DESIGN AND DEVELOPMENT OF SOLAR FLAT BED DRYER WITH REVERSIBLE AIR FLOW

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INTRODUCTION

Solar energy is the most promising renewable energy sources in view of its apparent limitless potential. Direct solar energy has been applied to seed and food drying for years. Based on the limitations of the direct sun drying it liable to lack of proper monitoring, and the escalated cost of the mechanical dryer, a solar dryer is therefore developed to cater for this limitation.

Drying and preservation of agricultural products have been one of the oldest uses of solar energy. The traditional method, still widely used throughout the world, is open sun drying where diverse crops, such as fruits, vegetables, cereals, grains etc. are spread on the ground and turned regularly until sufficiently dried so that they can be stored safely. However, there exist many problems associated with open sun drying. It has been seen that open sun drying has the following disadvantages. It requires both large amount of space and long drying time. The crop is damaged because of the hostile weather conditions; contamination of crops from the foreign materials, degradation by overheating, and the crop is subject to insect infestation. The crop is susceptible to re-absorption of moisture if it is left on the ground in the absence of sun, and there is no control on the drying process. This could lead to slow drying rate, contamination and poor quality of dried products, and loss in production. (Bena, B., Fuller, R.J., 2002. Natural convection solar dryer)

The disadvantages of open sun drying needs an appropriate technology that can help in improving the quality of the dried products and in reducing the wastage. Therefore, experimental performance of solar dryer with reversible air flow has been evaluated in this project.

OBJECTIVES

Hence, the objective of this work is to develop a reversible air solar seed dryer in which the seeds are dried simultaneously by both direct radiation through the black painted roof of the cabinet and by the heated air from the solar collector. The problems of low and medium scale processor could be alleviated, if the solar dryer is designed and constructed with the consideration of overcoming the limitations of direct and indirect type of solar dryer. So therefore, this work will be based on the importance of a reversible air flow solar dryer which is reliable and economically, design and construct a reversible air flow solar dryer using locally available materials and to evaluate the performance of this solar dryer.
METHODOLOGY

Materials Used:
The following materials were used for the construction of the domestic passive solar dryer:

- Wood – Wood material is used as the casing of the drying cabinet. Wood was selected being a good conductor of heat and relatively cheaper than metals.
- Black painted aluminium tube – Aluminium is used in the project as it has good heating capacity and absorbs solar radiations rapidly with less heat radiation.
- Chlorinated Polyvinyl Chloride (CPVC) Pipes - CPVC pipes have been used in the project as the air circulators. These pipes can withstand the temperature up-to 82°C. As our project is a seed dryer with reversible air flow, the valves have been used which are fitted to the pipes.
- Temperature Sensor - A temperature sensor is used to know the amount of heat that flows in the cabinet.
- Galvanized Iron Mesh - Galvanized iron can play a longer life advantage when hot air is passed. 1mm thickness Galvanized iron mesh is used in this process.
- Nuts and Bolts – Nuts and bolts are used in the wooden cabinet for the better adjustments and air tightening.

Working Method:
A solar panel of capacity 12 volts and 10 ampere is used to run a blower fan. This fan blows the air and it is further passed to the aluminium metal tubes where the air passes and gets heated. This hot air is passed in the cabinet where the seeds are placed on the galvanized iron mesh. At the inlet part of the chamber, two valves have been made which allows the air to flow in both the directions. An outlet vent is provided at the other end of the cabinet to facilitate and control the convection flow of the reversible air that flows through the dryer.

Initially when top inlet valve is open, the bottom outlet valve should be open as the hot air will enter the chamber from the top and dries the seeds and then exits from the bottom valve. After a certain period of time, the inlet top valve and outlet bottom valve is closed and the inlet bottom valve and the outlet top valve is opened as the hot air passes from bottom to top inside the chamber drying the seeds on the mesh. These two valves at the outlet are connected to a pipe which releases the hot air to the atmosphere. The chamber consists of one removable wooden panel (from where the seeds are placed in the flat bed) made of 5 mm plywood, which
are fitted tightly to prevent air leakages when closed. Thus the seeds are dried after continuously passing the hot air into the chamber.

**RESULTS AND CONCLUSION**

**RESULTS:**

This project presents the design, construction and performance of a reversible air flow solar dryer for seed drying. In the dryer, the heated air from a separate solar collector is passed through a grain bed, and at the same time, the drying cabinet absorbs solar energy directly through the walls of the cabinet. The results obtained during the test period revealed that the temperatures inside the dryer and solar collector were much higher than the ambient temperature during most hours of the day-light. The temperature rise inside the drying chamber was up to 55% for about three hours immediately after 12.00h (noon). The dryer exhibited sufficient ability to dry food items reasonably and rapidly to a safe moisture level and simultaneously it ensures a superior quality of the dried product.

**CONCLUSION:**

The following conclusions were made from the test carried out. The solar dryer can raise the ambient air temperature to a considerable high value for increasing the drying rate of agricultural crops. The product inside the dryer requires less attentions, like attack of the product by rain or pest (both human and animals), compared with those in the open sun drying. There is an ease in monitoring when compared to the natural sun drying technique. The capital cost involved in the construction of a solar dryer is much lower to that of a mechanical dryer. From the test carried out, the simple and inexpensive solar dryer was designed and constructed using locally sourced materials. The hourly variation of the temperatures inside the chamber and air-heater are much higher than the ambient temperature during the most hours of the day-light.