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## REVIEWS

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# Chinese Chemical Industry in Future

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**Abstract**—The state and perspectives of Chinese chemical industry are analyzed.

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Being the universally recognized leader in the production of various commodity, demonstrating to the entire world the unprecedented rapid development of automobile industry, the production of computers and of cell phones, the high level of the organization of manned space flights and measures of the global international significance (such as the recent Olympiad and coming soon Asian games), China recently began to pay ever closer attention to chemical industry – the branch, without which nothing of named above would realized. Actually, the state, scales and development of chemical industry, the most important branch of heavy industry, defines situation in many other spheres of our life.

The volume of the production of chemical industry in the entire world comprises more than 2 trillion dollar. From them 352.825 billion fraction belongs to C.P.R. (Chinese Peoples' Republic). Specifically, in this country occurs the highest increase in the indices of this branch, which is specialized essentially in the manufacturing of synthetic intermediates and products. The attractiveness of the Chinese economy for the foreign investors, the developed by government economic reforms, the enormous potential in the form of many working in this the field factories, raising the level of the education of the employed in the work specialists—all these factors act in favor of the progress of chemical industry of China stimulating actively its further development.

The assortment of chemical industry includes many diverse products. Ammonia, sodium hydroxide, sulfuric acid, phenol, ethylene, carbamide, herbicides,

polyester, nitroglycerol, vaniline, camphor, explosives, medicines – all are brightest representatives of chemical world, whose list can be continued ad infinitum. From them it is possible to isolate several products that have especially important significance for the Chinese chemical branch.

### *Sodium Hydroxide (Caustic Soda) Aqueous Solution*

Since 2007 the domestic demand for the solution of sodium hydroxide is characterized by specialists as “optimum”. In the international arena is observed a smooth increase in the Chinese export. In comparison with 2006, in 2007 the volumes of the export of caustic soda solution grew more than by 118 thousand ton, reaching the level of 1 026 905 ton, which in the cost expression is 189 992 089 US dollar.

According to the data on September 2008, the price of the exported caustic soda solution with the concentration 48% produced by the method of diaphragm ion exchange, was 280–285 US dollar for one ton (price FOB), the solution of 30% concentration reached in 2008 430 US dollar (the index increased by 7.5%).

Among the reasons for the sharp increase in the prices during several months only it is possible to isolate the following factors: the growth not only of internal consumption, but also world demand for the caustic soda, increase in the prime cost of raw material, increase in the expenditures for electric power. Moreover, considerably grew prices in north and east of China, in the South Guangdong province the price remains stable.

*Sodium Hydroxide (Caustic Soda) Solid*

Sodium hydroxide is widely used in the light industry (in particular, textile), metallurgy, pharmaceutical, chemical and petroleum branches. The yearly volume of the production of solid caustic soda in China grows approximately by 23–24%. In the previous year it reached 22 mln ton.

Export was in 2007 447 410 ton, which almost by 25 and one-half thousand ton is more than in 2006. In the cost expression the difference comprised more than 34 million US dollar. From January to October 2008 China exported 368 250 ton of solid caustic soda for the sum total of 147 569 237 US dollar. It is necessary to note that in comparison with the analogous period of last year, is observed an increase in the indices.

According to the statistics of Main Customs Administration of C.P.R., average price of the solid caustic soda at the beginning December 2008 was 400 US dollar per ton, being as before featured by its cheapness. For the comparison, world average price at the same moment was 579 US dollar per ton.

It is worthwhile to note that in recent years to the production of both forms of the caustic soda actively contributed the expansion of the sphere of application and the volume of the consumption of aluminum oxide in China, for which production this chemical product is used. According to the forecasts, in the next 2–3 years the volume of the production of aluminum oxide in C.P.R. can reach 30 mln ton, a half of the total volume of world production. As a result, this tendency will lead to an increase in the demand for consumption of the caustic soda. Today demand for this product is about 58 700 000 ton.

This amount includes consumption in Asia 45%, in North America 23%. China together with Japan and North Korea is the most important exporter of this product. In the last year C.P.R. reached absolute first place, after passing even the universally recognized leader Japan. Judging from current situation, in this year China has all chances to again obtain supremacy. The moments described above make it possible to speak about the favorable further development of the production of the caustic soda on the Chinese market. Even despite the fact that domestic demand for this product will remain low, export compensates balance on the market for raw material. Moreover, specialists promise that the price of the caustic soda in 2009 will remain relatively stable.

*Liquid Chlorine*

Relatively stable situation on the domestic market for liquid chlorine in China changed in first half of 2007. Closing many enterprises due to the uncomfortable results of monitoring environment involved a decrease of the volumes of production and an increase in the deliveries, which made price of this product very unstable. The large part of chlorine is consumed on the domestic market. And although producers prepare orders for the products of future export, the enterprises consuming chlorine are not ready to react flexibly to the sharp fluctuations in the price. In particular, the recent months of 2008 were marked by the sequential fluctuations in prices caused by financial crisis. As a result, the volume of the export of liquid chlorine in last 3 years invariably reduced, the decrease was 9.8%.

In November 2008 situation with the prices of the liquid chlorine was characterized by the nonuniform distribution of indices over different regions of the country and was from 1400 to 2800 yuan for 1 ton. Within the period of January to October 2008, China exported on the whole 1 750 ton of the liquid chlorine for the total sum of 670 121 US dollar. Import within the same period was 58.712 ton (1 957 056 US dollar).

The following picture was formed to the present day: enterprises proved to be overfilled by the reserves of the produced liquid chlorine. Since the transport of this product is complex, this causes closing some producing enterprises. The decrease in demand for this product led naturally to fall in the price. Before the crisis, essential correctives into the development of situation introduced the Olympiad, in connection with which the government introduced prohibition in sale of the chlorine-containing goods in many cities.

Furthermore, the production capacity of the enterprises consuming chlorine is also decreased because of the supervision of the environment. Transport by highways was forbidden as dangerous.

All these factors lead to further strengthening of a difference in the prices in the region and systematic decrease in the production of liquid chlorine at today's moment.

*Hydrochloric Acid*

The largest producers of hydrochloric acid at present are USA, Germany, France and Japan. On the average,

the volume of the production of each of these countries comprises more than 5 000 000 ton. In China at present act about 200 producers. From them 13 are capable of producing 100 000 ton of hydrochloric acid. In the past year the volume of the production of hydrochloric acid was 7476 thousand ton, which is higher by 4.33% over the index of 2006 (volume of production in 2006 was 7166 thousand ton). From January to June 2008 the volume of production was 3 524 400 ton. It is expected that the volume of the production at the end 2008 will be 7 815 080 ton. In 2007, China exported 7082 ton of hydrochloric acid, the volume of export was 739 295 US dollar. From January to October 2008 China exported 5 524 490 kg for the total sum 674 982 US dollar. The volume ratio of the export of hydrochloric acid in the total volume of the export of chemical products is only 0.09%. Import was 18 375 693 kg for the total sum 4 373 416 US dollar.

It should be noted that prices of this chemical raw materials on the north of the country are higher than in the south. This is explained by the fact that the north is rich in the natural resources, necessary for producing this substance. In 2007 the price of sale of hydrochloric acid, in the essence, did not change, but the overall level of prices became insignificantly above in comparison with the previous year. The coming of 2008 was marked by further increase in the prices of the hydrochloric acid. In June 2008 (this period is characterized by the increase in the prices in connection with the Olympic Games and by the fact that the small enterprises could not obtain license for the manufacturing this product) the national average price was 535 yuan/ton. In November 2008 the average price of the hydrochloric acid was about 500 yuan/ton.

In connection with the trend of rapid development of the branch of manufacturing hydrochloric acid in China, the greatest demand for this product is observed in the chemical industry (80% of whole product is used in this branch), in the second place on the consumption are machine-building and pharmaceutical branches of industry (7% and 6%, respectively) of the overall demand. In the recent several years, because of the rapid development of chemical industry, the demand for the hydrochloric acid in the chemical industry is increased stably by 5% a year.

Furthermore, the rapid development in C.P.R. of the branches which require application of hydrochloric acid for producing pulp and paper, and nonferrous metals,

appears the serious base, which makes it possible to assert that next several years it will be possible to observe an increase in the demand on the average yearly.

### *Sodium Hypochlorite*

In comparison with the total volume of the production of the chemical raw materials, the volume of the production of sodium hypochlorite is very unessential. In China there are today only about 130 small plants which generate this substance. This is connected with the fact that sodium hypochlorite is chemical raw materials with the low gross value addition and profitableness. In 2007 the volume of the production of this substance in China was 168 thousand ton. Toward the end 2008 the indices must increase approximately to 220 000 ton. In the period from January to October 2008 China exported 26 364 ton of sodium hypochlorite for 9 689 009 US dollar.

The such low indices of the volumes of production and export are explained in part by the fact that the exporters do not want to export sodium hypochlorite, since this substance is very dangerous. At the same time, the volume of this product cannot at the moment satisfy even domestic market. To year 2010, according to the forecasts of specialists, the volume of the consumption of sodium hypochlorite will reach 300 000 ton. The import of China within the period January to October 2008 was 1 515 ton. Average price in 10 months of the present year was 580 yuan/ton, which approximately by 100 yuan (17%) is lower than the average world price.

However, it is worthwhile to note that in this year the demand for sodium hypochlorite sharply increased. After atypical pneumonia of cattle and bird the industry again increases production of this chemical substance. According to the forecasts of experts, because of the state policy of the restraining of prices, the price of sale will remain relative stable in the near future.

### *Phosphorus Trichloride*

With respect to the production of this chemical it should be noted the obsolete equipment at the plants, poor working condition and the low level of safety. Not all plants of China have a permission for the export of phosphorus trichloride, since this chemical raw materials can be used for the production of dangerous chemical weaponry. Chinese government strictly limits export of phosphorus trichloride in accordance with the conven-

tion about the prohibition of development, production, accumulation and application of chemical weaponry, and by the position of the People's Republic of China about the controlled and uncontrollable chemical substances.

In China only two companies have a permission for the export of phosphorus trichloride: China Haohua Chemical (Group) Corporation and Sinochem Corporation. Moreover, these companies are under the control of central government. If foreign enterprises are intended to import of phosphorus trichloride from China, they must grant a guarantee letter that the chemical weaponry will not be produced and transported into other countries.

The volume of the production of phosphorus trichloride was in 2007 620 000 ton, export rose to 5 759 ton, its volume was 4 501 618 US dollar. From January to October 2008 export was 9 161.5 t, after increasing in comparison with the analogous period of last year almost twice. In 2007, the national price of sales remained stable. Average price was 8 000 yuan/t. In 2008 the price a little rose and was 9 000 – 10 000 yuan/ton. Specialists consider that the price will remain approximately at the same level even for a long time.

#### *Phosphorus Pentasulfide*

In last three years the government of China stopped the production of phosphorus pentasulfide because of its toxicity, the volume of the production of this substance was reduced. It should be in mind that this substance also can be used for producing chemical weaponry. The right to the export–import have at present only 2 companies, which monopolized prices of this chemical product. At present, in China are located 20 factories producing phosphorus pentasulfide, but only a few of them produce this substance for preparing the pesticides.

In the past year the volume of production was only 5 000 ton, export 958.6 ton for the sum 1 076 010 US dollar, import 3 511 kg for the sum of 18 197 US dollar. In the current year (2008) the indices changed. In the period from January to October 2008 the Chinese export of phosphorus pentasulfide was 265.2 ton in a volume of 626 589 US dollar. Diminishing in the volumes of export was a direct consequence of demand for this product in the course of the recent months. In this year the average price remains constant in comparison with last year, being approximately 2700–2800 US dollar per ton, moreover the level of price, in connection with the low

demand, will remain approximately on the same level.

#### *Inhibitors of the Deposition of Mineral Salts*

Examining this subbranch of chemical industry, it is necessary to note that the technologies of the water purification were not improved to the moment of introducing the petrochemical equipment in 1970. After 20 years of efforts, China independently developed chemical products for the water purification, and also develops technologies of the application of these chemicals for the cold, boiled, conditioned and natural water, and also in the distillation of sea water. At present in China are located about 200 factories, which are specialized in the sphere of chemistry of the water purification. The volume of production comprises more than 2.2 mln ton per year. More than 140 forms of chemicals are produced, the yearly volume of output of production is more than 2.7 billion yuan (about 397 thousand US dollar). Average price of the inhibitors of the mineral salts deposition to the beginning December 2008 is about 9 000 yuan/t.

According to the forecasts, in 2010 the national demand for the chemicals for water purification will comprise more than 4 mln ton. The future development of this branch will be concentrated during the development of highly effective flocculants, new forms of phosphorus free dispersers, anticorrosive substances, biocides, polyaspartic acid with the biodegradability and other agents for the purification of natural water. The branch of the agents for the water purification will be developed, being oriented toward environmental protection and economy of electric power.

#### *Plant Protection Means*

In this region are observed such positive changes as an increase of sales of high-quality pesticides in the convenient packing and for the acceptable price, the development of new compositions in connection with the use of the means against insects and strengthening of resistance against diseases of transgenic cultures, and also increase in the quantity of product with high efficiency, low level of toxicity and with a small quantity of withdrawals. Today in the different regions of China there is an enormous quantity of enterprises for the production of the means of plant protection.

In first half of 2008 the volume of produced pesticides was 1.011 mln ton (the index increased by 20.8%).



The volume of sales was 65.35 billion yuan (44.7%). Profit from sales was 62.51 billion yuan (46.8%). From January to May 2008 the index of increase in the profit of pesticides sales was 121.5% compared with the same period of last year. From January to October 2008 China imported 16 224 982 kg of the means of plant protection, the volume of import was 130 131 824 US dollar; exported 106 296 036 kg of the means of plant protection, the volume of export was 444 494 408 US dollar.

The end of 2008 is already noted by the beginning of an increase in the prices of this production. The basic reasons for this phenomenon are the sufficiently high demand of products for the export, an increase in the domestic consumption of product, an increase in the prices of the raw material, the growth of the capital investment of companies for environmental protection. Furthermore, after introduction in this year of new administrative policy toward the commercial names of pesticides increased marketing expenditures for new packing and advertisement.

Analyzing a change in the users demand on the national market for pesticides in the last 5 years, and also taking into account the condition of world financial crisis, experts do not forecast strong increase or reduction in the overall demand on the national market for the next three years. However, the portion of demand for the means against insects, the herbicides and the fungicides can considerably change. The professor of the Shanghai institute of pesticides, Chang Ibin points that according

to the data of statistics, the total volume of the utilized pesticides insignificantly changed as compared with the preceding year. Also he notes that the rate of increase in the export is reduced, and total product output a little will increase. Market will continue for certain time to be characterized by the excess supply of production.

Summing up all of the above said, it is desirable to note again that the chemical branch of China today approaches real "boom" of its development. Many products of this industry swiftly collect weight, passing their competitors and assigning new lath to the entire world. To the same contribute different world value discoveries of Chinese scientists. The systematic development of the chemical branch of C.P.R. rightfully corresponds to the name of the most rapidly developing country. At the same time, in this sphere the internal problems connected with the transport and the power supply remain unsolved, and strong direct dependence on the world prices of the oil also is significant. As already mentioned, the world financial crisis not left China aside and led to lowering the demand for a number of chemical products. Nevertheless, experts consider that the chemical branch of industry in China will not be strongly subjected to world cataclysms, after accumulating in the time of its existence the high potential for further development. According to the forecasts of specialists, the chemical industry of C.P.R. has all chances in the near future leave in the second place in the world, being inferior supremacy only to the acknowledged leader USA.