Extensive Performance Evaluation of Dual Booster Mirror Solar Cooker under Tracking Free Conditions

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Abstract—The aim of this research work is to conduct an extensive performance evaluation of a box type dual Booster Mirror solar cooker under tracking free conditions. To cope up with the need for continuous adjustment of the cooker during the cooking operation the optimal tilt angles of the Booster Mirrors have been calculated through numerical calculations for the location of 34° latitude. To evaluate the Performance parameters of the cooker, tests under tracking free conditions have been carried out and parameters such as, First and Second Figure of Merit, Cooking power, exergy efficiency and the Quality Factor, are evaluated for the BSC. Moreover, the cooker is tested on-field and different types of food items are cooked. The results indicate that orienting the Booster Mirrors at their respective optimal angles provides a viable and convenient alternative to the need for continuous tracking of the sun during cooking hours. With this technique the said cooker can be used for cooking 6.4 kg of 6 different dishes in a single day i.e. from 9:00 Am to 3:00 Pm in two batches.

Keywords—Optimal tilt angles, Box Type Solar Cooker, Tracking free conditions

I. INTRODUCTION

Cooking counts as one of the major fuel consuming activity in the world. Conventional cooking poses a major threat to the forests since, approximately two-third of the developing country’s population depends on firewood for their daily cooking and heating needs [1]. Solar cooking is a renewable activity that utilizes solar radiation to cook food. Solar cooking is a cost free, environment friendly, and convenient replacement for conventional cooking practices. Among all the types of solar cookers, box type solar cookers are the most preferred ones because of their lower cost and simple design. SBC utilizes the greenhouse effect to cook the food. Typically, a SBC has two transparent plan mirrors that act as the lid of the cooker box. Food is placed in the cooker box and the lid is closed under airtight conditions. The temperature of the air inside the cooker box is increased because of the greenhouse effect and thus the food inside the box starts cooking. The two BMs having the same size as the aperture of the SBC are mounted on both the edges of the SBC. These BMs direct the solar radiation onto the aperture of the SBC, thus making extra radiation fall on the aperture and thus speeding up the cooking process. The main disadvantage in SBC is the need for adjustment after every 15-30 minutes during the cooking operation due to change in the solar azimuth angle. The need for the solar tracking, makes the cooking process more hectic especially when the cooker is loaded, and is a major hurdle in the mass adoption of the SBC for cooking purposes [2].
A. The Dual Booster Mirror Solar Cooker

![The DBM solar cooker](image1.png)  
Figure 1: The DBM solar cooker with length L and width W and the BMs inclined at their respective angles with the horizon, α represents altitude angle.

The DBM Solar Cooker has two booster mirrors attached to the edges of the cooker box. The direct solar radiation falls on the aperture of the cooker directly whereas the diffused radiation are reflected by the BMs onto the aperture of the cooker. The dimensions of the BMs are the same as that of the solar cooker’s base. The BM B-1 and B-2 are inclined at an angle of β and θ with the horizon respectively as shown in Fig. 1.

In order to make more and more diffused solar radiation fall on the solar cooker, the inclination of both the BMs should be varied every 15-30 minutes. To make the cooking process free of the need for solar tracking, the optimal tilt angles of both the BMs are found through numerical calculations. This section covers the analysis of the solar radiation harnessed by both the BMs for 3 hours before and 3 hours after the solar noon, from 9:00 am to 3:00 pm, which is considered to be the most optimal time for solar cooking.

The solar altitude angle at an instant is given by

\[ \alpha = \sin^{-1} \left[ \sin \delta \sin \phi + \cos \delta \cos \phi \cos \omega \right] \]  
(1)

Where as the hour angle \( \omega \) is shown by

\[ \omega = 15(t - 12) \]  
(2)

The solar declination angle is given by

\[ \delta = \sin^{-1} \left[ 0.39795 \cos \left( \frac{98563(N - 173)}{365} \right) \right] \]  
(3)

The value of N in equation (3) varies from 1-365 based on the number of the day of the year. As Fig. 2 shows, the BMs B-1 and B-2 are inclined at angles β and θ respectively with the horizon. W is the width of the BMs. As shown in Fig. 2, I is the solar radiation intensity on a horizontal surface at time t then the solar radiation intensity on a surface held normal to the Sun \( I' \) will be given by

\[ I' = \frac{I}{\sin \alpha} \]  
(4)

![The Booster Mirrors inclined at their respective angles.](image2.png)  
Figure 2: The Booster Mirrors inclined at their respective angles. W represents the width of the BMs.

The solar radiation intensity normal to the surface of B-1 which is represented by \( I''_1 \) as shown in Fig. 3. is given by

\[ I''_1 = I' \sin(\pi + \alpha - 2\beta) \]  
(5)

If ‘W’ represents the width of the solar cooker and \( W_1 \) represent the projection length of the reflected light on the horizontal surface then the solar irradiance attenuated by the horizontal surface equals the power per unit length reflected by the mirror. This statement is given by

\[ I'''_1 W_1 = I''_1 W \]  
(6)

\( I'''_1 \) represents the solar irradiance reflected by the B-1 onto the top surface of the cooker. As clear the incident radiation is making an angle \( (\beta - \alpha) \) with the mirror, this implies that the angle made by the reflected radiation with the horizontal surface of the top glazing will be \( (\pi + \alpha - 2\beta) \). Thus by the law of sines

\[ \frac{w}{\sin(\pi + \alpha - 2\beta)} = \frac{W_1}{\sin(\pi + \alpha - 2\beta)} \]  
(7)

By comparing equation 7 and 8 we get

\[ I'''_1 = I' \sin(\pi + \alpha - 2\beta) / \sin \alpha \]  
(8)
If the same analysis is carried out for BM B-2 it will give the results as

$$I''_2 = I_2' \sin(\alpha - \theta)$$ \hspace{0.5cm} (10)

$$I''_1 = \frac{I_1' \sin(2\beta - \alpha)}{\sin(\alpha - \theta)}$$ \hspace{0.5cm} (11)

$$W_2 = \frac{W \sin(\alpha - \theta)}{\sin(2\theta - \alpha)}$$ \hspace{0.5cm} (12)

Integrating \((I_2' + I''_1, W_1 + I''_2, W_2)\) for 9:00 Am to 12:00 Pm for the range of values of \(\alpha\) between \(0^\circ\) and \(90^\circ\) for the fixed values of \(\theta\) and \(\beta\), gives the total energy per unit length received by the solar cooker box. The values of \(W_1\) and \(W_2\) are calculated using equation (9) and (12). Thus the total solar energy attained by the SBC is gives as

$$E = \int_{t_1}^{t_2} (I.W + I''_1.W_1 + I''_2.W_2) dt \text{ joules} \hspace{0.5cm} (13)$$

B. Calculation of the Optimal tilt Angles for Booster Mirrors

The optimal tilt angles of the BMs are the angles at which, if the BMs are tilted, will give the maximum energy output for a specific day of the year. Since the extra terrestrial radiation intensity \(I_0\) on a surface held normal to the sun on a specific day of the year is given as

$$I_0 = I_{so} \left[1 + \frac{0.034412 \cos \left(\frac{2 \pi (N - 3)}{365.25}\right)}{N} \right]$$ \hspace{0.5cm} (14)

\(I_{so} : 1367\ W/m^2\)

\(N : \) Day of the year

The extra terrestrial solar radiation on a horizontal surface \(I_{oh}\) is given as

$$I_{oh} = I_0 \cos \theta_z$$ \hspace{0.5cm} (15)

\(\theta_z : \) Zenith Angle

\(\theta_z\), In terms of the solar altitude angle \(\alpha\) is given as

$$\theta_z = 90 - \alpha$$ \hspace{0.5cm} (16)

The extra terrestrial solar radiation when reach the earth atmosphere is reduced to

$$I = I_{oh} \times 0.7 A.M^{0.578}$$ \hspace{0.5cm} (17)

The Air Mass A.M is given as

$$A.M = \frac{\cos \theta_z + 0.50572(96.07995 - \theta_z)^{-1.6364}}{1}$$ \hspace{0.5cm} (18)

Using the SR intensities, as deduced by the equations 

(14)-(18) and (8)-(12), for a given location i.e. Latitude Angle, the last two components of Eq.(13) may be integrated between the minimum and maximum value of altitude angle i.e. the altitude angle at 9:00 am and at 12:00 PM respectively for specific value of \(\theta\) and \(\beta\) to calculate the total energy contributed by each of the two BMs. The most optimal values of \(\theta\) and \(\beta\) are achieved by repeating the integration for all possible values of \(\theta\) between 0° and 60° and for the value of \(\beta\) between 40° and 110° for which the total energy received by the cooker is maximun[2].

B. Experimental Results

The fore-mentioned calculations are carried out for location of 34° Latitude i-e Peshawar Pakistan for the DBM solar cooker and the values of the OTAs for a 34° Latitude location, if plotted against the days of the year will give the result as shown in Fig.4. The BMs B-1 and B-2, with a length of 1.0 m and width 0.5 m if inclined at their calculated optimal tilt angles will contribute to the energy gained by the cooker as shown in Fig.5. Fig.6 is the depiction of energy contributed to the SBC by both the BMs and the top glazing. Fig.7 shows the dual BM solar cooker with its primary Booster Mirror B-1 facing South. The dimensions of the SBC used for the evaluation of the dual BM Solar cooker are given in Table.1. The optimal values of the tilt angles for both the booster mirrors calculated through numerical calculations for the location of 34°Latitude are given in Table.1 and Table.2.
The dimensions of the SBC used for the analysis are given in Table 3. Fig. 7 shows the actual dual BM Solar cooker, with its primary BM facing South is shown in Fig. 7.

**Table 1: Optimal tilt angles of the booster mirror B-1 and their corresponding days for 34° latitude location**

| N  | $\beta_{opt}$ | N  | $\beta_{opt}$ | N  | $\beta_{opt}$ | N  | $\beta_{opt}$ | N  | $\beta_{opt}$ |
|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|
| 1  | 78             | 56 | 85             | 97 | 94             | 143| 100            | 237| 96             | 271| 89             |
| 12 | 79             | 61 | 86             | 102| 95             | 202| 101            | 245| 95             | 280| 88             |
| 24 | 80             | 66 | 88             | 108| 96             | 214| 99             | 251| 94             | 282| 87             |
| 33 | 81             | 72 | 89             | 116| 97             | 223| 98             | 255| 93             | 299| 84             |
| 46 | 83             | 77 | 90             | 126| 99             | 229| 97             | 258| 92             | 310| 82             |
| 51 | 84             | 84 | 91             | 130| 99             | 236| 96             | 263| 91             | 361| 78             |

**Table 2: Optimal tilt angles of the booster mirror B-2 and their corresponding days for 34° latitude location**

| N  | $\theta_{opt}$ | N  | $\theta_{opt}$ | N  | $\theta_{opt}$ | N  | $\theta_{opt}$ | N  | $\theta_{opt}$ | N  | $\theta_{opt}$ |
|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|----|----------------|
| 1  | 21             | 39 | 26             | 71 | 33             | 113| 43             | 180| 49             | 255| 38             |
| 7  | 21             | 44 | 27             | 79 | 35             | 116| 43             | 201| 47             | 263| 36             |
| 13 | 22             | 50 | 28             | 84 | 36             | 123| 44             | 211| 46             | 272| 34             |
| 19 | 23             | 56 | 29             | 89 | 37             | 129| 45             | 223| 44             | 305| 26             |
| 26 | 24             | 58 | 30             | 103| 40             | 137| 47             | 236| 42             | 319| 24             |
| 32 | 25             | 65 | 31             | 108| 42             | 159| 48             | 240| 41             | 365| 21             |

**Table 3: Dimension of the SBC**

| Height (cm) | Width (cm) | Length (cm) | Aspect ratio (length/width) |
|-------------|------------|-------------|----------------------------|
| 33          | 45         | 120         | 2.66                       |
For conducting the extensive performance parameters of the dual BM solar cooker, four tests were conducted. The first test was conducted on 7th May, 2019 under unloaded conditions. And the rest of the three tests were conducted on 14th, 20th, and 21st May respectively under fully loaded conditions. The capacity of the cooker based on the aperture area was 3200 g. The exact same amount of Water was used for standard testing of the cooker. the load was evenly distributed in three containers of the same size. For the unladen conditions the base temperature is noted until the point when there was no more rise in the base temperature. For the loaded conditions, along with the cooker base temperature, the food vessel’s temperature was also noted down. The loaded tests were kept going on until the water inside the vessels reached its boiling point. For all the experiments the ambient temperature and solar irradiance was also measured. The readings were measured after every 5 minutes. The irradiance meter used for measuring the solar irradiance was METEON 2.0 irradiance meter. The ambient temperature was measured with UNIT-T UT33D Multimeter. the results of the unladen test are plotted in Fig.8. The data of all the three loaded tests are plotted in Fig.9-Fig.11. since there were three containers used, the cooking vessel’s temperature at every instant is the average of the temperature of the three vessels. The solar irradiance measured for all the tests, if plotted against the solar time, will give the results as show in Fig.12
and is the ratio of the optical efficiency to the heat loss.

\[ \frac{\ln \left( \frac{T_f - T_{amb}}{T_i - T_{amb}} \right)}{H_s} \]

Since \( I_s \) is the instantaneous solar insolation, \( T_a \) is the ambient temperature, \( T_s \) is the temperature of the surface of the Sun, and \( A \) is the aperture area of the SC. The exergy out is given by

\[ E_{xo} = M C_w \left[ (T_f - T_i) - T_a \ln \left( \frac{T_f}{T_i} \right) \right] \]

For the purpose of finding \( F_2 \) the water is heated sensibly up to 100 °C. The second figure of merit is the measure of heat transferred from the absorbing plate to the water that is being heated inside the solar cooker. \( F_2 \) is given by

\[ F_2 = \frac{F_2(MC_w)^2 \ln \left[ \frac{(T_{wi} - T_{amb})}{H_s R_{av}} \right]}{A t} \]

The cooking power of a solar cooker is an indication of the rate at which heat energy is supplied to a specific mass of the food inside the solar cooker. The cooking power is given by

\[ q = \frac{M C_w \left[ (T_f - T_i) - T_a \ln \left( \frac{T_f}{T_i} \right) \right]}{t} \] (15)

The second term in equation (17) represents the exergy loss from the system. Exergy efficiency is calculated by dividing equation (17) by (16) Thus exergy efficiency is given by

\[ \varphi = \frac{M C_w \left[ (T_{wi} - T_{amb}) - T_a \ln \left( \frac{T_{wi}}{T_{amb}} \right) \right]}{t} \]

2. First and Second Figures of Merit (\( F_1 \) and \( F_2 \))

The first and second FOM are the thermal performance indicators of solar cookers. The first FOM is represented by \( F_1 \) and is the ratio of the optical efficiency to the heat loss factor. The first FOM is evaluated for the unloaded test and is given by

\[ F_1 = \frac{T_b - T_{amb}}{H_s} \] (13)

\( T_b \) : solar cooker base temperature

\( T_{amb} \) : ambient temperature

\( H_s \) : average Solar insolation (W/m2)

The second FOM \( F_2 \) is evaluated for the solar cooker under loaded conditions. For the purpose of finding \( F_2 \) the water is heated sensibly up to 100 °C. The second figure of merit is the measure of heat transferred from the absorbing plate to the water that is being heated inside the solar cooker. \( F_2 \) is given by

\[ F_2 = \frac{F_2(MC_w)^2 \ln \left[ \frac{(T_{wi} - T_{amb})}{H_s R_{av}} \right]}{A t} \]

\( MC \) : product of mass and specific heat of Water

A : solar cooker aperture area

t : time taken by the water to boil

\( T_{av} \) : average ambient temperature

\( T_{wi} \) : water temperature

\( T_{fw} \) : final water temperature

\( H_s \) : average solar insolation

The first FOM \( F_1 \) is given in Table 4.

| \( T_b \) (°C) | \( T_{amb} \) (°C) | \( F_1 \) |
|--------------|--------------|------|
| 144          | 30           | 929  | 0.122 |

The cooking power of a solar cooker is an indication of the rate at which heat energy is supplied to a specific mass of the food inside the solar cooker. The cooking power is given by

\[ q = \frac{M C_w \left[ (T_f - T_i) - T_a \ln \left( \frac{T_f}{T_i} \right) \right]}{t} \] (15)

\( M_w \) : mass of water

\( C_w \) : specific heat of water

\( T_i \) : initial temperature of water

\( T_f \) : final temperature of water

\( t \) : time taken

The cooking Power and \( F_2 \) is calculated in Table 5. Since three loaded experiments are conducted, the value of \( F_2 \) and the cooking power for the solar cooker is the average of the values calculated for all the three experiments.

3. Exergy Efficiency and Quality factor

The exergy of a device is the measure of its potential to derive heat from the surrounding [3]. The exergy efficiency is the ratio of the exergy input to the system to the exergy output of the system. The exergy input to the solar cooker is the exergy of solar radiation flux which is given by equation

\[ E_{xt} = P A \Delta t \left[ 1 + \left( \frac{T_a}{T_s} \right)^{\frac{3}{2}} - \left( \frac{T_a}{T_s} \right) \right] \] (16)

Where \( P \) is the instantaneous solar insolation, \( T_a \) is the ambient temperature, \( T_s \) is the temperature of the surface of the Sun, and \( A \) is the aperture area of the SC. The exergy out is given by

\[ E_{xo} = M C_w \left[ (T_f - T_i) - T_a \ln \left( \frac{T_f}{T_i} \right) \right] \] (17)

\( T_{amb} \) : ambient temperature

The second term in equation (17) represents the exergy loss from the system. Exergy efficiency is calculated by dividing equation (17) by (16) Thus exergy efficiency is given by

\[ \varphi = \frac{M C_w \left[ (T_{wi} - T_{amb}) - T_a \ln \left( \frac{T_{wi}}{T_{amb}} \right) \right]}{t} \]

\[ \frac{P A \Delta t \left[ \left( \frac{2a}{T_f} \right)^{\frac{3}{2}} - \left( \frac{2a}{T_s} \right) \right]}{t} \] (18)
The exergy input to the system as given by equation (16) is calculated and the result for all the three sets of experiment is plotted in Fig. 13. Similarly, the exergy output calculated for all the three sets of the loaded experiments is plotted in Fig. 14. The plots of the exergy efficiency for all the three loaded experiments is given in Fig. 15.

**Table 5 Calculations of the Second Figure of Merit and Cooking Power**

| Exp No | Aperture Area | $T_{wi}$ | $T_{wf}$ | $T_{av}$ | $H_{av}$ | Duration | (M.C) | $F_2$ | Cooking Power |
|--------|---------------|----------|----------|----------|----------|----------|-------|-------|---------------|
| 1      | 0.44          | 27       | 100      | 29.8     | 884      | 16200    | 13440 | 0.25  | 60.5          |
| 2      | 0.44          | 28.4     | 100      | 26.44    | 943      | 13200    | 13440 | 0.278 | 72.9          |
| 3      | 0.44          | 25.6     | 100      | 29.5     | 928      | 16200    | 13440 | 0.233 | 61.7          |
| Average|               |          |          |          |          |          |       | 0.254 | 65            |

**Table 6 Calculation of the Overall Heat Loss Coefficient**

| Exp No | Length of cooker L(m) | Width of the cooker W(m) | Gross aperture area A(m²) | Slope of the Exergy loss curve (W/K) | Heat loss coefficient (W/Km²) |
|--------|------------------------|--------------------------|---------------------------|--------------------------------------|------------------------------|
| 1      | 1.2                    | 0.45                     | 0.54                      | 0.416                                | 0.832                        |
| 2      | //                     | //                       | //                        | 0.648                                | 1.2                          |
| 3      | //                     | //                       | //                        | 0.2082                               | 0.385                        |
| Average|                        |                          |                          |                                      | 0.78                         |
The exergy analysis of the cooker is considered to be a more complete synthesis technique because of the fact that it considers the quality as well as quantity of energy transferred from the solar cooker and vice versa. As proposed by (Kumar et al.) a graph of exergy output and temperature difference is plotted and the data points are fitted to a second order polynomial. The fitting of the data points to a second order polynomial makes it easy to obtain the peak value of exergy which is in a close proximity with the actual value of the peak exergy[4]. The exergy output data is plotted against the temperature difference and the data is fitted to the second order polynomial for all the three loaded experiments. To give a clear view of the plot the results are plotted separately for all the three experiments as shown in Fig.16-Fig.18. From the fitted curves, the temperature difference gap is obtained which is the value of the x-axis (\(T_{\text{water}}-T_{\text{amb}}\)) corresponding to the half exergy point of the curve. The exergy output curves are plotted separately for all the three loaded experiments. The exergy loss data (\(E_{\text{xi}}-E_{\text{out}}\)) is plotted against the difference of the water and ambient temperature for all the three loaded experiments. The plots are given in Fig.19-Fig.21. The slope of exergy loss curve divided by the gross aperture area gives the overall heat loss coefficient of the solar cooker in (W/K.m\(^2\)). The overall heat loss coefficient of the cooker is the average of the overall heat loss coefficient for all the three experiments. The heat loss coefficient is calculated in Table.6.

### TABLE 7 Calculations of the Quality Factor for all the Three Experiments Conducted under Loaded Conditions

| Experiment No | Peak Exergy gain \(E_{\text{X0}}\) (W) | Temperature difference \(\Delta T\) | Exergy loss \(E_{\text{xi}}\) (W) at \(\Delta T\) | Quality factor \(E_{\text{X0}}/E_{\text{xi}}\) |
|---------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------------------|
| 1             | 14.17                             | 37.05                             | 350.3                             | 0.04                             |
| 2             | 18.22                             | 39.901                            | 370                               | 0.049                            |
| 3             | 12.654                            | 37.109                            | 375.9                             | 0.033                            |
| Average       |                                   |                                   |                                   | 0.04                             |

### TABLE 8 Data of the On-field Tests of the Solar Cooker

#### DATE: June 18th, 2019

| container | food items                        | starting time | Irradiance (W/m\(^2\)) | \(T_{\text{ave}}\) (°C) | Time taken | comments         |
|-----------|-----------------------------------|---------------|--------------------------|--------------------------|------------|------------------|
| 1         | 350g split green gram+700g water  | 10:00 am      | 848                      | 30                       | 2.1 hours  | Properly cooked  |
| 2         | 350g Split Red Lentil+700g water  |                |                          |                          | 2.1 hours  | Slightly overcooked |
| 3         | 350g split black gram+700 g water |                |                          |                          | 2.1 hours  | Properly Cooked  |

#### DATE: June 24th, 2019

| container | food items                        | starting time | Irradiance (W/m\(^2\)) | \(T_{\text{ave}}\) (°C) | Time taken | comments         |
|-----------|-----------------------------------|---------------|--------------------------|--------------------------|------------|------------------|
| 1         | 350g chickpeas+700g water         | 10:00 am      | 848                      | 30                       | 2.5 hours  | Properly cooked  |
| Date: June 26th, 2019 |
|------------------------|
| Container | Food Items | Starting Time | Irradiance (w/m²) | Tave (°C) | Time Taken | Comments |
| 1          | 1kg chicken + 250g yogurt paste | 10:20 am | 856 | 31 | 3 hours | Properly cooked |
| 2          | 350g veal + 600g water | 10:20 am | 821 | 31 | 3 hours | Properly cooked |
| 3          | 300g rice + 200g Pea beans + 700g water | | | | 3 hours | Properly Cooked |
The Quality factor of the cooker is obtained by dividing the peak exergy value at that specific difference of temperature. The average Quality factor for all the three experiments is shown in Table 7.

C. On-field testing of the solar cooker

The cooker was also used for cooking different types of food items. During cooking, the full load of the food items was kept 3200 gm. Three containers were used to cook three different dishes in the cooker in one go. The start and end times of the cooking were noted down. The data of the on-field testing of the cooker is given in Tables 8-11.

CONCLUSIONS

The performance parameters of the dual BM BSC evaluated under tracking free conditions are satisfactory and suggest that the angular optimization technique is an excellent replacement for the labor involved in adjusting the solar cooker after every 15-30 minutes. The maximum time required to cook a dish is 3 hours, which implies that the same cooker can be used for cooking twice a day, making it possible to cook 6.4 kg of six different dishes in one day with no need for continuous attention thus making the cooking activity easy and less time consuming. Purohit and Purohit suggested that the value of F1 should not be less than 0.11 [4]. The value of F1 calculated for the box type dual BM SC is in the range of the optimal values for F1 and the cooker is a “Grade-A BSC” based on its calculated value of F1. The value of F2 is found to be 0.254. The overall heat loss co-efficient is the average of the heat loss co-efficient for all the three experiments conducted under fully loaded conditions. The overall heat loss co-efficient for the cooker is 0.78 W/K.m2. The quality factor is the average of the quality factor for all the three loaded experiments which is found to be 0.04. The peak exergy power of the cooker is found to be 15.01 watts. All the values of the performance parameters are in a proximity with the suggested values of these performance indicators. It is concluded that under the tracking free conditions the performance of the dual BM BSC with the aspect ratio of 2.66 and optimal tilt angles become optimized and it becomes a viable option for the household water-based cooking.
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