A Review on the Factors affecting Augmentation of Heat Transfer and Efficiency of DPSAH

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Abstract— The heat transfer rate of solar air heater can be increased by increasing the heat transfer coefficient on absorber plate. Various artificial geometries have been developed and experimented to determine the effect of geometry roughness on heat transfer rate. Moreover, a DPSAH with artificial geometry is more efficient than a single pass with artificial geometry. A review of such studies is presented in this paper.

Key words: DPSAH, Heat Transfer

I. INTRODUCTION

Solar energy is abundantly available on the earth in form of radiation. This energy can be converted to thermal energy and can be used for heating application. Solar Air Heater is a simple device that captures the incident solar energy and converts it into thermal energy to heat the air. Solar Air Heater are used in space heating, drying agricultural products like seeds, fruits etc, timber seasoning and some industrial application.

Various works have been carried out to increase the efficiency and heat transfer rate of SAH. This includes using different materials for absorber plate, artificial roughness geometry, surface roughness, number of pass, effect of porous material, mass flow rate etc.

II. LITERATURE SURVEY

A. Literature Review based on Experimental Model Based:

An investigated the thermal performance of solar air heater having different obstacles on absorber plates.

Considering four types of obstacles, namely triangular obstacles, leaf-shaped obstacles, rectangular obstacles and no obstacles. With the changing mass flow rates, it was found efficiency increased from 0.0052 kg/s to 0.0074 kg/s, shown in Fig.(1), which concluded that efficiency increases with increasing the mass flow rate up to certain limit. Also, the collector efficiency was found the highest with the leaf-shaped obstacles as it creates high turbulence than other obstacles.

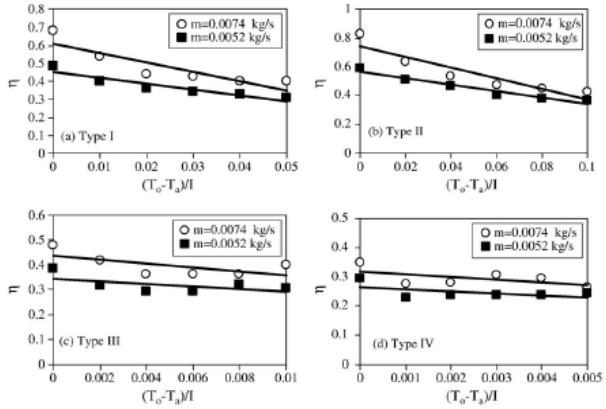


Fig. 1: Efficiency Vs Temperature diagramed

Fig. (1) Variation of efficiency with temperature at different mass flow rates [1]. An investigated the performance of a double pass solar air collector. With the usage if porous material in the second pass of double pass solar air collector, it yields a higher thermal efficiency compared to double pass solar air collector without the absorber matrix. It is due to the fact that the porous material provides a large surface area for the heat transfer. The thermal performance of double pass solar air collector with porous material was observed 25% higher than double pass solar air collector without porous material [2].

B. Literature Review based on Investigation and Result Analysis:

An investigate thermal performance investigation of double pass-finned plate solar air heater. Finned plates and v-corrugated plates were used for the experiments and results were compared. The outlet temperature of DPVCPSAH was obtained higher than DPFIPSAH, as shown in Fig. (2). It was because the surface waviness of the corrugated plate changed the flow structure of the fluid flowing. Due to the generated fluid flow, the turbulence of flow increases with the increasing mass flow rate [3].

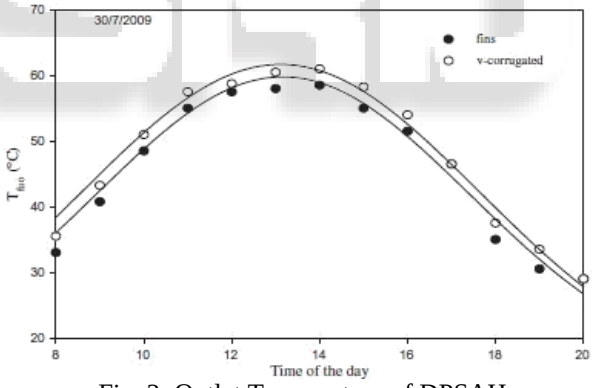
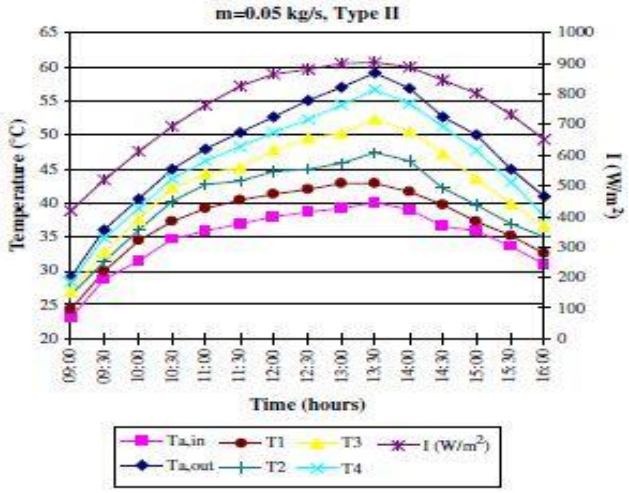


Fig. 2: Outlet Temperature of DPSAH



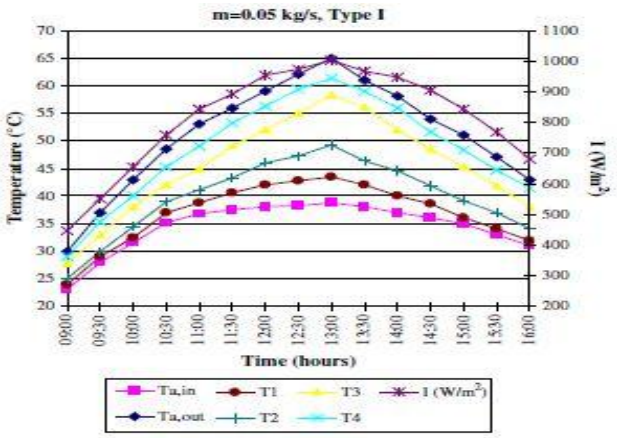


Fig. 3: Temperature vs. Time graph of Zigzag

F.Ozgen et. al.[4] investigated thermal performance of a double-flow solar air heater having Aluminium cans. From the two different arrangements of aluminum cans on the absorber plate, namely zigzag manner and arranged manner, it was found that the zigzag arrangement give higher efficiency than the arranged one. This was because the zigzag arrangement provided greater turbulence to the air. Thus, due to high turbulence, the temperature of air increase and hence the efficiency. Graphically it is shown as in Fig. (3) and Fig.(4) respectively.

Fig.(3)Temperature variation of zigzag arrangement at m=0.05 kg/s Fig.(4) Temperature variation of arranged arrangement at m=0.05 kg/s

A.Fudholi et. al.[5] investigated the performance of finned double pass solar air collector. The study involved investigation of the effect of mass flow rate and solar radiation intensity on the thermal efficiency. The efficiency of collector increases with increasing the mass flow rate, Fig. (5) With staggered fin absorber plate, the optimum efficiency was found about 70% between mass flow rates of 0.07-0.08 kg/s. It was also concluded that the efficiency of collector is directly proportional to the solar radiation, Fig. (6).

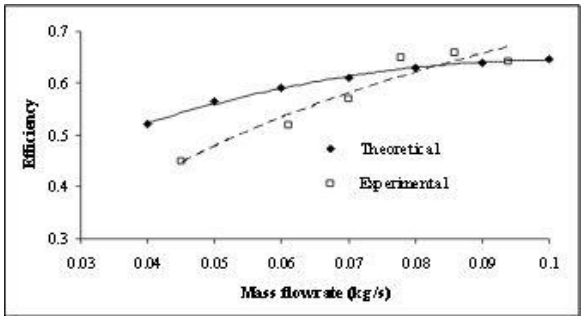


Fig. 4: Efficiency vs. Mass flow rate

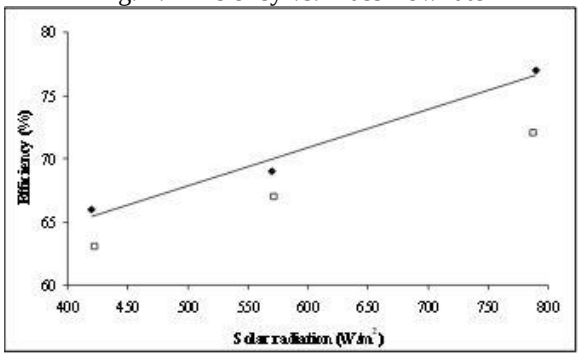


Fig. 5: Efficiency vs. Solarradiation

Fig. 5: Variation of efficiency with mass flow rate for I = 420 W/m^2 Fig .(6) Effect of solar radiation on efficiency for m= 0.09 kg/s

III. CONCLUSION

Following conclusions have been drawn from the studies:

- Mass flow rate effects the collector efficiency. The efficiency of S.A.H. Increase with the increase in mass flow rate up to certain limit.
- D.P.S.A.C. with porous material is more efficient than D.P.S.A.C. without porous material.
- Type of artificial roughness geometry effect the heater efficiency. The more roughness the geometry provides, higher is the turbulence which increases the collector efficiency.
- Arrangement of the geometry on absorber plate effects the turbulence creation which is directly proportional to the efficiency of S.A.H.
- S.A.H. efficiency is dependent on the solar radiation intensity.

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