

Renovation of Coal-Fired Boiler in Geriatric Ward in North Xin'an District

Beijing Shijingshan District Wulituo Hospital

GGHH Agenda Goals

- **Energy**

Hospital Goal

- Replace the original coal-fired boilers with electric boilers, and run it with 8h off-peak electricity at night.
- Alleviate the tension of heat source in Beijing, save energy and reduce consumption.

Progress Achieved

- The project improved the heating efficiency and degree of automation, while also significantly reducing energy consumption.
- The electric boiler achieved zero pollution, no noise, and reduced the hospital's CO₂, SO₂, and nitrogen oxide emission.

The Issue

Wulituo Hospital is located in Beijing Shijingshan District. Before the renovation, the hospital was heated with a non-press boiler. Though the heating pipe network facilities were completed, the boiler heating system was running in a low heating temperature and low efficiency, it also caused serious pollution. In addition, heating shortage has already appeared. The problem of heating source needs to be solved urgently.

Sustainability Strategy Implemented

According to the current municipal heating mode and the policy of low off-peak power price, the hospital selected two solid heat storage electric boilers to supply heat from different heat sources. The electric boilers store heat while heating at night, and then use the stored heat to supply heat during the daytime. Furthermore, the solid heat storage electric boilers come with a hot air-water heat exchanger, and the hot water produced can directly go into the heating pipe network.

Implementation process

Selection of main equipment:

Drawing on the calculation method of the whole day cooling capacity of Ice Storage Systems, the hourly temperature on the day when daily mean temperature is the lowest among typical years was adopted as a basis for heat load calculations, resulting in the total heating load 246KW. Two 350KW electric boilers were selected. The electric boilers supply and store heat during 11pm-7am, and the heat for 7am-11pm is provided by the heat storage tanks. According to the heat supply and demand balance table 1, the night 8hr heat storage of the boilers is enough to afford the 16hr of heat consumption during the day without the need to start the boilers for supplemental heat. Therefore, according to the heating principle of sub-time heating with different heat sources and the 246KW heating load, the project’s “coal to electricity” heating station influenced the use of two 350KW atmospheric resistance electric water boilers (including heat supply and storage mode). Specific parameters are as shown in the table 2.

Table 1 The balance of heat supply and demand

Thermal requirement per unit		60 W/m ²	Building area	4100m ²	Total capacity of boiler		0.7MW
period	The hourly coefficient	The hourly load per unit W/m ²	Daily maximum heat consumption MWh	The night 8h heat consumption MWh	Daytime 16h heat consumption MWh	The night 8h heat storage capacity MWh	The remaining heat MWh
0	0.96	57.62	0.24	0.24		0.46	
1	0.97	58.33	0.24	0.24		0.46	
2	0.98	58.90	0.24	0.24		0.46	
3	0.99	59.38	0.24	0.24		0.46	
4	1.00	59.72	0.24	0.24		0.46	
5	1.00	59.95	0.25	0.25		0.45	
6	1.00	60.02	0.25	0.25		0.45	
7	0.99	59.68	0.24		0.24		
8	0.97	58.26	0.24		0.24		
9	0.93	55.96	0.23		0.23		
10	0.89	53.12	0.22		0.22		
11	0.84	50.10	0.21		0.21		
12	0.79	47.33	0.19		0.19		
13	0.75	45.13	0.19		0.19		
14	0.73	43.84	0.18		0.18		
15	0.72	43.44	0.18		0.18		
16	0.73	43.64	0.18		0.18		
17	0.74	44.11	0.18		0.18		
18	0.74	44.55	0.18		0.18		
19	0.75	44.79	0.18		0.18		
20	0.74	44.62	0.18		0.18		
21	0.74	44.35	0.18		0.18		

22	0.74	44.25	0.18		0.18		
23	0.74	44.69	0.18	0.18		0.52	
			5.03	1.88	3.15	3.72	0.57

Table 2 Specifications of the main equipment

number	Equipment name	Specifications and parameters	Amount	Remarks
1	The atmospheric resistance electric water boilers	Heating load is 350kW, supply and return water temperature is 95/70°C	2	
2	The atmospheric resistance heat storage tanks	V=55m ³ , the temperature in the tank is 95°C	2	
3	The plate heat exchanger	exchanging heat quantity is 210.6kW, area is 15m ²	2	
4	First side hot water pump	33t/h, 11m, 5.5kW, 1450rpm	3	Two in used, one for backup
5	Secondary side hot water pump	13t/h, 20m, 2.2kW, 1450rpm	3	Two in use, one for backup
6	Softened water treatment device	handling capacity 1.5t/h	1	
7	Softened water supply pump for outer net	0.15t/h, 20m, 0.55KW, 1450rpm	2	One in use, one for backup
8	The straight dirty remover	66t/h, 100W/220V	1	
9	The straight dirty remover	26t/h, 100W/220V	1	

Operation mode of heat-supply system:

As mentioned above, sub-time heating with different heat sources, from 11pm to 7am next day, a total of 8hr heating by boilers using non-peak electricity, minimizes the energy input costs. At the same time, the electric heat storage boiler operates to supply a partial load directly and store the heat required during daytime. From 7am to 11pm, a total of 16hr of heating is provided with heat stored during the night before. The electric heating boiler room also works as a backup heat source and the standby ratio is 100%.

The heating pipe network uses the underground direct burial mode, which has advantages of small occupied road section, good waterproof and short construction period. The current heat network of hospital is a dendritic pipe network system, which is running in a good condition. Thus keeping the current outer net unchanged, the heat source side of the heating network is connected to the current outer net.

Automatic control system:

The structure of the control system is the man-machine interface -PLC- converter - instrument mode. The basic principle is that with the change of the heat users' temperature and the return water pressure, it can automatically control the valve opening, circulating pump and water supply pump speed so as to achieve constant temperature and pressure, as well as the interlocking protection for the system simultaneously. The heating operation units have the initiative to regulate the heating

system about the flow and temperature of water supply network to meet the heating needs of users and ensure a certain economic value.

Water supply scheme of the heating system:

The water source for the heating station is tap water from Tegang Property Company. According to the system's requirement on water quality, automatic water softener is used. A softened water supply pump provides constant pressure for the boiler and hot water system, and make-up water.

Tracking Progress

In the design, construction and operation of the project, the hospital has adopted more mature and reliable energy-saving measures, and selected conservation-oriented systems and products, thus met the State, and Beijing's laws and regulations on energy conservation and environmental protection as well as enhanced users' comfort.

Electric boiler technology has been very mature and has high thermal efficiency and automation; when using the off-peak electricity, the users can also reduce cost. So the social benefits of electric boilers can be seen obviously from technology, market, economy and so on.

In terms of environmental benefits, electric boiler is relatively cleaner, and has no pollution, no noise that can protect the environment and benefit the public. Also, it can reduce the hospital's CO₂, SO₂ and NO_x emission.





Challenges and lessons learned

In recent years, because of the high emissions of SO₂ and other acid gases emission from coal fired boiler, Chinese government has intensified efforts to shut down the coal fired boilers. Oil-fired boilers have also been limited. Though the use of natural gas is vigorously promoted and supported, the development of gas-fired boilers is also constrained because of the tight supply and a rising trend of future price. While, the use of electric boilers can effectively reduce pollution and can be an important way to solve smog in Beijing. For the power grid enterprises, it can improve the utilization rate of off-peak electricity at night and effectively reduce the peak-valley differences of grid load. For power generation enterprises, it can improve the utilization efficiency of the power generation equipment, increase the power generation amount, and reduce the power generation cost. For customers, it doesn't increase the heating costs. Therefore, for the comprehensive consideration of environmental protection, energy-saving, emission reduction, and full use of clean energy, electric boiler is the must choice in future development.

Demographic information

Shijingshan District Wulituo Hospital was built in 1976, and combined with the mental health care institute in Shijingshan District in 1996. It is responsible for health care, outpatient, hospital treatment and rehabilitation of the whole region's mental health communities. As the community health service center in Wulituo, it also undertakes the six-in-one functions of community health service (prevention, health care, health education, family planning, rehabilitation and medical treatment).

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