia	N/A	Rake drying	20,000	Not started	1st phase: 200,000 t/a formaldehyde, 20,000 t/a pentaerythritol; 2nd phase: 10,000 t/a neopentyl glycol; 3rd

							phase: 100,000 t/a formaldehyde, 20,000 t/a PF, etc.; 4th phase: 10,000 t/a calcium formate, etc.
6	Xinjiang Shunyuan Chemical Technology Co., Ltd.	Xinjiang	N/A	N/A	50,000	Not started	1st phase: 200,000 t/a formaldehyde, 200,000 t/a urea-formaldehyde resin, 50,000 t/a PF; 2nd phase:50,000 t/a urotropine and 300,000 t/a formaldehyde.
7	Qinzhou Juli New Energy Technology Co., Ltd.	Guangxi	N/A	N/A	20,000	Under construction	1st phase: 80,000 t/a formaldehyde, 20,000 t/a methylal, 20,000 t/a PF, 30,000 t/a DMMn; 2nd phase: 30,000 t/a polymethoxy dimethyl ether
8	Anhui Hehong Chemical Co., Ltd.	Anhui	N/A	Spray drying	90,000	Under construction	1st phase: 60,000 t/a PF, etc.; 3rd phase: 30,000 t/a PF, etc.
9	Wen'an County Decheng New Material Technology Co., Ltd.	Hebei	N/A	N/A	60,000	Not started	1st phase: 960,000 t/a formaldehyde (completed in Sept. 2023); 2nd phase: 960,000 t/a formaldehyde, 60,000 t/a PF, 500,000 t/a melamine-formaldehyde resin, 600,000 t/a urea-formaldehyde resin, and 200,000 t/a phenolic resin.
10	Yacoo Technology (Anqing) Co., Ltd.	Anhui	Domestic	Spray drying	30,000	Under construction	2nd phase: 30,000 t/a PF, etc.
11	Shandong Linfeng New Material Technology Co., Ltd.	Shandong	N/A	N/A	60,000	Not started	2nd phase: 60,000 t/a PF, etc.
12	Guangxi Guifulin Technology Co., Ltd.	Guangxi	N/A	Rake drying	100,000	Not started	/
13	Anhui Ruibai New Materical Co., Ltd.	Anhui	N/A	Spray drying	60,000	Under construction	/
14	Shanshan Shenglian New Energy Technology Co., Ltd.	Xinjiang	N/A	N/A	60,000	Not started	In Oct. 2023, the environmental impact assessment on its 100,000 t/a sodium methoxide, 60,000 t/a PF project was approved.
15	Gansu Hongfu Weiye Technology Co., Ltd	Gansu	N/A	N/A	20,000	Not started	20,000 t/a PF, 1,000 t/a bromine, 2000 t/a 2-anthraquinone
16	Hebei Yuanlu Chemical Co., Ltd	Hebei	N/A	Spray drying	30,000	Not started	1st phase: 200,000 t/a formaldehyde, 50,000 t/a urea-formaldehyde resin, etc.; 2nd phase: 200,000 t/a formaldehyde, 30,000 t/a PF

Source:CCM

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