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SOLAR FOOD DEHYDRATOR: APPLICATIONS AND USES

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ABSTRACT

Solar drying was modification of traditional sun drying technique which is tried for all agricultural commodities. Initially, solar dryer was used for non-agricultural commodities and later, its use was extended to dry agricultural products. The high temperature dryers used in commercial countries are found to be economically viable in developing countries only on large agro sectors and generally it is not affordable by small and medium entrepreneurs because of high cost and process variability. Therefore, the introduction of low cost and locally manufactured solar dryers provides a promising alternative to reduce the grand post- harvest losses. The opportunity to produce high quality marketable products appears to be a chance to improve the economic situation of the farmers. Taking into account the low income of the rural population in developing countries, the relatively high initial investment for solar dryers still remains a barrier to a wide application. However, if it is manufactured by locally available material such as wood, glass etc., it will be economically affordable by the farmers.

Keywords- *Green Energy, food drying,*

LITERATURE REVIEW

1. A Review on Solar Drying of Agricultural Produce. Tiwari J, Food Process Technol 2016 :- we have followed this research paper.
2. Leon MA, Kumar S (2008) Design and performance evaluation of a solar-assisted biomass drying system with thermal storage. Dry Technol 26: 936-947 :- from this paper we got an idea about the design and testing of a solid-sorption heat pump system.
3. Prasad J, Vijay VK, Tiwari GN, Sorayan VPS (2006) Study on performance evaluation of hybrid drier for turmeric (Curcuma longa I.) drying at village scale. J Food Eng 75: 497-502 :-we came across the performance of solar dryers.
4. Hii CL, Ong SP (2012) Quality characteristics of solar dried products, in solar drying. Fundamentals, Applications and Innovations, Singapore :-we thermodynamic analysed various works on Solar dryers.
5. Chapman K, Twishsri W, Marsh A, Naka P, Ngangoranatigarn P, et al. (2006) Robusta coffee drying alternatives in south thailand-includes a new solar dryer :-we got the idea on various alternatives for Solar dryer.

BASIC CONCEPT DESIGN

The main objective of this project is to determine the power from a renewable energy source which is the solar. Another objective of this project is to practice and apply the engineering concepts. But there are more objectives, which are:

- Design and construct a solar dryer which is going to decrease the pollution.
- Reduce the cost and energy.
- Learn the advantages and disadvantages of dryer.
- 5 Compare between theoretical and experimental study.

Solar Dryer can be only used during day time when adequate amount of solar energy is present.

- Lack of skilled personnel for operation and maintenance.
- Less efficiency as compared with modern type of dryers.
- A backup heating system is necessary for products require continuous drying.

Apart from weather conditions the drying behaviour of agricultural crops during drying depends on the: Product, Size and shape, Initial moisture content, Final moisture content, Bulk density, Thickness of the layer, Turning intervals, Temperature of grain, Temperature, humidity of air in contact with the grain, Velocity of air in contact with the grain

MACHINE TOOLS & EQUIPMENTS:

We must require different machines for different operations like. Jigsaw, Glue gun, Sheet cutter, Soldering iron, Hand drill.
And also some equipment like Measuring Tools , Marking Tools, Hand Tools etc.

Table 1: Components required for project:

Plywood	24 sq. feet
Transparent sheet	06 sq. feet
MS sheet metal	02 sq. feet
Wire mesh	20 sq. feet
Solar panel	01 no.
DC fan	01 no.
Temperature sensor	01 no.
Plumbing fittings	As per requirement
Electrical accessories	As per requirement
Fasteners etc.	As per requirement

Model Specification:

Overall height: 30 inches
Overall width: 18 inches
Overall length: 38 inches

COMPONENTS OF PROJECT MODEL

Solar panel:

Fig: Solar Panel

The solar panel is having the short-circuit current of 5.8 Amp, the open-circuit voltage of 48.3 V and rated power at 445 Watt/m2 solar radiation, all measured under STC. It has a dimension of 198.6 x 100.1 x 3.5 cm and weighs 22.5 Kilograms.

Temperature sensor:

Fig: Temperature Sensor

This temperature sensor has a range of 0-150 C, accuracy <o, 1 C +NTC spread over 0 to 70 C. maximum resistance of 3 ohm and require 12v and 3.5 mAmp of power to operate.

DC fan:

Fig: DC Fan

This Brushless DC Cooling Fan is operating at 12V with a dimension of 90 x 90 mm. It is very quiet and moves approximately at 65 CFM. It has a Dimensions of 90 x 90 x 25mm, Voltage of 12V, Speed of 2400RPM, Air flow of 65 CFM, Current of 0.10A, Cable Length:: 21cm, Sleeve type bearing.

Wire mesh:

Fig: Wire Mesh

The wire mesh is stainless steel ISO 9001:2000 certified mesh. It has weave wire mesh type having 0.01-25mm aperture. Air can easily pass through it and dries the food with ease.

DESIGN PROCESS-

- Layout of complete model
- Making of structure
- Installation of wire mesh
- Cover up with transparent sheet
- Installation of solar panel
- Assembly of plumbing fittings
- Assembly of electrical circuit
- Final check up and testing

Different types of SOLAR DRYER design:


Fig: Different types of Solar Dryer

RESOURCE PLAN

The cabinet is a large wooden or metal box and the product is located in trays or shelves inside a drying cabinet. If the chamber is transparent, the dryer is named as integral-type or direct solar dryer. If the chamber is opaque, the dryer is named as distributed- type or indirect solar dryer. Mixed-mode dryers combine the features of the integral (direct) type and the distributed (indirect) type solar dryers. The combined action of solar radiation incident directly on the product to be dried and hot air provides the necessary heat required for the drying process. In most cases, the air is warmed during its flow through a low pressure drop solar collector and passes through air ducts into the drying chamber and over drying trays containing the crops. The moist air is then discharged through air vents or a chimney at the top of the chamber. It should be insulated properly to minimise heat losses and made durable (within economically justifiable limits). Construction from metal sheets or water resistant cladding, e.g. paint or resin, is recommended.

Heated air flows through the stack of trays until the entire product is dry. As the hot air enters through the bottom tray, this tray will dry first. The last tray to dry is the one at the top of the chamber.

The advantages of this system are:
1. Simple in construction.
2. Low labour costs.
3. Simply load and then unload.
4. The product need not be exposed to the direct rays of the sun which reduces the loss of colour and vitamins.
5. Heat storage systems can be applied.
The disadvantages are:
1. A tendency to over-dry the lower trays.
2. Low efficiency, in terms of fuel consumption, in the later stages of drying when most of the trays got dried.

WORKING

The objective of a solar dryer is to provide ample amount of heat i.e. more than ambient heat under given humidity. It increases the vapour pressure of the moisture confined within the product and decreases the relative humidity of the drying air so that the moisture carrying capacity of the air can be increased. Air is drawn through the dryer by natural convection or sometimes by a fan. It is heated as it passes through the collector and then partially cooled as it catches moisture from the material. The material is heated both by the air and sometimes directly by the sun. Warm air can hold more moisture than cold air to maintain relative humidity, so the amount of moisture removed depends on the temperature to which it is heated in the collector as well as the absolute humidity of the air when it entered the collector. The moisture absorption capacity of air is affected by its initial humidity and by the temperature to which it is subsequently heated.

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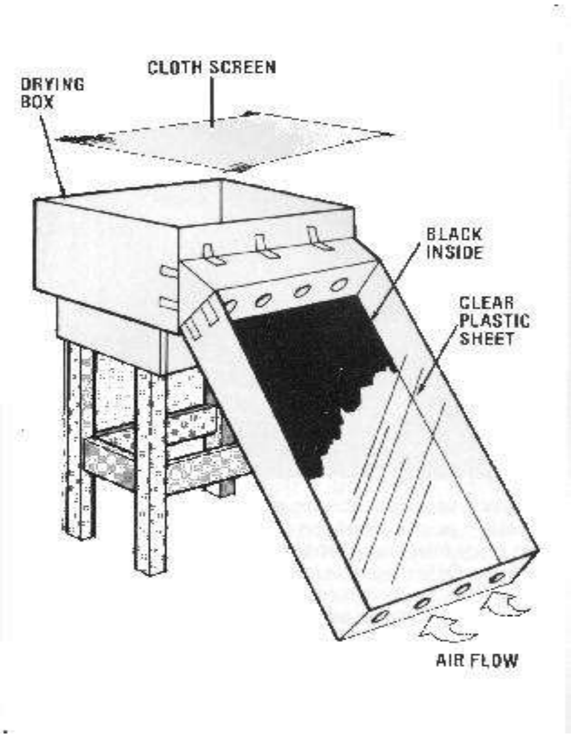

Fig: Schematic diagram of Solar Dryer

Fig: Actual Model

CONCLUSION

Solar Dryer is an eco-friendly technology which can address ozone depletion and global warming problem as it uses safe. The performance of solar dryers is significantly dependent on the weather conditions. Both the heat required for removing the moisture as well as the electricity necessary for driving the fans are generated in the most cases by solar energy only. In addition to the pre-treatment of the product, the weather conditions have the biggest influence on the capacity of product that can be dried within a certain time period. The drying time is short under sunny conditions and accordingly extended during adverse weather conditions. The difference in drying capacity between dry and rainy season has to be taken into consideration for the calculation of the yearly capacity of the dryer.

The utilization of solar energy as the only energy source is recommended for small-scale dryers where the risk of spoilage of big quantities of crops due to bad weather is low. If large-scale solar dryers are used for commercial purposes it is strongly recommended to equip the dryer with a back-up heater to bridge periods with bad weather. A huge advantage of solar dryers is the fact that different types of fruits and vegetables can be dried. The quality of products dried in this way is excellent, due to the fact that the food is not in direct sunlight (cabinet or in-house dryer), and due to a shorter drying process-up to a one third of the time in comparison to traditional sun drying.
The drying operation must not be considered as merely the removal of moisture since there are many quality factors that can be adversely affected by incorrect selection of drying conditions and equipment. Some desirable properties of dried products are:

- Low and uniform moisture content
- Minimal proportion of broken and damaged grains
- Low susceptibility to subsequent breakage
- High viability
- Low mould counts
- High nutritive value
- Consumer acceptability of appearance and organoleptic properties.

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