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INDIRECT FORCED SOLAR THERMAL DRYING WITH ENERGY GENERATION FOR DRYING THE MANGO CUTS AND KASOORI METHI

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Abstract:
The solar drying system gives duel benefit of solar drying as well as the solar electric energy generation. It includes the photovoltaic panel for energy generation. Due to forced air circulation it works in low temperature which results in increase in efficiency and life of panel also. In present research, we apply this technique for the Mango Cuts and Kasoori Methi for study the drying rate. The method applied for present study is indirect solar drying. The main objective of present study is to study the accuracy and control mechanism of indirect solar dryer. Finally we observed that, by using indirect forced convection method we got the good quality of the fruits for the longer time.
Keywords: Drying, Mango Cuts, Kasoori Methi, Solar Thermal Dryer.

Introduction

Solar energy is free energy and pollutant free with easily conversion into heat energy. It is very demanding, attractive and abundant form of energy. Now days there is huge demand for the dried food products and marine products in the market. For preservation of food products several methods such as drying, controlled atmosphere, refrigeration and dehydration are used across the world [7]. According to Teo et al. [3] air cooling for reducing PV panel temperature increases the efficiency of the PV panel. Because the electron permeability of silicon decreases when it works at high temperature and comes again at previous temperature. So increase in temperature also decreases the durability of P.V. Panels here we can get a heat output from the panel since only 20-25% solar energy is conversed into electric energy and other is converted into heat energy and it is about 60-65 %.[2]. In the present study we used this energy for drying the products of Mango cuts and Kasoori Methi by using the indirect forced solar dryer.

Material and Method

The schematic diagram of the indirect forced solar thermal dryer used for experiment shown in Figure 1.

Here we use solar panel in place of the glass in solar collector, because the solar collector only use for heat absorption. The solar panel gives us electric energy as well as excess energy is converted into heat energy. This heat energy is results in the increase in temperature of solar panel. Thus the air below the panel heats and that heated air are forced to the cabinet by means of preinstalled blower. By passing this continuous hot air in cabinet, cabinet temperature will increases. Finally the hot air comes out to the atmosphere with some humid particles [4]. From the above design we get easily control on temperature of air cabinet by regulating the speed of air flow. Since the products are kept in close cabinet colour of products should remain same. It also gives the advantage of safety from the rain and wind, prevention from the dust also provided by it. Forced convection helps us to increase the drying rate of product [1].

The data logger system having temperature sensors, humidity sensors, irradiation sensors, flow sensors, weight sensors, ammeter and voltmeter are used for the get continuous readings of the system for necessary calculations [5]. By knowing the weight of the products we can get the idea of how much product dries and the voltage and current are gives the power consumption [8]. For knowing the power generation we use the water pumping motor. The data logger gives a data to the remote computer with the help of Xbee system. As per product information of solar panel in 25^0 C temperatures and at 600 watt/m^2 radiation the 50 watt panel gives 60% power means 30 Watt power we get. So we required to select the blower below the 30 watts [6]. We needed only 0.003-0.008 kg/sec air flow which can be forced using 12 watt blower. So remaining energy is available to external use. The dimensions of the cabinet are as below. Calculation- Volume of air in cabinet is calculated by, V= L * B * H. Where V=36.1 lit. Where, V is volume of cabinet in lit., L is length of cabinet in mm. and B is width of cabinet in mm. H is height of cabinet in mm.

Table 1 Details of cabinet

Size	Length-380mm., Height-380 mm. and Width-250 mm.
Material	M.S.GI Sheet 0.4mm.
Insulator	Glass wool and Thermocol
Tray size	Length-295mm and Width-172mm
No. of trays	2

Result

3. Result Sample 1 mango slice. Date- 23/3/2017, Start Time- 7.20AM, End Time- 4.00PM

Table 2 Testing Results of Sample 1 mango slice

Time	Irradiation Watt/m²	Temp of Cabinet °C	Weight of product grams	voltage	Current	Power	Eng. prod. Watts* in hours
7:20	23	10.9	336	0.00	0.00	0	0.000
7:30	62	11.4	334	0.00	0.00	0	0.000
7:40	106	12.4	332	5.4	0.14	0.756	0.126
7:50	127	13.4	330	5.9	0.20	1.18	0.161
8:00	154	14.5	328	5.9	0.22	1.298	0.206
8:20	231	15.3	320	11.2	0.41	4.592	0.982
8:40	303	16.3	310	13.4	0.50	6.7	1.882
9:00	365	17.3	305	15.4	0.54	8.316	2.503
9:20	421	19.8	300	16.1	0.62	9.982	3.049
9:40	475	23.2	290	18.9	0.79	14.931	4.152
10:00	531	27.4	280	19.6	0.87	17.052	5.330
10:20	585	30.6	250	19.7	0.86	16.942	5.666
10:40	638	33.6	220	20.3	0.76	15.428	5.395
11:00	677	35.6	200	20.3	0.83	16.849	5.380
11:40	765	39.7	185	21.2	0.73	15.476	5.388
12:00	825	43.8	160	21.3	0.76	16.188	5.277
12:20	834	47.4	140	21.2	0.74	15.688	5.313
12:40	852	52.3	116	21.2	0.73	15.476	5.194
13:00	834	48	105	21.2	0.72	15.264	5.123
13:40	784	47.2	80	21.2	0.79	16.748	10.67
14:00	763	45.4	75	21.1	0.80	16.88	5.605
14:40	686	44.5	73	20.9	0.76	15.884	10.921
15:00	574	45	71	18.7	0.74	13.838	4.954
15:40	510	46.5	69	16.7	0.72	12.024	8.621
16:00	374	45	68	11.4	0.71	8.094	3.353

Table 3 Testing Results of Sample 2 Kasoori Methi

Time	Irradiation	Temp. of cabinet	Wt. of prod.	Voltage	Current	Power	Eng. prod. Watts* in hours
7:20	41	8.2	257	0.00	0.00	0.00	0.00
7:30	44	8.3	257	0.00	0.00	0.00	0.00
7:40	50	8.8	257	0.00	0.00	0.00	0.00
7:50	56	10.7	255	0.00	0.00	0.00	0.00
8:00	65	11.5	253	0.00	0.00	0.00	0.00
8:20	80	14.4	251	0.00	0.00	0.00	0.00
8:40	386	15.3	249	18.9	0.79	14.93	2.49
9:00	450	16.5	247	19.6	0.80	15.68	5.10
9:20	479	18.1	245	19.8	0.79	15.64	5.22
9:40	591	20.9	243	16.5	0.97	16.01	5.27
10:00	735	21.5	239	21.0	0.92	19.32	5.88
10:20	802	27.9	234	21.1	0.78	16.46	5.96
10:40	821	32.4	229	21.3	0.76	16.19	5.44
11:00	847	34.5	224	21.2	0.75	15.9	5.348
11:40	906	37.4	217	21.2	0.87	18.44	5.72
12:00	937	42.5	210	21.3	0.89	18.96	6.23
12:20	957	45.8	199	21.3	0.92	19.60	6.43
12:40	932	44.2	184	21.3	0.91	19.38	13.00
13:00	941	47.8	169	21.2	0.90	19.08	6.40
13:40	897	49.9	153	20.9	0.89	18.60	12.56
14:00	735	46	139	20.9	0.87	18.18	6.13
14:40	855	45.4	127	21.2	0.73	15.48	11.21
15:00	778	45.5	114	21.2	0.72	15.26	5.12
15:40	689	43.2	109	20.9	0.76	15.88	10.38
16:00	579	42	108	18.7	0.78	14.59	5.07

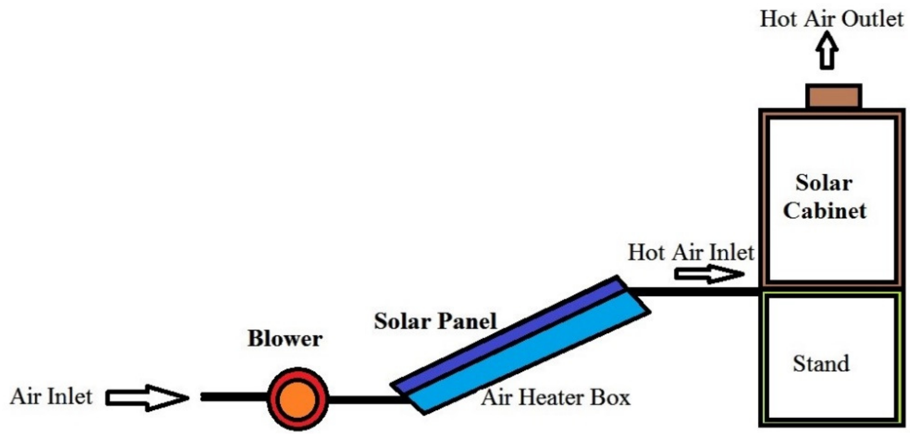

Figure 1 Design of the system

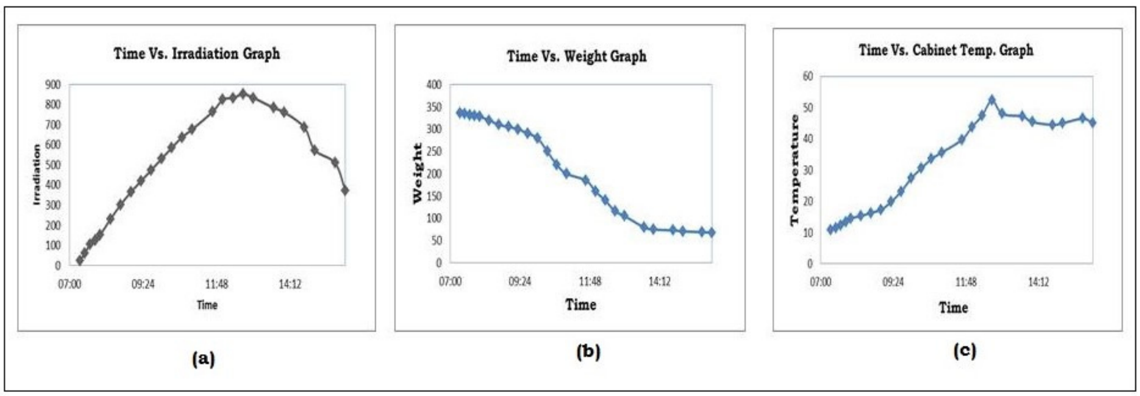

Figure 2 Sample 1 Graph of (a) Time against Irradiation, (b) Time against Weight and (c) Time against Cabinet Temperature.

Sample 2. Kasoori Methi. Date- 28/3/2017, Product- Kasoori Methi, Start Time- 07.20 and End Time- 16:00

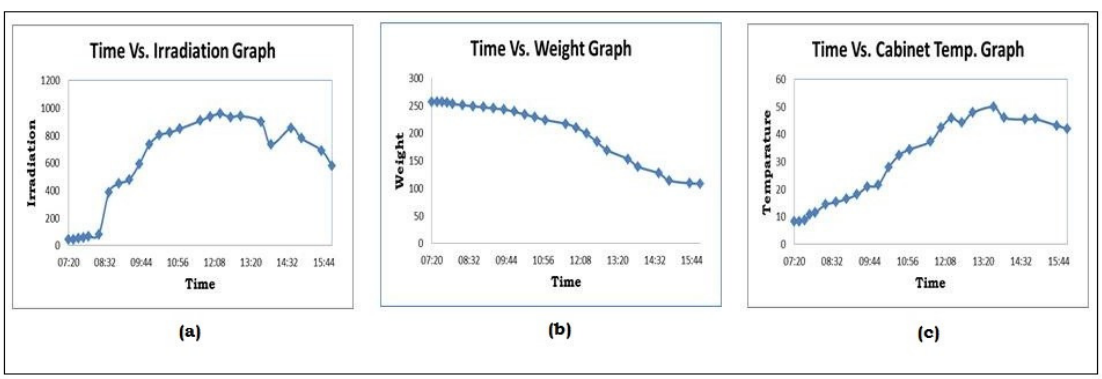

Figure 3 Sample 2 Graphs of (a) Time against Irradiation, (b) Time against Weight and (c) Time against Cabinet Temperature.

Conclusion

Doing this project we done lot of readings, from analysing these readings we can conclude that the System gives the use of electrical energy as well as the thermal energy to the farmers free of cost. This system Dry the products whose temperature of drying is in between 30-80 °C. This system give 68 ° C temperature using 0.3 m^2 and that can be increased above it. The forced convection cooling of solar panel gives more cooling than natural cooling and here we reduce up to 10-12 °C. The average temperature of Drying cabinet is in between 40-50 °C. By regulating the blower speed we can regulate the moisture removal rate. Using this system the Colour, Aroma and Test remains nearly as it is. The drying is more efficient from 11.00-15.00 as per local day time.

References

Adolfo G. Finck-Pastrana, (2014),"Nopal (OpuntiaLasiacantha) drying using indirect Solar Dryer", ScienceDirect, Energy Procedia 57 2984 – 2993.

Bulent Yesilata, Z. AbidinFiratoglu. (2008). "Effect of solar radiation correlations on system sizing: PV pumping case", Elsevier, Renewable Energy 33 155–161.

H. G. Teo, P. S. Lee, M.N.A Hawaldar, ELSEVIER, Applied Energy, 90(2012)309-315.

Kamran Moradi, M. Ali Ebadian, Cheng-Xian Lin, (2013). "A review of PV/T technologies: Effects of control parameters", Science Direct, International Journal of Heat and Mass Transfer 64 483–500.

Pratidnya P. Desai, Rohini R. Dhanawade, Rahul N. Nitturkar, Vikas S. Mane (2017). "Monitoring of Solar Water Pumping System". International research journal of engineering and technology. ISSN: 2395 -0056

R. K. Koech, H. O Ondieki, J. K. Tonui, S. K Rotich (2012) "A steady state thermal model for photovoltaic/thermal (pv/t) system under various conditions". International journal of scientific & technology research. ISSN 2277-8616.

S. P. Sukhatme, and J. K. Nayak. Solar Energy Principles of Thermal Collection and Storage,(2008) 3rd Edition,Tata McGraw hill.

Samira Chouicha, Abdelghani Boubekri. Mohamed, HafedBerrbeuh, (2013), Solar Drying of sliced potatoes. An experimental Investigation", Energy Procedia. 36 pp.1276 –85.