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Studies on Parabolic Solar Dish Collector – Review

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Abstract

A parabolic solar dish collector (PSDC) is like the dish antenna,but it does possess a reflector such as a mirror it contains an absorber at its focal point. It is concentrating solar radiation irradiated over it using that. It tracks the sun everywhere in the sky and gets irradiated with its radiation,for that, it requires powerful computers and dual-axis trackers. This review studies the improvement in hydrothermal efficiency of PDSC using oil-based nanofluids. It also observed that the use of PCM with PDSC may reduce cooking time by 25% and when used in place of a boiler in a small-scale steam power plant, it may reach an overall efficiency of 35%.

Keywords: *Parabolic collector, Radiation, Hydrothermal efficiency, Nanofluids, Boiler.*

1. INTRODUCTION

The conventional sources that we are using for years are extinct and they are still creating pollution in all forms. The only plan we have is to go for renewable energy sources considering a sustainable future in our minds. For the time being, solar energy is one typical source that catches the attention of global leaders. Due to the increase in population over time, power requirements increase tremendously. The advancement of new technologies, especially electronics, and their reach to common people increases the need for more electricity. Because of that, all these new findings are initiated for the discovery of more power which can be harnessed through the sun. Parabolic solar dish collector gives one such alternative for power transformation and harnessing.

2. EARLIER STUDIES ON PARABOLIC SOLAR DISH COLLECTOR

Abdiwahab et al. [1] here look into the improvement in hydrothermal efficiency of a PDSC which is charged with ahybrid nanofluid (oil-based). He considered a semi cone-shapedPDSC which is furnished with a smooth or corrugated absorber chamber. He used the Eulerian two-phase model for numerical simulation. He concluded that using hybrid nanofluid remarkably increases the efficiency. Also, he observed an increase in convection coefficient and pressure loss, thus showing better exergy efficiency.

Pourmoghadam et al. [2] here examined the thermochemical energy storage system which acts as an auxiliary of the sollar steam power plant(based on the Rankine cycle) which was also merged with the PSDC. He used TRNSYS and MATLAB software for simulation and modeling. Then he estimated the exergy and economic behavior of the system. He observed that increasing inlet pressure to the turbine by 50 bar induces solar fraction by approximately 15%. Also, he detects loss in unavailability.

Karimi et al. [3] here put forward an extensive mathematical model on an indirect solar water heater. Using that model he may be able to measure the outcome of heat losses in HEX, receivers, and oil-keepingtanks on system yielding.For that, he considered only radiation and convection heat transfer modes. He showed that by modulating different airflowrates at the inlet he may be able to get hot air of different temperatures which can be used for different purposes. Doing so varies the efficiency from 10% to 80% and up to 60% increase in thermal efficiency. He observed that performance may get increased with mass flow rate but he gets hot air in less amount. He concluded that this system is more efficient than conventional ones and that too at a low cost.

Rosnani et al. [4] deduced after simulating through MATLAB Simulinkthat solar power reaching the receiver end will decrease if the intercept factor was reduced. This, in turn,results in loss of solar radiation which was carried from the concentrate to the receiver. Ramalingam et al. [5] deduced that the use of phase change material (PCM)in a sollar cooker enhances its capacity by employing a parabolic dish collector. He observed a decrease in 25% of the time after employing PCM as a material for heating water to 90 degrees Celsius. He also observed a remarkable upgrade in cooking performance at off sunshine hour.

Praveen et al. [6] here used a new perspective toenhance the yield of commercial sollar thermal power(CSP) plants employing parabolic trough collectors(PTC). He took three places for his analysis Yanbu, Abha, and Dawadmi. He deduced that Yanbu and Abha are perfect places for setting up PTC CSP plants. The discovery of this analysis enhances the sustainability of PTC CSP technology over CSP technologies.

Basem et al. [7] made a small steam power plant with all the basic parts which are used in the Rankine cycle and auxiliariesfor its functioning and preservation. He used a parabolic solar dish collector instead of a boiler.He collected data in Situ in different weathers to check it'syielding and they deduced that station was creatingenergy around 1500 W and operating at around 35% overall efficiency. Mothilal et al. [8] in this paper showed his experimental conclusions which he got while examining solar parabolic dish thermoelectric generator (TEG). The temperature at the cold side is stabilized by using phase change material and hence used as a sink. This model forecast its yielding at any place and it performs better in rural areas.

Ghomrassie et al. [9]analyzedthe design characteristics of a parabolic dish receiver system to deduce the best design parameters to realize the most desirable system. For that, he performed a sequence of numerical simulations taking different spots, mainly first and second. He deduced that the second spot gives better efficiency with the low height receiver and the first spot gives better with the raised one.

Satyanarayana et al. [10] did desalination of water using solar energy. This process uses three steps the first one was preheating seawater and then the creation of steam using a parabolic trough collector and at last condensation. Prior studiesshow that it has a capacity of around 0.05 L/s of soft water when it gets a temperature of around 300 degrees Celsius. This was wiped out tiny scales in villages because of its high initial price however it's driven currently as a result ofa shortage of standard fuels and growing demand forwater.

Subramani et al. [11] used a conical receiver design to achieve higher thermal efficiency.It was earlier revealed that its efficiency ranges from 40% to 60% under various functioning situations. He deduced a mass flow rate of 0.009 kg/s for 34 degreesCelsius temperature difference. Also, the heat transfer coefficient was found to be around 1300 W/m2K at a discharge of 0.05 kg/s. It is because of less temperature difference which is close to 5 degrees Celsius. Praveen et al. [12] looks into the impacts on the Stirlling heat engine and a parabolic dish of circummsolar radiation. This broadens the solar cone irradiated on the parabolic dish which in turn deteriorates its yielding significantly.This remarkably decreases energy falling on it due to which average temperature of heat addition decreases and hence its thermal efficiency. He examined all these influences using a factor called circummsolar ratio. He concluded that bydetermining the optimal proportion of concentration ratio for PDSC and optimal proportion of temperature in the stirlling cycle maximum overall thermal efficiency can be reached.

Sagade et al. [13] in this paper investigates the usage of a PDSG (parabolic dish solar geyser) to create heated water in small-scale applications. A solar geysor is tried out for this motive and its thermal yielding is measured in two different layouts. Ray tracing technique is employed for its optical inspection. He deduced that PDSG straight away generates enough water at around 55 degrees Celsius and that too with reduced cost. He did an exergy analysis to collate his system and he got fair results.

Ouyang et al. [14] in this paper collates the yielding of parabolic dish collector and flat plate collector. He did this analysis at two different places the first one was the Chinese capital and the other one is the Iranian capital. He took these places because of their contrasting weather situations. Apart from that, he did his analysis employing, unlike operating fluids. He deduced that altogether they had better exergy efficiency but when collector efficiency is quite low in a few months, its application in the Iranian capital shows better outcomes.

Zainudin et al. [15] in this paper analyzed one important factor ie. Rim angle for getting imagging and nonimagging diameter of incident radiation per unit area. He deduced that shorter angles performed better ie. Giving better imagging and non imagging diemeter. It also gives the focal length of the dish. The quantity of sollar radiation depends on this angle so it's better we got to know about this.

3. CONCLUSION

Future energy strategies will rely heavily on the selection of appropriate technologies for power creation.The PSDC stirlling system has demonstrated much better efficiency than other CSP systems in the reformation of sollar to thermal energy. Also, the hydrothermal efficiency of PDSC can be improved by using oil-based nanofluids. It has been seen that the use of PTC enhances the yielding of CSP.This review examined the use of PSDC systems in electric generation, heat creation, and other applications. The PSDC systems and their many designs, as well as their various uses, have been demonstrated.More research is required to increase the net attainment of the PSDC system, which can be accomplished by selecting the best design parameters. Because the cost can be received from the system may decrease if the optimal decision is made.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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