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# Theoretical Study of Solar Dryer with Different Shapes of Absorber Plate

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**Abstract:** This paper presents a theoretical to implemented different shapes of two types of absorber plate (twisted shaped, uniformly increase v-shaped) in solar flat plate collector. Using different shapes noted and tested, which one get more drying efficiency, thermal efficiency with the help of theoretical using formulation and compared to the analytical results. Lets also discussed advantages of the shape of absorber plate.

**Keywords:** Solar flat plate, absorber plate, solar dryer, glass

## I. INTRODUCTION

An alternative solution for traditional drying method and to overcome the problem of open sun drying, indirect type solar dryer is used. The main reasons are as follows, In direct type solar drying maintains good product quality compared to open sun drying. Time for drying process can be significantly reduced as compared to open sun drying. Dried foods can be preserved for a long time period and the product becomes extremely lightweight hence easy for Transportation.

Therefore the main objectives of this theoretical work are using different shapes of absorber plates.

## II. PROBLEM IDENTIFICATION

The objective of this study is to develop a solar dryer during which the grains are dried simultaneously by the heated air from the solar dish. The problems 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 type of solar dryer. So therefore, this work are going to be supported the importance of a solar dryer which is reliable and economically, design and construct a solar dryer using locally available materials.

## III. METHODOLOGY

### A. Need For Project

To Increase the drying efficiency. Very low cost while compare to other experimental setup. The reason is we only modify the experimental setup and to avoid the low effective equipments and to alternate the good effective equipments. Easy to availability required equipments. To Increase the drying efficiency. Very low cost while compare to other experimental setup. The reason is we only modify the experimental setup and to avoid the low effective equipments and to alternate the good effective equipments. Easy to availability required equipments.

### B. Objective

- 1) To design and develop an experimental setup for indirect type solar dryer
- 2) To conduct the drying experiments with the sample product of fruit applications
- 3) To develop drying efficiency

### C. Climatedatacollection

The climate condition around the experimental area is to be analyzed and the data will be determined in this process .To check the previous climate condition around the experimental area with satisfies required data. The climate condition based Coimbatore district in tamilnadu state, india

- 1) *Climate Condition In Coimbatore*: The mean maximum summer temperature is 34.7°C while the minimum temperature around these months is around 22.1°C. Winter temperatures hover very near to this as Coimbatore has a mean maximum temperature of 32.2°C and mean minimum temperature of 19.2°C.
- 2) *Coimbatore Rainfall*: Coimbatore is cocooned between the Western Ghats in the north and western side, the Nilgiri Biosphere Reserve, Anamalai range, Munnar range and the western pass Palghat. As such, this location gives Coimbatore a peculiar rainfall pattern. It receives an average rainfall of 61.22 cms annually, spreading over an average of 44.5 days in a year. The south-west monsoon contributes rain in the months from June to August. A humid September is followed by an October-November rain by the retreating North-eastern monsoon.

#### IV. DESIGN

Design for experimental setup depends upon the requirement needed.

##### A. Absorber plate type

##### 1) Uniformly Increase V-Shaped Absorber Plate

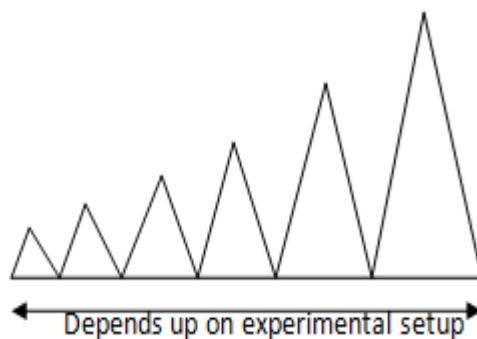


Figure 1; Uniformly increase the v-shaped absorber plate

v-shaped absorber plate will be based on the flat plate collector length.

$$\left[ \begin{array}{l} \text{UNIFORMLY INCREASE} \\ \text{THE V-SHAPED ABSORBER PLATE} \end{array} \right] = \frac{\text{NO.OF.V -SHAPED}}{\text{LENGTH OF FLATE PLATE}}$$

##### 2) Twisted Absorber Plate

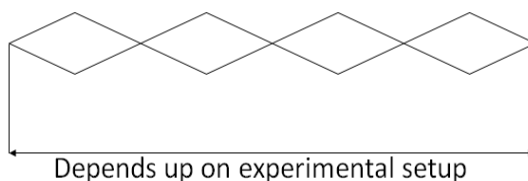


Figure 2; twisted absorber plate

$$\begin{array}{l} \text{TWISTED} \\ \text{ABSORBER PLATE} \end{array} = \frac{\text{NO.OF.V -SHAPED}}{\text{LENGTH OF FLATE PLATE}}$$

## V. SELECTION OF MATERIALS

In order to overcome this problem, we suggest the two material **SS444 and 317L** for the manufacturing of the solar flat plate collector.

### A. *Stainless Steel 317L*

Alloy 317L is a low carbon corrosion resistant austenitic chromium-nickel-molybdenum stainless steel.

The low carbon content of Alloy 317L enables it to be welded without inter regular corrosion resulting from chromium carbide precipitation enabling it to be used in the as-welded condition. With the addition of nitrogen as a strengthening agent, the alloy can be dual certified as Alloy 317.

Alloy 317L is non-magnetic in the annealed condition. It cannot be hardened by heat treatment, however the material will harden due to cold working. Alloy 317L can be easily welded.

### B. *Stainless Steel 444*

Type 444 is a low carbon, low nitrogen, ferrite stainless steel that provides pitting and crevice corrosion resistance superior to most ferrite stainless steels. Applications requiring superior corrosion resistance and resistance to chloride stress corrosion cracking are ideal for this alloy. It is used in Food processing, brewery and wine making equipment, hot-water tanks, heat-exchanger tubing and automotive components

### C. *Advantages of Aluminum*

- 1) It is highly sturdy and fully recyclable.
- 2) It is impact-resistant and extremely strong.
- 3) It is resistant to UV radiation.
- 4) It is considered the most common metal in earth's crust.
- 5) Low corrosion rates compared to rust, specially if anodized.
- 6) It is metal so good conductor of electricity.

## VI. ADVANTAGES OF AB SORBEPLATE IN DIFFERENT SHAPES

### A. *Uniformly Increase The V-Shaped Absorber Plate*

- 1) Mainly, heat energy will be fully passing through the flat absorber plate collector area.
- 2) It will be taken less time only compare to the flat absorber plate.
- 3) The main advantages less weight when compare to the flat absorber plate collector.
- 4) The heat will first quickly get heated the starting point of the v-shape.
- 5) Then, over heating passes next v-shape absorber also.
- 6) When, flat plate absorber fully heating process, not quickly heat the flat absorber but, this may be fully covered all absorber plate.
- 7) Even, uniform v-shaped compare to uniformly increase the v-shaped absorber plate temperature get highly so, dryer to dried requirements.
- 8) Cost wise same only.

### B. *Twisted Absorber Plate*

- 1) It fully covered the total area of flat plate collector.
- 2) The heat efficiency is high.
- 3) The travelling heat time is very low.
- 4) Heat capacity is high in the single twisted shape.
- 5) Time taken is high but temperature also high.
- 6) Highly requirements is preferable this type.
- 7) Cost wise same only.

## VII. CONCLUSION

This paper discussed the different types of solar flat plate collector dryer. Less amount of dryer suggested the uniformly increase v-shape absorber plate, while compare to twisted low only. So, high amount of energy apply and try in experimental setup. The Major disadvantages in flat plate travelling time taken are high and working time also high.

## REFERENCES

- [1] Ajayi, C., Sunil, K.S., and Deepak, D. 2009. "Design of Solar Dryer with Turbo ventilator and Fireplace". International Solar Food Processing Conference 2009.
- [2] A.A. El-Sebaei; S.M. Shalaby (2012): "Solar drying of agricultural products": A review, Renewable and Sustainable Energy Reviews 16, 37– 43.
- [3] Adegoke, C.O.; and Bolaji, B.O. 2000. "Performance evaluation of solar-operated thermosyphon hot water system "in Akure. Int. J. Engin. Technol. 2(1): 35-40.
- [4] Akinola, O.A.; Akinyemi, A.A.; and Bolaji, B.O. 2006. "Evaluation of traditional and solar fish drying systems towards enhancing fish storage and preservation in Nigeria". J. Fish. Int., Pakistan 1(3-4): 449.
- [5] Azad (2008) has "designed and developed an experimental study of natural convection solar dryer for rural area".
- [6] Aiswarya and Divya (2015) "performed a study on new indirect solar dryer with phase change material (PCM) as energy storage medium".
- [7] Bassey, M.W. 1989, "Development and use of solar drying technologies", Nigerian Journal of Solar Energy 89: 133-64.
- [8] Bolaji, B.O. 2005. "Performance evaluation of a simple solar dryer for food preservation" . Proc. 6 Ann. Engin. Conf. of School of Engineering and Engineering Technology, Minna, Nigeria, pp. 8-13.
- [9] Brenidorfer B, Kennedy L, Bateman C O (1995). "Solar dryer; their role in post harvest processing, Commonwealth Secretariat Marlborough house", London, Swly 5hx.
- [10] B.K. Bala; M.R.A. Mondol; B.K. Biswas; B.L. Das Chowdury; S. Janjai (2003):" Solar drying of pineapple using solar tunnel drier", Renewable Energy 28, 183–190 availability is inadequate or not available.
- [11] Bal et al. (2009) "designed and developed a solar dryer which uses paraffin wax as a PCM to store excess solar energy during the daytime".
- [12] C. Çakmak and Yıldız (2011) have studied "a novel type of a solar dryer for drying seeded grape".
- [13] Devahastin and Pitaksuriyarat (2006) investigated the feasibility of using latent heat storage to conserve excess solar energy during drying and release it when the energy
- [14] Esakkimuthu et al. (2013). "An indirect solar dryer which utilizes a Phase Change Material (PCM) "
- [15] Enibe (2002, 2003) presented an experimental study of indirect solar dryer with PCM.
- [16] (Ertekin and Yaldiz, 2004) "A black painted rocks were placed in the collector chamber in order to absorb solar radiation and to store thermal energy Drying is defined as a process of moisture removal due to simultaneous heat and mass transfer".
- [17] Ertekin, C.; and Yaldiz, O. 2004." Drying of eggplant and selection of a suitable thin layer drying model", J. Food Engin. 63: 349-59.



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