Applied Mechanics and Materials *Online: 2012-05-14*
ISSN: 1662-7482, Vols. 170-173, pp 2583-2586
doi:10.4028/www.scientific.net/AMM.170-173.2583

Application of WSHP in Air Conditioning System within Hospital Buildings

Yiran Wei

Handan Polytechnic College, Handan CHINA

wyr682008@yahoo.com.cn

Keywords: WSHP; Air conditioning system; Operation costs; Economic analysis

Abstract: Based on practical applications of WSHP (Water Source Heat Pump) system, equipment selection, operation management, economic performance of the system, etc. have been analyzed and expounded All of our work is helpful and valuable for peer reference.

Introduction

In recent years, heat pump which is one of the most efficient energy conversion technologies in cold and heat source of air-conditioning has being much focused and concerned. Because of the pressure of resource and environment, much effort have been paid on theoretical and experimental work of WSHP Air conditioning system by Chinese persons and institutes, and many practical engineering projects and related products have emerged. The actual use of WSHP Air conditioning system in Handan city is introduced in this paper, further analysis and discussion have been also done for peer reference.

Project Description

This building is a hospital consists of wards and operating rooms located in Weixian county on the southeast to Handan city. The four-storey building has a total construction area of 4850 m^2 and the total building height is 14.2 m. The building has the structure of brick and reinforced concrete, and has the window of aluminum alloy and glass. WSHP Air conditioning system is used in the building, cooling in summer and heating in winter. The system began its operation in June 2002 and it has been run for almost 10 years up to now.

The building site is located in the sedimentary of ancient watercourse of ancient Zhang River which has the stratum of quaternary sediments, river water has the 7.6 PH value and a higher salinity. The static water level of groundwater has the elevation of 27.03m while the stable water level has the elevation of 33m and the water temperature of thermostatic layer is 16 ℃. There are two wells with the spacing of 100m in the yard, one is pumping well and the other is injection well. The depth of pumping well is 100m and of injection well is 140m. Both wells were installed with depth well pump those flow rate is $32m^3/h$ and lift head is $90mH_2O$, the pumps are used for the translocation of supply and return water.

Cold (Heat) source plant with a ground area of 68 m^2 was built about 4 meters away from the hospital building. There are four DNSR-80 heat pump air conditioners and two IS100-160A circulating pumps were installed in the plant. Considering of the ward that requires high stability of cooling and heating, the plant should be able to provide cold and heat that can meet the basic load requirements in any case, one of the four main working units is set standby. Main equipments and technical parameters are illustrated in Table1. To ensure the circulation water of air conditioning system can operate normally, bag expansion tank and pressurization by make-up tank were installed in the closed cycle pipeline of air-conditioning water. To prevent the condenser fouling in winter, electronic de-fouling device was installed in the return water pipeline of working unit and it can relieve the condenser fouling which can worsen the effect of heat transfer.

Outdoor meteorological parameters: in summer, the design temperature of outdoor air is 35° C and the set temperature of indoor air is 28° C; in winter, the design temperature of outdoor air is -7° C and the set temperature of indoor air is 18° C.

Table 1 Main equipments and technical parameters

Equipment	Technical parameter	Number of units
WSHP DNSR-80	Air conditioning or heating conditions Rating cooling capacity 83.2KN Rating Heating capacity 96.4KN	4
Circulating pump IS100-160A	Rating flow 93.5M³/h Rating Head 28mH_2O	2 1 (in operation) 1 (standby)
bag expansion tank make-up tank		1 1

The interior rooms are mainly arranged for ward, operating room, delivery room, duty room etc. Fan coils are installed as the terminal devices of the air conditioning system. Device capacity for operating room and delivery room are set according to the maximum load, and the load of fresh air is not considered. The system diagram is illustrated in figure1.

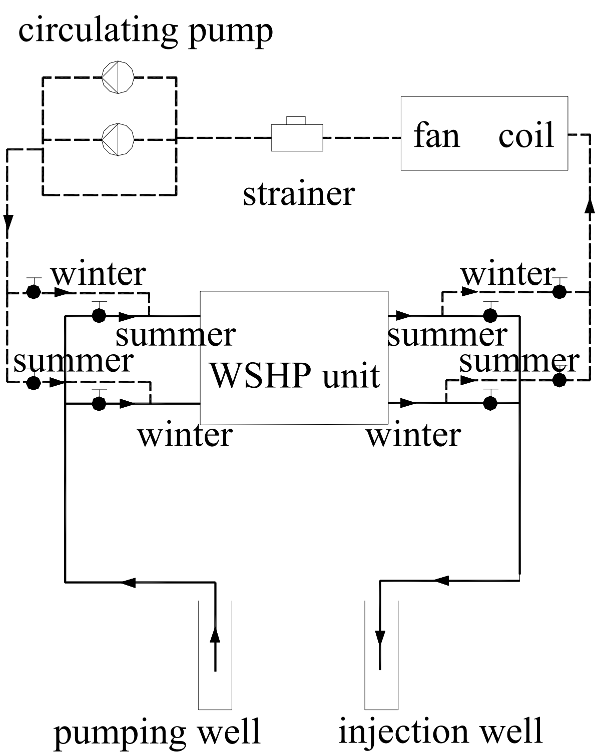

Figure1 Schematic diagram of WSHP system

Control method for the system operation

To ensure the indoor temperature be constant with the changes of cooling and heating load, four WSHP units are installed in parallel controlled by the electrical control cabinet and the number of unites in operation is determined by outlet water temperature. In control strategy, five grade level of outlet water temperature (5ºC, 7ºC, 9ºC, 11ºC, 13ºC) is established. When the outlet water temperature is at 11~13^{o} C, four units be put into operation, when the outlet water temperature is at 9~11^{o} C, three units be put into operation, when the outlet water temperature is at 7~9^{o} C, two units be put into operation and when the outlet water temperature is at 5~7^{o} C, only one unit be put into operation. Figure 2 shows the 24 hours' (average day) actual operating conditions of units in July. Figure 3 shows the corresponding indoor air temperature.

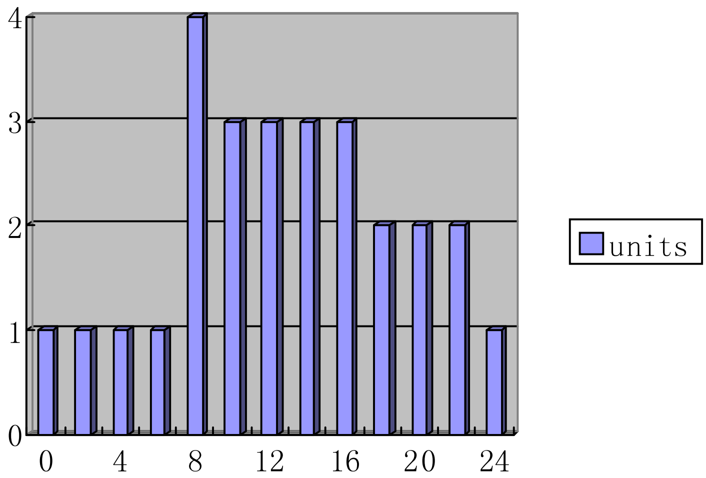

Figure 2 Units in operation
(average day in July)

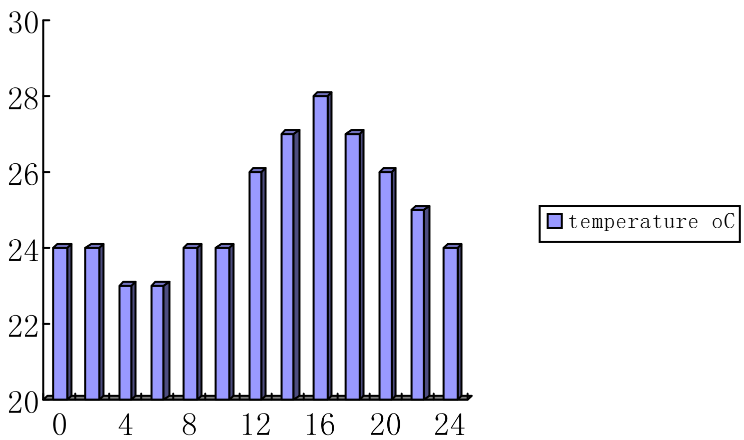

Figure 3 Indoor air temperature
(average day in July)

According to the measured data of indoor air temperature, the average temperature inside the building is 26.5^{o} C during the day and 24.5^{o} C during the night, they all meet the requirements.

Economic analysis

The cut down of the cost of the project can be seen in Table 2:

Table2 Summary table of cost

Project	Total (10^4 yuan)	Unit cost(yuan/m^2)
Investment in equipment	97	200(equipment+installation)
Investment in construction	2.7	2.6
Operating costs (1year)	11.2(by 0.4yuan/kWh)	Summer: 3.3yuan/ m^2 • month (2.5 months in total) Winter: 3.7yuan/ m^2 • month (4 months in total)

Conclusions

The average operating costs of WSHP during the air conditioning period is 3.5 yuan/m^2·month which is much lower than conventional air conditioning system. So it has energy-saving effect.

When the number of operating units is reduced, the water flow rate into single unit will increase. When a reasonable high flow rate and high water temperature is selected, the cooling capacity of air conditioning units will be improved and the room temperature will also meets the requirements.

References

[1] Qisen Yan and Bangyu Xu: *Refrigeration technology for Air-conditional,* Beijing Construction Engineering Press, Second Edition.