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DESIGN AND ANALYSIS OF SOLAR COOKER USING PHASE CHANGE MATERIAL

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Abstract

In order to cheaply fulfil the expanding energy demands of mankind, solar energy is now the most plentiful, unending, non-polluting, and free source of energy available. Solar energy is more economically significant than the usage of fossil fuels, which are non-renewable resources, to provide electricity and heat. This article discusses Cooking and other uses of solar energy manufacturing energy. One of the most important components of Inexpensive and environmentally friendly Natural sources of energy include solar power has gained interest from academia and industry in recent decades to supplement the growing demand for energy. The greatest need for solar energy is in the development of India. Having access to solar energy and using the right technologies are prerequisites for its utilisation. Big energy is released by the sun. This year releases more energy than humans have used since ancient times. Photovoltaic (PV) generation is a proven commercialtechnology. Energy domestic solar applications has always been thermal energy storage. As a cyclic and sporadic source of energy, solar radiation is emitted by the Sun. Heating requirements for homes change over time. The highest level of solar radiation is at midday, but there is a high heating demand at night or in the morning when there is no solar radiation. In this article, a paraffin wax is introduced that continuously generates heat at 43 ° C. In this article a best solar cooker is recommended for home cooking.

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1. INTRODUCTION

consumption has been crucial to existence since since the emergence of civilisation. The use of resources and the right technology are two aspects that affect energy use. Today, fossil fuels and nuclear energy account for most of the energy sources used. The supply of these fuels is finite and not renewable. and the costs of exploring them are very high. Therefore, this paraffin paper offers to cover the energy demand at any time with an output close to 43 ° C. This article presents a solar cooker ideal for home use.

2. RELATED STUDY

Utilizing solar energy for lighting and electricity generation would lessen reliance on fossil fuels and its detrimental effects environmental impacts of cutting trees. Solar power generation can be encouraged during drought periods when there is insufficient water for hydropower generation. Compared to other favorable times for hydroelectric projects, there is a greater vacuum of solar radiation at this time due to the increased amount of sunlight during this season. In many southern states such as Tamil Nadu, solar power stations can be built to expand existing outlets and reduce long-distance transmission. As a result, energy issues will significantly decrease. The sun radiation increased to 740 W/ m2 at 13.00 hours and to 246 W/ m2 at 11.00 hours. The average outside temperature for the experiment was 32.38 °C. According to the performance in terms of first figure and thermal efficiency, it performs well when compared to the national norm. The cooker may retain heat more effectively than others described in the literature. The cooker enjoyed cooking under varying precipitation situations, according to the test results for its thermal performance [1]. Thermal storage unit designs, heat storage accessories, Regarding the effectiveness of heated solar cookers for cooking storage units that were studied over the past two decades, they have been reviewed, interrelated, anatomized, and bandied [2]. Among PCMs, there are two main categories of compounds: organic and inorganic. Most organic PCMs have a high heat of reactivity and a low 10 vapor pressure per unit weight, they exhibit little cooling, are chemically inert, non-corrosive, and compatible with the majority of structural materials. Their drawbacks include flammability, significant volume fluctuations during phase shifts, and poor thermal conductivity. In contrast to organic composites, inorganic composites are non-flammable, inexpensive, and have high passive high thermal conductivity and heat output per unit of volume. However, despite their extreme sharpness, they deform and cool, which is detrimental to their phase-transition pockets. Nucleation and thickening chemicals are used in inorganic PCM processes to minimise subcooling and phase separation. The search for those agents by marketable businesses requires a lot of sweat. PCMs have a wide range of uses, Buildings heat and cold storage, satellites heat storage, and military gear. Knowing the correct melting point of PCM is very important when selecting PCM for solar photovoltaic applications. More activities to come.[3]. Every component is very important for a solar cooker to work well in any climate. These do not exclude any bone parameters for better cooking. According to the analysis of available materials, solar ovens must meet the following requirements to be effective [4]. Using integrated sensing and the passive thermal storage, To use hot water for home applications at an average temperature of 45°C, a thermal energy storage system was designed. The TES device is put through charging tests to evaluate how well it works with the solar flat plate collector. During the Controlled factors include the charging procedure, various porosities, flow rates, temperature histories, and energy storage capabilities of HTF & PCM. The injection rate

significantly affects the rate at Heat is produced by the solar collector, which has an impact on how quickly the TES tank is charged. For both SHS and integrated storage systems, tests are performed using batch and discontinuous dispatch. According to experimental findings, the integrated sensible and passive warehouse concept significantly reduces the size of warehouse bins in comparison to a conventional storehouse arrangement. For operations with fluctuating demand, a block-wise integrated storage system that extracts Perfect is hot water from a TES tank [5]. There is an analysis of TES that uses solid-liquid phase transition. These findings are explored. In order to fully understand heat transfer, several simulation methods are considered. PCMs have many applications including ice storage, construction applications, preservation and transportation of temperature sensitive materials and comparison of water tanks and PCM tanks [6]. It can be concluded from several topics described above that PCM's use in the storage of latent heat systems allows more energy to be stored in a smaller amount of surface area. Applications for the heating and cooling of spaces, PCMs offer greater comfort. The authors' opinions on some important issues and future directions are based on the information and experience they have gathered by reviewing the material discussed here. However, visions and paths for the future will be determined by societal demands and related developments [7]. Phase change materials (PCM) are used in Latent heat storage systems for solar cookers. The development of these devices is done in ascending order by working year. According to research, other PCMs with temperatures ranging from 120 $^{\circ}$ C to 180 $^{\circ}$ C are very close to the maximum temperature of paraffin wax of 156 $^{\circ}$ C, which is very close. The heat flow rates for paraffin wax are 90mW, 140mW and 70mW at 20ºC, 60ºC and 110ºC respectively. In light of this, it has been established that these heat flow rates are helpful for better day-to-day cooking needs [8]. In Indian homes and other homes around the world, cooking energy is critical to sustainable energy management. There are many choices to meet the needs of End users utilize both commercial and non-commercial services power. The creation of solar cookers should lessen the need for traditional fuels like wood chips, dung pellets and kerosene. Due to which people will have less work. Such an effort is effective in protecting the environment and improving the quality of life. This article focuses on the various

1. MATERIALS AND METHODS

The various components used in this cooker are as follows.

- ➢ Outer box
- ➢ Fin
- ➢ Lid
- ➢ Cooking vessel
- ➢ Plate
- ➢ Paraffin wax
- ➢ Thermopolis

OUTER BOX

The outer box is made of aluminium material. The fins are fixed inside, and between the gaps of the fins, the phase change material is positioned.

VESSEL

Each is a different character. A tube that carries blood throughout your body is an example of a vessel, as is a container for storing fluids. Ships have many different advantages of solar energy, including its abundance, environmental friendliness, cheap or operating costs, good savings, reduced monthly electricity bills, absence of accidents, low maintenance, etc. Apart

from that, food can Evening preparation with solar cookers is possible thanks to thermal energy storage technology now available [9]. meanings, although they all relate to liquids and transportation.

ALUMINIUM LID

The component of a container known as a lid, also known as a cover, serves as a closing or seal and often entirely encloses the object. Small lids, such as those in tubs, and large lids, such as those on open-top bags and drums, can both be covered with covers. To keep the lid secure until people wish to open it or have permission, some lids contain a security strip or tamper-evident band. To show that the container has been opened, they are often irreversible.

FIN & PLATE

Fins are little components or appendages attached to larger parts body or building. When 18 wheels are launched in water, air, or other fluids, the fins frequently act as fins to provide lift or push or provide the ability to steer or stabilise motion. The surface areas for an articulation or heat transmission are improved by fins. In general, the term plate can apply to a variety of small, flat things that can be used to hold food or other goods, such as more plates.

ALUMINIUM

Many materials are used to make a solar cooker. We choose aluminium to build a solar cooker. Due to its excellent property, aluminium is suitable for it. Aluminium has a thermal conductivity of 237W/mk, better than other materials. Aluminium solar cookers are cheaper to manufacture; due to their softness, they can be easily attached. Aluminium is light in weight and density. The properties of aluminium are shown in the table below.

WORKING PRINCIPLE

The goal of the current research is to determine whether it is possible to use phase change calculations (PCMs) to store solar energy for use at night to heat water for residential purposes. This guarantees hot water throughout the day.

Two heat-absorbing devices are used in the system at the same time. One of them is a PCM (paraffin)-heated thermal storage unit and a solar water heater are the two different types. Across the day, the heater of water runs continuously and provides hot water. The storage unit produces hot water at night and stores heat in the PCMs during the day. Small aluminum cylinders filled with paraffin wax are used as the thermal storage medium in the storage unit. In order to capture solar heat, it also includes a Solar Collector. Water has been poured to the top of the storage tank at the beginning of the day. This water is designed to go back and forth between the PCMs and the heating panel (solar collector). Heat is transferred from the water heating group to the storeroom unit and then to a PCM. The passive heat is absorbed using the PCM and causes a phase shift, and the additional heat is then stored as sensible heat. The charge in the palace is accelerated using parabolic reflectors. A suitable control mechanism is used to transmit water pressure to the storeroom unit at night by running room temperature water through the device, heat can be recovered from it. Fresh water enters the unit as water is drawn from the storeroom palace, disrupting the thermal equilibrium and heat from the PCM entering the water. The Storehouse Palace is fully insulated to minimize heat loss. Solar conditions are examined to see how well the system performs. First Introduction The intermittent nature of the output of solar energy prevents its efficient use in household tasks, especially water heating, and imposes restrictions on its use. Sensible heat storage (SHS)

technologies have enabled the small-scale turnpike. 22 However, they are necessary.

4.RESULT AND DISCUSSION

Figure 4.3 shows the water and PCM temperature measurements taken. This demonstrates that the PCM temperature reaches its maximum in the afternoon when the ambient temperature is 35 ° C along with the temperature of the water the pot and the heat stored in the PCM during the day. The PCM still has two hours of thermal energy when the sun sets. Consequently, the PCM weighs 3 kg. The amount of stored energy increases with mass. The temperature distribution of the cryo-formed cooker sample and its analysis in the Ansys program are shown below.

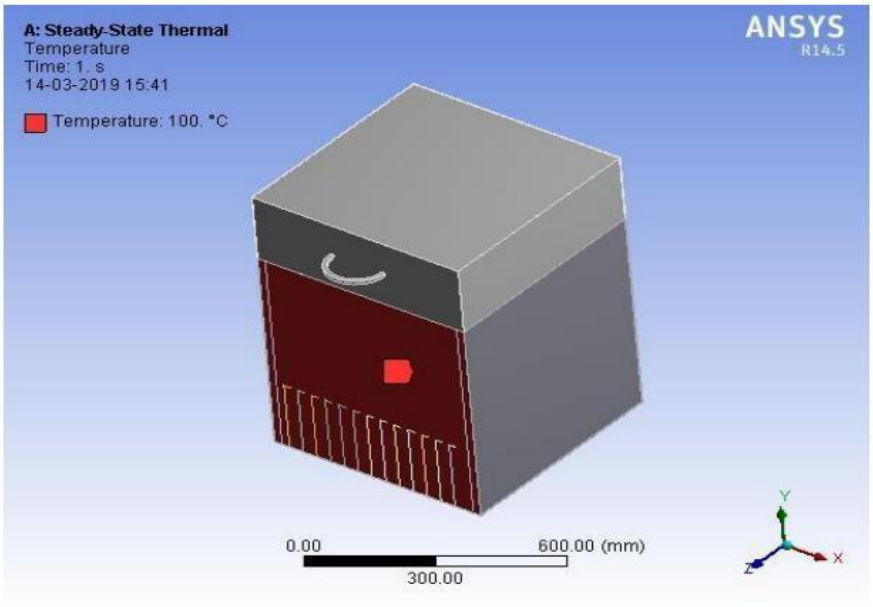

Figure 1: Temperature distribution of surface

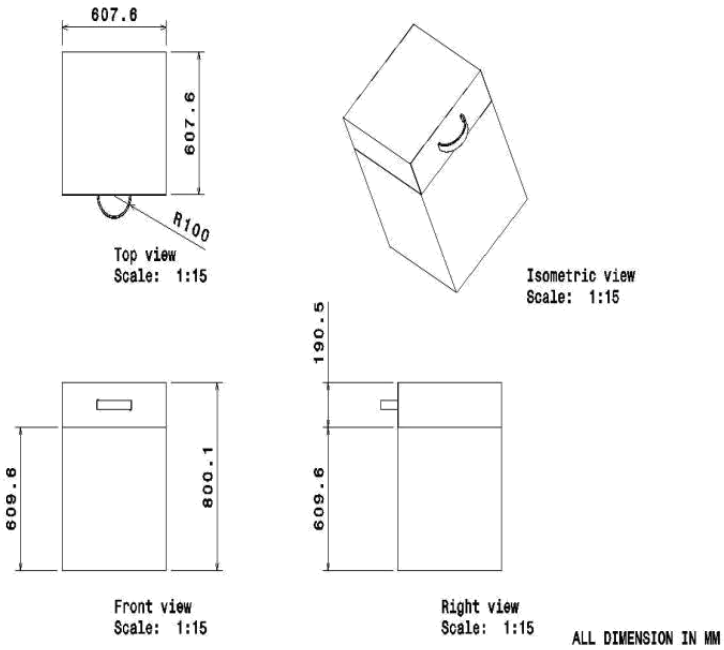

Figure1.1: Outer box

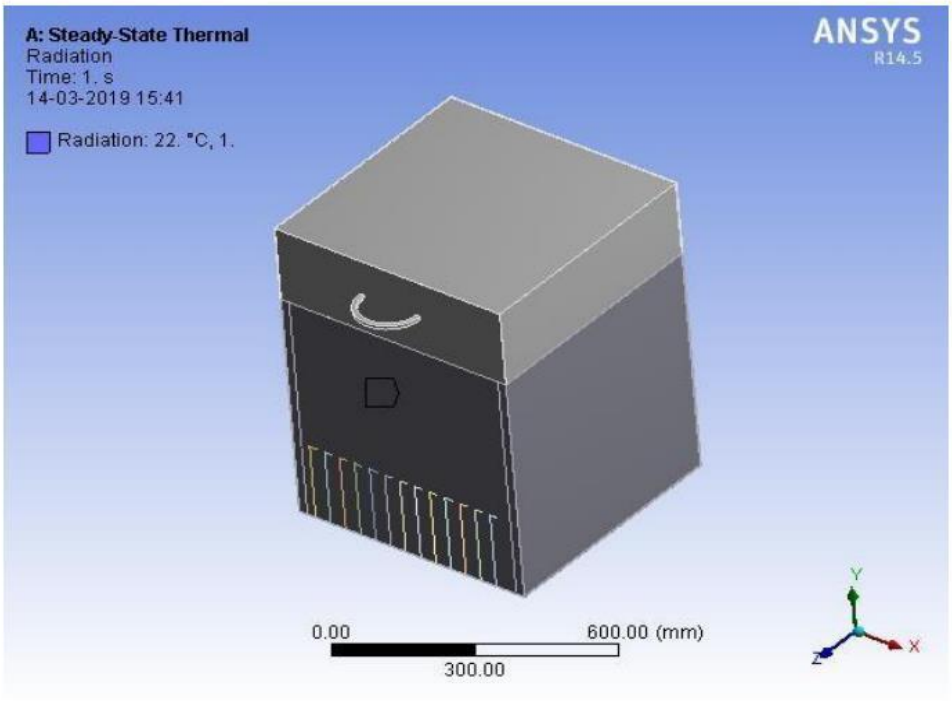

Figure 2: Creo model of cooker

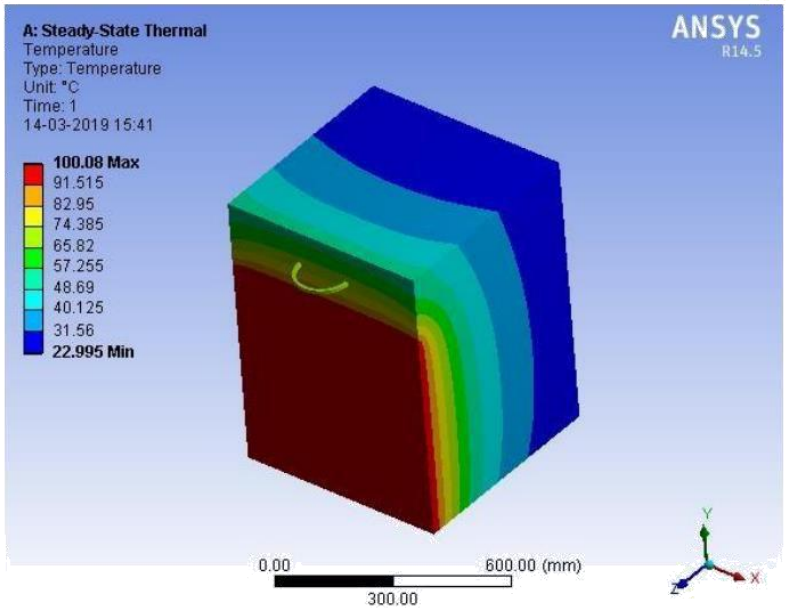

Figure 3: Temperature Distribution

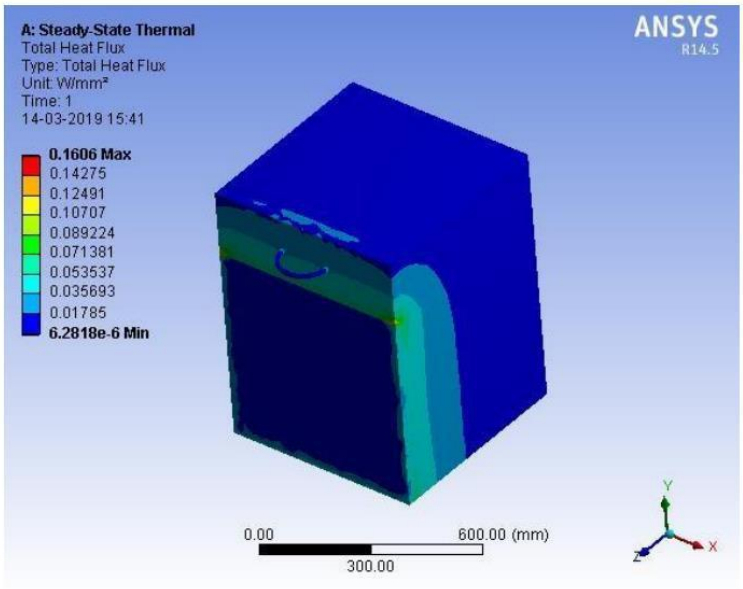

Figure 4: Heat distribution of cooker model

Table 1 : PCM and Water Temperature

Time	ATM Temp. (T1)	PCMTemp. (T2)	WaterTemp. (T3)	Heat Stored in PCM(T4)
10.00am	31	30	33	7.2
11.00 am	35	40	38	35.8
12.00 pm	35	50	45	107.2
1.00 pm	35	55	51	143.1
2.00 pm	35	45	52	130.2
3.00pm	35	40	46	112.5
4.00pm	30	45	43	107.3
5.00 pm	30	40	38	71.5
6.00 pm	30	40	37	71.5
7.00pm	28	35	33	50.1

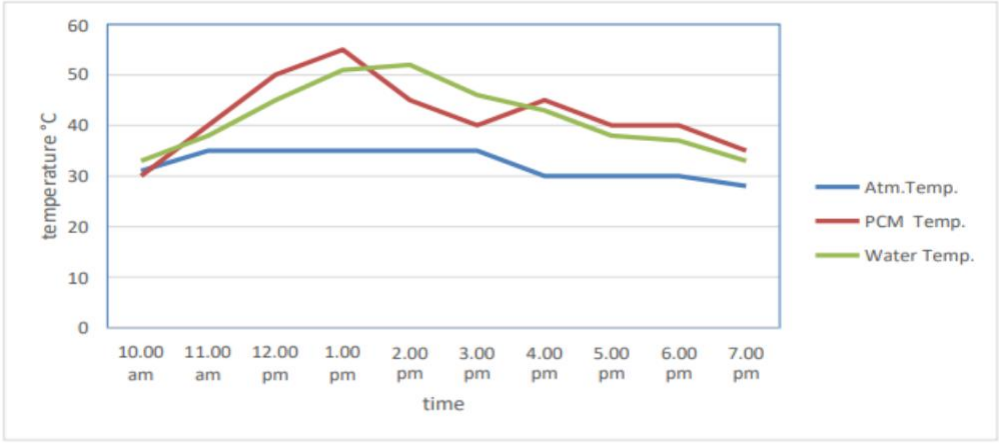

Figure 5: Comparison of PCM temperature, water temperature, and atmospheric temperature

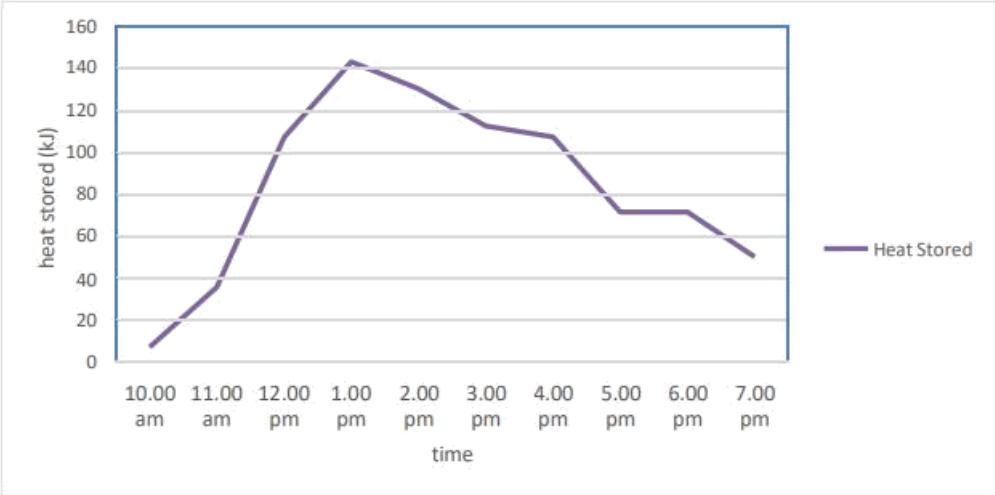

Figure 6 : Heat stored with tim

The graphs below show the variation in potential energy, which is the stored heat, corresponding as a result of the water's and the surrounding air's contrasting temperatures. We can see a graphical representation of the difference in insolation relative to the direction of the sun and wind and the radiation of the solar cooker. So based on graphical advice, understand the main ideal to implement the new system and get the optimization fashion.

CONCLUSION

The project carried out by us made an impressive take in solar cooker from home appliance. The heat storage time also increased when compared to other system. The fabrication work also simple with good performance. So this setup is more suitable for commercial water heating and also this is a Renewable Source Of Energy which neglect the electricity consumption. Advanced large scale solar cookers can cook for hundreds of people. because they use no fuel and cost nothing to operate. Manynon profit organizations for promoting their use worldwide in order to help reduce fuel costsand air pollution and to slow down the deforestation caused by gathering fire wood for cooking.

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