International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | June 2022 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Solar Air Dryer

Ajinkya Aurangabadkar

BE (ME) forth SEM, St. Vincent Pallotti College of Engineering, Nagpur, India.

Abstract - The solar dryer uses solar energy to heat the air and to dry the foodstuff which is extremely useful in reducing unwanted product and helps in drying the foodstuff. Considering the natural sun drying, for example: - exposing to direct sunlight, to guard the insects from the foodstuff and increase the time of drying, and to save lots of the value of the mechanical dryer, a solar dryer is therefore developed to beat for this limitation.

This project presents the design and construction of solar dryer for food preservation. within the dryer, the air from the copper tubes & ETC tubes was passed to the Drying cabinet, at an equivalent time the air gets heated while flowing through the tubes. Inside the drying cabinet the heated dries the merchandise placed on the drying trays. The results obtained during the test shows that the temperatures inside the drying cabinet and solar array was above the atmospheric temperature during the day light. The dryer helps to dry food products sooner to a required moisture level and it ensures a highest quality of the dried product.

Key Words: Solar Drying, Efficiency Comparison, Drying Rate.

1. INTRODUCTION

Agricultural and other products are dried by the sun and wind within the outdoors for thousands of years. The purpose is either to preserve them for later use, as is that the case with fruit; or as an integral a neighborhood of the assembly process, like timber, tobacco and laundering. Mechanized drying is faster than open-air drying, as it uses much less land and gives a better-quality product. But the equipment requires substantial quantities of fuel or electricity to work.

Drying is one among the simplest method to protect food products for while. The heat from the sun is used to dry food for storing for a long time. Drying is that the oldest preservation technique of agricultural products and it's an energy intensive process. Drying of agricultural products using renewable energy like solar power is environmental friendly and has less environmental impact. 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 80o. Drying processes is considered very important in the preservation of agricultural products.

1.1 Solar Energy

Solar energy may be a renewable, non-conventional and a free energy resource. It is one among the foremost reliable, efficient and effective non-conventional energy resource alternatives available. Solar energy in solar thermal is environmentally friendly. Numerous solar thermal uses of solar power are available; the drying process is one among the most important uses of solar thermal energy.

1.2 Types of Solar Air Dryer

The two main sorts of the dryers are indirect solar dryers and direct solar dryers. In the direct solar dryers, the merchandise 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.

Direct Solar Dryer- The item to be dried is exposed on to radiation through a transparent material that covers the structure. The heat generated from the solar power is employed to dry the crops or food items and also heats up the environment. The main disadvantage of using the direct mode is that the warmth which will be absorbed by the item can't be controlled.

Indirect Solar Dryer- This method doesn't expose the crop on to the daylight. The radiation is absorbed and converted into heat by another surface (like a black top) usually called the collector. Air which will be used for drying is omitted this surface and gets heated, which is then wont to dry the food item inside the dryer. The main advantage of indirect mode of drying is that the temperatures are often controlled.

2. LITERATURE REVIEW

Solar energy may be a renewable, non-conventional and a free energy resource. It is one among the foremost reliable, efficient and effective non-conventional energy resource alternatives available. The major disadvantage of solar power is that the lack of its availability in the least times i.e., unavailability during night; it's seasonal and varies from region to region. However, these problems are often solved by storing the energy when available excessively and utilizing it when the resource isn't available.

Solar energy in solar thermal is environmentally friendly. The drying process is one of the biggest uses of

solar energy. Drying involves reducing the moisture of a product in order that a product with different characteristics than the primary one is obtained. Dehydration is one among the oldest techniques for the storage of foods or agricultural products. About 20% of the total product is lost in our country due to inefficient storage. Once a crop is harvested, it can't be immediately marketed in order that the crop must be kept for a given amount of your time.

In many parts of the planet there's a growing awareness that renewable energy has a crucial role to play in extending technology to the farmer in developing countries to increase their productivity. Solar thermal technology may be a technology that's rapidly gaining acceptance as an energy saving measure in agriculture application. It is preferred to other alternative sources of energy like wind and shale, because it's abundant, inexhaustible, and non-polluting. (Akinola 1999; Akinola 2006; Akinola al., 2006).

Bahnasawy and Shenana designed a model of direct sun and solar drying of some dairy products. The main components of the equations describing the drying system were radiation, heat convection, heat gained or lost from the dryer bin wall and therefore the heat of transformation of moisture evaporation. The model was ready to predict the drying temperatures at a good range of ratio values. It also has the potential to predict the moisture loss from the merchandise at wide ranges of ratio values, temperatures and air velocities.

Sebaii, et al. done a study of an indirect natural convection solar which Investigated experimentally and theoretically for drying grapes, figs, onions, apples, tomatoes and green peas. The drying constants for the chosen crops were obtained from the experimental results and were then correlated with the drying product temperature. Linear correlation between drying constant and merchandise temperature were proposed for the chosen crops. The empirical constants of Henderson's equation were obtained for all the materials from investigation, which aren't available within the literature. The proposed empirical correlation suggested that it could well describe the drying kinetics of the chosen crops.

Gallali, et al. reported the results of an investigation of some edible fruit and Vegetables supported qualitative analysis and sensory evaluation data (colour, flavour, and texture). They compared the products which were dried by air solar dryer as well as natural sun drying. The study shows that using solar dryers gives more advantages than natural drying, mainly in terms of drying time.

Karathanos and Belessiotis reported the sun and solar air-drying kinetics of some agricultural products, i.e. sultana grapes, currants, figs, plums and apricots. The drying rates were found for solar as well as industrial drying operations. Air and merchandise temperatures were measured for the whole industrial drying process. It was shown that the majority materials were dried within the falling rate period. Currants, plums, apricots and jigs exhibited two drying rate periods, a primary slowly decreasing (almost constant) and a second fast decreasing (falling) drying rate period.

3. MATERIALS USED

Table -1:

Parts	Material Used
Solar Collector	Toughen Glass
Absorber Plate	Aluminium
Heating Chamber	Wood
Drying Chamber	Wood
Insulation	Glass wool
Tray	Aluminium
Roof	Wood

4. SCHMETIC DIAGRAM

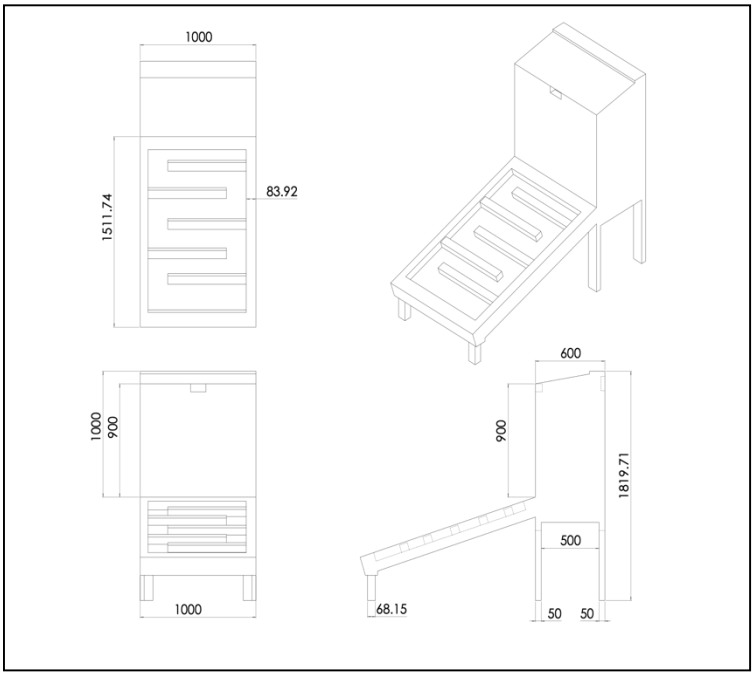

Fig -1: Schematic diagram of model

5. 3D DESIGN OF MODEL

Fig -2: 3D design of model

6. WORKING PRINCIPLE

A solar air heater is a lively system as against a passive system. Passive solar systems contain heat absorbing structural materials and building orientation that takes advantage of southern exposure. Active solar systems use solar panels to gather solar power and fans to manoeuvre the energy to a special place.

A solar air heater is meant to supplement your existing heating plant, not replace it. The most efficient way to utilize a solar air heater is to put in where it can blow warm air directly into an area that sees a lot of daytime use. Drawing on the principle that warm air rises and funky air sinks, the solar air heater pulls cooled air from rock bottom of an area, circulates it through the solar dish where it picks up heat, then blows the warmed air back to the space.

7. FORMULA

The total mass of water evaporated from the food items can be calculated by,

$$W = \frac{m_p - m_s}{m_p} 100\%$$

Where:

W = percentage of total moisture content lost

Mp = initial mass of the food item

Ms = mass after drying of food item

8. CONCLUSION

1. The performance of existing solar fruit dryers can still be improved upon especially within the aspect of reducing the drying time and doubtless storage of warmth energy within the system. Also, meteorological data should be readily available to users of solar products to make sure maximum efficiency and effectiveness of the system. Such information will probably guide an area farmer on when to dry his agricultural produce and when to not dry them.

2. Solar radiation is often effectively utilized for drying of agricultural produce in our surroundings if proper design is administered. This was demonstrated and therefore the solar dryer designed and constructed exhibited sufficient ability to dry agricultural produce above all fruit items to an appreciably reduced moisture level.

3. This will go an extended way in reducing fruit wastage and at an equivalent time fruit shortages, since it is often used extensively for majority of the agricultural fruit crops. Apart from this, solar power is required for its operation which is quickly available within the tropics, and it's also a clean sort of energy. The fruit items also are well protected within the solar dryer than within the open sun, thus minimizing the case of pest and bug attack and also contamination.

REFERENCES

[1] Alamu; Nwaokocha, and Adunola, O. 2010. Design and construction of a solar food dryer, Leonardo Journal of Sciences, 71-82.

[2] Bahnasawy, A.J and Shenana, J.R. 2004. Evaluation of a solar crop dryer for rural applications in Botswana. Botswana Journal Technology 11(2): 58-62.

[3] Bena, B and Fuller, R.J. 2002. Determination of the typical coefficient of internal moisture transfer during the drying of a skinny bed of potato slices. Journal of Food Engineering. 48(2):95-101.

[4] Bolaji, B.O. 2005. Performance of a solar dryer for food preservation. 6th Ann. Engineering. Conf. of School of Engineering and Engineering Technology, Nigeria. 8-13.

[5] Adegoke, C.O and Bolaji, 2000. Performance evaluation of solar operated thermo predicament system in Akure, International Journal of Technology. 2(1): 35-40.

[6] Akinola, A.O; and Fapetu, O.P. 2006. Exergetic analysis of a mixed- mode solar dryer. Journal of Solar Energy and Applied. Science. 1 : 205- 10.

[7] Ericson, J. 1980. Global solar radiation measurements in England. Renewable Energy,30(3):1203-1220.

[8] Ajinkya Aurangabadkar, Nikhil Sonkusare, Pranali Wahane; Design and Analysis of Modified Solar System Using Nano Fluid. International Journal of Engineering Research & Technology. Vol 9 Issue 5, May2020.