ISSN: 2395-2946

A Review on Flat Plate Solar Collector Integrated with Heat Pipes

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Abstract -Based on the heat transfer characteristics of absorber plate of a solar collector and the heat transfer effectiveness number or NTU method used for heat exchanger analysis, a new theoretical model for analysing the thermal performance of flat plate solar collector integrated with heat pipes has been put forward and the results have been validated by comparisons with the experimental results available in the literature. The theoretical model has been analysed and the results have been obtained for the specified values of input parameters by developing a CPP programmer. The influence of relevant parameters on the thermal performance of flat plate solar collector integrated with heat pipes has been discussed. The proposed theoretical model can be helpful for a designer to design a new solar heating system integrated with the heat pipes for a better performance.

Keywords- Heat transfer characteristics, NTU method, Heat Pipes, CPP programmer.

I. INTRODUCTION

Solar thermal utilization is of nice importance visible of environmental protection and traditional energy saving. a spread of flat plate star collectors and exhausted hollow star collectors are created and applied round the world. However, these standard star collectors suffer from some inherent drawbacks, akin to reversed cycle throughout cloudy periods of the day and also the night, high pumping necessities, scale formation, freeze and corrosion [1].

Heat pipes supply a promising resolution to the higher than issues of standard collector Heat pipes square measure devices of terribly high thermal electrical phenomenon, that transfer thermal energy by 2 section circulation of fluid, and might simply be integrated into most sorts of solar furnace [2, 3]. The fundamental distinction within thermal performance between a heat pipe solar furnace and a standard one lies in the heat transfer processes from the absorbent surface to the energy-transporting fluid. within the case with a heat pipe, the method is evaporation–condensation–convection, whereas for standard star collectors, heat transfer happens solely on the absorbent plate. A feature that creates heat pipes engaging to be used in star collectors is their ability to control sort of a thermal-diode, i.e., the flow of the warmth is in one directional. This minimizes heat loss from the transporting fluid, e.g., water and air, once incident radiation is low. Another advantage is redundancy, that is, a failure in one heat pipe wouldn't have a serious result on the operation of the collector.

II. LITERATURE REVIEW

An analytical model has been developed to analysis the performance of a ‘mini’ attraction heat pipe and a pair of ‘micro’ attraction heat pipes of varied sizes, victimization water as a result of the refrigerant. In general, the modelling results indicate ‘micro’ attraction heat pipes have higher heat transport limits than ‘mini’ heat pipes of a similar cross-sectional area [9].

Hussein [5, 6] investigated in theory and experimentally a thermosiphon flat plate reflector. The results discovered that the pitch distance restricted the selection of Associate in Nursing sorbent material plate to a minimum of one having a high price of thermal conductivity. Later, a wickless heat pipes flat plate reflector with a cross flow device was investigated in theory and experimentally below the condition of Cairo, Egypt [7]. The experimental and theoretical results indicated that the quantity of wickless heat pipes options a significant impact on the collector efficiency.

Xiao, Lan, et al.[4] investigated in theory thermal performance of heat pipe flat plate reflector with cross flow cash handler|device} supported the heat transfer characteristic of sorbent material plate and heat transfer effectiveness-number of heat transfer unit methodology of heat money handler.

Furthermore, Hussein et al. [1] investigated experimentally the impact of wickless heat pipe cross section math and its operative fluid filling relation on the performance of flat plate star collectors. The experimental results indicate that the elliptical cross section wickless heat pipe flat plate star collectors have higher performance than the circular cross section ones at low water filling ratios. The optimum water filling relation of the elliptical cross section wickless heat pipe reflector is concerning 10, whereas it's really on the purpose of two hundredth for the circular cross section one.

such effort has been created on the design of heat pipe star collectors at intervals the past few years. Riffat et al. [8] presented the results obtained from laboratory testing of four liquid flat plate collectors, i.e., a wavy fin collector, a pair of flat plate heat pipe collectors, and a clip fin reflector. Results showed the clip fin reflector to be promising, with experimental efficiencies approaching eighty six.

III. CONCLUSION

On the basis of present analysis it is concluded that:

1. The Efficiency of the system increases with increase in mass flow rate and increase in intensity of incident solar radiation in case of both fluids (Water & Air) .

2. Maximum system efficiency obtained for water as a fluid is 54.42% corresponding to Values of Io= 800 W/m2 and G = 0.0916 kg/s.

3. Maximum system efficiency obtained for air as a fluid is 51.39% corresponding to Values of Io= 800 W/m2 and G = 0.0916 kg/s.

4. It is very much clear that for same mass flow rate and same environmental conditions system efficiency obtained for water as a fluid is more as compared to that of air as a fluid.

5. The theoretical analysis proposed can be used for flat plate solar collector integrated with heat pipes design and assessment. It is an efficient approach to analyse and discuss the influences of solar intensity, water inlet temperature, environmental temperature, heated fluid mass flow rate and collector's parameters on the flat plate solar integrated with heat pipes performance.

6. This theoretical method is more suitable for the collector under certain conditions, i.e., intense solar radiation and small heated fluid mass flow rate.

IV. ACKNOWLEDGMENT

We are using the conceptual knowledge to do some useful work for the benefit of our society. This work is complete in the guidance of Assistant professor Mr. Saumitra sharma who showing confidence in me and showed me different approach to achieve my goal. I am thankful to work with him.

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