2 The world powdered detergent consumption status

According to some investigation data and the estimate, detergent consumption per person-year in the world is 11.9 kg and the gross volume is approximately 78.5 million tons. The powdered detergent is about 35%, so the production of the powdered detergent in the world is about 27.5 million tons and consumption is about 4.2 kg per person-year. It is higher than 3 kg per person-year in China. As a daily products, the world consumption of detergent is same with the change of family consumption per person-year basically, we tentatively estimates the average growth rate of the powdered detergent production in the world is about 2%, lower than it of China. In 2010, the powdered detergent production in China accounted for about 14% of the world and became a major country of powdered detergent production in the world.

1) The concentrated powdered detergent

Some advanced country began the concentration process of the detergent voluntarily from the 20th century. The United States started the concentration of powdered detergent at the beginning of the 1980s and the concentration of liquid detergent from 2003 respectively, at present liquid detergent accounts for about 80% of market shares. Japan began the concentration of powdered detergent from 1983, and now the concentrated powdered detergent accounts for 95% of the powdered detergent gross volume. In Europe, major market share is switching from powdered detergent...
to concentrated powdered detergent, whose share is more than 40%. Concentration of the powdered detergent is one of important techniques for sustainable development in the world detergent industry now. According to some estimation in 2010, the concentrated powdered detergent production in the world accounts for 35% of the powdered detergent, total output is over 9,500,000 tons. With promotion of the concentration process in Europe, especially Eastern Europe and the other country, the share of concentrated powdered detergent is expected to rise.

(2) Non-phosphate powdered detergent

Because the phosphoric salt has a reaction of the “eutrophication” to closed water body, from the 1970s every country had restricted phosphorus on law. The United States had limited phosphate from 1971 and by 1993 among of 50 states, 27 states enact a decree restricting phosphorus, but 23 states have not passed similar decree yet. Canada had limited phosphorus since 1972. Japan and Germany have limited in 1975 to control the eutrophication problem of the water body. However, some countries, such as Belgium, Denmark, Ireland, Portugal didn't limit phosphorus, and Sweden once enact a decree restricting phosphorus in 1992 but canceled it in 1995. Now, by the government management of the water body eutrophication problem in every country and the phosphoric salt price increase, the powdered detergent in the world was almost non-phosphate and the share has reached to 90%. In 2010, the production of the non-phosphorous powdered detergent in the world is about 25.0 million tons, and the recent growth rate is about 2%, the ratio change isn't so big in recent years.

(3) The powdered detergent with enzyme

Now, enzyme is widely used for the industry of the detergent as an additive. The most popular enzymes are alkaline-protease, lipase, amylase, cellulase enzyme, etc. In some advanced countries, such as Western Europe, Japan and the United States, the powdered detergent with enzyme accounts for 80-90% of the powdered detergent market. Even in China, it accounts more than 60% now. According to an incomplete statistics, the powdered detergent with enzyme got nearly 80% market share of the total powdered detergent market, growth rate is little higher of the whole powdered detergent.

(4) The oxygen type powdered detergent

The oxygen type powdered detergent has high detergency and suitable for washing machine, so is popular in some advanced countries and has a high market share. In the European Union area, it accounts for 80% and most of the detergent product contains peroxide in the United States. On the other hand, by the comparatively low penetration rate of washing machine, in the developing countries the market share of the oxygen type powdered detergent is low, in China it is 7%. According to some estimation, now the production of the oxygen type powdered detergent in 2010 in the world is about 5.5 million tons, about 20% of the total powdered detergent production volume, and the average growth rate in the recent 5 years was about 13%, much higher than the one of the whole powdered detergent. As the improvement of living standards and change of washing habit of the developing countries, the oxygen type powdered detergent has a huge space to grow.
3 The functional additive market in China

(1) China functional additive market status

In general, various auxiliary additives are added into the main active-ingredient (surface-active agent) of powdered detergent. Those additives can improve ability of removing obstinate dirt by preventing interference of alkaline metal ions in water with surface-active agent. In this paper, some widely-used functional additives, such as sodium tripolyphosphate, 4A zeolite and enzyme preparation, will be analyzed. Besides these, the production of sodium percarbonate, which is widely used in advanced countries and is expected to have a big potential in China, will be analyzed too.

(a) sodium tripolyphosphate

Sodium tripolyphosphate is applied to the detergent in the second half of the 1940s. By the good chelating ability of calcium/magnesium ion, hygroscopic property, suspensibility, dispersing quality and the property of cooperativity, it leads functional additive market over years and is the most effective functional additive so far. However, the “eutrophication” appeared in congregated population of some advanced countries in the 1970s and every country enact a decree restricting phosphorus, so the use of phosphatic is severely limited. In the second half of the 1980s, China restricted phosphorus also. On the other hand, by the price increase of the sodium tripolyphosphate in recent years, a lot of detergent manufacturer gave up sodium tripolyphosphate and transferred to the production of the non-phosphate powdered detergent.

According to the statistics of China Cleaning Industry Association(CCIA), the production and growth rate of sodium tripolyphosphate deceased year-on-year in 2006-2010, even so the ratio of export volume has accounted for over half of production as shown in Fig.8 and Fig.9. The sodium tripolyphosphate manufacturers concentrated in areas which has abundant phosphorus ore resources, such as Yunnan, Guizhou, Sichuan and Hubei. Development of new products and new application fields of phosphorus salts is an important theme to the survival and development of phosphate industry.

Fig.8 The production and the growth rate of sodium tripolyphosphate of China in 2006-2010

Fig.9 The production and export volume of sodium tripolyphosphate of China in 2006-2010

(b) 4A zeolite

As phosphorus-containing product market declines, 4A zeolite (widely used in the world as a phosphate-free additive) have played an increasingly important role in the additives market.
4A zeolite has a strong exchanging effect with calcium ion in water, it also has a co-sedimentation of the insoluble contaminants and improve the cleaning detergency. But 4A zeolite itself the calcium ion-exchange rate of is slow, magnesium ion-exchange capacity is weak, no balancing capacity, poor water solubility, PH buffering ability is not well, so it is necessary to be used with dispersant and other additives.

At present, the major manufacturers in China are: Shandong branch of Aluminum Corporation of China Ltd. (CHALCO), Huiying Chemical Industry (Quanzhou) Co., Ltd., Fujian Risheng Chemical Co., Ltd., Guangzhou Hengbang Fine Chemicals Ltd. etc. According to the statistics of China Cleaning Industry Association (CCIA), the production of 4A zeolite in 2010 was 419.5 thousand tons. As shown in Fig.10, in recent years, the production of 4A zeolite has an overall increasing trend, and due to the production stoppage of some companies, the production in 2010 was slightly decreased.

![Fig.10 The production and the growth rate of 4A zeolite of China in 2006-2010](image)

3. Enzyme

Enzyme preparation is as a bio-additives, it increase washing ability and decrease surfactant volume. Usually Enzyme preparation is 0.1%-0.5% on detergent. Most common enzymes are lipase, protease, amylase, cellulase.

The Chinese consumption of detergent enzyme is about 6000 tons per year, suppliers are mainly two Danish companies: Novozymes and Danisco, these have a factories in China, which cover 60% of chinese demand.

According to CCIA statistics 2006-2010, export volume of Chinese alkaline lipase had increased every year and, it reached 136.26 tons in 2008, but fell to 56.21 tons in 2009 in the financial crisis but it recovered in 2010. On the other hand, except 2006 and 2008, there are more import volume than export volume. In 2010, the import volume of the alkaline lipase reached 280.49 tons and almost doubled figure compared with previous year. (Table 1). In recent years, there is more import volume of the alkaline lipase than the export volume for a long time and in 2010, the export volume in 2010 was 99.07 tons but the import volume was 215.88 tons.

Nevertheless, import volume of alkaline lipase continues to decrease every year during 2006-2010 and it shows the production in China continues to increase in recent years (Table 2).

4. sodium percarbonate/the tetraacetyl ethylene diamine (TAED)
(1) sodium percarbonate

As for sodium percarbonate, it is a chemical compound mixed hydrogen peroxide and sodium carbonate. After decomposition, the residue substance are water, oxygen and sodium carbonate, and less bad influence to the environment.

The sodium percarbonate which represents an oxygen bleach replaces gradually a sodium perborate by the excellent bleaching effect and the bacteria-elimination performance and it applies to the various industrial area such as the washing, the dyeing, the textile, and the paper processing. Now, as for the sodium percarbonate, the application is wide in other country and the growth is fast.

It started the research and the production of the sodium percarbonate until the beginning of the 80s in China but China had already formed a constant scale of production. By the statistics of the Tianjin Inorganic Salt Industry Association, sodium percarbonate total production capacity in China had exceeded 310,000 tons (Table 3). By some market research, the production of the sodium percarbonate during recent years is increasing every year at the speed which exceeds 10%.

Figure 11 show the production and the growth rate of the Chinese powder detergent in 2006-2010. Sodium carbonate production is not only increasing every year but also the growth rate is increasing recently. In 2010, the growth rate exceeded 20% and marked 24.96%. Production volume became 153.1 thousand tons.

Because the market of the sodium percarbonate still is the early grown-up stages in China, so the rate of the oxygen system powder detergent is still low and at present, the product is mainly for export. According to the statistics of Chinese customhouse, the export volume of sodium percarbonate marked 107 thousand tons (Table 4).

But by the gentrification of the China domestic washing products the sodium percarbonate demand in oxygen system powder detergent rate will be increased gradually.

<table>
<thead>
<tr>
<th>企业名称</th>
<th>产能（万吨/年）</th>
</tr>
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<tbody>
<tr>
<td>浙江时代金科过氧化物有限公司</td>
<td>8</td>
</tr>
<tr>
<td>浙江奥赛亚化工有限公司（原绍兴化工）</td>
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</tr>
<tr>
<td>湖北宜化股份有限公司</td>
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</tr>
<tr>
<td>广东中成化工股份有限公司</td>
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<td>无锡市华宇化工有限公司</td>
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<tr>
<td>青岛碱业股份有限公司</td>
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</tr>
<tr>
<td>总计</td>
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</tr>
</tbody>
</table>

Table 3 Production capacity of sodium percarbonate manufacturer

![Figure 11](image)

Figure 11 The production and the growth rate of sodium percarbonate in 2006-2010.

<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>出口量（吨）</td>
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<td>75334.48</td>
<td>86999.13</td>
<td>95792.36</td>
<td>107095.08</td>
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<tr>
<td>同比增长（%）</td>
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<td>4.60%</td>
<td>15.45%</td>
<td>10.11%</td>
<td>11.80%</td>
</tr>
</tbody>
</table>

Table 4 the export volume of sodium percarbonate in 2006-2010.

When seeing the production manufacturer, there are 5 companies who export more than 3000 tons in 2010. Among of them 3 companies exceed 5000 tons and one exceed 10,000 tons (Figure 12).
(2) The tetraacetyl ethylene diamine

Tetraacetyl ethylene diamine (TAED) is a kind of oxygen system bleaching activator synthesized with ethylene diamine and the acetic anhydride, and can quickly biodegradation and there is little bad influence to the environment. TAED is mainly as the oxygen system bleaching activator used with the sodium percarbonate and show a bleaching effect at comparatively low temperature.

Now, the production of bleaching activator TAED in China is about 7500-8000 tons. Production on a large scale of TAED in China is only Zhejiang Modern Peroxide Products Company, all other corporations are still in test or factory construction stage.

The production in 2009 had reached peak in recent years (Ref. chart 13). Because there is very little amount of TAED consumption in China domestically, so most of products are exported.