

# Experimental Investigation on Solar Box Type cooking Device for Sustainable Development of Rural Area

Generally in Rural area, people cook foods by using conventional methods such as Chulha which produces lots of smoke. This results respiratory problem. The present research objective is to develop a solar operated box type of solar cooker as an alternative and cleaned energy solution for rural area. The main component of this cooker is a folding type reflector made up of Aluminium (highly glazing material) which transmits all radiation and focus into the cooking chamber. There were six numbers of reflector integrated and focuses incident radiation individually to one point so that heating effect was increased. It is light weight and can be easily handled. The maximum temperature found as 100°C and cooking power and standard cooking power were calculated as 17.5 W and 17.09W respectively which are sufficient enough for cooking.

Due to increasing population, better living standard, growth of urbanization, the global energy demand is increasing. At the present situation, due to less reservation of fossil fuel as per environment concern, the renewable energy is made for substantial contribution to the future domestic and industrial economies.

Due to unavailability of electricity and conventional cook stoves (which causes health problem), the present research aims for alternative cleaned technology in rural development.

## *2. Experimental set up:*

The figure 1 shows the experimental set up of solar cooker which consists of folding type of reflector, transparent or cover plate and absorbing plate. There were six numbers of reflectors made up of Aluminium materials (glazing type, 3 mm thickness) integrated with each other and fixed on the top of the cooker. The main reason of taking number of reflectors in order to achieve as much as incident radiation to focus on one point. The transparent plate made up of tempered glass was used to transmit the all the incident radiation to absorbing plate. The interior area of the cooker was black painted as well as absorbing plate in order to absorb maximum radiation convert into heat. The box was made slope with an angle of 20° and was faced towards south direction. At the bottom of cooker glass wool having 1 inch was provided for reducing heat loss and acting as an insulator. The cooker had bottom dimension of 16 Inch×16 Inch, front dimension 16×8.5 Inches, back dimensions 16× 12.5 Inches, glass dimensions 16×16 Inches, dimension of reflector was 17.5 ×19.75 Inches.



Figure 1. Experimental setup of Solar box type of cooker. (1). Transparent or cover plate, (2) Reflector(4 numbers), (3).Temperature sensor, (4) Lux meter.

Figure 2 . The interior part of the cooking chamber painted black.

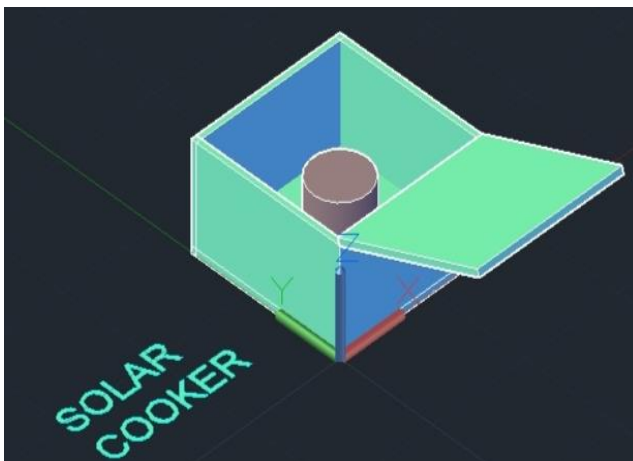


Figure 3. The catia modelling of solar cooker

### 3. Result and Discussion

The performance of solar cooker can be tested by placing it in open area where maximum solar radiation was available and without shadow effect. The cooker was faced due south throughout the day. With in regular interval of time the temperature was measured with the help of temperature sensor which was fixed within the cooker. At the same time solar radiation was measured with the help of Lux meter. For testing purpose the water was taken. The table 1 represents the testing data of cooker in a sunny day.

Si no	Timing (AM/PM)	Temperature in 0c	Intensity of solar radiation in LUX
	09:30AM	85	71400

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1			
2	10:40 AM	90	71900
3	11:00 AM	95	72500
4	12:20PM	100	80900
5	1:00 PM	100	73600
6	2:20 PM	60	53600
7	3:30 PM	50	12300
8	4:00 PM	50	12000

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The cooking power can be calculated by using the formula=  $M_{\text{water}} \times C_{\text{water}} \times (T_2 - T_1) / \text{time interval taken}$

Given  $C_{\text{water}} = 4.2 \text{ J/g}^\circ\text{C}$  or  $4179.6 \text{ J/KgK}$

Putting  $T_2 = 100^\circ\text{C}$  and  $T_1 = 95^\circ\text{C}$ ,  $M_{\text{water}} = 1 \text{ Litre}$ ,

Cooking power was calculated as  $17.5 \text{ W}$

Similarly standard cooking power was calculated as by multiplying standard intensity of solar light =  $700 \text{ W/m}^2$

$[M_{\text{water}} \times C_{\text{water}} \times (T_2 - T_1) \times 700 \text{ W/m}^2] / \text{time interval taken} \times g$ , where  $g = 9.8 \text{ m/s}^2$

Standard cooking power found =  $17.09 \text{ W}$

#### 4. Conclusion

The present experimental investigation is to use the box type solar cooker, an alternative solution for conventional method of cooking. The cooker is light weight and easily handled and it has one folding type reflector. In the experimental study the highest temperature found  $100^\circ\text{C}$  which is sufficient enough for boiling water or cooking food. The design of cooker can be modified by using of two numbers of cover plates in order to increase efficiency for future scope. And it can be used in night purpose by implementing storage devices.