Experimental based on solar air heater using double pass with different segmentation on absorber plate

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***Abstract* - In this experimental method substantially improves the collector efficiency by increasing the fluid velocity and enhancing the heat-transfer coefficient between the absorber plate and air. Solar radiation passes through a transparent cover and impinges on the blackened absorber surface of high absorptive; a large portion of this energy is absorbed by the plate and then transferred to the transport medium in the fluid those carried away for storage or use. In the first type (Type I), Spring coil will be arrange as perpendicular to direction of air in, while in Type II that will be arrange in zigzag on absorber plate. Type III is a flat plate (without spring coil). The efficiency increases with increasing air mass flow rate. For the same flow rate, the efficiency of the double pass is found to be higher than the single pass.**

***Keywords* - Introduction, Review papers, Methodology, Discussion about Results of SAH, Conclusion.**

I. INTRODUCTION

Solar radiation (heat, light and other radiation emitted from the sun) is the primary energy source for almost all natural processes on earth. The amount of solar energy that falls on the Earth in just one hour is enough to power the world for a whole year. Conventional energy resources are finite, depleting fast and this fossil fuel-era is gradually coming to an end. So, with the heightening concerns of environmental issues, rapidly rising fuel prices and continuous increase in energy demand as well as usages, it is important to develop renewable energy based technologies to meet the country's future energy demands and the pace of development. Solar air heater is mainly used for heating application. But, the main drawback of solar air heater is the low heat transfer rate between the absorber plate and the air. This results in the low efficiency of the solar air heater. Hence, to increase the heat transfer rate and the efficiency of solar air heater various techniques are used. The techniques used to increase the heat transfer are called heat augmentation techniques. Solar air heating is a renewable energy and solar air heater is a simple device that heats air by utilizing solar energy from the sun. Its wide range of applications involves drying of agricultural products, such as seeds, fruits, vegetables and space heating. Solar air heater produces hot air from atmospheric air which comes in contact with outer side of galvanized iron basin and leavers its latent heat and becomes cold air and it possess higher density hence it goes downside and further becomes hot air by receiving heat from sun. Also, solar air heaters are used as pre heaters in industries and as auxiliary heaters in buildings to save energy during winter times. Conventional solar air heaters mainly consist of a panel, insulated hot air ducts, a glass cover and air blowers if it is an active system. There are different factors affecting the air heater efficiency, these include collector length, collector depth, type of the absorber plate, glass cover, wind speed, inlet temperature, etc. Among all, the collector glass cover and the absorber plate shape factor are the most important parameters in the design of any type of air heater [1].

II. REVIEW PAPERS

the effect of artificial roughness of different shapes and sizes on heat transfer and friction factor characteristics of artificially roughened duct of solar air heaters. In various artificial roughness geometries have been reported in the literature by investigators, for determining the effect of various roughness geometries on heat transfer enhancement and friction characteristics in roughened duct of solar air heater. Reviews of various studies are presented in this paper. Development of correlation for heat transfer coefficient and friction factor by investigators and comparison of thermo-hydraulic performance of duct has been presented [2]. In an investigated thermal performance of solar air heater by using the artificial roughness in the form of repeated transverse chamfered rib-groove roughness on one broad wall of solar air heater. An experimental investigation on heat and fluid flow characteristics of fully developed turbulent flow in a rectangular duct having repeated integral transverse chamfered rib-groove roughness on one broad wall has been carried out. The effects of chamfer angle on Nusselt number and friction factor have been discussed. The results carried out from this experiment are compared with the square rib grooved and smooth duct under similar flow conditions to investigate the enhancement in Nusselt number and friction factor. The experiment was done to collect heat transfer and flow friction data under steady state conditions. As compared to the smooth surface the value for Nusselt number and the friction factor yield a maximum in case of the roughened surface. At the angle of 18° as the chamfer angle the maximum enhancement occurs in the Nusselt number where as the friction factor increases with increase in the chamfer angle [3]. In this comparisons between the measured outlet temperatures of flowing air, temperature of the absorber plate and output power of the double pass finned and v-corrugated plate solar air heaters were also presented. The effect of mass flow rates of air on pressure drop, thermal and thermo hydraulic efficiencies of the double pass finned and v-corrugated plate solar air heaters were also investigated. The results showed that the double pass v-corrugated plate solar air heater is 9.3–11.9% more efficient compared to the double pass-finned plate solar air heater. It was also indicated that the peak values of the thermo hydraulic efficiencies of the double pass finned and v-corrugated plate solar air heaters were obtained when the mass flow rates of the flowing air equal 0.0125 and 0.0225 kg/s, respectively [4]. To study of that the thermal performance of a single pass solar air heater with five fins attached was investigated experimentally. Longitudinal fins were used inferior the absorber plate to increase the heat exchange and render the flow fluid in the channel uniform. The effect of mass flow rate of air on the outlet temperature, the heat transfer in the thickness of the solar collector, and the thermal efficiency were studied. The present study aims to review designs and analyze a thermal efficiency of solar air heater. This experimental study compared a solar collector without using fins and with using fins attached back to the absorber plate. The efficiency of the solar air collectors depends significantly on the solar radiation, mass flow rate, and surface geometry of the collectors and with using fins back the absorber plate. The highest collector efficiency and air temperature rise were achieved by the finned collector with a tilt angle of 45º, whereas the lowest values were obtained from the collector without using fins. The efficiency of the solar air collectors depends significantly on the solar radiation and surface geometry of the collectors [5]. This study experimentally investigates a device for inserting an absorbing plate made of Aluminium cans into the double-pass channel in a flat-plate solar air heater (SAH). These types of collectors had been designed as a proposal to use aluminium materials to build absorber plates of SAHs at a suitable cost. The highest efficiency had been obtained, and a good agreement had been found. This method substantially improves the collector efficiency by increasing the fluid velocity and enhancing the heat-transfer coefficient between the absorber plate and air. Various air mass flow rates between 0.03 and 0.05 kg/s are also investigated at the experiments. The performance of double-flow type SAHs, in which air is flowing simultaneously over and under absorbing plate, is more efficient than that of the devices with only one flow channel over or under the absorbing plate because the heat-transfer area in double-flow systems is double [6]**.** The efficiency increases with increasing air mass flow rate. For the same flow rate, the efficiency of the double pass is found to be higher than the single pass. Thermal efficiency further decreases by increasing the height of the first Pass of the double pass solar air heater. ΔT reduces as after certain the air mass flow rate increase. The bed heights were 7 cm and 3 cm for the lower and upper channels respectively. The result of a single or double solar air heater using steel wire mesh arrange in layers as an absorber plate and packing material when compared with a conventional solar air heater shows a much more substantial enhancement in the thermal efficiency[7]. In investigation study a thermo-hydraulic analysis of a solar air heater with an internal multiple-fin array. A preliminary simple test was carried out to confirm the efficiency enhancement of the proposed arrangement. Proposed multiple fin-array technology enables to decrease the demanded air flux of 7-10 times in comparison to the smooth pipe arrangement of the absorber. Even with the flux decreased, the efficiency of internal multiple-fin array arrangement is higher than the one available for smooth pipe arrangement. A thermo-hydraulic efficiency test was used to obtain the best fin arrangement of the receiver [8]. An experimental investigation has been carried out to study the heat transfer coefficient by using 90˚ broken transverse ribs on absorber late of a solar air heater; the roughened wall being heated while the remaining three walls are insulated. The roughened wall has roughness with pitch (P), ranging from 10–30 mm, height of the rib of 1.5 mm and duct aspect ratio of 8. The air flow rate corresponds to Reynolds number between 3000 to12000. The experimental values of the thermal efficiency of the three roughened absorber plates tested have been compared with the smooth plates. A plate having roughness pitch 20 mm gives the highest efficiency of 83.5% [9].

III. METHODOLOGY

In SAH system air is heated by solar radiation on capture to glass. That absorber plate absorb with different point. Blower is required for suck air for improving the velocity of air. An aluminium spring placed on an absorber plate is also. An attachment that helps to increase the heat transfer area and increase the rate of heat transfer.

3.1. Discussion about result

In this case the double pass solar air heater is working with the different velocities 2/4/6/8/10 m/s and the necessary data has been found and calculated using the mathematical equations. Only the flow of air is flowing to inlet of the air heater defines the thermal efficiency of this Type – I, II, III as plot in table form.

3.1.1 Segment type 1

Double pass solar air heater without spring on absorber plate, which is Type-1.

3.1.2 Segment type 2

Double pass solar air heater with the aluminium spring perpendicular the air, which is Type-2.

3.1.3 Segment type 3

Double pass solar air heater with the aluminium spring in zigzag direction, which is Type-3.

3.1.4 Measured necessary data

Takes the readings for air sucked from blower at the outlet of those arrangement by helping of thermocouples.

IV. DISCUSSION ABOUT RESULTS OF SAH

4.1.1Results of 2m/s velocity in Type – 1, 2, 3

In this case the double pass solar air heater is working with the different velocities 2m.s and the necessary data has been found and calculated using the mathematical equations. Only the flow of air is flowing to inlet of the air heater defines the thermal efficiency of this Type – I, II, III as plot in table form.

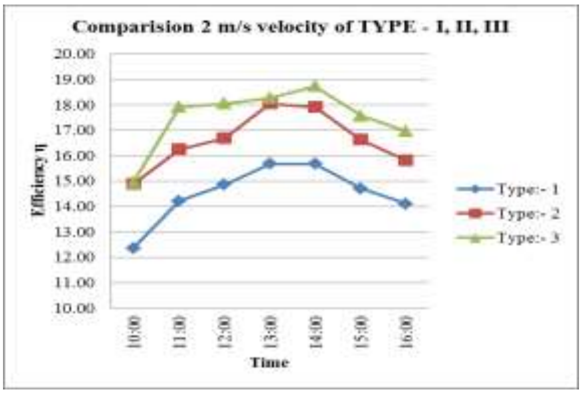

Figure 1 Comparison of efficiency 2m/s velocity of TYPE - I, II, III

4.1.2 Results of 4m/s velocity in Type – 1, 2, 3

In this case the double pass solar air heater is working with the different velocities 2/4/6/8/10 m/s and the necessary data has been found and calculated using the mathematical equations. Only the flow of air is flowing to inlet of the air heater defines the thermal efficiency of this Type – II as plot in table form.

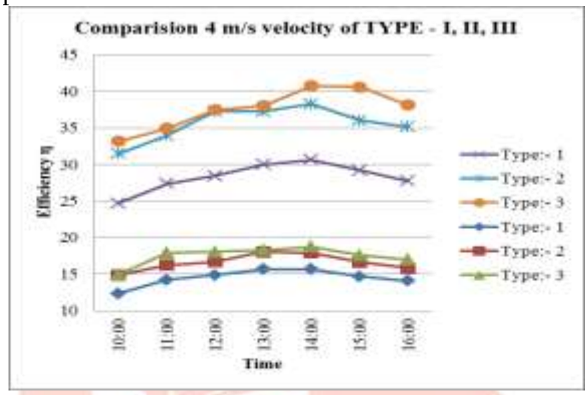

Figure 2 Comparison of efficiency 4m/s velocity of TYPE - I, II, III

4.1.3 Results of 6m/s velocity in Type – 1, 2, 3

In this case the double pass solar air heater is working with the different velocities 2/4/6/8/10 m/s and the necessary data has been found and calculated using the mathematical equations. Only the flow of air is flowing to inlet of the air heater defines the thermal efficiency of this Type – III as plot in table form.

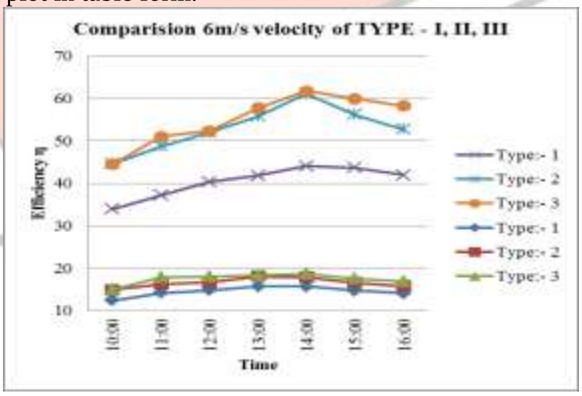

Figure 3 Comparison of efficiency 6m/s velocity of TYPE - I, II, III

4.1.4 Results of 8m/s velocity in Type – 1, 2, 3

In this case the double pass solar air heater is working with the different velocities 2/4/6/8/10 m/s and the necessary data has been found and calculated using the mathematical equations. Only the flow of air is flowing to inlet of the air heater defines the thermal efficiency of this Type – I as plot in table form.

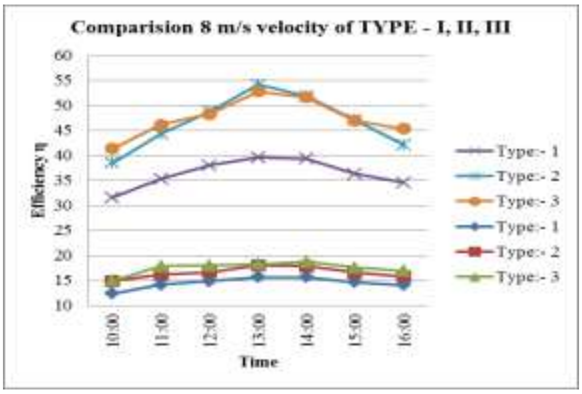

Figure 4 Comparison of efficiency 8m/s velocity of TYPE - I, II, III

4.1.5 Results of 10m/s velocity in Type – 1, 2, 3

In this case the double pass solar air heater is working with the different velocities 2/4/6/8/10 m/s and the necessary data has been found and calculated using the mathematical equations. Only the flow of air is flowing to inlet of the air heater defines the thermal efficiency of this Type – II as plot in table form.

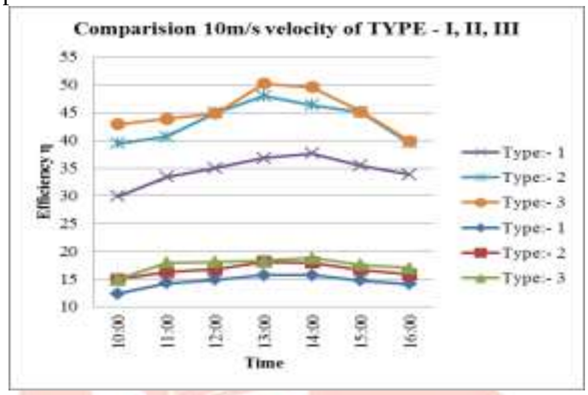

Figure 5 Comparison of efficiency 10m/s velocity of TYPE - I, II, III

V. CONCLUSIONS

In different types of collector this method uses a flat plate collector for better absorptivity of solar radiation. Solar air heating is a renewable energy and solar air heater is a simple device that heats air by utilizing solar energy from the sun. In solar air heater, which one absorber plate in flat plate collector are used to improves the collector efficiency and enhancing the heat-transfer coefficient between the absorber plate and air.

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