TO THE QUESTION OF DESIGNING SOLAR SYSTEMS IN RESIDENTIAL BUILDINGS IN THE CLIMATIC CONDITIONS OF BELARUS

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The price increase of non-renewable resources and environmental problems, associated with their use, lead to a change in energy policy in the world. However, with all the urgency of the problem, there are many barriers to widespread implementation of renewable energy sources, including solar systems in residential buildings.

Radiation conditions in Belarus are similar to many Central European countries with well-developed application of solar energy in building construction and solar architecture and in thermal solar systems. In central Europe, the annual amount of direct and diffuse solar energy on a horizontal surface is 1000 ... 1400 kWh / m^2 (in Germany - 1200, Belarus -1100 kWh / m 2), but the climate of Belarus has long periods with a predominance of the diffuse radiation.

Solar collectors are used for heating water. They convert high-frequency solar radiation into thermal energy and thermal energy accumulator, which smooth irregularity of solar energy and irregularity of consumption of heat by heating and hot water system.

Conventionally, modern solar collectors can be divided into solar collectors with high thermal insulation and solar collectors with single glazing. Evacuated tube collectors gained popularity among solar collectors with high insulation. The major component is the "tube", which consists of a glass flask with double glazing and vacuum gap and heat receiving element. Solar collectors with heat receiving element of aluminum alloy have best thermal qualities. There is a U-shaped copper tube circulating heat transfer fluid inside the thermal element. Due to this design there is a direct contact of heat transfer fluid with heat receiving element.

During the analysis of solar collectors some operational features of vacuum tube collectors were taken into account, for example, the real heat receiving surface of evacuated tube collectors is 0.60 ... 0.62 from its geometric surface (fig. 1).

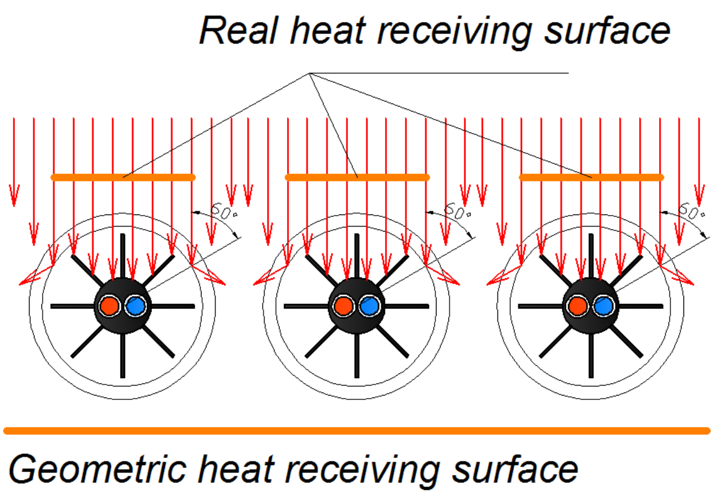

Fig. 1. Evaluation of real heat receiving surface of evacuated tube collectors

For flat-plate collectors, the ratio is 0.9 ... 0.85. Thus, for identical heat receiving geometric surface of tube collectors should be 0.88 / 0.61 = 1.44 times larger. Therefore, when comparing the cost should also be compared the unit cost per square meter of real surface of the flat and tube collectors.

For climatic and operational conditions of Belarus solar flat-plate collectors with a single translucent coating are more appropriate. They differ in the design of the housing, construction of thermal elements, optical and mechanical characteristics of glazing. Glass usually used in flat solar collectors is ordinary window silicate glass, which withstand the impact of large hail and significant bending loads. This glass can have a special outer surface that eliminates the reflection of sunlight at an incidence angle less than 30 degrees. The highest quality flat-plate solar collectors have a high strength of the housing, including bending, and long-term of its existence, as well as the quality and long-term of the sealant of glazing.

Design capacity of the pump or fan G = const (water flow) is designed, as a rule, on the TDP of solar system at nominal value of intensity of the incident solar radiation in the collector area, W/m^2. In this case, the estimated temperature distribution of while moving L (the length of the collector) heat transfer fluid in the flat-plate collector will be linear. Under the influence of the real intensity (with G = const) the temperature distribution along the direction of while moving L of heat transfer fluid is not linear. In the case of the maximum radiation intensity heat transfer fluid reaches maximum temperature, having only part of the way to the exit of the collector, so to increase the thermal power of collector should increase the water flow (G). At low intensity of radiation heat transfer fluid has a minimum temperature, so to raise the temperature and increase the period of operation of the pump water flow rate should be reduced. These findings were obtained by making a series of experiments. The basic scheme for these experiments of water solar collectors is shown in fig. 2.

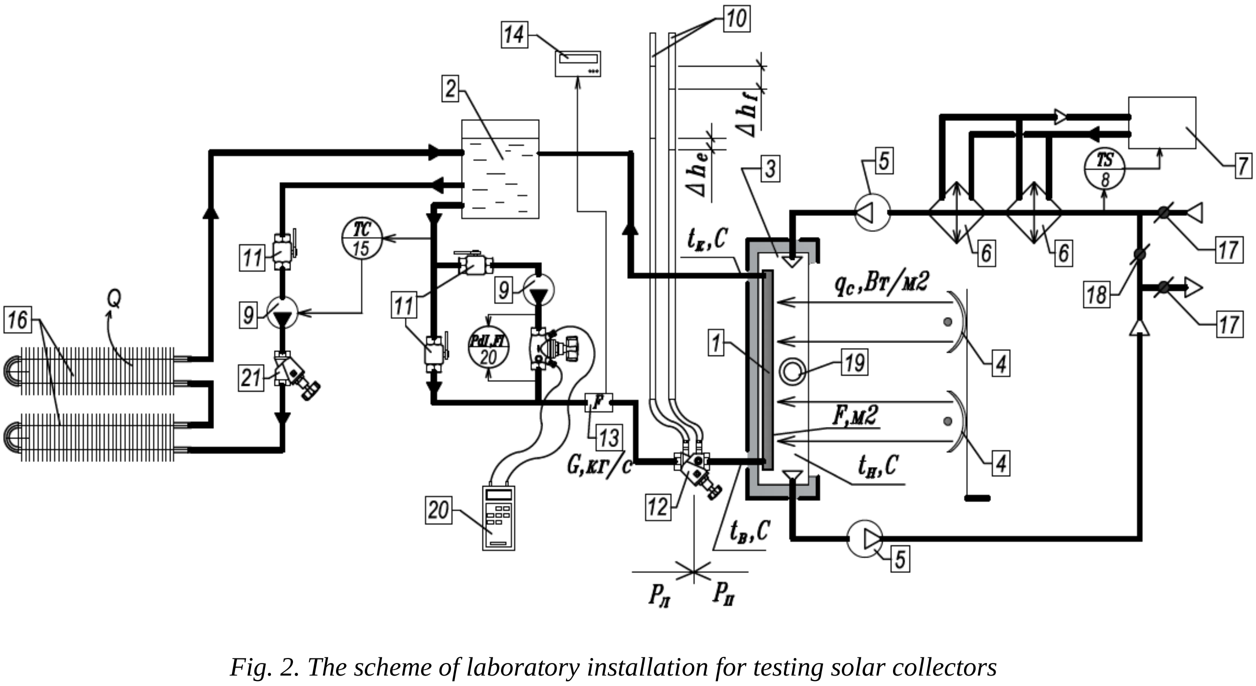

Fig. 2. The scheme of laboratory installation for testing solar collectors
1 – flat-plate solar collector, 2 - storage tank, 3 - thermostatic chamber 4 - halogen lamps, 5 - fans, 6 - air cooler, 7 - refrigerator, 8 - temperature controller in a thermostatic chamber, 9 - circulation pump, 10 - piezometric tube, 11 - ball valve, 12 - balancing valve with measuring nipples, 13 - ultrasonic flow meter, 14 - the electronic block counter of commercial accounting of heat 15 - proportional temperature controller, 16 - water cooler (in the form of two connected convectors), 17 - choke (closed), 18 - choke on bypass (in open position), 19 – pyranometer, 20 - computer to measure differential pressure and flow rate, 21 - balancing valve