Residential Solar Cooker with Enhanced Heat Supply

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Abstract- *Solar energy is available everywhere in free of cost. Solar energy can be directly converted in to electrical energy, mechanical or even direct thermal energy. The history of solar energy research is started in 18th century by developing solar powered steam engine by a scientist Augaste Mouchount in 1860. In this paper domestic use of solar energy is considered. The detailed structures of solar cookers is studied and compared with its efficiency and economy in production. Parabolic solar cooker SK-14 is considered for this paper.*

Keywords: ambient temperature, Parabolic reflector, solar radiation

I. INTRODUCTION

In the present days, solar cooking promises in our expenditure. It could potential future technology, when it come user friendly. The usage of solar cooker is not mainly introduce everywhere because of its periodic changes.

The concentration of the solar rays is random and often plays truant during rainy and winter periods. The harnessed energy is transferred and not stored properly. This reduces the overall efficiency of the device. The time required to cook the food is increased because of missing in heat storage.

To overcome these major difficulties, a new design has been devised to heat efficiently using the sunny days and as well as the other dusky circumstances. This device not only transfers energy efficiently and stores it for long time usage. The PCM material layered around the vessel stores heat commendably and heats up the container. This helps in reducing the fuel consumption to a greater extent during cloudy days. The harnessed energy is not liberated thus assuring fast heating process.[1]

In most parts of India, solar energy is available almost all over the year and can be used as substitute input to meet out energy needs. Solar energy is the cheapest, inexhaustible and can be used for various native and agricultural requirements including cooking, drying, dehydration, heating, cooling and solar power generation[2]

II. EXISTING SYSTEMS

A. Box Cookers

Box cookers are the most common type made for personal usage. They consist of a bounded inner box covered with clear glass or plastic, a reflector and padding. There is a wide variety of designs and plans that can be adjusted to work with available resources. While they do not heat quickly, they provide slow even food preparation. Box cookers are very easy and safe to use and fairly easy to paradigm.

B. Panel Cookers

Panel cookers are flat reflective panels which focus the sunlight on a cooking vessel without the inner box. Panel cookers are the easiest and least costly to make, requiring just four reflective panels and a cooking vessel, but they are unstable in high winds and do not retain as much heat when the sun is hidden behind clouds.

C. Parabolic Cookers

Parabolic cookers reach higher temperatures and cook more rapidly than solar box cookers, but are tougher to make and use. Parabolic cookers require more accuracy to focus the sunlight on the cooking pot. If the sunlight is not focused exactly on the cooking pot, the food will not cook. The parabolic oven is used, the temperature must be watched so the vessel does not overheat, burning the food. Risk of burns and eye injury is greater with home-based parabolic designs. While they provide excellent results when used appropriately, they are not easy to build at home and necessitate great care to use.[1]

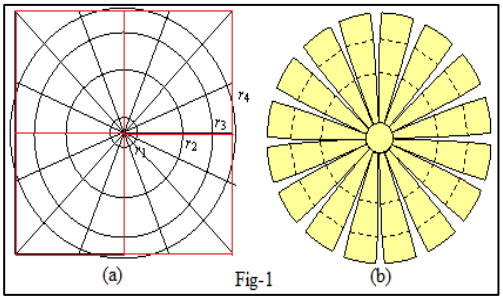

Fig 1: Concave projection of Parabolic Solar cooker

Reflectors are most significant parts in parabolic solar cooker. For unattended cooking of 2 hour the cooker needs

reflectors in parabolic profile. It can be shaped or stamped in required shape and magnitude or reflectors can also be fabricated by flat sheet metal with adequate surface finish. Design of reflectors with 140mm focal length, diameter of 800mm can be formed in 1000x1000mm square sheet metal Split the sheet metal in four equal parts and draw circles as shown in fig-1(a) and diameter given in table -1

Table:1

Circle	Inner	Small	Large	Outer
Radius (mm)	75	254	400	528
Arc Length (mm)	0	11	29	50

Dimensions of parabolic plate

Each square is divided in to 4 parts at an angle of 22.5 aparts as shown in fig-1. Most outer circle arc is cut off or bent to back side by 90 so that it can be used as brackets to join all parts together to form parabolic shape. Later it can be fixed to main support structure. Reflector material has reflectivity of 75%. Figure-2 shows assembled unit of parabolic SK-14 solar cooker.

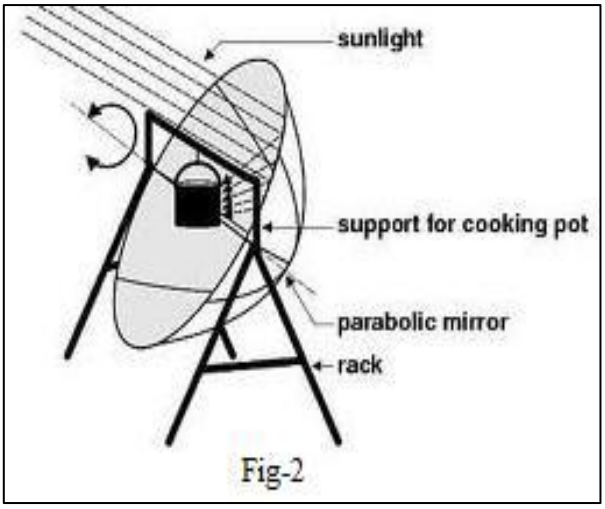

Fig 2: Parabolic SK-14 Solar Cooker [3]

IV. OPERATIONAL PRINCIPLE

In parabolic reflector type solar cooker, all the light dropping on mirror will be reflected such a way that all light rays will focus at small area of cooker. For this, there is artless mathematics i.e. angle of incidence of light ray must be equivalent to angle of reflection as in fig-3. This parabolic cooker has 2m focal length and 1.4m diameter. 4FD=R^2 Where F is the focal length, D is the depth of the dish, and R is the radius of its rim.

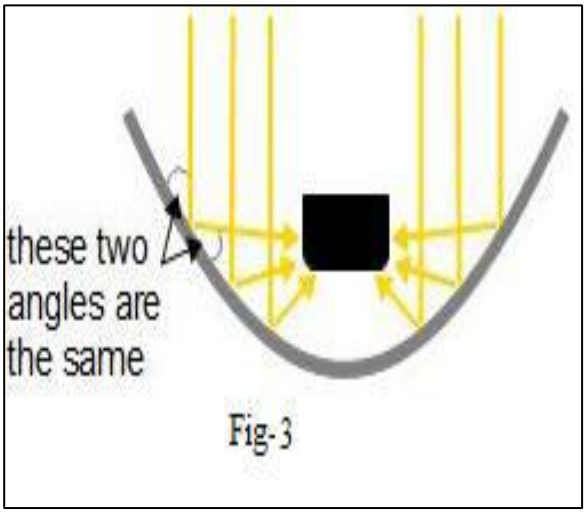

Fig 3: Shows equivalency of angle of incidence and reflection

V. FUTURE POTENTIAL OF SOLAR COOKERS

As reported by Panwar et al, renewable energy resources will play an vital role in the world's future. According to the global renewable energy situation, proportion of the solar thermal applications will be about 480 million tons oil equivalent by 2040. Average cost of solar cookers decreases day by day on the contrary their power output and efficiency significantly increases. In the upcoming future, extensive use of this technology is expected hopefully not only in developing countries but also throughout the world. Nowadays, solar cookers are also available to use in the areas with limited solar radiation depending on the developments in solar power concentrating systems and material technology. In addition, the most challenging point of solar cookers, unavailable to use when sun goes away, is overcome with thermal energy storage techniques. Briefly, it is anticipated that solar cooking technology will be demanded by a huge group of people in the near future because of its outstanding features.[4]

VI. CONCLUSION

SK-14 cooker is perfect for big family as it can make available sufficient temperature for cooking. Many food items can be prepared in one to two hour at sunny sunshine days. Morning hours ambient temperature affects its performance but at sunshine hours due to high surrounding temperature it has high effectiveness. Main advantage is that, sun stalking mechanism though it is labor-intensive but it can increase cooking time slightly bit more. Later on it can keep food stuffs warm. Parabolic cooker can cook food faster than box type cooker. This focused cooker heats the vessel uniformly so no burning and food vitamin will remain integral.

Dimensions and geometry of the fins should be studied in more detail in order to enhance the performances of this kind of cooking pot. The study should be carried out at different season so as to understanding the cooking profile of various stages in the year. Manufacturers of cooking pot should produce cooking pot with fins to accommodate those who want to use them for solar cooking. Solar cooking should be encourage and promote through mass production and distribution to students, rural residents and low income earners to supplement to high cost of convectional fuels such as kerosene, LPG ,Cooking gas and Fuel wood.[5]

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