Fabrication and Performance Analysis of Wooden Solar Dryer

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ABSTRACT

Industrial development artificial mechanical drying came into practice. This process is energy intensive and expensive. It increases product cost. The efforts to enhance sun drying have led to solar drying. Solar dryers control the drying process. Also protect agricultural foods from damage by insect pests dust and rain. The solar drying system utilizes solar power to heat up air and to dry any food substance. This is useful in reducing wastage of agricultural product and helps in preservation of agricultural product. The restrictions of the natural sun drying exposure to direct sunlight, liability to pests and rodents lack of proper monitoring. The intensify cost of the mechanical dryer a solar is developed to cater for this disadvantage. In the dryer, the heated air from a separate solar dish is skilled a grain bed, and at an equivalent time, the drying cabinet absorbs solar power directly through the transparent walls and roof.

Keywords: Solar dryer, PV cell, Agricultural products

1 Introduction

Solar dryers are devices that use solar energy of sun to dry substances. The solar energy is employed in various applications. There are different types of solar dryer including natural convection solar dryer and forced convection solar dryer. Natural convection airflow is generated by buoyancy induce airflow. In forced convection air is created by using fans. In forced convection dryer base on mixed mode with direct and indirect heating, it gives better result as compare to open air dryer. Drying is fast as compare to open air dryer. Drying preserves foods by removing enough moisture from food and to prevent decay and spoilage. Water content depending food varies. It should be in between 5 to 25 percent depending on the food. Like enough heat to draw out moisture, without cooking the food, dry air to absorb the released moisture and adequate air circulation to carry of the moisture.

2 Methodology

1. Construction of portable automatic solar dryer.
2. Compare solar dryer in relation to open sun dryer.

We will calculate drying time required for different product by using our solar dryer and open sun drying.

3. Maximum efficiency.

   Dryer is working on natural as well as forced convection with maximum efficiency.

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Figure 1: *Actual model setup*

3 Working Steps

Recognition of Need of Portable Solar Dryer

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Study of Existing Solar Fruit and Vegetable Dryers

⇩

Design of Portable Solar Dryer

⇩

Construction of Handle and Solar Panel

⇩

Experimentation

⇩

Tests Results &Conclusion

4 Working of Model

In this solar dryer firstly some sun-rays follows on the solar panel, this solar panel absorbs to it, then through wiring system it transfers to the battery which stores the extracted energy from the solar panel. By using forced convection our solar dryer of indirect type operates 12v DC fans and dry products which are kept inside.

Figure 2: *Actual model setup for Onion and Potato*

4.1 Solar dryer Specifications

1. Battery (DC 12v)-It is used for storing energy from solar panel.
2. Switch- The switch is used for the on/off purpose of fans. Solar Panel-It is used to absorb Sun light to generate energy
3. Fans (DC 12v 1.8A) -Fans are using to create airflow which deals with forced convection.

4. Inside Glass -It is used for enclose the system so that there is no leakage of air.
5. Aluminum Net Tray-To keep the desired product inside the used system
6. Wooden type - For making model portables

5 Experimental Calculations

The drying time required for different products by natural and forced convection.

Products:

1. Onion
2. Potato
3. Plotting graph of time Vs. moisture %

$$\text{Moisture\%} = \frac{\text{Initial mass-Final mass}}{\text{Initial mass}}$$

Table 1: *Drying product weight and moisture details*

Time in Hrs.	Item	Weight before drying in gm	Weight after drying in gm	Moisture % removed in solar dryer
5	Onion	920	280	69.56
5	Potato	1630	560	65.64

6 Results and Discussion

The weight reduction achieved by solar drying in comparison with solar drying is shown in table 1. The water content removal and moisture removal for solar drying is presented in Figs. 3 and 4, respectively. It can be noted from these figures that the performance of solar dryer. Figure 3 & 4 are the comparison of time vs moisture percentage removal of a products Onion and Potato respectively in a solar dryer after 100, 200 and 300 minutes. X Axis moisture % and Y Axis times in minutes represented in a figure 3 and 4 respectively.

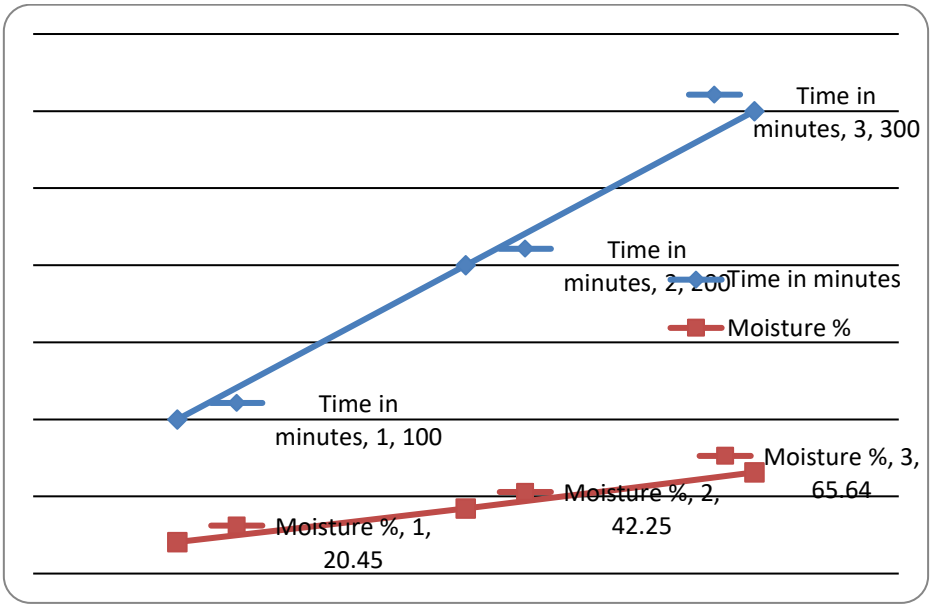

Figure 3: *Onion moisture percent removal vs time*

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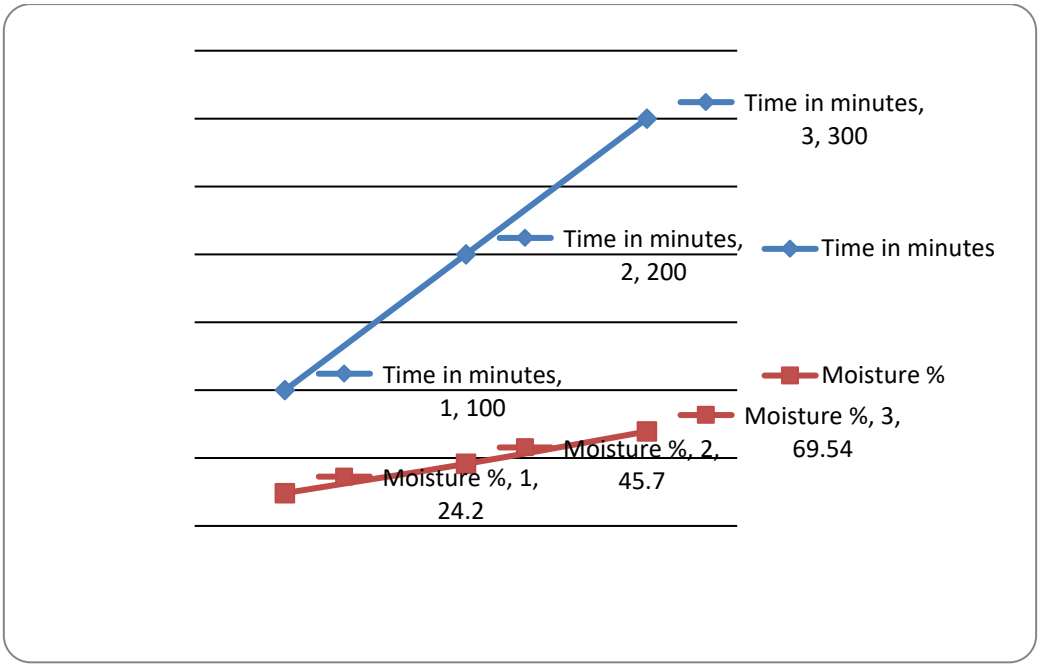

Figure 4: *Potato moisture percent removal vs time*

7 Conclusions

Solar radiations are often highly effective and utilized for drying of agricultural product in our surroundings if proper design is administered. The solar dryer designed and constructed expressed sufficient ability to dry agricultural produce above all food items to an appreciably reduced moisture level. Experimental analysis we've concluded that the solar dryer increases the temperature of ambient air up to maximum efficiency and dries the agricultural products, less care required for cover from rain, wind whirl, polluted air etc. as compared to the open sun drying. Hence this solar dryer is simpler and economical and acceptable.

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References

[1] Anil Kumar, Renu Singh, Om Prakash, Ashutosh, "Review on global solar drying status", *Agric Eng Int: CIGR Journal,* Vol. 16, No.4, pp. 161-177, December, 2014

[2] R. Vidya Sagar Raju, R. Meenakshi Reddy, E. Siva Reddy, "Design and Fabrication of Efficient Solar Dryer", *R. Vidya Sagar Raju et al Int. Journal of Engineering Research and Applications,* Vol. 3, ISSN : 2248-9622, Issue 6, Nov-Dec 2013, pp.1445-1458

[3] A. O. Adelaja, B. I. Babatope, "Analysis and Testing of a Natural Convection Solar Dryer for the Tropics", *Hindawi Publishing Corporation Journal of Energy*, Volume 2013, Article ID 479894, http://dx.doi.org/10.1155/2013/479894

[4] Abdul Jabbar N. Khalifa, Amer M. Al-Dabagh, and W. M. Al-Mehemdi, "An Experimental Study of Vegetable Solar Drying Systems with and without Auxiliary Heat", *International Scholarly Research Network ISRN Renewable Energy*, Volume 2012, Article ID 789324, doi:10.5402/2012/789324

[5] A.S.M.Mohsin , Md. Nasimul Islam Maruf , A.H.M. Sayem, Md. Rejwanur Rashid Mojumdar and Hossain Mahmud Shamim Farhad, "Prospect & Future of Solar Dryer: Perspective Bangladesh", *IACSIT International Journal of Engineering and Technology,* Vol.3, No.2, April 2011

[6] Scalin D., "The Design Construction and Use of an Indirect Through-pass Solar Food Dryer", *Home Power Magazine*,1997, 57, pp. 62-72.

[7] Whitfield D.E., "Solar Dryer Systems and the Internet: Important Resources to Improve Food Preparation", *Proceedings of International Conference on Solar Cooking, Kimberly, South Africa,* November 26, 2000

[8] Kshitij Moholkar, Akshay Jadhao, Rohit Chavan, Ravindra Bhosale and Kuldip Pukale, "Experimental Analysis of Solar Dryer for Agricultural and Food Products", *International Journal of New Technology and Research (IJNTR),* Volume-5, Issue-4, ISSN: 2454-4116, April 2019, pp. 86-88

[9] S. S. Gaikwad and A. A. Mote, "Experimental Analysis of Cabinet Solar Dryer for Food Drying", *International Engineering Research Journal (IERJ)*, Special Issue pp 169-174, ISSN 2395-1621, 2015

[10] S. S. Gaikwad, Anil B. Shinde, A. A. Mote and P. S. Kachare, "Design and Construction of Briefcase Type Portable Solar Dryer", *Springer International Publishing AG 2018, P.M. Pawar et al. (eds.), Techno-Societal 2016*, pp 771-778, DOI 10.1007/978-3-319-53556-2_79,

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