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Modernised Solar Cooker

S. Periasamy[1], Rajarshi Banerjee[2] and Binayak Debgupta[3]

ABSTRACT

In today's market where modernisation and technology improves every minute we have depleted all our natural resources to fulfil our daily need and luxury. In this context non-renewable energy sources are facing crisis while renewable sources of energy go unchallenged. The non-renewable resources which are the primary source of energy to suite our daily needs are expected to deplete completely by 2030. The challenge now, is to use the renewable energy resources to fulfil all our daily needs which are available in abundant but unused properly. Solar energy is the most widely available and the most easily harnessed form of renewable energy technology available till now. Keeping in mind the vast unused potential of solar energy, this paper aims in showing how the solar energy to cook food in a newer way using the modernised solar cooker.

The basic concept of Solar Cooker is using the sun's radiant heat energy to cook food. Though the traditional solar cookers have been quite useful to us in the past few years, it had some serious operating backdrops which made it unpopular.

This modernised solar cooker has been designed to reduce the problems associated with the conventional solar cookers. The paper reflects our efforts and research to improve the solar cookers to make it popular and more useful.

INTRODUCTION

A solar cooker is a simple zero pollution device that cooks food and/or boils water using only the radiant heat energy of the sun. Unlike photovoltaic cells, which convert sunlight into electricity, solar cookers use the radiant heat energy of the sun for cooking. Solar cookers are used to cook food and pasteurise water for healthy drinking. They use a free, renewable energy source and thus do not pollute the environment.

Solar cookers can be made using a diversity of materials, which includes wood, glass, cardboard and sheet metal available in local markets.

There are basically three types of solar cookers: panel, box and parabolic. They vary in many ways like size, weight, cost, durability, portability and cooking time. Solar panel cookers and solar box cookers use an enclosed space, a transparent cover and a black pot to capture, absorb and focus solar radiant heat and convert it slowly and evenly into heat all around the pot. Light coloured cooking pots will not work in these solar cookers since they have shiny surfaces which reflect rather than absorb sunlight. Parabolic solar cookers rapidly generate intense heat for frying and boiling by focusing a single beam of light on the (black) bottom of a cooking pot.

Panel Type Cookers: The panel cooker is the least expensive type of solar cooker available in the market now. It is designed to concentrate sunlight by reflecting it over the entire surface of a lightweight cooking pot painted black on the outside with non-hazardous paint. It can reach temperatures as high as 250ºF (121ºc). The low cost cardboard and aluminium foil, which resembles an open clamshell, is the most extensively used of all panel cookers.

[1] Asst. Professor, [2, 3] UG student

[1,2,3] Department of Electrical and Electronics Engineering, Faculty of Engineering and Technology, SRM University, Ramapuram, Chennai-600089

E-Mail: [1]periasamyeie@gmail.com; [2]rajarshitakeme@gmail.com; [3]binayakdebgupta@gmail.com

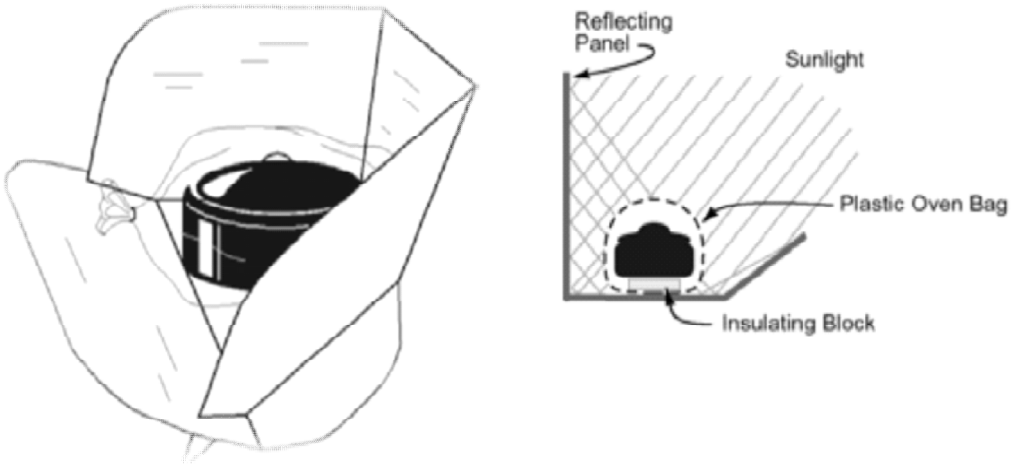


Figure 1: Panel Type Solar Cooker

The fig. 1 shows the structure of a panel type solar cooker. Food can be left for several hours in this cooker to be cooked in the sun.

Box type: This type of solar cooker consists of an insulated box made of wood, metal or plastic. It is painted black on the inside and has a large glass window on top to let in the sun. Just like panel cookers, box cookers can be left unattended in the sun for hours to cook food and/or pasteurize water. There is no danger of the food getting overcooked. Box solar cookers only need a small adjustment to track the sun every few hours. They are bigger and heavier than panel cookers, but most can hold more than one pot, are more long-lasting and can reach temperatures up to 350ºF (177ºC). Solar box cookers have aluminium reflectors on the outside to reflect even more sunlight into the box.

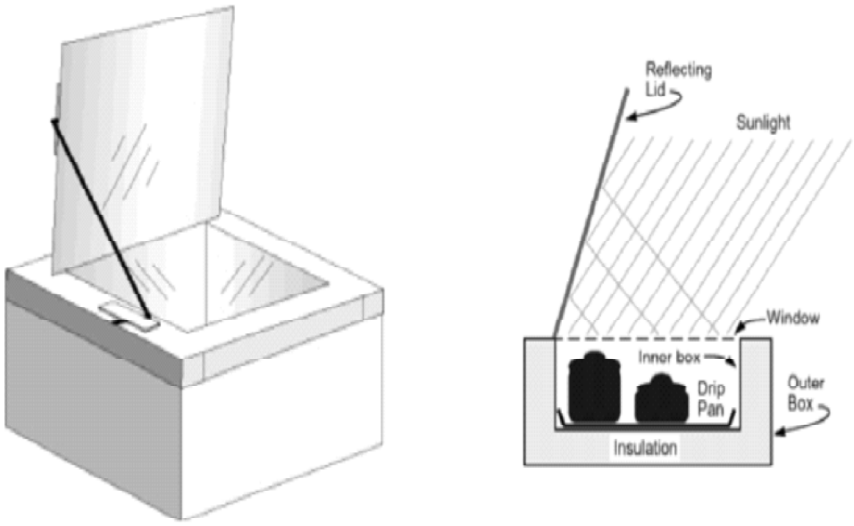


Figure 2: Construction of Box Type Solar cooker

The diagram above (Fig. 2) shows the construction and working of box type solar cookers.

Parabolic Reflecting Type: These solar cookers operate at a higher temperature than panel and box cookers. They focus a concentrated beam of sunlight on the bottom of a pot used for cooking that sits on a metal stand. This light instantaneously generates temperatures as high as 450º-500ºF. (232º-260ºC), which is as hot as an open fire or a gas burner. Parabolic solar cookers require regular adjustments to track the movement of the sun.

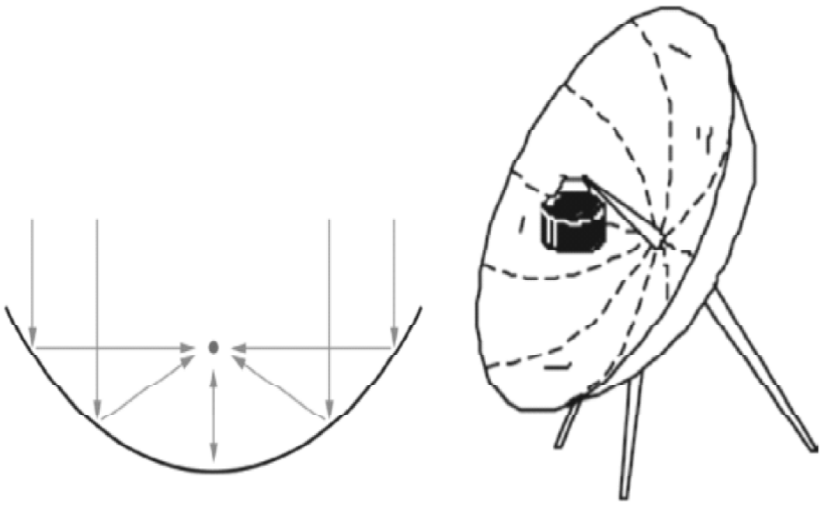


Figure 3: Diagram of a parabolic solar cooker

A parabola's distinctive shape has a slope which is proportional to the distance from the centre. This means the more the distance from the centre at which a light ray strikes the parabola, the lesser its incident angle, and the greater its change in direction when it is made to reflect. In this way, all the light rays get focused to a single point.

CONSTRUCTION OF THE MODERNISED SOLAR COOKER

This modernised solar cooker is very simple in construction. This solar cooker resembles the box type solar cookers in many ways. The body of the solar cooker is made up of aluminium which is a very good conductor of heat and thus gets heated up very fast. The oven is covered with high heat withstanding fibre glass to trap the collected solar heat energy. The interior and exterior of the oven is painted in matte black. Unlike the box type solar cookers, this modernised solar cooker is devoid of any mirror or any insulation around the oven. This reduces the weight of the device. The diagrammatical representation of the solar cooker is shown in Fig. 4.

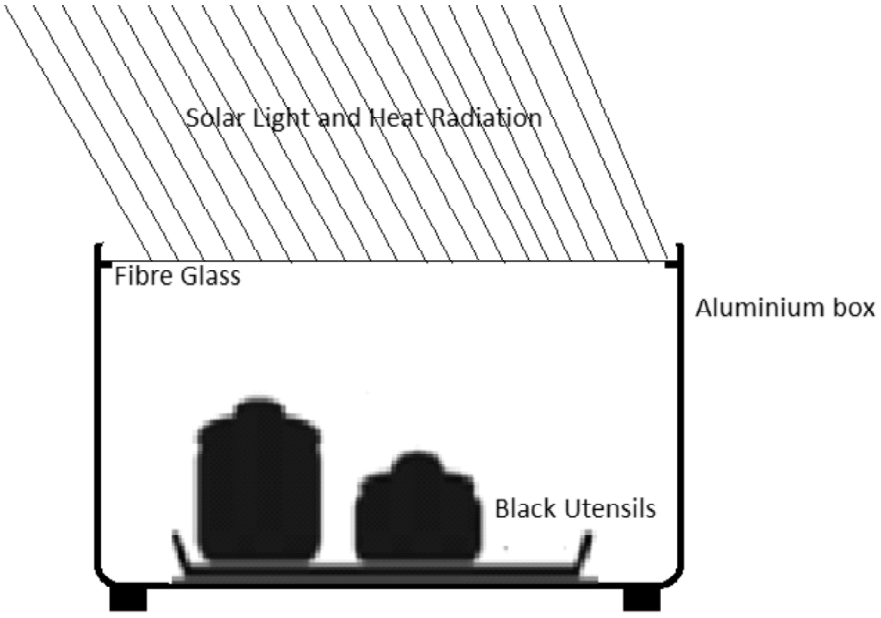


Figure 4: Construction of The Modernised Solar Cooker

The solar cooker is stands upon four plastic bushes. Plastic being an insulator keeps the base of the cooker hot reducing the heat loss to the ground.

OUR RESEARCH INVOLVED TO IMPROVE THE EFFICIENCY OF THIS SOLAR COOKER

Our efforts to improve the efficiency of this solar cooker have been introducing a convex lens on the top of the fibre glass cover. The working principle of this concept is that a convex lens focuses all the light rays coming from an infinite source into a point which is its focus point.

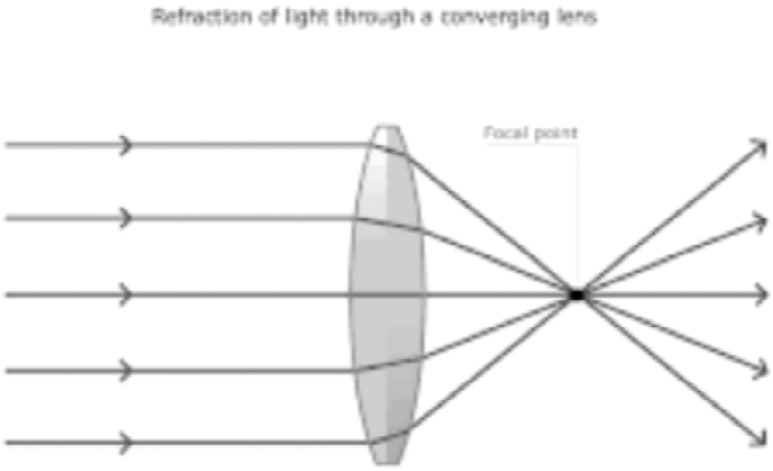


Figure 5: Convex lens as a converging lens

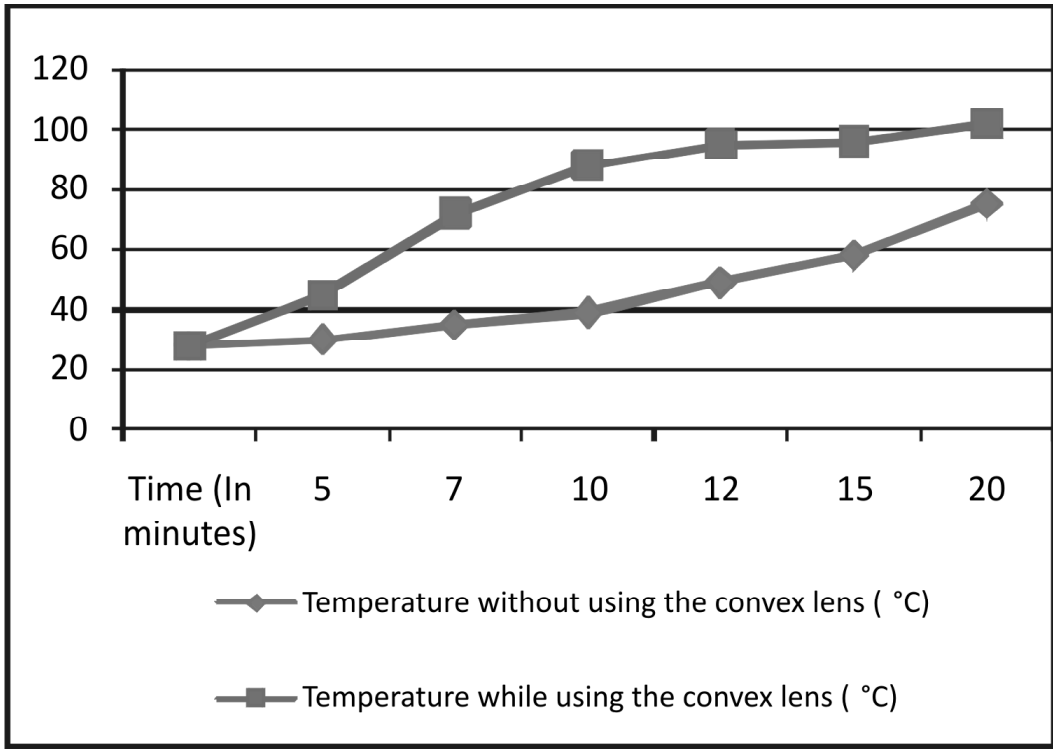
So, when the convex lens is kept on the fibre glass top of the cooker, it concentrates all the sun's energy received by it into a particular point which increases the temperature of the point exponentially at a small interval of time, thus letting the food inside the box to be cooked faster (light ray diagram as shown in fig 4). The comparative study between the performances of the cooker while using and while not using the convex lens is as given below:

(Experiment was conducted on a bright sunny day in between 11AM and 12:15 PM)

Table 1
Comparison of temperature differences while using and not using the convex lens

Time in minutes	*Temperature (Without using the convex lens) In Degree Celsius*	*Temperature (While using the convex lens) in Degree Celsius*
5	28	28
7	30	45
10	35	72
12	39	88
15	49	95
20	58	96
28	75	102

Another way to improve the efficiency is by using an array of 45° prisms with its base facing the sun in the place of the fibre glass covering. The principle of this technology is refraction of light rays by a prism. When a light ray falls on the base of a prism at any angle, it refracts and comes out of the prism through one of the sides only. When this array of prisms with its base up is fixed on the top of the box, it ensures that all



Graph 1: Comparison of temperature differences while using and not using the convex lens

of the suns energy received by the top goes inside the oven. This increases the heat energy received by the box at a particular time thus heating up the oven faster and more.

WORKING

The basic working principle of a solar cooker is concentrating and trapping the solar heat received. This solar cooker is similar to that.

When solar heat radiations fall on the oven, the box being painted matte black, which absorbs heat faster, gets heated up. The fibre glass on the top of the box creates a green house effect inside the box which doesn't allow the heat received by the box to radiate out. This increases the temperature of the box such that food can be cooked inside it.

ADVANTAGES

This modernised solar cooker is a step ahead of the conventional box type solar cookers in many ways:

1. It is light in weight (about 700 grams in weight)
2. It is small and portable, thus can be carried to anywhere.
3. The usage of fibre glass instead of glass keeps the weight of the box less and the cost too.
4. Aluminium, used to build up the oven is a good conductor of heat and also gets heated up faster. It is also lighter in weight than metals having the same property and cheap too.
5. Its needs almost no attendance as no mirror is used, so no need of tracking and setting the device at regular intervals.

Solar cooking is also a green way as it uses no fuel nor pollutes the environment to cook food which is our daily need.

CONCLUSION

Solar cooking is our tomorrow. The light weight and easy to manage device will come handy to large group of people. In the sun-drenched desert environment where many refugee camps are located, solar cooking is ideal. The use of solar cookers (whenever the sun is shining) in arrangement with fuel-efficient stoves (for nights and cloudy days) and retained heat cooking baskets (to keep cooked food hot) can significantly reduce the consumption of biomass fuel. This is true for the numerous families living in the camps but it is also true for adjoining neighbour villagers, who may want access to these trouble-free renewable energy technologies once they have seen them used in the refugee camps. Just as many city dwellers used to consider the microwave oven to be a strange and even unsafe device when it was introduced just forty years ago, people in traditional societies may at first be reluctant to accept solar cooking technology.

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