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Experimental Analysis on Vortex Circulating Solar Dryer

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ABSTRACT
Agriculture is the main source of livelihood in India. Drying particularly of crops is an important human activity and globally the use of dried products is widespread. For preservation, quality improvement and processing purposes, moisture must often be removed from both organic and inorganic materials. Sun drying and mechanical dehydration using fossil fuels are the most common technologies used, Sun drying is a low-cost drying method but the final quality is variable, while mechanical dehydration is an energy intensive process and contributes substantially to energy use and greenhouse gas emissions. The solar dryer consists of flat plate collector, a blower with pipe connections, and vortex circulating bed. The blower is used to circulate the hot air from the collector to the bed and Vortex-Circulating bed of the solar dryer is circulating while drying chillies that are present in it.

Keywords: Solar Drying, Flat Plate Collector, Vortex-Circulating Bed.

I.INTRODUCTION

The shortage of energy is an issue in many countries, particularly those in the developing world. Even where conventional energy is plentiful, there is pressure to reduce a number of fossil fuels used. Concern over global warming is universal and this has focused our attention on energy intensive processes like drying where fossil fuels can often be replaced by renewable and non-polluting sources of energy. The solar dryer consists of flat plate collector, a blower with pipe connections, and vortex circulating bed. The blower is used to circulate the hot air from the collector to the bed and Vortex-Circulating bed of the solar dryer is circulating while drying chillies that are present in it, this model can predict the change in the relative humidity of air across the bed with digital hygrometer, change in the air temperature, change in the moisture content and the efficiency of the dryer. The solar energy option has been identified as one of the promising alternative energy sources for the future. Agriculture is the main source of livelihood in India. One of the most commonly used methods for preserving foods & agricultural product is drying. Sun drying is the most widely practiced agricultural drying operation in India. The term sun drying is used to denote the spreading of the product in the sun on a suitable surface. Although sun drying is a cheap method, it often results in an inferior quality of dried agricultural products because of its independence on weather conditions and vulnerability of the products to insects, pests, and microorganisms. The direct exposure to sunlight, or more precisely ultra-violet radiation, can greatly reduce the level of nutrients such as vitamins in the dried product. Open sun drying is economical and simple, it has the drawbacks like; no control over the rate of drying, non-uniform drying, chances of deterioration due to exposure to products against rain, dust, storm, birds, rodents, insects and pests which result in poor quality of dried products.

1. Materials and methods

The solar dryer system consists of a flat plate collector, blower with flexible pipe connections, and vortex circulating-bed. The flat plate collector is used to heat the ambient air into hot air. The flat plate collector consists of collector plate, absorber plate with baffles. The material use for absorber plate is aluminum having good

thermal conductivity with black colour. Collector plate is made up of glass which can be used for trapping the solar radiations. The blower is used to suck air from the atmosphere and circulate hot air from the collector to the bed.

1. Results & Discussion

The initial moisture content in red chillies is found. The experiment on drying chilly is conducted in the vortex circulating solar dryer to evaluate the performance of the dryer under loaded conditions. The process is continued with the required moisture content is achieved. The results pertaining to chilly drying in the solar dryer are presented in following Tables & Graphs. The ambient temperature during drying period and the corresponding average temperature inside the solar dryer will be noted. It may be observed that the temperature achieved maximum inside the solar dryer is more than the ambient temperature. This is due to absorption of more solar energy inside the solar dryer and the prevention of heat loss from the dryer.

2. Tables and Figures

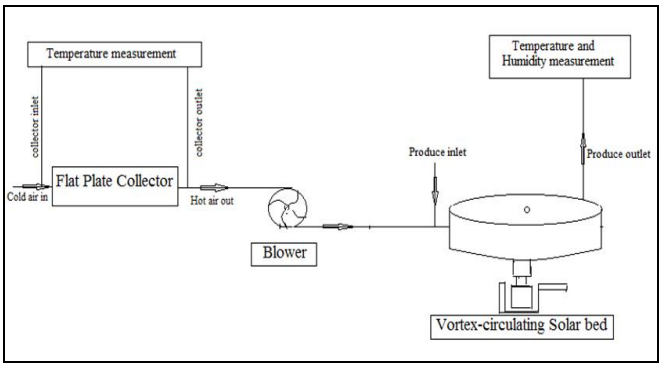

Fig. 1 Flow diagram of the drying process.

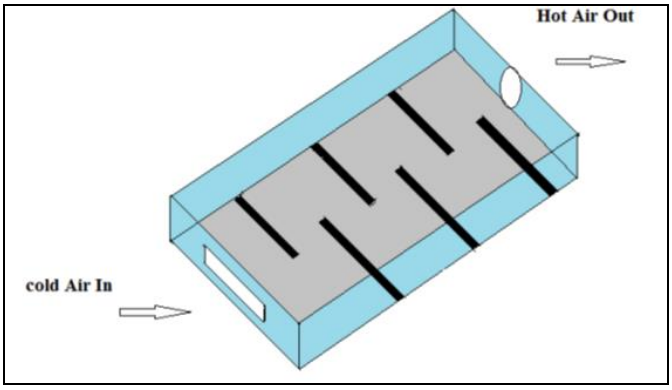

Fig.2 Flat plate collector.

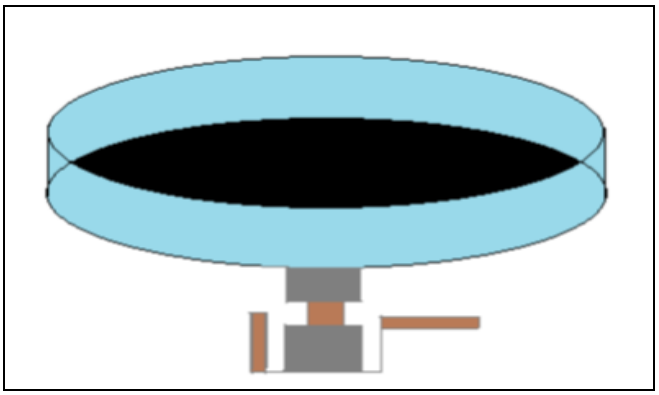

Fig.3 Vortex circulating bed.

3. Equations

5.1 Determination of moisture loss

Moisture loss of chillies is calculated every hour using the formula,

ML= (mi−mf) where,

mi= initial mass of chillies

mf= final mass of chillies

5.2 Determination of Moisture Content

The % of moisture content on wet basis (Mwb) is calculated by using formula

$$\% \text{ Mwb} = \frac{mi-mf}{mi} \times 100$$

Where,

mi= initial mass of chillies

mf= final mass of chillies

5.3 Determination of dryer thermal efficiency

The thermal efficiency of solar dryer is calculated by using the formula,

$$n_{th} = \frac{mw \times hfg}{ma \times Cpa \times (Tco-Tci)+Pb+Pm+ma \times Cpa \times (Tbi-Tbo)}$$

Where,

mw= moisture evaporated in time t, kg/s

hfg= latent heat of vaporization of water, kj/kg

ma= mass flow rate of air, kg/s

Cpa = specific heat of air, kj/kgk

Pb= power used by blower, kW-hr

Pm= power used by motor, kW-hr

Tco= collector outlet temperature, °C

Tci= collector inlet temperature,°C

6. Conclusions

The advantage of the vortex circulating bed is to provide constant movement of the chillies over the bed in order to enhance the resident time with hot air. Vortex circular motion technique provides efficient agitation and moisture removal of product, Achieve the uniform drying and reduce the over drying of food products. So, this method improves the efficiency of Vortex-circulating bed solar dryer. The study of the project concluded for a successful solar dryer, this solar dryer is of the project very important for Indian farmers as they are having small land holdings and a combination of agriculture along with small-scale agriculture based entrepreneurship is the key to a sustainable livelihood. The solar dryer has the potential for application in the drying of various others crops like ginger, figs, pineapple, potatoes, etc. as the products retain their quality, flavor and better shelf life. The solar dryer can be easily constructed using locally available materials. The fan system has an advantage of control air flow because there is a possibility of increasing relative humidity inside the drying chamber. Solar drying achieves higher drying rates compared with sun drying.

7. Appendix

Appendixes, if needed, appear before the acknowledgment.

8. Acknowledgments

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9. References

1. R. VidyaSagarRaju et al Int. Journal of Engineering Research and Applications www.ijera.com ISSN: 2248-9622, Vol. 3, Issue 6, Nov-Dec 2013, pp.1445-1458

2. UmeshToshniwal, S.R Karale / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3, Issue 2, March -April 2013, pp.896-902

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