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DEVELOPMENT OF STATIONARY PARABOLOCYLINDRIC SOLAR WATER HEATERS

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ANOTATION

This article presents the development of stationary parabolocylinder concentrator-based water heaters, their daily heat generation capacity, the results of experiments and the economic performance of the device.

KEYWORDS: ***solar*** *water heater, stationary hub, accumulator tank, receiving pipe.*

INTRODUCTION

It is known that one of the main conditions for the technical development of civilization of both individual states and the world community as a whole is the degree of energy supply. Modern energy production is based mainly on the combustion of oil products - 33%, coal - 28%, gas 25%. The rest of the balance is provided by all other energy sources, including nuclear energy, hydro and other renewable energy types [1]. Due to the growing population of the Earth and the demands of economic growth, the need for energy is constantly increasing, while the reserves of fossil fuels, primarily oil, are being depleted. At the same time, energy production from the combustion of fossil fuels leads to the release of gigantic and ever-increasing volumes of carbon in the form of greenhouse gases that poison the human environment and cause global climate change.

Under these conditions, mankind is forced to turn to renewable energy sources (RES) - the sun, wind, water, geothermal energy reserves in order to ensure the sustainability of energy supply in the present and future. The technical potential of renewable energy sources is quite sufficient to meet the growing needs of mankind for clean "green" energy that does not pollute the environment. It is for this reason that the development and expansion of the use of renewable energy sources are considered by many countries as the priorities of national energy programs for the foreseeable future [2-5].

In Uzbekistan, the technical potential of renewable energy sources is about 180 million tons of oil equivalent (toe), which is three times higher than its current energy consumption. At the same time, 95.5% of the potential of all renewable energy sources falls on the share of solar energy. The number of sunny days in Uzbekistan is 250-270 days a year, and the maximum direct solar radiation flux density reaches 1100 W / m^2. Therefore, the use of solar energy as the main source of renewable energy is the most natural and appropriate choice [6].

MATERIAL AND METHODS

Currently, there is a steady development of two main areas related to the conversion of solar energy into other types of energy. The first direction is the design and commissioning of tower-type solar thermal power plants, the second is the development and use of parabolocylindrical concentrators with linear focusing of the directional solar radiation flux. Solar devices based on parabolocylindic concentrators are widely used in agriculture and utilities, industry, as well as for various purposes, including heat supply, electricity generation, water

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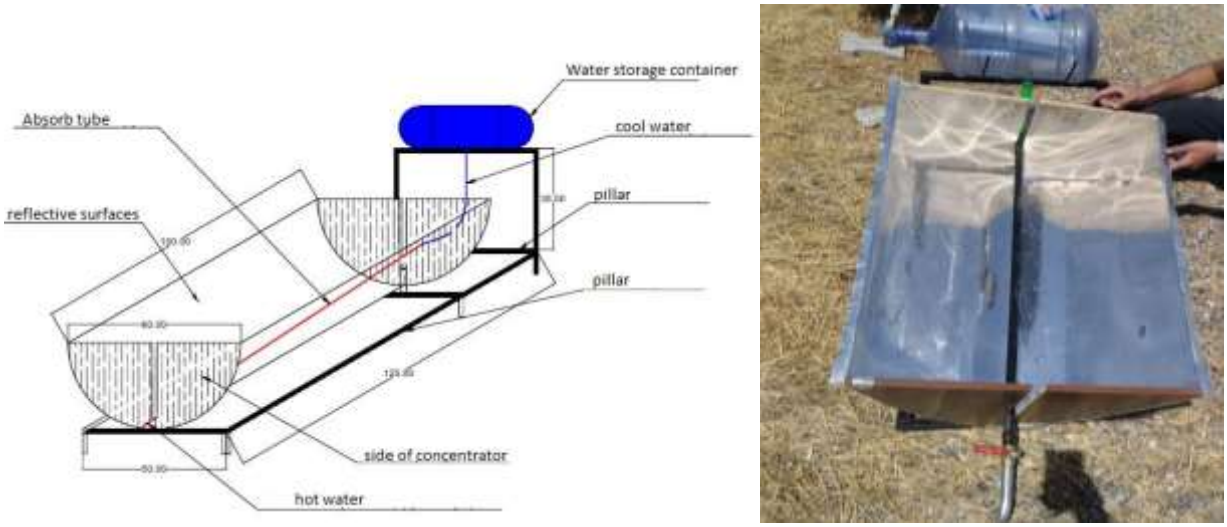
softening, cooking, cooling [7-8]. Despite the fact that research methods of these types of devices are widely studied in the field of economics, there are a number of scientific and technological challenges to their introduction into the economy of our country. In particular, the development of methods for determining the optical-geometric and optical-energy parameters of the device, depending on the purpose of use, the development of economically economical structures, the simplification of the operating modes of the device and increase efficiency.

In view of the above, this work involves the development of an experimental design of a stationary concentrator parabolocylindrical household solar water heater and the determination of their experimental results and economic performance.

Figure 1. shows a simple schematic diagram (a) and an overview (b) of a stationary concentrator parabolocylindrical home solar water heater.



a) b)

Figure 1. Construction scheme and general appearance of a parabolocylindrical solar water heater.

Figure 2.Parabolic cylindrical concentrator with hot water storage accumulator.

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This device consists of the following elements. The parabolocylindrical surface, which receives sunlight, consists of a tube that receives the sunlight, a water storage vessel, supports, a tap that serves to discharge hot water, and parabolocylindrical surfaces.

Geometric dimensions of the device:

Collector section - 1.15m x 0.6 m;
Base part - 0.5m x 1.25m;
Tank capacity - 19 l;
Height -0.55 m;
The diameter of the light-receiving tube is 0.015 m;
The length of the light-receiving tube is 1.15 m;

Optical parameters of the device:
Surface light reflectance - 0.75;
The light absorption coefficient of the receiver is 0.9.

The reflective surface of the parabolocylindric solar water heater is a silver-colored material with a thickness of 0.05 mm.

DISCUSSION RESULTS

The results of the experiments performed on the developed experimental stationary parabolocylindrical solar water heater are given in Table 1.

Table 1. Results of experiments performed on a parabolocylindrical device at different times of a sunny day

№	Days	hours	t◦C (temperature of environment)	t◦C (temperature of water in the container)	t◦C (absorb tube temperature)	t◦C (absorb tube temperature with water)	t◦C (outlet water temperature)	Wind speed (m/s)
1	12.06.2020	15:15	30	27	77	65	59	2
2		16:15	28	25	74	62	58	
3		17:15	27	24	69	60	56	
4	16.06.2020	11:00	32	26	78	64	60	2
5		11:30	33	28	80	65	63	
6		12:00	35	29	82	68	66	
7	18.06.2020	11:10	26	18	62	56	53	3,2
8		13:00	28	32	69	64	60	
9		13:30	30	33	70	65	62	

Experiments show that with the help of a developed device (on a sunny day) it is possible to get 60 liters of hot water at 60-65 ° C for domestic service needs.

The cost estimates of materials used to develop an experimental model of a stationary parabolocylindric water heater are given in Table 2.

Table 2. Costs for device development

№	Material name	units	quantity	unit price (*in USD*)	total cost (*in USD*)	note
1	Metal tin	m^2	0,9	5,600	5,600	
2	Reflective foil	m^2	0,9	5,230	5,230	
4	Tube	M	1,2	2,150	2,580	
5	Profile	m	5,5	2,140	11,770	
6	Container	L	19	3,120	3,120	
7	Faucet	piece	1	1,750	1,750	
8	Other expenses				9,363	
Total					39,413	

The cost of preparing a stationary solar water heater to receive 60 liters of hot water per day (domestic) for domestic services amounted to 39,413 USD.

CONCLUSION

1. The design and experimental design of a stationary solar water heater for domestic service needs have been developed.

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2. Experimental tests were carried out in natural climatic conditions using the developed device.

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