Review Paper on Comparative Analysis on Solar Crop Dryer

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Abstract:- In this paper we are focusing on the past history of solar crop dryer worldwide, their basics, construction material, devices used and the different- different optimization technique used by the researchers to increase the efficiency of the dryer. Comparison of solar dryers with respect to their construction, their parameters, rate of removing moisture content and between their efficiency. Some suggestions are put at the end of this papers some data are provided in respect of india.

Keyword:- Cabinet, P.C.M., Solar energy, Solar collector,., thermal efficiency, humidity.

I. INTRODUCTION

Human need solar energy for different different purposes like water heating,electricity generation etc. . Drying of crop is an important activity and used by all over the world for preservation of food so that they can be used for a long time without any spoilage. Drying is one of the methods used to preserve food products for longer periods

Drying is the oldest preservation technique of agricultural products and it is an energy intensive process. High prices and shortages of fossil fuels have increased the emphasis on using alternative renewable energy resources. Drying of agricultural products using renewable energy such as solar energy is environmental friendly and has less environmental impact. In Devloping counties like india , pakistan nepal , sri lanka etc. have large production of grain but due to lack of availability of suitable storage space most of grains spoil either by weather (moisture) or by insects ,bird etc.

In recent years, attempts have been made to develop solar dryers that can be used in agricultural activities in developing ,countries. Many of the dryers used for dehydratin'g foods are rela,tivelylow-

cost compared to systems used in developed countries'.In order to ensure continuous food supply to the growing populationand to enable the farmers to produce high quality marketable products, efficient and at the same time affordable drying methods are necessary

In sun crop drying process preservation is done by dehydrating the material. Dehydration may be done either by sun or by mechanical process with the help of fossils fuels. But the solar drying is relatively low cost and easy method to adopt.

Advantages of solar crop drying :-

1. Low cost because fuel used is solar radiation. No environmental impact.
2. Good quality of product obtained.
3. Protection from the insects , animals, storm , hails and dust.
4. Efficient and easy to use .
5. Can be made from locally available material.

Disadvantages of solar crop drying:-

1. Uses solar radiation so need good weather conditions.
2. If radiation fluctuate good product quality can not be achieved

II. TYPES OF SOLER DRYER

There are following main types of Solar dryer used in Practice

[1] **Direct type**:- in this type of solar dryer the solar cabinet (trays) is directly placed in the radiation of sun. Fig(1)

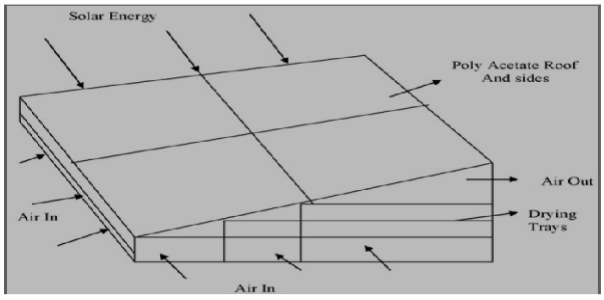

Fig1.Direct type (natural) solar drying

[2] **Indirect type**:- In this type of solar drying method the solar absorber or collector is placed toward the direction

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of solar radiation and then heated air is passed through the cabinet where moisture is extracted by the heated air and taken up in the atmosphere. It is also called active dryers.fig(2)

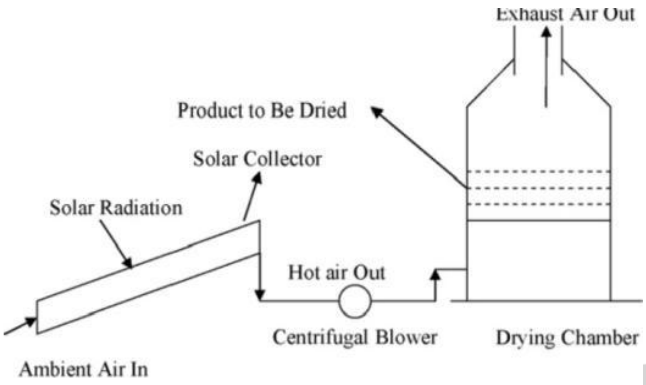

Fig2.indirect type solar drying

[3] **Natural Convection:-** IN natural convection solar dryer the air movement is resume due to the difference indensity of hot air and cold air.

[4] **Forced convection:-** In forced convection solar dryer we uses mechanically device like blower or fan to induced drought so that the movement of air gets high and take the moisture from the product at high rate .

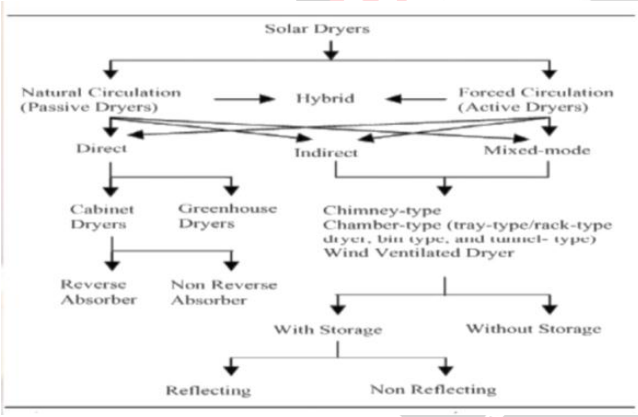

Fig3.Types of solar dryer

III. LITERATURE REVIEW

In this part of literature review, we highlited the past discoveries on solar crop dryers. It also compare the advantages and disadvsntages of different-2 solar crop dryers.

1. Ahmed AbedGatea :-They design and constructed a solar drying system of a cylindrical section which have solar collector flat plate drying chamber .the maximum temperature outlet was 71.4% at 4am. The radiation intensity was 750 w/m^2 and air flow rate was obtained 0.0401 kg/s, while the ambient temp was 34^{o}C. Max avg value of thermal efficiency of solar collector was 25.64% and max daily efficiency was 18.41% at flow rate was0.0405kg/s. system length is 1.10m and width is 1.10m. collector system faced south and tilled 45^o from the horizontal level. Drying cabinetwas in cylindrical section, with length and dia 1m each.Fig4.

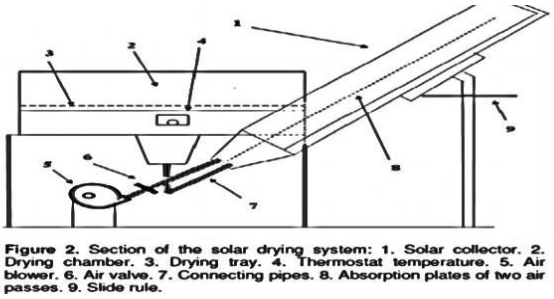

Figure 2. Section of the solar drying system: 1. Solar collector. 2. Drying chamber. 3. Drying tray. 4. Thermostat temperature. 5. Air blower. 6. Air valve. 7. Connecting pipes. 8. Absorption plates of two air passes. 9. Slide rule.

Fig4. Crop dryer with cylindrical section

2. F.K. Forson.et.al

He designed a mixed mode natural convecton solar dryer. They dried cassava for their experiment .The total mass of cassava is 160 kg and the moisture content is 67%initialy wet basis. Total drying time was almost 30-36h for thelocation Kumasi 6.71N,1.61W. The incident solar radiance was 400 W/m2 with ambient temp was 250C and 77.8% humidity. The collector area was 42.4m2 .the drying effiency was 12.3% with drying time 35H when the ambient temp was 28.20C and R.H. was 72.1%. Fig5

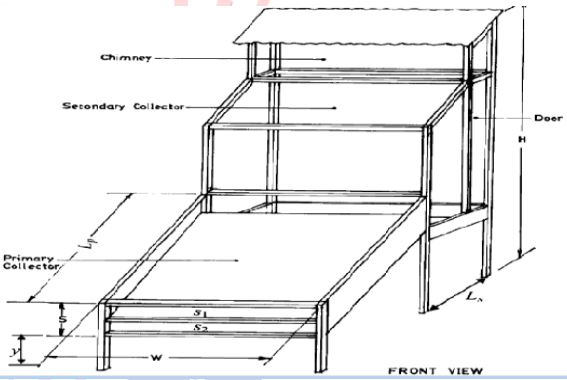

Fig5. Mixed mode natural convection dryer

3.Bukola O. Bolaji.et.al:- They constructed and tested the solar wind ventilated cabinet dryer for Nigeria for velocity in Solar dryer was 1.62m/s and the avg. efficiency of the system was 46.7%. The max

drying air temp was 64^{o}C. 80% weight loss were obtaine in the drying of pepper.Fig6.

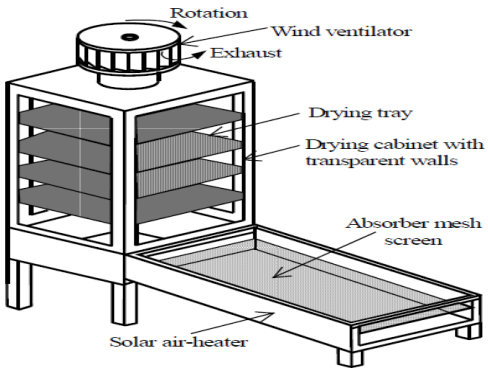

fig6. Solar wind ventilated dryer

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4.EL- Amin O Amin Omda Mohamed Akoy.et.al :- A natural convection solar dryer designed for mango slice wherecollector area was 16.m^2 and moisture remove from 81.4%to10% on wet basis. The drying time is around 2 days during April to June . a prototype is designed for max collector area of 1.03m^2 Fig7a,b.

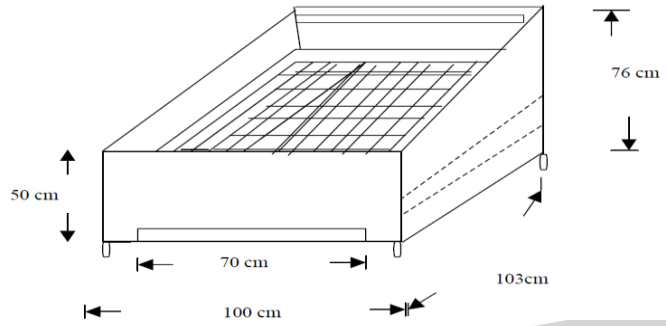

Fig7a.

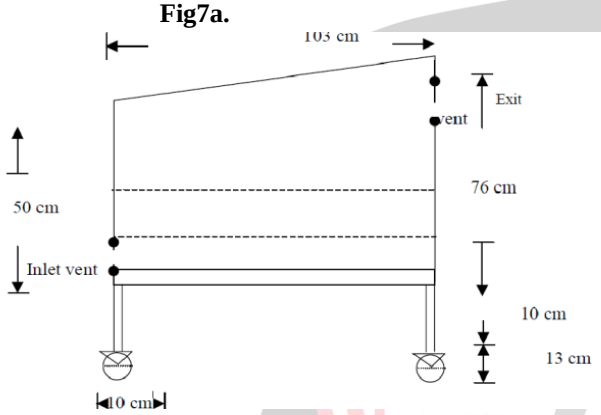

fig7b. Natural convection solar dryer

5.A.O.Adelaja et.al. Analysed and tested a natural convection solar dryer for the tropics. The product was plantain fillets. The collector and system efficiencies are found to be 6.% and 78.73% respectively. Thickness of mild sheet is 3mm and the dimension of collector case is 1.0x1.0mx0.2m with collector channel dimmention is 1.0x0.5x0.1m.

6. M. MOHANRAJ, P.CHANDRASEKAR:- They designedForced convection Solar dryer integrated with heat storage material . The drying material was chili. The moisture content about 9.7%9(wb) in top trays. Thermal efficiency was estimated about 21% and moisture extraction rate of about 0.87% kg/kWh Fig(8).

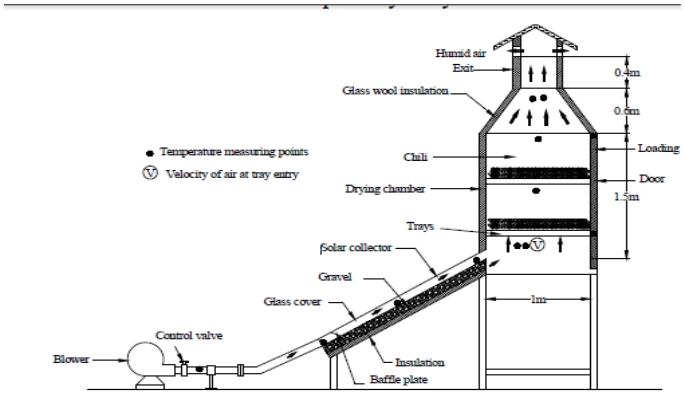

Fig8. Forced convection solar dryer

7. Goyal et al:- They done parametric study of a reveseFlate plate in which observer plate is placed horizontal and doenward facing , The cabinet dryer is placed on the top of the absorber which becomes heated. The length towidt ratio of the dryer is taken as 3:1 to avoid the shading effect.

8.N Seetapong et al:- they used natural convection solar tunnel dryer constructed in which movement of air through vents when the dryer is placed in the path of air flow.

The total base area of the drier is 0.35 m^2 with the length of 0.7m the width of 0.5m and coverdwitthe glass. The avg. thermal efficiency of solar collector is calculated to be 2.59% .at air flow rate of 0.023kg/s. The all day avg. ambient air and inside the chamber temp ws 38.34^{0}C and 63.19^{0}C respectively.(Fig9)

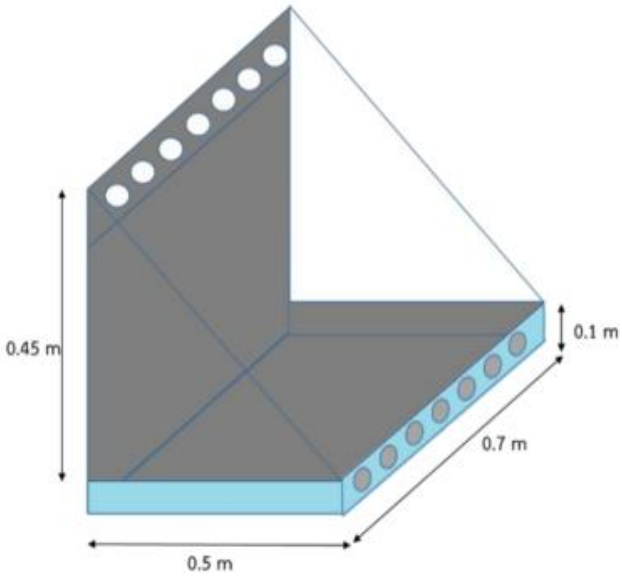

Fig9. Natural convection solar tunnel dryer

9.Modern development in solar crop dryer:-

1.**By using phase change materials :-** A phase change materials is a substance witth a high heat of fusion which , melting and solidifying at a certain temprature, is capable of storing and releasing larg amount of energy. Heat is absorbed and releaded when the material change

Drying parameter In drying, heat is transferred by convection(from the surrounding air) and radiation (from the sun in case of dryers of the direvt type) to the surface of the product. Drying can be accelerated by increasing the the flow rate of air and or by increaing the temperature of the drying air. The initial process of drying is essentially surface drying after which the rate of drying depends upon the rate of moisture migration from the interior of the product to the surface.(Fig 10)

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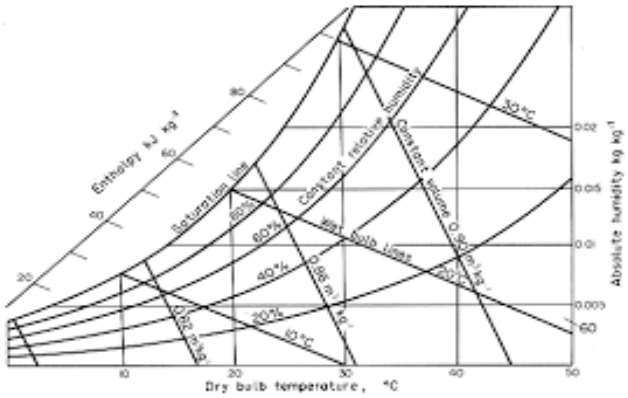

Fig10.process on the psychrometric chart

The process of drying is therefore, controlled by the properties of the drying air often known as external parameters and the properties of the product which we term as internal parameters. The important external parameters are the dr y and wet bulb temperatures and hence the relative humidity, humidity ratio, temprature and enthalpy of the drying air.All the proerties of air can be drawn on a chart called the psychrometric chart.

IN the process of drying ,evaporation of water can be caused by heated air from the wet product. The dry bulb temprature decreases, approaching the wet bulb temprature which remains constant. This change can be followed on the psychrometric chart by a line

The internal parametrs affecting the process of drying are moisture content and the latent heat. The moisture content M is usually defined on either dry basis or wet basis

$$M_{(db)} = w\text{-}d/\ d$$

$$M_{(wb)} = w\text{-}d/w$$

Where M_{db}= moisture on dry basis

M_{wb}= moisture on wet basis

W= weight of wet sample

d = weight of dried sample

When the rate of loss of moisture from the product to the surrounding environment equals the rate of moisture absorption by the product, is termed as the equilibrium moisture content (Me). The associated value of the relative humidity of the surrounding air is called the equilibrium relative humidity .

IV. SUGGESTION

According to India's scenario

1. The cost of Dryer should be such that even a small house family can afford it., because there are many works in houses which uses solar energy.
2. By giving awareness to the farmers because indias most of population are involved in agriculture so that they can increase the uses of solar dryer for their need.
3. Workshop and demonstration, importanance of solar dryer elaborate to the farmers.

V. CONCLUSION

The main purpose of the paper is to presents a study focused on the solar crop dryer their types and available design, performance available to these days. Describing the advantages and disadvantages of direct and indirect method. From the above all types of solar dryer we find forced convection solar dryer (designed by M. Mohan Raj Please. Chandrashekhar) best among all the dryers having thermal efficiency almost 21% in terms of drying rate and thermal efficiency. Some important suggestions are given in this review paper for increasing the efficiency of dryer and how can more population use dryer for agriculture purposes.

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