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EXPERIMENTAL STUDY OF HEAT TRANSFER ON RECEIVER TUBE OF PARABOLIC COLLECTOR WITH CONTINUOUS HELICAL FINS

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ABSTRACT:- *Heat transfer is the process of transfer of heat from high temperature reservoir to low temperature reservoir. In terms of the thermodynamic system, heat transfer is the movement of heat across the boundary of the system due to temperature difference between the system and the surroundings. The heat transfer can also take place within the system due to temperature difference at various points inside the system. The difference in temperature is considered to be 'potential' that causes the flow of heat and the heat itself is called as flux. The present work deals with modification of traditional concentric trough collector, receiver tube. Experiments are conducted on a modified receiver tube for various mass flow rates, and different helical pitches. The results reveal that the modified receiver tube of a solar trough collector gives plan move enhancement of heat transfer comparing to receiver tube. The work will be helpful for scientists focusing on sun powered vitality utilizing illustrative.*

Key words*: Single tube; Heat exchanger; Parabolic trough collector; Helical fins*

1. INTRODUCTION

A heat exchanger is a device used to transfer heat between two or more fluids. Heat exchangers are used in both cooling and heating processes. A solar collector is a gadget utilized for gathering solar radiation and exchanges vitality to liquid going in contact with it. Usage of solar vitality requires solar collector. These are general of two types i.e., Concentric and Non concentric type. The solar collector with its related absorber tube is the fundamental segment of any system for the change of solar radiation vitality into more usable shapes e.g. heat or power. In the non concentrating type the gatherer region is same as the absorber zone. Then again concentrating gatherers the zone capturing the solar radiation is more prominent, here and there 100 times more noteworthy than the absorber zone.

Non concentrating: As the name recommends the sun powered radiation is not moved in this compose 1.1 flat plate type solar collector – the principle segments of a flat plate solar are absorber tube, tubes or fins, coating, thermal insulation, cover strips, container or casing. Flat plate solar collector are ordered into 2 kinds, water type collectors which utilize water as the heat exchange liquid and air type collectors which utilize air as the heat exchange liquid. Concentrating: This sort of solar thermal innovation includes convergence of the vitality shape of the sun to a solitary line or focuses. The parabolic trough solar collector utilizes a reflector in the state of a parabola which is for the most part reflect, or an anodized aluminum sheet contingent upon the expected applications to reflect and think the solar radiation towards a beneficiary tube situated at the concentration line of the parabola. The absorber tube might be made of mellow steel or copper an is covered with a warmth safe dark paint for the better execution. The collector ingests the approaching radiations and changes them into warm vitality, which is being transported and gathered by a liquid medium circling inside the recipient tube. The warmth exchange liquid moves through the absorber tube, gets warmed and in this manner conveys thermal. The temperature of the liquid reaches up to 400 degree Celsius. Depending on the warmth exchange prerequisite diverse warmth exchange liquids might be utilized. The experimental data fit well with the numerical for the large heat exchanger. But, there were the some differences between the numerical and experimental data for the smaller coil; however these differences may have been due to the nature of the Wilson plots [11]. Studied the fluid flow and heat transfer characteristics of double type heat exchanger with rotating inner tube. The experiments carried out for the speed of rotation of inner tube from 0 to 1000 rpm. The effectiveness and NTU number obtained for parallel flow and counter flow arrangement. They found that speed of rotation increases the Reynolds numbers, NTU and effectiveness values [12].

2. EXPERIMENTATION

The solar radiations coming parallel to the central line of parabola (reflector) gathers at the surface of reflector and thinks it to the point of convergence. On the off chance that the reflector is as trough with illustrative cross segment, the solar radiation centers along a line. In concentrating collector that a focus proportion is vital parameter.

It is characterized as the proportion of the gather region at which radiation gathers to the territory (absorber) at which these radiations are concentrated. Focus proportion is characterized as the proportion of the authority zone to the absorber zone. So with the lessening in the absorber territory the focus proportion increments and thus more rapidly the high temperatures are come to. So higher fixation proportion implies higher temperature can be accomplished. The schematic outline of the illustrative trough solar authority with the absorber tube, following components and bolster structure.

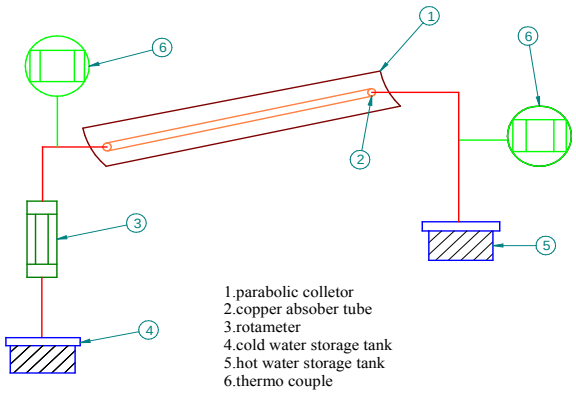

Fig-1: Schematic diagram of experimental setup

A parabolic solar collector uses a reflector in the shape of a parabola which is mostly a mirror, or an anodized Aluminum sheet depending on the required applications to reflect and concentrate the solar radiations towards a receiver tube located at the focus line of the parabola. The absorber tube may be made of mild steel or copper and is coated with a heat resistant black paint for the better performance. The schematic diagram of experimental setup is as shown in Figure 1.

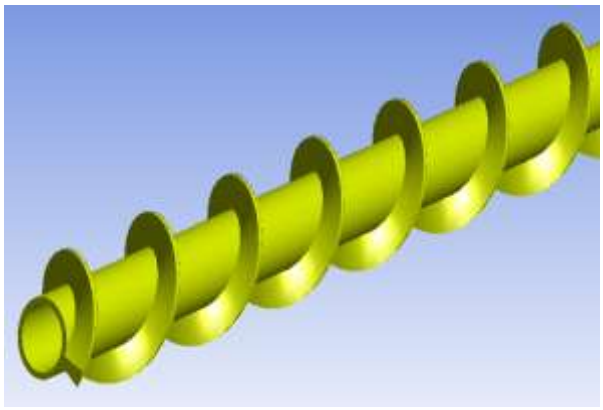

Fig-2: Geometry of helical fins of pitch 50 mm

3. RESULTS AND DISCUSSION

This project discusses the results of rate heat transfer of receiver tube of parabolic trough collector with and without fins for different duration of time. The deliberate factors are flow rate (LPM), temperature of water through temperature test (deg C). The information accumulation has been improved the situation different arrangements of the absorber tube amid 11am-2pm. A few information were dismissed because of high breeze and shady conditions. Results of the heat transfer rate variation of typical helical fin with different fin shown in the figure below combination of the swirling flow rate of the twisted-tape and the generated vortex due to louvered-fins on it.

3.1 Rate of heat transfer at 11-12 noon

Figure 3 shows the variation of rate of heat with volume flow rate for duration of 1 hour from 11-12pm. With reference to Figure 3, it is observed that the rate of heat transfer increases as the volume flow rate increases. The experiments are conducted for three volume flow rates i.e., 0.5LPM, 1LPM and 1.5LPM respectively.

The enhancement of heat transfer is improved in the case of 30mm pitch based annulus and 60mm pitch based annulus as compared to the annulus without fins. The rate of heat transfer for 30mm helical pitch based annulus is more as compared to 60mm helical pitch based annulus. This is due to the surface area of the 30mm helical fin based annulus is more as compared to 60mm helical fin based annulus.

The value rate of heat transfer for 30mm helical pitch, 60mm helical pitch and plain tube are is 1081W,

872.291W, 382.8W res for a volume flow rate of 0.5 liters per minute respectively.

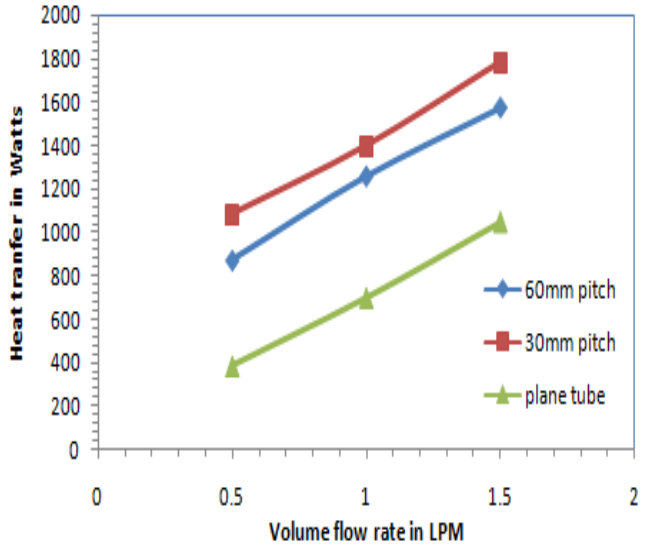

Fig-3: Variation of heat transfer with volume flow rate for the duration of 11-12pm

3.2 Rate of heat transfer at 12-1pm

Figure 4 shows the value rate of heat transfer for 30mm helical pitch, 60mm helical pitch and plain tube are is 1081.6W, 942.075W, 593.1W res for a volume flow rate of 0.5 liters per minute respectively.

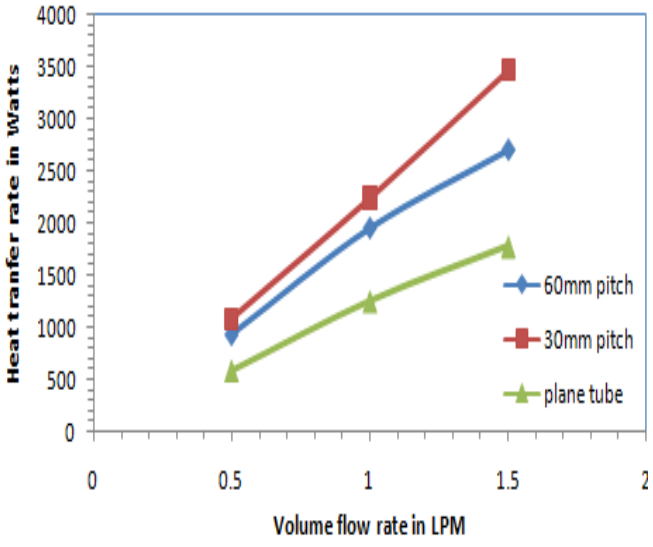

Fig-4 Variation of heat transfer with volume flow rate for the duration of 12-1pm

3.3 Rate of heat transfer at 1-2pm

Figure 5 shows the value rate of heat transfer for 30mm helical pitch, 60mm helical pitch and plain tube are is 558.2W, 453.5W, 383.8W res for a volume flow rate of 0.5 liters per minute respectively.

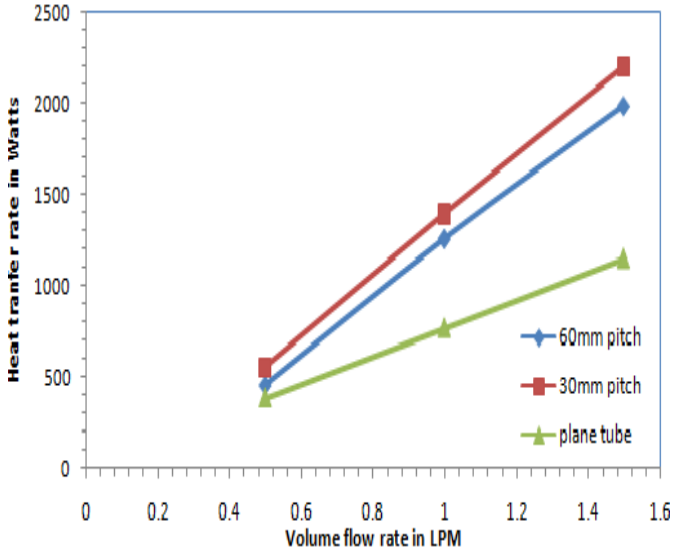

Fig-5 Variation of heat transfer with volume flow rate for the duration of 1-2pm

4. CONCLUSION

In present work the effect of a new continuous helical tape on heat transfer for an absorber tube or solar parabolic trough collector is evaluated experimentally. It is found that higher heat transfer rate is absorbed for 30mm helical pitch based receiver tube as compared to receiver tube without fins. The rate of heat transfer in case of 30mm helical pitch based receiver tube is better as compared to 60mm pitch helical based receiver tube. The application of new continuous helical tape insert resulted high performance especially for low mass flow rate.

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