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The Experiment and Analysis of the Solar Assisted Gas Combination System

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Abstract:This experiment is done during in a typical winter day in Shanghai, using the two models hot water for living and heating water complete of the solar assisted gas winter experiment. The influence of the solar radiation intensity, the outdoor temperature and other meteorological parameters on the solar energy guarantee rate and the gas consumption was analyzed. The experimental show that the meteorological parameters have a significant influence on the solar energy guarantee rate and the gas consumption. In fine weather the weather (average radiation amount is more than 400 (w / $m^{2)}$ alone under the heating mode guaranteed solar rate average of 82%, overcast to cloudy (average radiation dose of less than 250 (w / m^2) was 54%. In fine weather the weather in the heating mode of guaranteed solar rate can reach 10.3%, in overcast or cloudy conditions only 5.09%.

Keywords:solar energy; hot water for living；heating; solar guarantee rate; gas consumption.

I. INTRODUCTION

The experiment was carried out in Shanghai, Shanghai area of solar radiation in recent years average for 4700MJ/m^2, with the development and utilization of solar energy resources, but solar energy is intermittent, unstable, energy flow density is relatively low defects, resulting in the instability of solar thermal systems. Gas stoves can be very rapid and convenient for the building to provide hot water for living hot water and heating, but the use of a separate gas stove heating will consume a large amount of clean energy, and can not achieve the purpose of energy saving [1-2]. In this paper, a solar assisted gas combination system is designed and the typical operating conditions of the experiment are carried out in this paper. It provides valuable exploration for building energy conservation in Shanghai area.

II.INTEODUCTION OF THE EXPERIMENTAL PLATFORM

The experimental platform (solar **a**ssisted gas combination system) is located in Songjiang, Shanghai. This system mainly consists of solar set heat system, gas assisted system, indoor composed of four core part of hot water system at the end, control and monitor the operation of the system. At the same time, the system also has functions of antifreeze, high voltage protection and thermal protection. The process flow of this system is shown in figure 1.

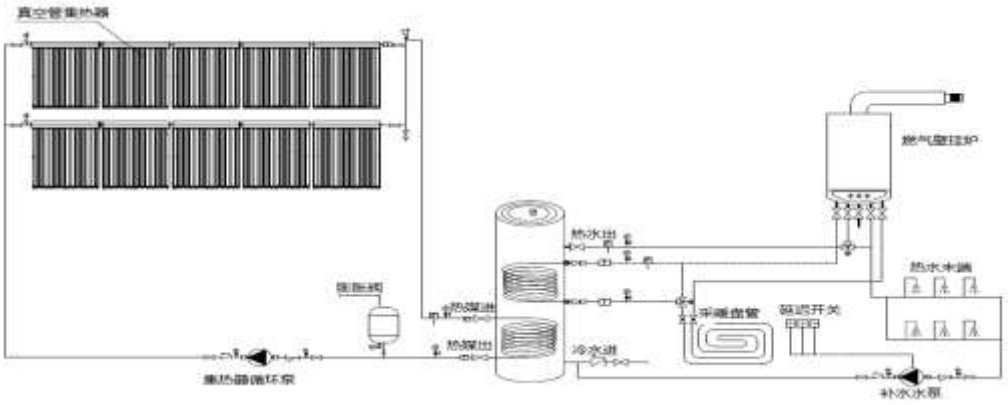

Fig. 1 flow chart of solar assisted gas process

III. DESIGN OF EXPERIMENT IN WINTER

1operation Strategy

According to the characteristics of the experimental platform and experimental requirements we use the following operational strategy. System in a vacuum tube solar heat collector to collect the sun's heat by set of heat exchanger circulating pump stored in the heat storage water tank, if the heat storage water tank temperature to heating requirements directly supply heat end, if to the requirements through auxiliary heater wall mounted gas boiler in supply at the end of the hot end. With the hot end includes a floor heating coil and hot end.

2 Experimental Arrangement

Due to the weak intensity of the solar radiation in winter, the sunshine time is short. Separate for living hot water experiment models only the evening household water, with three each water 50L include bathing and cooking dinner wash 60 DEG C is 150L hot water system design [3-4], the morning to open the set of heat exchanger circulating pump and supervisory control and data acquisition system. at sunset the release of water. Water temperature reached 60 degrees is directly discharged, not up to 60 DEG C is heated by a wall mounted gas boiler to 60 DEG C and then releasing, after shutting down the system. The Second days open the system to start a new experiment. Experiment in Shanghai city in January continuous uninterrupted, for a total of half a month.

January to 2 in early is the coldest time of the year in Shanghai, accounting for 80% of the annual cold weather days. Combined with hot water heating experiments conducted during this period. When the heating coil return water temperature is higher than the upper part of the water tank temperature directly through the wall mounted gas boiler circulation heating, when the temperature of the heating coil is weaker than that of upper part of the water tank temperature is heating cycle through the heating water tank after wall mounted gas boiler circulation heating; if the gas furnace inlet water temperature is greater than 45 DEG C when wall mounted gas boiler automatic shutdown, below 40 DEG C gas wall hanging furnace automatically boot. The heating room temperature reached 20 degrees Celsius, to create a comfortable and warm living environment. Figure 2 is the heating room temperature changes during the day before and after heating. In the hot water heating mode for life to take 24 hours non-stop experiment. At the same time in the evening to provide a family of 150 three liters of 60 liters of hot water [5-6

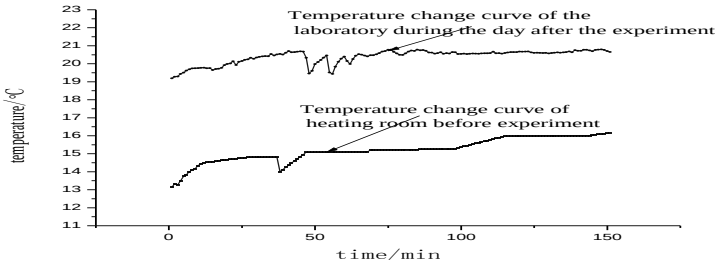

Fig. 2 temperature changes in the laboratory before and after heating experiment

IV. EXPERIMENTAL RESULTS AND ANALYSIS

The purpose of this study is to explore the relationship between solar energy and solar radiation in order to guide the actual winter heating project for the implementation of hot water heating system and analysis of the operating characteristics of the system itself.

The so-called solar energy guarantee rate is the proportion of the total solar energy in the system. As shown in the formula (1):

Solar guaranteed rate $f = \frac{Q_M}{L} = \frac{Q_M}{Q_M + Q_R}$ (1)

Q_M—Solar energy the system get， J;

Q_R—Heat supplied by gas， J;

L— Total heat load of the system ， J;

$Q_M = CM\Delta T = \sum_1^n (T_{jrc} - T_{jrj}) \times C\rho qt$， J;

1 experimental analysis of hot water supply for domestic hot water

Figure 4 Experimental data of solar radiation intensity for five consecutive days in the experiment. Fig. 5 the curve is the relationship between the temperature of the water in the water tank and the solar energy guarantee rate during the five days. Due to the temperature of the water tank has been to not to design temperature of 60 DEG C, so it must be with a wall mounted gas boiler auxiliary heating, also shows the necessity of gas assisted heating.

From Figure 4 can be seen in the five days, three days before the solar radiation curve is arc of rules, the amount of radiation from the beginning has been increased gradually reduced after noon after it reached maximum, one day the sun average amount of radiation in 400 (w / m^2) Above,

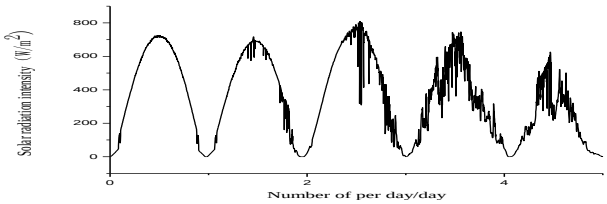

Fig. 3solar radiation intensity (hot water experiment)

No clouds blocking the sun belongs to the fine weather, the water temperature is high. The two day solar radiation curve was irregular, and the average amount of solar radiation was 250 (W/m2). When there are clouds blocking the sun is overcast or cloudy weather, the temperature of the water tank at sunset is lower. The experimental results show that the solar energy is influenced by the weather. Fine when the guaranteed solar rate average of 82%, while in cloudy and cloudy days guaranteed solar rate with an average of 54%.

In addition, the experimental results show that the instantaneous heat transfer increases with the increase of the instantaneous solar radiation intensity. At sunrise and sunset, the collector inlet temperature is greater than the outlet temperature, and the heat exchange rate is less than zero. This is due to the lower outdoor temperature in winter, sunrise and sunset when the heat collector to the outside environment is greater than the heat absorbed by the heat. Figure 6 is when the weather is fine instantaneous solar collector heat transfer data.

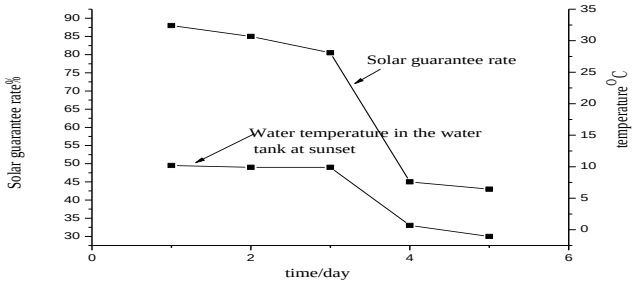

Fig. 4 Relationship between the temperature of the water tank and the solar energy guarantee rate

2 combined with hot water heating mode

2.1Relationship between solar radiation and solar energy guarantee rate

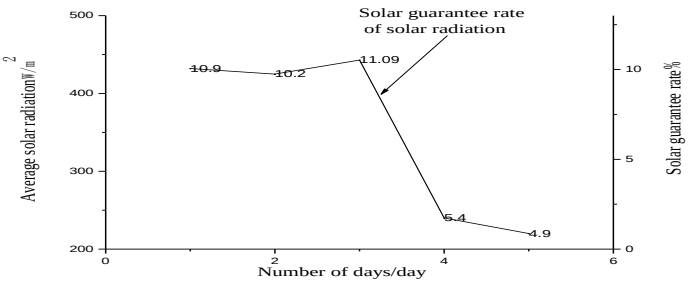

Fig. 5 Relationship between solar energy and solar radiation intensity

This experiment is carried out in Shanghai area in winter, and Figure 5 is the five day of solar radiation in the experiment.

The relationship between solar energy guarantee rate in the five day. In the five days before the three days of good weather (average radiation is greater than 400 (W/m^2)), after two days for cloudy to overcast weather (average radiation is less than 250 (W/m^2)).

Experimental results show that for domestic hot water heating combined mode fine weather average solar guarantee rate was 10.3%; under the cloudy to overcast conditions the average solar guarantee rate was 5.09%. In the hot water heating mode, solar energy guarantee rate and solar radiation are also very positive correlation.

2.2 Relationship between gas consumption and outdoor air temperature

At the same time, the experiment results show that the higher the temperature is, the lower the consumption of gas is. Figure 6 is the life of hot water heating mode for a 6 days of gas consumption and the relationship between the daily average temperature of the outdoor.

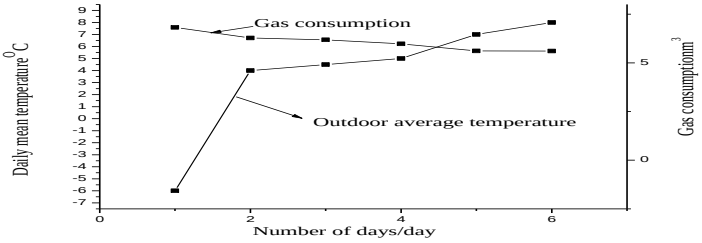

Fig.6 relationship between gas consumption and outdoor air temperature

V. CONCLUSIONS

In the area of Shanghai, completed a solar assisted gas boiler for hot water heating in winter January experiment, the main results are as follows:

1 in a single hot water supply mode in fine weather weather (the average amount of radiation is greater than 400 (W/m2)) under solar guarantee rate is 82% on average; in cloudy to overcast weather conditions (the average amount of radiation is less than 250 (W/m2)) under the guaranteed solar rate with an average of 54%. In the hot water supply heating mode under good weather conditions guaranteed solar rate is about 10.3%; cloudy to overcast conditions guaranteed solar rate is about 5.09%.

2 the instantaneous heat transfer increases with the increase of solar radiation intensity.

REFERENCE

[1]. Chen Yan, Cheng Jinhua. China's energy research review [J]. China energy, 2006 (10).

[2]. Wang Qingyi, Zhang Zhengmin. Development of renewable energy in China [J]. Beijing: National Development and Reform Commission Energy Research Institute, 2001

[3]. ho ho, Zhu Dunzhi. Technical Manual of solar heating and heating application technology [M].Beijing Industry Press.2010.

[4]. Liu Yin. The remote data acquisition system structure research [D]. Hunan: Central South University, 2005

[5]. Fu lvioArdente Giorgio Beccali Maurizio Celluraetal. Life cycle assessment of a solar thermal collector [J]. Renewable Energy 2005 30: 1031 -1054.

Onut and S.Soner

[6]. Energy efficiency ASSESSMENTFOR the Antalya Region hotels in Turkey. Energy and Buildings [J] 2006,38, (8): 964-971.Corgnati S.P,

[7]. V.Corrado, M.Filippi. Amethod for heating consumption assessment in existing and buildings: A field survey concerning 120 schools[J] Italian, 2008,, 40 (5): 801-809.

[8]. Qin XiaopengXiaopeng..Qin solar gas integrated heating system design to explore the [J]. technology innovation and productivity, 2010 (7)The research and design of the cascade control system of the water temperature and circulating water flow in