A Review on "Experimental analysis of effect of cooker base coating material on the performance of solar cooker"

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Abstract - *Solar energy is very large, in exhaustible source of energy. The use of renewable energy is receiving growing interest worldwide. Cooking is the measure necessity for people all over the world. The power from the sun is 1.8×10[11] MW on the Earth is thousand times greater than all other commercial sources of energy available on the Earth. Everybody demand clean and safe energy devices with cost effective. Its use do not effect on the pollutants to the environment and green house gases. Also in solar cooker device if black material coating is done for receiver it improves the efficiency of system and it also increases the temperature of cooker for cooking. Black coating improves the absorbptance of the receiver surface. Black coatings for solar applications are particularly presented and discussed. In this review paper, designing and fabrication of a Concentrated Parabolic Solar Dish concentrated on the Experimental analysis of effect of cooker base coating material on the performance of solar cooker.*

Key Words: *Keywords: Solar cooker, concentrator type parabolic solar dish, aluminium, black material coating.*

1.INTRODUCTION

Cooking in a rural area mainly depends upon conventional energy sources such as cow dung, wood, coal etc. Solar cooking can play an important role in rural areas for cooking. Solar cookers are rather important applications in thermal energy conversion.

The use of solar cooker for cooking purposes is spreading widely in most of the developing countries and in particular in villages. The solar cooker must be affordable, user friendly, light weight, working cost is low. These traditional methods are not only inefficient but also cause indoor pollution. In India large number of rural households is still dependent on bio-fuels for cooking purpose.

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1. Literature Review

1.1. Literature survey for the solar cooker

Parabolic Collector design and fabrication

In case of cylindrical parabolic concentrators solar cooker fluid temperature up to 400C can be achieved in cylindrical parabolic focusing collector system this still higher working temperature is possible by using parabolic reflector this cooker is referred to as a dish solar cooker temperature up to 200C are obtained in it and it can be used for cooking food item requiring roasting, frying or boiling the disadvantage of a dish cooker is that it requires manual tracking every 15 or 20 minutes. Also since the cooking is done outdoors, the operator has to spend a considerable amount of time in the sun.

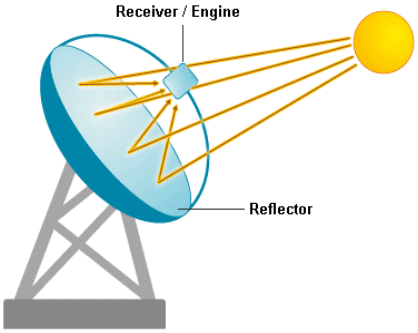

Figure 1.concentrated solar dish

The world's largest steam cooking system based on scheffler reflectors has been installed at tirumala tirupati devasthanam Andra Pradesh the specification on this system are follows.

Capacity: food for 15000 people per day.
No. of reflector: 106 each of 9.2 m2 area.
Reflector material: acrylic mirror.
Output: 4000 kg of steam per day at 180 c and 10 bar.[1]

In this research, parabolic solar cooker designed. The aperture diameter of the parabolic dish 1.4m, depth 0.4m, focal length 0.30m had fabricated. In that the use a different water load from half, one and two litre along with required quantity of the rice. These cookers was tested for the two conditions means No load condition and load condition. The experimental results show the thermal efficiency, solar radiation, temperature of the reflector, pot, ambient temperature. In this along with this the cooking power and standardized cooking power is also calculated. The concentrating type of solar cooker is further sub divided into parabolic dish cylindrical, spherical. this type of cookers usually employs reflectors/mirrors to concentrate the total

solar energy incident on the collector surface is usually very wide and the temperature achieved is very high. Parabolic dish cooker has the highest eff. In terms of utilization of the reflector area because in fully steerable dish system there are no losses due to aperture projections effects.[2]

Technical specification of the fabricated parabolic solar collector

Sr.no	Parameter	Technical details
1	Materials of reflectors	Bright anodizing aluminium sheet
2	Reflectivity	Above 80%
3	Size of focal point	100 mm
4	Focal length	280 mm
5	Dimension and shape	1.4 m dia. ,parabolide
6	Surface area of reflector	2.2 m2
7	Aperture area of reflector	1.5 m2

Fig 2 concentrating type of solar cooker[2]

Material for the Body of the Dish Aluminum material was selected because of its lightness, lower cost, ease of fabrication and energy effectiveness in use of material. The reflectivity of the aluminum material is more than 85% the absorber plate material should have high thermal conductivity and compressive strength and good corrosion resistance. Copper is generally preferred because of it's extremely high conductive and resistance to corrosion. Other suitable materials for the absorber plate are aluminum.
Material for the body of the dish

Steel was selected over aluminium because of its strength, durability and energy effectiveness in use of material. Energy consumed to produce steel is estimated to be 16500 kj/kg compared to that of aluminium of 141000 kj/kg.
Material for the absorber

Aluminium was selected over copper and steel because of its lower cost, light weight and ease of fabrication. Its light weight reduces the overall weight of solar cooker.[3]

Properties of materials used for absorber [3]

Material	Density [kg/m2]	Specific heat [kj/kg]	Thermal conductivity [watt/mc]
Aluminium	2707	0.996	204
Iron	7897	0.452	73
Steel	7833	0.465	54
Copper	8954	0.383	386

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The concentrating solar cookers primarily consists of a reflector to focus the incident solar radiation on the cooking pot, a support with turning mechanism to keep the reflector facing the sun and a cooking pot. Hence the cost and size of reflector is determined by heating capacity desired. Following are the important types of concentrator type solar cookers Wisconsin solar cooker (Spherical parabolic type).Folding Umbrella type solar cooker. Parabolic type solar cooker. Light weight molded aggregate reflector type solar cooker. Cylindrical parabolic solar cooker Multi- mirror or Multi-facet type solar cooker g) Spiral reflector type solar cooker. Out of these cookers only Paraboloid type solar cooker have received the commercial attention. [5]

1.2Literature survey for Surface Coatings

Black electroplating the thermal behavior of black anodic coating on magnesium alloy and revealed that the thermal emittance of coating increases with temperature

Phosphate is the most widely used metal pretreatment process for the surface treatment and finishing of ferrous and non ferrous metal in the automobile process and appliances industry due to its economy

Zinc plating using new single deep black chromate conservation coating delivers better corrosion resistance. Zinc electroplated on aluminiun surface using electrochemical conversion coating technique execute better optical properties

The new phosphate black was developed by jeeva et al for improving the life time of machine.

Solar selective coating

Selective coatings are those which are having optical properties of reflectance, absorbance, transmittance and emmitance spectrally the dependant, in other words which vary significantly wavelength so that the collection of thermal energy is correspondingly enhanced.

A selective absorber surface, for successfully operational using solar thermal system, must possess as many of the following characteristics as possible: high solar absorbtance (absorptivity > 0.90), low thermal emittance (emmisivity < 0.20), large angle of acceptance long term stability at desire operation temperature and environmental conditions.

Selective solar layer on absorber for solar collector improve the air thermal eff. A high solar absorbtance in the wavelength range 0.3 to 2.0 micro mm and a low thermal emmitance in a wavelength range of 2to 20 micro mm is needed an ideal solar selective(solar absorber) coating must have high solar absorbtance and low emmitance.

A solar selective coating consist of nickel, zinc and zinc sulphide is then obtained.[6]

In this paper review takes place on the black coating. Black coatings are widely used in numerous applications e.g., decorative coatings, solar panels, optical instruments. The films are mostly prepared by liquid phase deposition or vapour phase deposition. In this paper we review the techniques of deposition and the properties of the most important black coatings. Optical properties are particularly presented and discussed[7]

Which combine high absorptivity for sunlight with low emissivity for the reradiated infrared energy a black object is made from a material that absorbs all incoming light. In reality objects which look black reflect always some light and consequently the ideal black object does not exist.[8]

Coated and Non-Coated Solar absorber (Cooker)[8]

Use of black coating

Selection of the coating for the receiver surface is based on the following conditions the selected coating surface should consider the following properties.

1. Receiver should be good absorber of heat energy.
2. Receiver should have high thermal conductivity
3. Receiver should have low thermal resistance.
4. Receiver should not be corrosive.
5. Receiver should withstand high temperature.

Black coating improves the radiation absorbance of the receiver plate.[9]

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2. Problem Identification

i. conventional solar cooker is generated less pressure
ii. Time required for heating cooker is not satisfactory.
iii. Solar surface coating collect little diffused radiation depending on concentration.

3. Conclusion and Discussion

The following conclusion might be drawn from this project.

It is observed that system producing steam for solar heating of water will be very useful in the industrial and commercial sectors this system can help to reduced the load the fossil fuel energy used to steam generation also will the help of black coating it is to achieve boiling temperature as well as to improve the efficiency of the system receiver surface temperature increases

The solar cooker is always capable of cooking food within the expected length of time and based on the solar radiation levels.

The bottom portion of the cooking vessel is directly exposed to the solar radiation and the remaining parts of the cooking vessel are having contact with the atmosphere.

With minimum cooking power, the coated pressure cooker of capacity cook's the food at faster manner. This is due to the conductivity of the coating material provided in the cooker. Using coated surface cooker given more efficiency.

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