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Drying of Fruits & Vegetables by Using Solar Dryer

Vinayak S. Panchal¹, Ganesh B. Navale², Aditya A. Mahale³, Sayan MD. Jamali⁴, D.P.Patil⁵

B.E Final year Student, Department of Mechanical Engineering, Matoshri College of Engineering & Research Center,
Eklhare, Nashik, India^{1,2,3,4}

Assistant Professor, Department of Mechanical Engineering, Matoshri College of Engineering & Research Center,
Eklhare, Nashik, India⁵

ABSTRACT: In India, land is widely used for agricultural purpose hence the drying process is used over large scale for drying the merchandise and preserve it for longer period of your time. Green house drying may be a method of removing moisture contained from the product. The medium of drying is solar power which is straightforward available energy and low in cost for farmer. By this method the loss of product by spoilage are going to be stop and can be beneficial to farmer in low cost.

KEYWORDS: Drying, Solar, Efficiency, Moisture etc.

I. INTRODUCTION

Solar drying is one in all the applications of solar power. As drying may be a traditional process and used since thousand years over globe. Drying is moisture removal process from product. It's helpful for preservation of food of while and it prevents product from contamination. Direct, indirect and blend mode solar drying are different solar drying methods. Primarily hospitable sun or direct drying technique is used however it's some disadvantages. This disadvantage are often eliminated by indirect sort of dryer which is employed for drying product as application of solar power. Conveniently there are 13 sorts of indirect solar drying.

These are various modifications in collector of indirect solar drying over simple flat collector solar dryer acknowledged in last 50 years. These are double pass, multi pass type, fin type, VGroove type, trapezoidal type, parabolic type, Etc. out of which VGroove types most effective yet found. Parabolic shape type collector is a big improvement over flat plate type collector but as manufacturing purpose of parabolic collector is bit expensive. There was scope to form collector with features of parabolic collector but at reasonable cost. That's what exactly we do we are improving and optimizing design factors from both flat plate and parabolic collectors and integrating it with new sort of collector which can be cylindrical type collector. At now we assume that this idea is having some unique features like its compact, easy to manufacture, quite cheap over flat plate collector, great heat transfer rate, Etc.

II. PROBLEM FORMULATION

We are getting to design and green house drying chamber therefore the problem farmers face of spoilage of food while farming are going to be reduced. It takes solar dryer to next step rather of normal drying the greenhouse drying is used in usual method of farming's. The aim of this method is to develop a mixed-mode solar dryer during which the grains are dried simultaneously by both direct radiation through the transparent roof of the cupboard and by the heated air from the solar dish. The issues of low and medium scale processor might be alleviated, if the solar dryer is meant and constructed with the consideration of overcoming the restrictions of direct and indirect sort of solar dryer. Productivity of grains and crops will grow and hence farmers earn more profit.



III. OBJECTIVE

To take solar dryer to next level instead of normal drying the greenhouse drying is used. The objectives of this studies is to develop a mixedmode solar dryer during which the grains are dried simultaneously by both direct radiation through the transparent walls and roof of the cupboard and by the heated air from the solar dish. The problems of low and medium scale process or could be lighten, if the solar dryer is meant and constructed with the consideration of overcoming the restrictions of direct and indirect type of solar dryer So therefore, this work are going to be supported the importance of a mixed mode solar dryer which is reliable and economically, design and construct a mixed mode solar dryer using locally available materials and to gauge the performance of this solar dryer. In the process of drying, heat is a crucial to evaporate moisture from the material and a flow of air helps in carrying away the evaporated moisture. There are two basic mechanisms which are involved in the drying process. The migration of moisture from the interior of an individual material to the surface, and therefore the evaporation of moisture from the surface to the nearby air.

- A. Design and construct solar dryer using locally available materials and to evaluate performance of this solar dryer.
- B. Work will be based on importance of solar dryer which is reliable and economical.
- C. The matter of low and medium scale processor might be alleviated, if solar dryer is design and constructed withconsiderately of overcoming limitation of direct and indirect sort of solar dryer.

IV. WORKING PRINCIPLE

The working rule of drying is mix mode by means of open and indirect sun drying using only the solar energy. The crops are generally spread on the tray of drier where they receive small wavelength solar power during a big part of the day and also natural air circulation. The solar plate which is placed contains aluminum meshing sheet which accumulate the heat from sun. The absorb radiation is converted into thermal energy and the temperature of the material starts to increase. Long wavelength radiations from the surfaces of crop to ambient air through moist air and also convective heat thanks to the blowing wind through moist air over the crop surface. The fan helps the heated air to enter the cupboard by means of insulated pipe. The moisture is taken away by the air entering into the cabinet from below and runoff through at the top exit way within the cabinet dryer, of the entire radiation impinging on the tray cover, a neighborhood is reflected back to atmosphere and therefore the remaining is transmitted inside the cupboard. A part of the transmitted radiation is then absorbed by the surface of the crop which causes its temperature to extend and thereby emit long wavelength radiations which aren't allowed to flee to atmosphere thanks to the green poly cover. The overall phenomena cause the temperature above the crop inside the cupboard to be higher. The cabinet dryer serves in reducing direct convective losses to the ambient which plays a crucial role in increasing the crop and cabinet temperature.

V. FORMULAS USED FOR CALCULATE HUMIDITY

A) Humid Gas Properties and Psychometric Calculations

In psychometrics calculations we study thermodynamics of three phases: Inert gas phase, moisture Vapor phase, and moisture liquid phase. Two Gaseous phases form an answer (mixture) called humid gas. To determine the degree of complexity of our approach we we'll make the subsequent assumptions:

- a) Inert gas component is insoluble in the liquid phase
- b) Gaseous phase behaviors is on the brink of ideal gas; This limits our total pressure range to but 2 bars
- c) Liquid phase is incompressible
- d) Components of both phases do not chemically react with themselves.

I) Absolute humidity (A.H)

It is the total mass of water Vapor present in a given volume of air. It does not take temperature into consideration. Absolute humidity is the mass of the water Vapor (m), divided by the volume of the air and water Vapor mixture.

$$A. H. = \frac{mv}{V_{net}}$$

II) Relative Humidity (R.H or Φ)

It is the ratio of actual partial pressure exerted by the water Vapor in any Volume of air (p) to the partial pressure that would be exerted by the water Vapor if water Vapor in the air is saturated (p) at the temperature of the air.

$$\text{R.H or } \Phi = \frac{\text{Actual partial pressure (pv)}}{\text{Partial pressure at saturation (ps)}} * 100\%$$

iii) Specific Humidity (w)

Specific humidity (or moisture content) is the ratio of the mass of water Vapor (m) to the total mass of the moist air parcel (m). Specific humidity is approximately adequate to the "mixing ratio", which is that the ratio of the mass of water vapor in an air parcel to the mass of dry air for the same parcel. As temperature decreases, the quantity of water Vapour needed to succeed in saturation also decreases. As the temperature of a parcel of air become slower it'll eventually reach the aim of saturation without adding or losing water mass.

$$W = \frac{mv}{m_{net}} = 0.6629 \frac{Pv}{P_{net} - Pv}$$

VI. MODELLING AND ASSEMBLY

After completion of design the event is completed by observing the parameters needed to extend the efficiency of drying. Parameters are selected according to objectives. Main mottos of this project were to develop the primary prototype of any easy use, low priced and test its performance. Design must be easy to take care of and will not require highly trained worker or operator, which is tough to be found in rural and concrete areas. Assembly process should be simple and supported locally available techniques in rural areas. Important parts of the Solar Green House Drying is :

1. Drying space, where the fabric to be dried is placed and where the Drying takes place.
2. Collector to convert solar radiation into heat.
3. Auxiliary energy source (optional).
4. Heat transfer equipment for transferring heat to the drying air or to the fabric.
5. Means for retaining the drying of air in flow.
6. Measuring and control equipment (optional).

The assembly of various components of "Solar Food Drying" is done as follows:

- (1) The solar collector contains aluminum meshing sheet to collect solar radiation and drain to pass the heated air.
- (2) The insulated pipe is attached to the solar dish and drying cabinet.
- (3) The alphanumeric display is displayed on the drying cabinet and sensor is placed inside the cupboard .
- (4) The drying tray is putdown inside the drying cabinet.
- (5) The ducts and air exit is given on the highest of the drying cabinet.
- (6) The power is given by 12V battery to an digital display and the sensor.





Fig1. Parts of Solar Dryer

VII. TESTING AND ANALYSIS

The test we conduct on day time was the time taken for drying was less and thus the efficiency of drying was more. We took reading for one week (6 day) reading for the typical period of time 11am to 4pm and located out following readings.

VIII. RESULTS

1. Drying rate is quicker under forced convection than natural convection mode.
2. Convective heat transfer coefficient is quite the open sun drying mode.
3. Values of convective heat transfer coefficient diverse with the dimensions and first moisture content of a product.
4. Use of inclined reflection north wall up in solar drying can increased the entire radiation.
5. PV ventilated solar dryer gives a really top quality dried product and reduces drying time than outdoors sun drying.
6. Greenhouse drying reduces moisture content during a really less time.
7. Solar greenhouse tunnel drier are often utilized in rural areas.
8. Ratio under forced convection is inferior to natural convection mode.

Day	Wind Velocity	T1	Potato drying Time	Soyabeanvadi drying time
	(m/s)	°C	/hr.	/hr.
Monday	1.94	32	3 hr.	2hr.15min
Tuesday	5.55	31	3hr. 25min	2hr.
Wednesday	3.167	31	3hr. 19min	2hr
Thursday	4.55	33	2hr. 55min	2hr.30min
Friday	2.5	33	3hr. 30min	2hr
Saturday	2.5	33	2hr, 45min	2hr. 20min

Table1 Testing Table



IX. CONCLUSION

The solar dryer can raise the ambient air temperature to a substantial high value for increasing the drying rate of agricultural crops. The product inside the dryer requires less attentions, like attack of the merchandise by rain or pest (both human and animals), compared with those within the open sun drying. Although the dryer which was used to dry the potato, it can also be used to dry other crops like yams, cassava, maize and plantain etc. There is proficiency in monitoring in comparison to the natural sun drying technique. The cost of capital involved within the construction of a solar dryer is far lower thereto of a mechanical dryer. The moisture contain in amla candy can be reduced from 80% to 25% w.b in six days for the open sun drying, whereas the solar tunnel dryer took only five days. Result showed that for drying of soya bean vadi; Dryer took only 2 hours to attain the desired moisture content. Samples dried within the solar tunnel dryer were completely shielded from insects, rain and dusts, and therefore the dried samples were of top quality in terms of color and hygienic. It is a need of time to think about popularization of such technology from energy conservation and greenhouse gas emission points of view.

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