

# RESEARCH ON ENERGY SAVING PERFORMANCE AND PROMOTION STRATEGY OF WATER PURIFICATION PLANT IN NORTH CHINA – – CASE OF WATER SUPPLY SUPPORTING PROJECT IN SHENYANG

DOI: 10.18485/arh\_pt.2020.7.ch22

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## ABSTRACT

The water purification plant is more important than other public buildings in north China, but its energy saving level is low and the building comfort is poor. To achieve energy conservation and emissions reduction strategy and protection of water resources of the target in north China, the government has introduced policies to support to guide the construction of public building energy efficiency, the market also emerge some suitable products and technology. This paper aims to summarize the current energy saving technologies at home and abroad, and then analyze the energy saving construction and renovation work of public buildings, such as standard setting, financial subsidies, technology and material innovation drive. According to the specific cases, the existing problems of energy saving technology are expounded, and the solutions are put forward. On the basis of practical cases, this paper tries to look forward to the development trend of building energy saving technology.

**KEYWORDS** \_ *public building, energy saving, water purification plant*

## INTRODUCTION

Shenyang is located in the south of northeast China and the central and northern part of Liaoning Province, between east longitude 122°25 '9 " ~ 123°48' 24" and north latitude 41°11 '51 " ~ 43°2' 13". It is 115 kilometers from east to west and 205 kilometers from north to south. At the same time, Shenyang is also located in the south of northeast China, in the center of northeast Asian economic circle and Bohai Economic circle. It is a comprehensive hub city from the Yangtze River Delta, Pearl River Delta, Beijing-Tianjin-Hebei region to the Kanto region. The city has jurisdiction over 10 districts, 2 counties and 1 county-level city. The total area of the city is over 12,948 square kilometers, with an urban area of 3,495 square kilometers. In 2015, the city had a permanent resident population of 8.291 million and a registered population of 7.304 million, with a GDP of 728.05 billion yuan. Shenyang is a sub-humid continental climate in the north temperate zone affected by monsoon. The annual temperature and precipitation distribution decreases from south to northeast and from southeast to northwest. Four seasons throughout the year, winter is long; Spring warming fast, full of sunshine; Summer is hot and rainy, and the air is moist; Autumn is short, cloud-less, cool and

pleasant. The dominant wind direction in winter is north wind and northwest wind, and the average outdoor wind speed is 3.1m/s. The dominant wind direction in summer is south wind and southeast wind, and the average outdoor wind speed is 2.9m/s. The annual average temperature was 8.1 , the extreme maximum temperature 38.3 , and the extreme minimum temperature -30.6 . The annual average precipitation is 621.7mm, the maximum permafrost depth is 1.48m, and the maximum snow cover thickness is 0.20m.

By 2020, Shenyang must close 215 urban groundwater resources and self-provided water sources, close 495 water source Wells, and reduce the amount of groundwater exploitation to 20.443,000 cubic meters per year. In its place are the Northwest Water Supply Phase II project, the Partnership House water Purification Plant Phase II project and the public water supply network expansion project. Among them, the fifth, sixth and seventh plants under the Water supply group in the northern area of Shenyang have a total of 135 underground water Wells. The need to reduce groundwater extraction capacity to 66.85 million m<sup>3</sup> / year (183200 m<sup>3</sup> / d) is to be replaced by the Northwest Liaoning Water Supply Phase II project. According to the scope and construction sequence of the project, the water supply and groundwater replacement project will be divided into three projects respectively. Specifically, this project is Shenyang North Water Construction Project, namely "Shenyang Northwest Liaoning Water Supply Project, water conveyance Project". This project includes three parts: water conveyance pipeline project, water treatment project and water project. In the design process of the project, while meeting the basic functions of water treatment, also realized the energy saving of public buildings.

## DESIGN CONSTRAINT

Legal provisions in the fields of ecology, water supply, infrastructure and so on can better help us understand the use function and spatial nature of public buildings. Therefore, in the early stage of design, it is necessary to understand the relevant laws and regulations unique to China.

### 2.1 Relevant laws and regulations

- (1) Energy Conservation Law of the People's Republic of China (revised in July 2016);
- (2) Construction Law of the People's Republic of China (Order of the President of the People's Republic of China No. 91);
- (3) Electric Power Law of the People's Republic of China (amended in 2015);
- (4) Decision of the State Council on Strengthening Energy Conservation (Guo Fa [2006] No. 28);
- (5) Notice of the State Council on Printing and Distributing the Comprehensive Work Plan for Energy Conservation and Emission Reduction during the 13th Five-Year Plan Period, No. [2016] 74;
- (6) Measures for Examining Energy Conservation in Fixed Asset Investment Projects No. 44 of 2016;
- (7) "Comprehensive Utilization of Resource Conservation and Environmental Protection Technology encouraged by the State" (Decree No. 65 of the National Development and Reform Commission);
- (8) Notice of the State Council on Strengthening the Prevention and Control of Urban Water Supply, Energy Conservation and Water Pollution (No.36 [2000]).

### 2.2 Planning, industry access conditions and industrial policies

- (1) Outline of the 13th Five-year Plan for National Economic and Social Development of the People's Republic of China;
- (2) Outline of the 13th Five-year Plan for National Economic and Social Development of Liaoning Province;
- (3) Outline of the 13th Five-year Plan for Shenyang's National Economic and Social Development;
- (4) China Energy Conservation Technology Policy Outline (2006);

- (5). Outline of China's Water-saving Technology Policy (2005);
- (6). Implementation Plan of National Action for Energy Conservation and Emission Reduction;
- (7) Liaoning Province Building Energy Saving Technology (Product) Accreditation Project;
- (8) Catalogue of National Key Energy Saving Technology Promotion;

## RESEARCH EXPERIENCE IN ABROAD

### Room air conditioner

As a representative of energy-efficient buildings in Asia, Japan's creativity in this area is worth learning from. Relative to Japan's high technology of air conditioning, central air conditioning penetration rate is very high in the United States, the main reason is that America's economy is relatively developed, so the living standards of its people, and economic income is higher, this led to the electronic products, especially air conditioning such essential electronic products in the United States is very popular in the family, at the same time, the residents of the United States are often very high to the requirement of quality of life, this kind of circumstance also indirectly promote the use and popularity of the small central air conditioning.

### Green Building

The use of the maximum energy efficiency highest, guarantee the building will not affect the surrounding environment, and maximum reduce the consumption of non-renewable resources, as a worldwide subject, the theory of green building has relatively complete, eu countries, for example, many countries have paid great attention to green building techniques, the European countries by testing for a variety of energy, green building techniques of inspection, Such as the use of solar energy technology, geothermal energy technology and the use of water energy resources technology, for practice and application, and finally made great achievements.

### Cogeneration of heat and power

With the rapid development of co-generation of heat and power in the world, the technology of co-generation of heat and power is gradually concerned by people. Take the United States as an example, its installed capacity of co-generation of heat and power is constantly improving, with the capacity increased by 45GW so far. Meanwhile, in Japan's energy supply market, cogeneration systems are second only to gas and electricity in terms of energy supply, and are very popular. In some European countries, such as Denmark, the Netherlands and Finland, combined heat and power generation has reached one third of the domestic energy generation capacity, and carbon dioxide emissions have been directly reduced by 200 million tons, greatly protecting the surrounding environment.

## ENERGY SAVING MEASURES IN THIS PROJECT

### Standard Policies

The Proposal of the CPC Central Committee on Formulating the 13th Five-year Plan for National Economic and Social Development clearly states that it is necessary to regard resource conservation as a basic state policy, develop a circular economy, protect the ecological environment and speed up the building of a resource-conserving and environment-friendly society. The comprehensive utilization of resources is a basic state policy of resource conservation, an important way and an urgent task to transform the pattern of economic growth, develop a circular economy and build a resource-conserving and environment-friendly society.

### **Fiscal Policy**

Strengthening energy conservation is an important measure to thoroughly apply the scientific Outlook on Development, implement the basic state policy of conserving resources and build an economical society, and is also a long-term strategic guideline and urgent task for national economic and social development. Energy saving design of engineering projects is an important part of strengthening energy saving work, which is of great significance to rational use of energy, improving energy utilization efficiency, eliminating energy waste from the source, and promoting industrial restructuring and industrial upgrading.

### **Technological and material innovation**

As China is a country short of energy, it is especially important to save energy. "China Energy Conservation Technical Outline" puts forward the requirement that water pump equipment should give full play to its energy-saving function. For this project, water pump load is the main electrical equipment, so it is particularly important to save energy and reduce consumption. In water pump station adopts frequency control of motor speed technology, can realize stepless speed regulation, meet the requirements of water under various working conditions in the process of, and can be realized to save energy and reduce consumption, reduce the number of open stop related equipment, prolong the service life of equipment, operation scale and can deal with the engineering practice with the design size of deviation, to coordinate all kinds of conditions, play an important role in regulating.

### **Measures to save energy in production process**

- (1) According to the current situation of water supply, rationally plan the water supply system, determine the location of water plant and be close to its water supply range.
- (2) water on the premise of meet the technological process, the function layout to clear, reasonable arrangement of concentration and partition, good life, convenient production and reasonable use of terrain conditions, at the same time try to consider the process is smooth, the pipeline system layout is short, to avoid pipeline circuitous repeat, reduce factory head loss, reduce the water pump room of the pump head, save power.
- (3) This project adopts the advanced processing technology of the same industry in China, with high technology maturity, strong process adaptability, good matching with the processing scale, and high energy efficiency. While ensuring continuous and stable production, it can ensure a low comprehensive energy consumption level.
- (4) The technological process of this project is simple and smooth, reducing turning and de-tour as far as possible, reducing water lifting height and saving power consumption. In addition, this project has short technological process, compact, balanced and coordinated process, few structures, short fluid transport distance, small head loss and high energy efficiency level of the system.
- (5) In the design and selection of process equipment, necessary technical measures such as motor frequency conversion and speed regulation technology should be adopted to reduce the energy consumption of production equipment while meeting the requirements of mechanization, automation, program control and intelligence.
- (6) The configuration of production equipment is suitable for the processing scale, the matching between the main machines and auxiliary machines is reasonable, and the degree of automation is high. At the same time, energy-efficient mechanical and electrical equipment is selected to further improve the operating efficiency of equipment and achieve the purpose of energy conservation and consumption reduction.

### **Electrical energy saving measures**

- (1) Power system to minimize the circuit transmission current loss; The terminal transformer station should be distributed reasonably according to the load and close to the load center to reduce the line loss.
- (2) Improve the power factor, compensate the power factor not less than 0.92, reduce the power loss.
- (3) The substation of the water plant is located next to the water supply pump room and is close to

the monomer with large load, which can effectively reduce transmission loss. The cable is convenient in and out and can effectively reduce transmission loss.

(4) The distribution transformer selects the low-loss transformer and determines its capacity according to the economic load rate, so as to achieve the relative unification of economy and energy saving.

(5) The power supply and distribution system can not only achieve electricity saving of 5%-10%, but also be safe and reliable, green and environmental protection by reducing line loss, improving power factor, balancing three-phase load, suppressing harmonic and other technical measures.

(6) In the distribution system, the reactive power compensation method, compensation point and compensation capacity should be reasonably selected to effectively stabilize the voltage level of the system and reduce the active power loss caused by reactive power transmission through the line.

(7) Strengthen the training of maintenance and operation personnel, strive to fully grasp the use and operation performance of the equipment, and achieve the effect of energy saving by improving the use efficiency of the equipment

### **Energy saving technical measures for heating**

(1) The outdoor heating pipe network of the plant is directly buried with polyurethane insulation pipes to reduce the heat loss of the pipe network, and the heat preservation efficiency of the pipe network is more than 95%.

(2), choose a penetration alarm line of prefabricated polyurethane insulation pipe, once occurred during penetration, through the conduction alarm line, can be displayed on the special detecting instrument of thermal insulation pipe water seepage, leakage of precise location and size of the degree of leakage, easy to maintenance personnel quickly deal with leakage section, ensure the safety of the factory district heating operation, saving a large amount of hot water resources at the same time, also save accident situation of heat loss.

(3) Ensure water balance in pipe network. The premise of implementing all kinds of energy saving technology means is to ensure the hydraulic working condition of pipe network. Good thermal condition is guaranteed by good hydraulic condition, and hydraulic balance technology is the first step of energy saving. In order to ensure the stability of the pipe network pressure and the hydraulic balance of the system, to ensure that each hot spot can get the designed water flow, it has the outstanding advantages of no need for initial regulation, good hydraulic stability.

### **Energy saving of lighting system**

(1) Choose high-quality and energy-saving electric light sources and try to use LED lights to improve luminous efficiency.

(2), choose energy-saving lighting accessories, such as ballast, etc., in all kinds of gas discharge light sources are required to have electrical accessories. For example, the inductance ballast of the old T12 fluorescent lamp consumes 20% of its electric energy, while the ballast of 40W lamp consumes about 8W; However, the energy-saving inductive ballast consumes less than 10% of the electricity, while the more energy-saving electronic ballast only consumes 2 ~ 3% of the electricity, which can effectively save energy.

(3) Choose lighting circuit reasonably and adopt three-phase five-wire power supply.

(4) In the lighting system design of this project, under the condition of meeting the standard illumination, three lighting modes of general lighting, local lighting and mixed lighting are appropriately selected to meet the illumination and save energy at the same time.

### **Building energy efficiency**

(1) Rationally plan the orientation and orientation of the heating buildings in the factory to ensure sufficient sunshine in winter and avoid the dominant wind direction, so as to maximize the natural heat gain and reduce heat loss.

(2) The building of the project will create a comfortable indoor environment by means of construction technology to reduce energy consumption and emissions; Control its body shape coefficient,

reduce the contact between the outer surface and outdoor air, reduce heat dissipation, reduce building heating energy consumption.

(3) External thermal insulation structure is adopted for building exterior walls. The hollow lightweight aggregate concrete block and EPS insulation material with low heat transfer co-efficient, low heat storage capacity and low strength are used to make the thermal performance of the outer wall of the building meet the specified energy saving standards.

(4) The roof energy consumption accounts for a considerable proportion in the total energy consumption of the envelope structure. Therefore, the roof of this project adopts efficient heat preservation and heat insulation roof. According to the form of the roof, different insulation materials are selected, and the heat transfer coefficient and thermal inertia index should meet the local standards.

(5) External doors and Windows are the most active and sensitive part of heat exchange and heat conduction in buildings. Their insulation performance and air-tightness performance have a significant impact on heating energy consumption, which is 5-6 times of the heat loss of the wall. Therefore, they are the key part of energy saving, as well as the important link to improve indoor thermal environment quality and building energy conservation. In order to reduce the energy consumption of external doors and Windows, this project adopts measures such as appropriate window-wall area ratio and window-glass layer to improve the thermal insulation performance of doors and Windows by improving the air tightness of doors and Windows according to the specific situation of the project.

**Energy saving in transportation system**

In order to reasonably control the cost, the number of vehicles invested in the transport capacity should be rationally formulated according to the different trips, models and working conditions, in line with the principle of maximizing benefits, and the single and total consumption of each trip, model and vehicle should be stipulated. Regular, directional and quantitative consumption should be adhered to.

At the same time, I carried out supervision, examination and analysis, actively coordinated with the dispatching, and insisted on using energy-saving vehicles. Secondly, the vehicle mileage statistical analysis, strive for accurate data, energy conservation management work into the network management, to achieve the timing, qualitative and quantitative analysis of fuel, effectively guide energy conservation work, do everything possible to reduce transportation costs.

The vehicle should be inspected regularly to ensure that the vehicle is in good condition and experienced drivers are employed to reduce fuel consumption and save energy.

**INTEGRATED ENERGY CONSUMPTION OF THE PROJECT**

According to general Rules for Calculation of Comprehensive Energy Consumption (GB/T2589-2008), the annual comprehensive energy consumption of the project is calculated and shown in the following table.

Major energy sources	The measuring unit	Annual demand for physical quantity	The calculation USES the scaling factor	Discount coal quantity (TCE)
Electric power	KW · h	2193.2	equivalent value0.1229kgce/kW·h	2695.443
			indifference value0.3210kgce/kW·h	7040.172

diesel	t	15.64	1.4571kgce/kg	22.789
total			equivalent value	2718.232
			indifference value	7062.961

Comprehensive energy consumption list of the project

## OUTLOOK ON KEY TECHNOLOGIES OF BUILDING ENERGY CONSERVATION IN CHINA IN THE FUTURE

building energy conservation can be effectively promoted only when building energy conservation is carried out jointly from two aspects, which mainly include reducing room compatibility and improving energy utilization efficiency. Reducing housing price compliance refers to reducing the heat and cold load of the room. Designers are required to use the latest energy-saving materials to reduce the room compliance, such as reducing the energy loss caused by the heat release of lights and electrical equipment. Improving the efficiency of building energy consumption system mainly refers to the improvement of the efficiency of cold and heat sources, transmission and distribution system and terminal equipment. It is necessary to improve the energy utilization rate of this part and reduce the waste of resources.

## CONCLUSIONS

Japan's Ministry of Land, Land and Transport will launch a new energy efficiency standard for buildings, the Nikkei reported Monday. The new standards require the use of insulation and other materials to control the electricity used for air conditioning and lighting to a certain level. After 2020, applications for buildings that do not meet energy efficiency standards will not be approved. This is a contrast between the different attitudes of The two countries, Japan and China, towards rules. In building energy conservation technology research at the same time, the need to strengthen the application of building energy saving technology, often installed in time, at the same time, the government should increase the intensity of support, considering the development of energy-saving technology, from several aspects to building energy conservation mechanism and energy saving to strengthen and implement the standards, at the same time establish a system of heating and cooling metering charge, rely on laws and regulations for the development of energy saving technology for driving, in addition to establish rewards and punishment mechanism, high rewards for energy-saving building design, improve the speed of building energy conservation transformation and construction.

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