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The Analysis of Geothermal Heating in University in Tianjin China

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ABSTRACT

Taking a geothermal university project for instance, describes the geothermal heating system design, analysis of the design principles and design parameters of the system, analysis the system investment and operation cost, in order to induce the operation cost, lower the geothermal water flow and heating system frequency in winter vacation. Also the paper also describes the investment and operation cost of the city heating system in university, compares with the geothermal heating system, analysis the economy both the city heating system and the geothermal heating system.

1. INTRODUCTION

A university is located in a college town, where is 25 km away from downtown Southern. The total planned GFA is approximately 66×10^4 m^2, which is no gas pipeline network nor heating network. According to requirements of energy conservation, heat resource of geothermal is for college heating. The total project (school buildings, student apartments) is $l5.46\times10^4$ m^2, and construction area of teaching building is 3.76×10^4 m^2. The heating system is a fan coil system and a floor heating system.

1.1 Resources Overview

The project is located in the southern heat Wang Lan Zhuang, Cang xian western bulge of double kiln raised, the depth of bedrock is shallow, and the west is Tianjin fracture. According to the same tectonic unit geothermal wells, the deep geothermal resources in this area is rich, and the potential for development is high.

The purpose of layer for geothermal wells is Wumishan Jixian System. The depth is 2700m, and the temperature is 85℃, Water flow is 90 m^3/h, and geothermal fluid type of water chemistry is Cl ·SO_4-Na that PH is 7.5-7.8. The water is slightly corrosive, do not generate carbonate scale nor silicate scale, so geothermal system should use indirect ways, In order to improve the utilization of the geothermal system, injected water at lower temperature is heated to achieve the development and utilization of geothermal cascade by electric heat pump.

1.2 Heat Index and Heat Parameters

Heat load of the project is 8 296 kW. Heat load of teaching building is 3634 kW. Heat load of Student apartment is 4662 kW. The supply and return water temperature of fan coil heating system parameter are 50℃ and 40℃, respectively. The supply and return water temperature of floor heating system heating parameter are 45℃ and 35℃, respectively.

2. GEOTHERMAL HEATING SYSTEM

Geothermal water heating system is divided into two subsystems: a teaching building and a student housing. The design process and operating parameters of geothermal water heating system for the teaching building processes are shown in Figure 1. To achieve two geothermal water utilization through the heat pump, the required geothermal heat load is 1953 kW and the required heat pump heat load is 1681kW. The design process and operating parameters of geothermal water heating system for the student apartments are shown in Figure 2. To achieve two geothermal water utilization through the heat pump, the required geothermal heat load is 2733 kW and the required heat pump heat load is 1929kW.

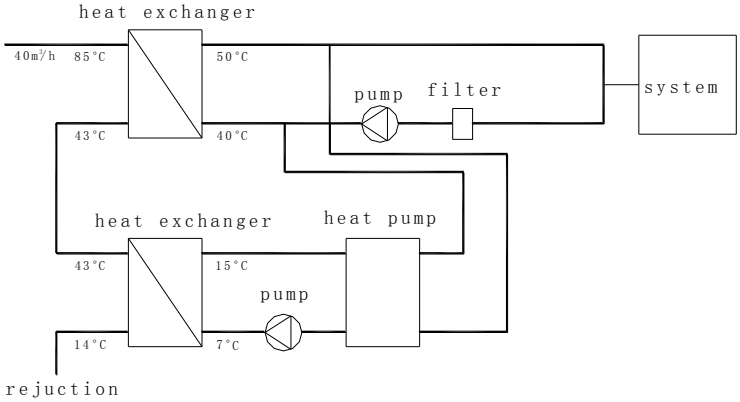

Figure 1: Flow chart of teaching building heating system.

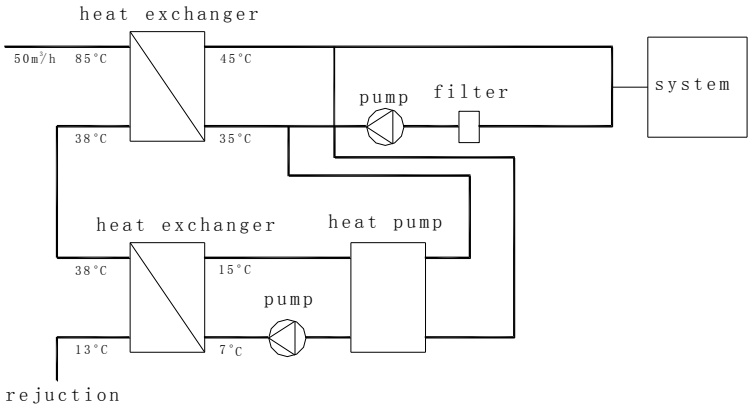

Figure 2: Flow chart of student apartment heating system.

3. THE ECONOMIC ANALYSIS OF GEOTHERMAL HEATING SYSTEM

3.1 The Investment Analysis of Geothermal Heating System

The investment cost of the geothermal heating system mainly consists of drilling geothermal wells, system equipment, and other costs. The depth of Geothermal well is 2700m. The cost of drilling is 2400 CNY/m. The system mainly consists of a circulation pump heating equipment, electric heat pump, heat exchanger, and ancillary equipment. Other expenses mainly includes geothermal wells demonstration costs, system design fees and prospecting fees, and specific costs, as shown in Table 1.

Table 1 the investment cost of geothermal heating system.

Drilling Cost(CNY)	Equipment Cost(CNY)	Other Cost(CNY)	Total Cost(CNY)
12960000	4200000	1800000	18960000

From Table 1, the total cost of geothermal water heating system for the l 896×104 CNY, the construction area of the unit cost of l22.6 CNY/m^2. Municipal heating network access fee is 160 CNY/m^2, containing pipes, thermal stations, construction and other expenses. The use of municipal heating network, network fee is 2 473.6×10^4 CNY.

3.2 Operating Cost Analysis of Geothermal Heating System

In TianJin city, heating from November 15 to March 15 in winter, the college students leave in the cold winter period, which is during the holidays. The heating system operates to maintain low temperature. The resource fee for geothermal water (recharge part) is 0.6 CNY/m^2, while the resource fee for geothermal water (no part of recharge) is 2 CNY/m^2. The electricity charge is 0.76 CNY/kWh. Depreciation objects include geothermal wells and major equipments. Geothermal water heating system annual operating costs are shown in Table 2.

Table 2 the operating cost of geothermal heating system.

Resource Cost(CNY)	Electricity Cost(CNY)	Artificial Cost(CNY)	Other Cost(CNY)	Total Cost(CNY)
192000	1613000	48000	818000	2671000

From Table 2, the geothermal water heating system annual operating cost is 267.1×10^4 CNY/a and the construction area operating cost is l7.3million/(m^2 • a). The use of municipal heating network, which costs 36 CNY/(m^2 • a), is much higher than the use of the geothermal water heating systems.

3.3 Economic Analysis

For the university, taking into consideration the system cost, the geothermal water heating system costs less than the municipal heating network access fee. With consideration to the running cost, the annual cost to run the hot water heating system is less than the municipal heating system.

4. CONCLUSION

For university users, school buildings and student apartments are different heights for heat. The heating system should be set so that the heating system is running for easy adjustment. Centralized district heating systems, which has not been covered yet, should be used to clean energy heating. Because heating systems in the university are not used through the years the actual local conditions, such as the use of geothermal water, is more economical than the use of the municipal district heating system. Comprehensive analysis of geothermal water heating system can effectively reduce demands and emissions of ash, sulfur dioxide, nitrogen oxides and other pollutants conventional fuels. The effective protection of the ecological environment and the environmental benefits are obvious.

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