

DETAIL STUDY OF SOLAR COOKER

Riby Merin John

Lecturer, Department of physics, Christ Junior College Bangalore, Karnataka, India

Mr.T.Arun Kumar & Dr.D.Shalini

Department of Chemistry, SNS College of Engineering, Coimbatore

Abstract

Solar energy is available everywhere for free of cost. Sun's energy can be directly converted into electrical, mechanical or even direct thermal energy. The history of solar energy research 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 taken into account. The fabrication is done and 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: Parabolic reflector, ambient temperature, solar radiation.

Introduction

In an attempt to find alternative source of fuel, solar energy utilization is a milestone as it is available free everywhere and it costs nothing. The only thing we need to do is to collect it in an efficient way and convert it into an useful source of energy.

The parabolic cooker is collects the light and concentrates it so that all thermal energy is utilized uniformly over blackened cooker which is specially designed for it. The advantage of using solar cooker is, it emits no harmful gases, nor reason for global warming, it is environmentally. Mainly it is freely available and inexhaustible energy source.

Fabrication

Reflectors are most important part in the solar cooker. For unattended cooking of 2 hours the cooker needs reflectors in parabolic shape. It can be molded or stamped in required shape and quantity. Or reflectors can also be fabricated by flat sheet metal with fine surface finish. Layout of reflectors with 140mm focal length, diameter of 800mm can be formed in 1000x1000mm square sheet metal Divide the sheet metal in four equal parts and draw circles as shown in fig-1(a) and diameter given in table -1

| Circle | Inner | Small | Large | Outer |
|-----------------|-------|-------|-------|-------|
| Radius (mm) | 158 | 260 | 400 | 530 |
| Arc Length (mm) | 0 | 12 | 30 | 50 |

Each Square is Divided into 4 Parts at an Angle of 22.5° Parts as Shown in Fig-1

Most exterior circle arc is trimmed off or bent to back side by 90° so that it can be used as brackets to join all pieces together to form parabolic shape. Later it can be fixed to the main support frame. Reflector material has the reflectivity of 75%.

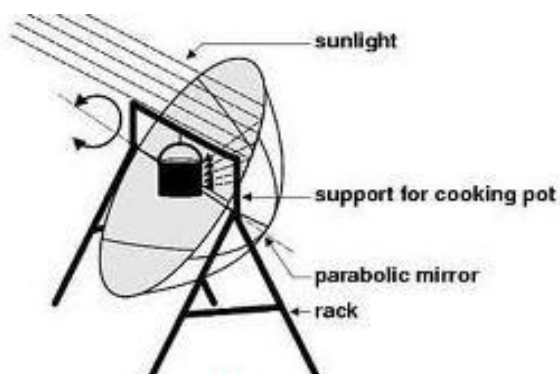


Fig-2

Working Principle

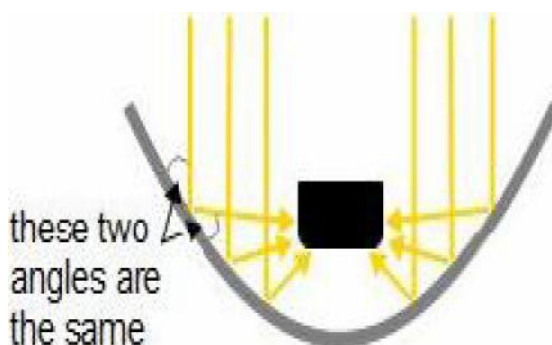


Fig-3

In parabolic reflector type solar cooker, all the light falling on the mirror will be reflected such a way that all light rays will concentrate at a small area of cooker. For this, there is a simple mathematics i.e. angle of incidence of light ray must be equal to the 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.

| Solar cell angle to sunlight | Voltage (Volt) | Current (ampere) |
|------------------------------|----------------|------------------|
| 90° to sunlight | 0.450V | 1.80A |
| 75° to sunlight | 0.437V | 1.75A |
| 60° to sunlight | 0.425V | 1.70A |
| 45° to sunlight | 0.400V | 1.60 A |
| 30° to sunlight | 0.362V | 1.45 A |
| 15° to sunlight | 0.325V | 1.30A |
| 0° to sunlight | 0.287V | 1.15A |

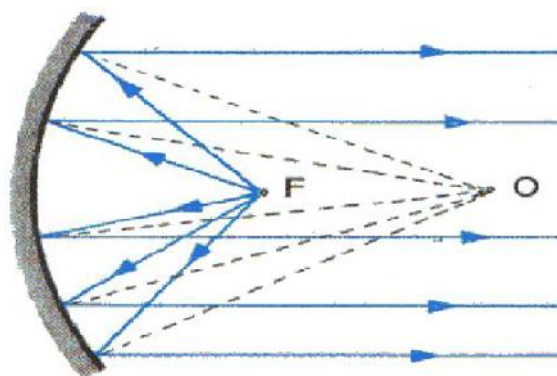


Fig-4

Table-2 experimental details

Experimental Details

The empty vessel made from Aluminum with black color has top temperature 76°C and bottom temperature of 118°C at morning time and average radiation recorded is 685W/m². 1000ml of water reached 90°C for time span of 90min with solar radiation 754 W/m².

Conclusion

This Solar cooker is ideal for a long time cooking as it can provide sufficient temperature. Many food items can be prepared in one to two hours at bright sunshine days. At morning hours ambient temperature affects its performance but at noon hours due to high surrounding temperature, it has high efficiency. The main advantage is that, sun tracking mechanism though it is manual, it can increase cooking time quite bit more. Later on, it can keep cooked food stuffs warm. Parabolic cooker can cook food faster than box type cooker. This concentrating cooker heats the vessel uniformly so no burning happens and food vitamin will remain intact.

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