www.ijiarec.com

ISSN:2348-2079

MAR-2016

IJIAREC

International Journal of Intellectual Advancements and Research in Engineering Computations

EXPERIMENTAL ANALYSIS OF SOLAR AIR DRYER USING ROOF SHEET AS HEAT ABSORBER FOR CHILLI DRY

[1]K.Madhan, [2]K.Mohankumar M.E., MBA.,

ABSTRACT

Drying of agro products in open air is reducing the quality losses. The direct sunlight drying process take long time and it's subjected to attack by the weather, animals and insects. It's also affect the quality, quantity and nutrition value of the food products. So use the solar dryer to dry the agricultural products. At, present renewable energies are increased energy efficiency play an important role in energy politics. Renewable energies are an important approach to reduce the environmental effect. So to use the solar energy to dry the agricultural products.

This project aim is investigate the performance of solar dryer using semi-circular solar absorber with heat storing materials and thermal analysis of the solar absorber plate. This project designed such a way that solar radiation is not incident directly on the food product. The sunlight is absorb by the solar absorber (GI) plate, and heat is send through (GI) tube by forced convection and electric air blower to dry the agricultural products in drying chamber. The (GI) is immersed in heat storing materials (charcoal or gravels).This heat storing materials store the heat at sun shining and transfer the heat to drying chamber to dry the agricultural products.

INTRODUCTION

Basically, the drying implies the partial removal moisture or water from the material. But when fuel fired equipment is used in the process the term dehydration is often applied. Sun has the potential to become the primary source of energy in every field of applications. Presently, solar energy is emerging the source of energy and solar drying is one of its important applications. Solar drying is frequently confused with sun drying, which is most wide practiced agricultural drying operation in the world. The direct exposures to sunlight, or more precisely ultraviolet radiation, can greatly the level of nutrients such as vitamins in the dried products. Increasing labor cost, improving quality standards and sometimes uncertain climates lead to the constructions of artificial dryers. These dryers are capable of providing a high quality product independent of the weather and with a low labor requirement. They are not, however intrinsically suitable for the small scale former or the majority of agro industries in developing countries. One of the common methods suitable for the farms of developing countries is solar drying. This method has several advantages such has less spoilage and less micro- biological infestation, thus leading to improved and more consistent quality. Solar drying can also be a feasible alternative to those natural convection dryers that use wood or agricultural

Author for correspondence:
[1]PG Scholar, Department of Mechanical Engineering, Thermal Engineering, Jayam College of Engineering & Technology, Dharmapuri, TN.
[2]Assistant Professor, Department of Mechanical Engineering, Jayam College of Engineering & Technology, Dharmapuri, TN.

waste products as fuel. The saving of wood would probably be the main attraction of solar dryers.

OBJECTIVE OF THE PROJECT

The objective of this project is tofind the efficiency of solar dryer by using solar energy source as well as GI roof sheet as a heat absorber.

To find the thermal performance of the GI semi-circular shape roof sheet.

To find the drying efficiency of solar dryer, without heat storing materials and with heat storing materials.

SOLAR ENERGY AND ITS APPLICATIONS

Solar energy has the greatest potential of all the sources of renewable energy and if only a small amount of this form of energy is used, it will be one of most important supplies of energy especially when other sources in the country have depleted. Energy comes to the earth from the sun. This energy keeps the temperature of the earth above that in colder space, causes current in the atmosphere and in the ocean, causes the water-cycle and generates photosynthesis in plants.

The solar power where sun hits atmosphere is 1017 watts, whereas the solar power on earth‘s surface is 1016 watts. The total world-wide power demand of all needs of civilization is 1013 watts. Therefore, the sun gives us 1000 times more power than we need. If we can use 5% of this energy, it will be 50 times what the world will require. The energy radiated by the sun on a bright sunny day is approximately 1 kW/m^2, attempts have been made to make use of this energy in raising steam which may be used in driving the prime movers for the purpose of generation of electrical energy.

Solar energy refers primarily to the use of solar radiation for practical ends. All other renewable energies other than geothermal and tidal derive their energy from the sun. Solar technologies are broadly characterized as either passive or active depending on the way they capture, convert and distribute sunlight. Active solar techniques use photovoltaic panels, pumps, and fans to convert sunlight into useful outputs. Passive solar techniques include selecting materials with favorable thermal properties, designing spaces that naturally circulate air, and referencing the position of a building to the Sun. Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies.

The applications of solar energy which are enjoying most success to-day are:

1. Heating and cooling of residential building.
2. Solar water heating.
3. Solar drying of agricultural and animal products.
4. Solar distillation on a small community scale.
5. Salt production by evaporation of seawater or inland brines.
6. Solar cookers.
7. Solar engines for water pumping.
8. Food refrigeration.
9. Bio conversion and wind energy, which are indirect source of solar energy.
10. Solar furnaces.
11. Solar electric power generation by –
    - Solar ponds.

K.Madhan, K.Mohankumar, et al., Inter. J. Int. Adv. & Res. In Engg. Comp., Vol.–04 (03) 2016 [143-149]

- Steam generators heated by rotating reflectors (heliostat mirrors), or by tower concept.
- Reflectors with lenses and pipes for fluid circulation

SOLAR DRYER

A solar dryer transparent are translucent walls is designed to transmit the largest percentage of the incident solar energy into the dryer. Surfaces are painted dull or black so that as much of the transmitted energy as possible is a absorbed. When this energy is absorbed, the absorbing surfaces are heated. Energy is the air in the drier, primarily by convection. The air is passed through electrical blower. Then transfers energy to the lumber where it evaporates the water from the food. However, this process of converting solar energy into evaporating and moving water is not very efficient. As an example, about one million BTU are required to dry 1200 board feet of lumber from fifty percent to twelve percent moisture content. At fourth Collins Colorado , a horizontal solar energy collector solar dryer roof with an efficiency of hundred percent and an area of twenty square feet, could collect 1 million BTU in two typical summer days are 5 typical summer winter days. On other hand it estimated that the solar dryer at fort Collins, with roof area of about 200 square feet. Would take almost a week in summer and over two week in winter to dry 1200 board feet from 50 to 12% the major question is where is the incoming solar energy going if it is not being used to dry the lumber.

According to experimental approach theory, the gain in solar dryer can be expressed as:

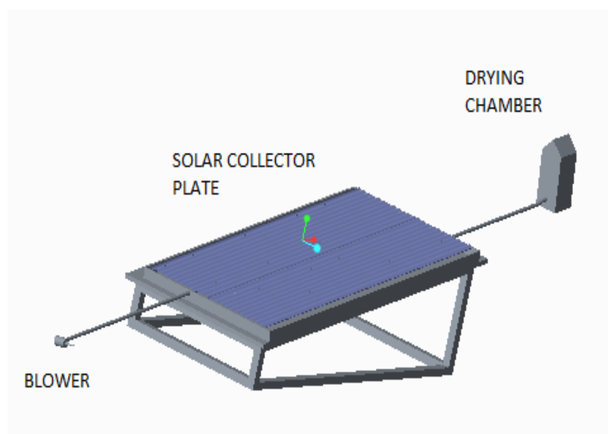
1. Incident solar energy
2. Incident long wave or infrared energy
3. Drying power or internal energy of the air entering through the vents.

The losses in the solar dryer can be expressed as:

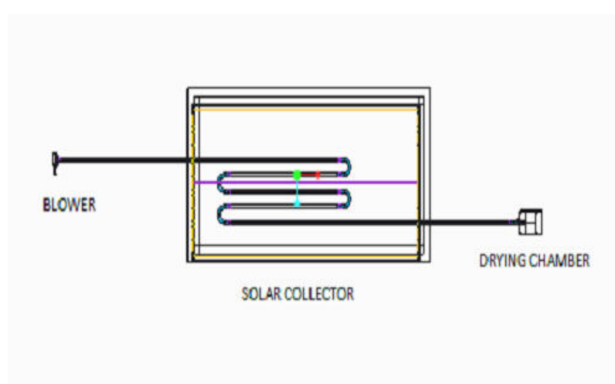
1. Changes in temperature of material
2. Changes state of food

By using the imaginary boundary or energy balance approach , the gains must equals the energy losses plus the increases energy of material in the enclosed volume, if the measurements do not confirm this equality, then either the significant energy term has been omitted accurately.

EXPERIMENTAL SETUP PRO-E MODEL



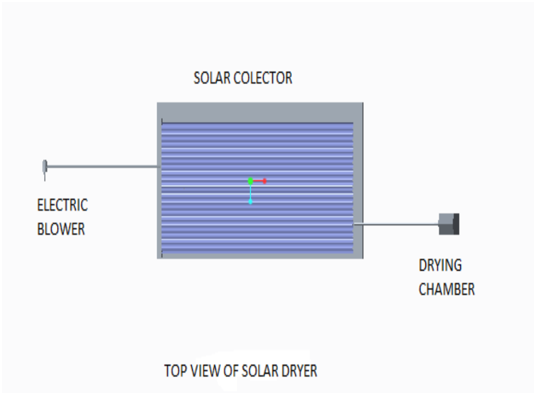
2D DIAGRAM OF SOLAR DRYER



2D DIAGRAM OF SOLAR DRYER

K.Madhan, K.Mohankumar, et al., Inter. J. Int. Adv. & Res. In Engg. Comp., Vol.–04 (03) 2016 [143-149]

TOP VIEW OF 3D DIAGRAM SOLAR DRYER



SPECIFICATION

Material use =GI sheet

Thickness of materials =0.6mm

Convective heat transfer coefficient=392w/m^2k

Speed of blower =900rpm

Blower capacity =0.2kw

Specific gravity of air =9.81m^2/s

Density of air = 1.096kg/m^3

EFFICIENCY CALCULATION FOR THE COLLECTOR

Collector Area And Dimension

Length of the sheet metal =2m.

Width of the sheet metal =1m.

Area the collector surface =l×b

=2×1 =2m^2

Pipe Area And Dimension

Pipe inner diameter d_i =0.016m

Pipe outer diameter d_o =0.020m

Diameter of the pipe d =d_1+d_2/2

=(0.016+0.02 0)/2

d =0.018m.

Mass flow rate m= ρ.V

m= ρ v A

Heat Transfer

$q=m.c_p(T_2-T_1)$

Here

c_p=Specific-heat

=1.005kJ/kg.k

SCOPE OF FUTURE WORK

To calculate the performance of semi-circular shape solar absorber plate with using heat storing materials.

And to make the thermal analysis of the solar absorber plate using any software.

RESULT AND DISCUSSION

A roof sheet integrated solar dryer was designed and fabricated. And using solar dryer dry the green chilli, it's initial moisture content is 78%,it's moisture content is reduced in two days drying process. The fabrication setup size (length 2m,width 1m),total collector plate area 2m^2.

K.Madhan, K.Mohankumar, et al., Inter. J. Int. Adv. & Res. In Engg. Comp., Vol.–04 (03) 2016 [143-149]

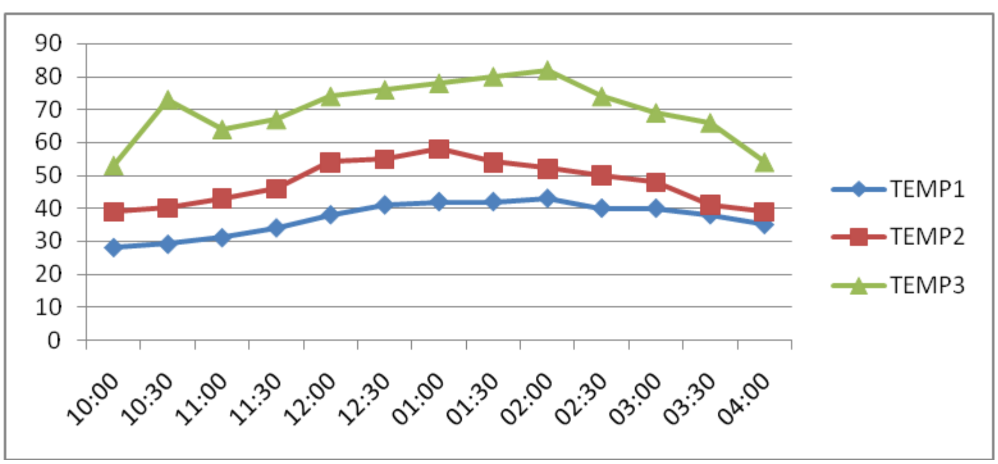
TABULATION

DAY 1

Time	T_1	T_2	T_s	T_{amp}	solar radiation			
	°c	°c	°c	°c	I1	I2	I3	I average
10.00	28	39	53	33.9	213	380	103.3	232.10
10.30	29	40	73	29	564	610.6	951.3	708.63
11.00	31	43	64	29	740	860	1227	942.33
11.30	34	46	67	29	917	949	1265	1043.67
12.00	38	54	74	30	929	947	1272	1049.33
12.30	41	55	76	31	1047	1067	1215	1109.67
13.00	42	58	78	31.3	1050	1161	1242	1151.00
13.30	42	54	80	32	1130	1200	1220	1183.33
14.00	43	52	82	33	1218	1215	1238	1223.67
14.30	40	50	74	32	1185	1220	1080	1161.67
15.00	40	48	69	32	1170	1150	819	1046.33
15.30	38	41	66	30	1092	1104	1030	1075.33
16.00	35	39	54	30	990	940	943	957.67
16.30	32	36	45	30	901	850	860	870.33
17.00	29	34	37	30	789	730	706	741.67
17.30	28	30	33	28	178	256	193	209.00

GRAPH: DAY 1

CHILLI DRY



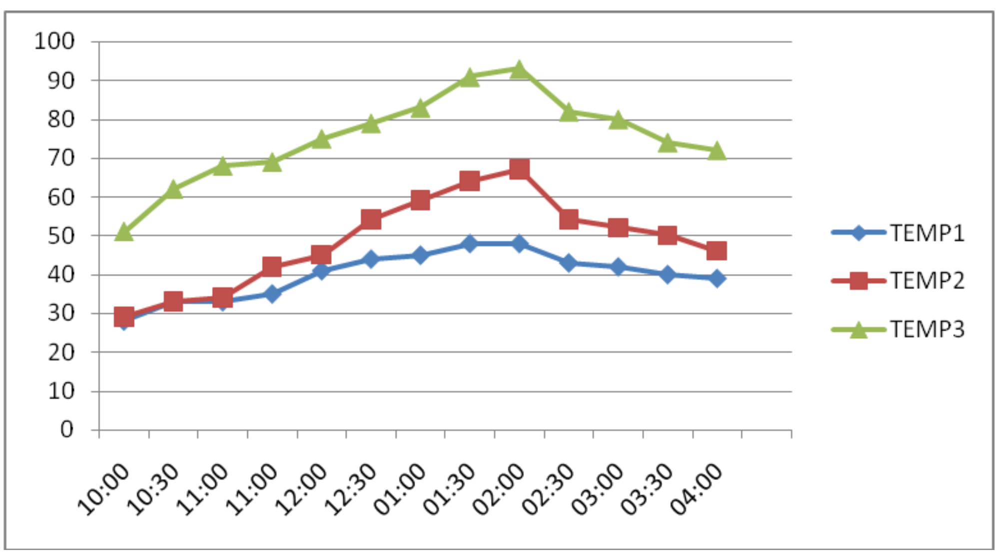
K.Madhan, K.Mohankumar, et al., Inter. J. Int. Adv. & Res. In Engg. Comp., Vol.–04 (03) 2016 [143-149]

DAY 2

Time	T_1	T_2	T_s	T_{amp}	solar radiation		
	°c	°c	°c	°c	I1	I2	I3
10.00	28	29	51	33	654	721	750
10.30	33	33	62	28	827	880	943
11.00	33	34	68	29	933	995	1002
11.30	35	42	69	30	985	1072	1093
12.00	41	45	75	30.5	112	1130	1192
12.30	44	54	79	31	993	1020	1102
13.00	45	59	83	31	1174	1223	1240
13.30	48	64	91	32	1251	1259	1259
14.00	48	67	93	32.3	1180	1172	1150
14.30	43	54	82	33	1115	1170	1162
15.00	42	52	80	34	1127	1073	1172
15.30	40	50	74	31	1050	1062	1085
16.00	39	46	72	31	997	982	960
16.30	39	41	52	30	890	872	900
17.00	34	37	44	30	684	714	824
17.30	34	31	39	29	530	580	525

GRAPH: DAY 2

CHILLI DRY



REFERENCE

[1]. P. Tung "Performance of a solar dryer using hot air from roof-integrated solar collectors for drying herbs and spices".

[2]. PannaLal Singh "Silk cocoon drying in forced convection type solar dryer".

[3]. P.N. Sarsavadia "Development of a solar-assisted dryer and evaluation of energy requirement for the drying of onion".

[4]. Franz Roman a "Potential of roof-integrated solar collectors for preheating air at drying facilities in Northern Thailand".

[5]. V.P. Motulevich "solar installations for drying agricultural produce in Turkmenistan".

[6]. M. A. Karim "An Efficient Solar Dryer for Agricultural Products".

[7]. A.K. Kamble I.L.Pardeshi "Drying of chilli using solar cabinet dryer coupled with gravel bed heat storage system" .

[8]. A. Sreekumar "Techno-economic analysis of a roof-integrated solar air heating system for drying fruit and vegetables".

[9]. V. Shanmugam E. Natarajan "Experimental investigation of forced convection and desiccant integrated solar dryer".

[10]. V. Ion G. Martins "Design, developing and testing of a solar air collector".