IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719,
|| Special Issue || June-2019, || PP 61-64 ||

Design and Fabrication of Solar Dryer Powered By Forced Circulation by Using Reflective Mirror

S.P.Kadu[1], Jadhao.H.M [2], Tarade.A.R[3], Kondubhairy.P.Y[4], Gurav.A.P[5]
[1]*(Assistant professor, Department Of Mechanical Engineering, JSPM Narhe Technical Campus, Pune, India)*
[2,3,4,5]*(BE Student, Department Of Mechanical Engineering , JSPM Narhe Technical Campus, Pune, India)*

***Abstract**: An indirect forced convection with photovoltaic powered forced circulation solar dryer has been built and tested. The main parts are: a V -grooved solar air collector, a scrap freeze as drying chamber, a battery and PV panel. The system is operated in one mode, sunshine hours. Experiment were conducted on drying of ginger as drying of ginger is problem in north India and Mahatma Gandhi Institute for Rural Industrialization Wardha (MGIRI, A national institute under the ministry of MSME Government of India) asked to look into it and study the effect of drying as well the climatic and operational parameters on the dryer performance.*

***Keywords:** Twisted tape, Turbulence, Heat exchanger, Forced Convection, Solar Module, Solar Radiation, PV Powered*

I. Introduction

Drying is an excellent way to preserve food and solar food dryers are appropriate food preservation technology for sustainable development [8] Drying was probably the first ever food preserving method used by man, even before cooking. It involves the removal of moisture from agricultural produce so as to provide a product that can be safely stored for longer period of time.

"Sun drying" is the earliest method of drying farm produce ever known to man and it involves simply laying the agricultural products in the sun on mats, roofs or drying floors. This has several disadvantages since the farm produce are laid in the open sky and there is greater risk of spoilage due to adverse climatic conditions like rain, wind, moist and dust, loss of produce to birds, insects and rodents (pests); totally dependent on good weather and very slow drying rate with danger of mould growth thereby causing deterioration and decomposition of the produce. The process also requires large area of land, takes time and highly labour intensive .

With cultural and industrial development, artificial mechanical drying came into practice, but this process is highly energy intensive and expensive which ultimately increases product cost Recently, efforts to improve "sun drying" have led to "solar drying".

In solar drying, solar dryers are specialized devices that control the drying process and protect agricultural produce from damage by insect pests, dust and rain. In comparison to natural "sun is drying", solar dryers generate higher temperatures, lower relative humidity, and lower product moisture content and reduced spoilage during the drying process. In addition, it takes up less space, takes less time and relatively inexpensive compared to artificial mechanical drying method. Thus, solar drying is a better alternative solution to all the drawbacks of natural drying and artificial mechanical drying [4].The solar dryer can be seen as one of the solutions to the world's food and energy crises. With drying, most agricultural produce can be preserved and this can be achieved more efficiently through the use of solar dryers.

Solar dryers are a very useful device for:
1. Agricultural crop drying.
2. Food processing industries for dehydration of fruits and vegetables.
3. Fish and meat drying.
4. Dairy industries for production of milk powder.
5. Seasoning of wood and timber.
6. Textile industries for drying of textile materials, etc.

Thus, the solar dryer is one of the many ways of making use of solar energy efficiently in meeting man's demand for energy and food supply.

Construction of Pipes for Air Collection


.

Cans are joined with the help of silicon sealant. First we joined 2 or 3 cans to each other. Then v-shape groove is formed from wooden strips and pipes are placed in it so that displacement of pipes prevents. About 10 cans are joined together and pipe is formed for the flow of air. We made 10 pipes for air collector. This entire pipe is stickled with silicon. Aluminum foil tape is also used to join the cans and to prevent the losses

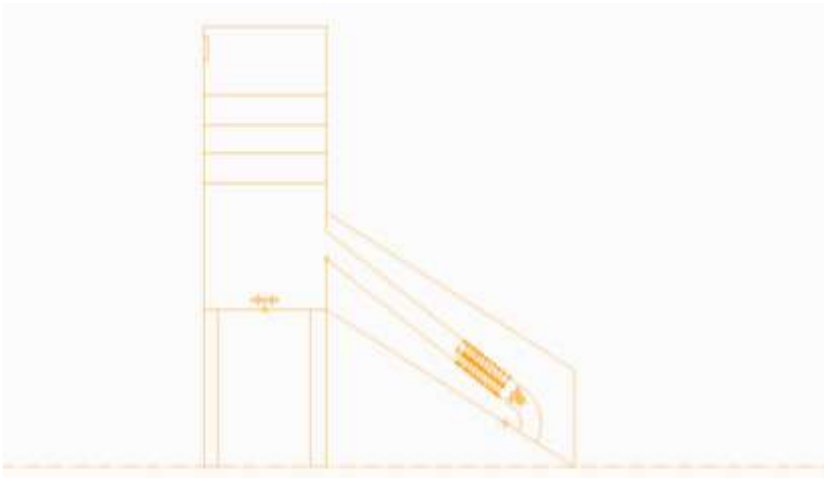
Construction of Frame of Compartment

In fig. the frame of solar panel is shown. We made 1.524 × 0.762 m^2 (5ft × 2.5ft) and 16mm thick wooden frame. Two wooden plates having 10 holes of 6cm diameter are placed at 15cm distance apart from the both end of frame. Rock wool is placed at bottom and at side portion of a frame to prevent the heat losses

Drying Chamber:

Drying chamber is box type design and hot air from the solar collector compartment is passed through this box. We used plywood for making this chamber because it is not so expensive. The size of box is 0.6096m × 0.4572m (2ft × 1.5ft) and the depth is 0.4572m. Number of trays is placed in that box which is used for placing food on it. The box is divided in their part as shown in fig.11. In that chamber 3 trays are provided which are made up of metal and wood. These trays are situated in proper way so that it can put inside it or remove from it. It is design in such a way so potato, onion, carrot, apple slice can spread properly.

EXPRIMENTAL SETUP

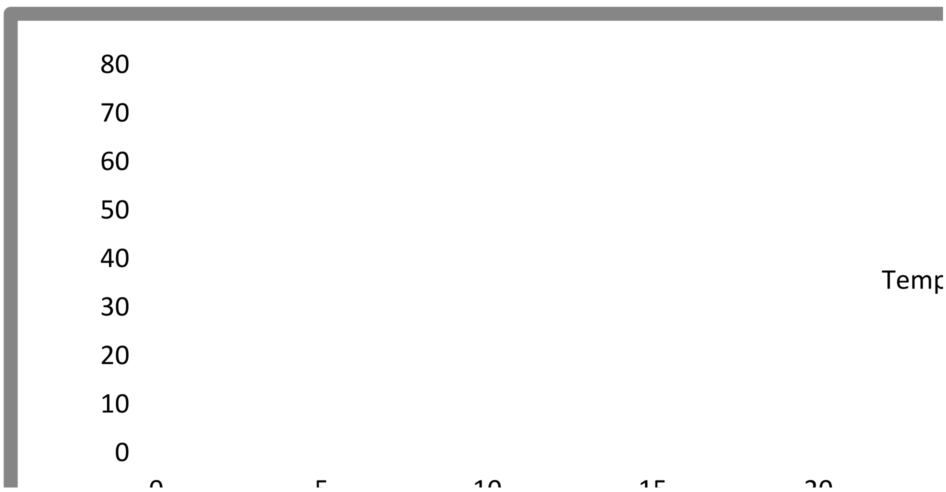


Absorber plate or pipe present in the solar heater assembly is get heated due to solar radiation falling on it. An air from environment will enter into the solar heater assembly where the absorber plate is placed. As the air present over there is get heated due to convection. This heated air will move forward as its density will drop and it enters into drying box where the moist food is placed. This type of circulation of heated air is called thermo siphon action. While heated air flowing through the garbage will remove the moisture from it. Provision of electrical heating coil will come into picture when drying is required to carry during nights & cloudy days.

II. Results

Product	Weight before drying (gm)	Weight after drying (gm)	Time (hr)
Grapes	250	125	8
Potato	130	20	6
Onion	120	12	4
Banana	420	125	4

Graphical Representation



Graph of Time Vs Temperature

III. Conclusion

The dehydrator described has worked well in our test. It produces temperature of 60^0C to 100^0C (140^0F - 212^0F) and dry up to 15 bananas about 1.6kg of 3mm thick slices and 1kg potato 2mm thick slices and 1kg onion 2mm thick slices in 8 hrs approximately one sunny day or partly sunny day. The best performance in outdoor test was attain with two glass cover and 15 pipes of aluminum painted black.

We are providing a glass, that two glasses would produce temperature almost as high as one glass. For the best performance the ventilator suction should be opened as per temperature requirement in drying chamber. The cost of the dehydrator and time to construct it can be reducing by using recycle material, simple plain glass instead of acrylic glass. We can make the unit more portable by wheels and stand for panel and improved durability by fastening the panel and stand by nut and bolts at certain angles.

Future Scope

We would also like to provide insulation of glass wool instead of thermocol to see if it significantly impacts the performance. We hope to compare this design to direct solar dryers which home power reader has recently suggested that can outperform our design. Thus far, we have avoided direct dryers because of concerns with vitamin loss in foods exposed to direct solar radiation. We have tried to carefully explore all of the significant variables affecting this dryer’s performance.

References

[1]. Ayensu A.,”Dehydration of Food Crops Using Solar Dryer with Convective Heat Flow", Research of Department of Physics, 2000, University of Cape Coast, Ghana.
[2]. Dorf R.G. "Energy, Resources and Policy", Massachusetts, Addison Werley Publishing Company, 1989.
[3]. Fisk M.J. and Anderson H.C., "Introduction to Solar Technology", Massachusetts, 1993.
[4]. GEDA-Gujarat Energy Development Agency, 2003, http://www.geda.com/.
[5]. Herringshaw D., "All About Food Drying", 1997, The Ohio State University Extension Factsheet-hyg-5347-97, www.ag.ohio-state.edu/.
[6]. Nandi P., "Solar Thermal Energy Utilization in Food Processing Industry in India", Pacific Journal of Science and Technology, 2009, 10(1), pp. 123-131.
[7]. Bal, L. M., Satya S. S. and Naik S.N.," Solar dryer with thermal energy storage systems for drying agricultural food products: A review". Renewable and Sustainable Energy Reviews, 14, pp. 2298-2314.
[8]. Scalin D., "The Design, Construction and Use of an Indirect, Through-pass, Solar Food Dryer", Home Power Magazine, 1997, 57, pp. 62-72.
[9]. Sukhatme S.P., "Solar-Energy-Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Limited, 1996.
[10]. The World Book Encyclopaedia (1982). World Book-Child craft International Inc., Chicago, USA.
[11]. Whitfield D.E.," Solar Dryer Systems and the Internet: Important Resources to Improve Food Preparation", 2000, Proceedings of International Conference on Solar Cooking, Kimberly, South Africa.
[12]. Singhal B.L. “Non-Conventional Power Plants: Solar Power Plant” Tech-Max Publications, 2007, pp. 1- 53
[13]. Shanmugam V. And Natrajan E. “Experimental validation of forced convection and desiccant integrated solar dryer,” Renewable energy, 31, pp. 1239-1251