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DESIGN MODEL FOR SOLAR PARABOLIC COOKER CONSTRUCTED FROM LOCALLY AVAILABLE MATERIAL

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Abstract

There is a need to reduce the dependence on firewood and biomass energy for cooking because it causes deforestation; by providing other alternative form of energy such as solar energy. Solar energy is an energy from the sun. It is the most abundant source of energy available in nature. It is available freely every day. In this study a solar parabolic cooker was designed from a parabolic dish. This helps to convert sunlight into thermal or heat energy for cooking. A parabolic dish of 90cm diameter was constructed at Covenant University Sango Otta, Ogun state at latitude 6.6718ºN and longitude 3.1581ºE during the month of April, 2018. The results show that the open air temperature varies from 32℃ to 35℃ and the temperature of the cooking pot varies from 30.5℃ to 44℃. It also shows that solar parabolic cooker is a renewable source of energy which is vital for places associated with high temperature.

1.0 INTRODUCTION

Solar parabolic cooker was first set up by Ghai in the 1950s at the National Physical Laboratory, in India [1]. Lof and Fester then explored numerous geometries and rising formations of parabolic cookers [2]. Use and application of renewable energy in which solar cooking one of the renewable energy is becoming easily accessible [3]. People all over the world are increasingly attracted to solar cook whereby people are able to cook on days with high solar intensity, their homes, kitchens will be left smoke free and they can be healthier[4].Factors affecting the effectiveness of a solar cooker which are: the Intensity of the sun, the sun angle and also the materials used. Due to the climate condition, it may take a longer time for a solar cooker to cook than normal conservative means [5] Many types of easily built solar cookers are available such as box-type solar cooker, solar panel cooker, solar funnel cooker, solar parabolic cooker. When incident solar radiation have temperatures up to 150℃, purification of water and baking of cake and bread can be done by this type of cooker[6]. The high energy photons absorb by a reflector and the incident solar energy converts it into thermal heat by the process of thermodynamics effect [7], [8]. At higher temperatures the radiation losses becomes more dominant [9]. In the case of solar parabolic cooker high temperatures and highly concentrated light reflected on the surface. Cooking is fast and nearly as fast as conventional cookers. It is sometimes not so easy to use because of gradual turning to track the sun [10]. High temperature can be obtained in a very short time. To make good use of solar parabolic cookers, good and high temperatures and weather conditions are necessary [11].

Theory

G is the amount of illumination intensity falling on the solar cooker of area A,

the amount of energy received by the solar cooker (E_{in}) is calculated by the following expression:

E_{in}. In time $\Delta t = GA\Delta t$ (1)

From this point of view,

Energy output of the solar cooker (E_{out}) is given as follows:

$E_{out} = M_w C_{pw}(T_{wf} - T_{wt})$, $E_{out} = M_w c_{pw}(T_{wf} - T_{wt})$ (2)

Where M_w is the mass of water in the cooking vessel, C_{pw} is the specific h eat capacity of the water, T_{wf} is the final water temperature and T_{wi} is the initial water temperature. ,

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After determining the input and output energy expressions for the solar cooker, energy efficiency can be calculated by the following expression: Efficiency of a solar cooker=

$$\eta = \frac{GA\Delta t}{MwCpw(Twf-Twt)}$$ [12] (3)

METHODOLOGY

Plywood, Wood and Aluminum foil are used to make a solar parabolic cooker

The plywood is divided into 15 flat parts making it easy for bending it into a parabolic disc shape.

PLATE 1: Dividing plywood for construction of parabolic dish into 15 equal parts

PLATE 2: Construction of parabolic

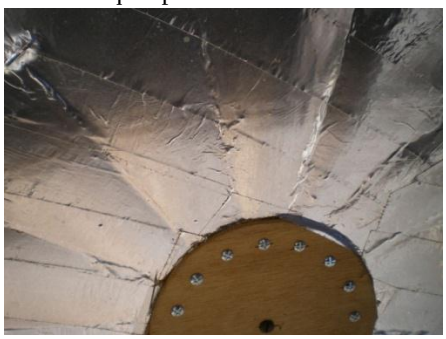

PLATE 3: Adding aluminum foil to the

Bamboo rings were used to hold the edges of the plywood together.. Bamboo rings were used here at the edges of the parabolic plywood to make it firm and tight. Wood is now caved in the shape of the plywood. Aluminum foil is spread and fixed with gum to the surface of the parabolic shape wood.

The cooking pot is placed at the focal point of the parabola dish so that the cooking pot can receive the maximum solar radiation concentration available at the focal point of the parabolic dish

PLATE 4. A SOLAR PARABOLIC COOKER

TABLE 1: SHOWING THE TIME OF THE DAY, TEMPERATURE OF THE COOKING POT, OPEN AIR TEMPERATURE AND ROOM TEMPERATURE

S/NO	TIME OF DAY℃	TEMPERATURE OF COOKING POT℃	OPEN AIR TEMPERATURE ℃	ROOM TEMPERATURE℃
1	11:02	31	34	32
2	11:05	30.5	34	31.5
3	11:08	31	33	31.5
4	11:11	31.5	34	31
5	11:14	32	34	31
6	11:17	32	32.5	31
7	11:20	32.5	34	32
8	11:23	33	34	32
9	11:26	33	34	32
10	11:29	34	35	32.5
11	11:32	33.5	34	32
12	11.35	35	35	32.5
13	11:41	35.5	34.5	32
14	11.44	36	34	32.5
15	11.47	36	33	32
16	11.50	36	32.5	31.5
17	11.53	36	32	32
18	11.56	36.5	33	32
19	11.59	37	33	32
20	12:02	37	32.5	32
21	12:05	37	33	31.5
22	12:08	37	34	32
23	12:11	37.5	34	31
24	12:14	38	34	32
25	12:17	38.5	34	32
26	12:20	39	34	33
27	12:23	40	34	33
28	12:26	40	34	32.5
29	12:29	40	34	32
30	12:31	40	34.5	33
31	12:34	40	34.5	32.5
32	12:37	41	35	33
33	12:40	41	34	32.5
34	12:43	41	34	33
35	12:46	41	34	32
36	12:49	41	34	33
37	12:52	41	34	33
38	12:55	40	33	32
39	12:58	41	34	32.5
40	1:01	42	35	33
41	1:04	42	34	33
TABLE 1:Cont.				
42	1:07	42	43	32.5
43	1.10	43	34	33
44	1.13	43	34	34
45	1.16	44	35	33
46	1:19	44	33	34
47	1.22	44	33	34
48	1.25	44	34	34
49	1.28	44	35	34
50	1.31	44	34	33
51	1.34	45	33	33
52	1.37	45	33	33
53	1.40	46	33	33
54	1.43	47	32	32
55	1.46	47	32	32
56	1.49	47	33	32
57	1.52	48	33	32
58	1.55	48	33	33
59	1.58	48	33	32
60	2.01	48	34	32
61	2.04	49	34	32
62	2.07	50	34	32
63	2.10	51	34	33
64	3.13	51	34	32
65	2.15	52	34	32
66	2.18	52	34	32
67	2.21	53	34	32
68	2.24	54	34	32
69	2.27	55	34	32
70	2.30	56	34	32
71	2.33	56	34	33
72	2.35	57	34	33
73	2.38	57	34	33
74	2.41	58	34	33
75	2.44	58	34	33
76	2.47	59	34	33
77	2.50	58	34	33
78	2.53	58	34	33
79	2.56	58	34	33
80	2.59	59	34	33
81	3.02	59	35	33
82	3.05	60	35	33
83	3.10	60	34	33
84	3.15	60	34	33
85	3.20	56	34	32
86	3.25	56	33	33
87	3.30	56	33	33
88	3.35	40	33	32
89	3.40	40	34	32
90	3.45	40	32	32
91	3.50	45	32	32
92	3.55	45	32	32
93	4.00	45	32	32

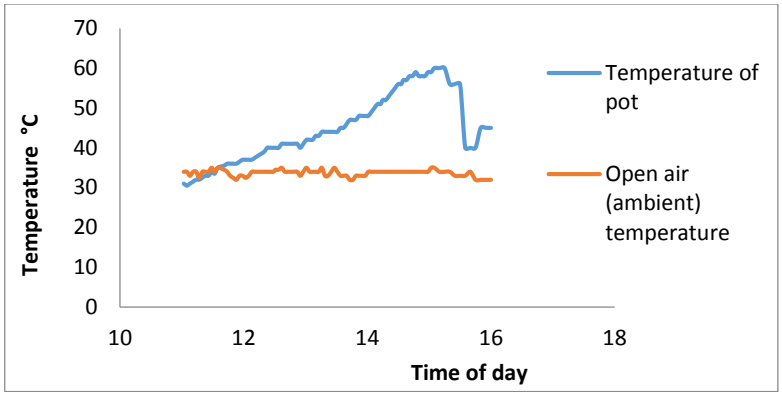

FIG. 1. A GRAPH SHOWING THE TEMPERATURE OF THE COOKING POT AND OPEN AIR TEMPERATURE AGAINST TIME

CONCLUSION

From the graph of Time of the Day against the Temperature of cooking pot, open air temperature and room temperature; it can be concluded that the temperature of the cooking pot varies proportionately along the temperature of the day. The temperature of the cooking pot is lowest in the morning at11:05 (30.5℃) and highest between 3.05 (60℃) and 3.10 (60℃) in the afternoon and that of the open air temperature varies from 35℃ to 34℃

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