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Comparative Analysis of Solar Cooker with Finned Cooking Pot and Finned cooking pot with Reflector.

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Abstract
This study presented a short review on the Box type solar cooker. Two box type solar cookers are tested. The first type has a two finned cooking pot and second type has a two finned cooking pot having 3 reflectors. The cooking pots are identical in shape and volume with all of the pots external surface provided with fins. The result of two tests (coolant heating and boiling test) revealed that 250ml of coolant was raised to 133° c in 120 minute and 60 minutes for finned and finned cooking pot having reflector respectively. These figures represent 50% saving in heating time. This clearly demonstrates that fins improved the heat transfer from the internal hot air of the cooker toward the interior of the pot where the coolant to be heated was kept.
Keywords- solar heating, thermal insulation, concentrating solar cooker and thermal performance

I. Introduction

From time immemorial, fire has been used for cooking food to make it palatable and digestible. In ancient times, in the villages, there was no scarcity of fuel, and hence, not much attentionwas given tominimize the loss of energy while using wood for cooking. Almost invariably, open fire was used for transferring the heat energy to the foodfromthe source of the fuel and this accounted for a large percentage of heat lost toThesurroundings Unfortunately, up to the present day, where gas cooker or electric stove is used, the problem of heat loss to the surrounding still exists. It is for this reason that very high amount of fuel is needed for cooking, so that enough heat is available for cooking of food in spite of considerable loss of heat from the source of fuel: wood, coal, gas, or electricity. The main sources of power generation today are fossil fuels (oil, gas, and coal), nuclear reaction, and hydro energy is also used. These are depletable, nonrenewable and pollute the environment. The hydro energy does not produce adequate and consistent power for the nation's consumption- [I]. Moreover, the high cost of exploration techniques andthe devaluation of the currency of a developing countries havemade the power from fossil fuel unaffordable for most people. [II]. Million of households depend on wood and charcoal to prepare food and worldwide supply of wood is rapidly disappearing. [III].Thedemands of massive population growthand the inefficient conversion of wood to charnel have outstripped much of the world's forests ability to regenerate, creating a phenomenon known as deforestation. Deforestation is the gravest environmental crisis facing the world today; its far reaching effects include the following.

(i) The decreasing availability of firewood.
(ii) Removing the trees from an area is to remove its source of life.
(iii) Forest protects the soil against erosion and reduces the risk of landslides and vacancies.
(iv) Forest increases the rate that rain water recharges ground water as well as controls the rate that water is released in watersheds, helping to sustain fresh water supplies.
(v) Forest affects the climate. The occurrence and strength of floods and droughts increase when they are Criminated.
(vi) Forest is an important source of oxygen.
(vii) Forest stores large amounts of carbon-dioxide that arereleased when trees are cut or burned

Wood stubble and grass are used in about half of the world's households as energy for cooking and heating. In most parts of the developing world, they are burned in open fires or inefficient stoves with less air in kitchens with little or no ventilation leading to incomplete combustion and production of poisonous gases such as carbon monoxide.

II. Description of Box type solar cooker, the finned cooking Pot and reflector

The solar cooker used in this investigation is the box type solar cooker. The two box type solar cookers are used. The cooker has aouter dimension of 82cm*42.5cm*20cm and inner dimension are 74cm*33.5cm*10 cm,

the sides and bottom of the tray are encased in wooden box. The clearance between the galvanized iron sheet and encasement is filled with 3cm foam to provide thermal insulation, the tray consist of movable doubled glass cover hinged to one side of the incasing at the top. The cooker was exposed to solar radiation. The absorber consist of a galvanized iron sheet painted black with thickness of 4mm. .For the purpose of this investigation, two solar cookers and two cooking pots were used. The one box type solar cooker provided with 3 reflector. Its one reflector is of glass material and other two are of a plywood sheet wounded by a aluminum foil. The cooking pots are made up aluminum painted black, are cylindrical in shape and have flat base. Both the cooking pots have identical lid, with a diameter of 16cm and height of 7cm.the lateral external surface of two of the cooking pot was provided with fins made ofaluminium painted black. The firstfin used are rectangular in shape with a have a length of 2cm along its circumference, and second fin is spaced at 2 cm apart and length of 4cm along its circumference. Arriving global solar radiation was focused on the solar cooker. For the purpose of this investigation heating test was conducted.

III. Experimentation

During each test, both cooking pot were placed side by side on the absorber of the solar cooker and loaded with the same mass of coolent250ml at the same temperature for coolent heating test. The pota and cooker is provided with a thermocouple.The temperatures of' the coolent in each pot as well as ambient temperature recorded at 15 minute intervals using temperature multimeter. Both the two potwas filled with coolent was placed in the cooker, and was closed with double glazing cover until test end. The cooker was manually oriented at an interval of 15 mm in order to collect a maximum of solar radiation.

Observations:-

Coolant heating test:-

Table 1:- Table1: Temperature distribution at various point of cooker for heating test

sr. no	time	environment temp	solar cooker without reflector		solar cooker with reflector	
			cooker temp	finned pot	cooker temp	finned pot
		0c	0c	0c	0c	0c
1	11.OO	40	107	109	110	100
2	11:15	41	117	120	112	121
3	11:30	42	124	125	120	130
4	11.45	43	126	126	126	130
5	12:00	43	126	127	126	132
6	12:15	44	130	130	132	142
7	12:30	44	134	130	134	150
8	12.45	44	130	131	130	145
9	13:00	44	124	133	127	142
10	13:15	44	126	130	128	150
11	13:30	44	120	130	120	150
12	13.45	44	120	129	122	152
13	14:00	44	111	129	125	148
14	14:15	43	103	130	115	145
15	14:30	43	95	128	109	138

Table 2: result of coolant heating test .250 liters

Mean ambient temperature (oC)	43.13
Initial water temperature (oC)	38
Time of heating of coolant of in finned pot (Max)	120
Time of heating of coolant in finned pot (Max), cooker having a 3 reflector	60
Reduction in time (min)	60
% reduction in heating time (Min)	50

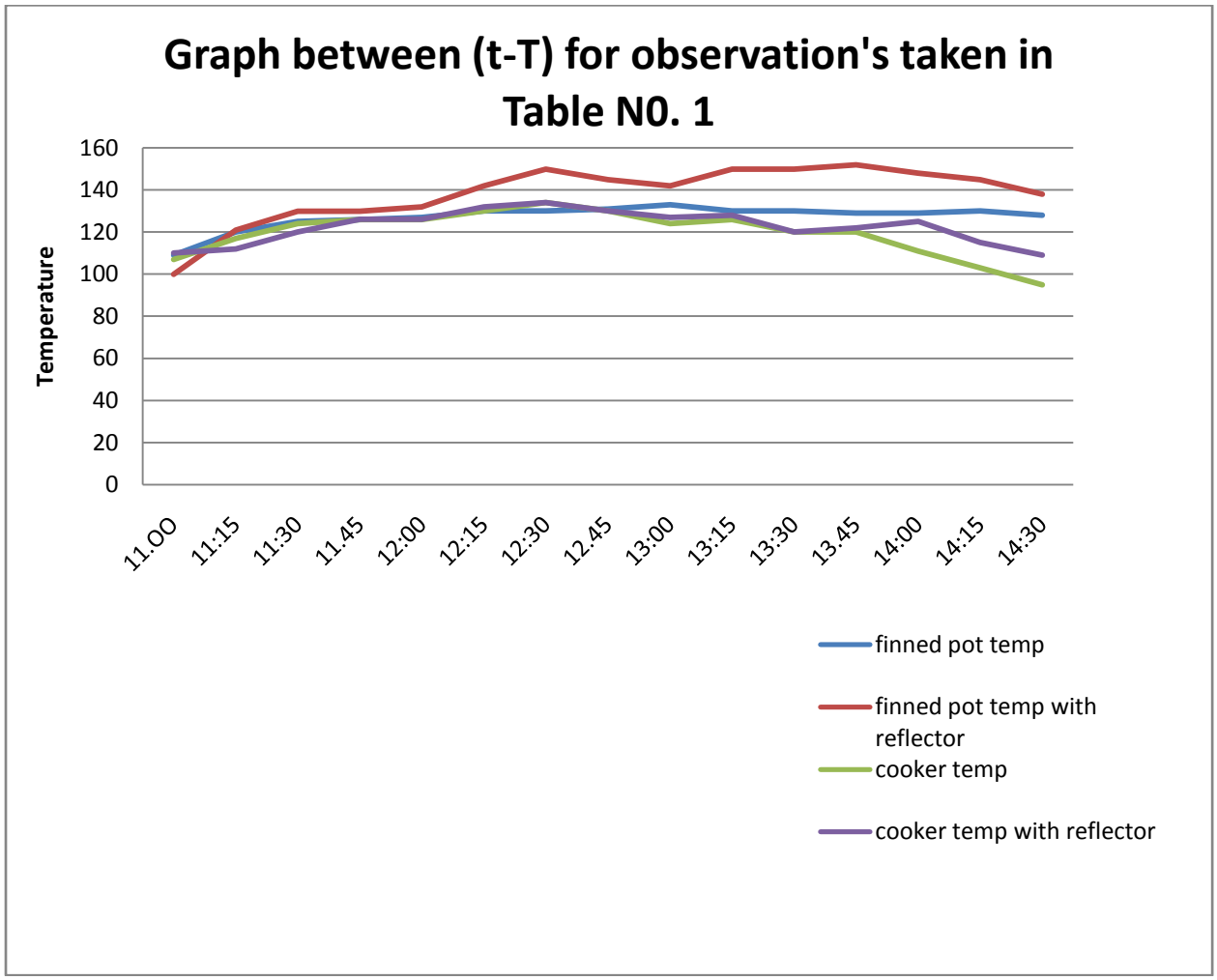

Figure No. 1. Where T = Temperture (˚C) & t = Time in minute

Results in accordance with Table No. 2 are as follows:-

1. Fig. 1shows the comparison between coolant temperature in the finned cooking pot and the coolant temperature in the finned cooking pot having 3 reflector under the same test conditions onJune4th, 2015.
2. It was found that the temperature of the coolant in the finned cooking pot having3reflector was always higher than the temperature of coolant in the finned cooking pot.
3. The time taken for attaining higher temperature (133 °C) by the two cooking vessels was 120 min for the finned, and 60 min for the finned pot having 3 reflectors respectively.
4. Table1: shows the various Temperature distributions at various point of cooker during the heating test. The ambient temperature fluctuates between 40.1oC and 43.oC during the test period.
5. The initial coolant temperature in the both the cooker were the same 38oC.
6. The coolant in the finned cooking pot having 3 reflector attained higher temperature nearly 60 min earlier than time coolant in the finned cooking pot.

IV. Conclusion

1. The result of two tests (coolant heating test) revealed that 250ml of water coolantraised to 133 °C in 120 and 60minutes for finned and finned cooking pot having 3 reflector respectively.
2. These figures represent a 50% reduction in heating time.
3. The investigation has revealed that heating time can be reduced by using a finned cooking pothaving 3 reflectors.
4. The reduction in cooking time is consistent with the increase of the heat transfer surface area by fins attached to the external surface of the cooking pot and use more reflector to the box type solar cooker.

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