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Energy Efficient Solar Fruit Dryer

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Annotation: this article shows the design of the experimental sample, the load capacity of raw materials is 50 kg, air heaters with a total area of 7 m² for solar dryers were carried out supporting experimental work for agricultural products. During the experiment, the results showed that time (26 hours) apples were dried to 15% moisture, pears showed a result of 25%, and control samples-42-45%. Temperatures were determined, the results were achieved when heating the air in the dryer from the sun at a power of 2 kWh, that is, 1300 m³/h. In the course of the experiment, these results became known that the disadvantages and descriptions of the designed solar dryer were described in detail.

Keywords: solar dryer, temperature and humidity air, heating, heat capacity.

Introduction

Due to the large number of sunshine days in our country, the products of fruits and vegetables and melons are considered environmentally friendly and rich in vitamins. Today, ensuring the Daily need for these products throughout the year is one of the pressing issues. One of the ways to store products for a long time is to dry it. It is known that most of the population uses solar energy to dry fruits, vegetables and greens in open areas, on large roads, on the roofs of their homes. In doing so, insects, birds, dust and various gases, such as the weather, show their effect on the product, causing its quality to be compromised.

Studies show that when drying agricultural products, the process requires energy. For example, in convective dryers, the power consumption of electric air heating is from 1.3 to 1.9 kWh, for each kilogram of moisture, from 1.4 to 2.2 kWh in thermo-radiation, energy is consumed at a high frequency from 1.8 to 3.5 kWh.

With the improvement of the design of Fusion dryers, in which direct radiation is reflected together infrared rays, the energy capacity varies from 0.9 to 1.3 kWh of the moisture removed in terms of electricity consumption per kilogram to the type of raw material being dried.

Research shows that the energy density and drying technology of agricultural vegetables and fruits is significantly different from the energy consumption of grain drying. If, in order to dry a grain, it is necessary to reduce its humidity by an average of 30% to 15%, that is, by 2 times, for drying vegetables and fruits, this figure should decrease by an average of 85% to 15%, that is, by 5.66 times it means. It is known that the season of fruit drying falls on periods during the summer months when the same amount of solar energy is high. For example, in regions with a geographical latitude of 410 m², 650 W/m² energy falls on a steep surface in June, 750 W/m² in July, 700 W/m² in August. This means that we use energy wisely.

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Structural structure of solar dryers

Solar dryers will mainly consist of a transparent layer, air circulation holes, a place for the product to be dried, and walls the working principle of The Greenhouse The Sun's rays pass through a transparent layer and are absorbed by the indoor air as well as the dryer elements. The absorbed energy is converted into heat. The drying temperature is formed at the expense of this energy. The air flow with a low temperature, which enters through the lower slits of the device, enters the dryer and increases the temperature at the same time, together with which it evaporates the moisture content of the product laid for drying, taking it out of the above slit.

Polyethylene film, glass window and plastic products are usually used as transparent layers of dryers. Different types of sun dryers differ from each other by the coefficients of heat transfer of the material and the size of the dried product.

Drywall walls are mostly made of substances with very small thermal conductivity coefficients.

The size and structure of the solar dryer will vary depending on the material or the size of the product to be dried.

Energy use in the process of drying fruits

The process of operation of the dryer is based on drying the fruits using sunlight, at the same time protecting them from dust, insects, rain, moisture (dew). Here is why the device should be such that it is necessary to pass as much sunlight as possible and at the same time lose the moisture generated.

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Fig 1. Solar dryer experimental field.

Figure 1 shows an experimental view of the solar fruit dryer device under study. According to him, as a thermal insulation, it is used from a polyethylene film. The number of floors of the dryer is 2. As a heat conductor, however, the metal gutter is fixed to the tiller and directed inside the dryer.

Fig 2. View of the solar dryer heat conductor.

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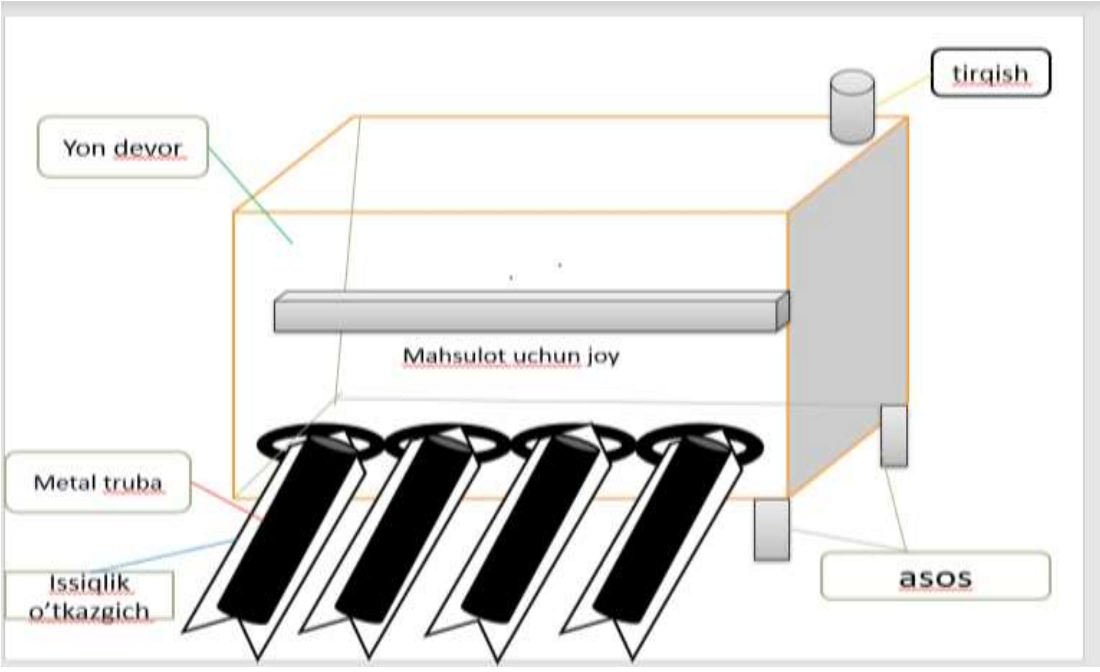

Fig 3. Constructive scheme of the solar dryer.

Leaves are placed on top of the racks inside the dryer, the reason is that the air should pass not only next to the fruits, but also across the opposite sides.

At the time of making the sun dryers, an open space of 4-5 mm is placed from the bottom of the box window. This place is necessary for the circulation of air flow, which acts as an outlet for moisture inside the dryer and additional ventilation.

The sun dryer is installed at an angle to the south, the reason is that after the dryer is installed, the wet Separation begins so that the sun's rays fall into the dryer at the right angle as much as possible, so that a constant exchange of air (screwing) is necessary inside the dryer from the upper and lower sides. It is necessary to constantly monitor the process inside the dryer, control ventilation according to temperature changes and the condition of the fruits. The characteristic of fruit dryers is that the drying mode (T, φ, V) in them has a variable character.

Conclusion

This table shows one-day results from experiments using the device. According to him, the daily change in temperature (t_t-external, t_i-internal) and relative humidity is given:

Teplatechnical parameters	Time					
	8	10	12	14	16	18
t_t °C	23,1	25,5	35,0	37,5	33	28
t_i °C	36,5	44,0	53,5	55	48,5	30
φ_i %	42.0	38,0	32,0	30,5	31,5	38

Further work is underway to create and put into practice the device of autonomous drying of fruits and vegetables based on solar energy. Having designed such autonomous devices, it is advisable to install and use them throughout the year for entrepreneurs who have up to 1-2 hectares of farm land, not only solving the problem of drying products for each family.

The characteristic of fruit dryers is that the drying mode (T, φ, V) in them has a variable character. The temperature of the heat sink (indoor air) goes up with the sunrise and reaches its maximum value during the dream, while in the afternoon it slowly goes down. If the device is controlled to receive good sunlight, it will be possible to maintain the maximum temperature value for a longer time.

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