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Performance Analysis of Scheffler Solar Concentrator for Cooking Purpose

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Abstract - The parabolic dish solar collector is very useful for all solar energy applications such as heating purpose, cooking purpose, power generations, etc. The experimental investigations were carried out to determine the performance of concentrating parabolic dish collector with different polymeric reflecting films as a reflector. There are three polymeric films use such as an aluminum polymer, silver polymer, and gold chrome polymer film. A parabolic collector having aperture diameter, depth, focal height and point for fabrication. The pot was filled with a suitable quantity of rice. The solar radiation, pot temperature, ambient temperature, cooking time and temperature were recorded. The thermal efficiency, useful energy and cooking power are calculated.

***Key Words*:**solar ,renewable energy.focal point Efficiency cooking power

1.INTRODUCTION

India is full of Solar Energy. We are very fortunate in the sense of solar energythat we get solar energy in excess amount. So it is necessary to utilize the solar energy in proper way. As India is 2nd largestcountry in the world in population. With increasing population we should also fulfil the demands of peopleregarding the energy. Scheffler is an alternative for high cost or unavailability of commercial fuels –Kerosene, Coal, Gas, Electricity. Many industrial process like drying, heating,process heat, etc. can also done with Scheffler.

2. Body of Paper

Solar energy is one of the best renewable energy sources which is easily andfreely available all over the world

• The Scheffler Reflector, named after its inventor, Wolfgang Scheffler. Aconcentrating primary reflector tracks the movement of the Sun, focusingsunlight on a fixed placeSolar energy is one of the best renewable energysources which is easily and freely available all over the world.

• In a world population, solar energy is contributing to major energyrequirements. If the majority of the populace use cleaner and environmentallyfriendly sources of energy like solar and wind,

• it is based on the principle of the concentration of the rays. The solar energy isconcentrated on a point of a pot surface hence it's attaining a hightemperature and giving a good efficiency

Fig -1: Figure

SELECTION OF MATERIALS

- Steel material
- Pot for cooking (pressure cooker)
- Food rice and water
- Silver reflective material
- Temperature measuring instrument

I. **THEORY**

The parabolic collector uses solar radiation directly and
heating at its focus which placed a pot.

Optical concentration (C0):
It is the ratio of solar intensity of the absorber to solar intensity of the collector.

C0 =Ir/I0
Where,

Ir = Solar intensity of absorber, in W/m2
I0 = Solar intensity of collector, in W/m2

Geometric concentration (C):
It is the ratio of aperture areal dimension of parabolic collector to absorber surface area.

C=Aa/Aab
Where,
Aa = Aperture area, in m2
Aab = Absorber area, in m

Focal point

the focal point is the point at which light waves travelling parallel to axis of the parabola meet after reflecting off its surface.
F=x2/4a
Where,
x= Radius of the collector, in mm
a = Depth of parabola, in mm

Rice cooking Main Process

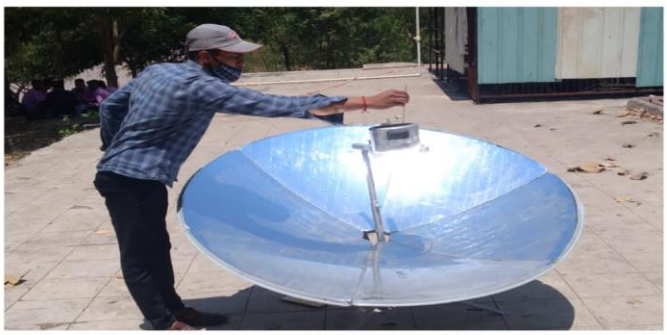
For testing we take specific quantity of rice and water in cooking pot and put on receiver stand

Then we adjust focal point according to our requirement

Our solar concentrator is mannually adjustable
Then we adjust focal point according to sun rays

And we take reading 3 in day different amount of rice and water

Our photos of during testing and recording readings



DAY 1

Reading for 100gm rice and 250ml water

Time	Cooking time	Ambient temp	Cooking temp	Solar radiation	Pot temp
10to11	47	39	80	660	103
12 to 1	42	37	81	855	110
2 to 3	44	39	79	987	105

Using this we calculate following points

Cooking power (Pabs):
Pabs = [mw x Cpw x (Tc – Ta)] / tc eq. (7)
Where,
mw = mass of water (kg)
Cpw = Specific heat capacity of constant pressure of water, in kJ/kg K
Ta = Ambient Temperature, in °C
Tc = Cooking Temperature, in °C
tc = Cooking time, in min

thermal efficiency

Ƞ th = mf x Cpw (Tc – Ta)] / tc Aa Ib eq. (5)
Where,
mf = Mass of food, in kg
Ta = Ambient Temperature, in °C
Tc = Cooking Temperature, in °C
Aa = Aperture area, in m2
Ib = Standard average solar radiation, in w/m2
tc = Cooking time, in min
Cpw = Standard value = 4186 KJ/ Kg K

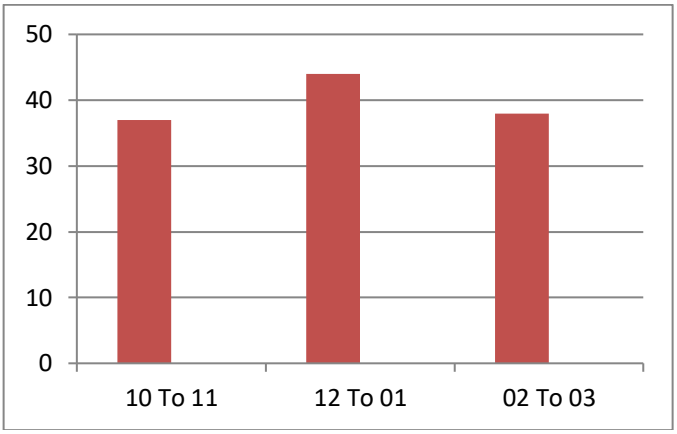
Useful energy (Qu):
Qu=Ƞ thIbAa
Where,
Aa = Aperture area, in m2
Ib = Standard average solar radiation, in W/m2

Using this formula we find out all data and arrange in tabular form as follows

Thermal performance of parabolic dish collector using silver

Time	Cooking power	efficiency	Useful energy
10 to 11	912	37	365
12 to 1	1096	44	438
2 to 3	951	38	382

This calculation is for day 1 reading observations



Graph for day 1 readings calculation

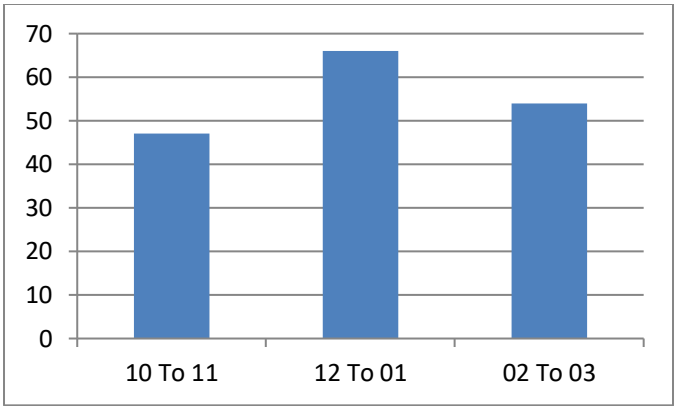
Next day we change cooking pot and take readings

DAY 2

time	Cooking time	ambient tem	cooking tem	Solar rad	Pot tem
10 to11	36	41	81	710	111
12 to 1	30	40	87	870	115
2 to 3	34	42	85	788	119

Calculation

Time	Cooking power	efficiency	Useful energy
10 to 11	1162	47	465
12 to 1	1639	66	655
2 to 3	1323	54	529



Graph of second day

We can try to minimize errors and take proper method readings

3. CONCLUSIONS

In this work, the parabolic dish collector was tested for cooking test purpose. In this work we understude in time 12 to 1 highest efficiency The graph shows variation in hourly cooking power of silver film, with time. From the above plot, it is also that the cooking power increases 12 pm -1 pm and it decreases 2 pm-3 pm.

The experimental and performance analysis of parabolic dish carried out with silver polymer filmas a reflecting material. Here we studied the useful heat gain, cooking power and thermal efficiency of reflecting materials. The analysis also indicates that thermal efficiency, cooking power, useful heat increases initially and thendecreases gradually along time. Another advantage of using a polymer film as a reflector is its weight less and also the filmsare cost effective

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