



A new “wireless on-off control” technique for adjusting and metering household heat in district heating system

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ABSTRACT

Field test results show that 20%–30% of thermal energy is wasted because of poor heating system regulation in China. In order to solve these problems, a new “wireless on-off control” system for adjusting and metering household heat is proposed. The technology works in the following way: 1) a calorimeter is installed in each building to measure the total heat consumption of the building; 2) on-off valves are installed in each household with an individual indoor temperature control provided. The room temperature can be maintained by controlling the valves according to the on-time ratio which is predicted by the thermal strategies; and 3) the heating cost of each household can be allocated according to the heating area and the accumulative open time of the valve. The proposed technique has been applied in twenty-five residential communities with a total area of 2,500,000 m². The test results show that: 1) indoor temperatures were accurately controlled within ± 0.5 °C of the set point; 2) the temperature difference in different rooms is less than 1 °C; 3) energy consumption in the households using a controlled system was approximately 30% lower than a similar within a similar building type with an uncontrolled system.

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1. Introduction

The survey results indicated that there are two factors responsible for making heating energy consumption in northern China approximately 30% higher than what is actually needed [1]. The first reason is that insufficient thermal insulation is applied in buildings, while the second is poor regulation and control of heating systems within buildings. The latter often leads to over-heating of the room, which would then be treated by opening windows. Moreover, a heating bill is charged on the basis of building area instead of actual energy consumption; therefore, the costs for space heating are the same for buildings with identical areas. In this way, home owners do not have a financial incentive to invest in building insulation or other energy-saving measures.

There are three aspects that lead to poor heating system regulation:

- a lack of effective regulation and controlling devices,
- complex and inconvenient operation of devices, and

- a lack of motivation for house owners to change due to the way energy use is currently charged.

Poor regulation of the control system accounts for 15%–40% of the actual heat loss in buildings. The key measures required to solve these problems are: 1) the availability of effective indoor temperature control systems; 2) the installation of acceptable and reasonable heat metering systems.

Currently, room temperature regulating devices in Europe are mainly used to install thermostatic valve in radiators [2]. This has some inadequacies when applied in China:

- (1) Interior heating systems in Europe are primarily twin-tube parallel systems, while in China, single-tube series systems (i.e., all pipes serving each individual room's radiator in an apartment are connected without bypasses; water enters the first room's radiator and passes through each room before exiting the apartment) are predominantly used. If valves are to be installed in each radiator, changing the indoor pipe network would be very difficult.
- (2) Two conditions must be satisfied to guarantee that the thermostatic valve will perform well in controlling temperatures. Firstly, effective control of the outer network is necessary.

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