JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ANALYSIS OF SOLAR DRYER USING HTML

[1]C. V. Papade, [2]S.S. Damawale

[1]Assistant Professor, [2] Assistant Professor,

[1]*Mechanical Engineering Department N. K. Orchid College of Engg. and Tech., Solapur, Maharashtra, India.*
cvpapade@gmail.com

[2]*Computer Science & Engineering Department N. K. Orchid College of Engg. and Tech., Solapur, Maharashtra, India.*
Sujatadamawale11@gmail.com

Abstract: Many agricultural products such as grains, spices, fruits and vegetables are dried directly under the open sun and it has many restrictions such by way of rain, puffing wind, beetle swarm, animal meddling etc. which leads to contamination of the products. Thus, there is a need to make the solar dryers more efficient and cheaper. In this research the solar panel is used to convert the light energy to electrical energy for blower supply and flat plate collector is used to heat the air. Solar dryer consists of main parts such as flat plate collector, cabin, blower, battery, solar panel, infrared LED and PCM as energy storing material. The design consideration is, the initial moisture content is about 89.4% and final moisture content after drying will be about 10%. Infrared radiation can be used for drying purpose, this method is unique and different from conventional drying. Using above consideration designing solar dryer to convert 50kg of grapes into raisins. This project which also useful for drying foods, fruits and wherever moisture content is present. The objective of this project is to design, develop and construct the solar dryer system, to reduce the drying time from 15 days to 26-28 hours and to increase the productivity. The analysis of results is done using HTML Code for calculation of drying time of different agricultural products with a capacity of 30 kg and 50 kg. Also, results are compared with agricultural products with time requirement. As per analysis results shown the maximum time required for grapes, less drying time required for carrot and intermediate time required for onion in between chilli and banana for 30 kg and 50 kg capacity.

Keywords: Solar Energy, PCM, Infrared LED's, Battery, Solar Panel, HTML

I. INTRODUCTION

Solar dryers require a confident asset aimed at the set-up of the employment, but no costs for the fuel. The elementary purpose of an astral dryer is to warmth air to a persistent temperature with sun-based power, which enables removal of moisture as of harvests private a aeriation space. Open air and uncontrolled sun drying are still the most common method used to preserve and process Agricultural product, But uncontrolled drying suffers from serious problem of wind born dust, infestation by insect, product may be seriously degraded to the extent that sometimes develop sooq inconsequential and subsequent damage of and have to the nutrition value whitethorn consume adversative financial belongings on inland and global sooq. Drying is one of the eldest approaches by means of solar based energy anywhere the creation such as root vegetable, fruits, fish, and meat are to be dried by revealing straight to the sun. It is a humble process of eliminating the wetness insides from a normal or manufacturing creation in instruction to spread the ordinary requirement. This method is economical on a large scale drying because of inexpensive operating prices associated to the drying apparatus.

However, this technique has numerous difficulties such by way of failed crops owing to stream, gust, powder, bug plague, physical bout and yeasts. Since of that, the solar based dryer expertise will develop another technique which can process the products in clean, safe, hygienic and yield improved superiority and more nutritious foods. In general, this solar dryer has saved energy, labour exhaustive, time, less area for spreading the product to dry, brands the process additional effective and defends the atmosphere. Solar energy has an enormous potential for different applications since it is easily accessible, abundant for the countries particularly located in tropical and subtropical regions. It is a sustainable source of energy. Solar drying of farming crops beats the faintness of the open sun drying such as dirtied by insects, animals and birds and option of enzymes and bacterial rot owed to widespread drying dated.

Boda M. and Papade C. [1]: This paper presents performance and construction calculation of the solar dryer using Tono-therm M-65 PCM. Many of the former facing the problem of reducing the moisture content from crops to spoilage of storing. This system consists of solar collector, food tray cabinet etc. The heated air passed through the system including with the PCM which store the heat energy. This heated air is used to dry the grapes and converted into the raisins. The circulation of air is done by naturally and forced circulation method. The inclusion of PCM increases the drying time after sunset by 3 hours per day. The forced convection with PCM is more efficient than other, more suitable for reducing drying time, increasing drying rate, and produces high quality dried grapes. The results obtained those temperatures inside dryer and solar collector were much higher than outside air temperature during more hrs in a day.

David E. and Whitfield V. [2] has work presents the concert of several separate, medium and large-scale food dispensation schemes, which integrate sun drying. Drying is a outstanding way to sanctuary the all type of food in current cohort. The drying produces protection of food and significant saving time of the former. Drying conserves foods by eliminating enough wetness from food to avert spoilage. Water content of final dried product contains the 5 to 20% of the moisture content. When drying foods, the aim is to remove moisture as fast as possible at a controlled temperature that does not seriously affect the flavour and colour of the food. If the temperature is too low in the start, microorganisms cultivate earlier the nutrition is sufficiently dehydrated. If the temperature is too tall and the humidity too little, the nourishment may toughen on the superficial.

Kamaruzzaman S. and Fudholi A. [3] this paper benefits the strategy and performance of the progressive sun dryer. This sun dryer mainly consists of sun dryer, V-groove sun gleaner, double-pass sun gleaner, loading system. The solar based dryer, sun power is used to heat the source (air), this is complete by either involuntary or usual convection. The involuntary convection solar dryer using double-pass sun power collector with fins has been connected in that organisation. In this, the V-groove collector is used which is having a 6 array of a solar collector. The outlet temperature does not drop suddenly as in any predictable solar based air hoarder. The vent temperature energies dejected slowly in the evening unfluctuating at low solar radioactivity points. The solar dryer using double-pass solar collector used for drying oil palm fronds from moisture content of about 63% to moisture content of about 15%, for drying time of about 7 hrs. The system efficiency is about 25 – 30% and evaporative capacity 1.26 kg/h. In this it also having an auxiliary heater which is used during un favorable sun radiation conditions, expressly in the before noon and the sundown.

Reyes A et al. [4] have intended industrialised solar power dryer for ventilation swells, this solar based dryer is hybrid type of solar based dryer. The mushrooms are cut into 4mm and 8mm thick slices and located in a tray and the outlet of the tray 80 to 90% warm air is recirculated and air temperature is attuned therefore ventilation is finished.

Natarajan E. and Shanmugam V. [5] have constructed and strained unplanned spontaneous convection solar based dryer. The core portions of this scheme are a flat plate solar based gleaner, aeration cavity, airline and desiccant bed. This organisation worked in 2 modes, that is off sunshine hours and sunshine hours. When sunshine is available the hot air from solar collector is passed into drying chamber for drying of products and at the same time from reflector mirror and solar radiations receives by desiccant bed. In off sunshine hours, dryer is operated by circulating air within drying chamber all the way through desiccant bed through a reversible fan. The record also recorded in desiccant unit. Kaewkiew J. et al. [6] has made greenhouse type solar dryer for drying chilies. The material is used for this solar drying system is polycarbonate which is having a parabolic shape in nature and base is made by for this solar dryer is concrete. It has having total 9 fans, used for ventilation purpose and which are works on 150 Watt solar panel (3 solar panels each 50 W). For drying of 500 kg of chili it takes 3 days 74% moisture content without using drying technology it take 5days. Devahastin S. and Pitaksuriyarat [7] have investigated dryer using latent heat storage with paraffin wax as a PCM to store excess solar energy and release it when the energy availability is not available. The inlet hot air temperature is around 70 to 90ºC. The amount of the energy extruded from the latent heat storage was 1920 and 1386 kJ min kg^{-1} and the energy savings was 40% and 34%.

Papade C.V. and Boda M.A. [8] have presented energy storing material can store either sensible or latent heat and they investigated that the storing of energy in latent heat storing material is very useful and efficient as it store more amount of energy as compared to sensible heat storing material. Use of solar dryer is limited because of drying is not possible due to frequent clouds in the day or in the evening, So that they have investigated such type of dryer which is efficient to use for drying purpose. Chr.Lamnatoua and Papanicolaoua E. [9] have grants thermodynamic concert examination of a solar based dryer through an evacuated-tube gleaner. It achieves the aeration on apples, carrots apricots. The outcome displays that the scorching air passage of gleaner achieves temperature apt for drying of farming crops without essential of warming. This also includes determination of collector efficiency. Design parameter determined based on minimum number of entropy generation. The proposed dryer has a capacity for drying larger quantities of products. This system provides an option for the penetration of this type of collectors in large-scale applications in the agricultural and industrial sector. Lingayat A. and Chandramohan V.P. [10] developed the Indirect Type of solar dryer for Banana Drying with controlled temperature. The sun based dryer entails of solar horizontal platter air gleaner through V-corrugated preoccupation cups, drying slot and funnel for killing the air. The final analysis for drying of banana showed that moisture content of banana was reduced from initial value of 356% (db) to final moisture content of 16.3292%, 19.4736%, 21.1592% and 31.1582% (db) for Tray1to Tray4 respectively. The normal thermal effectiveness of the gleaner is create that 31.50% and that of drying space remained 22.38%. The temperature of drying air is the most important and effective factor during drying. They have defined humidity of air as well as air velocity is also an important factor for improving the drying rate of the bananas.

Solar drying is more beneficial than normal convective drying such as hot air drying which needs more fuel and hence energy cost is high. Solar drying facilitates superior manufacturing practice and give up export valuable processed foodstuffs. Furthermore, solar drying saves energy, requires less area, less time, makes the course more suitable and enhances the quality of dried fruits and vegetables. In addition to this solar energy is one of the most attractive alternatives due to its clean abundant availability over the surface of earth.

II 3D MODEL OF SOLAR DRYER

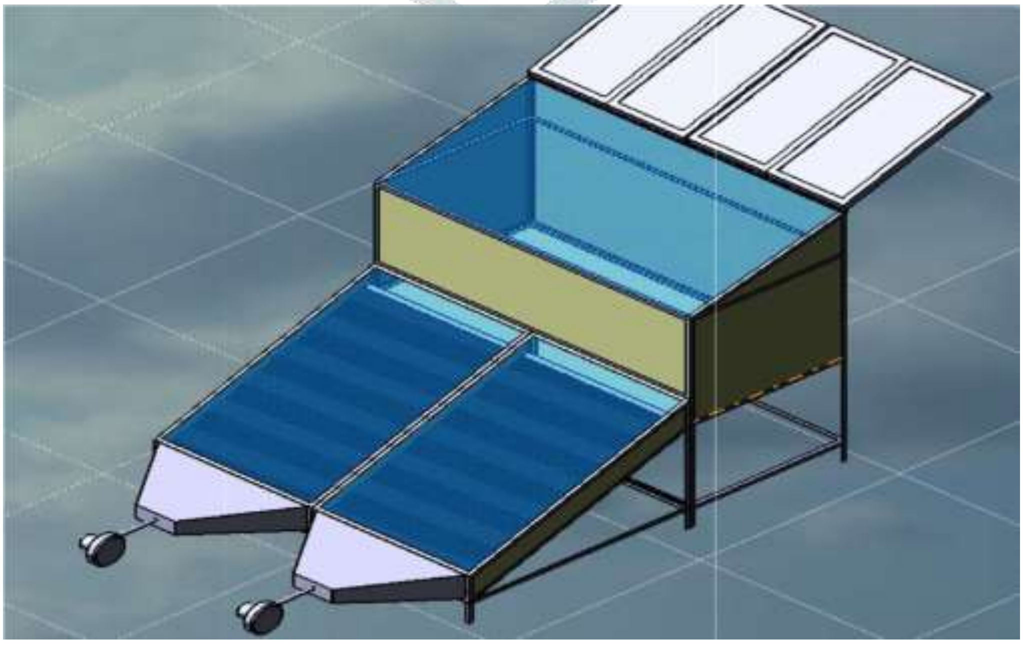

Figure 1. 3D model of Solar Dryer

Figure 1 shows an overall idea about the research project is cleared by the views shown in the the 3D geometry view of the solar dryer. This view importantly gives an idea about the flat shape of the solar collector. The flat shape is provided for the better absorption of the solar rays. Fig. is the front view of the CATIA model of the drying chamber which gives us an idea of the cabin in which the food product to be dried will be placed. This view clears the concept about the cabin size and shape. The proper selection of blower, motor, battery, solar panel, which are required for efficient running of solar dryer is done. According to that all the components which are required in fabrication are designed to find out all their dimensions. A typical flat plate collector is an insulated metal box with a glass or plastic cover (called the glazing) and a dark-colored absorber plate. The flat plate collector is the part of our system where the heating up of air take place and after heating the air this heated air will be given to the drying chamber. The upper surface of the flat plate collector will be Acrylic Sheet cover which will allow the sunrays to enter the body of the collector. The lower-inner surface will be a black colored surface which will act as the absorber plate. So when the sun rays enter the flat plate collector most of the heat from the sun rays will be stored inside and the air passing through the passage will get heated up. One end of the flat plate collector will be connected to the lower side of the drying chamber where the heated air is to be delivered and on the other end a section converging towards outside will be provided.

III RESULT AND DISCUSSION

The presents the expected observations by using the HTML code. It shows the expected drying time of the different products such as grapes ,apples, bananas etc . The reason of this HTML analysis is to compare with actual drying time and Table 1 shows the initial, final moisture content for different product and also approximate drying time for 50 kg in hours.

As per analysis drying time required for grapes is more due to higher initial moisture contents and lower time required for carrot, as initial moisture contents are less in carrots.

Table 1 Initial, Final Moisture Content and Drying Time for Different Product [8]

Sr. No.	Product	Initial moisture content (%)	Final moisture content (%)	Appr. Drying time for 50 kg (hour)
1	Grapes	89.4	10	28
2	Apple	85	18	26.62
3	Banana	80	15	25.05
4	Carrot	70	5	21.92
5	Chilies	80	10	25.62
6	Coffee	80	20	24.92
7	Garlic	80	4	25.50
8	Onion	82	4	25.68
9	Potato	75	13	23.48
10	Yam	80	8	25.62

As shown in Table's 2 and 3 which are observation tables consisting of the data for different food products. Each Table shows the capacity having 30 and 50 kg respectively. The HTML code is used here due to its versatile and effective for analysis purpose. The estimated time calculated by the HTML code for drying of 30 kg of mass of different food products is included in the Table 2, whereas the same data calculated for 50 kg of mass of the food products is shown in the Table 3. The food products were grapes, potato, onion, chili and some other products. These calculations are based on the previously calculated results in the research papers. As per analysis shown in both tables, drying time required for 50 kg of carrots in Table2 is less whereas drying time required for 50 kg of Grapes is more. Similarly, drying time required for 30 kg of carrots in Table2 is less whereas drying time required for 30 kg of grapes is more.

Table 2 Observation by HTML for 50 kg Mass of Different Products

Sr. No.	Product	Expected Drying Time (Hrs)
1	Grape	29.40
2	Potato	23.75
3	Chili	25.92
4	Onion	27.08
5	Apple	27.23
6	Banana	25.49

7	Carrot	22.80
8	Coffee	25
9	Garlic	26.38
10	Yam	26.08

Table 3. Observation by HTML for 30 kg Mass of Different Products

Sr. No.	Product	Expected Drying Time (Hrs)
1	Grape	17.64
2	Potato	14.25
3	Chili	15.55
4	Onion	16.25
5	Apple	16.34
6	Banana	15.29
7	Carrot	13.68
8	Coffee	15
9	Garlic	15.83
10	Yam	15.65

Following figures are the graphs of the results that are shown in the Table 1 and 2. The graphs show the time estimation for drying of 30 kg of mass of food products and similarly for 50 kg. Using these graphical Figure 2 it is easy to do the comparative study of the estimated times of drying of food products. As per graph results shown the max time required for grapes , less drying time required for carrot and intermediate time required for onion in between chilli and banana for 50 kg capacity.

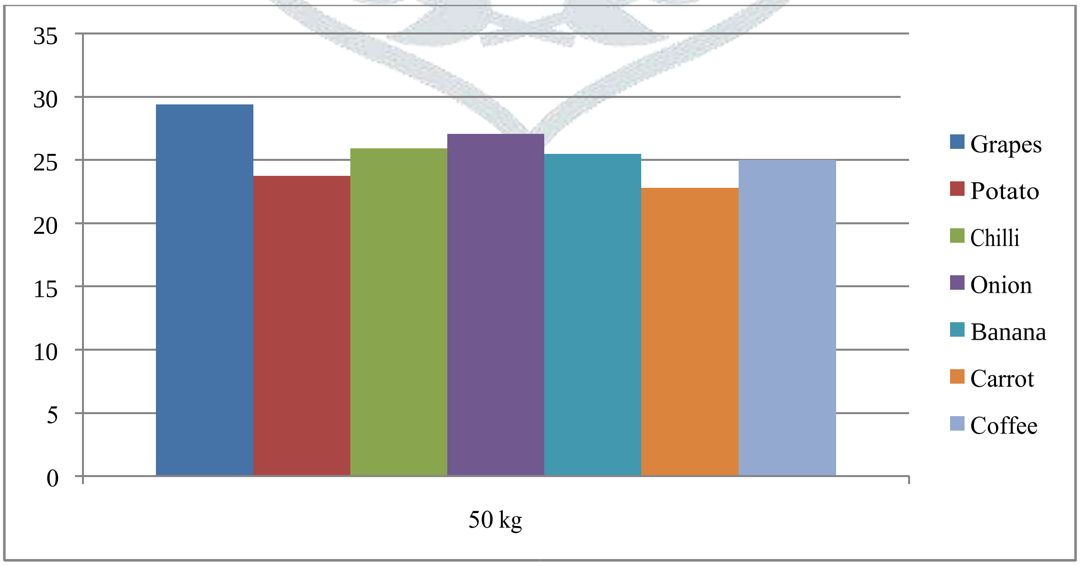

Figure 2 Comparison of Different product Having Mass 50 Kg

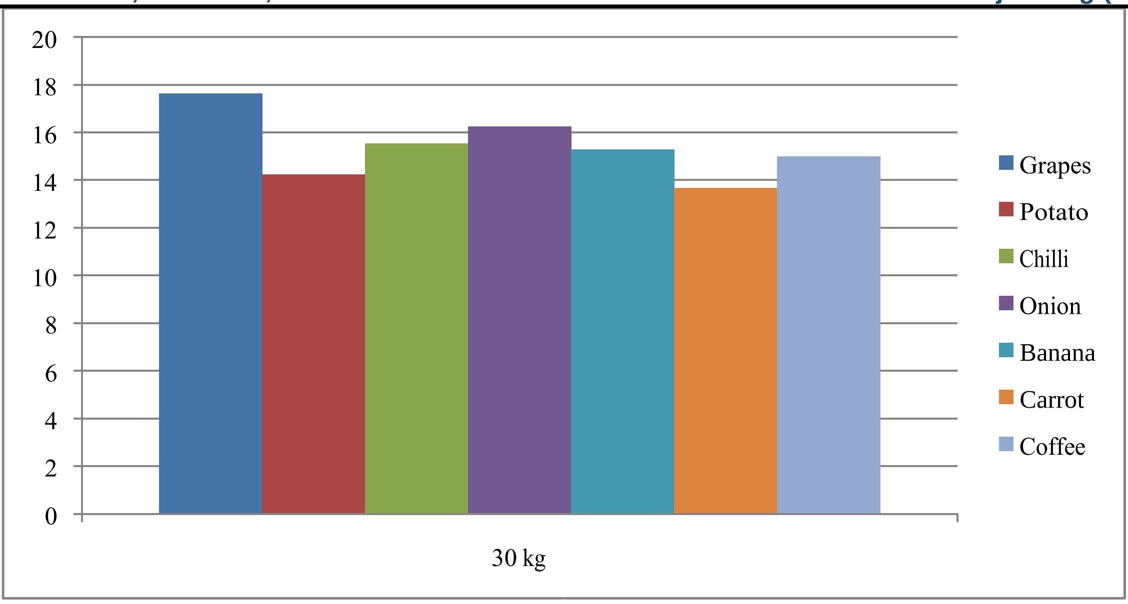

Figure 3 Comparison of Different product Having Mass 30 Kg

From above Figure 3 it concludes that, the grape will take more time than other because it contains the maximum percent of moisture content. This graph shows the expected time for different product with different mass(kg). As per graph results shown the max time required for grapes, less drying time required for carrot and intermediate time required for onion in between chilli and banana for 30 kg capacity.

IV CONCLUSION.

The test carried out; the following conclusions were made.

i. The solar dryer raises the ambient air temperature to a considerable high value for increasing the drying rate of agricultural crops.

ii. The HTML analysis is easy way to perform analysis of fruit products as shown in results.

iii. By using HTML, it has found that the drying time required for 30 kg and 50 kg of agricultural products like carrot is less and drying time required for grapes is more

iv. The decrease in aeration happens by growing air movement rate.

v. Although the dryer was used to dry grapes, it also used to dry other crops like spinach, potato, onion and chili etc

vi. The reduction in drying time productivity increased.

REFERANCES

[1] Boda M. and Papade C.,2017. Analysis of solar dryer using Tono Therm M-65 phase change material. Springer Atlantis Press, 137(1):035-040.

[2]David E. Whitfield V.2000. Solar dryer systems and the internet: important resources to improve food preparation.International conference solar drying, 5(3)-991-998.

[3]Kamaruzzaman S., Fudholi A., Othman M. Y., Ruslan M. and Mat S.2013 R&D of advanced solar dryers in malaysia: air based solar collectors. Renewable Energy. 31 (3):pp. 703-709.

[4]Reyes A., Cubillos F., Mahn A. and Vásquez J. 2016. Dehydration of agro products in a hybrid solar dryer controlled through a fuzzy logic system. Renewable Energy. 94 (1):147-156.

[5]Natarajan E. and Shanmugam V. 2007. Experimental study of regenerative desiccant integrated solar dryer with and without reflective mirror. Applied Thermal Engineering, 27 (8-9): 1543-1551.

[6]Kaewkiew J., Nabnean S., Janjai S.2011. Experimental investigation of the performance of a large-scale greenhouse type solar dryer for drying chilies in Thailand . Procedia Engineering: Elsevier. 32(1): 433 – 439.

[7]Devahastin S., Pitaksuriyarat S. 2006.Use of latent heat storage to conserve energy during drying and its effect on drying kinetics of a food product. Applied Thermal Engineering 26(14-15):1705-1713.

[8] Papade C.V. and Boda M.A. 2014. Design & development of indirect type solar dryer with energy storing material. International Journal of Innovative Research in Advanced Engineering, 1(12) : 109-114.

[9] Lamnatoua C. and Papanicolaoua E., Belessiotisa V. and Kyriakish N. 2012. Experimental investigation and thermodynamic performance analysis of a solar dryer using an evacuated-tube air collector", National Center for Scientific Research, 6(8): 15310-15319.

[10] Lingayat A., Chandramohan V.P. and Raju R.K.,2016. Design, development and performance of indirect type solar dryer for banana drying. Energy Procedia 109(2017) 409–416.

[11] Phadke P. C. and Walke P. V.2015. A review on indirect solar dryer. Asian Research Publishing Network. 10 : 008-013.

[12]Zomorodian A., Zare D., Ghasemkhani H. 2007.Optimization and evaluation of a semicontinuous solar dryer for cereals (Rice, etc.). Desalination 5(1) 129-135.

[13] Singh J., Pankaj Verma.2015. Fabrication of hybrid solar dryer. International Journal of Scientific and Research Publications, 5(6) 233-239.

[14] Diemuodeke O. and Momoh Y.2002. Design and fabrication of a direct natural convection solar dryer for tapioca. Leonardo Electronic Journal of Practices and Technologies.5(4):331-336.

[15] Maiti S., Patel P., Vyas K., Eswaran K. and Ghosh P.2011. Performance evaluation of a small scale indirect solar dryer with static reflectors during non-summer months in the Saurashtra region of western India. Solar Energy. 85: 2686-2696.