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Cram of Novel Designs of Solar Cooker

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Abstract

A solar cooker is the superior picking for cooking food and make a reduction in the use of LPG, Kerosene, firewood, biomass and cow-dung. In topical years, attention has been focused on the development of various design of solar cooker in order to overcome limitations. This work assesses the research on solar cooker and assists the researchers to understand the rudiments of solar cooker with the need, development and challenges in solar cooker to improve thermal performance to make it more and more cost-effective.

Keywords: Energy saving device, Solar energy, Renewable energy, Solar Cooker.

I. INTRODUCTION

Currently, we use many resources of energy for cooking, warming, lightening houses, industrial uses and for daily and necessary uses [1]. As the population increases, the need for energy is also increasing, resulting in an energy crisis in near future [2]. People in developing countries usually make use of firewood and charcoal for cooking. Furthermore, fire produces smoke often causing respiratory diseases, particularly women, who are in charge of cooking activity and their kids who usually live with them [3]. As solar energy is the most abundant permanent energy resource on earth. Among the applications of solar thermal energy, solar cooking is one of the fundamental issues in developing countries.

II. REVIEW

Gianluca Coccia et al. (2017) [1] worked on the design, manufacturing, and test of a high concentration ratio solar box cooker with multiple reflectors as shown in figure 1. The cooker has a cooking chamber with a glass cover on the top and is composed by two rows of booster mirrors. The prototype allows both an azimuthal and zenithal manual orientation. Results show that the cooker is able to cook at high temperature with good optical efficiency and thermal insulation.Tests showed that black vessels are able to cook food faster than standard vessels. In particular, water load tests revealed that the cooker has the theoretical potential to boil 1 kg of water in about 11 min. This time can be reduced to about 9 min when two pots containing the same quantity are loaded in the cooking chamber. A remarkable result is that the proposed cooker is able to perform as a parabolic cooker as regards optical efficiency. However, it has to be noted that, the cooker dimensions and cost are greater than those adopted in other works.

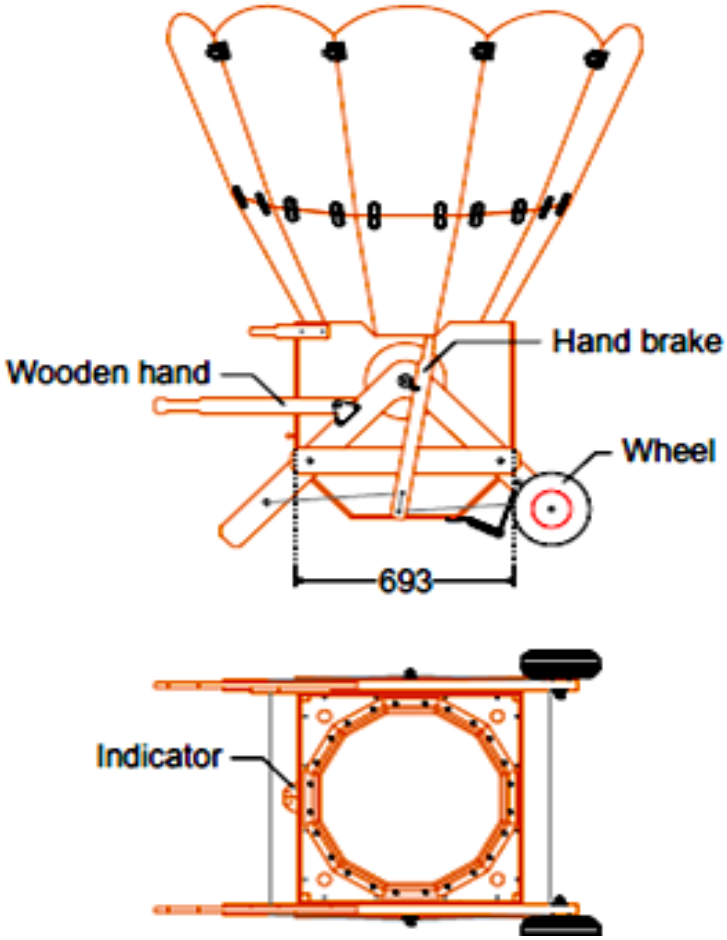

Figure 1: Solar box type cooker

Raghavendra Prasada S et al. (2016) [2] worked on design and fabrication of double angled eight sided solar cooker as shown in figure 2. Chrome plated steel whose reflectivity of 85% was used as the reflective surface to increase temperature and heat required to cook. The test results shown that, maximum of up to 95 C temperatures can be achieved without changing the position of solar dish and also it is possible to achieve heating power of 1981.2 Watt in 10 min, required for cooking any kind of vegetables. The maximum efficiency of this solar cooker is 21.1% for 10 min time span. The low efficiency of the parabolic cooker is attributed to the optical and thermal losses from the reflector and the pot. The energy efficiency can be increased only marginally by increasing the reflectivity of reflectors, proper designing of cooking place and by using a suitable cooking pot.

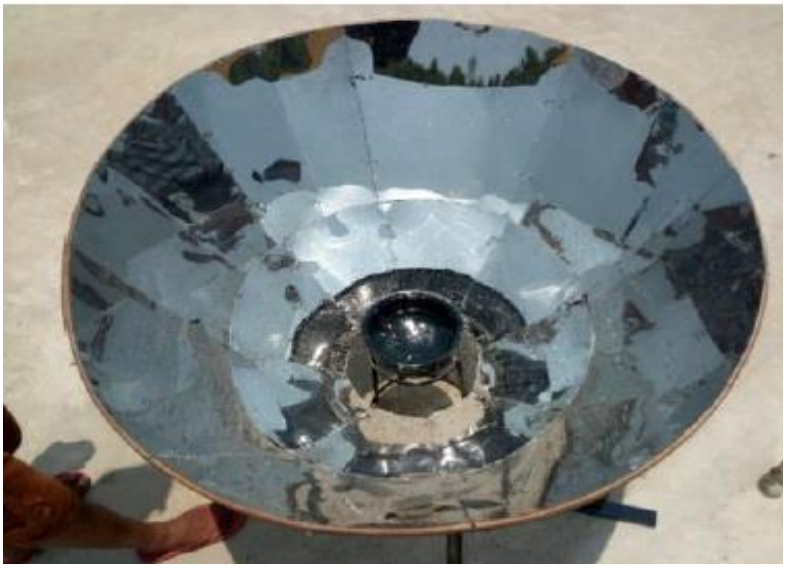

Figure 2: DAES solar cooker

Ajay Chandak et al. (2016) [3] worked on innovative balcony model of concentrating solar cooker as shown in figure 3. Higher speed of cooking attained by solar concentrating cookers. But it's almost impossible to accommodate such bulky cookers in the small space available to them. The author has developed an innovative balcony model of solar concentrating cooker that can satisfy the need of these city dwellers. Model of balcony cooker, comprised of a paraboloidal dish which is rectangular in plan is being developed. The dimension of the proposed balcony cookers is 1500 mm in length and 1000 mm in width. This design will have an overhang of only 1000 mm and can have wider acceptance, especially in multistory buildings.

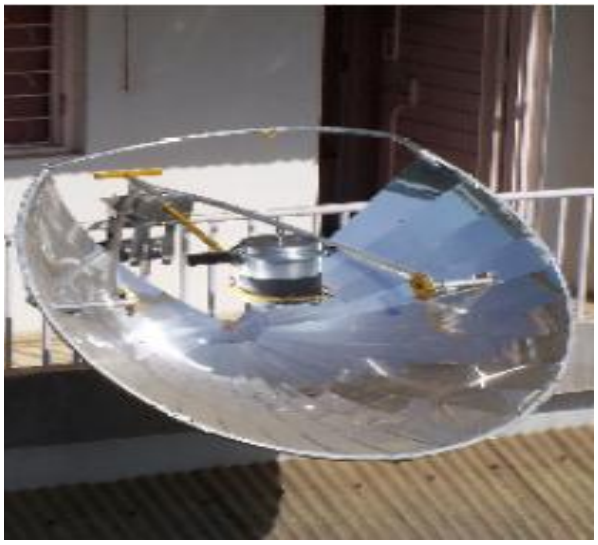

Figure 3: Concentrating solar cooker

Alberto Regattieri et al. (2016) [4] worked on the innovative portable solar cooker as shown in figure 4 using the packaging waste of humanitarian supplies. The cooker allows heating, cooking meals and boiling water as well as purifying raw water from rivers and lakes. This study demonstrates that a portable solar cooker from reused metalized cardboard of humanitarian aid kitchen-set could be an important cooking device for people living in developing countries of humanitarian camps where the lack of fossil fuel sand wood is a daily problem.

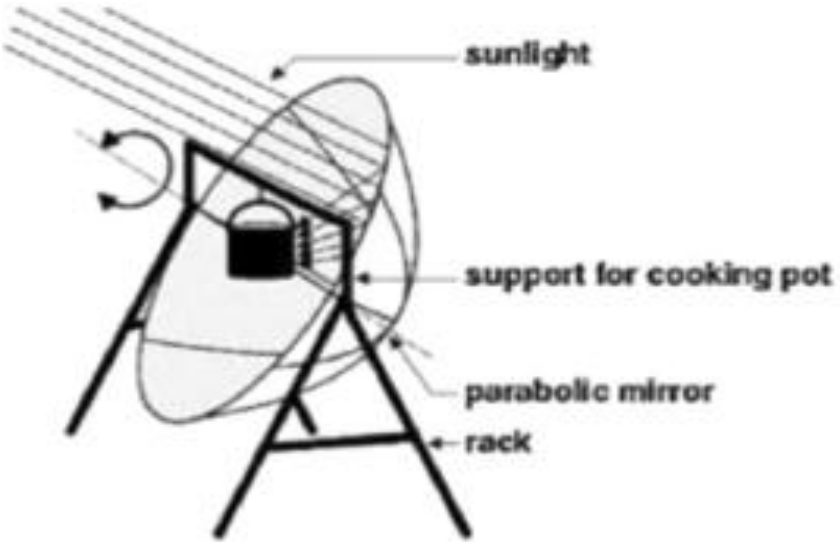

Figure 4: Concentrating type solar cooker

Mauricio et al. (2014) [5] worked on Rural Solar Cookers as shown in figure 5. The prototype implemented using mirror polished aluminum reflectors, aluminum pressure cooker manual tracking device and solar tilt. Currently they are working with the monitoring to quantify the improvements achieved in consumption-appropriation.

Figure 5: Rular type cooker

Virind Sharma et al. (2015) [6] worked on Solar Cookers for Off-Sunshine Cooking as shown in figure 6. They found that, the cylindrical storage unit is preferred over rectangular storage unit. Off-Sunshine/Evening cooking is possible with solar cooker using PCMs as energy storage medium. PCMs having melting point above or close to 100°C are more promising for the storage unit of solar cookers.

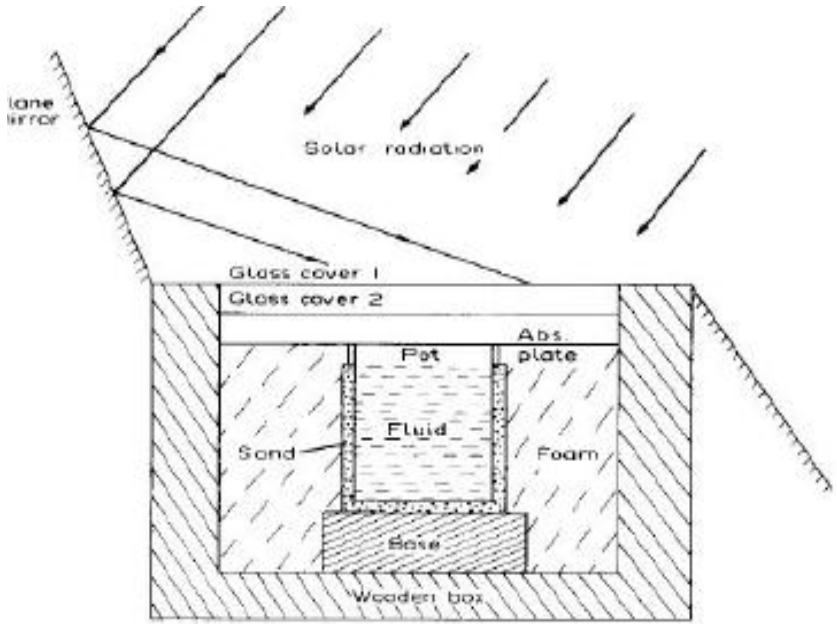

Figure 6: Solar cooker with sand

Miss Hemlata Deolal et al. (2014) [7] studied parabolic Dish Type Solar Cooking System with Gravity Based Solar Tracking System as shown in figure 7. The solar tracking system is based on gravity. A parabolic dish has been optimized to eliminate the need of solar tracking system along the path of sun. This work presents an excellent method for tracking the sun trajectory with parabolic dish type cooker. This mechanism does not require any external source of power. The required tracking work done is drawn by potential energy stored in source chamber. Water is discharged at a constant rate from the source chamber to sink chamber, which causes angular displacement and hence displace the parabolic dish to make maximum concentration of rays and parabolic dish displace along 45˚ along both side, to follow the sun. The thermometer and pressure gauge give appropriate readings and the whole system has been optimized for 6 hours of cooking per day. Practical results and analysis of prototype indicate that system is working successfully.

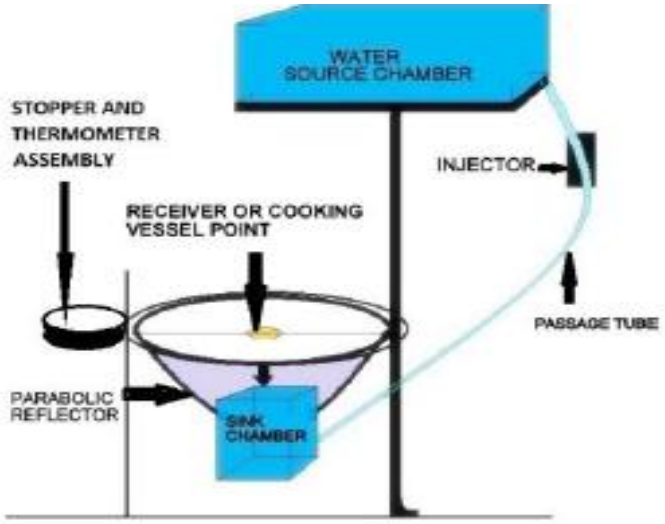

Figure 7: Parabolic dish type solar cooking system with gravity based solar tracking system

S. B. Joshi et al. (2014) [8] worked on a small scale hybrid solar cooker as shown in figure 8. A Small Scale Box type solar cooker (SSB) weighing 4.8 kg is modified into a novel photovoltaic and thermal hybrid solar cooker named as Small Scale Box type Hybrid solar cooker (SSBH) weighing 6.5 kg. Five solar panels each of 15W are attached with this cooker. Cooking time is reduced due to the photovoltaic power generated by solar panels along with the solar thermal power. Efficiency of Improved Small Scale Box type Hybrid solar cooker is 38%. Estimated cost (Rs. 6000/-) of the developed solar cooker can be further reduced upon commercialization to make it more affordable and popular.

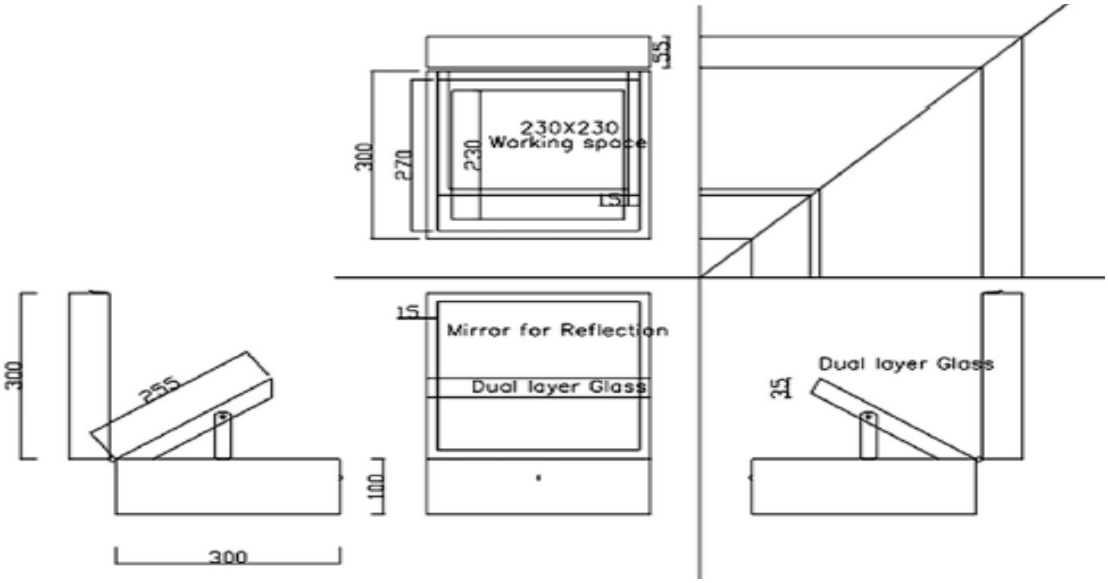

Figure 8: Hybrid solar cooker

Dave Oxford et al. (2016) [9] worked on the some preliminary field tests using a variety of evacuated tubes as shown in figure 9. A number of breakages are reported. Techniques already exist to construct more durable cooking tubes while maintaining the merits of the present generation of evacuated tubes. The next generation of dedicated cooking tubes could have larger diameters, a cooking compartment of stainless steel, and virtually unbreakable outer glass tubes.

Figure 9: Glass absorber tube

III. CONCLUSIONS

Many investigation have been carried out in the field for continuous innovative and efficient revolution of solar cooker. From the inclusive reviews of solar cooker, the following can be interpreted:

a) The solar box cooker with multiple reflectors can cook food faster at high temperature.
b) The black vessels are able to cook food faster than standard vessels.
c) In case of eight sides solar cooker the energy efficiency of solar cooker varies because input solar radiation is rich in energy and being utilized in form of heat the reflector and the pot.
d) The person who lives in apartments and does not have rooftops instead of using circular dish; a three quarter dish can be designed.
e) In solar cooker tube have shown good efficiency in cooking food.
f) Galvanized Iron sheet is not feasible for cooking purpose. The concentration of Solar Energy on Aluminum sheet has been intensified when compared to Galvanized Iron sheet for cooking purpose.
g) Research should be carried out for reducing the cost and increasing the efficiency of solar cooker.
h) Work should be performed in designing more compact and efficient thermal storage unit.
i) Work should be carried out to minimize thermal losses in order to make solar cookers more efficient.
j) Solar cooker should be designed for low temperature hilly and isolated areas.
k) High energy density PCMs should be developed for storage unit.
l) Research should be carried out in developing highly efficient hybrid solar cooking unit so that it could cook food uninterruptedly during the complete diffusion of energy from the storage unit.
m) Cylindrical shaped cooking vessels made of aluminum or copper and painted black should be preferred for a higher cooking efficiency.

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