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Research Paper

BOX TYPE SOLAR COOKER

Engineering

KEYWORDS : cooker, solar panel.

DINESH KUMAR.C.M	Final Year Mechanical Engineering,Saveetha School of Engineering,Saveetha University-602105 chennai
BOOBALAN.D	Final Year Mechanical Engineering,Saveetha School of Engineering,Saveetha University-602105 chennai
KOHUL RAJ.M.K.M	Final Year Mechanical Engineering,Saveetha School of Engineering,Saveetha University-602105 chennai
ALWIN.P	Final Year Mechanical Engineering,Saveetha School of Engineering,Saveetha University-602105 chennai
DEEPAK.S	Final Year Mechanical Engineering,Saveetha School of Engineering,Saveetha University-602105 chennai
R.Karthikeyan	Assistant Professor Mechanical Department, Saveetha School of Engineering, Saveetha University-602105 Chennai.

ABSTRACT

Solar energy is the most abundant form of energy on earth. Harnessing this energy may be of abundant importance to mankind as this energy is renewable. The main objective of this project is to cook food by using solar energy instead of electricity or fuel. A box type solar cooker is designed here at an economically affordable cost. This is accomplished with a simple design consisting of easily available components. The designed device has been tested for efficiency and the scope for future work has been realized.

1. INTRODUCTION

SOLAR ENERGY

Solar energy, radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaic, solar thermal electricity, solar architecture and artificial photosynthesis.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy Active solar techniques include the use of photovoltaic panels and thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air

2. TYPES OF SOLAR COOKER

BOX TYPE SOLAR COOKER

The most common and popular variety is probably the box cooker. Its design is based on the concept of a traditional modern oven where the food is placed inside of an insulated box for purposes of retaining or trapping the solar rays that have been converted to heat energy.

Reflector panels are usually added for purposes of concentrating the sun's rays toward the cooking pot and food for higher cooking temperatures and effectiveness.

These cookers can typically reach temperatures of 300° F (150° C) which is plenty hot to cook any food you would like. Food containing larger quantities of moisture cannot get much hotter than 212° F (100° C) so it is not necessary to cook at higher temperatures.

3. WORKING PRINCIPLE

The solar radiation diffused in air through the atmosphere reaching the solar cooker is of short wavelength and can therefore enter through double glazed glass panel inside the box which is blackened by a dull black paint and kept insulated from all sides and made airtight.

The solar radiation after entering the box through the glass panel is absorbed by the blackened surface and the cooking utensils and transformed into thermal radiation. The thermal radiation has longer wavelength and hence it is not possible for the thermal radiation to pass back through the glass sheets and so trapping the heat wave inside the box.

This reduces the loss due to radiation, minimizes the loss due to conduction on the back side of the black painted tray. It is necessary that the inside of the box is packed all around with insulating material like glass wool or paddy husk.

For reducing the convection loss the box should be made airtight by putting rubber beadings between the covers and the box and the covers. After a number of trials it has been found that it is possible to reach 105 degree to 120 degree Celsius in about half an hour time using this type of cookers. The box type solar cooker is shown in fig 2.1.

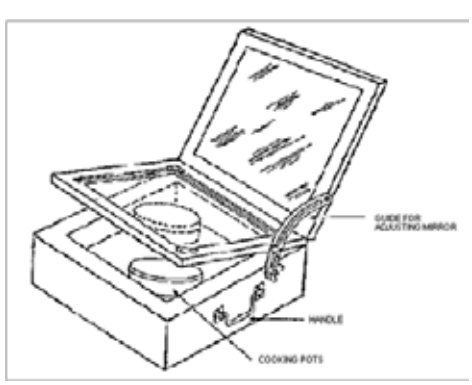

FIG 1 THE BOX TYPE SOLAR COOKER

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4. MATERIAL REQUIREMENTS & SPECIFICATION OF THE COOKER

There are three types of materials that are typically used in the construction of solar box cookers. A property that must be considered in the selection of materials is moisture resistance.

A. Structural material
B. Insulation
C. Transparent material
D. Moisture resistance

SPECIFICATION OF THE COOKER

1. wooden box=24inc/24inc and a height of 6 inc – 1 num.
2. 3mm plain glass= 24inc/24inc – 1 num.
3. 4mm thickness plain glass= 24inc/24inc – 1 num.
4. Castor wheel – 4 num.
5. Aluminium vessel – 2 num.
6. glass wool – 5 kg.
7. aluminium tray= 24inc*24inc.
8. ply wood= 6mm thickness.
9. plywood= 24inc*24inc= 4 num and 10 inches = 5 num.
10. black board paint = 0.5 litres.

COST OF THE PROJECT: RS.6000

5. RESULTS AND CONCLUSION

TEST RESULT

Routine Test:

i) Inner box leakage test (by filling water, then joints are examined): No sign of leakage

ii) Cover gasket leakage test (By inserting pieces of papers in four positions in each side of the cooker below the cover plate, after properly tightening the cover plate, the paper pieces should exhibit a firm resistance at the time of withdrawal by hand): No sign of leakage

iii) Leakage test of upper side of cover plate (by pouring a thin film water on the cover plate and then by examine the cover plate for any sign of water entry between the glass sheets): No sign of leakage

iv) Leakage test of lower side of cover plate (after boiling of water in cooking pots by solar heating and then by keeping the cooker in shaded location to allow the vapour to condense, there should be no sign of vapour entry between inner and outer glass sheets of the cover plate): No sign of leakage.

V) Temperature test for paint on inner box, cooking tray and cooking pots at 160 degree Celsius for one hour and temperature tests of cover gasket, cover glass and insulation at 200 degree Celsius in electric oven: No sign of damage or crack

Performance Test of Proposed Cooker:

1. Test timing, from 10 am to 10:40 am

Ambient temperature- 21degree Celsius

Intensity of solar radiation during test period: 0.55kw/sqmt/per hour

Peak temperature of the top cover of empty cooking pots 148 deg Celsius

2. Test timing, from 10.30 am to 11:10 am

Time taken for boiling of 4 liters of water in cooking pots (1 liter in each pot) 105 minutes. Inlet water temperature- 22 degree Celsius

CONCLUSION

Detailed constructional methodology along with some cost and performance figures are narrated in developing the presently proposed solar cooker. The cooker, presently fabricated can able to cook 2 Kg rice or equivalent food item at a time within two hours cooking is possible in between 9am to 3 pm.

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