Construction of A Solar Dish Concentrator for Hot Water Generation from Trapped Heat and Heat at Focus

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Abstract : The increased reliance on traditional energy sources has resulted in their depletion. Solar energy, which may be captured either through thermal energy systems or photovoltaic systems, is thus the most readily available energy source. Thermal systems are becoming more popular since they can attain high concentration ratios and temperatures. A parabolic dish collector is built in this project to generate hot water to meet household demand by establishing a greenhouse effect inside the dish and using the heat produced by radiations at the focus. The parabolic aperture with a diameter of 4 feet and a depth of 1/2 foot was used in the construction. The evaluation's findings will be used to estimate the parabolic dish collector's thermal performance, with a maximum outlet temperature of 53.1°C for direct solar radiation of 257.91W/m2 and a flow rate of 0.500 L/min.

Keywords - Temperature, Dish Collector, Demonstrative prototype.

1. INTRODUCTION

High-temperature collectors: when temperatures exceed 500°C, steam can be produced for power generation. Solar thermal energy is adaptable since it can use water as a heat transfer fluid or produce steam, as well as the ease with which hot water may be stored and used, as well as its ability to link to thermal networks. Energy is a critical area for both financial and social growth. The role of energy has an immediate impact on the growth of businesses, contributing to the expansion of the nation's economy. The evolution of energy from the sun is known as sunlight-based force. Warmth and light are the two most basic kinds of solar energy. The climate transforms and consumes daylight and warmth in a variety of ways. Some of these improvements result in environmentally friendly energy sources such as biomass, wind, and waves. The fly stream, the Gulf Stream, and the water level are all consequences of the climate's digestion of sun- based energy. A vast majority of the energy arriving at the Earth's surface is absorbed, while just a small portion is reflected. Around 70% of approaching radiation is absorbed by the air and the Earth's surface, while the other 30% is reflected back into space and does not heat the surface.

At higher altitudes, the Earth receives 174 petawatts (PW) of sunlight-based radiation.
When travelling above the climate, 6% of the approaching sunlight-based radiation (insolation) is reflected, while the remaining 16 percent is preserved. Insolation is further reduced by 20% by reflection and 3% through retention under normal barometric circumstances (mists, dust, contaminations). The winds and the water cycle are driven by the assimilation of sun-oriented energy via air convection (reasonable warmth transport) and the disappearance and accumulation of water fume (dormant warmth transport).

1.1 Literature Review

Nidhi. M. J-Ann George John, Nidhi. M. J-Ann George John, Nidhi. M. J- Consumption of traditional fuel sources has increased as a result of the increased reliance on them. Sun-powered energy, which may be bridled either by photovoltaic or nuclear power frameworks, is therefore the most effectively accessible fuel source. Warm frameworks are gaining popularity as a result of their ability to achieve high fixation proportions and temperatures. An allegorical dish gatherer is proposed in this study for the era of warm water, which can be used for home-grown applications. The dish gatherer is recreated using tangle lab programming.

2. Atul Sagade, Nilkanth Shinde- From an Indian perspective, there is a lot of potential for easy sun-based water heating systems. The shown structure can provide the needs for warm water in the mechanical region in a fraction of a second. Warming evaporator feed water, clothing uses, and other steam age applications can all benefit from this type of architecture. When compared to level plate and cleared cylinder sunlight based authority, concentrated sun powered gatherers have a high level of skill. As a result, considerable proficiency in the application of water warming can be achieved. For the moment water warming application, the designers used an allegorical dish gatherer. The model plan of a sun-oriented metaphorical dish gatherer with a truncated cone shaped helical looping beneficiary made of copper and covered with nickel chrome at the point of convergence is revealed in this study. With the approach described in this study, a current proficiency of 63.9 percent has been achieved. This

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model was evaluated for its presentation at Shivaji University in Kolhapur, Maharashtra, India in April and May 2010. [Longitude: 74.13° West, Latitude: 16.42° North].

3. Shubham Shinde, Rahul Shinde, and Ashish Patil
Water warming and cooking are both done with the help of a sun-oriented explanation dish. For the most part, one explanatory dish is used, with an illustrative collector preserved at its centre. In any case, we used four metaphorical dishes fixed on a stand with a helical curl at each dish's point of convergence. With water coursed as warmth moves liquid, the concentrator's presentation is tentatively examined. The framework is made of aluminium foil sheet that is extremely clever. The findings suggest that information about building a steam age for country use be disseminated. The concentrated warmth is ingested by a copper tube composed of loops that fit together like a fiddle, and the test results are taken during the summer on cloudless days. The dish is equipped with a global positioning system, and temperature estimation is completed. Temperatures ranging from 1200 to 1600 degrees Celsius have been achieved.

4. Krunal H. Siyatar, Ankita A. Chavda, and Kirti J. Vasaniya are the fourth and fifth members of the team. Rahul B. Chandegara- Concentrating sun-oriented force is power produced from mirrors to zero in daylight on to a collector that captures the sun's energy and transforms it to heat that can power a normal turbine generator or motor. CSP frameworks range from small remote force frameworks of a few kilowatts to large lattice associated power plants with hundreds of megawatts of capacity. CSP generates electricity by concentrating the sun's rays to warm a fluid, solid, or gas, which is then used in a downstream interaction to generate electricity. A CSP plant is made up of a sun-oriented concentrator structure with a beneficiary and gatherer for heat generation, as well as a force block.

5. Chaanaouia, Sébastien Vaudreuila, Tijani Bounahmidia
The progress of Concentrating Solar Power (CSP) Plants is the subject of this research. The investigation is based on data from 240 CSP plants, which provide us with a guide to the specialised and monetary features of these frameworks. We benchmarked and assessed the state of CSP plants from 1982 to 2020 using data acquired from the Internet. As measured by the results, 87 percent of CSP projects are in Spain and the United States, while other countries have invested in CSP since 2012. The Parabolic Trough Authority (PTC), Solar Power Tower (SPT), Linear Fresnel Reflector (LFR), and Parabolic Dish Collector are among the sun-based inventions investigated (PDC). Because itemised information reads for Fresnel and Dish are not readily available, the metaphorical box framework was given special consideration. The reformist decrease in PTC innovation's long-term speculation cost is shown, as well as the energy stockpiling alternative. PTC with warm oil and liquid salt stockpiling at 50 MW is the most mature framework, while SPT plants are promising and may have the best potential by mid-2018, according to our affectability analysis.

2. OBJECTIVE

Due to the rapid depletion of fossil fuels and petroleum products, today's civilization requires a shift to non-conventional energy sources. Researchers have discovered that residential demand accounts for a large portion of energy consumption in all dimensions of utility, and that thermal energy can be used to generate any mode of energy. Using a dielectric filter (ploythene and glass) and the heat at the focus, we are attempting to supply the hot water needs of families using trapped heat inside the solar dish concentrator. Constructing a solar dish concentrator with a diameter of 4 feet and a depth of 1/2 feet that can manually track sun radiations. This concentrator may be able to warm water more quickly, and we may be able to assess the system's commercial uses.

3. CONSTRUCTION OF MODEL

The model shown in bellow figure is a prototype. The design and geometry considered is based on previous researchers done on dish collectors.
Following steps are adopted to complete the setup.

Figure 1 Square Base Frame

The Base- Hollow iron rod is used to create a 3ft square base frame. A 3ft rod is welded inside the square frame at a distance of 1ft from the back end, which is referred to as A. Two 1ft hollow rods, b and c, are welded perpendicular to A at a sufficient distance, and two bearing bases are welded separately on b and c.

Sun Tracking Tracking the Sun A moveable joint is welded to one end of the dish, providing angular moment to a 600 MM long pipe. In this pipe, holes are drilled at predetermined lengths. Every month, the required angle must be changed and corrected using the tilt angle calculator below (shakti pumps dewas). (www.shaktipumps.com/solarcal-culator.php) The best angle for your solar panels changes throughout the year, based on the seasons and your location, and this calculator indicates the monthly differences in sun height. For even more exact angling, you'd have to follow the sun minute by minute as it moves throughout the day. This can be done with a mechanical solar tracker that is automated, however it is not particularly cost effective.

Every day, at solar noon (exactly halfway between sunrise and sunset), the sun reaches its highest point, and this calculator displays the angle at that time. The irradiance from the sun is at its peak at solar noon, and you can generate the maximum energy.

In the northern hemisphere, for example, the sun is directly south during solar noon. You should face your solar panels due south at the ideal angle to ensure that they receive as much sunshine as possible at this time.

When you want to get the most out of your photovoltaic system, the ideal angle for your solar project also depends on when you want to get the best out of it. You should slant your solar panels according to the height of the sun in the sky during the summer months (when there is the greatest sunlight). You will benefit from having the best performance from your solar system all year if you have the capacity to alter your photovoltaic panels throughout the year. "

In our situation, the same radiations would be present.

Receiver :-Mirrors are pasted on the concave part of solar dish concentrator. The focus calculated at a distance of 18 inches from the dish. MS pipes fixed as shown in figure bellow to fix receiver.

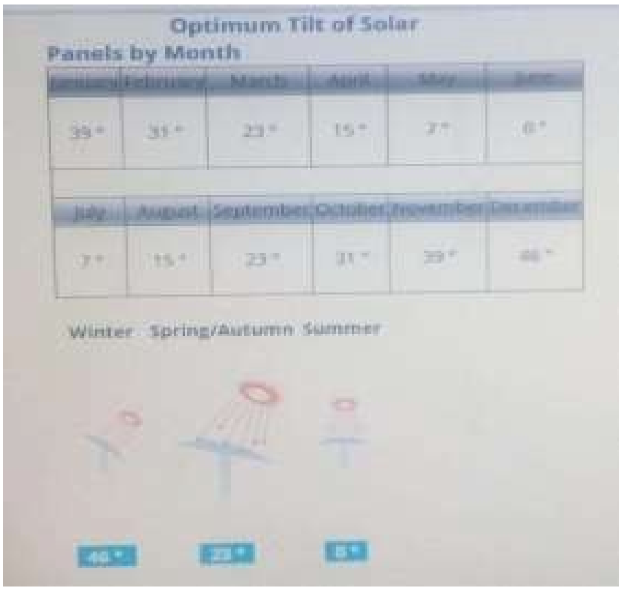

Figure 2 Optimum Angle of solar panel

Figure 3 Mirrors are bonded over a solar dish

4. EXPERIMENTAL SETUP

Figure 4 Image of Experimental

Maximum Temperature of Receiver At Focus (1:00 pm-1:30 pm) – 70.5°C

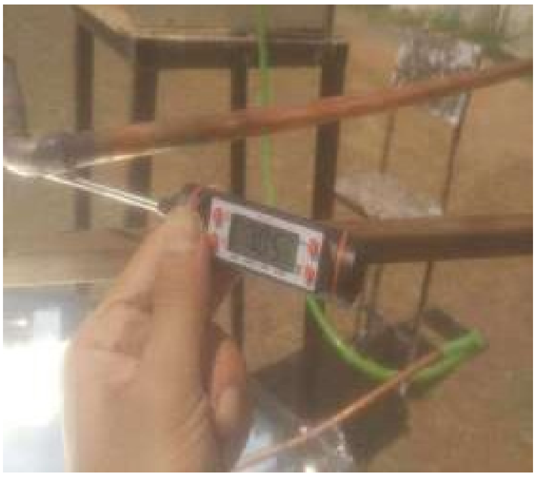

Figure 5 Maximum Temperature of Receiver

Maximum Temperature Inside the Dish (1:00pm-1:30pm) – 60.6 °C

Figure 6 Maximum Temperature inside dish

5. OBSERVATION TABLE

Date-12 APR 2021

Mass flow rate was 500ml/min. Ambient temperature- 23-38 °C

The average intensity of solar radiation received on Bhopal is 257.91 W/m$^{2.}$ Temperature inside the dish- 55-60 °C. Inlet water temperature was 31.8 °C during the whole time of experiment as water was in the camper.

Date-13 APR 2021

Mass flow rate was 500 ml/min. Ambient temperature- 23-38 °C.

The average intensity of solar radiation received on Bhopal is 257.91W/m square (watt permeter square

Inlet Water Temperature (1pm-1:30pm) –31.8^{O} C

Maximum Outlet water Temperature(1pm-1:30pm)-53.1^{O} C

Figure 7 Inlet water Temperature

Figure 8 Maximum Outlet Temperature

S.NO.	TIME	TEMPERATURE OF RECEIVER AT FOCUS (°C)	INLET WATER TEMPERATURE (°C)	OUTLET WATER TEMPERATURE (°C)
1	11:30am-12:00pm	46.2	31.8	36.1
2	12:00pm-12:30pm	53.6	31.8	43.8
3	12:30pm-1:00pm	62	31.8	51.9
4	1:00pm-1:30pm	70.5	31.8	53.1
5	1:30pm-2:00pm	70.1	31.8	52.0

Figure 9 Data obtained on 12 Apr 2021.

S.NO.	TIME	TEMPERATURE OF RECEIVER AT FOCUS (°C)	INLET WATER TEMPERATURE (°C)	OUTLET WATER TEMPERATURE (°C)
1	11:30am-12:00pm	46.0	31.8	36.0
2	12:00pm-12:30pm	52.8	31.8	42.6
3	12:30pm-1:00pm	61.3	31.8	51.1
4	1:00pm-1:30pm	68.3	31.8	52.0
5	1:30pm-2:00pm	67.9	31.8	51.2

Figure 10 Data obtained on 13 Apr 2021.

6.CONCLUSION

The present model can be viewed as a new experimental model, which can be used for parametric analysis of domestic water heating systems. The theoretical model presented can be an efficient tool to predict and design solar systems operating under thermo siphon principle flow conditions. The stratified storage tank has an advantage of obtaining higher heat energy output when compared to a conventional fully mixed hot water storage tank. The temperature distribution was investigated using a model with fixed inlets in this study. As a result, better stratification occurs, increasing the efficiency of both solar collectors. Nevertheless, the presented results are theoretical and explanatory, we must in future work develop this system and verify all these simulation results.

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