INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGY

https://journals.researchparks.org/index.php/IJOT e-ISSN: 2615-8140 | p-ISSN: 2615-7071

Volume: 4 Issue: 5 | May 2022

Use of Solar Battery Batteries

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Annotation: This article aims to increase the efficiency of solar collectors that heat water using solar energy. A new method of tank accumulation of solar water collectors has been proposed and several methods have been demonstrated. The order of water accumulation was studied on the basis of the developed structural elements.

Keywords: Bucket battery, solar collector, solar heater, solar energy, water heater.

Solar collectors are designed to produce hot water by converting solar energy into heat.

The hot water obtained from the solar collector is mainly used for domestic purposes, by individual consumers and small businesses. It saves traditional energy resources (various types of electricity and electricity) when using solar radiation as a renewable energy source. The use of solar collectors is the most effective in all regions of Uzbekistan, or in climatic zones characterized by stable solar radiation for a long enough period of time.

Solar water heaters are installed on the horizontal surface of the floor or roof, as well as on the sloping roof of buildings. The working surfaces of solar collectors should be oriented to the south with a deviation of up to 15˚. During installation, the slope angle of the solar collectors is determined and its value is selected depending on the latitude of the area and the duration of operation.

The size of the hot water tank in the solar collector is usually considered to be sufficient to meet the needs of a family of two to four people.

This article discusses the design options for domestic solar water heaters. The difference between this type of water heaters is that in one design the functions of a solar collector for water heating and a tank accumulator, which collects the heated water and is stored until use by the consumer, are combined. Such heaters are the most common and simple, they are manufactured in many countries and are still in production today.

Collector-accumulator type water heaters are usually manufactured in the form of one or more interconnected vessels filled with heated water.

To speed up the heating of the water, there is a special black paint or selective coating on the irradiated side of these vessels, which absorbs sunlight well.

The bottom and sides of the vessels are covered with thermal insulation material to reduce heat loss to the environment during heating and storage of hot water. The upper part of the container is insulated with one to three layers of transparent. In practice, the collector-accumulator can be described as a traditional flat solar collector with a sharp increase in the internal volume of the absorbing panel (10-100 times). The advantages of the collector-accumulator include low cost, novelty, simplicity of construction, reliability compared to other types of water heaters. The main disadvantage of the collector accumulator is the high level of heat loss through the

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transparent insulation. The aim of our work is to select a relatively inexpensive, reliable and efficient collector-battery design that can meet the hot water needs of the average family.

It should be noted that only one collector-accumulator of one design (model ShZ-1) has been produced in Russia and production continues.

At the end of the last century, a water heater BSVV-60 was produced. In the analysis of foreign data, hot water heaters from 120 to 200 liters per hour were considered. As a result of the use of modern design solutions, technologies and materials (mainly made in the USA), collector-accumulators have got rid of their own shortcomings. One of the most typical designs is the Cornell 360, manufactured by the American company Cornell Inc. This water heater consists of a single cylindrical absorbing tank with a capacity of 120 liters. It is mounted on a heat-insulated housing (Figure 1).

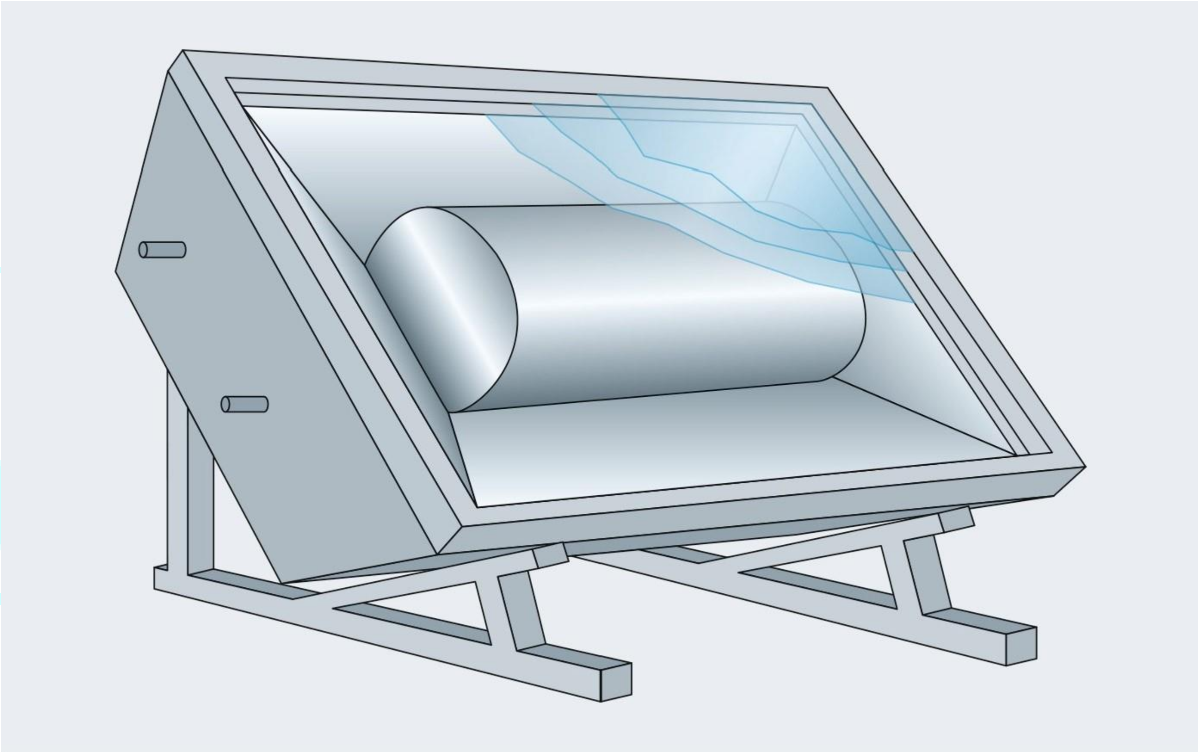

Figure 1 Cornell 360

The outer body of the collector-accumulator is made of non-corrosive and weather-resistant fiberglass. Thermal insulation material - polyofoam (high-temperature modified polyurethane foam), operating temperature up to 200˚C. The transparent coating is three-layered, the outer layer is made of glass with high light transmittance (up to 91-92%), ie low iron oxide content, and the inner layer is made of acrylic plates reinforced with fiberglass. The outer surface of the tank, where the sun shines, is covered with a special copper foil with a selective coating of the type "Black Nickel". The selected surface coating absorbs sunlight well in the visible spectrum, but in the infrared field the radiation coefficient of this surface is very low.

The selective coating of the tank reduces radiant heat losses well and increases the thermal efficiency of the device. To further increase the efficiency of heating the water in the tank, the body of the solar water heater is equipped with a four-mirror reflector that collects radiation on the surface of the tank.

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The manufacturer recommends combining water heaters in pairs at this time, so that their total size will be enough for a family of 3-4 people.

By applying thermal insulation, the failure of the tank as a result of freezing of the water in the tank is minimized.

Due to these factors, the Cornell 360 (USA) water heater can withstand night frosts down to -23˚C.

The warranty period of this water heater is 20 years. Another variant of the collector-accumulator is the RT-40 water heater from the American company Gulf Thermal Corp. A schematic of this collector is shown in Figure 2.

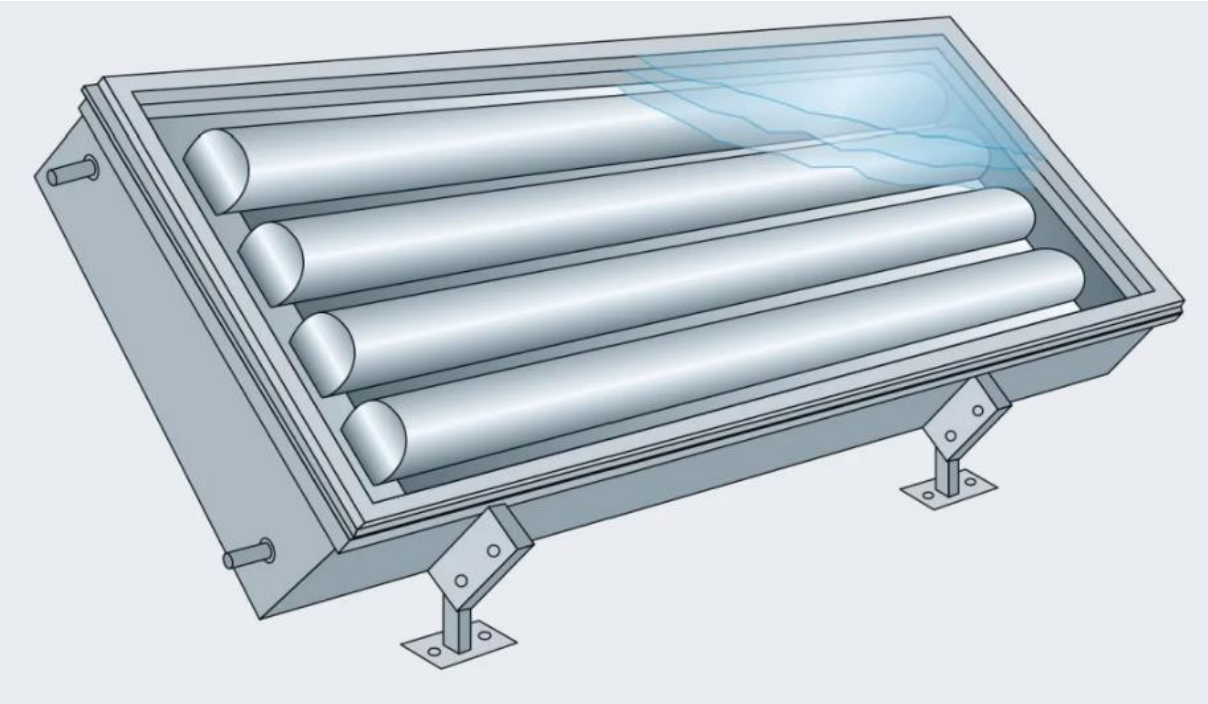

Figure 2. RT-40

The tank of the collector-accumulator consists of 4 parallel thin-walled pipes made of corrosion-resistant Ø100 mm steel, which are connected to each other by means of pipes. The total volume of this tank is 150 liters. To increase efficiency, the outer surface of steel pipes is coated with a selectively coated copper foil of the type "Black Nickel". This tubular structure is housed in a housing with dimensions of 2160x795x250 mm. The side walls of the case and the window frame are made of special aluminum profiles.

The transparent coating of the collector-accumulator is made of three layers: the outer layer is made of tempered glass, and the two inner layers are made of heat-resistant fluorine polymer film of the "oil" type.

The body of the collector-accumulator is insulated with foam insulation. There is no special protection to prevent freezing. In less cold cases, the thermal insulation protects against the cold, and when the cold is severe, the water must be drained manually.

Each RT-40 is provided with a set of mounting parts and allows the water heater to be installed on the floor, roof or wall. The warranty period of RT-40 is 20 years. Common features of these water heaters are three-layer transparent coating, the inner surfaces are glued with selectively coated copper foil and high-temperature thermal insulation.

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In both constructions, the storage tank or its composition pipes are located in a horizontal position. The main difference between these constructions is the presence of one or more water tanks.

The use of multiple pipes in the collector-accumulator increases the surface area of use of solar pipes, reduces the height of the tank and thus accelerates the heating of the entire volume of water. It is also possible to increase the working pressure of the water in the system when using pipes.

Typically, in modern constructions, the vertical location of the collector accumulator is almost not used, as such placement of tanks spoils the architectural appearance of the building.

Manufactured by US Solar Corporation (USA). Sunflare 4000 collector-accumulator excluding. This original design, according to the manufacturer, provides the lowest cost per unit of heat, schematically the design of the collector is shown in Figure 3. Analysis of special water heaters produced by foreign companies in the past and today shows that the main disadvantage of collector batteries - the large amount of heat loss at night - has been partially eliminated.

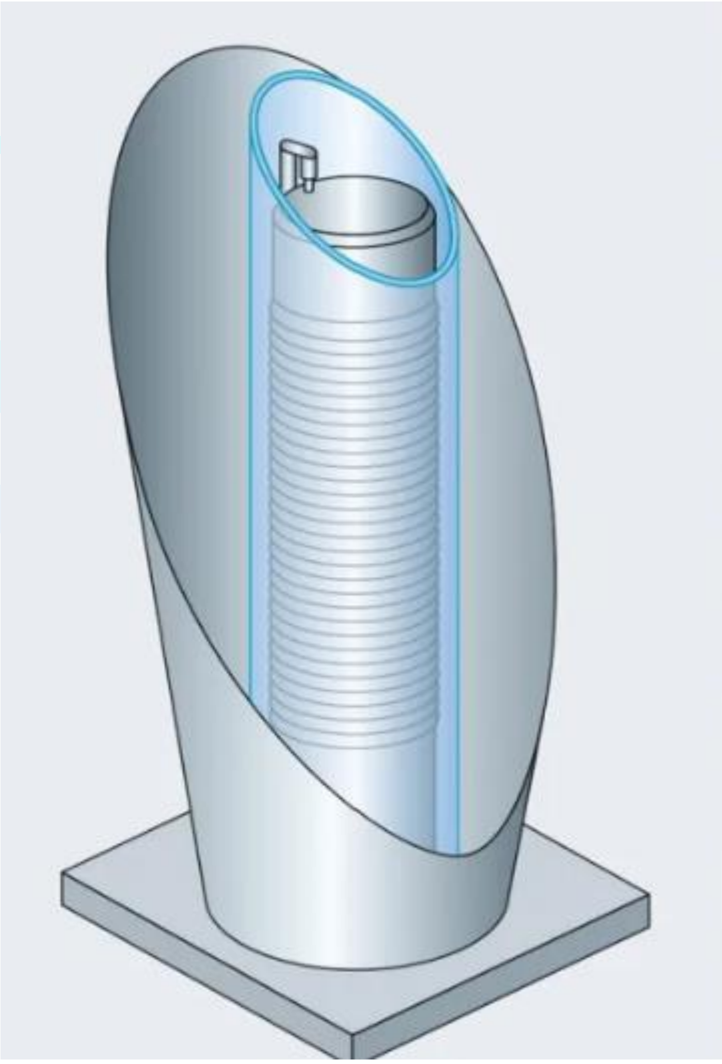

Figure 3 Sunflare 4000

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New design solutions and new materials (three-layer combined transparent coating, selective coating, foam insulation) allowed to enter the market of the United States and other countries.

The demand for collector batteries in the Russian Federation is very high and is estimated at 50 to 100 thousand per year. However, today the market for such devices is very small. This can be explained primarily by the lack of data and the high cost of the proposed devices.

The most successful example is the Sapun CPS model with a tank capacity of 165 liters, proposed by Mir Kotlov (Figure 4).

Figure 4 Sapun CPS

The estimated cost of this model is $ 1,000, which is one of the lowest prices. Accordingly, the current low cost of electricity justifies such devices for at least 10-15 years, which is not true for a large part of the population.

Conclusion: The selective coating of the tank reduced radiant heat losses and increased the thermal efficiency of the device.

Through thermal insulation, the failure of the tank as a result of freezing of the water in the tank was minimized.

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