IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 6.252

Volume 2, Issue 7, May 2022

Solar Dehydration System

Ahire Rohit Gulabrao[1], Borse Sagar Kadu[2], Davkhar Pratik Babaji[3], Gajare Arjun Bhaskar[4], Mr. Tushar T. Kapade[5]

Student, Department Of Mechanical Engineering[1,2,3,4]

Assistant Professor, Department of Mechanical Engineering[5]

Matoshri College of Engineering and Reserch Centre, Eklahare, Nashik

Abstract: A solar dryer was developed to account the limitations encountered in traditional open sun drying. With loading capacity and incorporated with a heating control system, this dryer is suitable for agricultural drying that requires drying capacity and products with high moisture content. In addition, this drying system offers flexibility in switching between different combinations of air vents based on the drying purpose required. Chaotic air flows produced in the drying chamber ensureuniform temperature distribution across the drying trays in an updraft air movement. Potential application of the drying system for potato chips, onion slicesand chili drying will be test. Based on the performance evaluation, a maximum temperature and maximum average temperature of will attain in the drying chamber will measure. The drying of chips, onion slices and chili with the setdrying temperature and operating condition of using the ventilation fan and opening the air vent achieved the drying time will measure. The Solar food dryer describes how to efficiently harness solar energy to preserve food quickly and easily. With the use of solar-powered food dehydrator, we can conveniently make all the high-quality dried foods - with free sunshine! Eat local and eat healthier by preserving the goodness of your favorite seasonal foods, garden veggies, fruits and herbs to enjoy all year long.

Keywords: Solar Dryer, Direct Type, Solar-Powered, Food Dehydrator.

I. INTRODUCTION

Agriculture has been the backbone of the Indian economy and it will continue to remain so for a long time. ―A man without food for three days will quarrel, for a week will fight and for a month or so will die‖. Agriculture is a branch of applied science. Agriculture is the science and art of farming including cultivating the soil, producing crops and raising livestock. It is the most important enterprise in the world. Fast increase in population and depletion of fossil fuels has summoned the requirement of alternate energy sources globally. India is developing nations which require both economy and energy. India has almost 300 sunny days in a year with theoretically 5,000 trillion kWh per year which exceeds than energy output from thermal power plants. Since majority of the population lives in rural areas in India, there is scope for solar energy being captured in these areas. For centuries, people of various nations have been preserving fruits, other crops, meat and fish by drying. Drying is also beneficial for hay, copra, tea and other income producing non-food crops. With solar energy being available everywhere, the availability of all these farm produce can be greatly increased. It is worth noting that until around the end of the18th century when canning was developed, drying was virtually the only method of food preservation.

In many parts of the world, awareness is growing about renewable energy which has an important role to play in extending technology to the farmer in developing countries like India to increase their productivity. Poor infrastructure for storage, processing and marketing in many countries of the Asia-Pacific region results to a high proportion of waste, which average between 10 and 40 %. Although India is a major producer of horticultural crops, many Indians are unable to obtain their daily requirement of fruits and vegetables. Drying is one of the best methods used to protect food products for long time. The heat from the sun is used to dry food for preservation for several years. 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. The two main types of the dryers are indirect solar dryers and direct solar dryers. In the direct solar dryers the product is directly exposed to air and in indirect solar dryers the airflow is provided by using blower or fan operated by electricity or fossil fuel.Solar drying technology involves exposing food to sunlight, while air flowing past the food to remove the moisture content from the food naturally. The warmer the air, the more moisture it can remove from the food. The present invention relates to an improved solar dryer with improved air movement and warmth increasing the drying efficiency.

II. METHODOLOGY

The below Methodology shows the sequential operation/steps that will be performed during the project process.

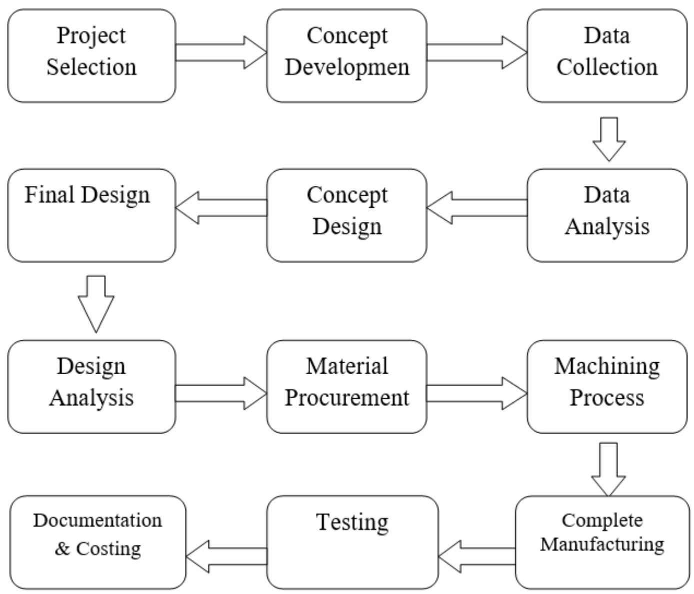

Figure 1: Flow Chart of Process

2.1 CONSTRUCTION

Solar drying will have to make direct solar dryer. In direct solar dryers the air heater contains the grains and solar energy which passes through a transparent cover and is absorbed by the grains. Essentially, the heat required for drying is provided by radiation to the upper layers and subsequent conduction into the grain bed. The objective of this study is to design adirect mode solar dryer in which the grains are dried by the heated air from the solar collector. The materials used for the construction of the direct mode solar dryer are cheap and easily obtainable in the local market. Fig. shows the main components of the dryer, consisting of the solar collector (air heater), the drying cabinet and drying trays.

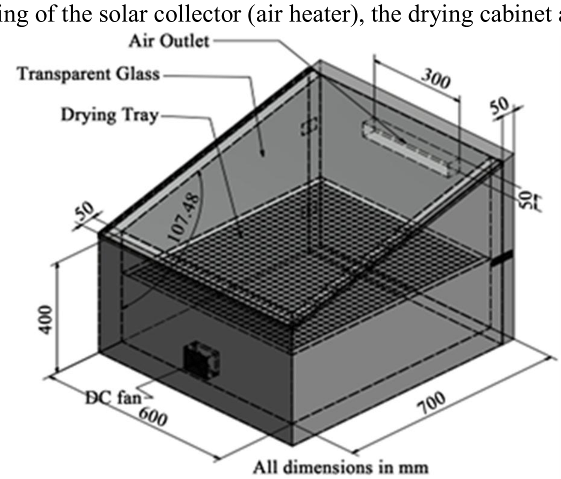

Fig 2.1 Experimental dryer.

DOI: 10.48175/568

Part Number	Part Name
1	Transparent Glass
2	Door
3	Tray
4	Dryer Body
5	Fan
6	Stand

Table 2.1: List of components of solar dryer.

2.2. Collector (Air Heater)

The heat absorber (inner box) of the solar air heater will construct using 2 mm thick metal plate, painted black, is mounted in an outer box built from woods. The space between the inner box and outer box is filled with foam material. The solar collector assembly consists of air flow channel enclosed by transparent cover (glazing). An absorber back plate provides effective air heating because solar radiation that passes through the transparent cover is then absorbed by back-plate. The glazing is a single layer of transparent glass sheet.

2.3. Drying Cabinet

The drying cabinet together with the structural frame of the dryer was built from woods which could withstand termite and atmospheric attacks as shown in Figure 3.2. An exhaust fan was provided toward the upper end of the cabinet to facilitate and control the convection flow of air through the dryer. Access door to the drying chamber was also provided at the back of the cabinet. The roof and the two opposite side walls of the cabinet are painted black, which provided additional heating.

2.4. Drying Trays

The drying trays are contained inside the drying chamber and construct from a wire mesh with a fairly open structure to allow drying air to pass through the food items as shown in Figure 3.2. The flat-plate solar collector is always tilted and oriented in such a way that it receives maximum solar radiation during desired season of use. The best stationary orientation is south in northern hemisphere and north in southern hemisphere. Therefore, solar collector in this work is oriented facing south and tilted.

2.5. Exhaust Fan:

Exhaust fan will require creating the pressure gradient inside the dryer so that air with moisture will go outside through the fan and ambient air will enter from the collector inlet.

Fig. Exhaust fan for ventilation

Solar dehydration system model

III. LITRATURE REVIEW

A. Jaivindra Singh, Mayur Pratap Singh, Modassir Akhtar, Akhil Khajuria, done the work on, Design And Performance Analysis Of An Indirect Type Solar Dryer, According to his work, renewable sources have become popular topics of study for engineering research. One such source i.e. solar energy is used in different applications like solar water heating, solar space heating, solar water distillation and solar drying etc. The solar dryer uses solar energy to heat up air coming through the collector and after that hot air passes over the product to remove the moisture, which is beneficial in reducing wastage of agricultural product and helps in preservation of agricultural product. On the basis of limitations of natural sun drying e.g. exposure to direct sunlight, liability to pests, lack of proper monitoring and the high cost of the mechanical dryer, a solar dryer is therefore developed to overcome this limitation. Current endeavor is focused on fabrication, designing and evaluation of thermal efficiency of an indirect type solar dryer. In the dryer, the heated air from a separate solar collector is passed through the drying trays on which product is placed to remove the moisture. The performance analysis is based on the experimental data collection and calculations with reference to thermal performance calculations, overall loss coefficient and heat correlations. So, different mathematical equations for calculation of thermal efficiency have been used. Experimental results revealed that the temperatures inside the dryer and solar collector were much higher than the ambient temperature during the drying period. The experimental thermal efficiency of the collector is around 43 % and the calculated thermal efficiency is around 51 %. The overall efficiency calculated by mathematical equations is around 44 %, while experimental overall efficiency is around 35%. The less value of experimental efficiency is due to more losses involved in the system in comparison to the losses considered in theoretical process.[1]

B. Janak Valaki, Vishal Patel & Jayesh Lakhani, done the work on,Design And Development Of Solar Dryer For Fruit Chips, According to his work,Agricultural and other products have been dried by the sun and wind in the open air for thousands of years. The purpose is either to preserve them for later use, as is the case with fruit; or as an integral part of the production process, as with timber, tobacco and laundering. In industrialized regions and sectors, open air-drying has now been largely replaced by mechanized dryers, with boilers to heat incoming air, and fans to force it through at a high rate. Mechanized drying is faster than open-air drying, uses much less land and usually gives a better quality product. But the equipment is expensive and requires substantial quantities of fuel or electricity to operate. Solar fruit dryer are simple devices to heat fruit chips by utilizing solar energy and employed in many applications requiring low to moderate temperature below 80oDrying processes play an important role in the preservation of agricultural products. 'Solar drying' in the context of this technical brief, refers to methods of using the sun's energy for drying, but excludes open air 'sun drying'. The justification for solar dryers is that they may be more effective than sun drying, but have lower operating costs than mechanized dryers. A number of designs are proven technically and while none are yet in widespread use, there is still optimism about their potential. 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. 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 and fruit supply, total system cost is a most important Consideration in designing a solar dryer for agricultural uses. No matter how well a solar system operates, it will not gain widespread use unless it presents an economically feasible alternative to other available energy sources.[2]

IV. Result and Conclusion

The moisture diffusion will be the physical dominant mechanism that governs the movement of moisture from within the fish species. Air humidity will the main factors controlling the drying performance and the higher the drying air temperature the higher the drying rate. High drying rate and high drop in moisture content will be observe on the day of each of the drying process. To avoid moisture lagging in the dryer, forced convective drying method will be employed. The experimental results will show that the best time to use the dryer is the dry season to avoid any trace of food spoilage while using direct solar dryer without thermal storage and better achievement during the dry season. Maximum drying efficiency will be recorded during the dry season. From the study, the solar dryer will be proving a better alternative technology and a useful tool for the preservation of the considered food species to increase the shelf life and market value in order to avoid disadvantages of open sun method of drying food products. The test is to be conducted on potato, chilly&greps.

Serial No	Time	Temp.
Outside temp. Inside temp.	10 AM	29 33
Outside temp. Inside temp.	11 AM	30 35
Outside temp. Inside temp.	12 PM	32 37
Outside temp. Inside temp.	1 PM	32 43

Table. Temperature of solar dryer cabin

- At first day at 10AM, 1000 grams of potato was placed to dry in open drying system and solar (closed) drying system. The weights of potatoes were found at evening 5PM; in open drying 348 grams and in closed drying it was 292 grams.
- At second day at 10AM, 1000 grams of chilly was placed to dry in open drying system and solar (closed) drying system. The weights of chilly were found at evening5PM; in open drying 643 grams and in closed drying it was 578 grams.
- At third day at 10AM, 1000 grams of greps was placed to dry in open drying system and solar (closed) drying system. The weights of greps were found at evening5PM; in open drying 596 grams and in closed drying it was 438 grams.

Solar radiation can be highly effective and utilized for drying of agricultural product in our environment if proper design is carried out. This was demonstrated and the solar dryer designed and constructed expressed sufficient ability to dry agricultural produce most especially food items to an appreciably reduced moisture level. Locally available cheap materials were used in manufacturing of solar dryer making it available and affordable to all and specially for farmers. This will go a long way in reducing food wastage and at the same time food shortages, since it can be used extensively for majority of the agricultural food crops. Apart from this, solar energy is required for its operation which is readily available in the tropics, and it is also a clean type of energy. It protects the environment and consume cost and time spent on open sun drying of agricultural produce since it dries food items faster. The food items are also well protected in the solar dryer than in the open sun, thus reducing the case of pest and insect attack and also contamination. However, the performance of existing solar food dryers can still be improved upon especially in the aspect of reducing the drying time and probably storage of heat energy within the system. Also, meteorological data should be easily available to users of solar products to ensure maximum efficiency and effectiveness of the system. Such information will probably guide a local farmer on when to dry his agricultural product and when not to dry them.

ACKNOWLEDGMENT

Every engineering student looks towards the project as an opportunity by which he can implement the skill that he has eventually nurtured in the year by hard work and dedication. This milestone of completing the project would have been intractable without the help of few people who need to be acknowledged. I owe this moment of satisfaction with a dear sense gratitude to my seminar guide Prof. T.T. Kapade whose technical support and helpful attitude gave me high moral support. I would also like to extend my sincere thanks to our HOD Dr. J .H. Bhangale and Principal Dr. G.K. Kharate for his guidance and constant encouragement. I am highly obliged to the entire staff of the mechanical department for their kind co-operation and help. I also take this opportunity to thank my entire colleague, who backed my interest by giving useful suggestions and all possible help. At last but not least I am thankful to my parents and all the people directly or indirectly concerned with this project.

REFERENCES

[1]. Jaivindra Singh, Mayur Pratap Singh, Modassir Akhtar, Akhil Khajuria, Design And Performance Analysis Of An Indirect Type Solar Dryer, IAETSD Journal For Advanced Research In Applied Sciences, Volume 5, Issue 2, Feb/2018, ISSN NO: 2394-8442, pp.553-568.

[2]. Janak Valaki, Vishal Patel & Jayesh Lakhani, Design And Development Of Solar Dryer For Fruit Chips, researchgate, Technical Report • May 2013,pp.1-47.

[3]. Vinay Narayan Hegde, Viraj Shrikanth Hosur, Samyukthkumar K Rathod, Puneet A Harsoor and K Badari Narayana, Design, fabrication and performance evaluation of solar dryer for banana, Hegde et al. Energy, Sustainability and Society (2015),pp.1-12.

[4]. Mamadou Lamine Coly, Bou Counta Mbaye, Mamadou Seck Gueye, Babacar Ndiaye, Joseph Sarr,A Tunnel mixed solar dryer for the drying of fishery products: design and experimentation,Journal of Scientific and Engineering Research, 2021, 8(2),pp.87-101.

[5]. Vikrant M. Tandel, Prasad M. Navgire, Rahul J. Mugutmal, Akshay B. Lahane, Sumeet S. Ingale, design and fabrication of solar Dryer, JARIIE-ISSN(O)-2395-4396, Vol-3 Issue-3 2017,pp.2045-2051.

[6]. Debashree Debadatta Behera, Biswajit Nayak, Shiv Sankar Das, Design and Fabrication of Solar Dryer for Sustainable Livelihoods of Fisher Women, International Journal of Engineering and Management Research, Volume-7, Issue-5, September-October 2017,pp.125-139.

[7]. Aremu, O. A., Odepidan, K.O., Adejuwon, S.O., Ajala, A.L., Design, Fabrication and Performance Evaluation of Hybrid Solar Dryer, International Journal of Research and Innovation in Applied Science (IJRIAS) | Volume V, Issue III, March 2020,pp. 159-164.