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TEST RESULTS OF COMBINED SOLAR PANEL INSTALLATION

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Annotation: The article presents the results of experimental studies of a solar installation, consisting of a field of flat and parabolic trough collectors, for the heat supply of agricultural facilities. It is determined that the efficiency of a solar installation in operating modes is 35 45percentage and it is possible to obtain up to 1190-2230 W of useful heat.

Key words: Solar energy, heat, solar installation, solar collector, thermal characteristics, tests.

Introduction

Recently, throughout the world, and especially in Asian countries, interest in renewable energy sources has increased; this is also relevant for Uzbekistan [1].

However, in these regions, that is, Europe, Asia, Australia or parts of South and North America, solar energy is mainly used either for heating homes or for generating electricity [2]. In this case, one of two things is almost always meant: either small flat solar collectors, installed, as a rule, on the roofs of houses and used for heating and hot water supply, or large industrial-type solar power plants based on the so-called parabolic cylindrical concentrators, designed to supply energy entire regions.

Solar energy cannot fully satisfy the energy needs of an agricultural facility, however, a significant part of traditional energy resources can be saved, in this regard, solar energy has its own prospects [3].

The purpose of this work was to develop and study a combined solar installation consisting of a field of flat-plate and parabolic-cylindrical collectors.

Figure 1 shows a general view of a combined solar installation consisting of a field of flat-plate and parabolic-cylindrical collectors.

Fig. 1. General view of the experimental combined installation for producing hot water.

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Main part.

The main structural element of a parabolic-cylindrical collector is a parabolic-cylindrical concentrator, the frame of which (Fig. 2.) was a V-shaped frame on which there are reflective coatings. The parabolic-cylindrical shell of the concentrator is formed by elastically curved supports made of stainless steel sheet, 2 mm thick. Sheets of mirror aluminum are laid on top of the cradle and secured using special side clamps. The mirror aperture dimensions are 1.7 5 m, focal length 650mm, coverage angle - 120°. The concentrator with a heat sink is suspended on two welded trusses, ensuring its installation at a given angle to the horizontal. The weight of the energy module of the parabolic-cylindrical collector is 257 kg.

Fig 2. Energy module of a parabolic-cylindrical collector

A flow-through solar radiation receiver is installed in the focal plane of the concentrator on three adjustable stands. Considering that this installation is designed for low operating temperatures (80-200°C), a simple and technologically advanced design of the heat sink was used. The receiver is a steel pipe with an outer diameter of 42 mm, coated with heat-resistant black paint KO 819 with a solar radiation absorption coefficient AS=0.91.

For thermal insulation, the heat receiver is placed in a tube made of molybdenum glass dH=70 mm, wall thickness =1 1.5 mm. In the non-irradiated sector, the gap between the radiator and glass tubes is filled with heat-insulating material - asbestos; The outside of the glass pipe is covered with polyurethane foam. The collector energy module is equipped with an automatic solar energy tracking system, located horizontally and oriented in the west-east direction. The installation scheme with a horizontal optical axis has significant advantages, in particular, a simplified design of supports and elements of the solar tracking device.

To work together with a parabolic-cylindrical collector, a simpler design of a flat solar collector was developed and studied (Fig. 3).

Fig. 3. General view of a flat solar collector

In the future, it is planned to jointly test this type of flat-plate collector with a parabolic-cylindrical collector [4]. The solar flat collector is structurally a flat, thermally insulated box. The upper plane of the box is formed by a transparent coating made of ordinary glass. Under the glass, inside the box, on a layer of thermal insulation, there is an absorbent panel with pipes for draining and supplying water. The panel is made of standard aluminum panels with longitudinal channels stamped into them for the passage of water, ending in two pipes. The total area of a single collector is 0.75 m2. The collector body is a box made of sheet aluminum with holes for the passage of the absorber panel pipes.

Let's consider the principle of operation of a combined solar installation: in it, water is initially heated in flat-plate collectors to a temperature of 35-50°C, then this hot water is supplied to a parabolic-cylindrical concentrator, where a temperature of up to 90-190°C is reached. In this case, it is necessary to establish the optimal field (approximately including 55% flat and 45% parabolic-cylindrical collectors).

The results of calorimetry of the experimental installation with a forced flow of water through a receiver with a constant flow rate made it possible to determine the thermal efficiency in various modes depending on the magnitude of direct solar radiation and environmental parameters and amounted to 36 42% in operating modes, while it can up to 2.9 kW of heat can be obtained (Fig. 4).

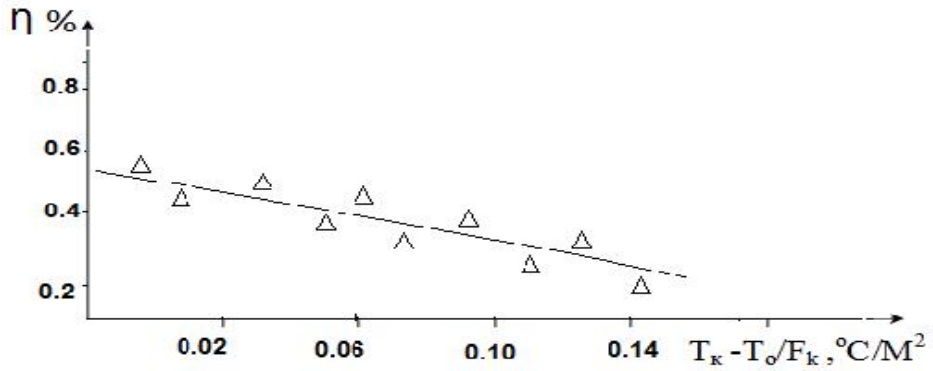

Fig. 4. Thermal efficiency of a solar parabolic-cylindrical collector

Table 1.

Results of calorimetric tests of a combined installation with a parabolic-cylindrical and flat-plate collector

Date	τ watch	E_0 Вт/м^2	t_0 ^{0}C	V м/с	$G_{пцк}$ кг/ч	$t_{вх.плк}$ ^{0}C	$t_{вых.пцк}$ ^{0}C	$Q_{пол}$ Вт	$Q_{пад}$ Вт	η%
22.08	14^{40}	730	**36**	**0**	55	18	84	2463	6158	40
24.08	15^{00}	730	**30**	**0.5**	35,4	18	78	2457	5475	40
28.08	13^{00}	650	29	1.5	36,4	18	68	2110	5553	38
02.09	13^{45}	650	32	1.0	33,3	18	72	2086	5490	38
04.09	13^{30}	640	29	0	27,4	18	82	2024	4600	44
07.09	14^{35}	615	31	0	31	18	64	1650	5290	31

From the results of calorimetry of the installation shown in Table 1, it can be seen that the drop in solar radiation (direct and diffuse) at noon was 460-730 W/m2, i.e. relatively small due to the dustiness of the atmosphere. At the same time, it was possible to obtain 1280-2460 W of useful heat, which corresponds to the efficiency of the combined installation up to 31-43%; These figures are quite consistent with the average efficiency values of this class of installations with a black-coated absorption receiver. The greatest interest for the joint operation of collectors is the low-flow mode for generating steam for technological needs [5]. The corresponding studies are expected to be carried out during further research into the operation of the combined installation.

Conclusion

In general, the positive experience gained in developing a combined solar installation consisting of a field of flat and parabolic-cylindrical collectors, as well as research into the possibility of its operation in various modes close to real ones, allows the developed design to be recommended for use for heat supply to industrial and small enterprises.

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