II-1 Summary of enzyme industry in china

The output of enzyme in China grew by 10.88% averaged annually in recent five years. For α-amylase, glucoamylase, alkaline protease and others, it grew by AGR 11.57%, 10.27%, 7.63% and 36.98% in recent five years. In 2006, the output forα-amylase, glucoamylase and alkaline protease is [redacted] kMTs, [redacted] kMTs and [redacted] kMTs respectively and the total output is [redacted] kMTs.

In 2006, the percentages of α-amylase, glucoamylase, alkaline protease and others is [redacted]% respectively, but in 1995, it was 15.74%, 63.73%, 20.39% and 0.15%.

The output of enzyme in the past decade has been increasing in China. However, from 1996~1998, the output decreased 10%, mainly because the demand from brewing industry decreased much. In those years, more than 60% of enzymes were used in distilled spirits. During the period of 1996~1998, the output of distilled spirits decreased 25%.

Figure II-2.1-1 Output of enzyme preparations in China, 1995~2006, MTs

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II-2.1.1 Glucoamylase (GA, Amyloglucosidase)

Table II-2.1.1-1 Major producers of glucoamylase, 2007

Name	Products	Total Capacity '07 (MTs/a)	Total Output '06 (MTs)	Location
[redacted]	Enzymes	[redacted]	[redacted]	Tianjin
[redacted]	α-amylase, glucoamylase	[redacted]	[redacted]	Hunan
[redacted]	amylase, glucoamylase, protease, feed enzymes	[redacted]	[redacted]	Heilongjiang
[redacted]	α-amylase, glucoamylase	[redacted]	[redacted]	Jiangsu
[redacted]	α-amylase, glucoamylase	[redacted]	[redacted]	Hebei
[redacted]	α-amylase,	[redacted]	[redacted]	Hubei
[redacted]	α-amylase, glucoamylase 、	[redacted]	[redacted]	Ningxia
[redacted]	α-amylase, glucoamylase, protease	[redacted]	[redacted]	Henan
[redacted]	Protease, glucoamylase	[redacted]	[redacted]	Yunnan
[redacted]	glucoamylase	[redacted]	[redacted]	Henan
[redacted]	α-amylase, glucoamylase, protease, feed enzymes、	[redacted]	[redacted]	Beijing
[redacted]	α-amylase, glucoamylase	[redacted]	[redacted]	Hunan
[redacted]	α-amylase, glucoamylase, protease	[redacted]	[redacted]	Jiangsu

[redacted]	α-amylase, glucoamylase, protease, lipase	[redacted]	[redacted]	Jiangsu
[redacted]	α-amylase, glucoamylase, protease	[redacted]	[redacted]	Jiangsu

In 2006, glucoamylase market is mainly shared by Novozymes ([redacted]% by value and [redacted]% by volume), Wuxi Genencor ([redacted]% by value and [redacted]% by volume), Hunan Jinshi Hongyingxiang([redacted]% by volume) , Zhaodong Sunshine ([redacted]% by volume), Jiangyin Synder ([redacted]% by volume).

II-3 Demand of enzyme preparation in China

In China, 95% of enzyme preparations are mainly consumed in distilled spirits, beer, starch processing, detergent, feed, leather and textiles. Although enzymes are widely used in other diverse fields like as baking, paper & pulp, fruit processing, diary products, pharmaceuticals, etc.

The major application fields including distilled spirits, beer, starch processing, detergents, feed, leather, and textiles, and the prospective application fields like as baking, paper & pulp, fruit processing, pharmaceuticals, are introduced in this part, as of these aspects mainly including: production, development trend, main producers, etc.

Figure II-3.1-1 Consumption pattern of enzyme preparation in China, 2006.

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Table II-3.1-1 Consumption patterns of different enzymes in China, 2006

	Deter-gent	**Starch processing**	**Textile**	**Pulp & paper**	**Leather**	**Distilled spirits**	**Beer**	**Fruit /vegetable processing**	**Baking**	**Feed**	**Pharma-ceutical**	**Others**	Total
α-amylase	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Glucoa-mylase	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
alkaline protease	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Lipases	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Pectinases	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Xylanases	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Glucanases	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Phytase	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%
Cellulases	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	100.0%

II-5.1 Comparison between Chinese and foreign/JV enterprises in China

In the past several decades, the enzyme industry in China has experienced a rapid development. But compared with the situation in the world, it is still backward. The main weaknesses are:

- Lack of scientific research cost. In the recent years, the governmental investment into the enzyme preparation research has shrunk due to the reconstructing of government and enterprises. Some state-owned enterprises were converted to private enterprises, so their financial capacities were weakened very much.
- The weakness of intellectual property. Till 2002, the strains for the main products such as amyloglucosidase, amylase and alkaline protease were mainly produced by separating from the imported strains or based on the imported technologies. There are few technologies with self-owned intellectual property.

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Table II-5.1-3 Competitive trend of Chinese and foreign/JV enterprises in enzyme industry

Features	Chinese	Foreign/JV
Market share by value		
Market share by volume		
Manufacturers numbers		
Capacity, averaged		
Product quality		
Product price		
Application		
Application technology		
Production technology		
R&D investment	Low, mainly outsourcing technologies.	High, 10% of income
Customer features	Generally small customers, relax relationship	Big customers, close relationship
Environmental protection		
Trend		

III Future forecast on enzyme industry of China

Introduction

- China's economic behaviors by GDP growth, by population and by import & export are discussed as the key macro factors. The GDP growth in China is going on the high level by around 10% in recent years. And the import & export is growing fast by AGR over 20% since 2001. The population growth is stable and the growth rate is slowing down in recent years. Besides, the 2008 Beijing Olympic Games is also discussed, which will has a positive impact on the economics.

- The main driven forces including demand growth, polices and the intrinsic characteristics, environmental & economical advantages of enzymes are discussed.

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III-1 Key factors and driven forces for the development of enzyme industry in China

III-1.1 Macro factors

Many macro factors affecting enzyme industry are discussed in this chapter including economic, demographic and social; the Olympic Games; international trade and environmental protection.

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Figure III-1.1-2 GDP growth in China, 1995~2006