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## Simulation and Analysis of Air Source Heat Pump Used in Different Heating Terminal of Beijing Rural House

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### Abstract

In recent years, Beijing rural “coal to electricity” is more and more attention. Among them, the air source heat pump as a clean energy is vigorously promoted, but due to of its low water supply temperature. So, for what kind of terminal equipment need to be researched. In this paper, the two terminal equipment of PE-X pipe are adopted as the low-temperature floor radiant heating and four-post 760 cast iron radiator in the bedroom of a Beijing farmhouse are simulated. The performance of two kinds of terminal equipment is analyzed from four aspects: indoor temperature field distribution, indoor air cleanliness, indoor air velocity distribution and energy consumption. The commercial CFD software was used to simulate the characteristics of two heating terminal equipment. The simulation results show that PE-X pipes as the low-temperature floor radiant heating is better than that the four-post 760 cast iron radiator heating, it has good heating effect.

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## 1. Introduction

Increasingly harsh air environment, forcing to access control coal stage in our country that heavy use of coal, especially in Beijing-Tianjin-Hebei and other in key areas. In this situation, the State Grid launched the “power alternative” work. Among them, “electricity instead coal” is its most important part, hope to use coal to electricity such as industrial boilers, residents heating cooking. “Coal to electricity” has become a trend. [1]

Beijing “coal to electricity” project is a large effective measure to construct low-carbon city. It plays a very important role in accelerating the development of low-carbon economy, building a resource-saving and environment-friendly city. In the meantime, this is also a relation to the vital interests of the people's livelihood projects. “Coal to electricity” project to control the soot pollution, improve the quality of the atmospheric environment has played a positive role. One heating season by household consumption of 1 ton of raw coal calculation, it will reduce the consumption of 121,000 tons of standard coal every year, greatly improve the quality of Beijing air [2]. At present, 2016 “coal to electricity” project has been completed, at the same time to meet the heating season “coal to electricity” users up to 10,000 degrees of electricity demand, make Zhangjiakou, Inner Mongolia, Northeast, Xinjiang and other regions of the clean green power into Beijing, all “Coal to electricity” users will use the Beijing outside clean electricity.

In Beijing rural “coal to electricity” work, the air source heat pump as a clean energy is vigorously promoted, but the supply water temperature is generally below 55°C, more suitable for the use of low-temperature floor radiation heating, but the rural residential more adopt radiator heating. This paper mainly studies the heating effect and indoor environment of two kinds of terminal equipment of low-temperature floor radiant heating and radiator heating, so as to provide engineering basis and technical reference for rural energy conservation work.

### Nomenclature

$Q$	radiator heat dissipating capacity (W)
$K$	radiator heat transfer coefficient (W/ (m <sup>2</sup> ·K) )
$F$	heat dissipation area (m <sup>2</sup> )
$t_{pj}$	radiator import and export hot water average temperature (°C)
$t_n$	winter indoor temperature calculation (°C)

## 2. Methods

### 2.1. Research object

The simulation object is a rural house in Beijing, in this paper, the numerical simulation of rural house is based on commercial software CFD, and the software can accurately simulate the HVAC system in the heat transfer and indoor environment and so on. Here with the help of the software simulation is the main analysis of the rural house using PE-X pipe as low-temperature floor radiant heating and using four-post 760 cast iron radiator heating for two terminal equipment condition contrast about indoor temperature field distribution, velocity distribution, air cleanliness and energy consumption.

The rural house is located in the suburbs of Beijing Haidian, the outdoor design temperature is -9°C, the indoor design temperature is 18°C, the architectural plan of the rural house is shown in Figure 1, the main simulation of the object to the living room of the rural house, the overall size of the living room is 6m×4.5m×3m, the north wall is connected to the outside, the west wall and east wall is connected to heating room. The envelope is made of ordinary concrete, painted inside the wall, east and west sides is the bedroom, use air source heat pump as heat source.

In the living room were placed radiator and floor heating respectively to simulate, as shown in Room 2 of Figure 2, the way to floor heating by laying folding back type, pipe is PE-X, the total length of pipe is 80m, supply water temperature is 48°C, return water temperature is 36°C, room 1 is equipped with four-post 760 cast iron radiator.

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