REVIEW ON SOLAR DRYER AND ITS TYPES

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Abstract: The unpredictable increase and frequent scarcity of fossil fuels has accelerated the ongoing search for an alternative source of energy. Solar energy is one of the renewable and sustainable energy sources that has attracted a large community of researchers from around the world. This is largely due to its abundance in direct and indirect form. As such, the development of efficient and inexpensive equipment for drying agricultural and marine products has led to a change in their usability, thus improving the quality of products and the quality of life. The use of solar dryers for drying agricultural products can greatly reduce or eliminate product waste, food poisoning and, in some cases, improve farmers' productivity for better incomes. A solar crop drying system does not depend solely on solar energy to function; It combines the combustion of fuel with the energy of the sun, thus reducing the consumption of fossil fuel. In this article, an analysis of the solar dryer is presented. The different designs of the solar dryer are described in the literature so far.

I. INTRODUCTION

Drying in the sun and in the open air is still the most commonly used method of preserving and processing agricultural products. But uncontrolled drying suffers from severe dust problems caused by wind, insect infestation, The product may be seriously degraded to the point of sometimes becoming a loss of value and the loss of food quality may have adverse economic effects on the domestic and international markets. Dryers have been developed and used to dry agricultural products to improve shelf life (Esper and Muhlbauer, 1996). Most of them use a costly source of energy such as electricity (El-Shiatry et al., 1991) or a combination of solar energy and another form of energy (Sesay and Stenning, 1996). . Most projects of this nature have not been adopted by small farmers, either because the final design and data collection procedures are often inappropriate or the cost has remained inaccessible and the subsequent transfer of researcher technology to the end user has been anything but effective (Berinyuy, 2004). The purpose of this study is to present some basic types of solar dryers in order to provide a best idea of their effectiveness in drying agricultural products.

Advantages of the solar drying system

1) Better product quality is obtained.
2) It reduces losses and offers a better market price to products.
3) The products are protected against flies, rain and dust; the product can be left in the dryer overnight despite the rain, since the driers are impervious.
4) Prevent fuel dependence and reduce the impact on the environment.
5) It is more efficient and less expensive.

Disadvantages of the solar drying system

1) The quality of the products is not obtained in some cases
.2) Adequate solar radiation is required.
3) It is more expensive. It takes more time for drying.

II. CLASSIFICATION OF SOLAR DRYER

Solar Dryer is available in a range of used for drying various agricultural products. Different types of dryers are available on the market as needed. Mainly, all drying systems are classified according to their operating temperature: high temperature solar dryer and low temperature solar dryer.

The following criteria are required for the classification of the solar dryer: -

1) Air circulation mode
2) Insulation exposure
3) Air flow direction
4) Dryer layout
5) Solar contribution

2.1) Direct solar dryer

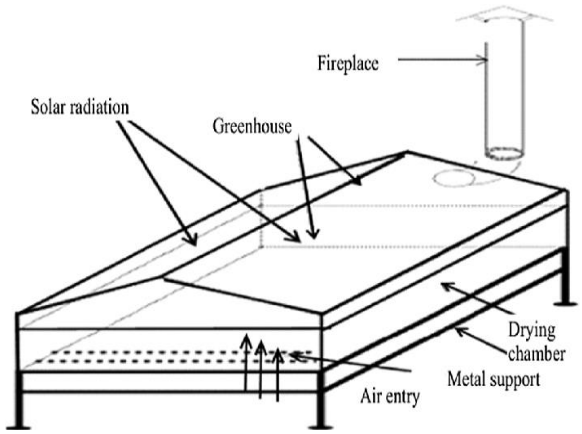

Figure 2.1. A schematic diagram of Direct solar dryer

It is a type of dryer in which solar radiation is directly absorbed by the product to be dried. This type of dryer includes a drying chamber covered with a transparent glass or plastic cover. The drying chamber is usually a shallow, insulated box with air holes to allow air to enter and exit the drying chamber.

2.2) Indirect solar dryer

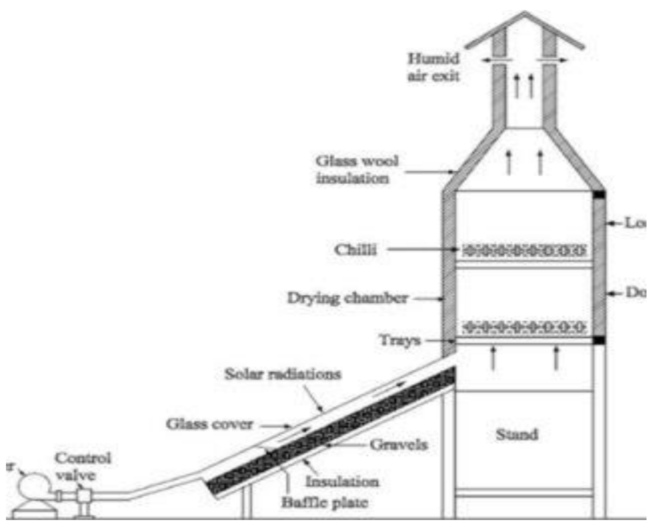

Figure 2.2. A schematic diagram of an Indirect solar dryer

The solar radiation obtained by the system is used to heat the air passing through the product to be dried in this dryer. With regard to drying, the quality of the product has improved, but the drying rate has increased. The heated air is blown into the drying chamber. At the top of the drying chamber, vents pass through the humidity. Indirect type solar drying systems provide better control of drying. Figure 2.2 Describes another principle of indirect solar drying, usually called conventional dryer.

2.3) Forced convection and natural convection solar dryer

2.3.1) Forced convection - In this type of dryer, air is forced through a solar collector and the product bed by a fan or blower, usually called an active dryer.

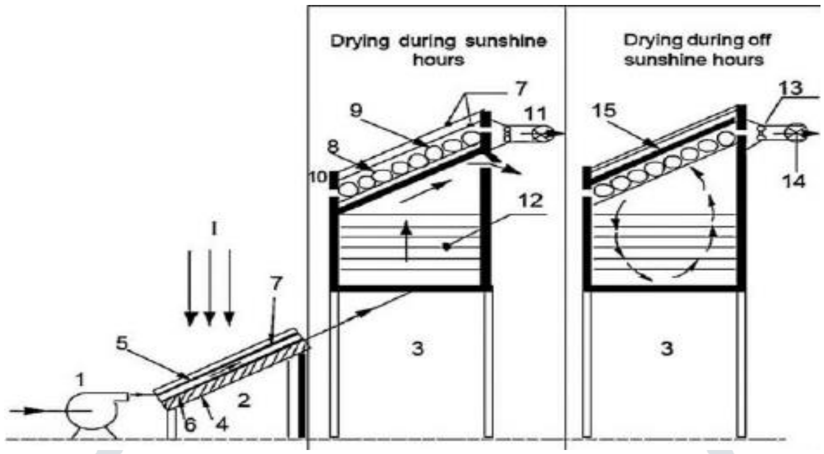

Figure 2.3 A schematic diagram of Forced convection solar dryer

2.3.2) Natural convection - In this dryer, a natural movement of the air takes place, called passive dryer. The heated air flow is induced by the thermal gradient.

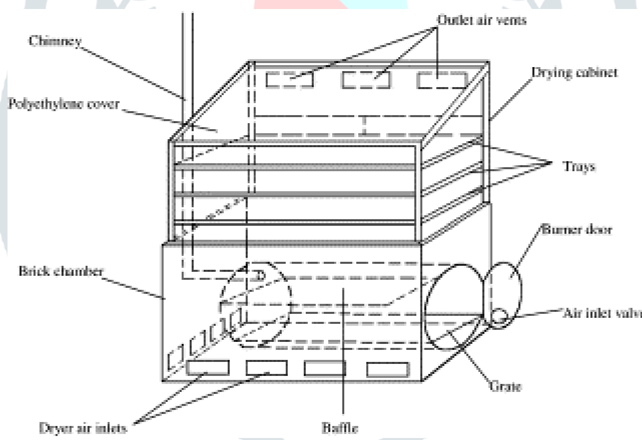

Figure 2.4 A schematic diagram of Natural convection solar dryer

2.4) Solar drying in mixed mode

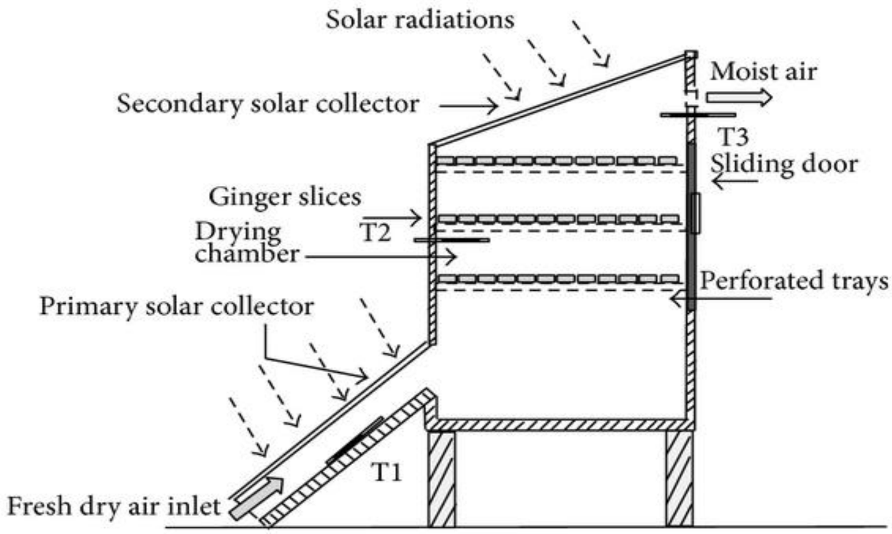

Figure 2.4 A schematic diagram of Solar drying in mixed mode

It's a combination of direct and indirect solar drying method. The product can dry with direct exposure to solar radiation and hot air supplier on it. Air can be heated in the solar energy collector first, then go to the room where the products are stored. In this treatment product can dry according to loss of moisture by convection. The same room . The system is divided into three main components: an air heater, drying room and a fireplace. Air heater through which the drying air is heated as flows on and under an absorbing plate which is heated in turn by direct absorption of incident radiation. The crop to be dried is placed in the drying chamber. Moist air flows through the chimney and escapes into the entourage is partially or totally covered with transparent material for exposure of products to solar radiation.

III. APPLICATIONS OF DIFFERENT SOLAR DRYERS

- It is suitable for small farmers in rural areas, where the electric current is not available. This kind dryer is more effective in drying small quantities of crops, fruits and vegetables. A natural product of indirect type manufactured locally the 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.
- Solar forced convection the dryer is used in small Companies with limited financial support from large industrial sectors. the dryer requires some time to dry the products and is built to last.
- The natural convection dryer is more advantageous and applicable than other types.
- In the meantime, the low cost solar indirect convection type dryers are used to dry cassava, bananas, and raw rice, among others some products.

IV. LITERATURE REVIEW

[1] Diemuodeke E. OGHENERUONA *, MomohO.L. YUSUF: - Direct and natural convection solar dryer designed and manufactured to dry tapioca in rural areas. A minimum solar collector area of 7.56 m2 is required to dry a batch of 100 kg of tapioca in 20 hours (two day drying period). The initial and final moisture contents considered were 79% and 10% respectively in humid conditions. The average ambient conditions are air temperatures of 32 ° C and 74% relative humidity, with daily global solar radiation incident on a horizontal surface of 13 MJ / m2 / day. The weather conditions are as follows: Warri (5 ° 30 'long, 5 ° 41' long), Nigeria. A prototype dryer was manufactured with a minimum collector area of 1.08 m2.

[2] M. MOHANRAJ, P. CHANDRASEKAR: - The performance of an indirect forced convective floorboard, integrated with a heat storage material, was designed, manufactured and studied for cold drying. The dryer with heat storage material maintains a constant air temperature inside the dryer. The inclusion of heat storage material also increases the drying time by about 4 hours per day. Thechili was dried from the initial moisture content of 72.8% to the final moisture content of about 9.2% and 9.7% (wet basis) in the lower and upper trays, respectively. . The thermal efficiency of the solardrier was estimated at about 21% with a specific moisture extraction rate of 0.87 kg / kWh

[3] Bukola O. Bolaji and Ayoola P. Olalusi: Construct a simple and inexpensive mixed-mode system of locally sourced materials. The increase in temperature inside the oven was 24 ° C (74%) for one hour immediately after 12:00. The drying rate, the efficiency of the sensor and the percentage of debris (on a dry basis) removed for yam chip drying were 0.62 kgh-1, 57.5 and 85.4%, respectively. The ability of the dryer to dry food at a safe moisture level and simultaneously with the superior quality of the dried product.

[4] Bukola O. Bolaji.et.al:- Designed, built and tested the solar wind ventilated cabinet dryer in Nigeria at a latitude of 7,5oN. During the test period, the average air speed in the solar dryer was 1.62 m / s and the average efficiency of the system in daylight was 46.7%. The maximum temperature of the drying air was set at 64 ° C inside the dryer. The average air temperature in the drying oven was above room temperature in the range of 5 ° C to the early hours of the day at 31 ° C in the middle of the day. in the dryer.

[5] Ahmed AbedGatea, designed and developed solar drying system with 2.04 m² V-groove collector, drying chamber and fan. The heat energy and heat losses of the solar collector were calculated for each of the three inclination angles (30º, 45º, 60º). The results obtained during the test period indicate that the maximum energy gained appeared at 11 o'clock and then gradually decreased from the maximum.

CONCLUSION

After studying different types of dryers, a solar dryer with indirect focus having recirculation of hot air is more appropriate so others of the food preservation like as well as the conservation of time and energy conservation also because there is no risk of appropriate sunlight as that in direct solar desiccators and air losses in this type of indirect solar dryer where there is no recirculation air and takes longer drying process compared to air Re-circulating solar dryer. Direct dryers are mostly best for areas where the adequate resources (such as electricity and other manufacturing material used indirect and mixed mode manufacturing tumble dryers) are not available.

REFERENCES

[1] Diemuodeke E. OGHENERUONA, Momoh O.L. YUSUF.Design and manufacture of a direct natural convection dryer for tapioca; Department of Mechanical Engineering, University of PortHarcourt, Department of Civil and Environmental Engineering, University of Port Harcourt, P.M.B. 5323, Choba, Rivers State, Nigeria; Leonardo Electronic Journal of Practices and Technologies ISSN 1583-1078; Number 18, January-June 2011 p. 95-104.

[2] Mr. Mohanraj, P.CHANDRASEKAR. Performance of a forced convection solar dryer integrated with gravel as heat accumulator for chili drying School of Mechanical Sciences, Karunya University, Coimbatore-641114. India, School of Engineering and Sciences, Swinburne University of Technology (Sarawak Campus), Kuching Sarawak - 93576 Malaysia; Journal of Engineering Science and Technology Vol. 4, No. 3 (2009) 305-314.

[3] Bukola O. Bolaji and Ayoola P.Olalusi. Performance Evaluation of a Mixed-Mode Solar Dryer; Department of Mechanical Engineering, University of Agriculture Abeokuta, Ogun State, Nigeria;AU J.T. 11(4): 225-231 (Apr.2008).

[4] Bukola O. Bolaji , Tajudeen M.A. Olayanju and Taiwo O. Falade. Performance Evaluation of a Solar Wind-Ventilated Cabinet Dryer;Department of Mechanical Engineering, The Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria; The West Indian Journal of Engineering Vol.33, Nos.1/2, January 2011, pp.12-18; (Received 11 August 2005; Accepted January 2011).

[5] Ahmed Abed Gatea. Design, construction and performance evaluation of solar maize dryer; Department of Agricultural mechanization, College of Agriculture, University of Baghdad, Iraq;Journal of Agricultural Biotechnology and Sustainable Development Vol. 2(3), pp.039-046, March 2010; Accepted 29 October, 2009