A Comparative Study of Aluminum(Al) Sheet Installed Indirect Type Solar Dryer

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Abstract- *Food is a prime requirement of Human beings along with air and water. In poor countries problem arises about their basic need for food and even in developing countries also faces this problem due to law production. They not able to preserve surplus food due to low production Agriculture yields are more than immediate consumption; it leads to wastage of surplus food. For Remain Surplus food there are many famous processes Available and Solar drying one of it. In Solar Drying Moisture Content of food Absorbed by High-Temperature Air, it Helps preserve for a long time. We Study Indirect Solar Drying Method, By Installing the Aluminum (Al) sheet in the Heating Cabinet. Aluminum Sheet Has More Thermal Conductivity and Reflectivity also it Helps for Enhancing Temperature in Solar drying Process.*

Keywords- Food, Aluminum Sheet, Solar Dryer, Heating Cabinet

I. INTRODUCTION

For drying, Energy can be supplied from various sources (Solar, Natural gas, fossil fuel, etc). But due to the rising cost of fossil fuel and harm effect on the environment, thus after that use of solar energy for drying is expected to be more efficient [1]. Rural peoples were already using solar drying techniques to dry their crops as it is efficient and free of cost but there are chances of but it has some disadvantages such as contamination of dust, pollution, and damage by Birds, Animals, Insect, etc [2]. Because in traditional method crops are dropped on-road and fields thus it may be possible of getting caught by bacteria indirect type solar dryer is one option to overcome the above issues.

Energy derived from sunlight can be used to dry food products and solar drying is one of the important techniques to preserve food and crop drying are essential to preserving agricultural goods and solar drying is a very essential and ancient technique for preservation technology And also for industries it is also useful such as textile, tea industry, cement, tiles, wood processing, paper industry, etc. But, solar drying is not widely used because it is time-consuming and also requires more investment cost, etc [6,7].

Solar drying techniques have many advantages such as it is pollution-free, free of cost, Renewable sources of energy but besides that, so many difficulties are also arising using solar drying systems which have to be overcome. Problems such as the intensity of radiated solar rays will not be constant during the whole day, therefore it requires a heat storage cabin to store an excess amount of heat in the system itself and after sunset and even in bad weather condition requirement of the source is must Also, solar radiation has a very low energy density, Which requires the large surface area to collect solar radiation (collectors) because of all this investment cost rises.

An alternative solution for traditional drying method and to overcome the problem of open sun drying, indirect type solar dryer is used. The main reasons are as follows,

(I) indirect type solar drying maintains good product quality compared to open sun drying.
(II) Time for drying process can be significantly reduced as compared to open sun drying.
(III) Dried foods can be preserved for a long time period and the product becomes extremely lightweight hence easy for transportation.

Therefore the main objectives of this Research work are,

(i) Make an Indirect type solar dryer setup
(ii) to conduct the drying experiments with the sample product of banana,
(iii) to measure the temperature difference at drying.

This Solar dryer is low cost because it constructs from material available in the market and cheap. It reduces the problems of low drying rate, risk of spoilage. This dryer consists of main parts namely the body of the dryer, the cabinet, chimney, and solar unit. Working Principle Solar energy dryers can broadly be classified into direct, indirect, and hybrid solar dryers. The working principle of these dryers mainly depends upon the method of solar energy collection and its conversion to useful thermal energy for drying.

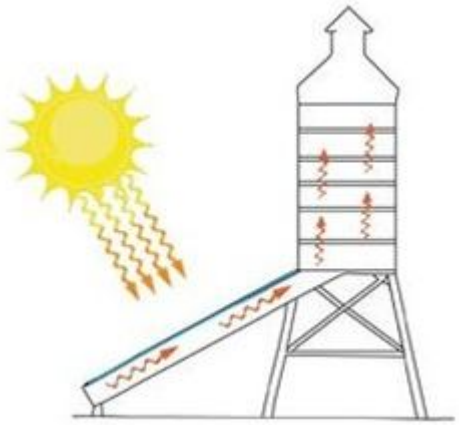

Fig. 1: Indirect Solar Dryer

II. LITERATURE REVIEW

In solar dryer, it uses solar energy as the principal source of energy that can a supplementary source. Drying of products can be done by various processes using different kinds of solar dryers. Since one of the traditional techniques is an open drying technique but that have its disadvantages and limitations, so many investigators have designed and developed their solar drying systems. Their published experiment reports have shown that the use of solar energy for drying of food is economically feasible. Detailed studies have stated the feasibility of solar-dried and naturally dried were good and given faster results. Some investigators have designed and developed their solar drying systems, working on different modes and different products. It is observed that the type of dryer and parameters (initial moisture content, final moisture content, drying temperature, and air velocities) chosen by each one of them are different. Many types of solar drying systems are developed by peoples and verities of solar dryers.

III. METHODOLOGY

3.1 Climate data collection:

A natural indirect type convection solar dryer was fabricated and installed at BMCET Surat (India). Longitude: 72.8311° E; Latitude: 21.1702° N. Total solar radiation on a 20.77' tilt surface toward the south during March month [9].

3.2 Design and construction:

The dryer consists of a solar flat plate air heater. Fig. no. shows the schematic view of the experimental setup. The gross dimension of the solar collector is 1 m x 0.5 m x 0.10 m. The collector was tilted by the angle of 20.76' with the horizontal. The drying chamber of 0.5 m × 0.25 m × 0.5 m (width, depth, and height) was developed from the wood. Outlet air from the collector enters into the drying chamber at the bottom. Then it flows in the upward direction through the drying material. The chamber was insulated from all sides except the top. The chamber was proved with chimney for exhaust air.

IV. INSTRUMENTATION AND EXPERIMENTATION

4.1 Instrument used for experiment:

Temperatures at different locations are measured using RTD Pt-100 sensor 6 channel data logger system (PPI Make) with the accuracy of ± 0.25%. Temperature readings were recorded on an hourly basis starting from 9:00 AM – 6:00 PM. RTD were fixed at inlet and outlet of the collector , and just after each tray in the drying chamber (Td1, Td2, Td3, Td4) for dry bulb temperature measurement.

4.2 Experimentation:

Experiments were conducted to study between May and June 2020 this experiment was conducted in Bhagwan Mahavir College of Engineering, Surat, India. A decrease in moisture content was determined by weighing the banana slices at each hour, this experiment was conducted by using raw bananas. First of all, we have made slices of banana which is to be used for drying. 2-3 mm of banana slices were used for effective drying. Slice was made by removing the outer skin of the banana and cylindrical shape chips were made out by cutting the banana then the chips were spread uniformly on the plates then four trays were placed inside the drying chamber. Then the doors were closed and we have waited for the experiment to be completed. And then the temperature was tested, solar radiation and humidity for one hour of interval of time.

The thermal conductivity (K), of 99.99% pure aluminum is 244 W/mK for the temperature range 0-100° C which is 61.9% of the IACS, and again because of its low specific gravity its mass thermal conductivity is twice that of copper [18].

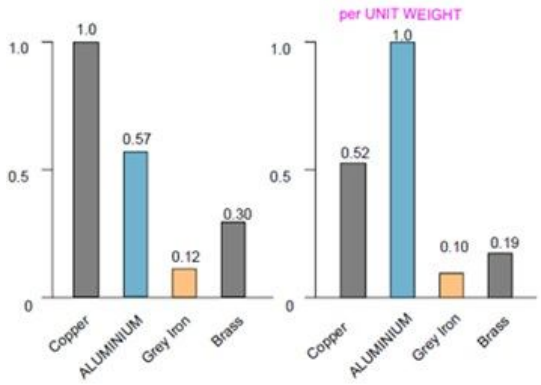

Fig. 2: Thermal Conductivity of Aluminum Compared with other Metals

Fig. 3: Final Model

Fig. 4: Aluminum sheet plates installed in Heating Cabinet

There are a total of 8 Aluminum plates in Heating Cabinet as Shown in Fig.3, Aluminum plate of 0.12 m × 0.1 m × 0.002 m(width, depth, and thickness) each. Total Area covered by Aluminum plates is 0.198 mm^2 and It enhances the direct incident solar radiation and helps for increasing air temperature for drying Process.

V. RESULT AND DISCUSSION

5.1 Initial Moisture Content:

The initial mass of fresh banana (W_{wet}) and final mass of dried banana (W_{dry}) was measured with the help of weighing balance. Initial moisture content was calculated by the following equation,

Dry basis,

$$M_{wb} = \frac{W_{wet} - W_{dry}}{W_{dry}}$$

Wet basis,

$$M_{wb} = \frac{W_{wet} - W_{dry}}{W_{wet}}$$

VI. CONCLUSION

Experiments were performed and found that indirect type of solar drying is more effective than open sun drying as it reduced the drying time. It is observed that the dried product is free from dust, environmental pollution. Solar dryer reduced the drying time with a quality product, so it is more efficient than open sun drying.

VII. ACKNOWLEDGMENT

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