Research Article ISSN 2771-666X

Journal of Advanced Materials Science and Engineering

Utilization of A Parabolic Solar Cooker for the Melting and Preparation of Paraffin Wax Based Skin Treatment in Ilorin, Kwara State

Dr. Olaore, Kayode Olatunde[1]* and Prof Aderemi Babatunde Alabi[2]

[1]*Department of Science Laboratory Technology (Physics/ Electronics Unit), Kwara State Polytechnic, Ilorin, Nigeria.*

[2]*Department of Physics, University of Ilorin, Ilorin, Kwara State, Nigeria.*

***Correspondence:**

Dr. Olaore, Kayode Olatunde, Department of Science Laboratory Technology (Physics/ Electronics Unit), Kwara State Polytechnic, Ilorin, Nigeria.

Received: 01 Nov 2025; **Accepted:** 26 Nov 2025 ; **Published:** 05 Dec 2025

Citation: Olatunde OK, Alabi AB. Utilization of A Parabolic Solar Cooker for the Melting and Preparation of Paraffin Wax Based Skin Treatment in Ilorin, Kwara State. J Adv Mater Sci Eng. 2025; 5(1): 1-7.

ABSTRACT

This study investigates the utilization of solar energy through a parabolic solar cooking system, specifically designed to heat and melt various substances, including paraffin wax. Solar cooking, a practice rooted in ancient traditions, serves as a viable method for food preparation and industrial applications by offering a sustainable alternative to conventional heating methods, which pose health and environmental risks. The primary objective of this research is to harness and concentrate solar radiation for the effective heating and melting of paraffin wax, intended for skin treatment, within the meteorological conditions of Kwara State. We employed a parabolic solar cooker to achieve this objective, utilizing mineral oil as a lubricant during the melting process. The results indicated a peak solar radiation of 1216.7 W/m², an ambient temperature reaching 48.7 ºC, and a maximum fluid temperature of 49.6 ºC. Furthermore, the cooker demonstrated a cover temperature of 59.6 ºC, a side temperature of 56.4 ºC, an absorber plate temperature of 94.6 ºC, and an air gap temperature of 70.4 ºC. The parabolic solar cooker successfully melted paraffin wax within one hour, and various thermal performance metrics—including average cooking power, standard cooking power, and cooker efficiency—were thoroughly evaluated. This research highlights the effectiveness of solar cooking systems in providing a safe, renewable energy solution for both domestic and industrial applications.

Keywords

Parabolic Solar Cookers, Paraffin Wax, Solar Radiation, Renewable Energy, Thermal Efficiency.

Introduction

The sun stands as our primary energy source, facilitating an array of methods to harness free energy for various applications. Among these, solar heating technology—commonly referred to as solar energy—has emerged as a significant application, manifesting in forms that vary from economically accessible and technically uncomplicated systems to large-scale, sophisticated installations intended for industrial heating purposes [1]. One innovative application of solar energy is found in solar cooking systems, which utilize sunlight to heat and melt various substances, including paraffin.

The genesis of solar cooking can be traced back to ancient times, with the first solar cooker constructed in 1767 by Swiss naturalist Horace de Saussure, often hailed as the pioneer of solar cooking. He devised a compact container to cook fruit using solely sunlight, achieving a temperature of 50.5°F. This groundbreaking endeavor paved the way for further exploration and advancements in solar cooking technology. Presently, a multitude of scientists and engineers globally are engaged in developing modern, high-efficiency solar cooker models. Numerous organizations and renewable energy centers are actively promoting the adoption of solar cookers in regions where their efficacy can be maximized.

There are primarily five types of solar cookers that are utilized worldwide: box type, funnel type, panel type, parabolic type, and advanced vacuum tube technology [1]. Concentrated Solar Power

(CSP) represents a technology focused on converting solar thermal energy into either electricity or thermal energy. While various forms of CSP serve as heat sources, parabolic concentrators have consistently demonstrated superior efficiency in heat generation over the years [2]. When employed as solar cookers, parabolic systems are acknowledged for their rapid cooking capabilities.

Solar cookers, particularly parabolic types, present viable solutions to several challenges faced by developing communities, including excessive dependency on unreliable electricity supplies, food insecurity, unemployment, and rural depopulation, among other social issues. Traditional heating methods consume substantial amounts of fossil fuels; therefore, utilizing a solar cooker embodies an innovative approach to harness solar energy for heating and melting processes. Contemporary parabolic solar cookers are characterized by their lightweight, economical design, and highly reflective glass mirrors that function as optimal reflectors. The solar energy concentrated by these cookers is sufficient for domestic cooking purposes. The parabolic geometry of the reflector focuses sunlight onto a small area, generating temperatures capable of melting paraffin. The heating apparatus can encompass a pot, pan, or other well-conducting heat containers suitable for cooking.

Parabolic solar cookers are ideally suited for regions where access to electricity or conventional cooking fuels is restricted, making them particularly beneficial for rural and developing areas. These cookers can melt wax rapidly, often in just a few minutes, contingent upon sunlight intensity. Additionally, they are straightforward to operate, requiring no fuel other than sunlight, and can be constructed from inexpensive, readily available materials [3].

The objective of this work is to employ a parabolic solar cooking system to capture and concentrate solar radiation for the purpose of heating and melting paraffin, ultimately leading to the formulation of a skin care solution.

Literature Review

The advancement of solar cooking technology has been underscored by several studies in recent years, detailing innovative approaches and performance evaluations.

Noman et al. [4] developed a mathematical model to assess the performance of a thermally exposed solar parabolic trough cooker, designed for domestic use under varying environmental climate conditions. Their experimental setup featured a stainless steel parabolic trough with a concentration ratio of 9.867. Through their efficiency analysis, they reported the optical efficiency, theoretical efficiency, and experimental efficiency of the parabolic trough, which ranged from 33% to 53%, 30% to 50%, and 5% to 38%, respectively. The researchers achieved a maximum water temperature of 37.2°C at the trough's outlet, while under stagnant conditions, the maximum reached 53.6°C. The energy and exergy efficiencies noted in their study were found to be 6.5% to 0.11% and 7.6 x 10^-2% to 2.1 x 10^-2% for direct cooking, providing valuable insights for developing more effective domestic solar cookers.

In a complementary study, Mbodji et al. [5] presented a dynamic thermodynamic model for a parabolic solar cooking system (PSCS) that incorporated heat storage. Their model, which employed various thermal resistances to simulate heat transfer, consisted of two experimental setups: one with a parabolic concentrator measuring 0.80 meters in diameter and a 1.57-liter cylindrical receiver, and another featuring a larger concentrator at 1.40 meters in diameter with the same receiver paired with a 6.64-liter heat storage. Conducted in Rabat, Morocco, their tests from April to July in 2014 and from May to June in 2015 utilized synthetic oil as a heat transfer fluid and for sensible heat storage. The results demonstrated a close correlation between predicted and measured temperatures, with a relative error of +4.4%. Their analysis revealed that an increase of 50 W/m² in daily maximum solar radiation raised the storage temperature by 4°C, while enhancements in receiver reflectance and absorbance yielded increases of 3.6°C and 3.9°C, respectively. They further optimized the receiver's aspect ratio to 2, which resulted in a maximum storage temperature of 85°C. Notably, increasing the thermal fluid mass flow rate from 0 to 18 kg/h and enhancing thermal insulation led to significant temperature rises of 65°C and 17°C.

Asmelash et al. [6] highlighted the pressing issue of fuel-wood scarcity and proposed solar cooking as a sustainable alternative. They identified the limited performance and convenience of existing solar cookers as barriers to wider acceptance. Their work involved testing a parabolic trough cooker (PTC) designed for indoor cooking, wherein the cooking section was placed indoors and the collector located outdoors. Utilizing soya bean oil as the heat transfer medium, they performed ray tracing and standard stagnation tests that indicated a 30 mm diameter copper pipe as the optimal absorber size. The study documentated maximum temperatures of 191°C at the mid-absorber pipe and 119°C at the stove, achieving an overall system efficiency of 6%.

Joyee et al. [7] underscored the escalating role of renewable energy sources, particularly solar energy, in the national economy. Their research focused on the design, construction, and performance evaluation of a parabolic dish solar (PDS) cooker with an aperture diameter of 106 cm and a focal length of 54 cm. The performance tests demonstrated a maximum temperature of 97°C inside the cooking pot, with rice and dal prepared in various amounts over different days. The findings illustrated that cooking times were influenced by the available solar radiation, with notable cooking efficiency achieved at radiation levels of 320 to 390 W/m². An economic analysis indicated a payback period of 16 months for the cooker, considered a realistic and promising investment.

Claude et al. [8] remarked that the Indian subcontinent benefits from abundant sunlight year-round, with approximately 80% of all seasons classified as sunny, and about 50% as dry. This climatic advantage presents an opportunity for enhancing solar cooking practices in the region.

Design and Construction of a Parabolic Solar Cooker

This study presents the design and development of a parabolic solar cooker that utilizes a parabolic dish as a concentrator. The primary component of the solar cooker is a parabolic dish, repurposed from a 1.8-meter-diameter television satellite dish with a depth of 26 centimeters. The dish is coated with rectangular reflective glass mirrors, each with a thickness of 3 millimeters, to enhance its solar concentration efficiency.

The structure features an arm measuring 1.1 meters in length, supporting the parabolic dish, which is mounted on a flat metal base that is 2 centimeters thick. The overall height of the solar cooker, measured from the ground to the pot hanger, is 0.6 meters. This design maximizes the cooker's ability to harness solar energy for cooking applications, offering a sustainable alternative for food preparation in various environments.

Table 1: Design and Construction Measurement and Parameters.

N/S	MEASUREMENT	PARAMETERS
1	Diameter	1.8m
2	Height	0.6m
3	Radius	0.9m
4	Area	0.26m
5	Aperture	0.016m
6	Concentrator	0.081m
7	Focal length	0.047m
8	Glass Thickness	0.3mm
9	Length	1.45m

Material Selection for Optimal Performance

Dish Material

The dish is constructed from steel, preferred over aluminum for its superior strength, cost-effectiveness, durability, and energy efficiency. The steel's smooth contours effectively minimize tilt errors associated with the reflective surface, enhancing the overall performance of the design.

Reflective Surface Material

For the reflective surface, a 3 mm thick glass mirror was selected due to its impressive reflectivity of 95%, which outperforms polished aluminum's 85%. This choice significantly contributes to the efficiency of light capture and heat generation.

Absorber/Pot Material

Aluminum was chosen for the cooking pot, or absorber, owing to its affordability, availability, and favorable specific heat properties per cubic centimeter. Additional advantages include its corrosion resistance, high tensile strength, and low density. The aluminum is non-toxic and has been coated in a matte black finish to enhance thermal absorbance, making it particularly effective for heating and melting paraffin wax.

Melting Materials and Heat Transfer Fluids

Paraffin wax was selected as the melting substance, with mineral oil utilized as a solvent during the melting process because of its established application in the cosmetics industry as a skin care component. Water was also chosen due to its stability at elevated temperatures, low maintenance requirements, cost-effectiveness in transportation, and its safety as a heat transfer fluid, making it the most widely used fluid in residential heating systems.

Pyranometer

The pyranometer is an instrument designed to convert global solar radiation into a measurable electrical signal, commonly employed in climatological studies and weather station monitoring. Its operational principle is based on the temperature differential between two surfaces, one dark and one transparent, allowing for accurate solar radiation measurements.

Thermocouple

A thermocouple is a thermoelectric device proficient in precise temperature measurement. It comprises two wires made of different metals, joined at one end. When the junction is heated, it generates an electrical current, which is then translated into a temperature reading via a thermocouple monitor.

Digital Weighing Scale

The digital weighing scale is a highly sensitive laboratory instrument capable of accurately measuring weights in the sub-milligram range. With a weighing capacity of 100g to 500g and a measurement accuracy of 0.1mg to 0.001mg, this device ensures precision in weight determination.

Methodology

Experimental Setup

The parabolic solar cooker utilized for this experiment was positioned behind Physics Lab B at Kwara State Polytechnic. Following the assembly of the cooker and the securing of the ring and arm, we determined the direction of the sun's radiation using a compass, aligning the dish to face east. A pot was secured onto the pot hanger and adjusted to ensure optimal convergence of solar radiation directly beneath it. A metallic arm served as the support structure for both the reflector and the receiver, with careful adjustments made to maintain alignment with the sun's trajectory.

We filled the pot with water and covered it. Once the temperature of the water reached approximately 47.6 °C, a smaller pot containing paraffin wax was placed inside the larger pot. This method was employed to maintain a mild temperature conducive to efficiently melting the wax, as excessive heat could compromise its integrity. Subsequently, 133 ml of mineral oil was incorporated into the wax, and the pot was re-covered.

Temperature measurements— including ambient temperature, the bottom and side temperatures of the pot, the air gap temperature, and the fluid temperature—were recorded at 10-minute intervals until the wax was fully melted. Afterward, the molten wax was carefully transferred into a container and permitted to cool. To enhance the product's scent, a suitable fragrance was added, resulting in a pleasantly aromatic final product.

Determination of Focal Length

According to Dasin et al., 2011, to determine the focal length of a parabolic dish,

Focal distance, $F = \frac{r^2}{4h}$

Diameter of dish is 1.8m and height is 2.6m

Where

$$r = \frac{d}{2} = \frac{1.8}{2} = 0.9 \qquad h = 2 \cdot 6$$

$$F = \frac{0.9^2}{4 \times 2.6}$$

$$F = 0 \cdot 078m$$

Determination of The Parabolic Aperture Area

According to Mahendra et al. 2020, the parabolic aperture area A is given as,

$$A = \frac{\pi D^2}{4}$$

$$A = \frac{3.142 \times 1.8^2}{4}$$

$$A = 2.5m^2$$

Determination of The Rim Angle

According to Craig [3], the rim angle can be calculated as,

$$tan\theta = \frac{1}{\frac{D}{8h} - \frac{2h}{D}}$$

$$tan\theta = \frac{1}{\frac{1.8}{8\times2.6} - \frac{2\times26}{1.8}}$$

$$\theta = 20°$$

Determination of Cooking Power Estimation

The cooking power, P, is defined as the rate of useful energy available during heating period. It is measured in watt. According to Samuel et al. 2021 it can be calculated as,

$$\boldsymbol{P} = \frac{\boldsymbol{M_W C_W \ (T_{f}-T_i)}}{\boldsymbol{t}}$$

where P is interval cooking power (W), T_i is initial water temperature is final water temperature is mass of water (kg), and C_W is specific heat capacity (4186 J/kg K). $(4186\, J/kg\, K)$

$$P = \frac{2.5\times4186\times(71.2-58.3)}{600}$$

$$P = 225W$$

The Quantity of Heat Power Q

According to Gundre et al. 2012, The heating-power of a solar cooker is calculated as;

$$Q_{heat} = m_w C_w \frac{dT_a}{dt}$$

$$Q_{heat} = 2.5 \times 4186 \times \frac{4.8}{600}$$

$$Q_{heat} = 83.72W$$

Calculation of Efficiency

Based on first law of thermodynamic

$Input = Energy\ Output + Energy\ Loosses$

Energy input to the parabolic solar cooker can be calculated as follows:

$$E_i = I_b + A_{sc}$$

Where;

E_i = Energy Output

I_b= Solar Radiation

A_{sc}= Surface area of the solar cooker in m²

But

$$A_{sc} = \frac{\pi\left(\left(a^2D^2+1\right)\right)}{6a^2}$$

Where $a = \frac{1}{4f}$

$$f = 7 \cdot 8cm = 0 \cdot 078m$$

$$a = \frac{1}{4\times0{\cdot}078}$$

$$a = 3.2m$$

Substitute a and other parameters into the equation, A_{sc} becomes;

$$A_{sc} = \frac{3{\cdot}142\left(\left(3{\cdot}2^2\times1{\cdot}8^2+1\right)\right)}{6\times3{\cdot}2^2}$$

$$A_{sc} = 1 \cdot 75m^2$$

Therefore,

$$E_i = I_b + A_{sc}$$

$$E_i = 1001 + 1 \cdot 75m^2$$

$$E_i = 1002 \cdot 75W$$

Where,

$$Efficiency\ (\eta) = \frac{Energy\ Output}{Energy\ Input} = \frac{E_o}{E_I}$$

$$E_o = (m_w C_w (T_{wb} - T_{wa})/t)$$

$$E_o = \frac{2.5\times4186(71.2-58.3)}{600}$$

$$E_o = 225W$$

$$\boldsymbol{Efficience}\ (\eta) = \frac{E_o}{E_I} = \frac{(m_w C_w (T_{wb}-T_{wa})/t)}{I_b + A_{sc}} \times 100$$

$$\eta = \frac{225}{1002{\cdot}75} \times 100$$

$$\eta = 22.44\%$$

Results and Discussion

Results

A series of melting tests were conducted using the parabolic cooker. The parameters measured included solar radiation, ambient temperature, absorber temperature, side temperature, cover temperature, air gap temperature, and water temperature, all recorded at 10-minute intervals to effectively monitor the wax melting process. Upon completion of the experiments, the collected data were systematically analyzed. The findings from this investigation are illustrated in the graphs presented below:

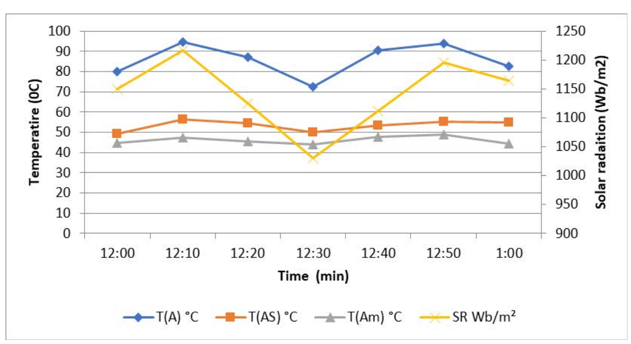

Figure 1: Showing the variation of the solar radiation and the temperature against time.

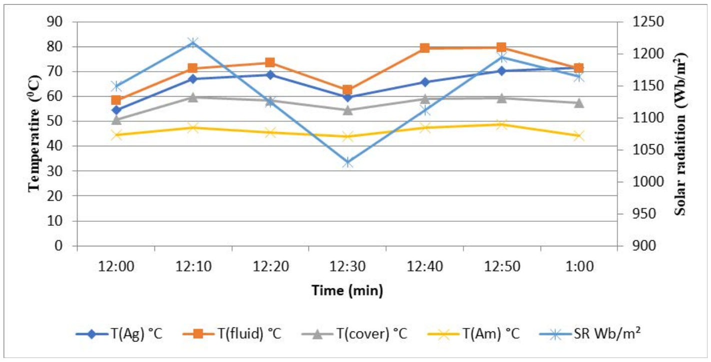

Figure 2: Showing the variation of the solar radiation and the temperature against time.

Time (pm)	T(Ag) °C	T(A) °C	T(AS) °C	T(cover) °C	T(fluid) °C	T(Am) °C	SR Wb/m²
12:00	54.6	79.8	49.1	50.8	58.3	44.7	1149.4
12:10	67.2	94.6	56.4	59.6	71.2	47.5	1216.7
12:20	68.8	87.2	54.3	58.3	73.4	45.5	1124.3
12:30	59.7	72.5	50.1	54.5	62.5	43.9	1030.6
12:40	65.9	90.3	53.2	58.9	79.3	47.6	1112.3
12:50	70.2	93.7	55.2	59.3	79.6	48.7	1195.1
1:00	71.5	82.6	54.7	57.5	71.2	44.4	1164.5

Discussion

The conducted experiment took place at Kwara State Polytechnic in Ilorin on May 12, 2023, between the hours of 12 PM and 1 PM. Figure 1 illustrates the correlation between solar radiation and ambient temperature over time. The data indicates a direct relationship: as solar radiation increases, so does the ambient temperature, which in turn influences other measured parameters. Initially, the solar irradiance recorded was 1114.9 W/m², with the starting ambient temperature at 32°C, rising to 36°C within the first ten minutes. After this duration, solar radiation measured 1216.7 W/m², coinciding with the increase in cooking fluid exposure from 12:00 to 12:10 PM. The lowest ambient temperature recorded during the experiment was 39°C, while the minimum solar radiation measured was 1030.6 W/m². These findings align with the studies by Adedeji et al. [9] and Reddy et al. [2], though their initial ambient temperatures were lower at 28°C and 30°C, respectively, with starting insolation values of 768 W/m² and 821 W/m².

Figure 2 demonstrates the variation in solar radiation and temperature over the duration of the experiment. The data clearly shows that an increase in solar radiation significantly affects the temperature of the absorber (pot), which in turn causes an increase in the temperature of other measured parameters. The maximum solar radiation recorded was 1216.7 W/m², with the highest absorber temperature reaching 93.7°C and the peak fluid temperature hitting 79.6°C—sufficiently hot to melt paraffin. This observation echoes the findings of Claude et al. [10], where an increase in solar radiation led to a notable rise in the temperature of the cooking material, facilitating the rapid melting of paraffin wax.

As solar radiation increases, the temperature of the cooking fluid correspondingly rises. Conversely, when solar radiation decreases, both the fluid and absorber temperatures drop. Additionally, with elevated ambient temperatures resulting from increased sunlight exposure, the paraffin wax melts at an accelerated pace; however, as temperatures decrease, the melting rate diminishes. According to Tibebu and Hailu [11] and Singh et al. [12], their results showed a maximum temperature of 60°C, which was influenced by variations in wind speeds and excessive cloud cover.

The experiment lasted a total of 60 minutes, with a calculated Rim Angle of 20°. The cooking power of the parabolic solar cooker was determined to be 225 W, yielding a total heat gain of 83.72 W. The overall efficiency of the parabolic solar cooker was calculated at 22.44%. Jacob et al. [13] and Sawarn et al. [14] found similar results, asserting the need for higher-quality materials in constructing parabolic solar cookers to enhance their efficiency and performance, particularly under colder, overcast conditions.

Research by Ahmed et al. [1] and Raza et al. [15], which corroborates this study, emphasizes the potential for achieving greater efficiency through modifications in the thermal conductivity of paraffin wax and the integration of solar tracking systems.

During the experiment, the range of solar radiation incident on the exposed surface of the parabolic solar cooker varied from 1030.6 W/m² to 1216.7 W/m². Concurrently, the ambient temperature recorded fluctuated between 44.4°C and 48.7°C. The fluid temperature ranged from 58.3°C to 79.6°C, while the pot cover temperature varied from 50.8°C to 59.6°C, and the pot side temperature was between 49.1°C and 56.4°C. The temperature of the air gap ranged from 54.6°C to 71.5°C, and the pot (absorber) temperature fluctuated from 72.5°C to 94.6°C. The peak solar radiation was observed at 12:10 PM, measuring 1217.6 W/m², while the minimum was recorded at 12:30 PM, at 1030.6 W/m². The ambient air surrounding the parabolic solar cooker was heated by solar radiation, which was subsequently absorbed by the pot, reaching a temperature of 94.6°C at 1216.7 W/m² of solar radiation.

Conclusion

Parabolic solar cooking represents a sustainable and environmentally-friendly alternative to conventional heating and melting techniques. While solar energy technology has made significant advancements both technologically and financially, further research and development are essential to enhance its efficiency and acceptance relative to fossil fuels. The growing global demand for solar cooking solutions, coupled with innovations in advanced components and systems, holds the potential to drive down costs.

Future advancements in low-cost parabolic solar cooking systems are expected to enable longer operational hours throughout the day, and possibly extend usage into the evening hours. It is anticipated that solar energy will become increasingly pivotal within the energy sector in the coming years, underscoring the necessity for proactive utilization of this resource. In many developing nations, including Nigeria, the energy consumed for cooking constitutes a substantial portion of overall energy expenditure. Thus, the parabolic solar cooker serves as a viable supplementary cooking method alongside traditional approaches.

Designed with locally sourced materials, the parabolic solar cooker was constructed and subsequently subjected to a series of performance tests under varying operating conditions. Results demonstrated that the cooker could effectively melt 171 grams of wax in under one hour, with solar radiation measured at 1164.5 W/m^2. The findings indicate that the performance of the parabolic solar cooker is commendable. Despite its low construction and operational costs, this solar cooking solution holds promise for promotion in remote and rural communities, contributing to sustainable energy practices.

Recommendation

Following a comprehensive evaluation of the conducted experiment and the subsequent performance results, the parabolic solar heating method is highly endorsed as an efficient alternative to conventional heating and cooling systems, particularly within the chemical, pharmaceutical, and agricultural sectors, as well as in scientific laboratories. Furthermore, this method is recommended for science and engineering students in Nigeria, providing them with practical insights into sustainable energy solutions. Additionally, we advise users of parabolic solar cookers to wear dark safety glasses during the heating and melting processes to ensure their safety throughout operation.

References

1. Ahmed SA, Prasanna Rao NS, Srinivas Murthy PL, et al. Detail Study of Parabolic Solar cooker SK-14. IRJET. 2015; 02: 27.
2. Reddy RM, Prasad TH, Mallikarjuna P. Experimental Investigation of Performance of Parabolic Solar Cooker with Different Reflectors. Journal of Energy, Heat and Mass Transfer. 2015; 37: 147-160.
3. http://hdl.handle.net/2263/49491.
4. Noman A, Ali G, Ullah MF, et al. Performance evaluation of a thermally exposed solar parabolic trough cooker. A mathematical model Energy Reports. 2019; 5, 123-130.
5. Mbodji M, Chaib S, Coulibaly K. Dynamic thermodynamic modeling of a parabolic solar cooker system with heat storage. Renewable Energy. 2017; 114: 124-135.
6. Asmelash E, Tadesse T, Emanuelli F. Addressing fuel-wood scarcity: Solar cooker based on concentrating collector. Solar Energy. 2014; 103: 222-230.
7. Joyee EB, Rahman ANM. Design and Construction of a Parabolic Dish Solar Cooker. Interna Conf on Mech, Indu and Ene Eng. 2014; 26-27.
8. Claude BL, Kumar A, Dubey S. The potential of solar cooking in the Indian subcontinent. A review Rene Sustai Ene Rev. 2014; 36, 34-41.
9. Adedeji MA, Umunnakwe CK, Adesigbin AJ, et al. Modification and Construction of Solar Cooker Using Parabolic Reflector: Engineering and Applied Sciences. 2020; 5: 28-33.
10. Claude A, Balakrishnan M, Kumar DR. Engineering, design and fabrication of a solar cooker with parabolic concentrator for heating, drying and cooking purposes. Arch Appl Sci Res. 2012; 4: 1636-1649.
11. Tibebu S, Hailu A. Design, Construction, and Evaluation of the Performance of Dual-Axis Sun Trucker Parabolic Solar Cooker and Comparison of Cooker. Journal of Renewable Energy. 2021; ID 8944722.
12. Seveda MS, Kharpude SN, Digambar NP. Experimental Investigation of Performance of Parabolic Solar Cooker in NEH Region of India. Int J Curr Microbiol App Sci. 2020; 9: 3964-3974.
13. Jacob AS, Timothy NC, Adebayo KR, et al. Performance Evaluation of Locally Designed and Produced Parabolic Solar Cooker. Interna Jo of Ene and Envir Sci. 2021; 6: 96-106.
14. Sawarn H, Kumar P, Singh R, et al. Techno-Economic Feasibility Analysis of Parabolic Solar Cooker in Tropical Environment of India. Renew Sustain Energy Rev. 2021; 81: 2703-2713.
15. Raza G, Saqib I, Farooq AS. Paraffin Wax-Based Thermal Composites. Paraffin - Thermal Energy Storage Applications. 2021; 3: 24-27.