

Production and Market of Glycine in China

The Tenth Edition

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Executive summary

China is one of the major production countries of glycine in the world, and four grades of glycine are produced here, namely tech-grade, food-grade, feed-grade and pharmaceutical-grade.

Commercial production of glycine by the chloroacetic acid ammonolysis process hadn't been started until the late 1970s, and this pathway was accessible and the requirement for facilities was relatively low. Almost all Chinese glycine producers adopt chloroacetic acid ammonolysis process, which is a backward technology now. Guang'an Chengxin (formerly Guang'an Chengyang), whose glycine production lines were built up in Nov. 2015, is the only company in China adopting the Hydantion process.

Both the capacity and output of glycine in China kept increasing during 2013–2020, along with the development of glyphosate (glycine's key end use segment) in China. Output of the tech-, feed- and food-grade glycine increased in this period in general.

National capacity of tech-grade glycine increased from 330,000 t/a in 2013 to 589,000 t/a in 2020, and its output increased from less than 250,000 tonnes to 340,000 tonnes in this period. However, China's glycine industry has often witnessed overcapacity in the past few years, and this situation will not change much in the coming few years.

China's glycine production is highly concentrated, while its upstream industries including both chloroacetic acid and urotropine are not. Hebei Donghua is the top glycine producer in China and even in Asia. In 2020, its tech-grade capacity accounted for about 31% of the national total.

Some glyphosate producers have built up glycine production lines for their glyphosate technical production.

- Hubei Trisun's 100,000 t/a glycine: firstly supplied to itself, and the rest sold to others
- Fuhua Tongda's 40,000 t/a glycine: mainly consumed by itself
- Inner Mongolia Xingfa's 10,000 t/a glycine: consumed by itself
- Henan HDF's 15,000 t/a glycine: mainly consumed by itself

The price of glycine is closely linked with that of glyphosate (high-positive correlation), because of glycine's limited consumption fields and simple production technology. In H1 2021, affected by COVID-19 situation at home and abroad, stricter environmental protection and work safety policies have been adopted, raw material cost jumped up, and both glyphosate and glycine were in short demand. The price of glycine hit USD3,185/t in June 2021, the peak since Jan. 2013.

China's total export volume of glycine increased on the whole in 2013–2020, rising from 25,019 tonnes in 2013 to an estimated 59,950 tonnes in 2020. Food-grade glycine is the main product in China's glycine export, with its export volume accounting for about 80% of the total glycine export volume during 2018–2020. China started to export tech-grade glycine in 2018, with 3,688 tonnes, accounting for 6.7% of total export volume. In 2020, the export volume of tech-grade glycine is expected to be 5,200 tonnes, 8.7% to the whole.

Quite different from the overseas consumption structure, the largest end-use segment of glycine in China is glyphosate. The output of glycine route glyphosate reached 452,000 tonnes in 2020, consuming about 263,000 tonnes of glycine in total, which meant around 78.6% of tech-grade glycine was applied in the domestic glyphosate industry, and the rest was consumed to produce food-, feed- and pharmaceutical-grade glycine.

The consumption of food-, feed- and pharmaceutical-grade glycine all increased from 2013 to 2020, with their CAGR in this period at 3.8%, 5.1% and 4.7% respectively.

Methodology

- **Research objectives**

Objectives of this research are to present an in-depth and comprehensive view of Chinese glycine market. CCM's goal of this research is to determine the current status of Chinese glycine industry and assess its growth potential from 2021 to 2025.

Having accumulated profound understanding on industrial chains of glyphosate, the most important downstream industry of glycine, CCM will present an insight into glycine market and future trends, together with its industry structure, including upstream products, applications, etc. A review of glycine's competitiveness is also provided in the report.

- **Scope of report**

All of the four grades of glycine, including tech-grade, food-grade, pharmaceutical-grade and feed-grade, will be investigated in this research.

This report will present industry insights from the following aspects:

- Supply (capacity, output)
- Key players (active producers, potential producers)
- Technology
- Raw materials
- Demand by volume
- Trade
- Price

- **Methodology**

Telephone Interviews

The interviewees include:

- Producers
- Traders
- Researchers
- Raw material suppliers
- End users

Data processing and presentation

The data collected and compiled were sourced from:

- Published articles from Chinese periodicals, magazines, journals, and third-party databases
- Government statistics & Customs statistics
- Telephone interviews with Chinese producers, traders, end users, etc.
- Comments from industrial experts
- CCM's database
- Professional database from other sources
- Information from the Internet

The data from various channels have been combined to make this report as precise and scientific as possible. Throughout the process, a series of internal discussions were held in order to analyse the data and draw conclusions from it.

Information sources

Sources of desk research are various, including published magazines, journals, government statistics, industry statistics, customs statistics, association seminars as well as information on the internet. A lot of work has been done to compile and analyse the information obtained. When necessary, checks were made with Chinese market players regarding market information such as production, demand, consumption, competition, etc.

Glossary

Abbreviations in this report are listed as follows:

DEA: Diethanolamine

IDAN: Iminodiacetonitrile

HCN: Hydrogen cyanide

CAGR: Compound annual growth rate

GM: Genetically modified

HHI: Herfindahl-Hirschman Index

MEP: Ministry of Environmental Protection of the People's Republic of China

Unit

tonne: equals to metric ton in this report

/t: per tonne

t/a: tonne/annual, tonne per year

USD: currency unit in the US

RMB: currency unit in China, also named Yuan

Table USD/CNY exchange rate, Jan. 2013–June 2021

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	-	-	-	-	-	-	-

Source: The People's Bank of China

1 Overview of glycine in China

1.1 Introduction of glycine in China

China is one of the major glycine production countries, but is still backward in technology. Most homemade glycine is tech-grade, and only a small quantity of other grades is produced.

China's glycine industry was started in 1969. At that time, Hebei Normal University took the initiative to set up the first glycine facility adopting the chloroacetic acid ammonolysis process in China. Later, it transferred the technology to Zhengding Joint Chemical Factory for free, the former of Hebei Donghua.

Commercial production of glycine by the chloroacetic acid ammonolysis process hadn't started until the late 1970s, and this pathway was accessible and the requirement for facilities was relatively low.

Both the capacity and output of glycine in China kept increasing during 2013–2020, along with the fast development of glyphosate (glycine's key end use segment) in China. There is an overall upward trend in the output of tech-, food- and feed-grade glycine.

Table 1.1-1 Supply and demand of glycine in China, 2013–2020

Year	Capacity, t/a		Output, tonne		Export, tonne	Apparent consumption, tonne	
	Tech-grade	Others	Tech-grade	Others		Tech-grade	Others
2013	330,000	64,100	225,000	29,050	25,019	225,000	4,031
2014	357,000	53,300	242,000	30,100	25,896	242,000	4,204
2015	407,000	81,300	259,000	34,600	30,106	258,000	4,494
2016	477,000	82,800	303,500	47,600	42,887	308,500	4,713
2017	509,000	118,800	307,000	52,900	48,020	304,000	4,880
2018	519,000	141,800	328,000	56,600	55,270	323,312	5,018
2019	569,000	135,800	332,000	56,400	56,153	327,102	5,145
2020	589,000	135,800	340,000	60,200	59,950	334,800	5,450

Note: 1. The year-end inventory of tech-grade glycine is taken into account, while that of others is not.

2. Others include feed-grade, food-grade and pharmaceutical-grade glycine.

Source: China Customs & CCM

Table 1.1-2 Supply and demand of glycine except tech-grade in China, 2013–2020

Year	Output, tonne			Export, tonne			Apparent consumption, tonne		
	Food-grade	Feed-grade	Pharmaceutical-grade	Food-grade	Feed-grade	Pharmaceutical-grade	Food-grade	Feed-grade	Pharmaceutical-grade
2013	22,300	4,200	2,550	20,340	3,144	1,535	1,960	1,056	1,015
2014	25,550	1,700	2,850	23,533	583	1,780	2,017	1,117	1,070
2015	27,110	5,450	2,040	24,987	4,200	919	2,123	1,250	1,121
2016	38,300	7,240	2,060	36,096	5,946	845	2,204	1,294	1,215
2017	44,470	6,200	2,230	42,193	4,852	975	2,277	1,348	1,255
2018	46,300	8,600	1,700	43,953	7,225	405	2,347	1,375	1,295
2019	46,650	7,750	2,000	44,221	6,345	689	2,429	1,405	1,311
2020 (est.)	49,550	8,500	2,150	47,000	7,000	750	2,550	1,500	1,400

Note: The year-end inventory is not taken into account.

Source: China Customs & CCM

1.2 Classification of glycine

Table 1.2-1 Comparison on properties of Chinese glycine and overseas glycine

Index	Chinese glycine				Overseas glycine	
	Pharmaceutical-grade	Food-grade	Feed-grade	Tech-grade	Food- & pharmaceutical-grade	USP-24, BP-98
Appearance	White crystalline powder				White crystalline powder	
Purity (C ₂ H ₅ NO ₂), %	99.5–101.5	98.5–101.5	98.5–101.5	≤98.5	99.5–101.5	98.5–101.5
Chlorine (CL), %	≤0.007	≤0.021	≤0.50	≤0.70	≤0.006	≤0.007
Heavy metal, %	≤0.002	≤0.002	≤0.002	/	≤0.001	≤0.002
Lead (Pb), %	/	/	≤0.0005	/	≤0.0005	/
Sulfate (SO ₄ ⁺), %	≤0.006	≤0.0065	/	/	≤0.006	≤0.0065
Arsenic (As), %	≤0.0002	≤0.0002	≤0.0003	/	≤0.0001	/
Ferric (Fe), %	/	/	/	≤0.003	≤0.001	/
Ammonia (NH ₄ ⁺), %	≤0.01	≤0.02	/	/	≤0.01	/
Loss on drying, %	≤0.20	≤0.2	≤0.2	≤0.3	≤0.07	≤0.2
Ash content, %	≤0.1	≤0.1	≤0.1	/	≤0.05	≤0.1
PH value	5.5–6.5	5.5–6.5	/	/	5.8–6.2	/

Source: CCM

In China, glycine is typically manufactured and sold in four grades: tech-grade (≤ 98.5%), food-grade (98.5%–101.5%), feed-grade (98.5%–101.5%) and pharmaceutical-grade (99.5%–101.5%). Chinese producers mainly produce tech-grade glycine for diverse uses. Quite different from the situation in most overseas countries, the output of and demand for tech-grade glycine are accounting for over 85% and 95% of China's total respectively.

Content of glycine and chlorine is key parameter in glycine quality evaluation.

In international market, glycine is mainly made from hydrocyanic acid, by-product of acrylonitrile production. The glycine produced adopting this method has good properties with high glycine content (about 99%) and low chloride content which is about 1/30 of that of homemade products.

In China, glycine is mainly produced through the chloroacetic acid ammonolysis process with relatively higher production cost and lower glycine content compared with that overseas. Glycine productivity by this process can reach 90% and there is no significant quality disparity among the homemade products.

Glycine with content of 98.5% is the most common specification in China. As for higher glycine content, re-crystallization is needed, resulting in increased production cost. Because of this, domestic glyphosate producers prefer glycine with content of 98.5% (tech-grade) without re-crystallization.

2 Production of glycine in China

2.1 Supply of glycine in China

2.1.1 Capacity and output of glycine in China

Chinese glycine industry has always witnessed overcapacity in the past few years, and this situation will not change much in the coming few years.

In 2016, the national capacity of glycine (tech-grade) grew by 70,000 t/a: Fuhua Tongda entered the sector with 40,000 t/a capacity, and Hubei Trisun's capacity was expanded from 60,000 t/a to 100,000 t/a.

National capacity of glycine (tech-grade) reached 509,000 t/a in 2017, during which Hebei Chuncheng finished a 10,000 t/a tech-grade glycine project and Hebei Huaheng completed a 22,000 t/a tech-grade glycine project. The capacity came to 519,000 t/a in 2018, as Hebei Donghua's capacity expanded to 190,000 t/a. What's more, the 30,000 t/a tech-grade glycine and 10,000 t/a food-grade glycine of Hainan Zhengye Fine Chemical Co., Ltd. was put into production in 2018.

In 2019, the national capacity of tech-grade glycine came to 569,000 t/a. Xizang Newtrend Fine Chemical Co., Ltd. built a 60,000 t/a glycine project. Besides, Yuanshi Xinhongsheng Pharmaceutical Technology Co., Ltd. built a 10,000 t/a glycine project (food-grade included). However, Hebei Donghua's 10,000 t/a glycine suspended production.

In 2020, the national capacity of tech-grade glycine reached 589,000 t/a, during which Linyi Hongtai Chemical Co., Ltd. had its glycine capacity expanded by 20,000 t/a.

Table 2.1.1-1 Capacity and output of glycine in China, 2013–2020

Year	Capacity, t/a		Output, tonne			
	Tech-grade	Others	Tech-grade	Food-grade	Feed-grade	Pharmaceutical-grade
2013	330,000	64,100	225,000	22,300	4,200	2,550
2014	357,000	53,300	242,000	25,550	1,700	2,850
2015	407,000	81,300	259,000	27,110	5,450	2,040
2016	477,000	82,800	303,500	38,300	7,240	2,060
2017	509,000	118,800	307,000	44,470	6,200	2,230
2018	519,000	141,800	328,000	46,300	8,600	1,700
2019	569,000	135,800	332,000	46,650	7,750	2,000
2020	589,000	135,800	340,000	49,550	8,500	2,150

Note: "Others" includes food-grade, feed-grade and pharmaceutical-grade glycine.

Source: CCM

2.1.2 Key glycine producers in China

- Production of various grades of glycine by producer in China

In China, there were 21 active producers of glycine as of June 2021, among which 9 of them are located in Hebei Province.

Among the 21 active producers, 6 companies engage in tech-grade glycine production only, 7 companies produce both tech-grade glycine and other grades glycine, and the rest purchase tech-grade glycine for production of other grades.

Hebei Donghua produces all grades glycine products. From Jan. 2013 to June 2021, the company was the top glycine producer in China by market share, accounting for around one-third of the national total capacity (tech-grade).

Six active producers who only produce tech-grade glycine in China are listed as follows. In 2020, the capacity of these six producers totalled 295,000 t/a, which accounting for 50.1% to the national capacity of tech-grade glycine in China.

- Hubei Trisun Chemical Co., Ltd.
- Linyi Hongtai Chemical Co., Ltd.
- Sichuan Leshan Fuhua Tongda Agro-chemical Technology Co., Ltd.
- Henan HDF Chemical Co., Ltd.
- Inner Mongolia Xingfa Technology Co., Ltd.
- Xizang Newtrend Fine Chemical Co., Ltd.

Table 2.1.2-1 Production for various grades of glycine in China by producers, H1 2021

No.	Producer	Abbreviation	Status, H1 2021	Production situation			
				Tech-grade	Food-grade	Feed-grade	Pharmaceutical-grade
1	Hebei Donghua Chemical Group	Hebei Donghua	Active	√	√	√	√
2	Hubei Trisun Chemical Co., Ltd.	Hubei Trisun	Active	√	×	×	×
3	Linyi Hongtai Chemical Co., Ltd.	Linyi Hongtai	Active	√	×	×	×
4	Sichuan Leshan Fuhua Tongda Agro-chemical Technology Co., Ltd.	Fuhua Tongda	Active	√	×	×	×
5	Xizang Newtrend Fine Chemical Co., Ltd.	Xizang Newtrend	Active	√	×	×	×
6	Hainan Zhengye Fine Chemical Co., Ltd.	Hainan Zhengye	Active	√	√	×	×
7	Hebei Huaheng Biological Technology Co., Ltd.	Hebei Huaheng	Active	√	√	√	√
8	Guang'an Chengxin Chemical Co., Ltd.	Guang'an Chengxin	Active	√	√	×	×
9	Henan HDF Chemical Co., Ltd.	Henan HDF	Active	√	×	×	×
10	Inner Mongolia Xingfa Technology Co., Ltd.	Inner Mongolia Xingfa	Active	√	×	×	×
11	Shandong Zhenxing Chemical Industry Co., Ltd.	Shandong Zhenxing	Idle	×	×	×	×

No.	Producer	Abbreviation	Status, H1 2021	Production situation			
				Tech-grade	Food-grade	Feed-grade	Pharmaceutical-grade
12	Hebei Huayang Biological Technology Co., Ltd.	Hebei Huayang	Active	√	√	√	√
13	Hebei Chuncheng Biological Technology Co., Ltd.	Hebei Chuncheng	Active	√	√	×	×
14	Yuanshi Xinhongsheng Pharmaceutical Technology Co., Ltd.	Yuanshi Xinhongsheng	Active	√	√	√	√
15	Hebei Granray Bioproducts Co., Ltd.	Hebei Granray	Active	×	√	√	√
16	Jiangxi Ansun Food Ingredients Co., Ltd.	Jiangxi Ansun	Active	×	√	×	×
17	Shijiazhuang Shixing Amino Acid Co., Ltd.	Shijiazhuang Shixing	Active	×	√	√	√
18	Nantong Guangrong Chemical Co., Ltd.	Nantong Guangrong	Active	×	√	√	√
19	Suzhou Yotech Fine Chemical Co., Ltd.	Suzhou Yotech	Active	×	√	√	√
20	Hubei Bafeng Pharmaceuticals & Chemicals Co., Ltd.	Hubei Bafeng	Active	×	×	×	√
21	Hebei Changhao Biotechnology Co., Ltd.	Hebei Changhao	Active	×	√	√	√
22	Shijiazhuang Jirong Pharmaceutical Co., Ltd.	Shijiazhuang Jirong	Active	×	√	√	√
23	Shijiazhuang Zexing Amino Acids Co., Ltd.	Shijiazhuang Zexing	Idle	×	×	×	×
24	Jiangxi Electrochemicals Zhongda Chemical Co., Ltd.	Jiangxi Zhongda	Stopped	×	×	×	×
25	Xinle Huada Chemical Co., Ltd.	Xinle Huada	Idle	√	×	×	×
26	Baoding Mantong Fine Chemistry Co., Ltd.	Baoding Mantong	Idle	√	×	×	×

Note: √: produce, X: not produce
Source: CCM

Table 2.1.2-2 Capacity of glycine by producers in China, 2016–2020, t/a

No.	Producer	2020		2019		2018		2017		2016	
		Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
1	Hebei Donghua	180,000	37,000	180,000	37,000	190,000	43,000	180,000	30,000	180,000	30,000
2	Hubei Trisun	100,000	0	100,000	0	100,000	0	100,000	0	100,000	0
3	Linyi Hongtai	70,000	0	50,000	0	50,000	0	50,000	0	50,000	0
4	Leshan Fuhua	40,000	0	40,000	0	40,000	0	40,000	0	40,000	0
5	Xizang Newtrend	60,000	0	60,000	0	0	0	0	0	0	0
6	Hainan Zhengye	30,000	10,000	30,000	10,000	30,000	10,000	0	0	0	0
7	Hebei Huaheng	22,000	30,000	22,000	30,000	22,000	30,000	22,000	30,000	0	10,000
8	Guang'an Chengxin	20,000	8,000	20,000	8,000	20,000	8,000	20,000	8,000	20,000	10,000
9	Henan HDF	15,000	0	15,000	0	15,000	0	15,000	0	15,000	0
10	Inner Mongolia Xingfa	10,000	0	10,000	0	10,000	0	10,000	0	10,000	0
11	Shandong Zhenxing	10,000	0	10,000	0	10,000	0	10,000	0	10,000	0
12	Hebei Huayang	6,000	11,000	6,000	11,000	6,000	11,000	6,000	11,000	6,000	11,000
13	Hebei Chuncheng	10,000	3,000	10,000	3,000	10,000	3,000	10,000	3,000	0	0
14	Yuanshi Xinhongsheng	8,000	2,000	8,000	2,000	0	0	0	0	0	0
15	Hebei Granray	0	5,000	0	5,000	0	5,000	0	5,000	0	5,000
16	Jiangxi Ansun	0	20,000	0	20,000	0	20,000	0	20,000	0	5,000
17	Shijiazhuang Shixing.	0	2,500	0	2,500	0	2,500	0	2,500	0	2,500
18	Nantong Guangrong	0	3,000	0	3,000	0	3,000	0	3,000	0	3,000
19	Suzhou Yotech	0	1,000	0	1,000	0	1,000	0	1,000	0	1,000
20	Hubei Bafeng	0	700	0	700	0	700	0	700	0	700
21	Hebei Changhao	0	2,000	0	2,000	0	2,000	0	2,000	0	2,000
22	Shijiazhuang Jirong	0	400	0	400	0	400	0	400	0	400
23	Shijiazhuang Zexing	0	0	0	0	8,000	2,000	8,000	2,000	8,000	2,000
24	Jiangxi Zhongda	0	0	0	0	0	0	20,000	0	20,000	0
25	Xinle Huada	6,000	0	6,000	0	6,000	0	6,000	0	6,000	0
26	Baoding Mantong	2,000	0	2,000	0	2,000	0	2,000	0	2,000	0
Others		0	200	0	200	0	200	10,000	200	10,000	200
Total		589,000	135,800	569,000	135,800	519,000	141,800	509,000	118,800	477,000	82,800

Note: "Others" includes food-grade, feed-grade and pharmaceutical-grade glycine.

Source: CCM

- Distribution and market share of glycine producers in China

Generally speaking, Chinese glycine producers are mainly located in places where the raw materials such as chlor-alkali, chloroacetic acid and natural gas are adequate, mainly resulted from governmental restriction on transportation of highly toxic chemicals including chlor-alkali, chloroacetic acid and HCN.

In particular, most glycine production in China is concentrated in chlor-alkali-rich Hebei Province, where capacity of tech-grade glycine was 234,000 t/a in 2020, taking up to 32.3% of the national capacity (all grades). Distribution of glycine producers is showed in the following figures. Guang'an Chengxin, the only producer producing glycine via the Hydantion process, is located in Sichuan Province.

Figure 2.1.2-1 Distribution of major glycine producers by capacity of tech-grade glycine in China, 2020



Source: CCM

Figure 2.1.2-2 Distribution of major glycine producers by company number of tech-grade glycine in China, 2020



Source: CCM

Table 2.1.2-3 Industrial concentration of tech-grade glycine in terms of output in China, 2016–2020

No.	Item	Value				
		2020	2019	2018	2017	2016
1	Top one concentration ratio	38.2%	39.2%	45.4%	42.3%	42.8%
2	Top three concentration ratio	72.1%	72.9%	76.8%	79.2%	77.1%
3	Top five concentration ratio	84.4%	85.5%	88.1%	90.6%	87.3%
4	HHI	2,236	2,318	2,738	2,710	2,566

Source: CCM

Chinese glycine industry seems highly concentrated. The high concentration mainly embodies in large-scale production, which is beneficial for top players to reduce cost and control market price.

Actually, pioneering the glycine industry, Hebei Donghua has always played a predominant role in pricing. The company always takes the lead in setting price which is usually followed by other domestic producers. Indeed, evidences from CCM's studies suggest that domestic glycine producers have gained more profits by making the most use of high production concentration and making advantage of pricing power.

However, the concentration of this industry is declining, and HHI will decline in the coming few years because some producers are possible to equip themselves with new facilities that can produce more than ten-thousand tonnes of glycine each year. These companies include Inner Mongolia Xingfa, Shaanxi Beiyuan and Hebei Huayang.

In the future five years, Hebei Donghua will still remain competitive but its competitiveness will decline.

Some glyphosate producers have established or will establish glycine facilities for their glyphosate production.

- Glyphosate producers such as Hubei Trisun and Inner Mongolia Xingfa have established glycine plants, with the glycine capacity of 100,000 t/a and 10,000 t/a respectively, and the latter also has a 60,000 t/a expansion plan.

- Glyphosate producer like Fuhua Tongda has established 40,000 t/a glycine installation, and the 2nd phase 40,000 t/a will be decided by the market situation.

- Glyphosate producers like Henan HDF has established 15,000 t/a glycine installation, and it proposes a 40,000 t/a (1st phase 20,000 t/a, 2nd phase 20,000 t/a) expansion plan.

- Output of glycine by producer in China

Table 2.1.2-4 Output of glycine in China by producer, 2016–2020, tonne

No.	Producer	2020		2019		2018		2017		2016	
		Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
1	Hebei Donghua	130,000	20,000	130,000	20,000	149,000	20,000	130,000	20,000	130,000	17,000
2	Hubei Trisun	80,000	0	84,000	0	73,000	0	83,000	0	69,000	0
3	Linyi Hongtai	35,000	0	28,000	0	30,000	0	30,000	0	35,000	0
4	Leshan Fuhua	25,000	0	25,000	0	22,000	0	20,000	0	16,000	0
5	Xizang Newtrend	6,000	0	0	0	0	0	0	0	0	0
6	Hainan Zhengye	10,000	800	8,000	300	2,000	0	0	0	0	0
7	Hebei Huaheng	5,000	7,300	5,000	6,200	4,000	6,600	3,000	8,800	0	7,300
8	Guang'an Chengxin	17,000	2,500	17,000	2,500	15,000	2,500	15,000	1,400	15,000	500
9	Henan HDF	10,000	0	11,000	0	12,000	0	10,000	0	7,000	0
10	Inner Mongolia Xingfa	10,000	0	10,000	0	10,000	0	10,000	0	10,000	0
11	Shandong Zhenxing	1,000	0	1,000	0	1,000	0	2,000	0	5,000	0
12	Hebei Huayang	3,000	11,000	5,000	10,000	5,000	11,000	4,000	11,000	4,500	11,000
13	Hebei Chuncheng	5,000	1,500	5,000	1,000	5,000	1,000	0	1,000	0	0
14	Yuanshi Xinhongsheng	3,000	1,000	3,000	1,000	0	0	0	0	0	0
15	Hebei Granray	0	2,500	0	2,600	0	2,300	0	1,800	0	1,000
16	Jiangxi Ansun	0	10,000	0	9,200	0	9,400	0	5,000	0	5,000
17	Shijiazhuang Shixing	0	1,200	0	1,200	0	1,100	0	1,100	0	1,800
18	Nantong Guangrong	0	1,000	0	1,000	0	1,000	0	1,100	0	1,200
19	Suzhou Yotech	0	200	0	200	0	200	0	200	0	200
20	Hubei Bafeng	0	100	0	100	0	100	0	100	0	100
21	Hebei Changhao	0	1,000	0	1,000	0	1,000	0	1,000	0	1,000
22	Shijiazhuang Jirong	0	100	0	100	0	100	0	100	0	100
23	Shijiazhuang Zexing	0	0	0	0	0	300	0	300	2,000	1,400
24	Jiangxi Zhongda	0	0	0	0	0	0	0	0	8,000	0
25	Xinle Huada	0	0	0	0	0	0	0	0	2,000	0
26	Baoding Mantong	0	0	0	0	0	0	0	0	0	0
	Others	0	0	0	0	0	0	0	0	0	0
	Total	340,000	60,200	332,000	56,400	328,000	56,600	307,000	52,900	303,500	47,600

Note: "Others" includes food-grade, feed-grade and pharmaceutical-grade glycine.

Source: CCM

- Capacity utilization of glycine by producer in China

Table 2.1.2-5 Capacity utilization of glycine producer in China, 2016–2020

No.	Producer	2020		2019		2018		2017		2016	
		Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
1	Hebei Donghua	72.2%	54.1%	72.2%	54.1%	78.4%	46.5%	72.2%	66.7%	72.2%	56.7%
2	Hubei Trisun	80.0%	/	84.0%	/	73.0%	/	83.0%	/	69.0%	/
3	Linyi Hongtai	50.0%	/	56.0%	/	60.0%	/	60.0%	/	70.0%	/
4	Fuhua Tongda	62.5%	/	62.5%	/	55.0%	/	50.0%	/	40.0%	/
5	Xizang Newtrend	10.0%	/	0.0%	/	/	/	/	/	/	/
6	Hainan Zhengye	33.3%	8.0%	26.7%	3.0%	6.7%	0.0%	/	/	/	/
7	Hebei Huaheng	22.7%	24.3%	22.7%	20.7%	18.2%	22.0%	13.6%	29.3%	/	73.0%
8	Guang'an Chengxin	85.0%	31.3%	85.0%	31.3%	75.0%	31.3%	75.0%	17.5%	75.0%	5.0%
9	Henan HDF	66.7%	/	73.3%	/	80.0%	/	66.7%	/	46.7%	/
10	Inner Mongolia Xingfa	100.0%	/	100.0%	/	100.0%	/	100.0%	/	100.0%	/
11	Shandong Zhenxing	10.0%	/	10.0%	/	10.0%	/	20.0%	/	50.0%	/
12	Hebei Huayang	50.0%	100.0%	83.3%	90.9%	83.3%	100.0%	66.7%	100.0%	75.0%	100.0%
13	Hebei Chuncheng	50.0%	50.0%	50.0%	33.3%	50.0%	33.3%	0.0%	33.3%	/	/
14	Yuanshi Xinhongsheng	37.5%	50.0%	37.5%	50.0%	/	/	/	/	/	/
15	Hebei Granray	/	50.0%	/	52.0%	/	46.0%	/	36.0%	/	20.0%
16	Jiangxi Ansun	/	50.0%	/	46.0%	/	47.0%	/	25.0%	/	100.0%
17	Shijiazhuang Shixing	/	48.0%	/	48.0%	/	44.0%	/	44.0%	/	72.0%
18	Nantong Guangrong	/	33.3%	/	33.3%	/	33.3%	/	36.7%	/	40.0%
19	Suzhou Yotech.	/	20.0%	/	20.0%	/	20.0%	/	20.0%	/	20.0%
20	Hubei Bafeng	/	14.3%	/	14.3%	/	14.3%	/	14.3%	/	14.3%
21	Hebei Changhao	/	50.0%	/	50.0%	/	50.0%	/	50.0%	/	50.0%
22	Shijiazhuang Jirong	/	25.0%	/	25.0%	/	25.0%	/	25.0%	/	25.0%
23	Shijiazhuang Zexing	/	/	/	/	0.0%	15.0%	0.0%	15.0%	25.0%	70.0%
24	Jiangxi Zhongda	/	/	/	/	/	/	0.0%	/	40.0%	/
25	Xinle Huada	0.0%	/	0.0%	/	0.0%	/	0.0%	/	33.3%	/
26	Baoding Mantong	0.0%	/	0.0%	/	0.0%	/	0.0%	/	0.0%	/
	Others	/	0.0%	/	0.0%	/	0.0%	0.0%	0.0%	0.0%	0.0%

Note: "Others" includes food-grade, feed-grade and pharmaceutical-grade glycine.

Source: CCM

2.1.3 Potential production lines of glycine in China

If potential production capacity goes into production, the capacity of tech-grade glycine in China will increase steadily in the coming five years, from 589,000 t/a in 2020 to over 800,000 t/a in 2025.

Table 2.1.3-1 Potential projects of glycine in China, as of June 2021

Classification	Company	Designed capacity, t/a	Planned commissioning date	Details
Expansion	Hebei Donghua Chemical Group	30,000 tech-grade	N/A	2 nd phase of Hebei Donghua Jiheng Chemical Co., Ltd.'s 60,000 t/a glycine project (1 st phase had been put into commercial production in 2018).
	Sichuan Leshan Fuhua Tongda Agro-chemical Technology Co., Ltd.	40,000 tech-grade	N/A	This 2 nd phase of 80,000 t/a glycine project (1 st phase had been built up in 2016) will be decided by the market situation.
	Xizang Newtown Fine Chemical Co., Ltd.	2 nd phase: 90,000 glycine	N/A	2 nd phase 90,000 t/a glycine will be determined by the future market situation. (1 st phase including 60,000 t/a glycine and 6,000 t/a chloroacetic acid was built up in 2019.)
	Hebei Chuncheng Biological Technology Co., Ltd.	2 nd phase: 14,000 tech-grade, 3,000 food-grade	N/A	2 nd phase: 17,000 t/a glycine and 45,000 t/a chloroacetic acid (1 st phase 13,000 t/a glycine had been built up.)
	Cangzhou Huachen Biological Technology Co., Ltd.	1 st phase: 30,000 tech-grade	2021	1 st phase: 30,000 t/a tech-grade glycine 2nd phase: 30,000 t/a food-grade glycine
	Henan HDF Chemical Co., Ltd.	1 st phase: 20,000 tech-grade	N/A	1 st phase: 20,000 t/a tech-grade glycine 2nd phase: 20,000 t/a tech-grade glycine
	Inner Mongolia Xingfa Technology Co., Ltd.	60,000 tech-grade	2023	60,000 t/a tech-grade glycine and 90,000 t/a chloroacetic acid
New	Sanmenxia Jiema Electrification Co., Ltd.	50,000 tech-grade	N/A	Application
	Inner Mongolia Jiaquan Chemical Technology Co., Ltd.	20,000 tech-grade	N/A	1 st phase (100,000 t/a formaldehyde, 15,000 t/a paraformaldehyde and 6,000 t/a urotropine) was built up in 2015. 2nd phase (100,000 t/a formaldehyde, 15,000 t/a paraformaldehyde, 20,000 t/a glycine, etc.)
	Shaanxi Beiyuan Chemical Industry Group Co., Ltd.	120,000 tech-grade	N/A	120,000 t/a glycine, 180,000 t/a chloroacetic acid
	Heilongjiang Chengfu Food Group Co., Ltd.	25,000 food-grade	N/A	N/A

Source: CCM

2.2 Price of glycine in China

2.2.1 Price of glycine in China, Jan. 2013–June 2021

Only the price of tech-grade glycine in China is analysed here, as other three grades glycine are made from tech-grade one, and their prices are mainly subject to that of tech-grade one.

Ex-works price of tech-grade glycine climbed from USD2,097/t in Jan. 2014 to USD2,624/t in April 2014, mainly because glycine producers in Hebei and Shandong provinces, the main production areas, halted or cut production due to the pressure from environmental policies after the Spring Festival.

However, the price soon experienced a declining trend, falling from that temporary peak to USD1,264/t in Nov. 2016, due to the following reasons:

- Demand for glycine from the downstream glyphosate industry declined, and the export volume of glyphosate declined in 2015 compared with that in 2014.
- With new capacity launched, total capacity of glycine increased further and the supply gradually exceeded demand.

From Nov. 2016 to the end of 2017, ex-works price of tech-grade glycine was on an upward trend in general. The price bottomed at USD1,154/t in April 2017 but quickly rose to USD2,621/t in Nov. 2017 and USD2,573/t in Dec. 2017, due to the following reasons:

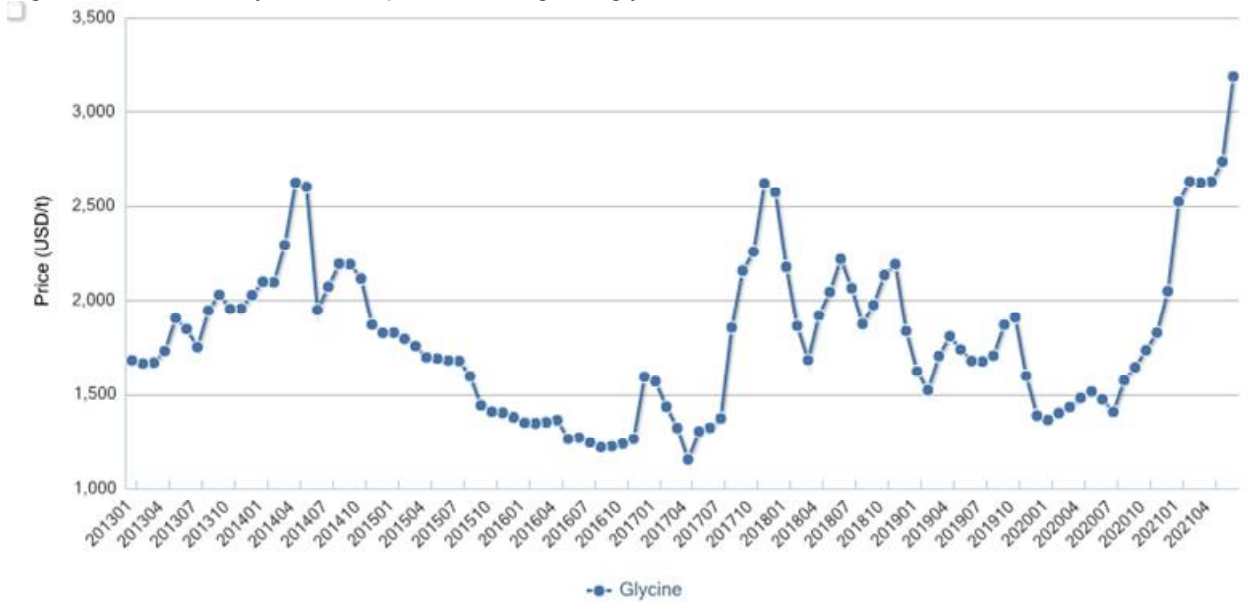
- The second-, third- and fourth-round environmental inspections were carried out in Nov. 2016, April 2017 and Aug. 2017, respectively. Besides, the supervision of production safety in 2017 had been strengthened. During the environmental inspections, production of glycine was restricted and operating rate of the industry was reduced, which led to short supply of the product.
- After July 2016, China banned the sales and use of paraquat AS, part of whose market was replaced by glyphosate. So the demand for glyphosate had increased, leading to an increase in the demand for glycine.
- Since H2 2016, with the rapid development of overseas glyphosate-resistant genetically modified crops, China's export of glyphosate increased, thus the demand for glycine increased.

In 2018, the price fluctuated between USD1,600/t–USD2,200/t, and the annual average was about USD2,000/t, driven by the increasing price of glyphosate technical, rising demand for glycine, and stricter environmental protection requirement.

Affected by COVID-19, domestic and foreign demand for glycine decreased in H1 2020, and thus its price kept at a low level. Entering the peak season for glyphosate in H2 2020, demand for glyphosate exceeded its supply, which drove up the demand for glycine. The price of glycine rebound to USD2,048/t in Dec. 2020.

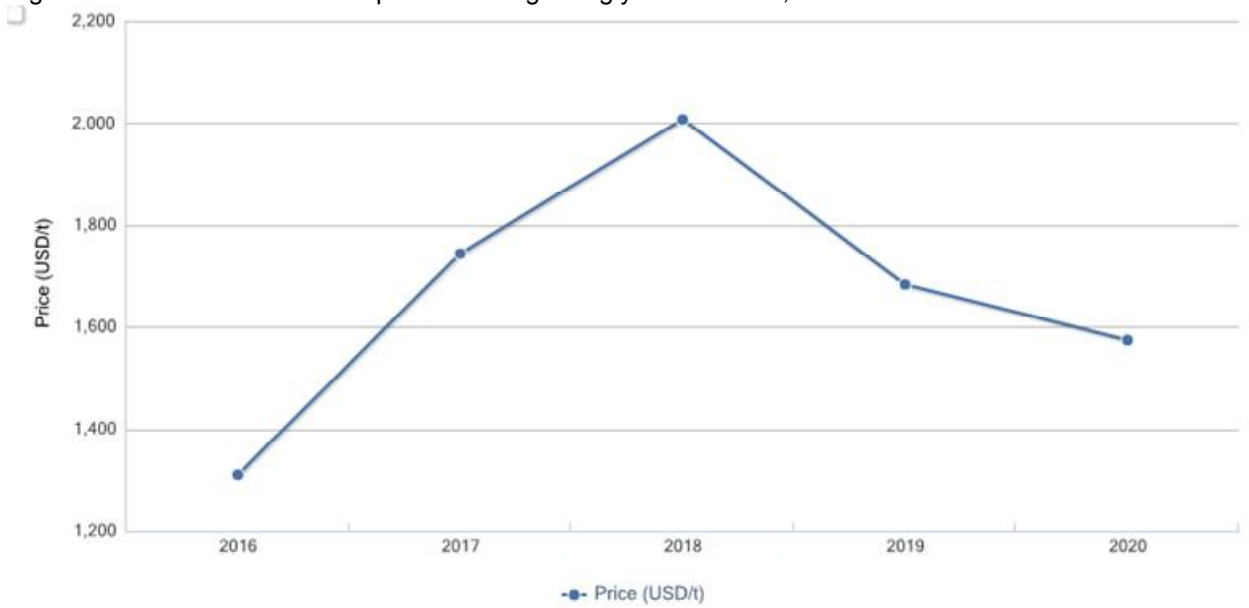
The price of glycine climbed further in H1 2021, reaching USD3,185/t in June, mainly inspired by the soaring price of glyphosate. Due to tightening environmental protection policies in China, some small- and medium-sized glyphosate producers with lower competitiveness were forced to withdraw. Supply from large glyphosate producers could not keep up with the continuously growing demand. The booming market prompted big price rise of glyphosate and tech-grade glycine. In addition, increases in the prices of raw materials such as urotropine and chloroacetic acid also pushed the price of glycine higher.

Figure 2.2.1-1 Monthly ex-works price of tech-grade glycine in China, Jan. 2013–June 2021



Source: CCM

Figure 2.2.1-2 Annual ex-works price of tech-grade glycine in China, 2016–2020



Source: CCM

2.2.2 Factors influencing glycine price in China

Glycine price in China is influenced by the price of glyphosate technical, instant supply of & demand for glycine, government policies, and the price of glycine's raw materials including chloroacetic acid, urotropine, liquid ammonia and methanol.

- Glyphosate technical price

Glycine price in China is largely subject to the price of glyphosate technical, since some 80% of tech-grade glycine is applied in the domestic glyphosate industry.

- Government policies

Under the guidance of national industrial policies, China's amino acid industry develops rapidly. And due to some environmental policies, supply of and demand for glycine and enterprises' operating profits in China are limited, affecting the price of glycine. For example, during the period from Aug. to Oct. 2017, the fourth-round environmental inspection and the national production safety inspection were carried out, glycine production was under stricter supervision, leading to a tight supply of glycine.

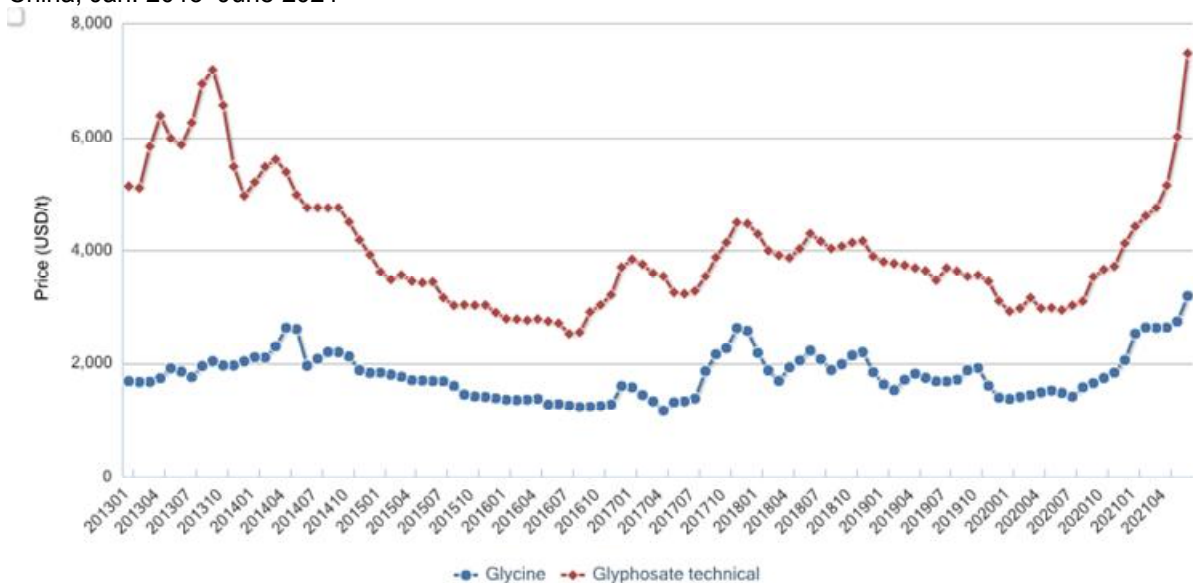
- Instant supply of & demand for glycine

In general, there has been a great oversupply in glycine industry in China, and in most cases, glycine price won't change much. However, the price may increase a lot when the instant supply cannot meet the demand.

- Raw material price

The cost of raw materials, like urotropine and chloroacetic acid, accounts for over 80% of the total production cost of glycine.

Figure 2.2.2-1 Monthly ex-works prices of tech-grade glycine and 95% glyphosate technical in China, Jan. 2013–June 2021



Source: CCM

2.2.3 Price trend of glycine in China

Glycine mainly follows the trend of glyphosate's market price.

As of June 2021, the price of glyphosate had risen by some 69% from Jan. and the price of glycine up over 26%. Entering H2, so far glyphosate industry has seen greater concentration; the manufacturers have already been replenishing inventory for the peak season in October. Besides, routine maintenance in high-temperature season will drive up prices of glyphosate and glycine amid supply shortage of glyphosate. However, the price of glycine is expected to fall in Q4 along with eased situation in glyphosate market.

At the same time, China will further its environmental protection and follow its roadmap towards carbon emission peak and carbon neutrality. The price of glycine will be affected by environmental factors.

It is estimated that the annual ex-works price of tech-grade glycine in China will range between USD1,600/t–USD2,200/t during 2021–2023.

2.3 Export of glycine in China

Since China's glycine import volume is so small, less than 300 tonnes annually, this report just delves into export analysis on glycine.

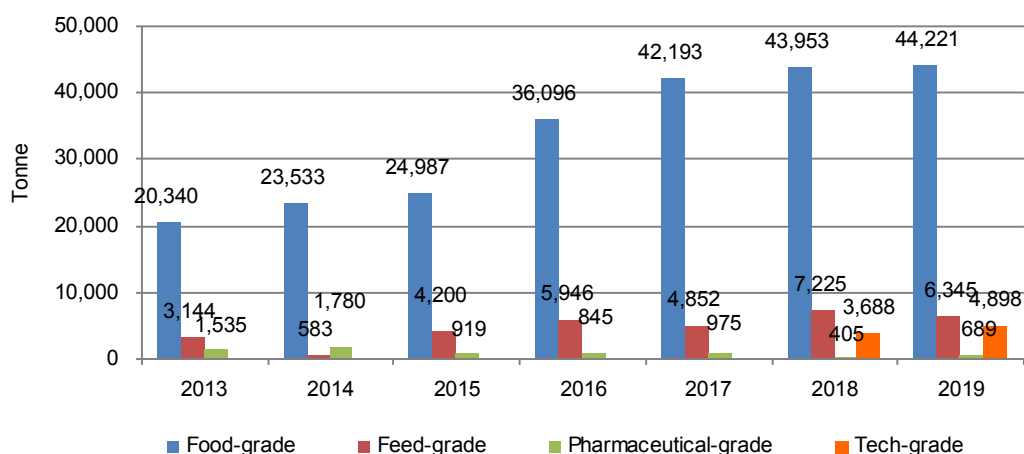
2.3.1 Export volume of glycine in China

China's total export volume of glycine increased on the whole in 2012–2019, rising from 25,019 tonnes in 2013 to 56,153 tonnes in 2019.

China started to export tech-grade glycine in 2018, with the export volume of 3,688 tonnes, accounting for 6.7% of total export volume of glycine in 2018. In 2019, the export volume of tech-grade glycine increased greatly to 4,898 tonnes which took up to 8.7% of the whole.

Food-grade glycine is the main glycine product exported in China, with its volume accounting for 87.9%, 79.5% and 78.8% of the total glycine export volume during 2017–2019 respectively. And it increased from 20,340 tonnes to 44,221 tonnes with a CAGR of 13.8% from 2013 to 2019.

Figure 2.3.1-1 China's export volume of various grades glycine, 2013–2019



Source: China Customs & CCM

2.3.2 Export price of glycine in China

The average export price of food-grade glycine in China hovered ranging from USD2,000/t to USD2,100/t in 2013, and experienced a fast rise in 2014 to a record high around USD2,400/t–USD2,700/t from April to Nov. because of tech-grade glycine's high price.

Since the end of 2014, the export price of food-grade glycine has been declining continuously, reaching only about USD1,552/t in Dec. 2016. Since Jan. 2017, export price of food-grade glycine rebounded and climbed to USD2,518/t in Jan. 2018, due to the gradual rises in the prices of domestic glyphosate technical and tech-grade glycine.

The export price of food-grade glycine declined in Feb. 2018, and kept declining in the first half of 2018. The price was relatively stable in the second half of 2018, at USD2,000/t–USD2,125/t. The decline was mainly influenced by the increasing export volume and sufficient supply.

In 2019, the export price of food-grade glycine slowly decreased but it was pretty stable, ranging from USD1,800/t to USD2,000/t. The reason for the price decline was the price decreases of glyphosate technical and tech-grade glycine.

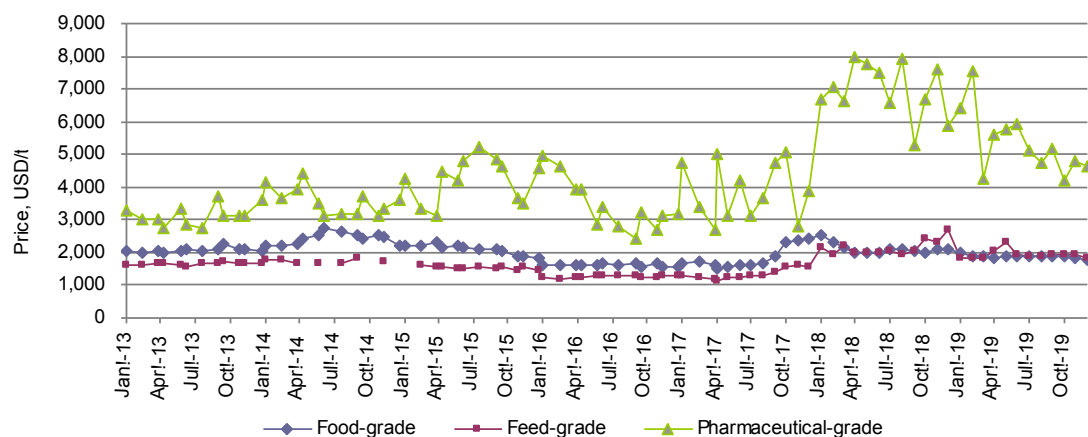
During 2013–2019, the average export price of feed-grade glycine showed the same trend as that of food-grade glycine. In 2019, the export price of feed-grade glycine was stable and close to the price of food-grade glycine.

The average export price of pharmaceutical-grade glycine fluctuated greatly compared with food- and feed-grade glycine, due to the following factors:

- The ex-works price of pharmaceutical-grade is much higher than that of other two grades, and it is not appreciably affected by the market price of tech-grade glycine compared with that of other two grades.
- The knockdown price mainly depends on the bargaining power of trade companies.

In H2 2019, the fluctuation of pharmaceutical-grade glycine decreased and the price ranged between USD4,000/t and USD5,000/t.

Figure 2.3.2-1 Export prices of various grades of glycine in China, Jan. 2013–Dec. 2019



Source: China Customs & CCM

2.3.3 Export destination of glycine in China, 2017–2019

In 2019, the main export destinations of China's glycine include the Netherlands, Germany, India, Thailand, Russia, Japan and South Korea.

The Netherlands surpassed Germany and became the largest export destination of China's glycine in 2019, constituting 15.2%, 16.2%, 15.0%, 18.7%, 19.2% and 19.6% of China's total export volume of glycine in 2014–2019 respectively.

Germany was the second largest export destination of China's glycine in 2019, constituting 21.7%, 29.0%, 20.0%, 21.1%, 25.4% and 18.0% of China's total export volume of glycine in 2014–2019 respectively.

Table 2.3.3-1 China's exports of glycine by destinations, 2019

No.	Country/region	Tech-grade		Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
1	The Netherlands	139	1,776	9,330	1,871	1,508	1,845	10	2,418
2	Germany	592	1,665	8,466	1,907	1,015	1,689	22	2,145
3	India	979	1,727	3,446	1,681	486	1,848	22	2,008
4	Thailand	88	1,649	3,660	1,812	1,078	1,805	1	10,532
5	Russia	171	2,030	2,956	1,909	660	1,969	347	4,425
6	Japan	27	6,329	3,239	2,119	107	1,875	35	6,416
7	South Korea	90	1,788	2,414	1,939	135	2,265	13	7,953
8	Vietnam	34	1,712	1,573	1,690	447	2,354	21	1,937
9	Spain	654	1,597	1,131	1,625	97	1,751	0	0
10	Belgium	305	4,899	1,140	1,790	20	1,909	133	7,717
11	Australia	376	1,613	645	1,950	61	1,771	7	8,303
12	The US	877	1,923	0	2,502	15	2,044	0	0
13	Poland	186	1,668	621	1,823	0	0	0	0
14	Indonesia	10	1,630	730	1,932	60	2,102	0	13,737
15	The UK	16	2,374	569	1,980	148	2,084	2	3,835
16	Italy	0	0	541	1,865	108	1,629	0	6,667
17	Brazil	33	2,181	369	1,846	78	2,009	23	2,462
18	France	0	0	492	1,749	9	7,551	0	12,356
19	Taiwan Province	171	1,527	672	1,887	59	1,767	1	6,871
20	South Africa	32	1,939	243	1,821	2	2,340	7	2,125
21	Mexico	34	1,892	222	1,927	2	2,300	8	2,754
22	Switzerland	0	0	220	1,767	40	1,730	0	0
23	Sweden	0	0	131	2,195	76	1,998	0	0
24	Egypt	0	4,844	176	1,933	5	1,901	9	3,875
25	Ireland	0	0	160	1,750	0	0	0	0
26	Malaysia	0	0	146	1,930	0	0	1	24,590
27	Argentina	4	2,195	58	2,140	68	2,077	3	3,087
28	Turkey	0	4,760	117	1,838	6	2,467	4	6,800
29	Nigeria	0	0	115	2,048	2	2,069	0	0
30	Canada	39	2,085	67	2,195	2	2,107	0	0
	Others	41	1,994	572	1,915	51	2,192	20	12,236
	Total	4,898	1,967	44,221	1,871	6,345	1,891	689	5,182

Note: The data has been rounded.

Source: China Customs & CCM

Table 2.3.3-2 China's exports of glycine by destination, 2018

No.	Country/region	Tech-grade		Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
1	Germany	243	2,099	11,650	2,110	2,160	2,083	10	2,760
2	The Netherlands	164	2,204	9,065	2,091	1,404	2,006	0	0
3	Thailand	138	2,001	4,404	2,069	2,559	1,894	2	11,289
4	Japan	0	1,250	2,768	2,413	66	2,563	49	6,378
5	Russia	67	2,101	2,942	2,144	130	2,383	22	4,855
6	South Korea	3	2,107	1,886	2,033	13	5,348	26	7,835
7	India	769	1,973	1,792	2,025	199	2,150	15	3,228
8	Vietnam	89	1,917	1,367	2,037	30	1,872	0	9,095
9	Spain	484	1,804	1,124	2,062	20	1,909	0	0
10	Belgium	30	2,259	891	2,164	100	2,272	210	8,102
11	Poland	285	1,867	734	2,067	0	0	0	12,000
12	Italy	96	2,451	637	2,111	30	1,800	0	0
13	Taiwan Province	328	1,723	698	2,113	10	2,406	3	9,509
14	Indonesia	0	0	594	2,240	37	1,977	0	8,173
15	Malaysia	0	0	565	1,999	0	0	1	4,405
16	The UK	23	2,621	375	2,275	200	2,393	0	10,393
17	Australia	287	1,849	257	2,092	0	0	1	3,226
18	Sweden	0	0	255	2,515	0	0	0	0
19	South Africa	54	2,525	236	2,170	0	0	4	2,555
20	Mexico	50	2,290	212	2,177	0	4,130	0	0
21	Brazil	24	2,167	167	2,162	157	2,422	1	3,018
22	Canada	25	2,257	156	2,335	1	2,977	0	6,680
23	France	0	0	154	2,248	0	0	0	10,000
24	Argentina	1	2,340	113	2,033	1	2,810	0	15,000
25	Iran	0	0	110	2,136	0	0	0	0
26	Colombia	0	0	82	2,299	0	0	0	0
27	New Zealand	0	4,760	74	2,200	20	2,673	0	12,320
28	Ukraine	72	1,753	73	2,066	0	0	1	7,171
29	Nigeria	0	0	68	2,205	0	0	0	0
30	Saudi Arabia	0	0	64	2,307	0	0	0	3,520
	Others	452	2,139	316	2,325	63	2,468	58	6,547
	Total	3,688	1,982	43,953	2,122	7,225	2,040	405	7,097

Note: The data has been rounded.

Source: China Customs & CCM

Table 2.3.3-3 China's exports of glycine by destination, 2017

No.	Country/region	Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
1	Germany	9,244	1,732	848	1,317	52	3,926
2	The Netherlands	8,772	1,738	194	1,278	3	2,401
3	Thailand	4,114	1,796	764	1,197	2	2,013
4	Japan	2,911	2,065	20	1,297	218	3,173
5	India	2,333	2,001	244	1,317	119	2,498
6	Russia	2,092	1,710	124	1,396	232	2,590
7	South Korea	1,451	1,798	374	1,390	49	4,585
8	Belgium	1,445	1,769	83	1,291	195	7,515
9	Vietnam	1,277	1,903	324	1,201	16	2,005
10	The UK	1,113	2,052	133	1,393	5	4,274
11	Taiwan Province	1,048	1,805	72	1,198	2	8,260
12	Spain	956	1,896	296	1,247	0	0
13	Poland	549	2,054	206	1,266	0	0
14	Australia	426	2,051	305	1,207	9	5,129
15	Italy	479	1,982	235	1,309	10	2,996
16	Indonesia	587	1,953	0	0	0	0
17	Malaysia	477	1,687	56	1,359	0	0
18	Nigeria	340	1,629	0	0	0	0
19	South Africa	318	1,765	98	1,346	0	0
20	Cambodia	196	1,668	165	1,273	0	0
21	Brazil	333	1,905	0	0	2	2,562
22	Mexico	233	1,721	20	1,370	0	0
23	Canada	217	1,893	18	1,339	12	2618
24	Sweden	241	2,089	0	0	0	0
25	France	101	1,980	58	1,206	1	3,320
26	Argentina	134	1,649	0	0	0	0
27	Iran	132	1,821	22	1,405	2	6,500
28	Ireland	123	1,858	0	0	0	0
29	Ukraine	114	1,786	60	1,332	4	2,970
30	Saudi Arabia	70	1,951	0	0	2	3,243
	Others	367	1,902	133	1,330	40	4,147
	Total	42,193	1,818	4,852	1,282	975	3,974

Note: The data has been rounded.

Source: China Customs & CCM

2.3.4 Exporter of glycine in China, 2017–2019

Glycine producers play a dominant role in glycine export in China, and the export by glycine producers and their related companies took up over 82% in terms of volume during 2017–2019.

The top five domestic exporters have always been glycine producers or related companies during 2017–2019.

Hebei Donghua is one of the top glycine exporters. Its glycine export is conducted by its related companies including Hebei Donghua Jiheng Amino Acids Co., Ltd., Hebei Donghuajian Chemical Co., Ltd., Shijiazhuang Donghuajian Amino Acids Co., Ltd. and Hebei Pushiyongdao Trade Co., Ltd.

Hengshui Yangli Commerce Co., Ltd. is a trading company of Hebei Huayang.

Hebei Harmony Amino Acid Co., Ltd. is the trading company of Shijiazhuang Shixing.

Table 2.3.4-1 China's exports of glycine by exporter, 2019

No.	Exporter	Tech-grade		Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
1	Hebei Huayang Biological Technology Co., Ltd.*	269	1,568	9,133	1,793	349	1,697	0	3,100
2	Jiangxi Ansun Chemical Technology Co., Ltd. *	0	/	5,321	1,877	1,077	1,884	0	/
3	Hebei Pushi Yongdao Trade Co., Ltd.*	109	1,652	5,267	1,900	340	1,826	0	/
4	Hebei Donghua Jiheng Amino Acid Technology Co., Ltd. *	1,171	1,581	3,701	1,835	0	/	0	/
5	Hebei Huaheng Biological Technology Co., Ltd. *	131	1,737	4,161	1,827	20	1,355	0	/
6	Nanchang Newtrend Technology Co., Ltd.*	0	/	2,972	2,034	802	2,119	0	/
7	Shijiazhuang Donghuajian Amino Acids Co., Ltd. *	36	1,614	2,740	1,979	333	1,656	0	/
8	Guang'an Chengyang Bio-tech Co., Ltd. *	0	/	2,614	1,712	0	/	0	/
9	Hebei Granray Bioproducts Co., Ltd. *	92	1,629	401	1,815	1,163	1,684	0	/
10	Shijiazhuang Chiyuan Food Technology Co., Ltd. *	0	/	1,653	2,082	0	/	0	5,882
11	Hebei Harmony Amino Acid Co., Ltd. *	113	1,547	903	1,545	0	/	0	/
12	Shijiazhuang Haitian Amino Acid Co., Ltd. *	502	1,805	347	1,758	88	1,754	0	/
13	Chengdu Shanfeng International Trade Co., Ltd.	830	1,924	0	/	0	/	0	/
14	Xiamen Yuanbaolong Import & Export Co., Ltd.	0	/	653	2,004	0	/	0	/

No.	Exporter	Tech-grade		Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
15	Shanxi Chengxin Chemical Co., Ltd.	0	/	560	1,747	0	/	0	/
16	Hebei Chuncheng Biological Technology Co., Ltd. *	0	/	153	1,870	383	1,750	0	/
17	Hengshui Yangli Commerce Co., Ltd.	60	1,920	463	1,870	10	1,889	0	/
18	Hebei Changhao Biotechnology Co., Ltd. *	0	/	515	1,803	0	/	0	/
19	Jilin Shengrong Chemicals Import & Export Co., Ltd.	210	1,628	99	1,787	191	1,717	0	/
20	Shanghai Yunyuan Trade Co., Ltd.	0	/	0	/	454	1,642	0	/
Others		1,376	2,493	2,566	2,079	1,136	2,294	689	5,183
Total		4,898	1,967	44,221	1,871	6,345	1,891	689	5,182

Note: 1.* Glycine producers or their related companies

2. The data has been rounded.

3. Zhaocounty Granray Bioproducts Co., Ltd. has changed its name to Hebei Granray Bioproducts Co., Ltd.

Source: China Customs & CCM

Table 2.3.4-2 China's exports of glycine by exporter, 2018

No.	Exporter	Tech-grade		Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
1	Hebei Huayang Biological Technology Co., Ltd. *	113	1,929	10,378	2,066	318	2,076	0	/
2	Hebei Pushiyongdao Trade Co., Ltd. *	28	2,263	6,424	2,144	0	/	0	/
3	Nanchang Newtrend Technology Co., Ltd. *	0	/	2,756	2,121	3,213	2,120	0	/
4	Hebei Donghua Jiheng Amino Acid Technology Co., Ltd. *	719	1,895	3,977	2,298	0	/	0	/
5	Hebei Huaheng Biological Technology Co., Ltd. *	331	1,908	3,405	2,164	0	/	0	/
6	Jiangxi Ansun Food Ingredients Co., Ltd. *	0	/	2,256	1,936	880	1,993	0	/
7	Shijiazhuang Donghuajian Amino Acids Co., Ltd. *	18	2,090	2,873	2,054	0	/	0	/
8	Guang'an Chengyang Bio-tech Co., Ltd. *	0	/	2,686	2,093	0	/	0	/
9	Shanghai Yunyuan Trade Co., Ltd.	0	/	0	/	2,499	1,888	0	/
10	Zhaocounty Granray Bioproducts Co., Ltd. *	0	/	2,164	2,073	0	/	0	/
11	Hengshui Yangli Commerce Co., Ltd. *	0	/	932	2,152	0	/	0	/
12	Hebei Harmony Amino Acid Co., Ltd. *	144	1,764	679	1,927	0	/	0	/
13	Hebei Changhao Biotechnology Co., Ltd. *	12	2,204	759	2,064	0	/	0	/
14	Xiamen Yuanbaolong Import & Export Co., Ltd.	0	0	549	2,287	0	/	0	/
15	Jilin Shengrong Chemicals Import&Export Co., Ltd.	252	1,744	254	2,070	0	/	0	/
16	Foodchem (Shanghai) Biotechnology Co., Ltd.	0	/	492	2,124	0	/	0	/
17	Chengdu Shanfeng International Trade Co., Ltd.	430	2,143	38	2,052	0	/	0	/
18	Zhejiang Chemicals Import&Export Corporation	275	1,886	62	2,129	78	2,102	0	/
19	Xiamen Ditai Imp & Exp Co., Ltd.	198	1,848	196	1,978	2	2,365	0	/
20	Hebei Chuncheng Biological Technology Co., Ltd. *	0	/	394	1,970	0	/	0	/
Others		1,170	2,117	2,679	2,331	235	2,665	405	7,097
Total		3,688	1,982	43,953	2,122	7,225	2,040	405	7,097

Note: 1. * Glycine producers or their related companies

2. The data has been rounded.

Source: China Customs & CCM

Table 2.3.4-3 China's exports of glycine by exporter, 2017

No.	Exporter	Food-grade		Feed-grade		Pharmaceutical-grade	
		Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t	Volume, tonne	Price, USD/t
1	Hebei Huayang Biological Technology Co., Ltd.*	10,125	1,815	1,330	1,319	0	/
2	Hebei Huaheng Biological Technology Co., Ltd. *	4,898	1,631	611	1,173	0	/
3	Shijiazhuang Donghuajian Amino Acids Co., Ltd. *	4,839	1,929	23	1,291	0	/
4	Hebei Donghua Jiheng Amino Acids Co., Ltd. *	4,193	1,813	559	1,184	0	/
5	Jiangxi Ansun Food Ingredients Co., Ltd. *	3,601	1,608	112	1,269	0	/
6	Hebei Pushiyongdao Trade Co., Ltd. *	3,416	1,927	54	1,337	0	/
7	Zhaocounty Granray Bioproducts Co., Ltd. *	1,749	1,981	105	1,273	0	/
8	Guang'an Chengyang Bio-tech Co., Ltd. *	1,091	1,839	0	/	0	/
9	Shenzhen Newtrend Co., Ltd. *	434	1,734	556	1,395	0	/
10	Hebei Changhao Biotechnology Co., Ltd. *	599	2,070	175	1,271	0	/
11	Foodchem (Shanghai) Biotechnology Co., Ltd.	439	2,468	239	1,348	0	/
12	Hebei Harmony Amino Acid Co., Ltd. *	420	1,887	254	1,160	0	/
13	Hengshui Yangli Commerce Co., Ltd. *	535	1,910	100	1,327	3	2,989
14	Xiamen Yuanbaolong Import & Export Co., Ltd.	560	1,979	60	1,450	0	/
15	Beijing FortuneStar S&T Development Co., Ltd.	433	1,638	0	/	0	/
16	Shanghai San Kai Import & Export Co., Ltd.	370	1,979	0	/	0	/
17	Jilin Tongrun Trading Co., Ltd.	243	1,756	96	1,331	0	/
18	Shanghai Foodmate Biological Technology Co., Ltd.	321	1,676	0	/	0	/
19	Nanning Yingchuang Meishi Pharmaceutical Co., Ltd.	0	/	0	/	227	7,720
20	Shanghai Pharmtech Co., Ltd.	0	/	0	/	216	2,592
Others		3,927	1,822	578	1,293	529	2,936
Total		42,193	1,818	4,852	1,282	975	3,974

Note: 1.* Glycine producers or their related companies

2. The data has been rounded.

Source: China Customs & CCM

2.4 Raw materials for glycine production in China, 2020

Urotropine and chloroacetic acid, two main raw materials for glycine production via the chloroacetic acid ammonolysis process, both have weak market positions compared with the downstream sectors of glycine, thereby having slight impacts on domestic glycine industry.

2.4.1 Urotropine

Urotropine is prepared from the reaction of formaldehyde and liquid ammonia. It is a kind of raw material for curing agent of phenolic plastics, catalytic agent of amino plastics, blowing agent H (DPT) of vulcanized rubbers, black explosives and pesticides.

The national capacity of urotropine was about 500,000 t/a in 2020. For the top 15 producers, their total capacity accounted for 72.0% to the national total. Nearly one third of urotropine producers in China are located in Shandong and Hebei provinces, both of which are important production bases for formaldehyde and liquid ammonia—urotropine's raw materials.

Table 2.4.1-1 Main urotropine producers in China, 2020

No.	Company	Location	Capacity, t/a
1	Shandong Runyin Bio-chemicals Co., Ltd.	Shandong	30,000
2	Tianshan Green Kuqa Petrochemical Co., Ltd.	Xinjiang	30,000
3	Jiaozuo Runhua Chemical Industry Co., Ltd.	Henan	30,000
4	Inner Mongolia Jiaquan Chemical Technology Co., Ltd.	Inner Mongolia	30,000
5	Yangmei Fengxi Fertilizer Industry (Group) Co., Ltd.	Shanxi	30,000
6	Hebei Donghua Chemical Group	Hebei	30,000
7	Wuzhi Huayu Oil Chemical Co., Ltd.	Henan	20,000
8	Shandong Jinmei Mingshui Chemical Group Co., Ltd.	Shandong	20,000
9	Hebei Yuhang Chemical Industry Co., Ltd.	Hebei	20,000
10	Jiangsu Sanmu Group Co., Ltd.	Jiangsu	20,000
11	Changji RYT Chemical Co., Ltd.	Xinjiang	20,000
12	Shanxi Lanhua Sci-tech Venture Co., Ltd.	Shanxi	20,000
13	Xinjiang Wanchang New Energy Co., Ltd.	Xinjiang	20,000
14	Xinjiang Huachun Energy Co., Ltd.	Xinjiang	20,000
15	Gansu Taier Fine Chemical Co., Ltd.	Gansu	20,000
Sub-total			360,000
National total			500,000
Share of top 15			72.0%

Note: The former name of Tianshan Green Kuqa Petrochemical Co., Ltd. is Tianshan Green Kuqa DME Co., Ltd.

Source: CCM

The top five urotropine producers (by capacity) took up about 30% of the national capacity of urotropine in 2020. The Herfindahl-Hirschman Index (HHI) of urotropine in China was 425, which is far lower than 1,800, suggesting that urotropine market in China is not concentrated and it would be easy for this industry to realize capacity concentration if any merger and acquisition is

proposed. According to the US Department of Justice's merger guidelines, an industry is considered as "concentrated" if the HHI exceeds 1,800.

Table 2.4.1-2 Industrial concentration of urotropine in terms of capacity in China, 2020

No.	Item	Value
1	Top five concentration ratio	30.0%
2	Top ten concentration ratio	52.0%
3	Herfindahl-Hirschman Index (HHI)	425

Source: CCM

In China, urotropine is mainly consumed in phenolic plastics, explosives and glycine. About 40% of urotropine is used as curing agent of phenolic plastics; 20% is consumed in the production of cyclotrimethylene trinitramine (RDX) and about 15% is used in glycine.

To sum up, China's urotropine industry has entered a mature stage. Though a certain amount of urotropine still needs to be imported to satisfy domestic demand each year, urotropine will not impose great influence on glycine industry.

2.4.2 Chloroacetic acid

Chloroacetic acid, a kind of chemical intermediate, is mainly used for the production of carboxymethyl cellulose (CMC), agrochemicals and surfactants overseas. However, in China, the application situation is different, with pesticides being the largest end-use segment, followed by pharmaceuticals, dyeing, CMC, carboxymethyl starch, etc.

There were about 20 chloroacetic acid producers in China with a total capacity of about 1,198,000 t/a as of 2020. Hebei, Hubei, Henan and Shandong provinces are main production areas.

Large glycine producers, such as Hebei Donghua, Hubei Trisun, Linyi Hongtai, Fuhua Tongda, self-developed chloroacetic acid production installations to acquire chloroacetic acid, to reduce production cost of glycine.

Table 2.4.2-1 Main chloroacetic acid producers in China, 2020

No.	Company	Location	Capacity, t/a
1	Hebei Donghua Chemical Group	Hebei	250,000
2	Hubei Trisun Chemical Co., Ltd.	Hubei	160,000
3	Shandong Minji Chemical Co., Ltd.	Shandong	120,000
4	Dongying Huatai Fine Chemical Co., Ltd.	Shandong	100,000
5	Linyi Hongtai Chemical Co., Ltd.	Shandong	80,000
6	Nouryon Chloroacetic Acid Chemical (Taixing) Co., Ltd.	Jiangsu	60,000
7	Sichuan Leshan Fuhua Tongda Agro-chemical Technology Co., Ltd.	Sichuan	55,000
8	China Pingmei Shenma Group Kaifeng Dongda Chemical Co., Ltd.	Henan	51,000
9	Hebei Huadong Chemical Co., Ltd.	Hebei	50,000
10	Shanxi Yushe Chemical Co., Ltd.	Shanxi	50,000
11	CABB Jinwei Specialty Chemicals (Jining) Co., Ltd.	Shandong	45,000
12	Weifang Binhai Petrochemical Co., Ltd.	Shandong	40,000
13	Henan Lianchuang Chemical Co., Ltd.	Henan	30,000
14	Jiyuan Fangshen Chemistry Co., Ltd.	Henan	20,000
15	Dongying Kangrui Argochemical Co., Ltd.	Shandong	20,000
Sub-total			1,131,000
National total			1,198,000
Share of top 15			94.4%

Source: CCM

The top five chloroacetic acid producers (by capacity) accounted for about 59.3% of the domestic market share in 2020, meaning that chloroacetic acid is predominated by these top players. The Herfindahl-Hirschman Index (HHI) is 938, suggesting that the market is not concentrated.

Table 2.4.2-2 Industrial concentration of chloroacetic acid in terms of capacity in China, 2020

No.	Item	Value
1	Top five concentration ratio	59.3%
2	Top ten concentration ratio	81.5%
3	Herfindahl-Hirschman Index (HHI)	938

Source: CCM

Chloroacetic acid in China has faced overcapacity for many years, and it will be stable with a little decrease in the coming few years, under the situation of stricter environmental protection requirement.

2.5 Production technology of glycine

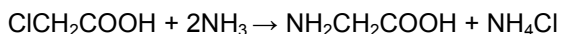
There are three major glycine production methods in the world, namely the chloroacetic acid ammonolysis process, the Strecker process and the Hydantion process.

In China, glycine is mainly produced via the chloroacetic acid ammonolysis process, which is a mature production technology adopted by almost all domestic glycine producers except Guang'an Chengxin.

Guang'an Chengxin is the only company in China adopting the Hydantion process to produce glycine. This production process has advantages such as less reaction steps, higher yield, higher purity, lower production cost and less pollution, compared with the chloroacetic acid ammonolysis process.

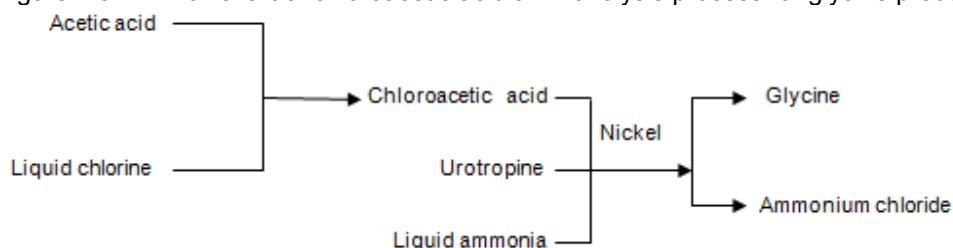
2.5.1 Brief introduction of the chloroacetic acid ammonolysis process

The reaction equation of chloroacetic acid ammonolysis process is as follows:



Main materials for glycine production by chloroacetic acid ammonolysis process include chloroacetic acid, ammonia and urotropine. Chloroacetic acid and ammonia are mixed in urotropine solution. When the reaction is finished, methanol is added to the solution for separation of glycine from the byproduct, ammonium chloride.

Figure 2.5.1-1 Flowchart of chloroacetic acid ammonolysis process for glycine production



Source: CCM

As a major glycine production method in China, chloroacetic acid ammonolysis process has some advantages:

- Simple and mature process
- Low requirements for equipment performance
- Easy availability of raw materials

However, the disadvantages of this method are also obvious:

High production cost

Besides huge consumption of raw materials, there is also quite high energy consumption for removal and disposal of a large quantity of ammonium chloride in wastewater in the chloroacetic acid ammonolysis process. Meanwhile, the catalyst—urotropine, cannot be reclaimed, which largely increases production cost as well.

Poor product quality

Only tech-grade glycine can be produced through chloroacetic acid ammonolysis process. In order to get higher grade glycine, tech-grade glycine needs to be decolorized and recrystallized.

Serious environment pollution

Three tonnes of wastewater can be generated from one tonne glycine production through chloroacetic acid ammonolysis process and wastewater discharged contains large amounts of ammonium chloride, formaldehyde and ammonia nitrogen.

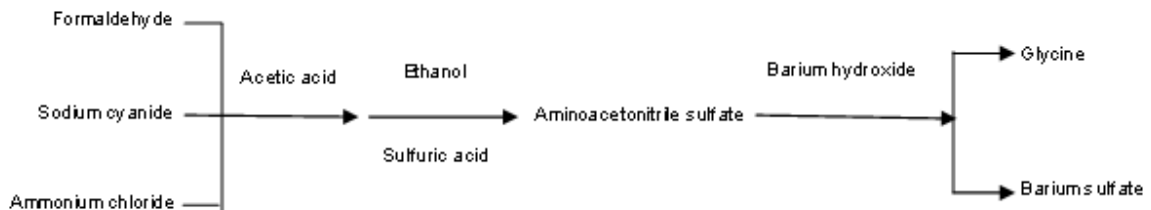
Regional concentration

Companies adopting this process have to set up their factories close to raw material producers. As liquid chlorine and liquid ammonia, the raw materials of chloroacetic acid, are hazardous chemicals and difficult to transport. So most chloroacetic acid and glycine producers in China are located in Hebei Province, which is one of China's major production areas of liquid chlorine and liquid ammonia.

2.5.2 Brief introduction of the Strecker process

Strecker process is a popular glycine production method in foreign countries.

Figure 2.5.2-1 Flowchart of the Strecker process for glycine production



Source: CCM

Strecker process is quite suitable for large-scale glycine production, mainly attributed to advantages such as easy purification of the product, fast production process, high yield, and low production cost.

However, sodium cyanide, the major raw material in the Strecker process, is poisonous and not suitable for long-distance transportation. Therefore, glycine producers have to build their production lines near raw material production bases.

2.5.3 Brief introduction of the Hydration process

Glycine production by the Hydration process uses glycolonitrile, carbon dioxide and ammonia as raw materials. Glycolonitrile can be formed after formaldehyde reacts with hydrogen cyanide with excess amounts of sodium cyanide as the catalyst.

Firstly, glycolonitrile reacts with carbon dioxide and ammonia at about 100°C to form a more stable compound. Subsequently, the main reaction proceeds at about 150°C. After the reactions are steady, the reaction solution is concentrated to remove water, ammonia and carbon dioxide, thereby undergoing crystallization to obtain glycine. The water, ammonia and carbon dioxide removed could be recycled and the mother liquor is also fed to the reaction zone. The glycine yield could be significantly improved by recycling the mother liquor.

Using the mixture of compounds, namely ammonia and carbon dioxide under the reaction conditions, with the presence of ammonium carbonate and ammonium bicarbonate, is possible to achieve favorable results.

The reaction equation of the Hydantion process is as follows:

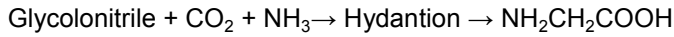
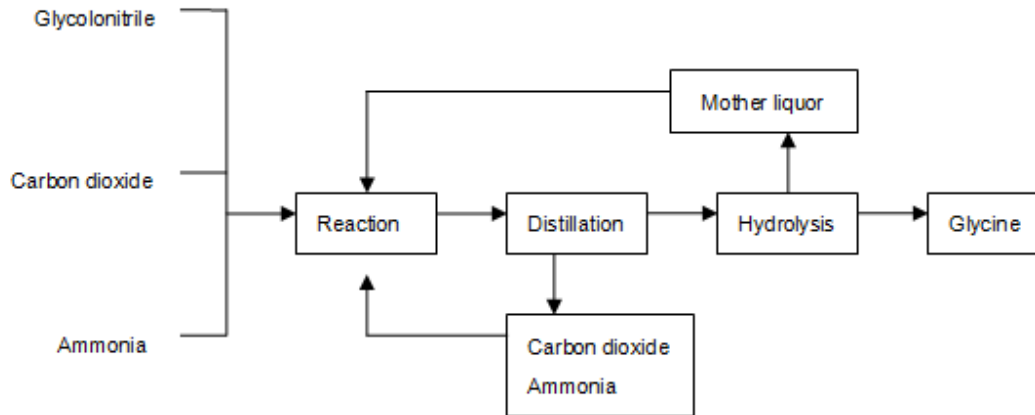


Figure 2.5.3-1 Flowchart of the Hydantion process for glycine production



Source: CCM

The Hydantion process, by which glycine could be produced directly without using sodium hydroxide, is considered to be an economical process without any environmental pollution, since the byproducts, sodium sulfate and the like are not generated.

2.5.4 Development trend of glycine technology

The chloroacetic acid ammonolysis process will still be popular, and the Hydantion process will play as a supplement in the next few years, unless important glycine production technical innovation appears.

As for the chloroacetic acid ammonolysis process, though glycine made by this process has high chloride and formaldehyde content with the purity of only 95%, the process is mature and the key raw materials are abundant and also easily produced (simple technology).

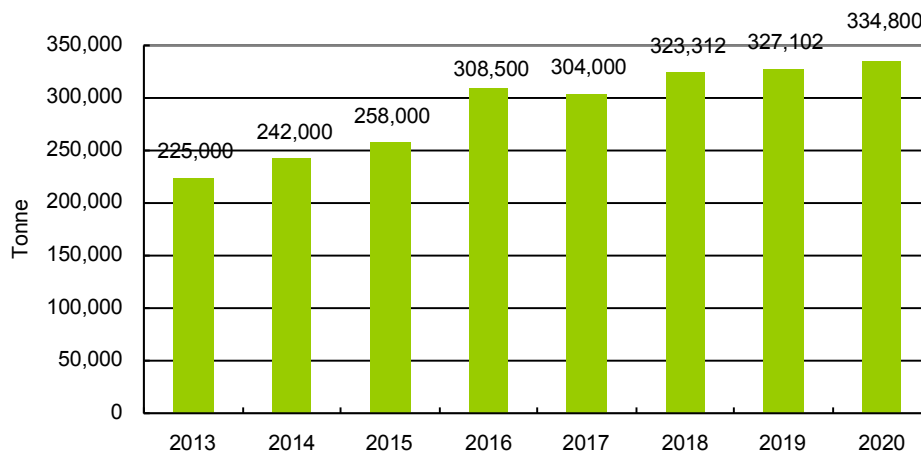
The Hydantion process has advantages of less reaction steps, high purity (98.5%), lower production cost and less pollution, but the domestic technology is not mature, and the industrial chain (from natural gas to hydrocyanic acid, glycolonitrile and glycine) sets higher requirements for the whole production flow.

3 Demand for glycine in China

3.1 Consumption of glycine in China

Major end-use segments of glycine are glyphosate, food, feed and pharmaceutical in China. In 2020, 78.6% of tech-grade glycine was applied in the domestic glyphosate industry, and the rest was consumed to produce food-, feed- and pharmaceutical-grade glycine.

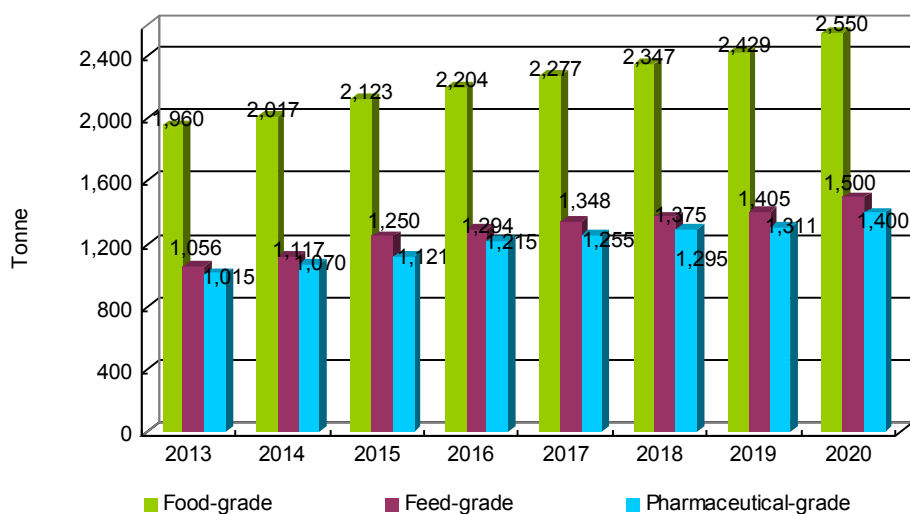
Figure 3.1-1 Consumption of tech-grade glycine in China, 2013–2020



Source: CCM

Consumption of food and feed-grade glycine increased constantly from 2013 to 2020. The consumption of food-grade glycine has increased from 1,960 tonnes in 2013 to 2,550 tonnes in 2020, with a CAGR of 3.8%. Feed-grade glycine consumption increased from 1,056 tonnes in 2013 to 1,500 tonnes in 2020, with a CAGR of 5.1%. Pharmaceutical-grade glycine has always been the smallest end use segment; from 2013 to 2020, its consumption increased from 1,015 tonnes to 1,400 tonnes, with a CAGR of 4.7%.

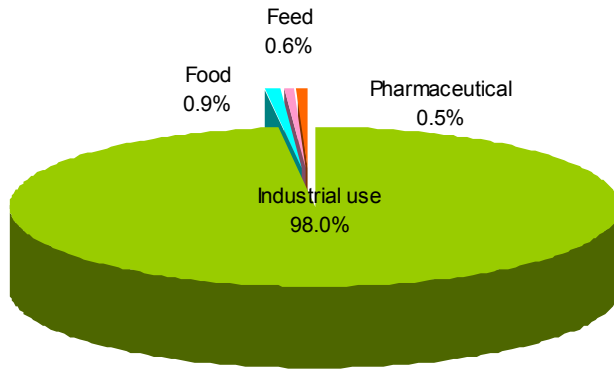
Figure 3.1-2 Consumption of various grades glycine in China, 2013–2020



Source: CCM

On the whole, consumption of glycine in industrial use is at absolutely dominant position in glycine consumption in China. It took up to around 98.0% to the total in 2020, while for food, feed and pharmaceutical uses, their consumption only accounted for about 0.9%, 0.6% and 0.5% respectively.

Figure 3.1-3 Consumption pattern of glycine in China by application field, 2020



Source: CCM

3.2 Major application segments of glycine in China

3.2.1 Glyphosate

Glyphosate is the most important end-use segment of glycine in China, as some 80% of tech-grade glycine is consumed in glyphosate industry in recent years.

China's glyphosate industry has developed rapidly since 2007 with fast increase both in capacity and output. By Dec. 2015, total capacity of glyphosate had tripled to nearly 1 million t/a on 2007 basis. Rapid expansion in capacity led to a huge overcapacity in the industry and increasingly intensified market competition. Living space for small and medium enterprises greatly narrowed. As a result of national supply-side reform and increases in penalties for environmental pollution, capacity of glyphosate has been shrinking.

Glyphosate market started to recover from H2 2016 with increases in output and operating rate for the following reasons:

- In H2 2016, as the news spread that environmental inspections would be carried out in some regions, the price of glyphosate rose rapidly. Producers expanded production in succession owing to substantial increase in profit margin.
- China's ban on paraquat AS had led to an increase in demand for glyphosate.
- The US Environmental Protection Agency said it had ruled out the direct relationship between glyphosate and risk of cancer. The European Commission has adopted the act to renew the approval of glyphosate for 5 years. The news is in favour of the glyphosate market and stimulates China's exports of glyphosate.

In 2016–2018, the number of glyphosate producers in China decreased from about 30 to less than 20, and the national glyphosate capacity also declined correspondingly, due to the nationwide centralised environmental inspections and production safety inspections.

In 2019–2020, the capacity of glyphosate in China kept unchanged, and the output increased a little.

Figure 3.2.1-1 Capacity and output of glyphosate technical in China, 2013–2020



Source: CCM

Table 3.2.1-1 Consumption of glycine in glyphosate in China, 2013–2020, tonne

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Output of glyphosate technical (glycine route)	289,500	336,300	361,800	387,100	451,000	437,900	444,000	442,000	452,000
Consumption of glycine	168,000	195,000	210,000	225,000	262,000	252,000	258,000	257,000	263,000

Source: CCM

Currently, three production routes are adopted in glyphosate industry in China, namely glycine route, IDAN route and DEA route. Output of glyphosate technical produced through glycine route, the dominated one, accounted for 72%–76% of the total glyphosate output in China in 2016–2020.

Table 3.2.1-2 Major glyphosate producers adopting glycine route in China, 2020

No.	Producer	Status, 2020	Capacity 2020, t/a	Output, tonne				
				2016	2017	2018	2019	2020
1	Fuhua Tongda Agro-chemical Technology Co., Ltd.	Active	153,000	120,000	130,000	126,000	129,000	123,000
	Nantong Jiangshan Agrochemical & Chemical Co., Ltd. *	Active	30,000	30,000	30,000	30,000	29,000	30,000
2	Hubei Trisun Chemical Co., Ltd.	Active	130,000	118,000	122,900	110,000	110,000	115,000
	Inner Mongolia Xingfa Technology Co., Ltd.	Active	50,000	34,000	25,000	29,000	35,000	36,000
3	Zhejiang Wynca Chemical Group Co., Ltd.	Active	30,000	30,000	5,000	31,000	31,000	31,000
	Zhenjiang Jiangnan Chemical Co., Ltd.	Active	50,000	50,000	50,000	50,000	50,000	50,000
4	Henan HDF Chemical Co., Ltd.	Active	30,000	15,000	25,000	28,000	18,000	27,000
5	Jiangxi Jinlong Chemical Co., Ltd.	Active	20,000	20,000	20,000	20,000	20,000	20,000
6	Anhui Dongzhi Guangxin Agrochemical Co., Ltd.	Active	20,000	19,000	20,000	20,000	20,000	20,000
Others			35,000	15,000	10,000	0	0	0
Total			548,000	451,000	437,900	444,000	442,000	452,000

Note: Producers with * have at least two routes of glyphosate production, and here only the capacity and output of glycine route is presented.

Source: CCM

The popularity of glycine route for glyphosate production is attributed to the following factors:

Simple process: Compared with the other two routes, glycine route is quite simple and easier for new comers to master.

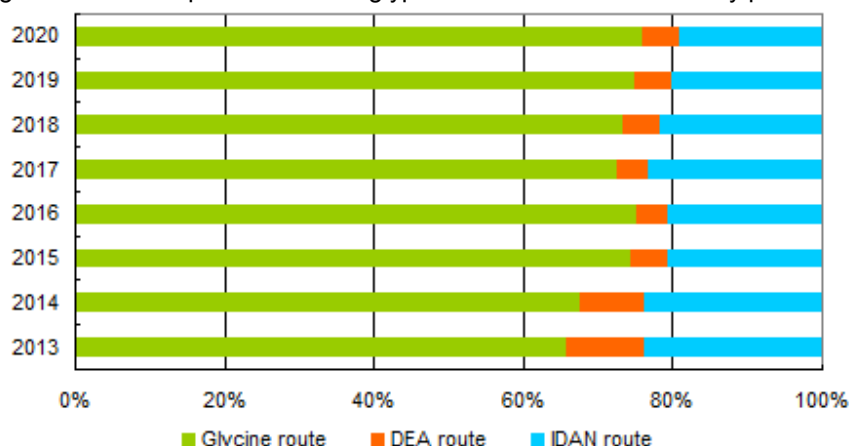
Abundant raw materials: All raw materials including glycine, paraformaldehyde and dimethyl phosphite are in abundant supply in China. Meanwhile, China has plenty of coal (the raw material of glycine and paraformaldehyde) and phosphorous ore (the raw material of dimethyl phosphite).

Mature technology: Since developed in 1987, glycine route has been widely applied in China for years. The whole process is quite mature at present, and the byproduct recycling technology has been developing and helped reduce the cost in recent years.

Establishment of complete industrial chain: These key players try to build complete industrial chain from upstream materials (chloroacetic acid, glycine, phosphorus trichloride, dimethyl phosphite, or paraformaldehyde) to final products (glyphosate formulations) and byproducts (methylal, methyl chloride, phosphorous acid, sodium salts, ammonium salts, or acids) to reduce the cost and strengthen the competitiveness.

Glycine route will still has a good future in China in the next five years, though glycine route faces challenges in the aspect of environmental protection as it causes severer water pollution than other routes. Output of glyphosate produced by glycine route will maintain its leading position and is expected to keep at a high level.

Figure 3.2.1-2 Output structure of glyphosate technical in China by production route, 2013–2020



Source: CCM

Most glyphosate producers have signed contracts with glycine producers to guarantee the supply of glycine in China. Large-scale glyphosate producers such as Zhejiang Wynca and Jiangxi Jinlong, prefer signing contracts with different glycine producers.

Table 3.2.1-3 Main glycine producers and consumers in glyphosate industry in China, 2020

No.	Glycine producer	Glycine consumer
1	Hebei Donghua	Zhejiang Wynca, Nantong Jiangshan, Anhui Guangxin, etc.
2	Hubei Trisun	Hubei Trisun, Jiangxi Jinlong, Inner Mongolia Xingfa, etc.
3	Fuhua Tongda	Fuhua Tongda
4	Linyi Hongtai	Zhejiang Wynca
5	Inner Mongolia Xingfa	Inner Mongolia Xingfa
6	Henan HDF	Henan HDF

Source: CCM

3.2.2 Food

In food industry, glycine is mainly used as a nutritional supplement in food additives to improve flavor. Only 2,550 tonnes of food-grade glycine, taking up 5.1% of the national output of food-grade glycine, was applied in food industry in 2020, 121 tonnes more than that in 2019.

Table 3.2.2-1 Main end-use segments of glycine in China's food industry

No.	End-use segment	Additive rate, %	Usage
1	Minced fish products, peanut butter	1.00–2.00	Restraining function of colon bacillus and bacillus
2	Alcoholic drinks	Wine	0.45
3		Whisky	0.20
4		Champagne	1.00
5	Soup spices	2.00	Flavoring agents, with prawn and cuttlefish flavor
6	Liquor pickled products	1.00	
7	Salted preserves	0.3–0.7	Buffer solutions and acidity regulators
8	Pickles	0.05–0.5	
9	Creams	0.1–0.5	Prolonging storage life for three to four times
10	Cheeses	0.3–0.7	
11	Bakery products	0.5	Stabilizing agents with the function of antioxidation
12	Semolina	0.1–0.5	

Source: CCM

As a synthetic amino acid, if taken in excess, glycine cannot be absorbed by humans, also will break the balance of other amino acids that being absorbed. It will also have an adverse effect upon health. According to *GB 2760*, glycine cannot be used in milk dairy products in China. However, in order to reduce production cost, some milk beverage producers once used glycine instead of milk powder to increase the content of protein. After rectification, this rarely happens now.

3.2.3 Feed

In feed industry, glycine is mainly used as a nutritional supplement in feed additives and feed attractants. About 1,500 tonnes of feed-grade glycine, constituting 17.6% of the national output of feed-grade glycine, was applied in feed industry in 2020, 95 tonnes more than that in 2019.

Glycine used as a feed additive can not only improve nutrition level, but also have the effects of antioxidation and prolonging the shelf life of feed. In China, glycine is mainly used in cattle feed, sheep feed and chicken feed, with an additive rate of 0.07%.

Glycine used as a feed attractant has the following advantages:

Weight gains

It can improve aquatic animal food intake and effectively accelerate the growth of animals. Usually, the glycine additive rate is about 0.2%–1.5%.

Feed saving

As a better feed attractant, before glycine feed falls into the bottom, aquatic animals will soon eat up the feed. Therefore, it makes efficient use of feed to avoid waste.

Raise feed nutrition level

According to the test, one unit glycine nutritional value equals to 3.5 unit methionine nutritional value.

Entrapping agent

People use glycine feed to entrap fish, and the fish capture rate can reach 85%.

3.2.4 Pharmaceutical

Glycine is widely used in pharmaceutical industry, applied in protective agents, stabilizing agents, amino acid nutritional injection solutions and intermediates of some medicaments, etc. About 1,400 tonnes of pharmaceutical-grade glycine, accounting for 65.1% of the national output of pharmaceutical-grade glycine, was applied in pharmaceutical industry in 2020, up 6.8% year on year.

Table 3.2.4-1 Main end-use segments of glycine in China's pharmaceutical industry

No.	End-use segment	Additive rate, %	Usage
1	Freeze-dry preparation	2.0	Protective agents
2	Glycyrrhetic acid	1.9	
3	Rescinnamine injection	2.0	Stabilizing agents
4	Bleomycin Injection	0.1	
5	Glycine irrigation	1.5	Amino acid injection solutions
6	Oral solution	0.09	
7	Propacetamol hydrochloride	49.7	Intermediates of some medicaments
8	Compound preparation of calcium carbonate	30.0	
9	Glutamic acid, alanine acid and glycine acid capsules	11.0	

Source: CCM

4 Forecast on glycine in China, 2021–2025

4.1 Influencing factors

Major factors concentrate on the following aspects. Glyphosate market will still remain as the most important influencing factor for the development of Chinese glycine industry in the future.

Table 4.1-1 Major factors influencing China's glycine industry

No.	Impact of development	Glycine industry
1	Glyphosate market	The market size of glyphosate, especially glyphosate produced via glycine route, will greatly affect glycine, and glyphosate produced via glycine route will face great challenges from that via the IDAN route and the DEA route.
2	Production technology	Only Guang'an Chengxin (formerly Guang'an Chengyang) adopts Hydantion process, which will lead to great challenges to glycine producers adopting the chloroacetic acid ammonolysis process if this technology will be improved and become mature in the future.
3	Location limitation	Policy on transportation of hypertoxic chemicals including chlor-alkal, chloroacetic acid and hydrogen cyanide (upstream materials of glycolonitrile) is very strict in China. Therefore, glycine production by the chloroacetic acid ammonolysis process is limited to be distributed in the places that are abundant in raw materials of chlor-alkali and chloroacetic acid, and glycine production by the Strecker process should be distributed in the places where are abundant in natural gas and hydrocyanic acid.

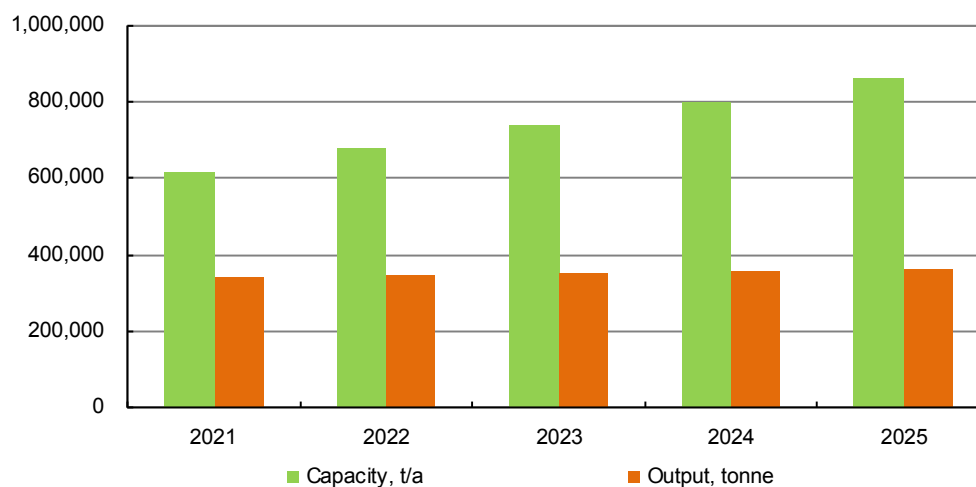
Source: CCM

4.2 Forecast on glycine supply in China

The national capacity of tech-grade glycine is estimated to be over 850,000 t/a in 2025, if all those potential glycine projects are launched in the coming few years.

China's output of tech-grade glycine will reach about 364,000 tonnes in 2025, with a CAGR of 1.6% during 2021–2025. Glycine route glyphosate will maintain its leading position in China in the coming five years, ensuring the increasing demand for tech-grade glycine from glyphosate industry.

Figure 4.2-1 Predicted capacity and output of tech-grade glycine in China, 2021–2025



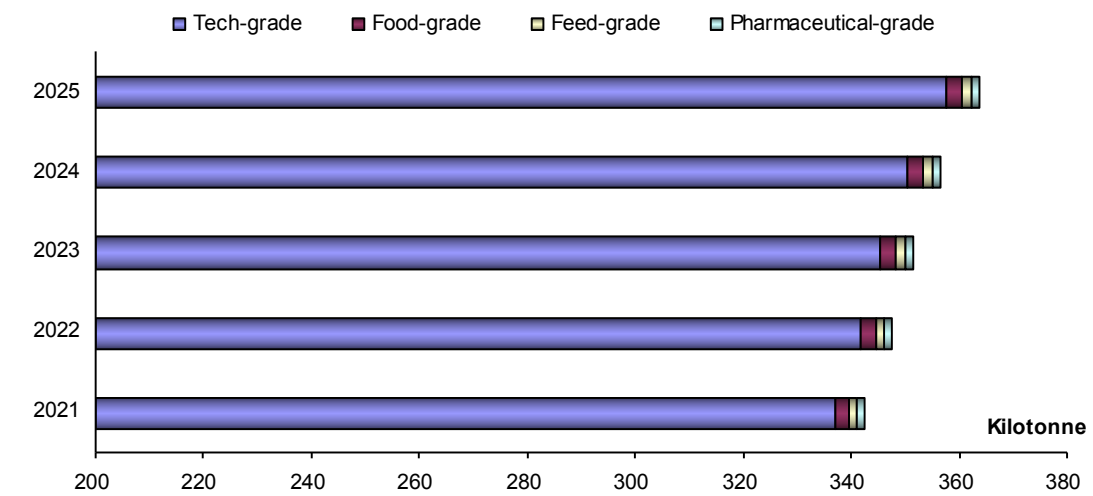
Source: CCM

4.3 Forecast on glycine demand in China

Domestic demand for glycine from food, feed and pharmaceutical fields has kept increasing stably year by year. The increasing glycine demand from these three fields is expected to continue due to good properties and relatively wide application of glycine with these three grades, but it has limited impact on domestic glycine market structure since the tech-grade glycine still takes up over 98% of Chinese glycine market.

With the promotion of GM crops especially GM soybean and corn, demand for glyphosate will keep increasing in the coming few years, which will ensure sustainably robust demand for glycine in the coming five years. China's demand for tech-grade glycine is estimated to reach 357,500 tonnes in 2025, with a CAGR of 1.5% during 2021–2025.

Figure 4.3-1 Predicted market demand for glycine in China by grade, 2021–2025



Source: CCM

5 Investment opportunities and suggestions

Table 5-1 Strengths and weaknesses of Chinese glycine industry

Strength	Weakness
<ul style="list-style-type: none"> - Large scale production (not too many producers, high industrial concentration) - Relatively complete industrial chain - Sufficient supply of raw materials such as chlor-alkali and chloroacetic acid, which is helpful for cost control - Growing demand for glycine from glyphosate industry due to increasing global demand for glyphosate 	<ul style="list-style-type: none"> - Tech-grade glycine highly depended on glyphosate market - Food-, feed- and pharmaceutical-grade glycine highly depended on overseas market - Less-advanced technology—the chloroacetic acid ammonolysis process, taken by almost all producers - Oversupply of glycine

Source: CCM

China's glycine industry will face many challenges in the future, and China shall accelerate integration of the industry.

Major challenges for the industry are as follows:

- Poor profit

It is one of the most important factors influencing the operating rate, and slim profit is unlikely to change in the short run.

- Oversupply

With blind expansion, oversupply has been aggravated in general, and domestic glycine producers have weak bargaining power with glyphosate producers.

- High dependence on glyphosate

No other potential applications have been developed, and domestic glycine industry becomes increasingly passive and susceptible when facing market risks.

- More investments in environmental protection

Glycine producers will spend a lot on pollutant treatment due to stricter environmental policies released by the Chinese government.

Integration of China's glycine industry is an opportunity for both large glycine and glyphosate producers. Some small glycine producers have suspended or stopped glycine production, and more and more small- or medium-sized glycine producers will be eliminated in the coming few years. Thus, it offers a chance for top domestic producers to merge with these small- or medium-sized companies to enhance competitiveness, and for top glyphosate producers to build a complete industrial chain for cost reduction.

From Feb. to June 2021, China's glyphosate and glycine industries have experienced the most prosperous market in the past eight years. Looking forward to 2025, large glyphosate enterprises may merge with glycine producers and continue to integrate and improve the industrial chain.

6 Profile of key glycine producers in China

6.1 Hebei Donghua Chemical Group

Address: No. 89 Erhuan East Road, Shijiazhuang City, Hebei Province 050037, P. R. China

Tel: +86-311-83097676, 66619888, 83097811; +86-318-6109699, 6109877

Fax: +86-311-85318041, +86-318-6109698

E-mail: donghua@glycine.com.cn

Website: www.glycine.com.cn, www.dhjglycine.com, www.donghuajian.com

1. Company background

Hebei Donghua Chemical Group (Hebei Donghua), founded in 1979, is composed of 5 related companies (sales companies excluded), among which 3 are engaged in tech-grade glycine production.

- **Shijiazhuang Donghua Jinlong Chemical Co., Ltd.** produces 90,000 t/a of tech-grade glycine and 10,000 t/a of other three grades.

- **Hebei Donghua Jiheng Chemical Co., Ltd.**, established in 2005, produces tech-grade glycine only with a capacity of 70,000 t/a.

- **Hebei Donghua Jiheng Amino Acid Technology Co., Ltd.** produces the other three grades with a capacity of 15,000 t/a.

- **Shijiazhuang Chiyuen Chemical Co., Ltd. (the former Hebei Donghuajian Chemical Co., Ltd.)** produces 20,000 t/a of tech-grade glycine.

- **Shijiazhuang Chiyuen Food Technology Co., Ltd.**, established in 2015, produces the other three grades with a capacity of 12,000 t/a.

2. Product species

The main products of Hebei Donghua are as follows:

- Glycine: tech-grade, food-grade, feed-grade, pharmaceutical-grade
- Chloroacetic acid
- Zinc glycinate, ferrous glycinate, ferric glycinate, magnesium glycinate, calcium glycinate, sodium glycinate
- Glycine phosphate, glycine fumarate, glycine citrate
- Lysine carbonate
- Hydantoin
- Di-sodium glycine carbonate (Di-SGC)
- Mono-sodium glycine carbonate (Mono-SGC)

3. Situation of glycine

Table 6.1-1 Capacity and output of glycine in Hebei Donghua, 2016–2020

Year	2020		2019		2018		2017		2016	
	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
Capacity, t/a	180,000	37,000	180,000	37,000	190,000	43,000	180,000	30,000	180,000	30,000
Output, tonne	130,000	20,000	130,000	20,000	149,000	20,000	130,000	20,000	130,000	17,000

Note: Others include food-grade, feed-grade and pharmaceutical-grade.

Source: CCM

Shijiazhuang Donghua Jinlong Chemical Co., Ltd.'s 10,000 t/a tech-grade glycine was built up in May 2018 and put into trial production in September 2018. Shijiazhuang Chiyuen Food

Technology Co., Ltd.'s 12,000 t/a glycine (the other three grades) was put into production in H2 2018.

Hebei Donghua produces chloroacetic acid as well, so the raw material supply is guaranteed and the production cost of its glycine could be reduced greatly.

Its glycine is sold all over the country. The company is highly recognized by key glyphosate producers in China such as Zhejiang Wynca, Nantong Jiangshan, etc. for good product quality and abundant supply.

Its trademark of "Donghuajian" was successfully registered in Japan, Europe and South Korea and its products are also exported to Thailand, India, Japan, Switzerland, Germany, etc.

6.2 Hubei Trisun Chemical Co., Ltd.

Address: No. 66-4 Xiaoting Street, Xiaoting District, Yichang City, Hubei Province 443000, P. R. China
Tel: +86-717-6917103

1. Company background

Hubei Trisun Chemical Co., Ltd. (Hubei Trisun) purchased the whole share of Yichang Jinxin Chemical Co., Ltd. in 2018.

Its key products include:

- Glyphosate: 130,000 t/a
- Glycine: 100,000 t/a
- Chloroacetic acid: 160,000 t/a
- Phosphorus trichloride: 210,000 t/a
- Calcium chloride: 80,000 t/a
- Others

2. Situation of glycine

Table 6.2-1 Capacity and output of glycine in Hubei Trisun, 2016–2020

Year	2020	2019	2018	2017	2016
Capacity, t/a	100,000	100,000	100,000	100,000	100,000
Output, tonne	80,000	84,000	73,000	83,000	69,000

Source: CCM

Hubei Trisun produces tech-grade glycine only.

Its glycine is firstly supplied to itself and Inner Mongolia Xingfa, and the rest is sold to other glyphosate producers.

Its key customers include Inner Mongolia Xingfa, Jiangxi Jinlong, etc.

6.3 Sichuan Leshan Fuhua Tongda Agro-chemical Technology Co., Ltd.

Address: Qiaogou town, Wutongqiao District, Leshan City, Sichuan Province 614800, P. R. China
Tel: +86-833-3359989, +86-833-3350538
Fax: +86-833-3359989
Website: www.fuhua-tongda.com

1. Company background

Sichuan Leshan Fuhua Tongda Agro-chemical Technology Co., Ltd. (Fuhua Tongda), established in Leshan City of Sichuan Province in Dec. 2007, specializes in R&D, production and sales of glyphosate and related agrochemicals.

Its products include:

- Glycine: 40,000 t/a
- Glyphosate: 153,000 t/a
- Ion-exchange membrane caustic soda: 200,000 t/a
- Paraformaldehyde: 60,000 t/a
- Phosphorus trichloride: 180,000 t/a

2. Situation of glycine

Table 6.3-1 Capacity and output of glycine in Fuhua Tongda, 2016–2020

Year	2020	2019	2018	2017	2016
Capacity, t/a	40,000	40,000	40,000	40,000	40,000
Output, tonne	25,000	25,000	22,000	20,000	16,000

Source: CCM

Fuhua Tongda started producing tech-grade glycine in 2016, and its glycine is used for its own glyphosate production. It also purchases glycine from other glycine producers such as Hebei Donghua. Its second phase of the 80,000 t/a tech-grade glycine project has not decided yet, and it will be determined by the glycine market situation.

6.4 Linyi Hongtai Chemical Co., Ltd.

Address: Huaihai Road, Economic Development Zone, Ju'nan County, Linyi City, Shandong Province 276600, P. R. China
Tel: +86-539-7858888
Person to contact: Mr. Wang
Email: hongtailxl@163.com

1. Company background

Linyi Hongtai Chemical Co., Ltd. (Linyi Hongtai) was established in 2009 with a registered capital of RMB100 million.

Its products include:

- Glycine: 70,000 t/a
- Hydrochloric acid: 86,000 t/a
- Ammonium chloride: 43,000 t/a
- Calcium chloride: 100,000 t/a

2. Situation of glycine

Table 6.4-1 Capacity and output of glycine in Linyi Hongtai, 2016–2020

Year	2020	2019	2018	2017	2016
Capacity, t/a	70,000	50,000	50,000	50,000	50,000
Output, tonne	35,000	28,000	30,000	30,000	35,000

Source: CCM

Linyi Hongtai produces tech-grade glycine only. The company has expanded its glycine capacity from 50,000 t/a to 70,000 t/a, and it has four glycine production lines with the capacity of 10,000 t/a, 20,000 t/a, 20,000 t/a and 20,000 t/a respectively.

Its customers include Zhejiang Wynca and Nantong Jiangshan.

6.5 Inner Mongolia Xingfa Technology Co., Ltd.

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Tel: +86-473-6988121

Website: www.tlonggroup.com

1. Company background

Inner Mongolia Xingfa Technology Co., Ltd. (Inner Mongolia Xingfa), the former Inner Mongolia Tenglong Fine Chemical Co., Ltd., became a wholly owned subsidiary of Hubei Xingfa Chemicals Group Co., Ltd. in March 2018. Inner Mongolia Xingfa mainly produces glyphosate technical and its intermediates.

Its key products include:

- Glyphosate technical: 50,000 t/a
- Glycine: 10,000 t/a
- Chloroacetic acid: 10,000 t/a
- Dimethyl phosphate: 54,000 t/a
- Phosphorus chloride: 60,000 t/a

2. Situation of glycine

Inner Mongolia Xingfa produces tech-grade glycine only, and its 10,000 t/a glycine production line was put into production in 2015. All of its glycine is consumed by itself for the production of glyphosate technical.

Inner Mongolia Xingfa's EIA report of "organic silicon new material integrated and recycling project" was published in April 2021, and this project includes 50,000 t/a glyphosate technical, 60,000 t/a glycine, 90,000 t/a chloroacetic acid, etc. with a proposed construction period of 24 months.

6.6 Hebei Huaheng Biological Technology Co., Ltd.

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Tel: +86-318-8628255

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E-mail: jizhouhuaheng@163.com

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

1. Company background

Hebei Huaheng Biological Technology Co., Ltd. (Hebei Huaheng), established in Feb. 2011, is a subsidiary of Jizhou Huaheng Group, which is comprised of Hebei Huaheng, Hebei Gerunde Biological Technology Co., Ltd., and Jizhou Huaxiang Commerce Co., Ltd.

Hebei Huaheng focuses on the R&D and production of amino acids. Its products include glycine, L-lysine hydrochloride, DL-methionine, L-threonine, L-glutamine acid, L-cysteine, L-cysteine hydrochloride, L-alanine and DL-alanine.

The company has got the certificates of FSSC22000, ISO22000, ISO9001:2008, Kosher and Halal.

2. Situation of glycine

Table 6.6-1 Capacity and output of glycine in Hebei Huaheng, 2016–2020

Year	2020		2019		2018		2017		2016	
	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
Capacity, t/a	22,000	30,000	22,000	30,000	22,000	30,000	22,000	30,000	0	10,000
Output, tonne	5,000	7,300	5,000	6,200	4,000	6,600	3,000	8,800	0	7,300

Note: Capacity and output of glycine of Hebei Gerunde Biological Technology Co., Ltd. is included.

Source: CCM

Hebei Gerunde Biological Technology Co., Ltd. (Hebei Gerunde), Hebei Huaheng's brother company, began to build 22,000 t/a tech-grade and 20,000 t/a food-grade glycine production facilities in 2014, which were put into operation in 2017. Hebei Gerunde proposed a technological transformation project (adjusting 20,000 t/a food-grade glycine to 10,000 t/a food-grade glycine, 5,000 t/a pharmaceutical-grade glycine, and 5,000 t/a guanidinoacetic acid) in August 2020, and this project was finished in early 2021.

6.7 Guang'an Chengxin Chemical Co., Ltd.

Address: Xinqiao Industrial Park, Guang'an District, Guang'an City, Sichuan Province 638000, P. R. China

Tel: +86-826-2820015, 2820006; +86-311-85695996

E-mail: guanganchengxin@126.com, guanganxiaoshou@163.com

1. Company background

Guang'an Chengxin Chemical Co., Ltd. (Guang'an Chengxin) acquired Guang'an Chengyang Bio-tech Co., Ltd. (Guang'an Chengyang) in March 2019. Two projects (30,000 t/a glycine, 2,000 t/a food additives) of Guang'an Chengyang (its registration has been cancelled), were merged into Guang'an Chengxin.

Key products of Guang'an Chengxin include:

- 20,000 t/a glyphosate technical
- 15,000 t/a PMIDA
- 25,000 t/a IDAN
- 50,000 t/a formaldehyde
- 30,000 t/a glycine
- 112,500 t/a glycolonitrile
- Others

2. Situation of glycine

Table 6.7-1 Capacity and output of glycine in Guang'an Chengxin, 2016–2020

Year	2020		2019		2018		2017		2016	
	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
Capacity, t/a	20,000	8,000	20,000	8,000	20,000	8,000	20,000	8,000	20,000	10,000
Output, tonne	17,000	2,500	17,000	2,500	15,000	2,800	15,000	1,400	15,000	500

Source: CCM

Guang'an Chengxin's 30,000 t/a glycine production lines (20,000 t/a tech-grade and 10,000 t/a food-grade) were built up and put into trial production in Nov. 2015.

Guang'an Chengxin reformed its 10,000 t/a food-grade glycine production line in 2017, and the current lines are 8,000 t/a food-grade glycine, 500 t/a food-grade sodium ferrocyanide, 500 t/a food-grade potassium ferrocyanide, 500 t/a food-grade disodium ethylene diamine tetraacetate, and 500 t/a food-grade ferric sodium edelate.

Guang'an Chengxin is the only glycine producer that adopts Hydantion process in China, and the key raw material—glycolonitrile is produced by itself.

6.8 Henan HDF Chemical Co., Ltd.

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Tel: +86-374-5699599

Fax: +86-374-5699618

Person to contact: Mr. Sheng

E-mail: sales@xcdfchem.com

Website: www.xcdfchem.com

1. Company background

Henan HDF Chemical Co., Ltd. (Henan HDF), former Xuchang Dongfang Chemical Co., Ltd., is a well-known chemical enterprise in China and mainly engages in the R&D, production and sales of fine chemicals and pesticides. It covers an area of 33 hectares and has about 370 employees, including 63 engineering technicians in different fields. The registered capital of the company was RMB86.34 million as of June 2021.

Its products include:

- Glycine: 15,000 t/a
- Chloroacetic acid: 15,000 t/a
- Glyphosate technical: 30,000 t/a
- Dimethyl phosphate: 30,000 t/a

2. Situation of glycine

Table 6.8-1 Capacity and output of glycine in Henan HDF, 2016–2020

Year	2020	2019	2018	2017	2016
Capacity, t/a	15,000	15,000	15,000	15,000	15,000
Output, tonne	10,000	11,000	12,000	10,000	7,000

Source: CCM

Henan HDF produces tech-grade glycine only and its glycine is mainly consumed by itself for the production of glyphosate technical. Henan HDF published a 6,000 t/a chloroacetic acid and 20,000 t/a glycine expansion plan in June 2019, but this project has not been built as of May 2021.

6.9 Hebei Chuncheng Biological Technology Co., Ltd.

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E-mail: admin@hbccbio.com
Website: www.hbccbio.com

1. Company background

Hebei Chuncheng Biological Technology Co., Ltd. (Hebei Chuncheng), was established in March 2015, covering an area of 67,000 square meters. The company's main products include glycine, L-alanine, DL-alanine, L-lysine hydrochloride, L-threonine, L-methionine, L-cysteine hydrochloride, L-phenylalanine, L-glutamic acid, L-cystine, L-cysteine, L-arginine, L-leucine, L-tryptophan, D-xylose, L-aspartic acid and so on. The company got the certificates of ISO9001-2015, ISO22000-2005, Kosher and Halal.

2. Situation of glycine

Table 6.9-1 Capacity and output of glycine in Hebei Chuncheng, 2017–2020

Year	2020		2019		2018		2017	
	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
Capacity, t/a	10,000	3,000	10,000	3,000	10,000	3,000	10,000	3,000
Output, tonne	5,000	1,500	5,000	1,000	5,000	1,000	0	1,000

Source: CCM

Hebei Chuncheng's production lines of 10,000 t/a tech-grade glycine and 3,000 t/a food-grade glycine were built up in early 2017. Its 2nd phase 14,000 t/a tech-grade and 3,000 t/a food-grade glycine has no further information yet.

6.10 Shandong Zhenxing Chemical Industry Co., Ltd.

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1. Company background

Shandong Zhenxing Chemical Industry Co., Ltd. (Shandong Zhenxing), former Shandong Zhenxing Chemical Plant, was established in 1985. It covers an area of 46,000 square meters and the fixed assets of the company were RMB75 million as of May 2021.

The company engages in the production and sales of white carbon black, glycine (10,000 t/a), hydrochloric acid (12,000 t/a), chloroacetic acid (15,000 t/a) and aqueous ammonia (1,800 t/a).

2. Situation of glycine

Table 6.10-1 Capacity and output of glycine in Shandong Zhenxing, 2016–2020

Year	2020	2019	2018	2017	2016
Capacity, t/a	10,000	10,000	10,000	10,000	10,000
Output, tonne	1,000	1,000	1,000	2,000	5,000

Source: CCM

Shandong Zhenxing produces tech-grade glycine only. All of its tech-grade glycine is sold to domestic companies. In May 2021, it suspended production under stricter environmental protection policy.

6.11 Hebei Huayang Biological Technology Co., Ltd.

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E-mail: trade@huayangchems.com

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1. Company background

Hebei Huayang Biological Technology Co., Ltd. (Hebei Huayang), former Jizhou Huayang Chemical Co., Ltd., was established in April 1987 with a registered capital of USD1.45 million (RMB10 million).

Hebei Huayang obtained the import and export license in Sept. 2001, and got the certificates of Kosher and Halal in Aug. 2002 and ISO9001:2000 in Sept. 2002.

Hebei Huayang Group has three production bases with a total area of 120,000 square meters, owning more than 380 staffs as of June 2021. The company mainly produces amino acid series products, including glycine, lysine salt, L-threonine, DL-methionine, D (L) L-cysteine and other food- and pharmaceutical-grade amino acid products.

2. Situation of glycine

Table 6.11-1 Capacity and output of glycine in Hebei Huayang, 2013–2020

Year	2020		2019		2018		2017		2016	
	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others	Tech-grade	Others
Capacity, t/a	6,000	11,000	6,000	11,000	6,000	11,000	6,000	11,000	6,000	11,000
Output, tonne	3,000	11,000	5,000	10,000	5,000	11,000	4,000	11,000	4,500	11,000

Note: Others include food-grade, feed-grade and pharmaceutical-grade.

Source: CCM

Hebei Huayang purchased tech-grade glycine to produce food-grade glycine and pharmaceutical-grade glycine before 2008.

In March 2008, its new 6,000 t/a tech-grade glycine unit was put into production. And all the four grades of glycine are produced.

Cangzhou Huachen Biological Technology Co., Ltd., a subsidiary company of Hebei Huayang and established in Oct. 2017, proposed to construct a glycine project (30,000 t/a tech-grade, 30,000 t/a food-grade) in Dec. 2019. It is estimated that the first phase 30,000 t/a tech-grade will be completed by the end of 2021.

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