A Discussion on the Technology and Equipment in Chinese Grain Distribution

Guan Jintao

Abstract
The position and function of grain warehousing technology and machinery is expounded in this paper. Some issues concerning the design and equipment selection are put forward. The developments of warehousing technology and equipment are discussed briefly.

Introduction
Technology design and equipment selection play the decisive role in saving investment, reducing running cost, meeting the requirement of environment protection and in giving full play to the warehousing facilities. In modern grain distribution system, every procedure, from the overall distribution of grain depots to the flow diagram in a storage facility, has something to do with the technological design. Thus, to realize the importance of technological equipment, to learn from the past experiences and to strengthen the development of new technology and new equipment are of great significance for future grain warehouse construction as well as for the development of the whole grain distribution system.

Recognize the Position of Technological Equipment in Grain Warehouse Construction
To analyze grain distribution by using modern distribution theory, it will be defined as follows: Grain distribution is the movement of grain in time and space. For convenience of statement, this movement was divided into three kinds: big, medium and small movement.

Big movement
The so-called big movement refers to grain movement in the whole country. We can also call it grand distribution or grand technology that can be realized through the links of handling, transportation and storage. In the past, the construction of grain warehouse in China is only the construction of storage facilities. But the building of storage facilities is closely related to the whole distribution system, i.e., distribution of warehouse, selection of warehouse mold, transport route and means, production & marketing conditions, and so on. For these reasons, warehouse construction should be treated as a grand distribution system. Any carelessness in engineering design may cause great economic loss or even worse social influence. Past lessons still come clearly into our mind, such as some depots were built up, but there was no grain to be stored; or grain was loaded in, but could not be loaded out; or when construction had been finished, but equipment could not match with them. More over, there were some difficulties in selling and buying grain. These problems were resulted from various reasons, but if we were able to observe based on the technology, the main reason is very clear, that is we did not consider the grand distribution and grand technology theory to approach warehouse building. Grand distribution and grand technology belong to the nation's activities that need big investment. Developed countries have been engaged in grand distribution for scores of years, even for almost a hundred years. Our country's organization system, financial resources and technology make it very difficult for us to engage in grand distribution. But we must acquire a grand distribution thinking, propagate this thinking and make progress step by step. Although we have to be facing various difficulties and problems, from the 'Word Bank Project', we can see that grand grain distribution is going ahead and development. 'Distribution Creates benefits', this is a concept well received by every country in the world today. It is generally acknowledged that distribution has become the third profit source following the first profit source (reducing material consumption) and the second profit source (saving labor consumption). For example, the United States has lowered the percentage of distribution cost in the GNP from 14% in 1980 to 11% in 1990 as a result of laying stress on distribution technology. In just ten years, 3% of its GNP was cut down! What an economic benefit it is. Through past experiences, the grain industry of China also becomes aware of the benefits of distribution. For example, in 1950's, our country's grain department has
gained obvious benefit from organizing reasonable grain transport along the main railway lines. The grain transport fees in 1956 decreased by 124 million yuan RMB compared with that in 1955. In the late 1970’s, 70 % of the rice were transported in bulk from processing plant to depots, thus the transport payment was reduced RMB 340,000 yuan every year. These examples show that the grain department in China has gotten many benefits from distribution. Now, the grand distribution technology are even more important to our grain warehouse construction.

Middle movement

The middle movement means that the grain’s movement within a depot. It includes the receiving and laying out operations of grain in this depot. We called it middle distribution or middle technology.

Middle technology is the key in building a depot. The quality of the depot is mainly determined by the quality of its technological design. If distribution theory was used in explanation, it is only to know that if the movement of grain (both in time and in space) will be achieved in the shortest time, through the closest route, with the least equipment and the least cost.

Here, we put forward several issues concerning technological design and equipment selection that directly influence the function of the depot and the investment to discuss as follows.

Decision of loading capacity and style

The receiving capacity and style of a depot directly affect the function of the grain depot, but there are many factors to restrict loading capacity and ways. For example, movement of flow which includes total receiving amount annually, daily average receiving amount, the maximum monthly, or moisture content, and if the grain received is necessary to be dried or not. General situation of transport means including carriage, tractor or truck, their self-dump ability must be considered also. The other elements needed to be considered are the weather, the climate, etc. All these factors may affect the decision to the receiving capacity and style.

It may be left a doubt that if we can decide the suitable receiving capacity and style only based on analysis and comparison of the above mentioned conditions and elements. If only one or several kinds of factors will be taken into consideration, then the calculated receiving capacity may be over the practical necessary or not be able to meet the requirement.

Decision of the total capacity and single silo capacity of an intermediate depot

Total capacity of a depot and the capacity of a single silo are closely related to various factors, such as the capacity, the turnover rate, utilization rate of storage capacity, material variety and grade, directly getting capability, and so on. These factors are restricted by other elements. For example, for train out-loading, its ‘turnover’ is related to the railway’s transport capacity, plan and dispatch. Only after a synthetic analysis of these factors, we can get a feasible turnover rate based on which we can calculate a practical storage capacity to meet the functional requirement as well as to save investment.

Continuous quantitative loading of train

Continuous quantitative loading holds a very important position in intermediate depots that adopt train out-loading. It directly effects the transfer function and the benefit of the depot. The main factors are ‘quantitative’ and ‘continuous’. The former means accurately calculate the weight of grain in every wagon; and the latter means the continuous running of the loading system and the continuous flow of the grain. Factors affecting the continuous quantitative loading are technological process, flow balance, equipment selection, wagon shunting speed, number of wagons to be shunted each time, shunting time, automatic control level, etc. Based on a synthetic analysis of the above mentioned factors, we can design a loading system which meets the requirement.

Selection of train unloading point

In the intermediate depots with train unloading system, unloading point can be regarded as a key that affects the overall arrangement of depot and gives full play to the function of the special railway line and saves the investment. In the ‘World Band Project’, some design organizations adopted suitable wagon-shunting means, selected optimum train unloading point to meet the functional requirement and saved a lot of investment.

Generally, in the so-called medium distribution, once one has grasped the above mentioned four points, the middle technology would successfully meet the requirement of grain movement in a given depot in the shortest time through the closed route, and would need the least equipment and spend the least investment.

Small movement

The so-called small movement means grain’s movement in a given storage facility (silo, headhouse, multi-storied warehouse, or flat storage). We always call it ‘Small Distribution’ or ‘Small Technology’.

The small movement is the silo technology, flat storage technology, multi-storied storage technology, etc. This technology varies with the storage function and the type of storage. For example, the technology and equipment for reservation storage, transfer storage and raw material storage are quite different each other. Different type of warehouse has a distinctive technology and equipment. Even for the same type of storage, if their scale and natural conditions are different, the technology and equipment needed are not complete the same. Therefore, when small
Development of Technology and Equipment for Grain Warehouses in China

Technology and equipment for grain storage in China had been very poor before 1949. Although the first silo in China was built in 1936, the technology and equipment were all foreign ones. After founding of New China, technology and equipment for grain has been growing out step by step. This process can be divide into four stages: enlightening stage, growing-up stage, developing stage, and perfecting stage.

Enlightening stage

The 1950’s was the enlightening stage of grain storage technology & equipment in China.

In the late of 1950’s, the older generation of Chinese grain engineering researchers designed the silos in Beijing Dongjiao Flour Mill and the brick silos in Zhengzhou Flour Mill, Hangzhou Nanxiangqiao Grain Depot and Jiaxing Qujungqiao Depot, based on experiences from the former Soviet Union. These achievements opened up the way to design our own silos. In this period, Chinese engineers in grain industry designed and made some simple and practical warehousing machinery.

Growing-up stage

The 1960’s and 1970’s, especially the middle and the late of 1970’s was the growing-up stage. In the middle 1970’s, some vertical silos were built up in some big cities (Shanghai, Guangzhou, Wuhan and Changsha) in South China. The technological design were all done by ourselves which symbolized a great improvement in the design level for grain warehousing technology in China.

Some leader of former Ministry of Cereals, P. R. China called on to develop warehousing machinery in 1973. It resulted in rapid development of warehousing machinery in the middle and late 1970’s. According to the statistics, the total number of warehouse machinery was 10,000 sets in 1973, but this figure was increased to over 69,000 sets in 1978. By 1980, there were already more than 40 grain-machinery factories in China.

The rapid development in grain machinery brought some problems such as non-standardized models, quality requirements and supply of spare parts. The selection of model and finalization the design has been carried out since 1979. Then, six kinds and altogether 25 types of grain warehousing machines were finalized. The six kinds of machines are loading and unloading conveying machines, cleaning machines, drying machines, weighing machines, dust removing machines and transport vehicles. The 25 types of machines are as follows:
accompanied the development of science and technology as well as the building of grain warehouses. This is a very formidable and complicated work. Large numbers of technicians and factories threw themselves into this work and finally symbolized the growing-up of China’s grain warehousing machinery industry.

Development stage

Development stage refers to the 1980’s. Development of grain warehousing technology and equipment in China accompanied the development of science and technology as well as the building of grain warehouses.

(1) Due to the development of science and technology during Chinese Sixth and Seventh Five-year Plan executed in 1980’s, granary machines had gotten satisfactory achievements through scientific and technological key-task project, technical import, digesting and absorbing. The technical condition of conveyors, elevators, cleaners, weighing scales and dryers had been obviously improved.

(2) The 1980’s was the big development period of warehousing machine industry in China.

- Chinese government has invested 3 billion yuan (RMB) in all since 1983 to build grain depots. The total capacity was over 35 million tons.
- The building of steel silos was developed very rapidly, and the Lipp Silo technology was introduced into China.
- Bulk grain terminals have been built up in some port cities such as Zhanjiang, Tianjin, Dalian, etc.

Perfecting stage

Perfecting stage was in the 1990’s. During this time, the technical level of China’s grain warehousing technology and equipment has been perfected through the construction of mechanized depots and the World Bank Financed China Grain Distribution and Marketing Project.

Design means

Almost all the drawings except structural drawings in the design of the mechanized depots were worked out manually until the ‘World Bank Project’ was executed. Most of research and design units in the grain industry have realized CAD due to the joint design of Chinese and Foreign experts and the development of computer technology.

Design level

With the practice in building the mechanized key depot and the ‘World Bank Project’, Chinese design level of technological equipment was greatly improved, especially in following aspects:

(1) Chinese design troops have the ability to design large-scale comprehensive grain silos. We designed 50,000-ton silo group for the mechanized key depots, and designed 300,000-ton silo block for the ‘World Bank Project’. This quantitative change has caused a lot of profound and lasting qualitative changes.

(2) Chinese design troops have the ability to design highly mechanized and automatic silos. It made the level of automation for grain silo to be greatly raised and made computer techniques to be used widely. The PLC and computer have been widely used in IDs and highly automatic control has been realized for operations like process flow, equipment supervision and management.

(3) The level and scale of technological design were improved rapidly. In the past, if one mentioned technological design, it mostly meant the technological process flow, equipment supervision and management, i.e. the small distribution or technology. Today, the concept and contents of technological design have been greatly expanded, it shall be treated using the concept of big distribution, middle distribution and small distribution respectively for different design objects.

Improvement in technical level of mechanical equipment

(1) Weighing equipment: In the past, mechanical or electro-mechanical weighing scales were used. At present we use electrical totaling scales. The totaling scale has some characteristics such as high accuracy, simple structure and cheap price, and it is easy for automatic control.

(2) Conveying equipment: air-cushion belt conveyors are widely used due to their low energy consumption, low price and good sealing property.

(3) Ventilation and dust-removing equipment: low-pressure pulse dust collector is widely used. The service life of pulse valve has been prolonged greatly.

(4) Equipment monitoring technology: In the past, almost
all of grain machines had no monitoring devices. Through the ‘7th Five-year Plan’, through digestion and absorption to foreign advanced techniques, through building of mechanized key depots and the ‘World Bank Project’, the supervision devices in China are developed greatly. Flow rate monitor, temperature sensor, pressure sensor, block sensor are all widely used now.

All these greatly promoted the development of techniques in grain warehousing machinery in China. Generally speaking, Chinese technical level has reached to that of developed countries at the beginning of 1990’s. Certainly, in the areas of large-scale equipment, special transport vehicles and handling machinery, etc., we still have a long way to go to catch up with the developed countries.

Questions and Suggestions

Strengthen study and technical exchange

Through the joint research and design of Chinese and foreign experts in the world Bank Project, we recognized that Chinese engineers possess quite rich in professional knowledge, but more deficient in width of knowledge. So we present some suggestions as follows:

(1) Chinese engineers, especially process engineers, should strengthen the study on interrelated knowledge, advanced technology as well as knowledge concerning mechanical design, electrical design, civil design, physical distribution and other new and high-tech knowledge to enable themselves to be erudite experts.

(2) Strengthen technical exchange to learn from and help each other.

Strengthen research and development to high technology and electronic technology

We have still needed to import some monitoring devices, some sensors and some testing equipment in the mechanized key depot project and the World Bank Project. Therefore, we suggest to strengthen research and development in this respect. If it is necessary, we will invite technicians from other industries to form joint research teams.

Strengthen research on the manufacturing and quality control technology of key warehousing equipment

Although Chinese technical level in warehousing machinery has been greatly improved. Now we are able to provide 300t/h main equipment, but there were some problems to remain to be solve, such as the quality of equipment, the reliability in running, and so on. The research on technology in manufacture and quality control should be strengthened.

Strengthen management of grain depots and to train technical personnel

The advanced managerial and technical personnel are required for operating modern grain distribution facilities. The best equipment may not necessarily bring good benefit without advanced management. Therefore, it become a key to strengthen study of modern management knowledge and to train the operators of equipment to make modern distribution facilities play their full role.

References

The model selection and determination rule for grain storage machinery (in Chinese), July 1979 A restricted publication.