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Development of a Solar Tray Dryer

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Abstract: ***The solar drying system utilizes solar energy to heat up air and to dry food materials which in turn helps in preserving agricultural product for long duration in ambient condition. In light of the impediments of the normal sun drying for example openness to coordinate daylight, obligation to pests and rodents, absence of proper monitoring and the raised expense of the mechanical dryer. A minimal expense sunlight based dryer is subsequently evolved to cater for this limitation. this project presents the plan and development of a domestic passive solar powered dryer. The dryer is composed of solar collector (air heater) , a solar drying chamber with three cloth (net) tray ,inlet for air at the bottom and an outlet with exhaust fan operated by solar panel fitted of the top of the chamber. The air permitted in through air inlet is warmed up in the solar collector and diverted through the drying chamber where it is used for drying***

Keywords: Solar collector, Net, Dryer, Agricultural product, Sunlight

I. INTRODUCTION

Drying fruits and vegetables is an important form of food preservation in many developing countries. It enables longer storage times and easier transportation, while also preserving the nutritional value and reducing the growth of harmful pathogens/bacteria. It is critical to not overcrowd the drying track and to turn the produce consistently to dry uniformly. Agricultural items can be dried outside straightforwardly in the sun or with dryers fueled by biomass or solar based energy. This article outlines the different drying methods.

II. METHODOLOGY

A. Site Specification

1) Location Of The Plot

This study was conducted in Gandhi Institute for Technology (Autonomous) – In Agriculture Lab. This area was near to the workshop where we have constructed our model frame for our experiments. For proper analysis of data.

2) Layout

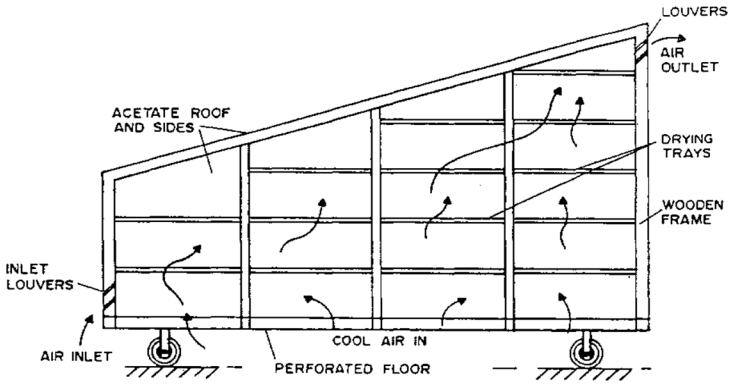


Fig 2.1.1 Layout of Solar tray dryer

B. Project Description

This project aims to design and develop a solar tray dryer using solar panel, iron rod, exhaust fan, glass, transport wheel, plywood, net .This equipments are used to make a Solar tray dryer. This Solar tray dryer we can use for domestic or industrial purpose, and to removal of moisture from fruits and vegetable for long time preservation, and make a different test of this product.

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It has the following features:

1) Easy to handle
2) Operated in renewable energy
3) Compact and portable
4) Pollution free

C. Material And Methods

This part examins the thermal efficiency of natural convection and forced solar convection dryers, separately. We will explore the outcome of airflow rate on the thermal efficiency of the solar powered dryer, which will assist to promote public awareness of the application, benefit and need of solar oriented drying, to demonstrate solar based dryer as a device for harnessing energy from the sun

1) Iron Frame

We have designed a frame for completion of the whole process, which is 3 foot of length, 2 foot of width, front height 2.5 foot and back height is 3 foot. Steel frames are strong, robust and moldable, when all components are joined together. Steel is also resistant to corrosion to zinc coatings that help to enhance its performance against rust, meaning it will last on other qualities other than its incredible strength. There are so many advantages fire, pest and weather resistant, strength, durability, and longevity. Iron frame is coated with black oil colour for corrosion resistance.

2) Solar Panel

Solar powered technologies convert sunlight into electrical energy either through photovoltaic (PV) boards or through mirrors that concentrate sun based radiation. This energy can be utilized to generate electricity or be stored in batteries or thermal storage. Solar panel is use renewable energy to produce electricity .This is also pollution free .In our project there is 10 watt exhaust fan is installed, to operate this fan we want electricity, so we installed 40 watt solar panel to generate 18 volt ectricity and operate the exhaust fan for air ventilation.



Fig 2.4.2 Solar panel

3) Exhaust Fan

Exhaust fan are used for maintaining proper ventilation in a chamber. They help in removing the bad air and humid air from the chamber and keep the room filled with fresh air. In our project we use 10 watt exhaust fan. Inside the chamber there we stored some fruits, leaf, vegetable for drying purpose, the drying purpose maximum temperature of the chamber is 72 degree centigrade, this much range temperature is best for drying. When chamber temperature is high, to maintain the chambers temperature we use exhaust fan for air ventilation and also remove the water drop present into the inside the glass.



Fig 3.4.3 Exhaust fan

4) Drying Trays

There is net is attached in tray, there is two tray installed inside the chamber. The working of net tray is continuous circulation of hot air. In the dryer, moisture is removed from the solids that are placed in the tray by a forced convectional heating. The moisture air is removal is done partially but in a simultaneous fashion. In the net tray there is easily air can pass though the tray, so it helps to remove the solid products moisture present in the upper tray.

5) Transport Wheel

The wheel is the main key components of the wheel and axle which is one of the six simple machines. Wheels helps for movement of heavy objects while provide supporting to a load, or performing labor in machines. In our project solar tray dryer there is transparent wheel is attached in bottom. By the help of wheel we can easily transform one place to another place.

6) Glass

The main purpose of installing the glass cover is to maintain isolation. It is placed at the top part of the solar dryer. The transparent glass is used for providing maximum amount of solar radiation inside the drying chamber. Glass is used to capture the solar radiation inside the chamber; it decreases the value of irradiation, it is also decrease the UV radiation. The purpose of glass cover installed on the top of the solar dryer is to maintain the heat.

7) Plywood

Some construction material is used to construct a solar dryer .The plywood makes a wooden box. It is covered by total design of the box. It is black painted inside to increase the heat and hold the heat for long duration.

III. RESULT AND DISCUSSION

A. Observation 01

Moisture removed during drying (in the month of April-May) both in outside and the inside chamber are as follows. Room temperature during drying period was 31degree Celsius and the comparing the percentage of moisture removed from the solar dryer and the ordinary air (fruit present in the atmosphere) the following table is experimental based data.
Also we take different fruit like chilli, potato, grapes for calculation of experiment.

Table 1. Temperature, weight and % of moisture removed in different condition.

Sl. No	Time	Upper Tray			Lower Tray			Outside Chamber	
		Temp in degree C	Weight (gm)	Moisture Removed (%)	Temp in degree C	Weight (gm)	Moisture removed	Weight (gm)	Moisture removed
1.	10:00(AM)	31	250	0.00	31	250	0.00	250	0.00
2.	11:00(AM)	58	225.00	10.00	56	227	8.8	247	1.19
3.	12:00(PM)	63	202.01	19.20	63	206.45	17.42	263.03	5.58
4.	01:00(PM)	66	177.02	29.20	65	184.66	26.13	226.54	9.40
5.	02:00(PM)	71	125.00	50.00	68	128.20	48.72	199.04	20.28
6.	03:00(PM)	75	90.03	64.00	73.97	93.44	62.66	150.00	39.90

Physical appearance of (chilli) before and after 6 hours of drying in a fully sunny day.

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Chili before drying


Chili after drying in Inside


Chili after drying in outside

B. Prototype Set-Up


Fig 4.3 Working model of solar tray dryer

IV. SWOT ANALYSIS

A. Strength

1) Reduces drying time.
2) Easily assembling and disassembling and ease for transportation.
3) Low maintenance.
4) Good efficiency.
5) No fuel requirement.
6) It can be viable in any areas.
7) Pollution Free
8) Simple Construction.
9) All the nutrients possessed in the product.

B. Weakness

1) Depending on the weather condition.
2) Human efforts must required during operation..

C. Opportunities

1) Use in where electricity is not available.
2) It requires low maintenance.
3) This is the advanced model of dryer.
4) It is use for long distance transport.

D. Threats

1) Fluid type foods are not able to use in solar tray dryer (net tray).
2) Chances of breaking of glass.

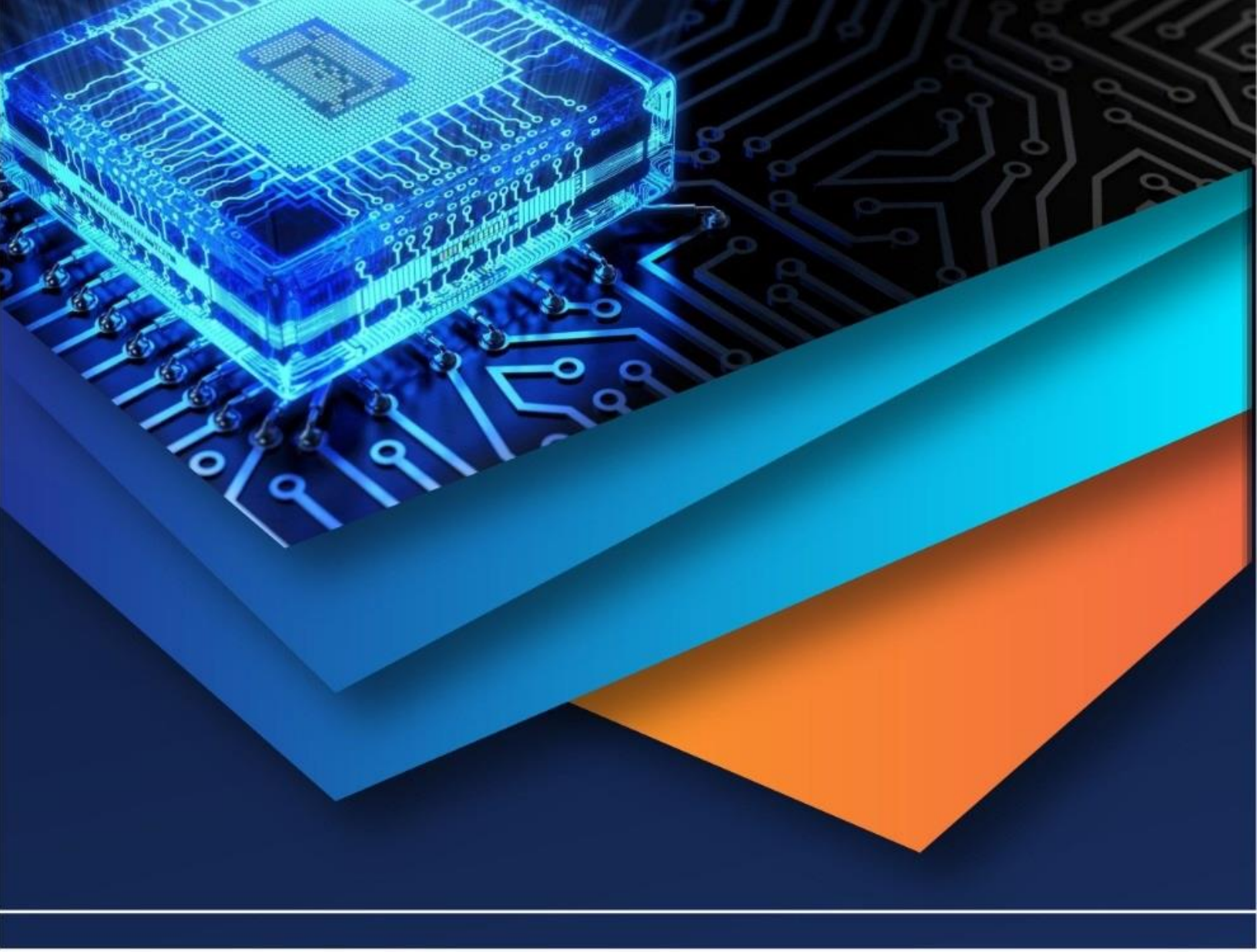
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V. CONCLUSION

Solar drying system has proved to be technically and economically valuable for several crops. It is, however, necessary to develop small-scale dryers that may be used throughout the year for different products to make them attractive to the farmers. Protection against dust, insects, mold, and other sources of contamination, all these factors are essential to optimize the quality of the product.

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