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# Design Considerations Of Solar Cooker

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## ABSTRACT

Simple box cookers created towards end of twentieth century are now being used all over India. Reflector type solar cookers focuses the solar rays on open cooking pots or pans. Solar ovens trap the solar heat inside insulated boxes with transparent top. Efficiency of solar cooker is a function of the total area exposed to the sun and the effectiveness of collection. From the reflectors, maximum light must enter the cooking chamber to enhance the efficiency. If the angle of reflectors is not proper, the sunlight will skip off the surface of reflector without entering into cooking chamber. In current review, different types of solar collectors are studied. Design considerations, nature of working, efficiency and drawbacks are discussed shortly.

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## I. Introduction

In rural India, gathering of wood as cooking fuel by cutting down trees has resulted in eroded hill sides with loss of precious topsoil thus reducing their ability to grow food. In urban areas, most of the families are using LPG cylinders and now a day's its prices are going up tremendously. Most of rural Indian housewives are cooking outside using charcoal or lighter fluid. This fire will produce air pollution. Wood fires are even worse causing respiratory diseases. The concept of solar cooking began at start of second century. All solar cookers work on the principle of collecting the direct solar rays to raise temperature of food or water. A solar oven or solar cooker is a device which uses sunlight as its energy source. Because they use no fuel and they cost nothing to run, humanitarian organizations are promoting their use worldwide to help slow deforestation and desertification, caused by using wood as fuel for cooking. Solar Cookers are a form of outdoor cooking and are often used in situations where minimal fuel consumption is important, or the danger of accidental fires is high. Reflector type solar ovens focuses the solar rays on open cooking pots or pans. Solar ovens trap the solar heat inside insulated boxes with transparent top. Simple box cookers created towards end of twentieth century are now being used all over India.

### 1. Solar Cooker-

There are many types of solar cookers - heat-trap boxes, curved concentrators and combinations of both. Solar cookers are used to cook food and pasteurize water for safe drinking. They use a free, renewable energy source and do not pollute the environment. There are many benefits to solar cooking, explained later in the pack. They are particularly useful when other sources of fuel are unavailable.

#### 1.1 Box cookers

Box cookers are the most widely used in households. There are several hundred thousand in India alone. This type of solar cooker consists of an insulated box made of cardboard, wood, metal or plastic. It is painted black on the inside and has a large glass or Plexiglas window on top to let in sunlight. Just like panel cookers, box cookers can be left unattended in the sun for hours to cook food and pasteurize water. There is no danger of burning the food. Box solar cookers only need a slight adjustment to track the sun every few hours. They are bulkier than panel cookers, but most can hold more than one pot, are more durable. Some solar box cookers have aluminum reflectors on the outside to direct even more sunlight into the box. There are hundreds of thousands of box cookers in India alone.

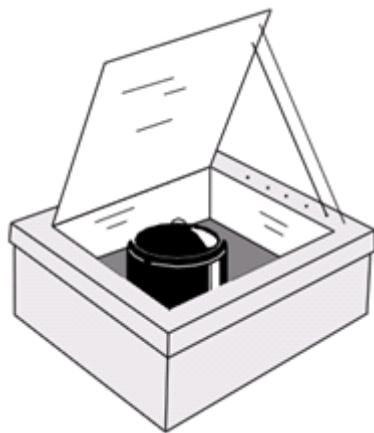


Fig 1 – Box type Solar Cooker

### I. CURVED CONCENTRATOR COOKERS

Curved concentrators (often called parabolic cookers) cook fast at very high temperatures like fire, but require more frequent adjustment and supervision for safe operation. They are not considered in this study, but several hundred thousand households in western China use them. They are especially useful for large-scale institutional cooking. Parabolic solar cookers operate at a much higher temperature than panel and box cookers.

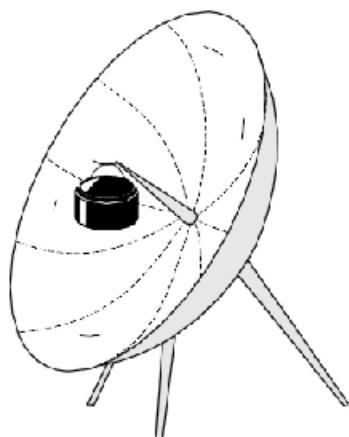


Fig- 2 Curved concentrator cookers

They focus a narrow beam of sunlight on the bottom of a cooking pot that sits on a metal stand. This light instantly generates temperatures as high as 450°-500°F. (232°-260° C), which is as hot as an open fire or a gas burner. Although parabolic solar cookers require regular adjustments to track the movement of the sun, they can be used from sunrise to sunset even

in freezing temperatures. Hundreds of thousands of families in China and India use parabolic solar cookers for cooking food and boiling water whenever the sun is shining. Large institutional parabolic reflectors like the Prince and the Shuffler are used for cooking in community kitchens at schools, health centers, bakeries and orphanages.

### 2.3 Panel Cookers-

The panel cooker is quite similar in operation to the simple box cooker. The same principles are employed but instead of an insulated box, panel cookers typically rely on a large (often multi-faceted) reflective panel. At the focus of the reflector rests the cooking pot contained within a transparent medium, such as an oven bag or a glass bowl (FSEC, 2002). Energy from the sunlight is reflected into the bowl or oven bag, heating up a dark painted pot and whatever may be inside of it. The pot in this case is generally less insulated from the environment than the pot in the case of the Simple box cooker. The panel cooker relies much more heavily upon reflected sunlight and less so on heat retention as compared to the simple box cooker. This can make the panel cooker more portable and cheaper to construct but the panel cooker will suffer from generally somewhat poorer performance, particularly on days of marginal insulation or intermittent cloudy conditions.

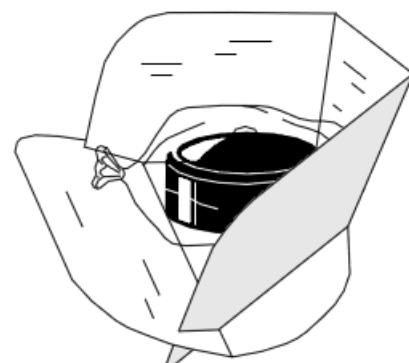


Fig-3 Panel Cookers

### I. USAGE OF SOLAR COOKERS

Traditional cooking customs differ significantly with cooking with a solar cooker. This paragraph discusses some uses and requirements. A solar cooker can only be used when the sun shines, i.e. in daylight hours. Even then, cooking time can vary according to the weather conditions. As any type of solar cooker is dependent on the amount of sunshine, a solar cooker cannot replace the traditional energy source completely. In practice, the solar cooker is used to prepare a certain type of food, for example to

cook the rice while the traditional stove is used to prepare the meat.

Cooking times for a parabolic type cooker are about as fast as conventional stoves, but these cookers need constant attention. It has to be positioned at the sun frequently. This does also mean that the cook has to be at home in the afternoon to prepare the evening meal. In practice, often a haybox is used to store the food after preparation. The food can then be used in the evening.

## II. THE BENEFITS OF USING SOLAR COOKERS

Solar cookers can be life-saving devices for people in sunny but fuel-scarce regions.

### 4.1 Solar cookers save money and fuel

Free sunshine is available most days of the year in countries located like India. Solar cooking on sunny days allows families to save scarce wood, charcoal, dung or gas for use at night and on cloudy days. Some urban residents spend 30-50% of their income to buy cooking fuel—mainly charcoal, kerosene or Liquefied Petroleum Gas (LPG). Many impoverished governments currently use a significant percentage of their budgets to subsidize imported LPG and kerosene. If their citizens had access to solar cooking technology, they could dramatically reduce their consumption of dung and charcoal, wood, and the need for subsidized LPG.

### 4.2 Solar cookers save time

With panel and box solar cookers food can be left unattended to cook while women do other work indoors or in the shade. Since food will not burn in box and panel solar cookers, no stirring is necessary. Pots are easy to clean because food doesn't stick—an important factor in regions where water is scarce. Parabolic solar cookers, which instantly generate the intense heat of an open fire, can boil a pot of water in 15 to 20 minutes.

Solar cookers can be made from locally available and recycled materials. Solar cookers can be made using a variety of materials, including wood, glass, cardboard and sheet metal available in local markets.

### 4.3 Solar cookers are safe, and convenient

With solar panel and solar box cookers there is no fire hazard. Although parabolic solar cookers do generate very high temperatures, they (like box and panel cookers) consume no fuel and they produce no smoke to irritate the eyes, nose and throat or cause respiratory disease. Panel and box solar cookers cook food slowly at between 250°-350° F (121°-177°C) ideal temperatures for retaining nutrients, moisture and flavor. Due to worldwide fuel shortages, some families are being forced to reduce their consumption of nutritious beans and legumes that require lengthy

cooking and extra fuel. When women are able to solar cook on sunny days, their homes, kitchens and courtyards remain smoke-free and they can afford to prepare healthier, slow cooked foods.

## III. THE DRAWBACKS USING SOLAR COOKERS

Solar cookers can be useful devices for people in sunny regions but there are many limitations for using these solar cookers. The very important is solar cookers are a form of outdoor cooking. Housewife has to cook in the limited time span. In the box type and panel type solar cooker, time required for the cooking is more than conventional cooking.

The solar cooker requires a location in the sun. This can be in the courtyard or on the roof for example. Especially in urban areas, users may not have access to a sunny location. Also, the solar cooker needs to be positioned where it is able to withstand the weather conditions, panel and parabolic solar cooker types are typically vulnerable for strong wind. The solar cooker usually cannot be left unattended outside; the cooker may be damaged by children or livestock. (Cows, buffalos are especially notorious solar cooker haters). Users have to be prepared to take out the solar cooker every day and cook in an open/public area.

Especially parabolic and box type cookers are generally too heavy to carry in and out each time. The portable nature of the solar cooker also means that other people can take it somewhere else too (theft). Even when the idle solar cooker can be left unattended, a box or panel type cooker requires long cooking times in the sun. The contents of the solar cooker could be eaten by children, livestock or other animals.

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