Review Paper of Design of Solar Dryer for Agriculture Product

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Abstract :

This paper presents the state of various kinds of solar dryers that are widely used today and about drying process that has been perform during drying of various food products and percentage containing moisture in different food products. The indirect, direct and mixed mode dryers that have shown potential in drying agricultural products in the tropical and subtropical countries are discussed. A side from identifying the active and passive mode solar dryers, we also highlight the environmental influence on solar energy (harnessing) that plays a vital role in the solar drying sector and says that the indirect solar dryer is more suitable than other dryers and recirculation of air in an indirect dryer can reduce the drying time of food product in comparison to normal indirect solar dryers. The dryer having recirculation of air have more efficiency than other dryers.

1.Introduction :

Background :

The Background of Drying is a complicated process involving simultaneous heat and mass transfer. The required amount of energy to dry a particular product depends on many factors, such as initial moisture content, final moisture content, drying air temperature, relative humidity and velocity. Various mathematical models describing the drying behaviour of different food materials have been proposed to optimize the drying process and design efficient dryers. Modelling is advantageous because full scale experimentation of different products and configurations of drying system is very time consuming and costly. In order to improve the quality, the traditional natural sun drying must be replaced by modern drying methods. Drying characteristics of specific products should be determined to improve the quality.

Objectives of the research:

The objective of this study is to develop a solar dryer in which the grains are dried simultaneously 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 solar dryer which is reliable and economically, design and construct a solar dryer using locally available materials and to evaluate the performance of this solar dryer.

2. METHODS OF SOLAR DRYING TECHNOLOGIES :

Direct Solar Drying:

Direct solar drying is also called natural convection cabinet dryer. Direct solar dryers use only the natural movement of heated air. A part of incidence solar radiation on the glass cover is reflected back to atmosphere and remaining is transmitted inside cabin dryer. A direct solar dryer is one in which the material is directly exposed to the sun's rays. This dryer comprises of a drying chamber that is covered by a transparent cover made of glass or plastic. The drying chamber is usually a shallow, insulated box with air-holes in it to allow air to enter and exit the box. The product samples are placed on a perforated tray that allows the air to flow through it and the material.

Indirect Solar Drying:

Indirect solar drying or convective solar drying is the new technique of product drying. It is very efficient method than the direct type of solar drying. In this method the atmospheric air is heated in flat plate collector or concentrated type solar collector. The heating process is either passive or active. This hot air then flow in the cabin where products are stored. Therefore moisture from the product may lost by convection and diffusion. This method of drying is used to avoid direct exposing to the solar radiation.

Solar radiation after passing through the glass cover is reflected by cylindrical reflector toward an absorber. After absorber, a part of this is lost to ambient through a glass cover and remaining is transferred to the flowing air

above it by convection. The flowing air is thus heated and passes through the placed in the drying chamber. The exhaust air and moisture is removed through a vent provided at the top of drying chamber.

3. Moisture Contents of Solar Drying of Various Agricultural Produces:

Products	Moisture Content		Max Allowable Temp	Drying Time [h]
	Inital %	Final %		
Onion	85	6	55	48
Onion Flakes	80	10	55	24
Onion Rings	80	10	55	18
Tomatoes	95	7	60	36
Green Peas	80	5	60	8-10

4. Experimental setup:

A. Collector (Air Heater):

The heat absorber (inner box) of the solar air heater was constructed using well seasoned woods painted black. The solar collector assembly consists of air flow channel enclosed by transparent cover (glazing). An absorber mesh screen midway between the glass cover and the absorber back plate provides effective air heating because solar radiation that passes through the transparent cover is then absorbed by both the mesh and back-plate.

B. The Drying Cabinet:

The drying cabinet together with the structural frame of the dryer was built from well- seasoned woods which could withstand termite and atmospheric attacks. An outlet vent was provided toward the upper end at the back 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 covered with transparent glass sheets of 4 mm thick, which provided additional heating.

C. Drying Trays:

The drying trays are contained inside the drying chamber and were constructed from a double layer of fine chicken wire mesh with a fairly open structure to allow drying air to pass through the food items.

4. Advantages and Disadvantages of Solar Drying :

1. Drying rate is high as compare to direct solar.
2. Final condition of product after drying can be controlled scientifically.
3. Losses in product are avoided on the circumstances of natural phenomena.
4. Floor surface area required is very low for the same quantity of material in direct solar drying.

5. Same dryer can be used for different seasonal products
6. Quality of products are not obtained in some cases.
7. Adequate solar radiation is required.
8. It is more expensive.
9. Require more time for drying

5. APPLICATIONS OF DIFFERENT SOLAR DRYERS :

Direct solar drying is mainly used in on-farming sectors. It is also suitable for small farmers in rural areas, where electrical power is not available. This kind of dryer is more efficient in drying small amounts of crops, fruits, and vegetables. A locally made indirect- type natural convection dryer is useful for drying fruits and vegetables in rural areas. A solar tunnel dryer can be used for drying jackfruit bulb sand leather. The mixed-mode dryer is cheap, readily available, and can be easily made by local farmers. Tomatoes, mango slices, and grains can be dried using this dryer, which is driven by a fan .Therefore; agricultural products are dried within a short time at ambient temperature. The natural convection dryer is more advantageous and applicable than other types. Mean while, the low-cost indirect- type natural convection solar dryers are used for drying cassava, bananas, and rough rice, among other products .The forced convection solar dryer is used in small Firms with limited financial support from large industrial sectors This efficient dryer requires a short time to dry products.

6. CONCLUSION:

After the study of various type of dryers, an indirect forced solar dryer having recirculation of hot air is more suitable then others from the food preservation as well as time conservation and energy conservation also because there is no risk of proper sun light as that in direct solar dryer and losses of air in that type of indirect solar dryer where there is no recirculation of air and takes more time in drying process in comparision to air recirculating solar dryer. the direct driers are mainly best for those areas where the proper resources (such as electricity and other fabricating material which is used the fabrication of indirect and mixed mode.

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