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MELON DRYING IN SOLAR DRYING SYSTEMS

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Abstract

To eliminate the disadvantages of air-solar drying and to find energy-saving technologies, many researchers recommend using solar-radiation drying units (SRDU) and solar drying complexes (SHC).

Introduction

At present, research and development work is being carried out in our Republic and abroad in countries with long sunny days: the republics of Central Asia, Iran, Greece, Spain, Italy, China, South Africa, etc. Various types of solar drying plants are being developed. Below are descriptions of the construction of dryers for the artificial drying of fruit, grapes and other agricultural products using solar energy. They can be divided into solar-convective, solar-radiative and combined according to their design features and principle of operation.

Solar-radiation drying plants are described in detail in the works and their main advantage is a sharp reduction in the drying time of products in comparison with the air-solar method.

Main part

The principle of these solar dryers is that the product to be dried is placed in the radiation and chamber parts of the plant. By forcing outside air through the radiation part of the dryer, the product is heated up and dried at the same time, and when it enters the drying chamber, the drying process in the chamber is accelerated. The disadvantages of such plants include the possibility of strong exposure of the product to radiation, which can cause "thermal burns" and reduce the quality of the final product. In addition, these solar plants are not mechanised, have low productivity, and their operation is seasonal, i.e. after the drying season the drying equipment will be idle. A big negative impact on the operation of solar dryers is caused by weather conditions: rain, cloud cover and gusty squally winds.

Solar-convective (chamber) solar plants, which consist of a solar-air heater and a drying chamber, where raw material is dried by means of warm air heated to 60-70 0C, are more advanced in terms of design. The raw material is not subjected to 'thermal burn' and the quality of the finished product is good. Productivity of solar drying chamber plants is 0.8 to 1.2 kg of finished product per day from a unit (1m^2) radiant surface. The vapour-air mixture is evacuated either by natural draught created by the inclined position of the plant to the horizon, or by forced air circulation created by a fan (Fig. 1.1). The drying capacity of this type of dryer is 1.5 to 2 times higher than that of a natural draught chamber dryer.

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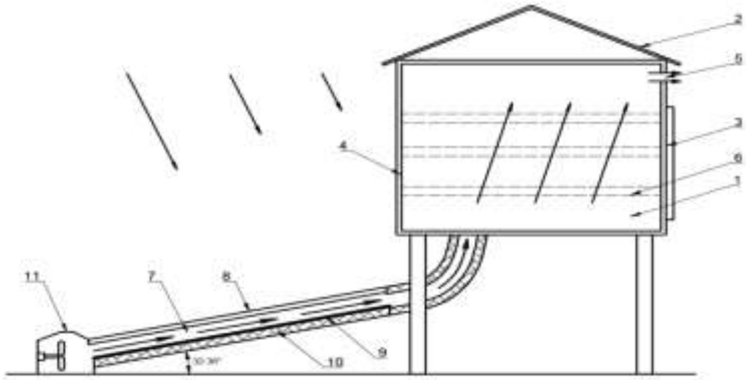
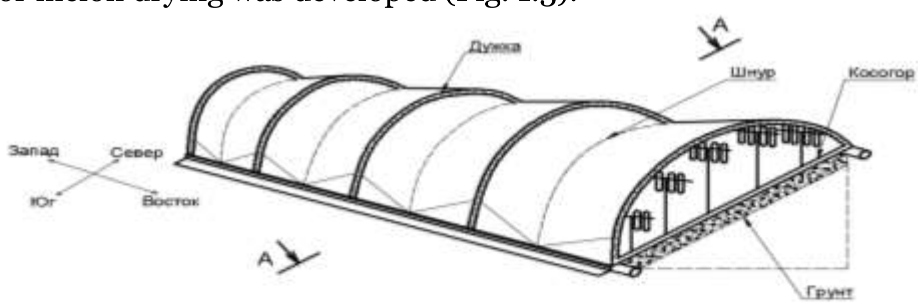


1-drying chamber; 2-lid; 3-door; 4-glazing; 5-window; 6-mesh trays; 7-air heater; 8-transparent cover; 9-thermocouple; 10-heat insulation; 11-fan.
Fig.1.2. Forced-air solar installation.

A. Akhmadaliyev has developed an industrial solar plant for drying fruit and grapes with an area of 120 m². The dryer includes an air heater compartment and a drying chamber. Corrugated metal sheets are used as elements of the air heater, providing heating of the air to t=60-800C.
X. Nuriddinov studied a radiation-convective drying unit for drying berries and fruits. The working chamber with dimensions of 5x3.5 m was covered by a translucent surface of single-layered glass and oriented to the south.
Prof. G.G. Umarov and Prof. B.P. Shaymardanov contributed greatly to the theory and practice of SRSU use. They classified solar drying units and developed a project for a mechanized technological line of solar dryers for fruit, vegetables and gourds [10; P.247]. The proposed technical solution is designed for farms with a volume of harvesting 300 tons of dried product per year. For small and medium-sized farms a slant-film drier for melon drying was developed (Fig. 1.3).



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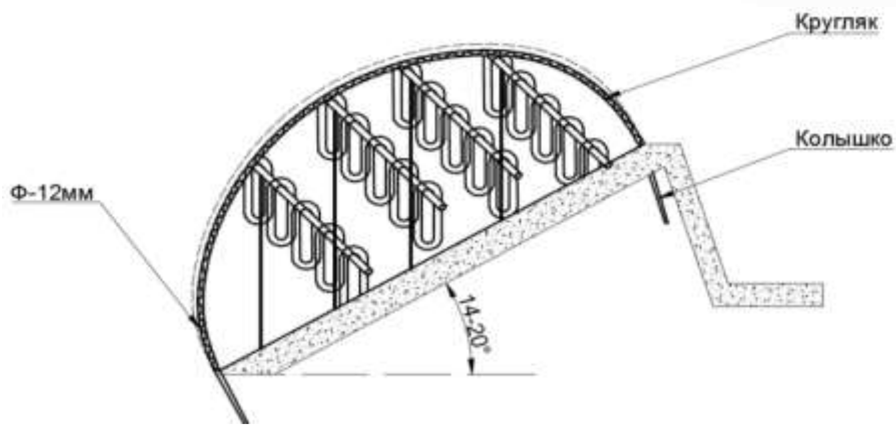

Figure 1.3. Tilt-film solar-radiator for melon drying

The melon drying system consists of a number of round-arched arches mounted on pegs, over which a translucent polyethylene film is stretched. To prevent the film from being torn by wind loads, it is tied between the arches with a clothesline. Inside the dryer, pegs with cradles are driven into the ground in rows, on which poles with longitudinally cut or ring-shaped melon slices are placed.

The drying air enters through a slit at the bottom of the foil due to the natural draught and bathes the hanging product with a circulating flow, moving inside along the contour of the foil and removing it through the raised edges of the foil. The moisture evaporated during the drying process condenses on the inner surface of the foil, flows down and is removed into the soil, and some of it is removed with the exhaust air.

The analysis has shown that the main advantages of this construction are: low unit cost of the structure's radiant surface; low metal consumption, reduction of raw material transportation costs, protection from external factors and bad weather. Covered translucent shell allows saving up to 25-30% of energy consumption and reducing the drying time by 1-2 days.

The disadvantages of solar drying systems are that they require large areas for construction, are bulky and inconvenient to operate. The translucent covers and heat-accumulating nozzles, which use water, sand, crushed stone or rubble, are ineffective due to insufficient heat-absorbing capacity. The dryer buildings are stationary structures and are hardly ever used during the drying season which does not justify the capital investment and increases the prime cost of the product.

Conclusion

From the above data and their analysis it follows that solar-radiation drying plants (SRDU) have a number of advantages compared to air-solar drying, but due to the dependence on weather factors they cannot ensure the processing of agricultural products on a national scale, which requires transferring the drying process to an industrial basis using an artificial method.

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