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CHARACTERISTICS OF SOLAR COLLECTOR OF TEXTILE MATERIALS

I.K.Zhmakin, Ph.D.

All-Russian Research Institute for Electrification of Agriculture, Moscow

LI Zhmakin, Ph.D.

AA Kryukov, Ph.D.

Moscow State University of Design and Technology, Moscow

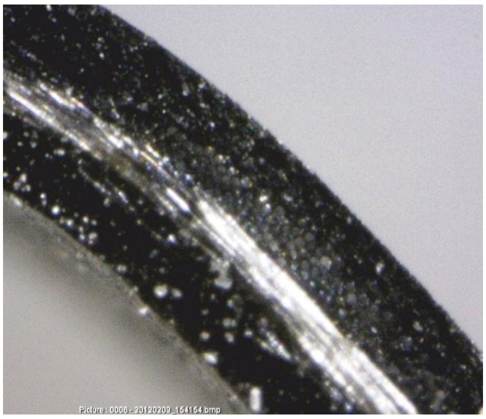
Describes a solar collector to heat water, the absorber is made of water-resistant fabric with a polymer coating. An experimental study of its thermal characteristics. Experimental data obtained from the coefficients of heat loss and efficiency of these collectors. A number of reservoir characteristics determined using mathematical modeling.

Solar collector, water-resistant fabric, the coefficient of heat loss, the efficiency of the collector.

Currently, the most common and mastered the technology in the solar power industry is a seasonal hot water using a flat-plate solar collectors [2]. As they develop a low-grade heat, saving energy, reducing the region's reliance on imported fuel and reduce emissions of harmful substances into the environment.

The purpose of research - development of a collector of modern textile and polymer materials.

Materials and methods of research. As is known, the main element is the water-filled reservoir cover (absorber) in which absorption occurs in solar radiation and its heat transfer fluids. We have developed and investigated a prototype collector panel produced with the help of adhesive technology from two panels watertight awning fabric in black with a double-sided PVC coating. We used cloth brand «Unisol - 630", manufactured by the South Korean firm «Hanwha». It had a thickness of 0,53 ± 0,02 mm and a surface density of 630 g/m2 ± 0,4%, and it served as a basis polyester yarn 1100 dtex. According to the manufacturer of this fabric is operable in the temperature range -30 ... +70 ° C and can withstand water pressure up to 3 bar. In the process of bonding the panel in it, a system of parallel channels (17 pcs.) For fluid flow and two hydraulic reservoir - handing out and collecting. In recent mounted fittings for water.



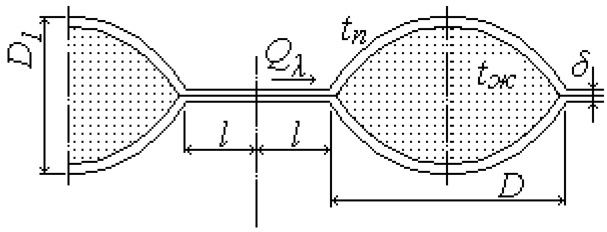


Fig. 1. End tissue section **Fig. 2. Channel configuration in tissue panel**

Fig. 1 shows a front section of water-resistant fabric at 100 - fold increase, and Fig. 2 - channel configuration in the panel. Channel section is formed by two circular segments with the size D = 19 mm D1 = 12 mm channels linked by edges to half-length l = 6 mm, thickness edges δ = 1,06 mm.

Fabric panel area was 0.84 m2, and she had a size of 1320 x 640 mm, dry specific gravity of 1.7 kg/m3 and accommodates 4.4 liters of water. In experiments panel housed in insulated casing with a coating of transparent polycarbonate sheet thickness of 4 mm. Polycarbonate is opaque to radiation with wavelengths λ <380 nm, and thereby protect the textile panel from damaging ultraviolet tough. In the visible region of the spectrum of its transmittance is high and is 81,5-82% [1].

Rejection of traditional solar materials (metal and glass) allowed us to significantly reduce the specific gravity of the reservoir and increase Sit its impact resistance while maintaining satisfactory Thermotechnical-cal characteristics, as confirmed by laboratory tests and experiments in natural conditions (Moscow). Recent conducted using a quasi-stationary method for universal thermal-hydraulic test a closed-loop circulation of the coolant. Automated system for recording and processing of the experimental data that is connected to a personal computer, let the specified interval to record and archive the results of the measurements. On the stand of the instantaneous efficiency of the collectors:

$$\eta = gc_p (t'' - t')/E . \qquad (1)$$

Equations are approximated Wheeler and Wheeler-Hottel-Bliss [6]:

$$\eta = F_R\eta_0 - F_R U_L \frac{t' - t_0}{E} = A_1 - B_1 t_1^*; \qquad (2)$$

$$\eta = F'\eta_0 - F'U_L \frac{0{,}5(t' + t'') - t_0}{E} = A_2 - B_2 t_2^*, \qquad (3)$$

where F_R and F '- the coefficient of heat from the collector and the effectiveness of absorbing panels; U_L - total loss factor, E - radiant flux density; g = G / F_K - specific water flow (G - consumption, F_K - panel area); c_p - specific heat of water; t 'and t" - the temperature at the inlet and the outlet; t_0 - ambient temperature - optical efficiency (the product of the transmittance of the coating and the absorption coefficient of the panel) - the reduced tempera ¬ tour. Equations (2) and (3) establish a linear relationship between the temperature efficiency and reduced provided that the loss coefficient is constant. In the corresponding dance with current standards is a complex $A_1 = F_R\eta_0$; $A_2 = F'\eta_0$ and $B_1 = F_R U_L$; $B_2 = F'U_L$ are the basic parameters of heat engineering excellence solar collectors.

The results of research. Regression equations for the instantaneous efficiency of the collectors with textile absorber obtained from full-scale tests are of the form:

$$\eta = 0{,}69 - 6{,}37 t_1^*;$$

$$\eta = 0{,}72 - 6{,}81 t_2^*.$$

Instrumental efficiency measurement error does not exceed 12%, but the scatter of the experimental points leads to an additional error of approximation, is 5 - 7%.

For solar panel with fabric were held and independent measurements of the coefficients of heat loss using the regular cooling mode [5]. They were conducted in a laboratory room during the cooling off collectors with liquid circulation. In the experiments a fixed temperature of water in the panel at different timings. Of the differential equation of heat balance collector can obtain the following expression for the total loss factor:

$$U_L = m c_p M_{жс} / F_к, \qquad (4)$$

where M_x - the mass of water in the panel; m - its rate of cooling, determined by treating the corresponding thermogram. The average value of the loss factor for the collector panel with fabric was found to be 5.77 Vt/m^2gr, which is 10-15% higher than the losses of domestic sewers without selective coatings [3, 4].

By mathematical modeling [6] for the textile panel solar collector has identified the following characteristics:

1) the effectiveness of the edge (the thermal conductivity of tissue at 0.22 W / mK) Ep = 0.73;

2) calculated the temperature distribution along the length of the ribs;

3) The effectiveness of the textile panel collector F '= 0,84;

4) the proportion of conductive heat flow Qλ from the ribs to the liquid in the channel with 31% of the total energopostupleniya.

In the simulation were also calculated water temperature at the outlet of the panel, as well as the production of heat-collector under different external conditions, the coefficients of heat loss to the environment. Calculated data within the error consistent with those found experimentally.

Conclusions

Technical and economic evaluation showed that the cost of parts, materials for the manufacture of prototypes collectors with textile panels are about 1,400 rubles. It is hoped that the mass production of their cost will not exceed 2000 rub/m2. The use of these reservoirs will be economically justified in decentralized consumers with hot water, but only if they replace the heat generated by electric water heaters. For example, in central Russia, according to our calculations, they will be repaid in two seasons of operation.

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