Combined heating system based on solar collector and district heating

Ivan Nakonechnyi [1], Muron Kuzyk [2]

1. Department of Heat Engineering and Thermal and Nuclear Power Plants, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: ivan.patriot12@gmail.com

2. Department of Heat Engineering and Thermal and Nuclear Power Plants, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: kuzyk.lp@gmail.com

Abstract – The scheme based solar collectors to support heating and hot water in the house, which has installed central heating. Submitted the calculation of the solar installation and its technical capabilities. In addition, a selection of equipment and explains the principle of operation of the solar.

Keywords – solar collector, heliosystem, diagram of covering the needs.

I. Introduction

The rise in prices and the shortage of solid, liquid and gaseous fuels, as well as for electricity makes more and more reflect on the use and development of unconventional sources of energy. Solar energy will play a fundamental role, as a source of heat, and the source of electric power.

On the territory of Ukraine the energy of solar radiation for one annual light day is an average of 4 KW per hour per 1 m2 (in the summer days – up to 6-6,5 KW per hour) that is about 1.5 thousand kilowatt hours per year for every square meter. This is about as much as in Middle Europe, where the use of solar energy is very broad.

Solar collector is the main element of the installation, in which the sunlight turns into heat energy, has proved its effectiveness, as evidenced by the placement of millions of collectors on the roofs of the houses on all continents.

The receipt of such low-temperature heat can be accomplished with flat and Vacuum solar collectors, working on the principle of the greenhouse effect. The physical essence of this effect is that the solar radiation falling on the surface of the solar collectors, transparent to sunlight, practically without any loss of penetrate and getting the receiver of the manifold heats up it, and the process of dispersion of heat energy receiver in the solar collector minimized. Since the main solar radiation in terrestrial conditions is located in the spectral range of 0.4 μm micron -1,8, how transparent top layer is used ordinary glass and having the transmission rate in this spectral range up to 95%. Located at the bottom of the manifold (flat) or inside the tube (vacuum), the receiver of the manifold is an absorbent coating with a coefficient of absorption of solar radiation to 82-95%. Absorbing solar radiation, this абсорбирующее coating can heat up depending on the power of the incident solar radiation to 50-90 ° C. A heated up to the temperature of the body radiates heat energy, the main power is in the infrared range.

In Ukraine the use of solar collectors hampered by expensive prices for them, since the full cycle of their production in the country is missing. However, the rise of energy and an example of the effective use of them in the diaspora will inevitably increase their popularity. There is another serious fact that must be taken into account in the implementation of solar collectors in life in conditions of Ukraine. The majority of the urban population in Ukraine live in multi-storey buildings with central heating. Cottage houses mostly equipped with boiler-houses facilities that provide water and heat supplies during the cold season. The transition to the full use of solar collectors in this situation is technically impractical and costly, especially in the area of heat, bearing in mind the low levels of solar radiation in winter time. Hence, it is necessary to focus on the gradual introduction of solar collectors in life. This means that the parallel use of watering system from the central heating system and heat circulation in solar collectors. The consideration of the possible variant, the implementation of such combined systems on the example of the house, to which a centralized heat supply is dedicated to this work.

II. The task

In this work we have developed a pattern to support the heating and hot water supply for the house, which already placed on the system of central heating. The house is located in Lviv.

Summarizing of our requirements for heating and hot water supplying.

Hot water supply:

1) The consumption – 350 liters/day.
2) The temperature of the hot water – 50 °C.
3) The temperature of the cold water – 10 °C.

Heating:

1) Heating area is 150 m^2.
2) For our convenience we accept that all of the heating system is carried out using a warm floor. So, that is a low temperature heating.

Text have to be prepared in two column separated by 5mm. Paragraph indent should be 3 mm. The page margins and size are given in Table 1.

III. Modeling

Based on the results of modeling, according to our source data and the location of the object, using the service polysunonline.com get that from solar collectors we can in general for the year cover 60 % of the needs in hot water, as well as 20 % in heating, that for solar collectors is a very good result. The total for the year we are covering 32% of our energy needs. To achieve this result, we need 10 solar collectors with an area of 2.5 m^2 each. Hence, the total area of the manifolds is 25 m^2.

Using the service Http://www.polysunonline.com/ we get a chart covering our needs for heating and hot water supply (Fig.1).

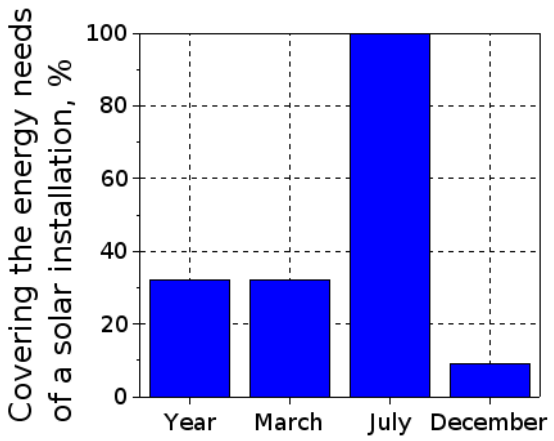

Fig.1 Diagram of covering the needs of heating and hot water supply with a solar installation.

From this diagram it is clear that all three months of summer (June, July and August) we fully cover our needs. This is due to the fact that in summer there is the most arrival of solar radiation, as well as the needs are nevliki (need only in hot water supply). In winter, we cover less of our needs, because, in addition to the need for hot water, we must support the heating system. But in general, we cover 20% of heating for the year and 60% for hot water supply, which significantly saves money and resources.

Consider the installation scheme. Its feature is that the combined install individual heating system based on solar collectors and central heating. Our two sources of heat combined with the tank battery. Solar collectors are connected via the installation of Drainback, which provides the unboiling mode in the heliosystem. This is done in order to improve the lifetime of solar collectors, which are the foundation of the solar heating and, of course, is the most expensive part of the installation, as well as for the prevention of emergency situations in their operation. The heated water in the tank battery and enters the boiler indirect heat, which is aware of its warmth of water, which goes to the hot water supply. In addition, the water from the accumulator is drawn for heating. All control of solar collectors and heat supply from the central heating system is controlled by the control unit.

The heated water in the tank battery and enters the boiler indirect heat, which is aware of its warmth of water, which goes to the hot water supply. In addition, the water from the accumulator is drawn for heating. All control of solar collectors and heat supply from the central heating system is controlled by the control unit. Its inputs is the temperature of the collectors, the temperature in the tank and the battery in the boiler as indirect heating and the temperature of the coolant flow to the warm floor. In the summer of the thermocouple is switched off, because there is no need for heating the building.

IV. Payback period

According to the payback period of this installation, it is approximately 9 years old, not taking into account running prices, and considering that the price for heating and hot water supply tends to increase, the establishment of this installation becomes more and more profitable. The number of collectors can be increased over time without any special system modifications of the installation.

Conclusion

Since the traditional fuel is an exhaustive resource, it must be all the more to migrate to the non-traditional resources. In this case, solar energy will play a decisive role. In this work we have developed a scheme on the basis of solar collectors for heating and hot water supply in the house, which already has central heating. Since the growth of prices for heat supply tends to grow, the use of this installation is a cost-effective and environmentally friendly.

References

[1] F. de Winter, Ed. Thermal Theory and Modeling of Solar Collectors: Solar Collectors, Energy Storage, and Materials, MIT Press, Cambridge MA,1990-43 p.

[2] Netradytsiini dzherela enerhii: teoriia i praktyka: Monohrafiia / Mysak Y.S., Ozarkiv I.M., Adamovskyi M.H.[ta in.]. – Lviv: NVF «Ukrainski tekhnolohii», 2013. – 356 p.

[3] Ozarkiv I.M., Mysak Y.S., Kopynets Z.P. Vykorystannia soniachnoi enerhii u promyslovosti: Navchalnyi posibnyk / Za red. d-ra tekhn. nauk I.M.Ozarkiva – Lviv: NVF «Ukrainski tekhnolohii, 2007.» – 276 p.

[4] Soniachna enerhiia. Retrieved from: http://www.vaillant.ua/dlia-klientiv/korisna-informatsia/available-energy-sources-for-heating/solar-energy/index.uk_ua.html.