A Survey on Solar Cookers

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ABSTRACT

In times of energy crises and global warming, using alternative energy sources is a greener way to consume energy. Although solar energy is a better choice for cooking, it has yet to be established as a user-friendly and cost-effective option. Food is the most basic need of humans. Foods can be cooked use conventional fuels such as wood, cowdung, kerosene, LPG, and electricity. Solar cooker is a clean and environmentally friendly energy technology for cooking. Despite numerous solar cookers being researched and developed by scientists and researchers worldwide, their use remains limited. There are numerous causes for the limited usage of solar.

Cooker-like, its bulky size, hefty weight, lack of open space, slow cooking, predetermined schedule for cooking Less awareness, etc. This document discusses many types of solar cookers, including panel, parabolic, box, and hybrid cookers. Further adjustments are needed to make the solar cooker more user-friendly, lighter, smaller, and cost-effective. The development of a photovoltaic and thermal hybrid solar cooker has opened up a new frontier in the area.
of solar cookers because they cook faster than traditional box-type solar cookers and can be used in Users' convenience time.

Key words: booster mirrors, Photovoltaic effect, solar cooker, solar dryer, sun basket, , solar concentrator.

INTRODUCTION

Solar cookers use solar radiation to cook meals. Solar cooking saves significant amounts of conventional energy. Solar cooking is the easiest and safest ,clean, environmentally friendly, and most convenient a method to prepare meals without using fuels or Heat up the kitchen. Today's biggest worry is the depletion of natural resources. It is vital to lessen support on non-renewable energy sources. Using the remaining materials wisely and at the simultaneously transitioning to new , better options and a renewable source of energy. Solar cookers have a long history, dating back to the 18th century when Nicholas-de-Saussure developed the first Solar Box Cooker. Solar cooking has gained popularity in areas where traditional fuel sources such as firewood are scarce, with over 60 major designs and over 100 variations. Solar cookers have piqued the interest of researchers worldwide. However, efficient and cost-effective solar cookers remain a challenge. Recently, there has been increased interest in designing, developing, and testing different types of solar cookers. . Solar cookers are constantly being developed by researchers and manufacturers, with numerous types available worldwide. However, it might be argued that most of the Solar cookers today split into three major categories: solar panel cookers, solar box cookers, and Solar parabolic cookers, Collector Cooker , Parabolic dish Cooker.

Cooking Energy Scenarios in India	
Urban Area	Rural Area
LPG(88.6%)	LPG(9%)
Firewoood(14%)	Firewood (67%)
Kerosene(6 to 7%)	Kerosene (1%)
Other fuels (47%)	Cow dung (10%)

Literature Review

Garg and Rishikesan [1] conducted a thorough investigation of a system comprising a flat plate collector and two reflectors. They proposed a model that was numerically simulated for the conditions that existed in Three different Indian stations during three separate months. They discovered that the enhancement is greatest. For the month of December, in all three stations for both horizontal and inclined surfaces. Narasimha et al. [2] conducted a comprehensive analysis of solar cookers using booster mirrors. The researchers added a single adjustable booster mirror to a solar box cooker and calculated the total energy landing on it. Cooking aperture for the latitude of 18 N (Warangal City, India) and different declinations of the sun. The energy output from the booster mirror increases dramatically as the latitude of the location. Nahar et al. [3] investigated the use of transparent insulating materials (TIM) in solar box cookers. Under an indoor sun simulator, they evaluated a hot box solar cooker with a glazed surface composed of 40 and 100 mm thick TIM. The stagnation temperature using the 40 mm TIM was discovered to
be 158 C, compared to 117 C without the TIM. A two reflector hot box solar cooker, with TIM was created, built, and tested, and its performance was compared to a single reflector hot. Buddhi et al. [4}built and tested a solar cooker with three reflectors and a phase-change material storage unit. Experiments indicate that the proposed solar cooker can cook late into the evening. Algifri and Al-Towaie et al. [5] conducted research in order to study the effect the cooker's orientation affects its performance. Prasanna and Umanand et al. [10} created a hybrid solar cooking system, seen in Fig. 3, where solar energy is delivered to the kitchen. The thermal energy source supplemented the commonly used LPG in kitchens. The literature clearly shows that solar cookers are very promising equipment for the future. However, there are certain drawbacks to the solar cooking technology. The main disadvantage of solar cookers is their inability to function after the sun has set. Some Researchers worked hard to improve solar box cookers so that they could be used late at night PCMs were deemed a remedy in most cases. Sonune and Philip et al. created a Fresnel-type household SPRERI concentrating cooker. The cooker can feed a family of four or five people. The plate bottom temperature reached 255 C in 40 minutes, whereas the ambient temperature was 30 degree C, and direct sun radiation was 859 W/m2. The small-scale Photovoltaic and Thermal Hybridized (Casserole type) solar cooker was constructed and tested for performance using thermal energy storage materials (TES), sand, and ionic liquids (IL) BF4- and PF6- [22, 23-25]. And the maximum usage of the solar cooker was researched. Cooking various foods in it [26,28]. The hybrid cooker became more efficient by tracking the sun Panel with dual-axis solar tracker . Bushnell et al. developed and tested a solar energy-storing heat exchanger to advance the notion of solar cooking. The methodologies for describing system performance were explained and applied to a test system with configurable parameters. Replacement for solar input power. The first step of this research activity was followed by a heat exchanger was connected to a concentrating array of CPC cylindrical trough.A global survey reveals diverse designs for solar cookers.

A global survey reveals diverse designs for solar cookers.However, the current designs of solar cookers collapse into Cookers, often known as solar ovens, panels Cookers, Collector Cookers, and Concentrating or Reflector cookers. The feature that they all share The design is the brilliant reflective surface that guides the Sun's rays on the cooking area and dark inside bof the cooking area and cooking vessel.

1. **Solar box cooker** :- The most popular solar cooker for personal use is the solar box cooker or oven. It has a relatively simple construction, consisting of a box (square, rectangular, or cylindrical) painted black From the inside and insulated from all sides except The window side is double glazed. Up to Four black-painted vessels are placed within the box. with the dish that will be cooked. Cooker takes 1 ½ to 2 hours to cook stuff like rice and vegetables.

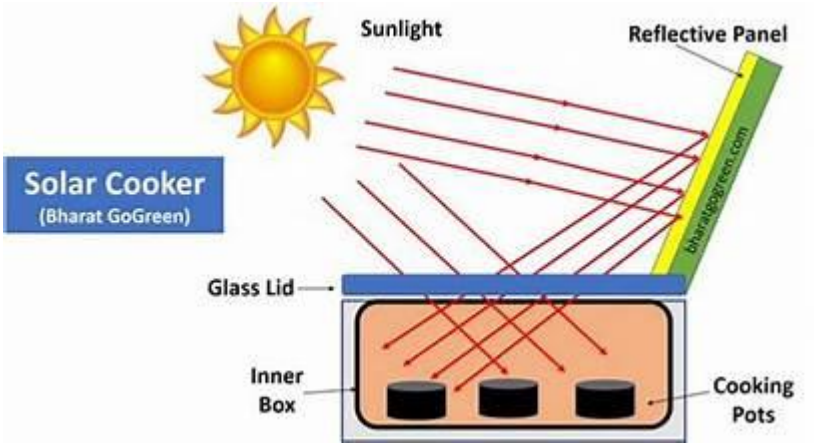

Figure1 : Solar box cooker

2. Solar Panel Cooker :- The panel cooker operates similarly to the solar box cooker. Panel cookers use huge, multiple reflecting panels to focus sunlight on a cooking vessel, similar to how insulated boxes are used. Panel cookers are the simplest and most affordable option, requiring only four reflective panels and a cooking vessel. However, they can be unstable in strong gusts and may not hold heat when the sun is obscured by clouds.

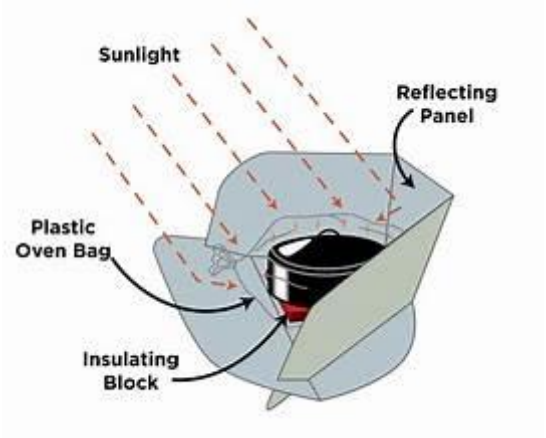

Figure 2:- Solar Panel Cooker

3. Collector Cooker :- The collector cooker consists of two sections, commonly housed in a single casing: a heat collector and a cooking section to maximize yield.
A conventional collector cooker consists of a flat plate solar collector, side and head mirrors, and the stove itself. The cooking element is separate and radiation-protected, so the user is not impacted by radiation or heat. Oil is utilized to transmit heat and attain greater temperatures.

Figure 3:- Collector Cooker

4) **Parabolic Concentrator Cooker :-** This solar cooker is ideal for households and small businesses, featuring a focusing parabolic dish design. A common dish solar cooker has a 1.4 meter aperture diameter and a focal length of 0.28 meters. This cooker is made of anodized aluminum sheet, which has a reflectivity of more than 80%. The cooker's manual tracking system requires adjustments every 15-20 minutes throughout cooking. With a power output of around 0.4 kW, it can boil 2-3 liters of water in half an hour. The vessel might be between 3000 and 3500 degrees Celsius, which Suitable for roasting, frying, and boiling.

Figure 4 :- Parabolic Concentratot Cooker

5) **Parabolic Dish Cooker**:-Parabolic Dish is square dish. Such dish can be obtained by cutting Paraboloid with parallel planes. Paraboloid square dish is manufactured in four symmetrical segments as shown in figure 5. One such segment is to be manufactured in sheet metal using die with flange such that flanges can be bolted together to form complete dish. Total dish size in plan is 1250 mm × 1250 mm.

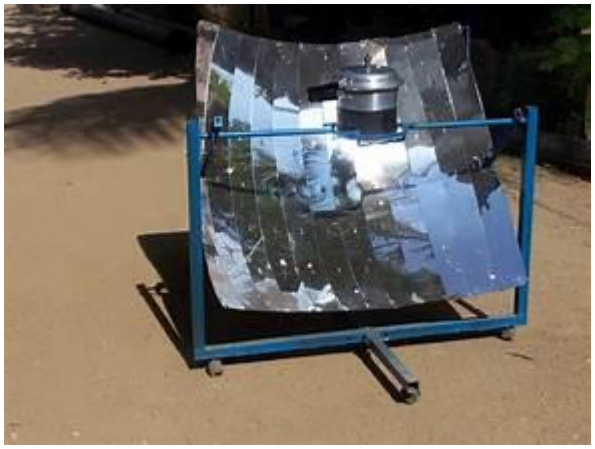

Figure 5 :- Parabolic Concentrator Cooker

Conclusion

Scientists worldwide have spent decades constructing various sorts of solar cookers. Despite being an excellent culinary alternative, it is not widely recognized in society. There are numerous reasons for this, including lack of awareness, enormous size, slow cooking, heavily depending on weather conditions, predetermined cooking duration. A hybrid solar cooker is being created that can operate continuously and cook faster than traditional sun cookers. If marketed, it has the potential to surpass traditional solar cookers and benefit society.

References

[1] Ashok K. A review of solar cooker designs. TIDE; 1998.

[2] Erdem Cuse, Pinar Mert Cuce "A comprehensive review on solar cookers/Applied energy 102(2013)1399.

[3] Muthusivagami RM, Velraj R, Sethumadhavan R. Solar cookers with and without thermal storage: a review. Renew Sust Energy Rev 2010;14:691–701.

[4] Rogers EM. Diffusion of innovations. New York: Free Press; 1995.

[5] Kimambo CZM. Development and performance testing of solar cookers. J Energy SAfr 2007;18(3).

[6] Garg H. &Prakash J. 2000, "Solar Energy Fundamentals and Applications", Tata McGraw-Hill Publishing Compnany Limited, New Delhi.

[7] Saxena A, Varun, Pandey SP, Srivastav G. A thermodynamic review on solar box type cookers. Renew Sustainable Energy Rev 2011;15:3301–18.

[8] B Khan Non-conventional energy resources. Tata McGraw Hill Publications;2008.

[9] D Kothari, K, Singal and R Ranjan. Renewable energy resources and emerging technologies. Prentice-Hall; 2008.

[10] Dang A. Concentrators: a review. Energy Convers Manage 1986;26(1):11–26.

[11] Garg HP, Hrishikesan DS. Enhancement of solar energy on flat-plate collector by plane booster mirrors. Solar Energy 1988;40(4):295–307.

[12] Narasimha Rao AV, Sitharama Rao TL, Subramanyam S. Mirror boosters for solar cookers – III. Energy Convers Manage 1991;32(1):51–8.

[13] Buddhi D, Sharma SD, Sharma A. Thermal performance evaluation of a latent heat storage unit for late evening cooking in a solar cooker having three reflectors. Energy Convers Manage 2003;44:809–17.

[14] Algifri AH, Al-Towaie HA. Efficient orientation impacts of box-type solar cooker on the cooker performance. Solar Energy 2001;70(2):165–70.

[15] Nahar NM, Marshall RH, Brinkworth BJ. Studies on a hot box solar cooker with transparent insulation materials. Energy Convers Manage 1994;35(9):787–91.

[16] Sonune AV, Philip SK. Development of a domestic concentrating cooker. Renew Energy 2003;28:1225–34.

[17] Prasanna UR, Umanand L. Optimization and design of energy transport system for solar cooking application. Applied Energy 2011;88:242–51.

[18] Bushnell DL. Performance studies of solar energy storing heat exchanger.Solar Energy 1988;41(6):503–12.

[19] Bhatt, V.D. and Gohil, K.N.(2010) International journal of ChemTech Res.,2, pp 1771-1779.

[20] Sharma, A.Tyagi, V.ChenC.Buddhi,D.(2009)Renewable and Sustainable Energy Reviews 13 pp 318-345.

[21] Tyagi, V.Pandey, A., Kaushik,S.Tyagi,S.(2012)Thermal Analatical Calorimetry, 107,pp 1345- 1352.

[22] Joshi, S.B. and Jani, A.R, (2013) Photovoltaic and Thermal Hybridized Solar Cooker, ISRN Renewable Energy, Hindawi Publishing Corporation. Article ID746189

[23] Smita B. Joshi and A. R. Jani, Certain Analysis of Photovoltaic - Thermal Hybrid solar cooker with ionic liquids. ICIE-2013, SVNIT, Surat; 11/2013

[24] Joshi S.B . and Jani A.R., Development of heat storage system for solar cooker. Int. J.Lat. Technol. Engin. Manag. App. Sci.,3(4),199-9,(2014).

[25] Smita Joshi: performance of sand for heat storage in solar cooker. Journal of Environmental Research And Dvelopment 11/2015; 10(02).

[26] S.B.Joshi and A.R.Jani “All time operating photo voltaic and thermal hybrid solar cooker”, Multidisciplinary Sustainable Engineering: Current and Future Trends – Tekwani, Bhavsar & Modi (Eds) © 2016 Taylor & Francis Group, London

[27] Smita Joshi, A.R.Jani: A new design of Solar cooker for optimum Utilization. Solar Asia- 2013, 2nd international Conf. on Solar Energy Materials, Solar Cells,and solar energy Applications, University of Malaya, Malasia; 08/2013

[28] S.B. Joshi, A.R. Jani: Design, development and testing of a small scale hybrid solar cooker. Solar Energy 12/2015; 122. DOI:10.1016/j.solener.2015.08.025

[29] Smita B Joshi, A R Jani: Certain analysis of a solar cooker with dual axis sun tracker. 2013 Nirma University International Conference on Engineering (NUiCONE); 11/2013

[30] Smita B Joshi, Hemant R Thakkar, A R Jani: A Novel Design Approach of Small Scale Conical Solar Dryer. International Journal of Applied Quality Management 04/2014; III(IV)