

Detail Study of Parabolic Solar cooker SK-14

Adil Ahmed.S.¹, Dr. N.S.Prasanna Rao², Dr. P.L.Srinivas Murthy³, Bheemarayappa.P.Terani⁴

¹Assistant Prof, Mechanical Department, M S Engineering College Bangalore, Karnataka, India

²Professor, Mechanical Department, MSRIT Bangalore, Karnataka, India

³Professor, Mechanical Department, MSRIT Bangalore, Karnataka, India

⁴PG Scholar, Mechanical Department, MS Engineering College, Bangalore, Karnataka, India.

Abstract - Solar energy is available everywhere for free of cost. Sun's 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.

Key Words: Parabolic reflector, ambient temperature, solar radiation.

1 INTRODUCTION

In an attempt to find alternative sources of fuel, solar energy utilization is a big milestone as it is available free everywhere and it costs nothing. The only thing we need to do is to collect it in efficient way and convert in to required form. Solar parabolic cooker is one which collects the light and concentrates at small area so all thermal energy is utilized uniformly over blackened cooker which is specially designed for it. The advantage of using solar cooker are, it emits no harmful gases, nor reason for global warming, it is very environmental friendly. Mainly it is freely available and inexhaustible energy source.

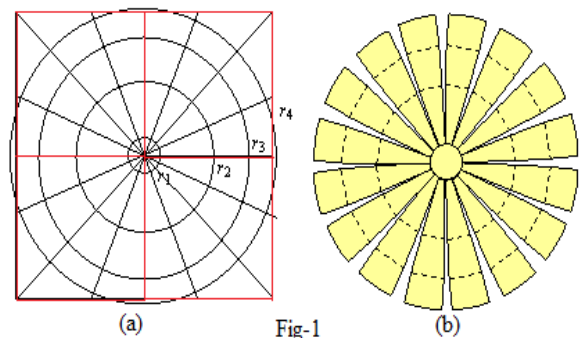
2. Fabrication

Reflectors are most important parts in parabolic solar cooker.

For unattended cooking of 2 hour 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 squire 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)	75	254	400	528
Arc Length (mm)	0	11	29	50

Table-1

Each square is divided in to 4 parts at an angle of 22.5° aparts 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 main support frame.

Reflector material has reflectivity of 75%. Figure-2 shows assembled unit of parabolic SK-14 solar cooker.

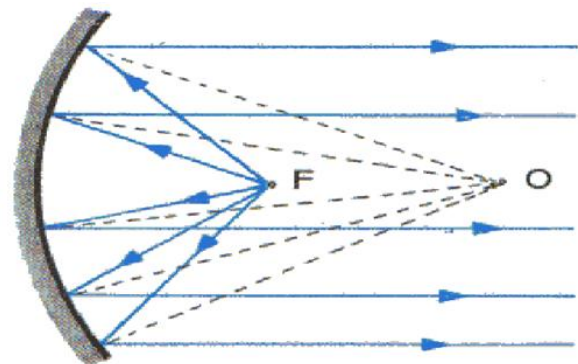
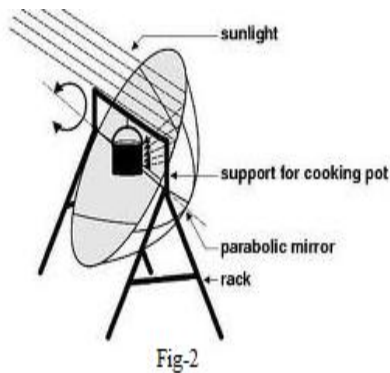
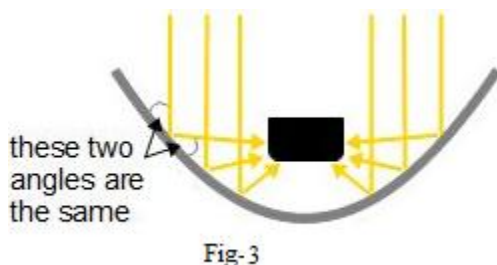


Fig-4

3. Working principle

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



4. Experimental details

Empty vessel made from Aluminum with black colour 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.

Quantity & items	Time for Cooking(min)	Avg solar radiation(W/m ²)
250ml water + Rice 100gm	20	686
Rice 100gm+ water 205ml+daal 30gm	40	675
400ml water + 100ml milk	35	710
100 ml milk	10	700

Table-2 experimental details

5. Conclusion

SK-14 cooker is ideal for large family as it can provide sufficient temperature for cooking. Many food items can be prepared in one to two hour at bright sunshine days. At morning hours ambient temperature affects its performance but at sunshine hours due to high surrounding temperature it has high efficiency. Main advantage is that, sun tracking mechanism though it is manual but it can increase cooking time quite bit more. Later on it can keep food stuffs warm. Parabolic cooker can cook food faster than box type cooker. This concentrating cooker heats the vessel uniformly so no burning and food vitamin will remain intact.

Reference

- [1] Domestic parabolic Solar Cooker (manual) by Prof Ajay Chandak
- [2] Solar Energy: Principles of Thermal Collection and Storage by S P Sukhatme and J K Nayak
- [3] Solar Energy Utilization by G D Rai
- [4] The sunny side of cooking by LissaRayner
- [5] Solar Energy: The Ultimate Renewable Resource by Bharik Shah
- [6] Solar Energy Materials & Solar Cells by C M Lampart(International Journal)
- [8] Solar Radiation & Daylight models, Book, by Muneer
- [9] Status of Markets for Solar Thermal Power Systems, Arthur D. Little, Cambridge
- [10] Solar Energy Engineering, Book, 2009, by Kalogiross

- [11] Thermal Performance of a novel rooftop Solarmicro Concentrating Collector by Tanzeem Sultana & Graham L Morrison
- [12] Dr.ByreGowda, Ph.d Thesis.
- [13] Solar Energy Conversion , Book, 1995, by Nerille
- [14] Morse, F.H., and M.K. Simmons, 1976, "Solar Energy," Annual Review of Energy1:131-158, Palo Alto, Calif.
- [15] Prediction of global solar irradiance based on time Series analysis: Application to Solar thermal power plants energy production planning [Luis Martin, Luis F Zarzalejo, Jesus Polo]

BIOGRAPHY:



Adil Ahmed S is Assistant Professor of Mechanical department at M S Engineering College, Bangalore. He has completed M-Tech at Gousia College of Engineering and presented journal papers in international research journals. He has teaching experience of 16 years and 1 year industrial experience. His area of interest are composite and smart materials.



Dr. N S Prasanna Rao is Professor in Mechanical Department at MSRIT. He has 21 years of teaching experience. There are many international research journals with his name. His area of interest is CFD.



Dr.P L Srinivas Murthy is Professor in Mechanical Department at MSRIT. He has 29 years of teaching experience in same college. Materials are special interested field and there are many international journal papers on these.



Bheemarayappa P Terani is PG scholar (Machine Design) Department of Mechanical Engineering M S Engineering College, Bangalore. His area of interest is automotive engineering.