STUDY OF N- EVACUATED TUBULAR COLLECTORS INTEGRATED SOLAR DISTILLATION SYSTEM USING CQD-NANOFLUIDS

Cluster Innovation Centre | University of Delhi

ISHIKA RAI , RIYA KUMARI

B.Tech (IT and MI)

Mentors
Prof. Swati Arora
Dr. Harendra Pal Singh

ABSTRACT

This paper studies enhancement of performance of Single Slope Solar still by addition of Carbon Quantum Dots (CQD) along with water. We study the effect of the particles of CQD to the output of the Solar still. The analysis has been carried out by developing a thermal model of the system to not only fulfil the electricity requirement but to also enhance the system productivity as compared to the conventional solar distillation systems. The daily productivity of the hybrid system was found to be higher by using nanofluids as expected from the heat transfer results. This modified passive distillation system is a self-sustained system; and its two-in-one controllable output (electrical power generation as well as potable water production) option is very significant which fulfils our both demands.

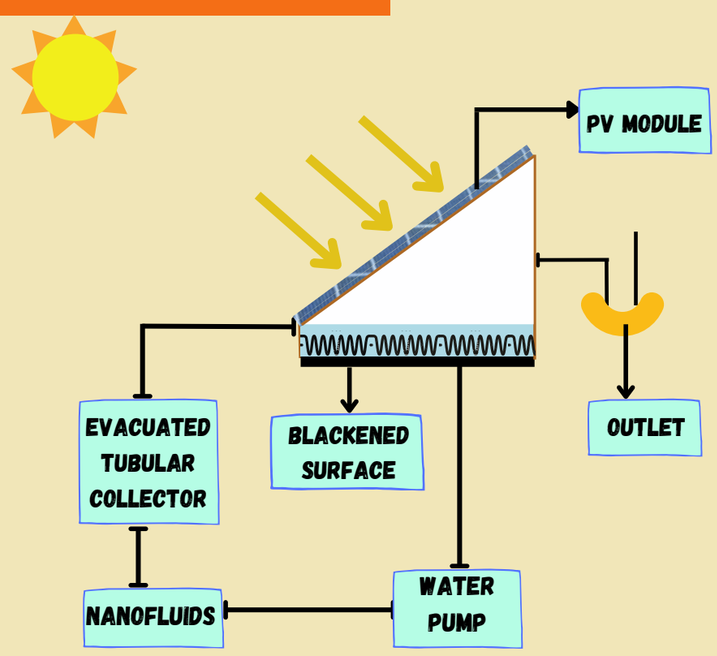
OBJECTIVE

To study the enhancement of performance of Solar still integrated with N-ETCs by addition of Carbon Quantum Dots (CQD) along with water.

METHODOLOGY

- Different heat transfer coefficients (HTCs) of the system have been calculated using design parameters using thermo-physical properties of water.
- From the estimated HTCs, hourly temperature of solar cell, blackened surface, passive condenser, and basin water; and solar cell efficiency) and module efficiency of the system has been obtained.
- Hourly productivity (yield) the proposed system has been calculated.
- Electrical energy, net electrical gain, thermal gain, overall thermal energy gain; thermal energy efficiency and overall thermal energy efficiency of the system has been evaluated.

SYSTEM DIAGRAM



INTRODUCTION

- Solar still replicates the natural hydrological cycle as a closed system. In the still, saline water or feed water placed in a basin with a cover of transparent glass is heated using solar radiation.
- Evacuated tube collectors are a way in which heat loss to the environment, inherent in flat-plates, has been reduced. Since heat loss due to convection cannot cross a vacuum, it forms an efficient isolation mechanism to keep heat inside the collector pipes.
- Carbon dots (C-dots) have been defined as discrete, quasi spherical, nontoxic (or less toxic), water-soluble, highly fluorescent nanomaterial . They consist of clusters of carbon with various other atoms such as nitrogen, oxygen, sulphur, and phosphorus.
- Helical coil heat exchanger (HCHE) offers distinct advantages, such as improved thermal efficiency, compactness, easy maintenance and lower installed cost.

VARIATION OF PROPERTIES OF WATER (WITHOUT CQD) VS TIME

With the help of the Matlab Software, we did the thermal modelling, and plot the output of the results, we can see the variations of the physical properties of water with temperature.

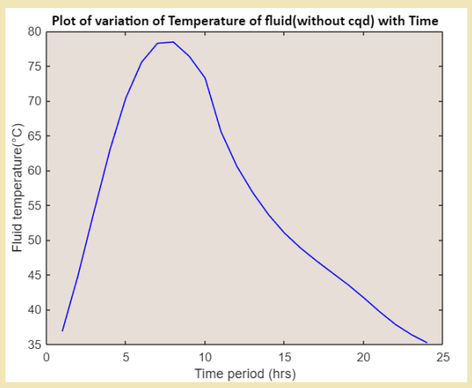


Fig 1 : Temperature of outlet water without CQDs

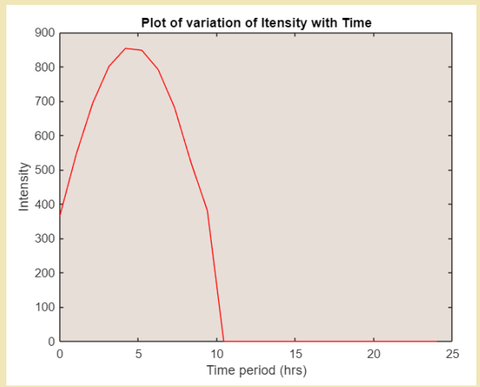


Fig 2 : Plot of variation of Intensity with Time

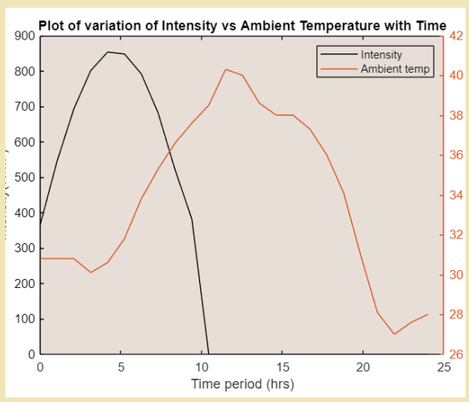


Fig 3 : Variation of Intensity vs Ambient Temperature

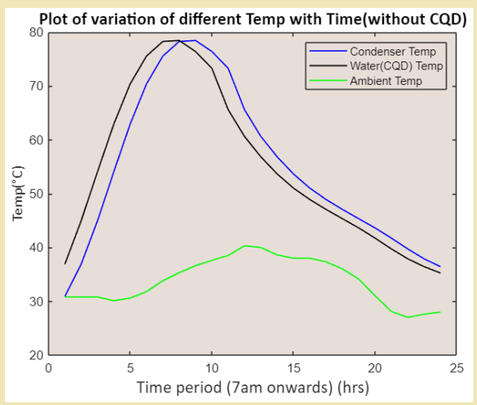


Fig 4 : Variation of different Temperatures without CQDs

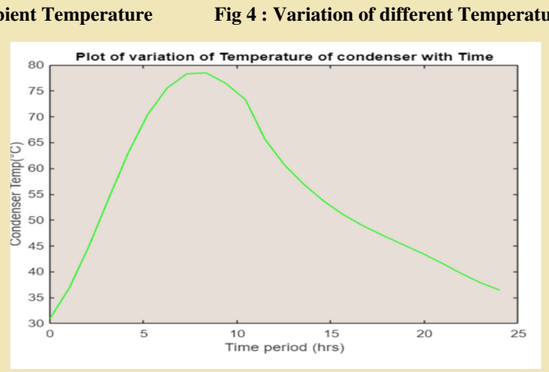


Fig 5 : Temperature of condenser without CQDs

COMPARISON OF PROPERTIES WITH AND WITHOUT CQDS

With the addition of nanofluids we can observe that the efficiency and productivity of the solar distillation system has significantly increased .

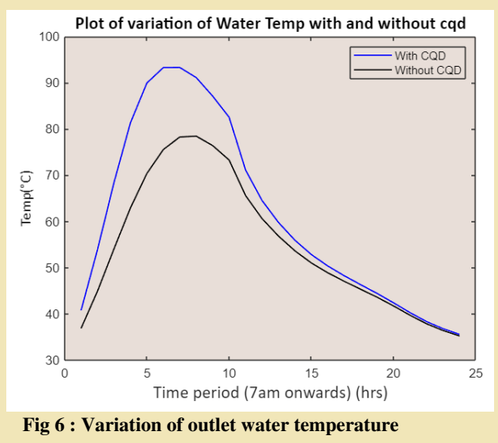


Fig 6 : Variation of outlet water temperature

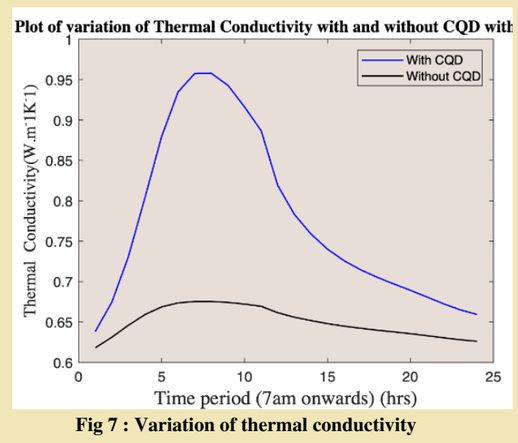


Fig 7 : Variation of thermal conductivity

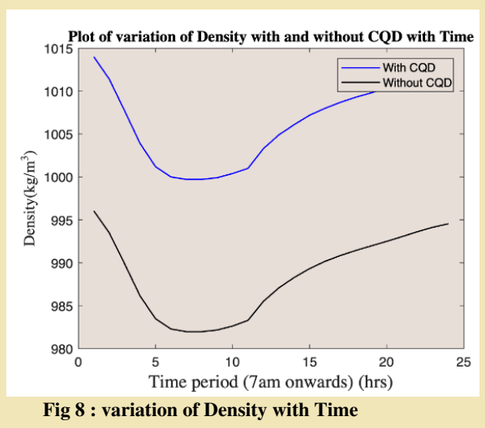


Fig 8 : variation of Density with Time

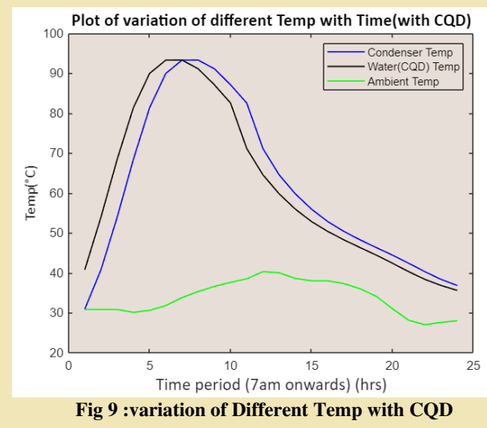


Fig 9 :variation of Different Temp with CQD

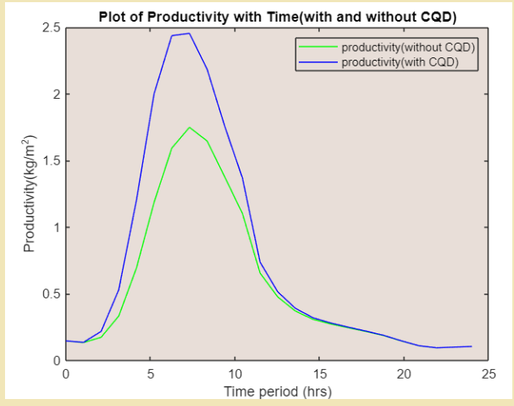


Fig 10 : Improvement of Productivity with the addition of CQDs

CONCLUSION AND FUTURE WORK

We can conclude that with the addition of CQD based nanofluids there is a significant increase in the outlet water temperature. The numerical analysis shows that the total productivity of the system without CQD in 24 hrs was 7.4 litres per day and with the addition of the nanoparticles we observed that the productivity increased to 11.3 litres per day. The use of Evacuated Tubular 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.

REFERENCES

1. G.N. Tiwari, H.N. Singh, R. Tripathi, Present status of solar distillation, Sol. Energy (2003) 75–367.
2. Tiwari G.N., Sahota L., Advanced Solar Distillation Systems: Basic Principles, Thermal Modelling and Its Applications, Springer (Nature), ISBN 978-981-10- 4672-8. [3] S.S. Narayanan, A. Yadav, M.N. Khaled, A concise review on performance im provement of solar stills, S N Applied sciences (Springer Nature journals) 2 (2020) 511–531.