Study on Clean Heating Technology and Engineering Case based on Computer Aided Implementation in North China

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Abstract. Based on the concept of green and sustainable development, clean heating in northern China has become the key work of local governments, which has been gradually implemented in major cities to meet different heating supply. Therefore, in the new situation, we need to pay more attention to the high quality and sustainable heating mode. Under the new situation, clean heating in northern China needs to focus on optimizing the heating energy structure, which will improve the utilization rate of renewable energy. By strengthening the coordinated planning of the system, we can coordinate the available energy, which will build a multi energy complementary, green and efficient clean heating system. Based on Computer aided technology, we can realize the scheme design of clean heating system. Finally, this paper lists an engineering case.

Keywords: Computer-aided, Northern Area, Clean Heating Technology, Engineering Example

1. Introduction

The climate in northern China is cold and dry in winter. Therefore, winter heating has become a rigid demand of urban and rural residents in winter life. In recent years, with the increasing pressure of energy conservation and environmental protection, governments at all levels have launched coal-fired boiler reduction policies. At the same time, rural areas are the main users of bulk coal combustion¹. Therefore, we need to promote clean energy heating, which will replace bulk coal combustion to respond to energy saving and emission reduction. Clean heating is a way to make full use of clean energy to produce heat for heating, which can meet the requirements of building indoor heating under the condition of thermal comfort consumption of the least fossil energy and the formation of the least pollutant emissions².

In December 2017, China issued the "northern region winter clean heating plan (2017-2021)" , which for the first time clearly defined the definition of clean heating³. Clean energy refers to the energy with low or no pollution to the ecological environment in the process of production, storage, transportation...
and consumption, including geothermal energy, air energy, distributed electronic heating, natural gas, waste heat resources, solar energy, biomass energy, etc. Clean heating is a systematic project of the whole process, involving heat source, heat supply network and heat users. Therefore, we can’t one-sided think that clean heating is only clean energy heating, which needs to pay attention to the key role of heat supply network and heat users in the planning. Therefore, we must implement clean heating, which needs to be optimized from the end of the building, central heating pipe network and heating source[4]. Through building insulation technology, we can reduce the heat demand, which will reduce the loss of transmission and distribution process and excessive heating loss. Therefore, through efficient and clean heat sources, the northern region can finally achieve clean heating[5].

2. Computer aided clean heating technology in rural areas

2.1. Integrated design of heating system

The system adopts "solar energy + capillary network" heating system, which will integrate the whole phase change heating system. Therefore, the clean energy system is applied to the rural heating system, which will transform the rural traditional heating system. By conforming to the concept of increasing income and reducing expenditure, we can provide good indoor thermal environment for rural areas in northern China. In solar heating system, we should use capillary network as terminal heating equipment, which will improve the overall indoor comfort. Through reasonable pipe network equipment, we can make the room temperature distribution more uniform, which will better save energy and heat the temperature[6]. Therefore, through solar energy, we can provide heat source for capillary network, which not only saves energy, but also popularizes clean energy. Therefore, the integrated design of heating system provides a technical basis for clean energy in northern rural areas. The integrated heating system in rural areas is composed of solar collector, water storage tank, pipeline, pumping pump, capillary network at the end, phase change Kang, fire wall, soil heating, etc. The heat storage part is generally an open heat preservation water tank and installed indoors, which is conducive to reducing heat loss and daily maintenance of the system. The control system is composed of temperature controller, water level controller and various sensors. Through the control system, we can realize the automatic control of the solar part of the integrated system, which will make the solar system run reasonably and ensure the efficiency. The integrated heating system in rural areas is shown in Figure 1.

![Figure 1](image)

Figure 1. Design of “solar energy + capillary network + phase change” heating system

2.2. Operation principle of integrated heating system
The operation principle of integrated heating system is shown in Figure 2. When the solar energy can be guaranteed, the system will store the hot water generated by solar energy in the heat storage tank. Through the pump, we can supply hot water to the capillary network to release heat into the room. Among them, the fire Kang, fire wall and soil heating share the Kang stove as the heat source, and the flue gas first heats the Kang stove. The coil pipe provides hot water for the indoor radiator through the water pump, and then the flue gas enters the phase change heat storage Kang and fire wall flue, which can make full use of the waste heat of the flue gas to heat the wall. The phase change material in the phase change Kang will absorb and store more heat, which can store as much heat as possible and increase the indoor temperature. When the indoor temperature decreases, the heat stored in the box transformer material is released to maintain the indoor temperature. Through phase change materials and solar energy, rural areas can save fuel combustion and reduce emissions, which will further reduce the capital expenditure in heating period. The water supply and return pipes are connected between the heat storage tank and the Kang stove. When the solar energy is insufficient, the system can store the hot water heated by the Kang stove in a small water tank, which will provide the capillary network in the room. With the increase of water temperature in the small water tank, there will be scaling or blockage in the capillary network. At the same time, the capillary network can provide indoor heat at 40 ℃. Therefore, the temperature control switch should be set at the outlet of the capillary network. When the temperature is higher than 40 ℃, the circulating water pump is turned off; when the temperature is lower than 30 ℃, the circulating water pump is turned on.

![Figure 2. The operation principle of integrated heating system](image)

3. Computer aided clean heating technology in urban

3.1. Clean heating technology route

The building density of the city is high. Therefore, the clean heating technology in North China has built a complete large-scale central heating system, which has become the main way of heating system. Therefore, clean heating technology should mainly implement clean coal combustion, which will reduce coal consumption and expand heating scale. The heat sources are mainly large thermal power plants and industrial waste heat utilization around the city. Through long-distance heat transmission network, the city can provide heat for residents. Combined with the local photovoltaic and wind power resource conditions, the city can build a supporting electric heating boiler room. According to the natural gas source conditions, the city can moderately develop gas-fired boiler room heating. At the same time, the heating system should continue to optimize the heating network and heating station, which will improve the heating efficiency. Through building energy-saving transformation, northern city heating can reduce building energy consumption. The technical route of urban clean heating is shown in Figure 3.
Figure 3. The technical route of urban clean heating

3.2. Special heating planning under the new situation

The planning method and implementation steps of urban clean heating need to be more carefully demonstrated. Under the background of the new era, the focus of special heating planning should be divided into two aspects, one is to meet the demand of heat load, the other is to adjust and optimize the energy structure, save resources and the sustainability of heating mode, which will put more emphasis on the coordinated planning of heat, electricity and gas. By giving priority to the development of waste heat heating, we can make full use of the waste heat and waste heat of thermal power plants and industries. We must realize the relationship between centralized coal-fired boiler room and clean heating. Clean heating project provides conditions for more efficient operation of centralized coal-fired boiler room. Therefore, in the planning of centralized heat sources, we need to fully analyze the regional resource endowment and carrying capacity. We should highlight the monitoring scheme of coal-fired boiler room operation process, which will ensure that the heat source emission meets the requirements of relevant standards. Therefore, in the previous planning, the dispersed heat sources should be mainly electric energy and gas. Combined with the regional energy situation, cities can make plans to apply renewable energy such as solar energy and geothermal energy according to local conditions. In the planning of heat supply network system, we should emphasize the application of advanced automatic control technology in heat supply network system, which will realize the whole process monitoring of heat supply network system operation. Under the new situation, the technical route of special heating planning should be adjusted accordingly.

3.3. Shijiazhuang clean energy case

The planning scope is Shijiazhuang urban area, and the planning period is 2017-2030. As of 2016, the total heating area of Shijiazhuang city center is 1.48×108m², including 5180×104m² for large-scale coal-
fired thermal power plant, $2296 \times 10^4 \text{m}^2$ for small-scale coal-fired thermal power plant, $4014 \times 10^4 \text{m}^2$ for large-scale coal-fired boiler room and $2500 \times 10^4 \text{m}^2$ for gas-fired boiler room. The heating area of industrial waste heat, sewage source heat pump and electric heating is $810 \times 10^4 \text{m}^2$. Based on the analysis of the energy conditions around the city, Shijiazhuang has formed a heating mode with suburban coal-fired thermal power plant, industrial waste heat (industrial waste heat comes from recycling chemical industry park) and other clean energy (sewage source) as supplement.

4. Conclusion

Clean heating is a major livelihood project that the government pays close attention to, and has made some achievements at present. At the same time, there are still many problems in clean heating, which need to give full play to the role of government guidance. By increasing policy support, we can improve the working mechanism, which will make overall planning, coordination and scientific organization and implementation. According to the technical route of multi energy complementary, we can choose the appropriate heating mode, which will implement the rural clean heating project step by step.

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