

# Glass industry and glass research in China – Brief overview

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China's glass industry is a large-scale branch of industry involving many products; the main ones of which are given as follows:

- flat glass and flat glass products, such as automotive glass, mirror glass and decorative glass;
- domestic glass including container glass, tableware glass, vacuum flasks, glass lamp shades, etc.;
- electronic vacuum glass, such as TV tube glass;
- optical glass, such as microscope, camera and telescope lenses;
- glass fibres and glass fibre-reinforced composite materials;
- arts and crafts glass products.

Before 1949, little progress was to be noted in China's production of glass; only a small amount of some varieties of domestic glass could be turned out. A large-scale glass industry has developed only after the founding of New China over the past 40 years and more. During the first 30 years of this period, many kinds of larger glass factories altogether producing a quite complete range of glass products were set up all over the country. The output of glass increased year by year, and the need of the domestic market could basically be met. A rapid development of the Chinese glass industry, however, has taken place only since the beginning of China's economic and political reconstruction for about the last ten years.

In 1980, the output of flat glass was only 1.2 million t, which did not include any float glass. In the same year an experimental float glass production line was established. By the end of 1994, the yearly output of flat glass hit 5.8 million t; 35 float glass production lines were established and the float glass output accounted for 40% of the total flat glass production (table 1). About ten years ago, China had no more than a few plants which were manufacturing small quantities of mirror glass and processed glass such as toughened glass and laminated glass used for the maintenance of automobiles. Since then, more than one dozen production lines for processed glass producing a large quantity of automotive glass, mirror glass, double-glazing units, coated glass, etc. have been set up. Today, the glass products needed by China's car and construction industries and the decoration of high-grade buildings can be supplied by its domestic market.

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Table 1. China's glass production in 1980 and 1994

glass product	output in the year	
	1980	1994
drawn glass	1.20 · 10 <sup>6</sup> t	3.48 · 10 <sup>6</sup> t
float glass	–	2.32 · 10 <sup>6</sup> t <sup>1)</sup>
container glass	1.64 · 10 <sup>6</sup> t	7.00 · 10 <sup>6</sup> t
vacuum flask	130 · 10 <sup>6</sup> pieces	240 · 10 <sup>6</sup> pieces
TV tube	–	31 · 10 <sup>6</sup> sets
coloured TV tube	–	15 · 10 <sup>6</sup> sets

<sup>1)</sup> This float glass output was produced by 35 float glass lines.

In 1980, the output of China's container and tableware glass amounted to 1.64 million t and 130 million vacuum flasks were produced, while in 1994 the output of these products reached 7 million t and 240 million pieces, respectively. In 1980, the TV glass tube production was just at the stage of starting, and only a small quantity of black and white TV tubes was turned out. In 1994, 31 million TV glass tubes were produced, of which 15 million were colour TV tubes and 6 million black and white TV tubes (table 1). All these products were produced by the large newly-built production lines in Shenzhen (Guangdong Province), Shanghai, Shijiazhuo (Hebei Province), Anyang (Henan Province), Xianyang (Shanxi Province) and Chengdu (Sichuan Province). Moreover, also for other glass products great developments were achieved during the same period.

The reason why China's glass industry developed so fast is that, on the one hand, the general conditions of the overall economic growth increased the demand of the domestic market, and on the other hand, during the past 30 years, a sound foundation for development was laid. The introduction of advanced technology from abroad was of great help to speed up this process. China has a huge home market. The various kinds of glass products are made mainly for domestic consumption and only a small part of them are exported. Due to the further development of China's national economy and the rise in the standard of living of the population the domestic market will be enlarged accordingly. At present, the annual consumption of flat glass per capita is still rather low in China, i.e., less than 0.5 m<sup>2</sup>, while it is over 3 m<sup>2</sup> in the developed countries. The annual consumption of container glass per capita is only 5.5 kg in China, while it reaches 30 to 40 kg and in some cases even over 50 kg in developed countries.

Considered in absolute figures, China's glass industry is quite large even now. China has no less than 2000 glass factories of different sizes. However, only the furnaces for the production of flat glass, TV tubes, and a small quantity of container glass can be considered large ones. The technologies of the factories having large furnaces, with equipment either made in China or imported from abroad, are quite advanced, and the quality of their products is quite good. For instance, the melting capacity of float glass furnaces generally ranges from 400 to 500 t/d; the thermal consumption is about 6300 kJ/kg molten glass. The melting capacity of the furnaces for the production of large glass containers and TV glass tubes is 100 t/d and the thermal consumption is also quite low. The corresponding plants have a high standard of mechanization and automation using electronic computers to control production. Productivity and product quality of several production lines for processed glass built with imported technology and equipment also show a high standard. But technology and equipment of some small plants are unsatisfactory, resulting in high energy consumption and low product quality and, moreover, in serious environmental pollution. Consequently, great efforts should be made to improve this situation.

In China's glass industry partly heavy oil, partly coal tar gas or generator gas are used as fuels; only in a few factories natural gas or electric energy is used. The raw materials including mineral rocks, soda ash, saltcake etc. are domestic products. Various kinds of equipment including machines and instruments used for melting, forming, annealing and cold processing are for the most part made and developed at home, and only a small part is imported. China has already established refractory works to produce sintered and fusion-cast refractories used in a variety of furnaces. The quality of refractory has been raised continually. In recent years, some Chinese companies, using their own technology and machinery made in China, established several flat glass and container glass works in other Asian countries. Efforts were made to adapt these plants to the social and economic conditions of those countries, which is appreciated by the customers.

In the near future, China's glass industry intends to readjust industrial and product structures, raise the quality of production technology, transform the backward enterprises, adopt advanced management, upgrade product quality, and solve the troubles of high energy consumption and environmental pollution, rather than to enlarge production range or quantity. In respect of flat glass production, the existing production lines still using the Fourcault or the Pittsburgh process, whose output accounts for half of the overall productive capacity, are to be converted into float glass lines. Attempts will be made to enlarge the furnace capacity, develop new varieties, such as thick and superthin glass, as well as various kinds of coloured glass, and after that, to develop glasses used in the car, ship and aviation in-

dustries as well as to extend the range of application of safety glass, energy-saving glass and architectural glass. In respect of domestic glass, importance will be attached to familiarize the backward enterprises with the advanced technologies and machinery from abroad, such as container glass manufacturing machines, high-efficiency gob feeders, pressing equipment and automatic examining and measuring devices. etc., for the manufacture of thin-wall and light-weight products. Regarding the TV tube plant, the introduced advanced technology is meant for developing the production of large TV screen tubes. As for the manufacture of other glasses, production technology and product quality must be improved and, moreover, new products must be developed.

Great importance is attached to scientific research as well as to the training of professional personnel in China's glass industry. Throughout the country, there are now dozens of glass research and development institutes, universities and vocational schools; and there are several thousand scientists, professors and engineers engaged in research and development of glass as well as glass science and technology. The research projects are usually directed towards problems arisen in the production process. Plenty of research and development has been done relating to the mechanization, production technology, new equipment and new products in the field of preparation of raw materials, melting, forming, annealing, cold processing as well as energy saving and environmental protection. For instance, the Luoyang float glass process is the research result of Chinese technical personnel who started their work on a laboratory level. This research result is the only one in the world without patented technology from Pilkington being introduced, and it speeded up the development of large-scale float glass production in China. The improvement of the float process is being carried on by research work on the glass forming condition in tin bath, on in-line coating technology, etc. Regarding flat glass, further research will be done on improving the properties of safety glass, on new technology and equipment for deep-bending toughened glass and air-cushion toughened glass, as well as for the new process of microparticle-toughened glass, and on improving the dry and wet processing of laminated glass. As for domestic glass production, the light-weight technology of container glass, optimum batch composition, electric and boost melting and melt homogenization technologies, as well as high-grade tableware glass, glass-ceramic tableware and lead crystal glass products are all under research.

Another important aspect of research is that much work has been done to adapt the introduced technology. China has imported many advanced technologies as well as equipment from abroad to produce various kinds of glass, particularly TV glass tubes, and so, it is very important to adapt these technologies to the practical conditions and to make technological innovations in production. Furnace design is taken as an illustration. Some years ago, glass melting per unit area at a definite unit

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time was rather low in China. Since advanced new melting processes have been introduced, the melting rate has risen by about 40%. The introduction of computer control in the glass production process has also greatly increased productivity.

In addition, glass research in China has also included some new areas, such as physical and chemical properties of glass, new processes of surface treatment, development of new materials and new applications of glass, etc. In China's glass research, work is organized in a special way, called "storming a strategic pass", that is, an important subject is just like a strategic pass and force is concentrated to attack such a "pass" aiming at achieving technical breakthrough. The government usually gives financial support to such projects and coordinates the work of the scientific research units and the factories, a definite period of time being fixed in which the key problems of the said project should be tackled. For many years, this method of working has been very effective. However, there are still many problems to be solved in glass production

and development, and great efforts should be made accordingly.

Today, China is making contacts with the international glass community more frequently. Some foreign glass firms have invested in China's glass industry. More contacts are resulting from the import of technology and equipment, as well as the trade in raw materials and products. Durable business connections with many glass companies, machine manufacturers, refractory producers and glass businessmen in Europe, the USA, Japan and South Korea have been made. Scientific conferences, technical exhibitions and visits provided China's specialists in the field of glass with many opportunities to keep contact with foreign partners in the same trade. In this context, especially also the XVII International Congress on Glass in Beijing in October 1995 should be mentioned. Furthermore, in June 1996, the 6th International Glass Exhibition – China Glass 96 – will be held in Beijing; with an expected number of over 300 companies participating in this exhibition, its scale will be unprecedented.

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