Experimental Investigation of Heat Transfer Characteristics of Trapezoidal Channel with Sharp Edged Wavy Plate

Er. Mudasir Ahmad Wani[1] Er. Neeraj Kumar[2]
[1]M.Tech Student [2]Associate Professor
[1,2]Department of Civil Engineering
[1,2]RNCET Madlauda Panipat, I, India

Abstract— Warmth move gadgets have been utilized for transformation and recuperation of warmth in numerous modern and homegrown applications. More than fifty years, there has been deliberate exertion to create plan of warmth exchanger that can bring about decrease in energy necessity just as material and other cost sparing. Warmth move upgrade strategies for the most part diminish the warm obstruction either by expanding the powerful warmth move surface region or by creating disturbance. Now and then these progressions are joined by an expansion in the required siphoning power which brings about greater expense. The adequacy of a warmth move improvement procedure is assessed by the Thermal Performance Factor which is a proportion of the adjustment in the warmth move rate to change in rubbing factor. Different kinds of additions are utilized in many warmth move improvement gadgets. Mathematical boundaries of the supplement in particular the width, length, turn proportion, curve heading, and so on influence the warmth move. The current work presents an examination on execution investigation and ideal plan of warmth exchangers and warmth exchanger organizations. The examination remembers a trial examination of steam buildup for plate heat exchangers, ideal plan of plate heat exchangers and plate-blade heat exchangers, and streamlining of warmth exchanger organizations. In the current investigation heat move qualities is tentatively examined, because of pragmatic significance of warmth move improvement a need is felt to break down in an agent component of warmth exchanger. The examination includes assurance of the warmth move qualities in a trapezoidal formed channel with a sharp edged wavy plate. The exploratory investigation gives genuine data of temperature conveyance alongside the impact of various boundaries on heat move improvement. In the current investigation endeavor will be made to recommend another strategy for heat move improvement utilizing a trapezoidal channel for heat move upgrade in the warmth exchangers. The test contraption comprise of a rectangular conduit which was comprised of compressed wood. The complete length of the channel is 1750 mm. the contraption comprise of four sections, initial segment is the channel area having length of 500 mm, width 200 mm, stature 120 mm. The aftereffects of this work uncover that the trapezoidal plate with a sharp edged wavy plat as an age of different impacts, for example, disturbance enlargement and distribution of stream is a valuable gadget for improving warmth move in heat exchangers.

Keywords: Heat Transfer, Sharp Edged Wavy Plate

I. INTRODUCTION

A. Heat Exchanger

Warmth exchanger is the gadget utilized for trade of warmth between the two liquids that are at various temperatures, is known as warmth exchanger. The warmth exchangers are usually utilized in wide scope of utilizations, for instance in vehicle radiators, in coolers, in steam condensers, oil treatment facilities, synthetic plants and force plants.

B. Desirable Qualities of Heat Exchangers

To get greatest warmth move at lower cost without containing dependability, a warmth exchanger ought to have following characteristics.

1) Higher warmth move coefficient and bigger warmth move region.
2) Lower pressure drop.
3) Countercurrent stream course of action.
4) A warmth exchanger ought to have the option to with stand plant climate for high liquid weight, vibrations created because of liquid stream and for various temperature or environmental conditions.
5) A warmth exchanger ought to be minimal.

II. EXPERIMENTAL SETUP

A. Definite Model of Experimental Setup

The trial set up for the current examination is introduced in Figure 4.1. The exploratory device comprise of a rectangular pipe which was comprised of compressed wood. The absolute length of the conduit is 1750 mm. the device comprise of four sections, initial segment is the delta area having length of 500 mm, width 200 mm, tallness 120 mm. A straightener is utilized in the bay segment up to a length of 200 mm to limit the choppiness noticeable all around and to keep a uniform wind stream before entering the test segment. A port is made in the top aspect of the channel area for the estimation of speed by hot wire anemometer. Second aspect of the conduit is the test area having the general length of 600 mm, width 200 mm, stature 120 mm. Test area comprise of a rectangular plate comprised of aluminum \, having measurement of 300x150x6 mm.

Fig. 2.1: Picture of experimental setup

III. RESULTS AND DISCUSSION

A. Introduction

In this trial study the perceptions were done in an open sort air stream of cross-segment 200×120mm and length 1750mm for different test examples (designs). The test examples were put in a test area individually to investigate the warmth move improvement under different warmth transition and stream conditions and afterward perceptions were completed by fluctuating the warmth motion for example (10.88, 25, 44.16, 68.8watt) and Reynolds number (17037.1, 19799.9, and 26246.3) for plane plate. In the wake of finishing over plane plate it was supplanted by the trapezoidal plate having 11mm notches on 17 mm plane plate (Aluminum). The perceptions with respect to warm exchange and weight drop were done over trapezoidal plate on same states of warmth transition and Reynolds number. And afterward a sharp edged wavy plate was set over trapezoidal plate in focus at 15mm tallness. The variety in the warmth move qualities is contrasted and all sort of channel designs that were concentrated in this section.

B. Validation of Plane Plate

Trial results for the plane plate have been made by setting it in the test part of open kind air stream. From fig 6.2 it has been seen that the Nusselt number increments with increment in Reynolds number. It is likewise obvious from fig 6.1 the variety of Nusselt number got from the current work with the relationship for example Nu=0.036Re0.8 Pr0.333 suggested by the Nusselt himself for fierce course through non roundabout lines.

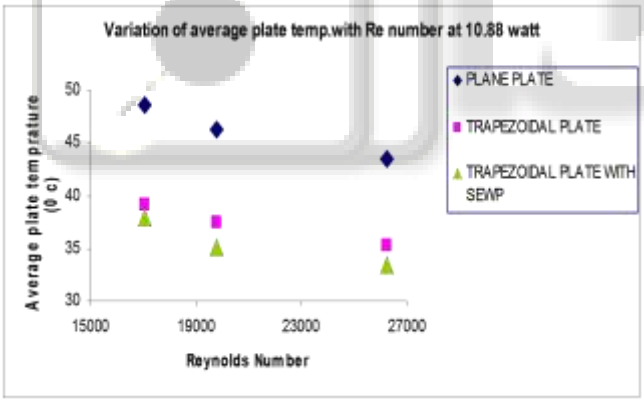

Fig. 3.1

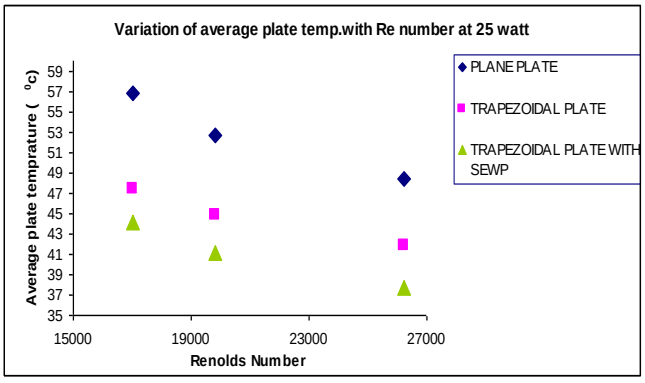

Fig. 3.2

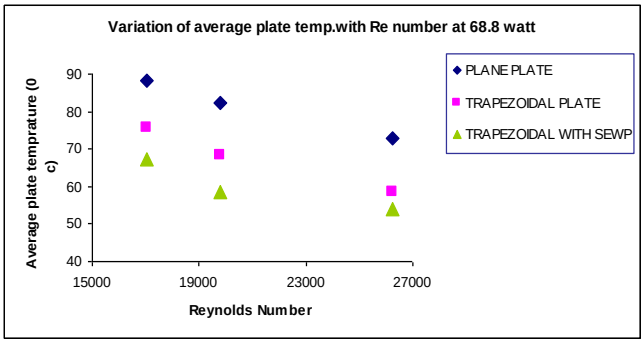

Fig. 3.3

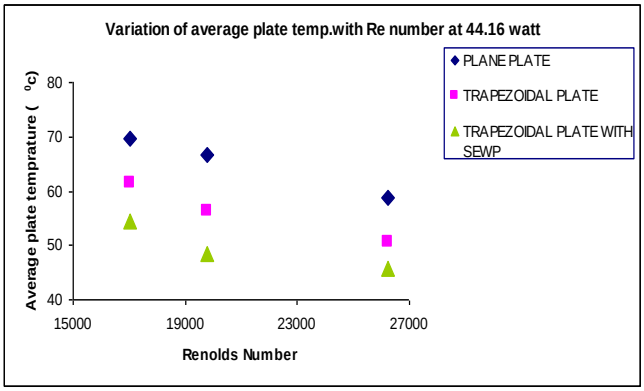

Fig. 3.4

C. Variation of Outlet Air Temperature with Reynolds Number at Different Heat Flux

Fig 3.5-3.8 shows the variation of outlet air temperature with Reynolds number at different heat flux and comparison between three cases also discussed in the given fig. In fig given it is observed that the outlet air temperature decreases with increase in Reynolds number due, to the turbulence and recirculation effect are permitted in the air flow with increase of Reynolds number. In the fig it is clear that the outlet air temperature for trapezoidal plate is more than plane plate, but for trapezoidal plate with SEWP outlet air temperature is highest than in other two cases. Due to the presence of turbulence in such channels causes, re-circulation as air flows through such surfaces in the main flow and hence leads to the enhancement in heat transfer rate and increases the surface temperature of plate. As the heat flux increases the outlet air temperature increases for particular Reynolds number, because with increase in heat flux the surface temperature of plate further increases which rises the outlet temperature of air.

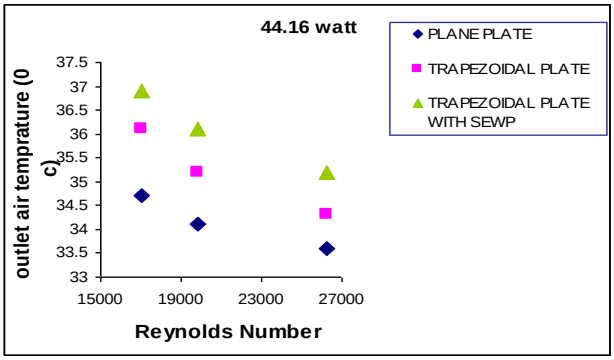

Fig. 3.5

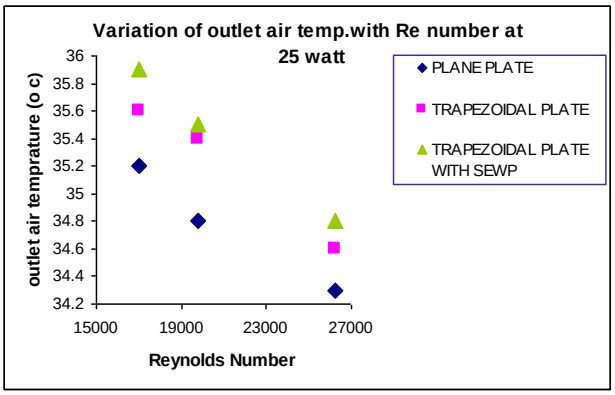

Fig. 3.6

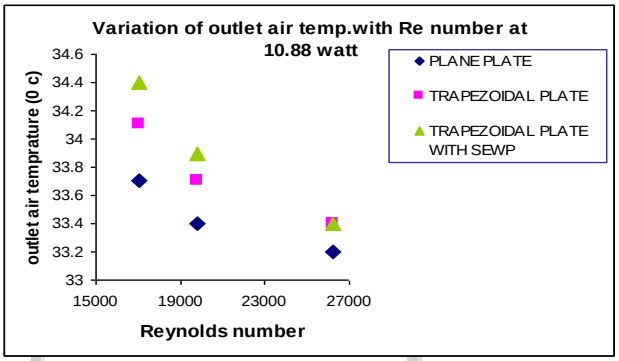

Fig. 3.7

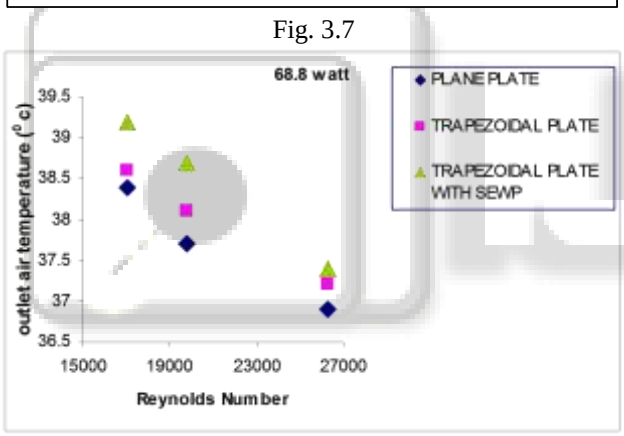

Fig. 3.8

IV. CONCLUSION

A. *Conclusions*

In the present test work, tests were performed on three distinctive test plates, initial one was plane plate, second trapezoidal plate and third trapezoidal plate with SEWP. The examination of warmth move improvement between these plates has been done in this trial study.

Based on the outcomes acquired the accompanying ends are made:

Because of the presence of waviness in trapezoidal plate altogether improves the warmth move from the plate. Nusselt number for the trapezoidal plate is upgraded by 40-55% at 10.88 watt, 45-65% at 25 watt, 30-45% at 44.16 watt, and 25-35 % at 68.8 watt in the Reynolds number scope of present investigation.

The Nusselt number increments with increment in Reynolds number and the air outlet temperature diminishes with Reynolds number disregarding increment in heat move.

The upgrade in heat move for trapezoidal plate lessens the plate temperature by 7-10 % as contrast with plane plate.

By presenting a SEWP over the trapezoidal plate further upgrades the warmth move. The Nusselt number for such plate is upgraded by 70-85% at 10.88 watt, 65-80% at 25 watt, 50-65% at 44.16 watt, and 35-half at 68.8 watt in the Reynolds number scope of present investigation, in this way trapezoidal plate with SEWP has discovered better warmth move attributes.

The normal plate temperature with SEWP is low as contrast with plane plate. This is a result of growth in Nusselt number.

The improvement of warmth move accomplished by utilizing a SEWP over trapezoidal plate is related with an expansion in pressure misfortune and furthermore pressure drop increments with increment in Reynolds number.

B. *Scope for Future Work*

The consequences of this work uncover that the trapezoidal plate with a sharp edged wavy plat as an age of different impacts, for example, choppiness expansion and distribution of stream is a valuable gadget for improving warmth move in heat exchangers. Here the calculations have been finished expecting stream system to be fierce.

The current issue can be stretched out in future in the accompanying ways:

Further augmentation of present investigation can be made by changing the length of even pitch on both sharp edges of wavy channel.

By changing the stature of wavy plate over trapezoidal plate, this trial study can be additionally broadened.

The present exploratory investigation can be reached out by diminishing the cross-sectional region of rectangular pipe.

Mathematical reproduction can be made of the current work and correlation should be possible with exploratory examination.1 Conclusions

REFERENCES

[1] Tatsuo Nishimura, Yoshiji Ohori and Yuji Kawamura, Flow characteristics in a channel with symmetric wavy divider for reliable stream. Journal of Chemical Engineering (1983).
[2] E. M. Sparrow and J. W. Brush, Effect of between divider isolating and fluid stream channel conditions on furrowed divider heat exchanger. Overall Journal in Heat and Mass Transfer 26 (1983) 993-1005.
[3] Tatsuo Nishimura, Yoshiji Ohori and Yuji Kawamura and Yoshihiko Kajimoto, Mass trade characteristics in channel with symmetric wavy divider for reliable stream. Deptt of Chemical Engg, 1985.
[4] T. Brunner, W. Brenig, Coupled channel means the rotational excitation of particles at furrowed surfaces. Surface Science 201 (1988) 321–334.
[5] B. Sunden, S. Trollheden, Periodic laminar stream and warmth move in a wrinkled two-dimensional channel. Worldwide Communications in Heat and Mass Transfer 16 (1989) 215–225.

[6] Shinichiro Mrakami, Shingho Arakawa and Yuji Kawamura, Flow recognitions and mass trade ascribes in adjusted wavy walled channels at moderate Reynolds number for predictable stream. Worldwide Journal of Heat and Mass Transfer Vol. 5 (1990) 833-845.
[7] G. Wang and S.P. Vanka, Convective warmth moves in irregular wavy passages. Worldwide Journal of Heat Mass Transfer vol. 17 (1995) 219-3230.
[8] K.M. Stone and S.P. Vanka, Numerical Study of Developing Flow and Heat Transfer in Wavy Passages. Cooling and Refrigeration Center University of Illinois Urbana IL (1998) 61801, 217.
[9] T.A. Flood, T.A. Newell and A.M. Jacobi, an Experimental Study of Flow and Heat Transfer in Sinusoidal Wavy Passages, International Journal of Heat and Mass Transfer 42 (1999) 1541-1553
[10] D.Bereiziat, R. Devienne, Experimental depiction of Newtonian and non-Newtonian fluid streams in layered channels. Overall Journal of Engineering Science 37 (1999) 1461–1479.
[11] G. Fabbri, Heat move headway in layered divider channels. Worldwide Journal of Heat and Mass Transfer 43 (2000) 4299–4310.
[12] B. Niceno and E. Nobile, Numerical Analysis of Fluid Flow and Heat Transfer in Periodic Wavy Channels. Overall Journal of Heat and Fluid Flow 22 (2000) 156-167.
[13] A. Hamza, H. Ali, Y. Hanaoka, Experimental examination on laminar stream obliged convection in a channel with upper V-layered plate warmed by radiation. Worldwide Journal of Heat and Mass Transfer 45 (2002) 2107–2117.
[14] Y. Islamoglu, C. Parmaksizoglu, The effect of channel stature on the improved warmth move characteristics in a furrowed warmth exchanger channel. Applied Thermal Engineering 23 (2003) 979–987.
[15] Mohammad Zakir Hossain and A.K.M. Sadrul Islam, Numerical Investigation of Unsteady Flow and Heat Transfer in Wavy Channels. fifteenth Australasian Fluid Mechanics Conference, the University of Sydney Australia (2004) 13-17.
[16] Esam M. Alawadhi, Forced convection cooling improvement for rectangular squares using a wavy plate. IEEE, Transactions on Components and Packaging Technology, Vol. 28.

