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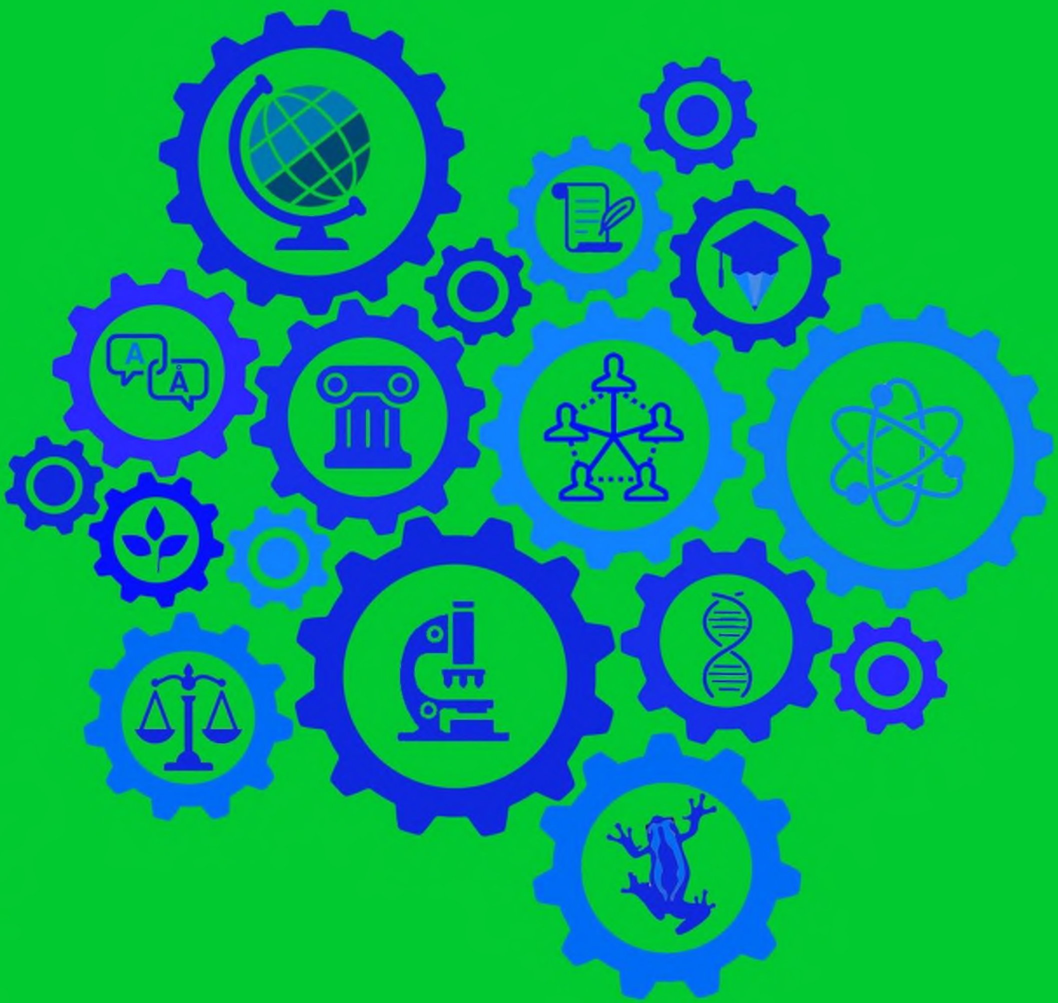

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CONSTRUCTION OF PARABOLIC AND PARABOLOSLINDRICAL CONCENTRATORS AND ANALYSIS OF THE OBTAINED RESULTS.

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Annotation. To meet the rapidly growing needs of humanity, scientists around the world are proposing the use of alternative energy sources. Solar energy - an inexhaustible source of energy - received by the Earth, is approximately $1.8\text{x}10^{11}$ MW, which is many times higher than the current level of consumption. Solar energy technologies can be quickly deployed and have the potential for a global transfer of technology and innovation. In order to manufacture parabolic and parabolic cylindrical concentrators, an analytical review of these two types of solar devices was carried out and, after their creation, experiments were conducted on them in the season of maximum solar radiation. The article also presents data and their comparison for planning subsequent actions of research activities.

Keywords: solar energy, concentrators, radiation, parabolic concentrator, parabola, parabolic cylindrical concentrator, temperature, energy.

Solar energy - an inexhaustible source of energy - received by the Earth, is approximately 1.8x1011 MW, which is many times higher than the current level of consumption [2]. In this way, it can regularly meet all the future energy needs of the world. In addition, two main advantages of solar energy: unlike nuclear and fossil fuels, it is an environmentally friendly source of energy, and the other is its availability in sufficient quantities throughout the world. Solar high temperature designs require concentrating systems such as parabolic reflectors. Solar thermal power plants with concentrated technologies are important to provide most of the solar electricity needed over the next few decades. A review of the existing literature revealed that it is advisable to use solar concentrators in the areas indicated in Fig. 1.[3]

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Fig.1. The feasibility of using solar energy in the processes of generating electrical energy through the use of solar concentrators: - optimal; - very good; - good ; - unfavorable.

To date, there are 4 main types of concentrators: parabolic-cylindrical, parabolic, solar tower, Fresnel lenses. For our research activities, we have chosen parabolic and parabolic concentrators.

Serious environmental problems and the finite reserves of fossil resources lead to the need to create new sustainable energy production options that allow the use of more economical renewable energy sources. Solar energy has many advantages, including environmental protection, profitability, and the creation of new jobs. Solar energy technologies can be quickly deployed and have the potential for a global transfer of technology and innovation. During the year, a huge amount of energy enters the Earth’s surface (3.65 × 1024 J or 1.08 × 1018 kWh). This amount of energy is more than 10,000 times the annual human consumption of all kinds of energy. Current global energy consumption shows that approximately 84.7% of global energy is consumed from fossil fuels, and only 9.9% from renewable energy sources. World energy consumption is projected to increase by 50% from 2005 to 2030 [1].

Hubs are optical devices that increase the flux density of solar radiation. For solar power plants with thermal cycles of energy conversion, concentrators allow you to create the high temperatures necessary to produce steam with certain parameters. The shape of the reflective surface of the paraboloid is formed by the rotation of the parabola around the axis of symmetry. One of the properties of a parabola is the convergence of all light rays incident parallel to the main optical axis (axis of symmetry) in focus. A paraboloid creates an image of a distant object in the focal plane. Parabola belongs to the category of high-potential concentrators, the radiation concentration of which can exceed 104 [2]. Therefore, for our research work, we decided to manufacture and experiment two types of concentrators: parabolic and parabolic. In some concentrators, the radiation of the sun is focused along the focal line, in others - at the focal point, where the receiver is located. When solar radiation is reflected from a larger surface to a smaller surface (to the surface of the receiver), a high temperature is reached, the heat carrier absorbs heat moving through the receiver.

The advantage of systems with concentrating solar receivers is the ability to generate heat with a relatively high temperature and even steam. The disadvantages include the high cost of construction; the need for continuous cleaning of reflective

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surfaces from dust; work only in the daytime, and, therefore, the need for large-capacity batteries; high energy consumption for the drive of the tracking system for the solar movement, commensurate with the generated energy. These disadvantages hinder the widespread use of active low-temperature solar heating systems with concentrating solar receivers. Recently, most often for solar low-temperature heating systems, flat solar receivers are used.

Parabolic concentrators are in the form of a satellite dish. The parabolic reflector is controlled in two coordinates when tracking the sun. The energy of the sun focuses on a small area. Mirrors reflect about 92% of the solar radiation incident on them. In the focus of the reflector on the bracket, a Stirling engine, or photoelectric elements, is fixed. The Stirling engine is positioned so that the heating region is in focus of the reflector. The main advantage of such devices is that it is a proven technology. The disadvantages include the following: high costs relative to other "green" sources; low coolant temperature; in some cases, such systems require the provision of water, which is not easy in desert conditions; the installation site should not have a slope of more than 1%.

Below are comparative tables of characteristics of solar thermal power plants using parabolic cylindrical and parabolic types of concentrators. [3], [4].

To obtain reliable data and compare them with each other, two options for the experimental setup were selected. A standard offset satellite dish with a diameter of 1.8 m was taken as the base of the parabolic solar concentrator of the first embodiment. The antenna surface was covered with a cotton cloth and pre-prepared 3x4 cm mirror pieces were glued onto it. The total surface area is 2.54 m2.

Fig.2 Appearance of the fabricated parabolic concentrator

The second experimental setup in the form of a parabolic cylinder concentrator was made on the basis of the parabola function

$$Y^2 = 4500 * X.$$

To do this, originally wooden planks measuring 2.4 m in length and 2 m in width were parabolic in shape. They served as the foundation for mounting on them two reflective surfaces 2 m long and 80 cm wide. Between them 30 cm of space were left, because there is a focus on top and reflective radiation should not fall from it. On the stand of the concentrator, whose height is 1 m, levers are attached, the purpose of

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which is to manually adjust the position of the device depending on the location of the Sun. These levers can change the height of the hub supports that support it from all sides. The total surface area is 3.2 m2.

Fig. 3 Appearance of parabolic cylindrical hub

Having mounted the solar installations in certain places, the following work was carried out, namely, from 8 a.m. to 20 p.m., the external temperature and the temperature in focus at both concentrators were measured with a digital sensor every hour. Based on the data obtained, the values of solar radiation, the amount of incoming energy, as well as the mass of water that will be required for heating using the received energy were calculated by calculation. Below are the experimental results.

Table 1. The dynamics of thermal parameters in the hourly interval of the day in the summer

№	Hourly interval	Outdoor air temperature °C	Temperature in focus of a parabolic concentrator, °C	The temperature at the focus of the parabolic cylinder concentrator, °C	Solar radiation, V/m^2	The amount of energy, MJ * h	
						parabolic concentrator	Parabolocylindrical hub
1	8.00-9.00	32	192	117	418	3.83	4.81
2	9.00-10.00	36	291	137	528	4.82	6.08
3	10.00-11.00	42	332	151	671	6.14	7.73
4	11.00-12.00	44	394	171	770	7.05	8.87
5	12.00-13.00	44.5	412	187	814	7.45	9.38
6	13.00-14.00	45	425	195	825	7.55	9.5
7	14.00-15.00	46	440	199	803	7.35	9.25
8	15.00-16.00	48	511	214	770	7.05	8.87
9	16.00-17.00	46	473	189	605	5.54	6.97
10	17.00-18.00	42	412	174	462	4.23	5.32
11	18.00-19.00	40	394	156	330	3.02	3.8
12	19.00-20.00	38	248	137	154	1.41	1.77

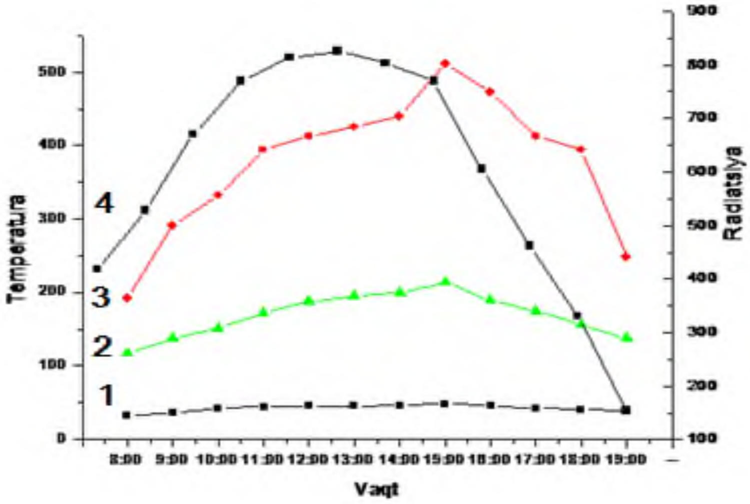

Fig. 4 Graph of the temperature in the foci of experimental plants on solar radiation in the hourly interval of the day: 1-ambient temperature; 2-temperature in focus of the parabolic cylinder concentrator; 3- temperature in focus of a parabolic concentrator; 4-solar radiation

Table 2 . Dynamics of thermal parameters of a parabolic trough concentrator in the hourly interval of the day in the summer period

№	Hour interval	Outside air temperature, °C	The temperature at the focus of the parabolic trough concentrator,°C	Солнечная радиация, Вт/м^2	The amount of energyМДж * ч Parabolic-cylindrical concentrator
1	8.00-9.00	32	117	418	4.81
2	9.00-10.00	36	137	528	6.08
3	10.00-11.00	42	151	671	7.73
4	11.00-12.00	44	171	770	8.87
5	12.00-13.00	44.5	187	814	9.38
6	13.00-14.00	45	195	825	9.5
7	14.00-15.00	46	199	803	9.25
8	15.00-16.00	48	214	770	8.87
9	16.00-17.00	46	189	605	6.97
10	17.00-18.00	42	174	462	5.32
11	18.00-19.00	40	156	330	3.8
12	19.00-20.00	38	137	154	1.77

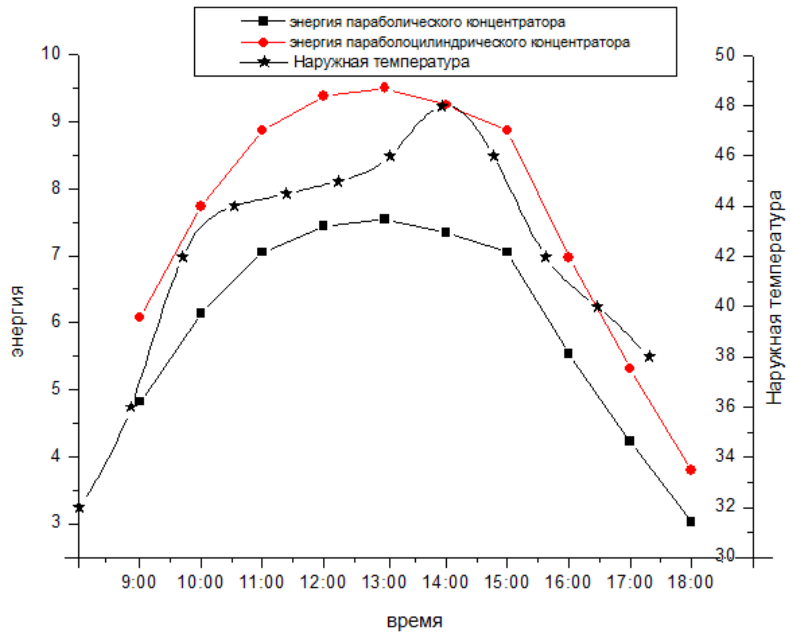

Fig.5 Graph of the dependence of the energy generated in the experimental installations on the outside temperature in the hourly interval of the day: 1- energy of the parabolic concentrator; 2-energy of a parabolic trough concentrator; 3- outdoor temperature

Summarizing the above, we came to the conclusion that independently made solar concentrators of both types are suitable for heating water and can be used in domestic conditions when heating a room, supplying hot water to suburban areas. To maximize their effective use, it is planned to supplement our plants with steam engines in order to generate free electricity, as well as to continue experiments at both concentrators and at other times of the year to determine their efficiency and economic efficiency.

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