

Design and Fabrication of Portable Solar Multi Dryer

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ABSTRACT: Now a days food preservation sector has been facing several problems. Even though food products are dried in convenient ways, their natural look and taste are not completely satisfied. To compensate this problem, here introducing the solar drier there is no use of external energy and chemical or biological pesticides for drying. It is done only by using direct solar energy. Hence, to get good quality, good odor having dried food items like meat, vegetables and fruits, etc. Since, there is no use of any other energies like electrical, mechanical, etc. This product is less expensive compare to other dryers. It can be easily shift from one place to another place with the help of wheels and it is mainly used for domestic purpose.

KEYWORDS: V-groove absorber plate, Portable solar dryer, Renewable energy, Drying duration.

I. INTRODUCTION

Now days, food sector has a crucial role in human and global development. While considering the health of living beings, it cannot neglect the role of food preservation. So that, here discussing about the production of dry fruits, vegetables, fishes, meats, etc. by using solar energy. Now a day there are many types of driers; Natural drying, sustainable energy drying, and conventional drying methods. Here, the drying process is natural. They contribute to the dried food product's long shelf life, pleasant aroma, and nearly 80–90% retention of its original color.

Solar drying uses solar radiation to dry the fruits and vegetables either directly or by employing a solar air collector for forced convective drying. Solar drying does not add to the emissions produced by dryers. Direct solar drying has some significant drawbacks in terms of dehydration duration and quality, but it has no negative environmental effects. Due to its capacity to decrease both specific energy consumption and dehydration time, a solar air dryer has higher efficiency compared to direct solar drying. The intermittent nature of solar radiation harms the solar dryer and lowers its efficiency. An effective heat storage system is needed to combat the solar radiation's erratic behaviour and ensure that the drying process is carried out continuously.

In this project we modify this system can easily use to everyone. This project is more concentrated to domestic purpose. Generally solar collector as used as flat plate but here used v-groove absorber plate, it can absorb maximum heat from the sun and to achieve maximum efficiency of the collector. In homes it is not bear the drier cost and accommodate its size. So that this paper following traditional way of natural drying which is under sun light.

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II. RELATED WORK

According to P. Moghini et.al [1] to divide the direct cabinet into two distinct chambers, he offers a black-coated absorber plate. By adding a new tray to the optimized drier, the drying capacity rose by more than 50% in contrast to the direct type. Ebnezer et.al [2] this guide line explained that maximum temperature of 49 °C, where getting from the heat releasing portion of the refrigerator. By getting this heat to dry several food products in a chamber and also the wet cotton clothes were dried in the drying chamber at 45-47°C. [3] This study has shown that hybrid fish dryers that use both solar and biomass energy can dry fish in 15 hours at temperatures between 40 and 80 degrees Celsius. When the sun is not present, this system uses biomass energy. [4] In this paper explained that the agricultural products are done carefully. There for this type of dryer will occur variable temperature drying process, it will maintain the temperature of drying chamber. This type of dryer can provide the required temperature of agricultural product. So, they can dry the agricultural product at accurate temperature for easy drying. N. Vigneshkumar et.al [5] this article concentrated on indirect sun dryers that used phase change materials (PCM) to dry sliced potatoes. For two more hours after sunlight, the assimilation of phase change materials inside the solar collector dramatically increased the dryer room inlet temperature. Maunda Nicholas Musembia et.al [6] was published a paper based on design and analysis of solar dryer for Mid-Latitude region it consists of indirect natural convention, objectives, properties, performance and their efficiency. This report claims that the dryer was inexpensively made utilising materials that were readily available locally. H. Krabh et.al [7] he conducted a study on solar dryers and designed three passive solar dryers. This design was based on the natural process of drying and the quality of dried orange slices. He made use of the acquisition system that was utilized to track the variations in climate variables. Vishnuvardhan Reddy Mugi [8] he looked at the indirect sun dryer's energy and exergy using both natural and forced convention. He dried slices of muskmelon using an indirect solar dryer. He contrasted the results of indirect natural sun dryer with forced conventional solar dryer. He employed DC fans to turn on diverging tunnels that had PV panels at the collector's inlet.

III. METHODOLOGY

The project's major goal is to produce high-quality preserved dry foods while reducing the drying period of food goods to just a few hours utilizing solar energy. The product is manufactured by considering the homely need of dried foods without directly introducing under sunlight. It is a type of traditional of drying, but our new method will help us to obtain dried foods with natural color, without bad odor and with good taste.

This project consists of a drying chamber, dual side heat absorber in the sides of drying chamber, v-groove absorber plate and curved type glass sheet on the upper side. The frame is made by using GI pipes and the side walls that made in three layers. The inner layer is made up of GI sheets, middle layer is thermo coal and the outer most layer is made by using plywood; these three layers, which can be hold the temperature more time in the drying chamber. The upper side to constitute more solar energy to the drying chamber by made the glass surface in the form of curvature also fixed a v-groove absorber plate in the inner portion of glass, which should be spread more heat in to dryer.

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IV. EXPERIMENTAL RESULTS



Fig 1: 3D view of portable solar dryer

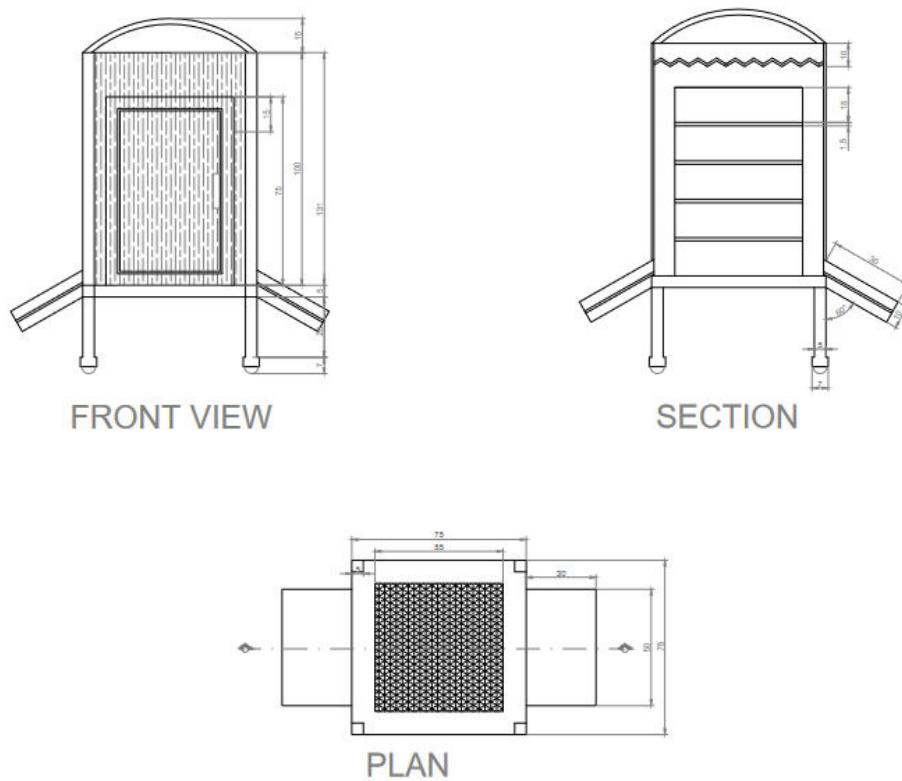


Fig 2: 2D view of portable solar dryer

The above drawn design of drier using solar energy is designed to obtain the faster and quality dried food items using solar energy. There are many types of solar dryers, in which they are using external energy for its working like

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electricity and firing. But here is only using solar energy for the working. For the good result we are providing v-groove absorber at the top and bottom sides. This design is working under the principle of natural convection. Here are the other details of the design. There is a v-groove absorber plate at the top side instead of flat absorber. The reason behind this v-groove absorber plate is the obtaining of increased surface area for heat absorption. Since the absorber is blackened. It is easy to absorb the solar heat. At surface of the absorber food graded black coated materials is applied. Mostly there are using GI sheets, Mild steel; since they are lite in weight, more affordable and good heat absorbing materials.

At the same time, here introduced absorber at the bottom side also. This is getting the better heat inside the drying chamber. By the absorber at the top side and the heat circulated inside the drying chamber causes for the less amount of heat at the bottom side. That's why here providing heat absorber at the bottom side. Then it can increase the heat at the bottom chamber also. So that it should maintain the required amount of heat inside the drying chamber. Better heat trapping there use a glass covering along with the absorber.

From the research got the idea that better to use thermo coal and wooden material as heat trapping material for the dryer chamber. Thermo coal is lite in weight and cheaply available. And wooden material such as ply wood are very lite in weight and cheap in rate. Which is more economically favourable for a quality dryer. Thermo coal is a good insulating material for heat. To concentrate more solar radiation to the dryer chamber, here introduced a curved glass fibre material at the top of the dryer. The curved (convex) shape of the fibre glass material is provided to concentrate more heat to the dryer chamber than flat fibre glass material.

The dryer's dimensions in the design are 0.75 metres long, 0.75 metres wide and 1.3 metre high. The average height of a person worldwide is 1.3 metres. That is the rationale behind picking this. If the gap between the trays is larger, the possibility of the formation of water droplets inside the drying chamber is small, and if the gap is too small, a big food product like cocoanuts can't be dried. So that the preferred average distance between trays is 0.15 m. The absorber is held at an inclination of 60 degrees from the side wall of the dryer on the bottom side. There are three layers to it. Plane glass makes up the top layer, a v-groove absorber plate fills the centre, and blackened GI sheet makes up the bottom layer. The v-groove absorber plate receives solar light from the plane glass, which causes it to absorb more heat and reach high temperatures inside the absorber. The high temperature inside the absorber travels to the drying chamber via convection.

Angle plate and GI pipe are the two materials that are primarily employed here during the manufacturing process. In contrast to the materials, angle plate is highly reinforced and can support heavier weights. GI pipe is also economical, lightweight, and corrosion-resistant. GI sheet, which absorbs more heat, is placed within the drying chamber as the inner layer. Thermo coal serves as the side walls' intermediate layer, preventing heat from escaping through to the outside, while plywood serves as the final layer. Additionally, it prevents heat from escaping outdoors.

V. CONCLUSION

This solar dryer uses solar energy directly to speed up the drying process of a variety of food goods, including fruits, vegetables, meats, and other food items. The top portion, which is made of glass sheet and fastened in the shape of a curve, can focus more heat and light onto the v-groove absorber plate. Additionally, the v-groove absorber plate, whose larger surface area enables greater access to the drying chamber, Two absorbers were placed in the sidewalls of the building to carry more heat from the sun and transfer it to the drying chamber, solving the issue of variations in sunlight falling to the earth according to the time of day. So that the drying speed can be increased than that of directly under sunlight, also it can avoid the chances of occurrence in bad odor, bad taste in drying products like meat, vegetables, fruits, etc.

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