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STUDY ON IMPROVING PERFORMANCE OF SOLAR COOKER BY USING DIFFERENT COATING MATERIAL

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Abstract- Day by day demand of the energy increasing in all over the world. Solar energy is very large, in exhaustible source of energy. The use of renewable energy is receiving growing interest worldwide. Everybody demand clean and safe energy devices with cost effective. One of the most essential energy needs for human living is for cooking. In India mostly rural sector uses Biogas, Kerosene, and LPG for cooking. According to the World Health Organization comparative risk study, exposure to smoke from household use of solid fuels is responsible for the premature deaths of approximate 400000 women in India every year.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. This project paper is Improving performance of solar cooker by using different coating material.

Keywords—Solar cooker, concentrator type parabolic solar dish, aluminum, black material coating.

I. 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

Cooking fuels

The below graph shows Global greenhouse gas emissions in percentage caused from different cooking fuel like wood, wood stove, root, kerosene, LPG, electricity, charcoal, dung, crops and coal. Wood is the maximum used fuel for cooking up to 45% globally. Coal is another fuel used for cooking in 16%.

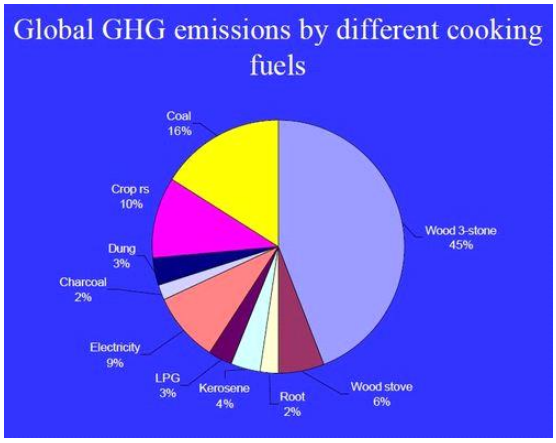

Fig:-1 Global GHG emissions by different cooking fuels

Cooking Energy Scenario in India

Table No.1 Cooking energy scenario in India

Sr. No.	Urban Sector	Rural sector
1	LPG (47.96%)	Firewood (64.10%)
2	Firewood (22.74%)	Other sources of biomass-crop residue (13.10%)
3	Kerosene (19.16%)	Cow-Dung (12.80%)
4	Other Fuels (10.14%)	LPG (5.67%) is now Increasing in importance

Air Pollutance with Cooking

Berkeley report explained the indoor air pollution. The indoor smoke poses serious health threats. Because of poor ventilation in the homes, exposures to particulate matter, along with carbon monoxide, nitrogen dioxide, and other gases. This Exposure is very dangerous for the human health. Because of this pollutant ion number of serious defects enters in to the human body by breathing.

2 Principle of Solar Cooking

Most solar cookers convert sunlight to heat energy that is utilized for cooking. The ability of a solar cooker to collect Sunlight is directly related to the projected area of the collector perpendicular to the incident solar beam radiation. The geometric concentration ratio is defined as

$$C = Aa/Aabs$$

Where,
Aa:- is the total collector area and
Aabs:- is the area of the receiver/absorber surface

3. Fabrication of Experimental Set up

The various elements of the setup (Parabolic Concentrating Solar Cooker) are as follows:
1] Design of Concentrated Solar dish
2] Manual tracking mechanism
3] Selection of the material for the experimental set up

3.1 Design Parabolic Solar Dish

The various factors taken into consideration for formulating the primary reflector are
1] Diameter of the Reflector (Dish) = 1.4 m
2] Diameter of the Absorber (Cooker) = 0.213m

Design specification of the concentrated solar dish

Table.No2. Design specification of the concentrated solar dish

Sr. no	Description	Sizes
1	Concentrated type	Parabolidal
2	Aperture area	1.539 m2
3	Aperture diameter	1.4 m
4	Focal length	0.35 m
5	Absorber diameter	0.213
6	Absorber area	0.03563 m2

3.3 Selection of the material for the Experimental set up

3.3.1 Material for the Body of the Dish

Aluminium 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%

3.3.2 Material for the Absorber

Aluminum was selected over copper and steel because of its lower cost, light weight, ease of fabrication and energy Effectiveness in use of material. Although copper having good thermal conductivity but cost is high. So Aluminum material was selected because of the good thermal conductivity.

Table No. 3 Properties of metals used for absorber plates

Material	Density (kg/m2)	Specific heat (kJ/kg)	Thermal Conductivity (W/m0c)
Aluminium	2707	0.996	204
Iron	7897	0.452	73
Steel	7833	0.465	54
Copper	8594	0.383	386

3.3.3 Material for the Absorber Surface Coating

Table No 4 Material for the Absorber Surface Coating

Sr. no	Selective coatings	absorptance	emmitance
1	molybdenum	0.56	0.21
2	Black chrome	0.93	0.1
3	Black nickel	0.92	0.11
4	Black paint	0.98	0.98
5	Magnesium oxide	0.09	0.90

The choice of the selective surface coating is on the basis of the absorbance and the Emittance of the material. Black Nickel and Black Zink Black Paint material is selected on the basis of availability, cost and absorbance and Emittance
Percentage.

3.3.4. Material for the Vertical Support of the Dish

The vertical support is required to dish which is given by iron rod. This is selected by the strength and cost basis.

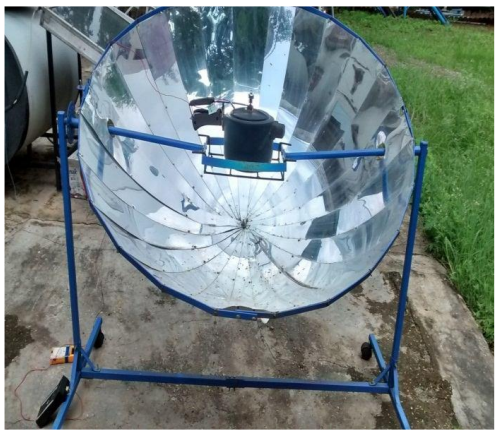

Fig.2 Material for the vertical support of the dish

4. Benefits of the Solar Cooking

a) No Smoke inhalation
b) Minimal water requirement
c) Reduced surveillance
d) No risk of burning the food
e) No soot accumulation on pots
f) No worry about fire
g) No burns from fire or coals.

5. Calculate

I. Thermal Efficiency for coated and non coated cookers.
II. Cooking power of coated and non coated cookers.
III. Checking performance for coated and non coated cookers.

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