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Improved Solar Fruit Dryer Collector Insulated Test Results

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ABSTRACT: In this article, the accumulation part of all types of solar (convector radiation) fruit dryers works only in sunny times due to not being well insulated, and cannot accumulate enough heat, as a result of which the time for the construction of fruits and plants increases, which negatively affects the quality drying of the fruit. Analyzing renewable energy resources, the drying of fruit vegetables and the use of solar energy in the supply of hot water fully justifies itself economically in the conditions of Uzbekistan. According to the results of the study, it is possible to increase the energy efficiency of the dryer by improving the accumulation part of the solar fruit dryer.

KEYWORDS: collector heliocurator, temperature, convective, radiation, cabinet, dryer, black stones, polyethylene, ultraviolet, accumulator.

I.INTRODUCTION

The advantage of solar fruit dryers is that when drying agricultural products, quality dried products can be obtained for a short time using alternative energy. When drying fruits, plants and vegetables, renewable energy sources are carried out using solar–powered dryers, a certain amount of organic fuel resources is saved and the level of pollution of the environment by exhaust gases is reduced. To date, solar collectors serve as the most efficient device in the use of solar energy. If photovoltaic panels use 14-18% of the solar energy falling on them, this effect in the solar collector will reach 70-80%. The total amount of solar energy falling to earth during the year $62 \cdot 10^{16} kW/m^2$ is equal [2]. 4 depending on the type of product to get 1kg dried finished product. It is necessary to expel 10 kg of moisture, in which the specific energy consumption is 2,6...7,3 $\frac{kW}{h}$ [1,3]. Therefore, improving solar dryers and optimizing their basic thermal and technical parameters, improving energy efficiency is one of the important directions. Many scientific studies have been carried out by scientists to improve energy efficiency and improve solar fruit dryers, and several drying devices have been created.

In 2020, J.S.Vishnu (India), launched a large-scale solar dryer operating in convection mode, and simultaneously delivered an internal temperature of 66, receiving 300 kg of dried product from a tonne of fruit [2.4].

In 2019, O. Rakhmatov launched a device for drying grapes with rotor blanching, the heat saving in the dryer was 27-28%, including 14-15% from the use of solar radiation and up to 14% at the expense of regenerating the heat being discharged [1.5].

To date, while several scientific research studies have been carried out by scientists to improve energy efficiency by improving solar fruit dryers, the Collector part is not researched, since all existing dryers dry in sunny times and the drying process in the evening will touch.

II.MATERIALS AND METHODS

Drying agricultural products is one of the energy-intensive processes. The energy intensity of drying mainly depends on the drying product and the energy efficiency of the drying system. Currently, due to the energy crisis and problems of environmental pollution, the development of green energy is considered a priority in the world [2]. The recommended, continuous mode collector part and drying cabinet improved low potential multi-function solar fruit drying device does not require any conventional electricity or fuel energy (Figure 1). The solar drying device consists mainly of two parts:

- drying cabinet.
- solar collector (for accumulating heat).

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The Collector part of the solar dryer heat accumulator will consist of a transparent film layer, studs that provide air circulation, an iron cabinet for the drying product. The principle of operation of the solar collector is that the sun's rays pass through a transparent layer and are absorbed by the elements of internal air and heat accumulation. The temperature inside the dryer is formed at the expense of this energy. An air stream with a Low Temperature entering from the bottom slits of the device will enter the dryer and increase the temperature so that it also evaporates the moisture of the product put for drying, bringing it out of the slits above in a convection manner. In hot summer months, the temperature inside the drying cabinet reaches 70-74, the temperature inside the collector reaches 80-85, the temperature of the heated 100 liters of water is 67 in the morning from 6:00 to 14:30 on hot summer days when solar radiation is 966. The temperature below the stelages inside the cabinet will be 74-75, the temperature above will be 73-74. The most optimal temperature inside the drying cabinet according to the kinetics of drying fruits should be 60-65 [4]. With this in mind drying to balance the temperature of the device, air inlet and outlet slits are placed on the lower and upper parts, which can also be changed in diameter.

Figure 1. Insulation of the base and sides of the collector.

Figure 2. The top of the collector is open and closed view.

Curitiladigan offers products of the highest quality that meet the requirements of the Purchasing and Production Guidelines. The inner volume of the drying cabinet is 1 m^2 , the surface of the transparent collector is 12 m^2 , the bottom part is 9 m^2 (Figure 2). On August 6, 2022, the necessary parameters were studied by measuring the temperature of the rock layers inside the collector, the temperature humidity of the collector with the top open and the top closed. On the same day , the weather temperature was a maximum of 38-39, and the solar radiation was 960.

Transparent film, custom-made polyethylene film, glass made of plastics. Biz kuritgichda transparent polyethylene film is called foidalanganmiz. Solar radiation is absorbed into the walls of the fruit and dryer after passing through the transparent surface of the dryer and turns into thermal radiation. A certain amount of heat goes out into the environment through the dryer transparent surface and the outlet forbox. The total heat lost in the solar collector can be calculated as [2]:

$$\sum Q_{\text{infectious}} = Q_{\text{tile}} + Q_{\text{dust layer}} + Q_{\text{tag part}} + Q_{\text{hole}} \tag{1}$$

Q_{tile} - The amount of heat that the film loses through the surface:
$Q_{\text{dust layer}}$- The amount of heat lost when the collector surface is non-clear dust;

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$Q_{\text{tag part}}$ - The amount of heat absorbed (lost) under the collector ground part.
Q_{hole} - The amount of heat that the Collector loses through the slits [4, 6].

To the recommended solar collector $Q_{\text{tag part}}$ – under the collector the number of unworthy definitions, duty collector under the collector in the hold (1) Formula working composition:

$$\sum Q_{\text{infectious}} = Q_{\text{tile}} + Q_{\text{dust layer}} + Q_{\text{hole}} \quad (2)$$

(2) we can know that the formula increases the efficiency of solar collectors. It is necessary to reduce the amount of heat lost in the collector as much as possible so that its useful coefficient of work increases.

III. RESULTS AND DISCUSSION

In our solar collector, the useful work factor increases from 85% to 90%. The bottom of the ground to heat is treated with liquid vitrified, bitumen, so that energy is not absorbed, and is insulated with Earth as a result, which is closed with a foil vitrified that returns light over it by drying.

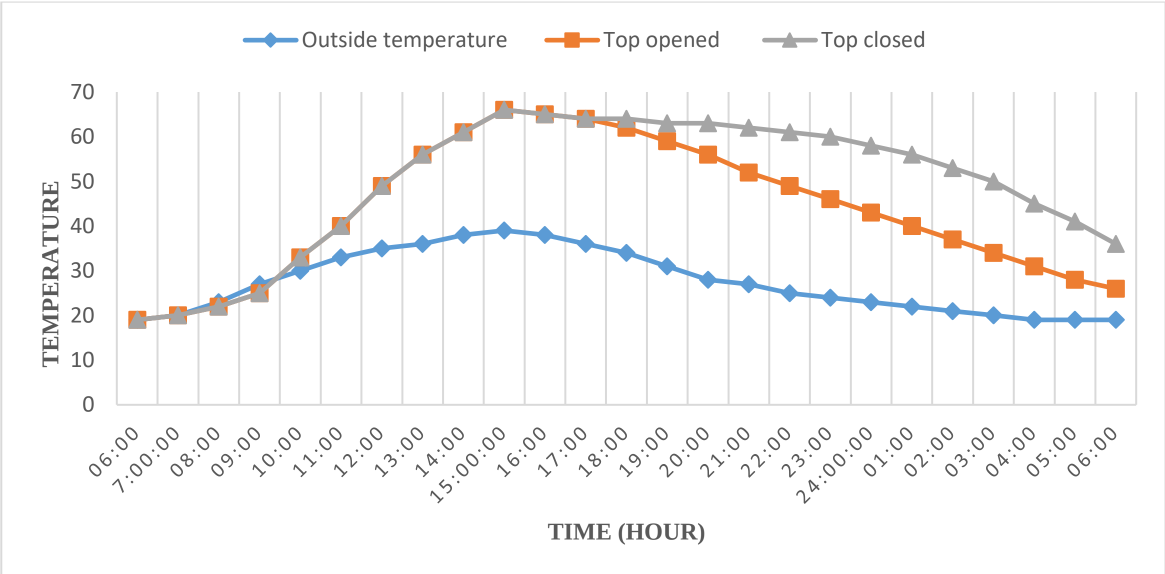

Figure 3. Time dependence of the internal temperature of the collector in the open and closed position of the top.

The results of the study from Kura improved the insulated collector with a temperature difference of 1:00 pm compared to the closure of the high temperature differed by 20. This thermal energy will be concentrated on 3-4 kg of stones with a mass of 400 pieces placed inside the collector. This provides thermal energy to the drying cabinet in the evenings.

$$Q = cm(t_2 - t_1) \quad (3)$$

(3) the amount of heat in one piece according to the formula;

$Q = cm(t_2 - t_1) = 997 \cdot 4(60 - 20) = 159520\,J$ will have an amount of heat. The average heat content of 400 stones inside the collector is;

$Q_1 = cm(t_2 - t_1) = 997 \cdot 1600(60 - 20) = 63744000\,J = 63744\,kJ$ the amount of heat is absorbed with the collector top closed. With the top open;

$Q_2 = cm(t_2 - t_1) = 997 \cdot 1600(40 - 20) = 31904000\,J = 31904\,kJ$

$\Delta Q = Q_1 - Q_2 = 63744\,kJ - 31904\,kJ = 31840kJ$

the amount of heat was saved by improving the collector. Initially, the amount of moisture that evaporates in the drying chamber is determined from the formula below.

$$m = \frac{G_1W_1 - G_2W_2}{100} \quad (4)$$

Here G before drying and dried (fruit) special mass of the material, respectively; $W_1 W_2 -$ the moisture content of the material after drying and drying %. The material (fruiting) of bundai is the amount of parlatib namlik as needed [6].

$$Q = \frac{1000m}{d_2 - d_1} i_0 \tag{5}$$

here $i_a -$ drying agent enthalpy [7].

IV.CONCLUSION

The recommended solar fruit dryer can be used in agriculture, farms, yard apartments. Based on the results of the experimental study, the following were cited.

- as a result of heat accumulation of stone and water inside the collector when drying fruits and plants in the sun dryer, the temperature inside the drying cabinet was different from the external temperature at 14:00 in the afternoon, the temperature difference was 36 ℃ at 1:00 in the evening, the temperature difference was 20 ℃.

The improvement of the solar fruit dryer differs from other solar dryers in that it has lower quality and drying time of fruits and plants, while maintaining thermal energy in the Collector part at a longer time. With an external temperature of 32℃-33℃ and solar radiation of 956 W/m^2, the temperature inside our improved solar drying cabinet will be 60℃-61℃ compared with the results of the scientific experiment conducted it was found that the drying efficiency is 11-16% higher. With an increase in external temperature, the amount of dried product also increases.

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