

Application and Effectiveness of Low Cost Solar Cabinet Dryer: Experimental Investigation

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Abstract: Now a day with the rapid development in various developing countries, all over the world there is an increase in energy demand with each passing time. The problem of food crisis in most part of the developing countries takes place due to inability to preserve food surpluses rather than low production. This article is concentrated on the solar dryer and the experimentation of different samples (food stuffs). Drying is a process of removal of liquid by evaporation from the food stuffs like apples, grapes etc and other agricultural products. Mechanical methods for separating a liquid from a solid are not generally considered drying. In the following section an attempt is made to provide an overview of the solar dryer (prototype) for agricultural products. In our experiment average dryer efficiency for one day is found to be 13% for different samples while the moisture content for various samples like chilli, grapes and apples is found 64%, 58% and 60% respectively. All the readings are on a day basis i.e. for one day.

Keywords: Solar dryer, preservation, dryer efficiency, moisture content, collector.

I. INTRODUCTION

Preservation of fruit and vegetables are essential now a days, and it has become a part of our life. From ancient times fruits, vegetables and other eatables were kept to dry in the sun in order to preserve them. This is one method by which we can preserve our food items, the other method of food preservation is solar dryer. In this method we preserve the food items by taking out the moisture content from them. The more we heat the air, its moisture absorbing capacity increases [1]. This is the main principle behind the working of solar dryer. This is an economic way of preserving food and that too using solar energy. No other source of conventional energy is used in this process. In today's world, where there is rapid demand for conventional fuels and the fact that it will not be available to us in the near future, in that case the need and development of non conventional sources of energy is good for the future generations [2]. The solar dryer can be of great use in the developing countries such as military feeding and space food formulations etc. One of the main advantages of solar dryer over open sun drying is that it prevents the fruits and vegetables and other eatables away from insects and flies and also from dust particles. In this paper we will do some important calculations based on the observation regarding solar dryer which are as follows: 1. Determination of moisture content 2. Dryer efficiency

Kalra and Bhardwaj (1981) described two simple models of solar dehydrator with the functions of direct and indirect dryers for mango products and vegetables which are well suited to rural conditions and small scale industries. Sharma (1987), described the design details and performance of two types of low cost solar crop dryers, conventional cabinet dryer with direct heating mode and an integrated solar collector-cum-drying system based on the principle of natural convection [3]. O.V. Ekechukwua and B. Norton (1997) discussed the review of solar drying technologies for application of each design type for rural farmers in developing countries. D. R. Pangavhane and R. L. Sawhney (2002). Presented the review article of different solar drying technologies with detailed development and performance for grape drying. [4]. V. Belessiotis and E. Delyannis (2010) presented comprehensive study of different solar drying technologies with fundamental principles and parameters Babagana Gutti (2012) presented how the solar dryer technology effective for agricultural products preservation and also discussed the various evaluation methods for solar dryers [5]. B. K. Bala and Nipa Deb Nath (2012) presented comprehensive review of solar dryer developments and potentials for drying of fruits, vegetables, spices, medicinal plants [6], and fish. Atul H Patel (2013) reviewed the different types of solar dryer with detailed development and performance [7].

II. EXPERIMENTAL SETUP

1. Construction of the solar dryer :

The construction of the solar dryer is simple and the outline of the construction is shown below with the help of following diagram along with its dimensions.

2. Materials required for making the solar dryer :

The materials which are used to make the solar dryer are used in our everyday life .And they are found easily near our locality.

- Plywood
- Hammer
- Nail and glue
- Wired mesh
- Glass
- Thermometer
- Black paint

3. The main principle of solar dryer is based on the greenhouse effect where the solar heat is trapped inside the drying chamber and thus increase the temperature level of the cabinet of the solar dryer The solar dryer will be covered in black paint for absorption of heat, the actual picture is shown in Figure 1.

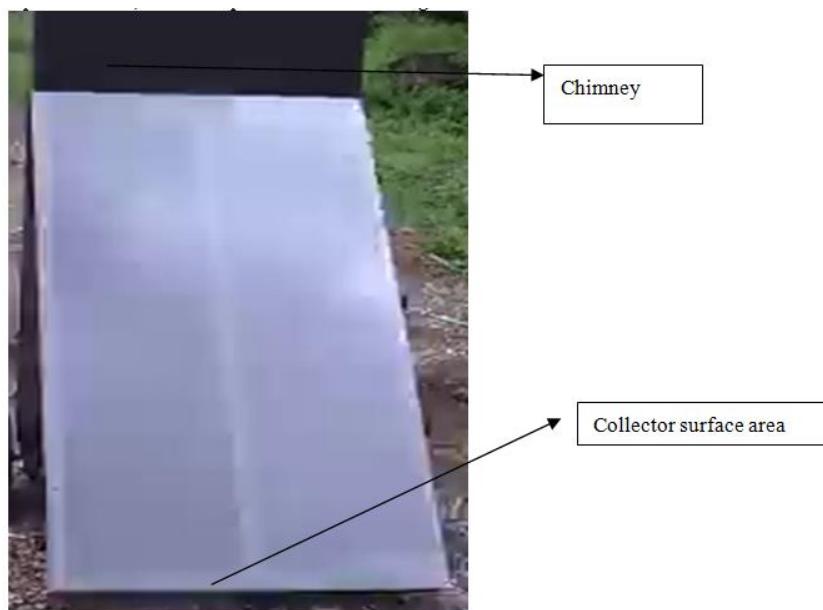


Fig.1. Front view of the solar dryer



Fig. 2. Construction of solar dryer

III. CALCULATION AND RESULT

FORMULAE USED

Some important formulae used in this paper are given as follows:

1. Dryer efficiency(η_d)

Dryer efficiency is the ratio of collection efficiency (η_c) and the system efficiency (η_s)

$$\eta_c = \frac{Q_u}{AcI_s}$$

Where, $Q_u = mC_p\Delta t$

A_c = collector surface area

I_s = Insulation on tilted surface

WL

$$\eta_s = \frac{W}{AcI_s}$$

Where, W= mass of moisture evaporated.

L= latent heat of evaporation in the dryer temperature.

Therefore, dryer efficiency (η_d)

$$\eta_d = \frac{\eta_c \text{ (collector efficiency)}}{\eta_s \text{ (system efficiency)}}$$

2. Determination of moisture content :

$$M_{wb} = \frac{(M_i - M_d)}{M_i} \times 100$$

Where, M_{wb} = moisture on wet basis

M_i = initial mass of the sample

M_d = final mass of the sample

1 Dryer efficiency

One day Dryer efficiency (η_d) for green chilli = 13.6%

One day Dryer efficiency (η_d) for grapes = 14.19 %

One day Dryer efficiency (η_d) for apples = 13.78%

The average dryer efficiency is found out to be 13% for one day.

2 Moisture content

➤ Moisture content for green chilli = 64%

➤ Moisture content for grapes = 58%

➤ Moisture content for apple = 60%

IV. CONCLUSION

These experimental observation shows that the solar dryer can be used as an alternative in case of food preservation and the efficiency is also acceptable . The people can make it in their homes, especially in the developing countries where the energy demand is skyrocketing. It can be handy in times of recession .The food stuffs can be stored in this dryer and used for days without wasting it .The data concluded while performing this experiment is shown in the following table for different samples:

SAMPLES	DRYER EFFICIENCY(one day)	MOISTURE CONTENT
Green chilli	13.6%	64%
Grapes	14.19%	58%
Apple	13.78%	60%

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