CHARACTERISTIC EQUATION OF N-PVT-CPC COLLECTOR INTEGRATED SOLAR STILL USING CNTS & CQDS –WATER BASED NANOFLUID

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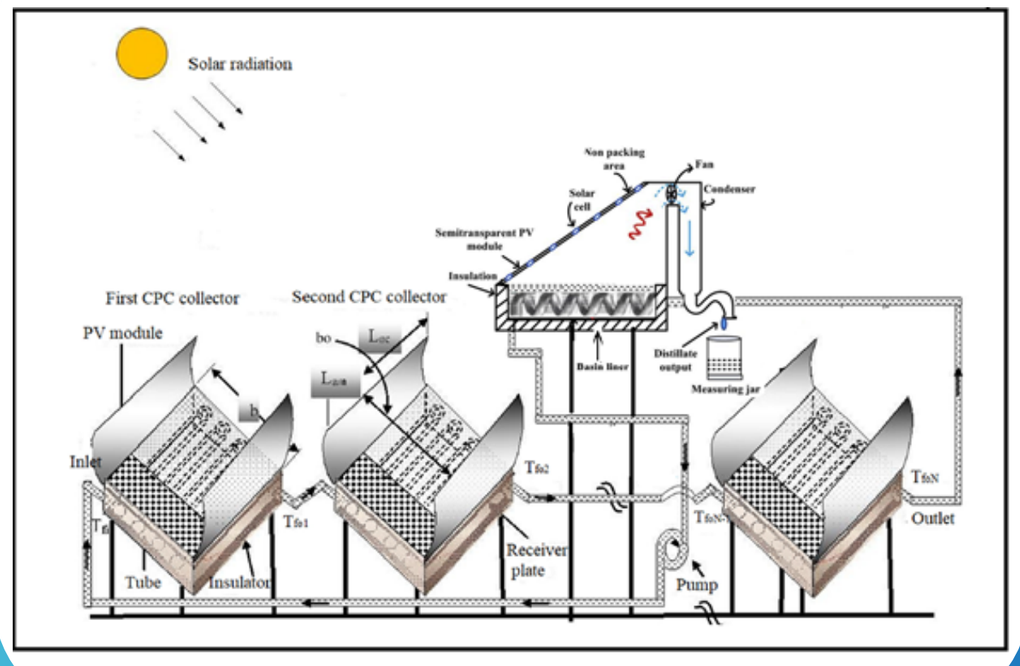
ABSTRACT

This research article investigates the performance enhancement and thermophysical characteristics of a single slope solar still with the addition of Carbon Nanotubes (CNTs) in water-based nanofluids. The system incorporates partially covered series connected N-Photovoltaic Thermal (PVT)-Compound Parabolic Concentrator (CPC) collectors and a helically coiled heat exchanger (HE). The study focuses on optimizing various parameters such as concentration of CNTs, basin fluid mass, and number of PVT-CPC collectors for hot weather conditions. The addition of Single Wall Carbon Nanotubes (SWCNT) to the water-based nanofluid resulted in significant enhancements in heat transfer coefficients (HCTs), and total yield of the system. Moreover, the cost analysis showed that the production cost of daily yield obtained from the system with CNTs is very nominal.

INTORDUCTION

The global water shortage crisis and the need to find alternative, sustainable methods for water purification. Solar distillation has been a viable process for producing drinking water from an economic standpoint for thousands of years. With the advancement in technology, hybrid solar distillation systems that use renewable energy have been developed. Photovoltaic thermal (PVT) technology, coupled with a heat exchanger, has been used to provide external thermal energy to these systems. Solar concentrator collectors have been found to be more efficient in providing external thermal energy, but few studies have been done on PVT-CPC collectors. Nanofluids have also been introduced to solar distillation systems, and researchers have found significant enhancements in yields when using Al2O3 and CuO particles. Different thermo-physical and optical characteristics of nanofluids have been studied to improve the productivity of solar distillation systems.

SYSTEM DIAGRAM



OBJECTIVE

To study the enhancement of performance of Solar still integrated with N-CTC collectors by addition of CNT(Carbon Nanotubes) based nanofluid along with water.

- Without Heat Exchanger
- With Heat Exchanger

*We worked on a system without Heat Exchanger

METHODOLOGY

- Estimation of solar intensity falling on the single slopes of DSSS, PVT collector, and solar concentrator (beam radiation) for hot weather conditions.
- Execution of mathematical modeling in MATLAB by considering the initial temperatures of all different parts of the system, including the heat exchanger, fluid, and outlet of the fourth collector, equal to the ambient temperature.
- Estimation of important HTCs using correlations of temp. of basin, solar still, and condensor.
- Evaluation of thermal gain & loss, density, specific heat and thermal conductivity.

RESULTS

Fig.1

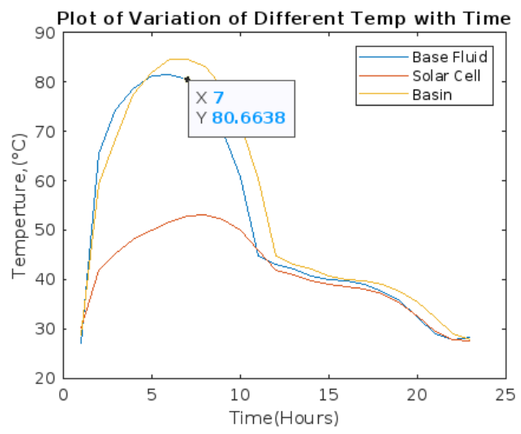


Fig.2

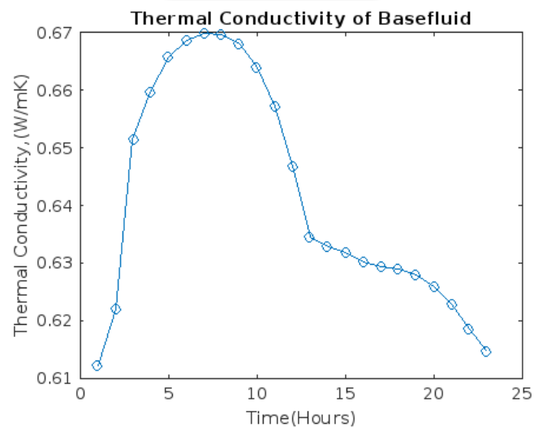


Fig.3

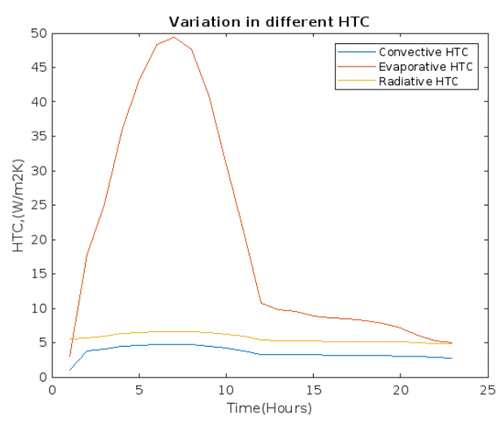


Fig.4

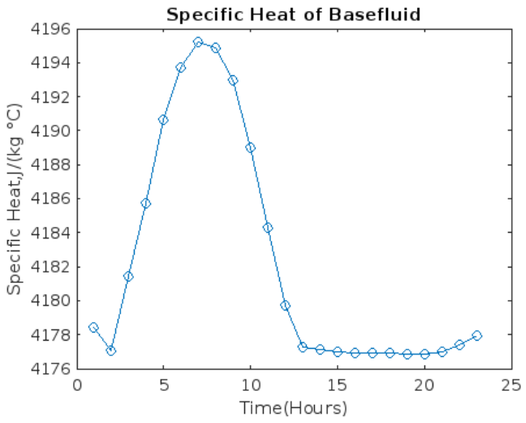


Fig.5

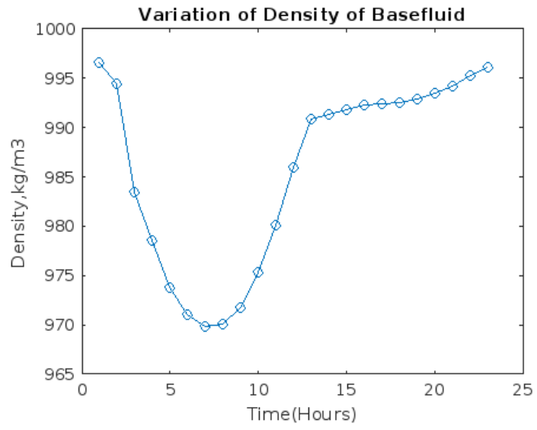


Fig.6

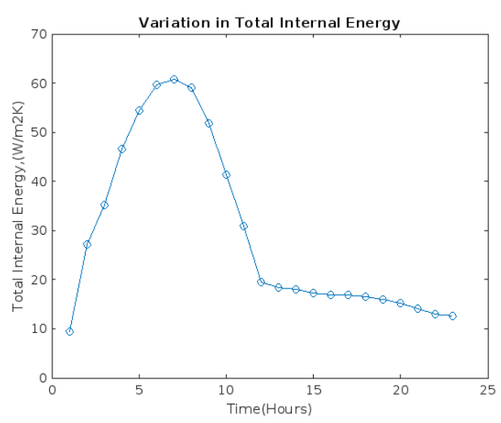


Fig.7

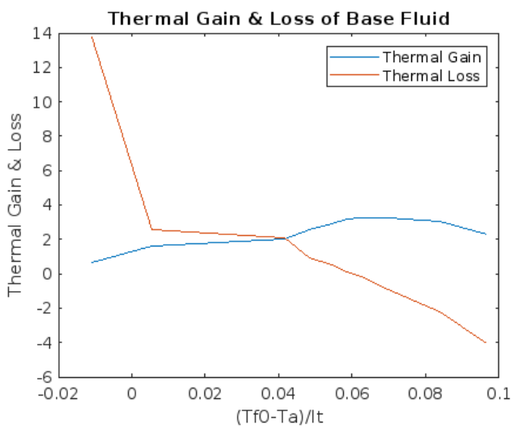


Fig.8

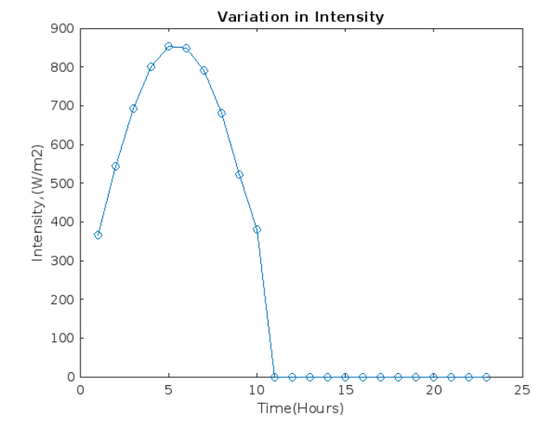
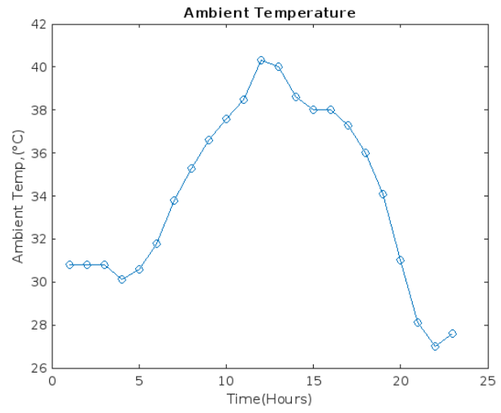


Fig.9



CONCLUSION

We can conclude that with the addition of CNT based nanofluids there is a significant increase in the outlet water temperature. The numerical analysis shows that the total productivity of the system without CNT in 24 hrs was around 6.3 litres per day and with the addition of the nanoparticles we observed that the productivity increased to 10.7 litres per day. The use of CPC Collectors has increased the efficacy of our system by conserving heat energy and minimising convective heat loss.

Cost analysis of the system provides an option for the designers to find alternative techniques for the improvement of the system performance. Conventional solar distillation systems are popular in rural areas. Its use can be further maximised in the rural areas by reducing the cost of the system design. The future work includes the cost analysis of the system and further improvements to increase the efficiency and productivity of the system.

REFERENCE

Arora, S., Singh, H. P., Sahota, L., Arora, M. K., Arya, R., Singh, S., Jain, A., & Singh, A. (2020). Performance and cost analysis of photovoltaic thermal (PVT)-compound parabolic concentrator (CPC) collector integrated solar still using CNT-water based nanofluids. Desalination, 495, 114595. https://doi.org/10.1016/j.desal.2020.1145952.