STUDY OF FORCED CONVECTION EVACUATED TUBE SOLAR GRAPE DRYER

Anuj Kumar [1], Mr. Himanshu Sharma [2]
[1] *M. tech ME, Translsam Institute of Technology & Management, Meerut, India*
[2] *Assistant Professor, Translsam Institute of Technology & Management, Meerut, India*

Abstract: Environmental pollution and energy crises are very severe environmental and sustainable environmental issues in the globe. It becomes essential to apply solar energy to heat, generate electricity, dry plants, etc. Many scientists have created effective solar collectors over the past two centuries. Solar drying is one of the major solar energy apps used to remove moisture from agricultural products. This research was performed to select the optimum bed thickness of heat storage products and optimum wind speed for a 0.5 m2 drying chamber region and 0.5 m2 heat storage cabin area intended for solar dryer. However, most of the models have been shown to enhance the solar collector structure, the recent absorber coating methods or to reduce the absorber or collector losses. Many scientists have proved solar drying for the multiple foods and agricultural products. This is a cost-effective and cost-effective solution to standard drying.

Keywords: solar collector structure, solar energy, absorber or collector losses, optimum wind speed

I. INTRODUCTION

One of the earliest types of techniques of preserving agricultural products is to reduce moisture by washing vegetables and berries. The preservation of the meat product is the most significant procedure since the performance of the frozen products is heavily affected [1]. The main aim of washing agricultural products is to reduce moisture content to a point known as a balance moisture content, which enables secure retention for a long span of time. Removing moisture from foodstuffs stops the development and breeding of deteriorating microorganisms. The drying of fruit and the production of raisins in various grape kinds have a strong economic significance. The drying method used has a great deal of effect on product quality [2]. Sun washing, traditionally done in many nations, is the most prevalent washing technique. The benefits of convenience and less original expenditure are offered by this traditional technique [3].

One of the oldest types of agricultural product conservation techniques is to reduce the moisture content by drying vegetables and fruits. It is the most significant method to maintain food content because it has a lot of impact on the dried products ' quality. India currently spends around 100 million tons of fossil fuels (FF) annually for multiple uses, where 40% is consumed exclusively by the sectors [5]. Approximately 40-50 percent of almost 15 MT of fuel oil per year is used for heating appliances below 250 ° C to meet an enormous annual energy requirement in India of around 150 GW / hr. The abundantly accessible solar energy can be efficiently harnessed to meet the heating demands of different sectors. The use of heated air for drying applications in automobiles, plastic packing, printing, food and beverage, dragging and chemical sectors is one such significant application [6].

II. PROPOSED METHODOLOGY

BASIC DESIGN:
A triangular isolated cabinet coated with fiberglass is the basic design. Figure 1 demonstrates the layout for the complete laboratory set-up using an additional feeder and thermal storage. There are lifts in the box's foundation and bottom parts, allowing fresh air to go in and moist water to exit alternatively. The interior of the cabinet and the collection panel was coloured with dark white to withstand sunlight attack radiation. The absorber layer heats air as it moves through the container into the drying cabinet. Food to be washed is put on perforated trays within the cabinet, with warm air from the collector rising through the meat and leaving it through the roof.

III. RESULT

The sample experimental information for a specific test day is shown in Table 6.1. The tests are carried out under the environment's uncontrolled circumstances. DC fans run on the solar 15 W panel generate the forced air. The velocity of the fan is the function of the solar radiation, since more is the radiation of the beam, more is the current and voltage of the PV panel and therefore more air is distributed through the system.

IV. CONCLUSION

Here the drying efficiency under uncontrolled circumstances is researched, taking into account all the researchers ' prior results. The solar collector evacuated tube is intended and manufactured on the basis of analytical calculations. The grapes ' drying conduct is analytically and experimentally studied at the same time. The solar collector's thermal efficiency and the manufactured dryer's drying effectiveness were discovered more than previously accessible information. This model is more appropriate for practical implementation as it maintains the same drying circumstances as traditional schemes.

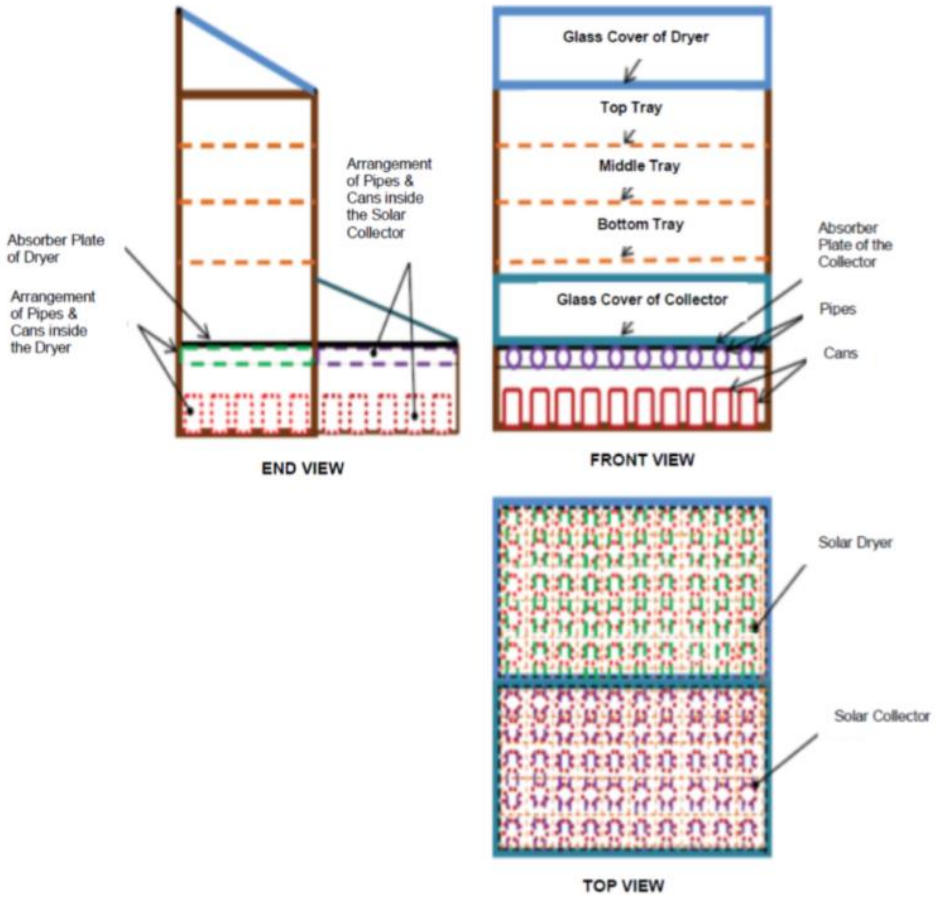

Figure 1: Dryer in Mixed Mode with Thermal Storage Unit

The above figure 1 shows the Dryer in Mixed Mode with Thermal Storage Unit.

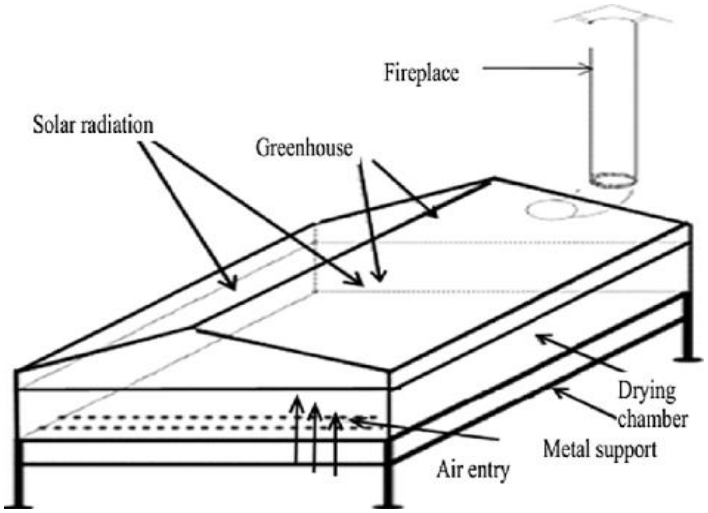

Figure 2: Direct solar drying

The above figure 2 shows the direct solar drying. Solar dryers are available and used to wash various agrarian goods in various dimensions and styles. On the industry, various types of dryers according to producers ' demands are available. All washing equipment are mainly classified based on their operating frequency range, which is a high-temperature sun dryer and a low-temperature sun dryer.

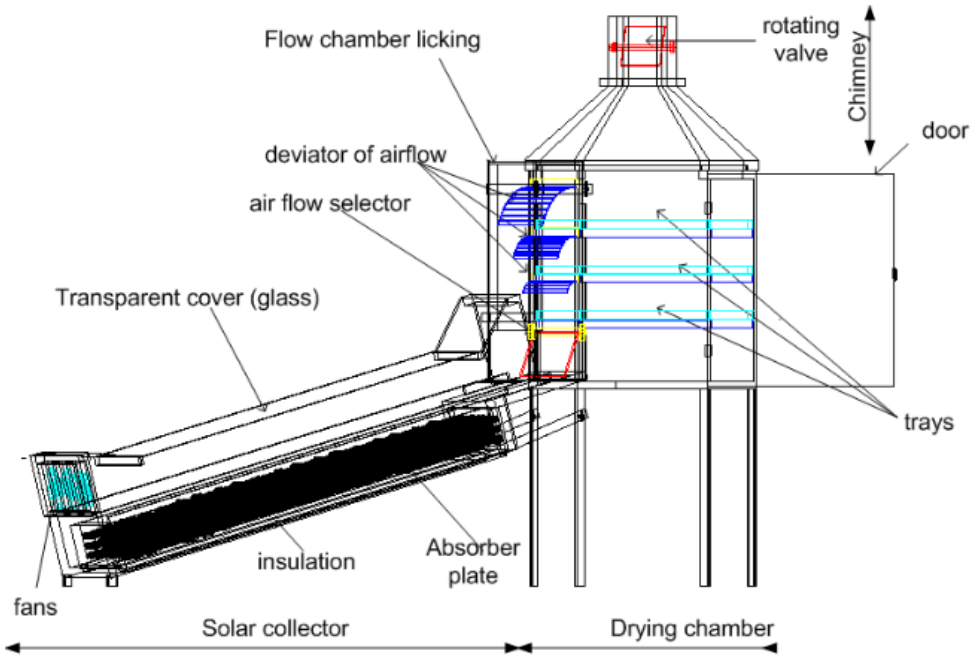

Figure 3: Indirect solar drier

The above figure shows the Indirect solar drier. The system's solar radiation is used to heat the air that flows through the item in this dryer to be dried. In this dryer product quality enhanced with enhanced drying speed.

Table 1: Sample Test Data

time	solar radiation	Ambient		Dryer tray -1		Dryer tray -2		Dryer tray -3		Collector outlet Temp.	Velocity of air m/s	Mass of air kg/s	Heat gain in J/s	Thermal efficiency
	in W/m2	Temp	% RH	Temp	% RH	Temp	% RH	Temp	% RH					
9	510	25.3	28	32.2	61	31	67	30.6	64	33.7	2.3	0.00915	77.3738	9.4821
10	750	31.5	24	54.1	57	52.6	64	50.4	55	55.4	2.4	0.00813	195.6863	16.3072
11	895	33.7	22	62.5	53	61.8	59	58.2	51	64.9	2.5	0.00813	255.4567	17.8392
12	976	34.5	21	76.3	43	73.8	54	68.6	50	77.9	2.7	0.0078	340.5406	21.8072
13	1003	36.2	20	79.2	33	75.6	41	69.8	36	80.3	2.6	0.00881	391.168	24.3749
14	1024	37.3	19	80	29	76.3	38	69.9	34	81.6	2.4	0.00813	362.7157	22.1384
15	870	34.8	21	77.1	33	72.8	44	64.5	38	77.9	2.3	0.0078	338.1867	24.2950
16	693	32.5	22	69.4	37	67.2	48	62.7	40	71.2	2.2	0.00746	290.4591	26.1958
17	530	30.1	26	61	42	56	47	51	44	62.5	2.2	0.00746	243.1751	28.6763
18	390	25.3	32	44.2	47	40.1	47	38.1	47	43.9	2.5	0.00847	158.6369	25.4226

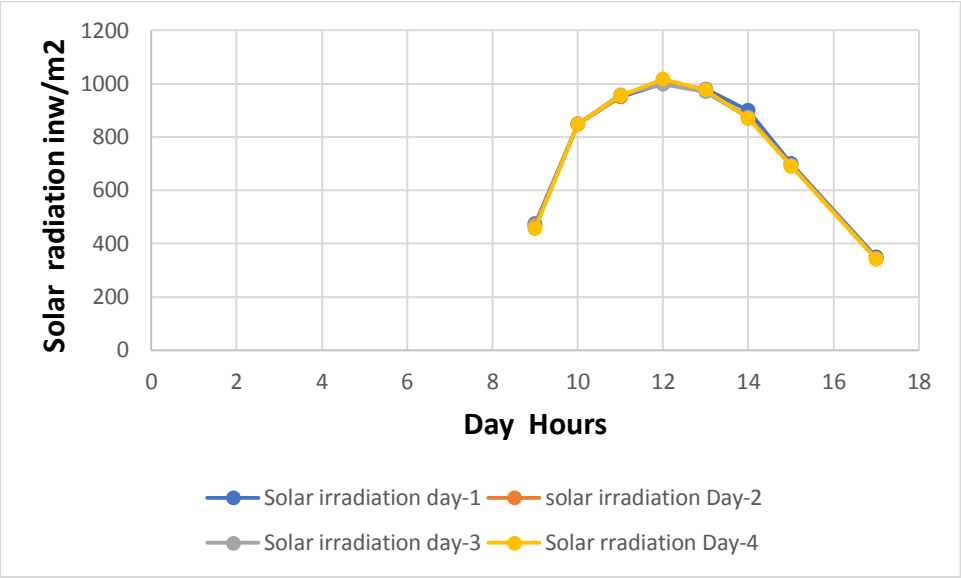

Figure 4: Diurnal variation of the solar radiation for test days.

The above figure 4 show the Diurnal variation of the solar radiation for test days.it show the Solar irradiation in four day. The graph is Day Hours verse Solar radiation inw/m2. Here see the Solar radiation is almost same in four days

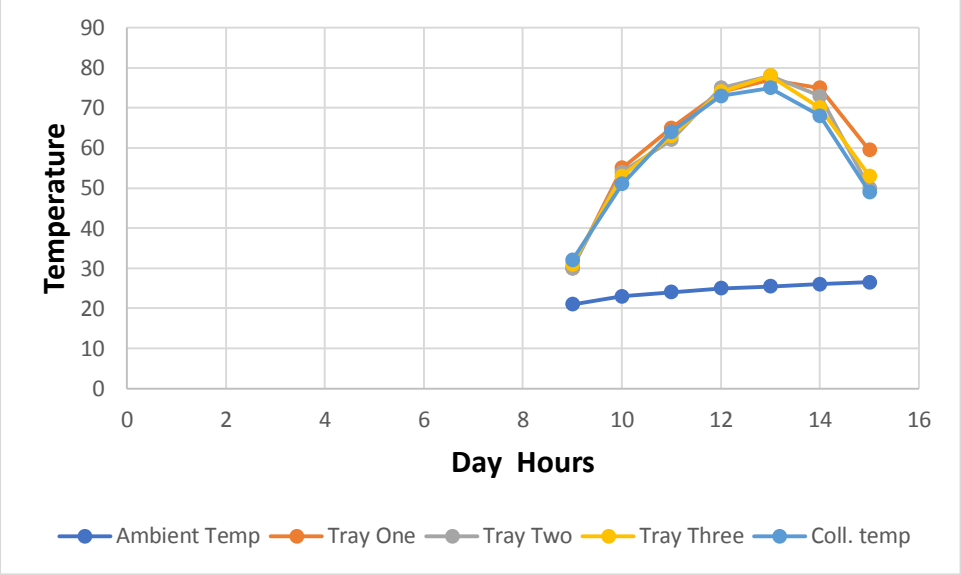

Figure 5: Temperature distributions in the solar dryer

The above figure 5 show the Temperature distributions in the solar dryer. The graph is Day Hours verse temperature.

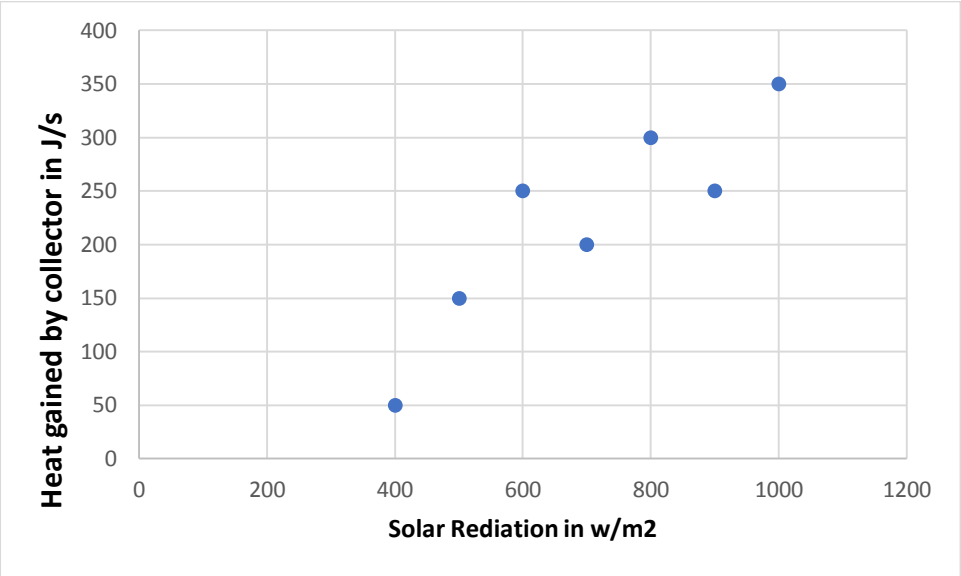

Figure 6 Heat gained Vs solar radiation

The above figure 6 show the Heat gained Vs solar radiation. The value are showing the dots.

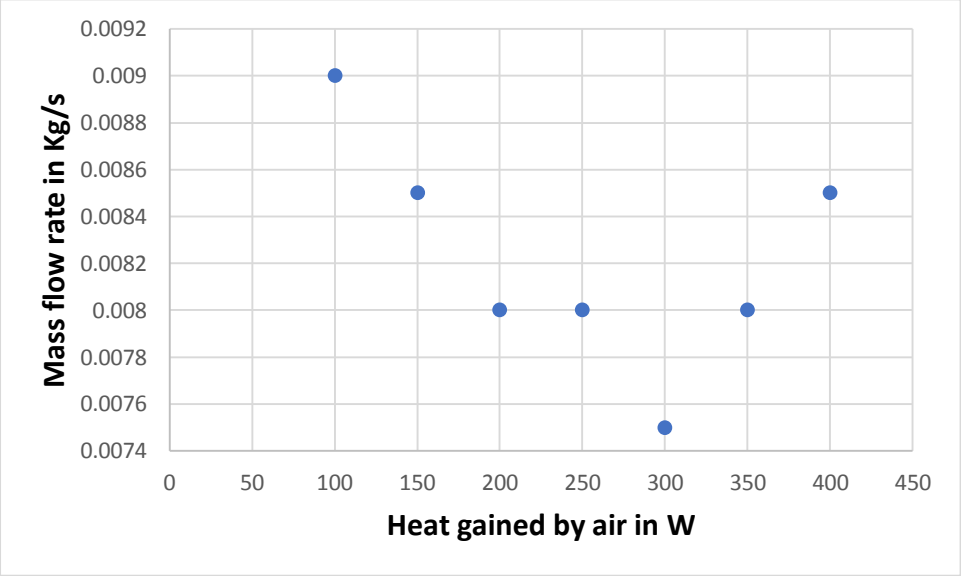

Figure 7: Mass flow rate Vs heat gained by the working fluid

The above figure 7 show the Mass flow rate Vs heat gained by the working fluid. The value are showing the dots.

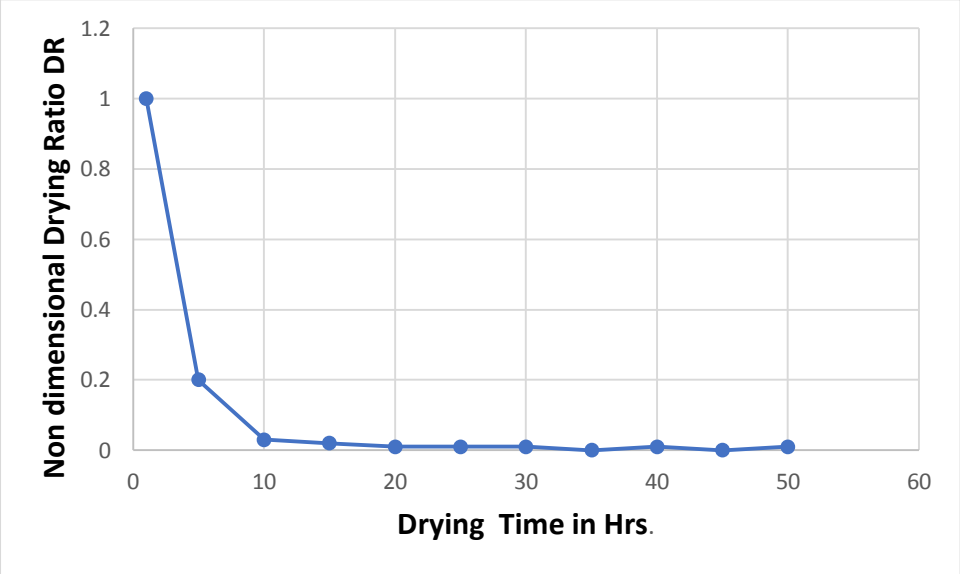

Figure 8: Non dimensional drying rate Vs drying time

The above figure 8 show the Non dimensional drying rate Vs drying time. The Non dimensional drying rate is constant at particular point(zero).

V. REFERENCES

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