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RESEARCH ARTICLE

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Development of Low Cost Solar Cooker

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Abstract: Low cost solar cookers are developed and tested. The paper discusses the methodology, development and testing of a reflective panel type low cost solar cooker. From the tests, it is found that such low cost solar cookers are dependable and viable alternative to cooking using conventional sources. The cooker is found suitable for cooking once in winter and twice in summer for 1-2 persons with the estimated cost of Indian Rs. 200.00.

Keywords: Solar cooker, reflective panel type, low cost

1 Introduction: The present crisis due to depletion of non-renewable sources of energy is a major concern. Solar energy harnessing and its utilization [1, 2] have seen tremendous development over several decades. One of the areas where solar energy can be readily utilized is in cooking. The main limitations towards this objective are (1) availability of clear sun shine, (2) the materials for cooking vessels, (3) local weather conditions, to name among few.

Over several decades, solar cooking has gone through number of designs and phase development. A comprehensive review on solar cooking is presented in [3]. A number of models exist in the open literature and research; however, it can be broadly classified into three major categories: (1) box-type solar cookers, (2) reflective panel type solar cookers, and (3) concentrating type solar cookers. The first two of these utilize the greenhouse concept of heating, whereas, the third type simply utilizes the focussed (hence concentrated) beam of sunlight onto the cooking pot or vessel for heating. In the third type one can also indirectly cook utilizing the energy from sun to first heat water or suitable oil etc. And then to use this heated water (or steam) for cooking. The advantage of concentrated type cookers are that cooking time is relatively less and higher temperatures can be reached. The disadvantage however, is that the cooker requires re-orientation all the time till cooking finishes to get maximum focus. Box type cookers rely basically on the greenhouse effect for cooking. One or more reflective surfaces can be added to the box-type cooker for increasing the amount of solar radiation. Reflective panel type cookers are very handy and low cost and can be prepared in relatively very short time.

The objective in the present study is to develop an ultra low cost solar cooker of the reflective panel type. The state of Chhattisgarh is abundant with plenty of sunshine at least during 6-8 months of a calendar year. Moreover, a low cost solar cooker can be used effectively as an alternative or compliment to the cooking utilizing LPG, kerosene, wood, etc. This would not only help in much safer, healthier and nutritious cooking but also cuts down the cost incurred in utilizing non-renewable fuels. There are two hidden advantages: (1) One does not have to spend whole time during the cooking; one can prepare the rudimentary things for cooking and simply put it in the solar cooker and the cooker would take care of the rest by slow cooking during which time, one can do other works, and (2) The food being cooked

retains all the nutrients, it adds to the healthier being of the individual or family, thus cutting the hidden costs incurred in healthcare.

2. Development of the Cooker:

In order to keep the cost as low as possible several alternatives were explored for the material to be used for the panel. It was decided to use the packaging card board material (used in making cartons) for the panel. Then among several alternatives to choose the reflective materials, low cost rough-surface reflective aluminium paper was used. This paper was glued to the base panel material using food grade adhesive.

For cooking purposes, cylindrical aluminium boxes are used because aluminium has high thermal conductivity as compared to stainless steel. The diameter of the box is 7 inches and height is 3 inches. The outside of the boxes are painted black with epoxy black paint which can sustain high temperatures without chipping or leaving away from the surface. The schematic diagrams of the panel and the box are shown in Figure (1).

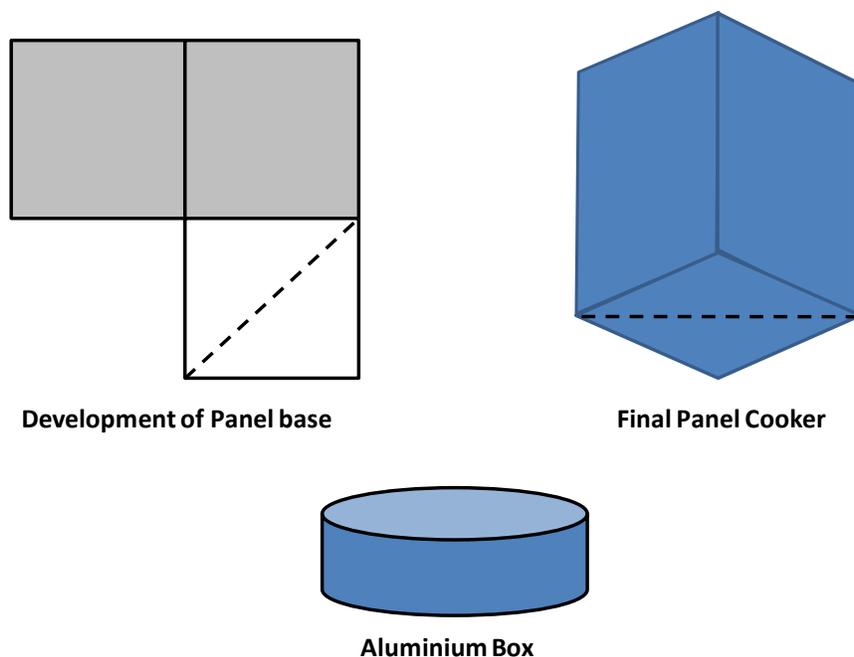


Figure (1): Schematics of panel solar cooker.

3. Cooking Procedures:

Once the panel and the boxes are ready, the cooking can be done on a clear sunshine day. In this study, plain rice is used to test the cooking. As usual, rice is first washed thoroughly and then kept aside for 10-15 minutes for the rice grains to get soaked. It is then followed by addition of desired quantity of water to cook rice. The water is twice the amount of rice used.

Then the soaked rice boxes are put inside a transparent plastic bag free from holes etc for facilitating greenhouse effect. One can also choose other alternatives for it, but this was found cheap and easily available.

The box is then put in the area where maximum reflective rays are gathered. In order to facilitate maximum heating, a small stand is used such that the box is above the panel surface.

4. Testing of the Cooker:

The cooking is tested for duration in the months of December, January and March. This is to ensure that the proposed panel cooker can cook during all other times as long as clear sunshine is available. Furthermore, the amount of rice being cooked is also varied to test the optimal loading of the cooker. From several trials, it is found that 150–200 grams of rice can be cooked one time. During the summer months, the quantity can be increased to 400 grams.

Figures 2 and 3 show respectively the complete unit while cooking and the cooked rice. The optimal time for cooking depends on the amount as obvious. However, typical time duration of 1.5 hours during summers and 2.5 hours during winter has been found optimal for the range of amounts used for cooking in this study.



Figure (2): Reflective panel type solar cooker with two boxes.



Figure (3): Cooked rice in the two boxes.

The cooker is found suitable for cooking once in winter and twice in summer for 1 - 2 persons. Additionally, the cooker can be used for reheating cooked food, if needed since it does not burn the food. The present cooker is ideal for farmers working in the field, factory workers, labourers, since rice can be prepared onsite without much attention needed (as compared to conventional cooking).

5. Conclusions: The study dealt with the development of a low cost solar cooker based on the reflective panel type. The developed cooker was tested and found suitable for cooking rice for 1-2 persons with the estimated cost of cooker being 200.00 INR including the boxes and stand. It was found suitable for cooking once in winter and twice during summer months. The developed cooker is a promising alternative in rural areas in Chhattisgarh where plenty of sunshine is available.

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