© 2020 IJNRD | Volume 5, Issue 6 June 2020 | ISSN: 2456-4184

Review of Experimental Analysis of the effect of Different Inlet Condition of air by using Forced Convection Heat Transfer

[1]A.V. Chauhan,[2]A.R. Mankar,

[1]M.Tech Student,[2]Assistant Professor,
[1]Department of Mechanical Engineering,
[1]Guru Nanak Institute of Technology, Nagpur, India.

Abstract— **The current paper is a review of various types of inlet condition of air (0^0,45^0,90^0) and baffle arrangement. The utilization of baffles in channel is usually used for passive heat transfer enhancement strategy in single phase internal flow. Heat transfer improvement technology is that the method of rising the performance of a heat transfer by increasing the convective heat transfer coefficient. Typically, the main objective is to cut back the dimensions and prices of heat exchanger. General techniques for enhancing heat transfer is divided in two classes. One is Passive Methodology like twisted tapes, whorled screw tape inserts, rough surfaces, extended surfaces, baffles, additives for liquid and gases. The other class is Active methodology, which needs additional external power, for instance mechanical aids, surface fluid vibration, use of electricity fields. Passive heat transfer strategies have been found additional cheap as compared to active strategies. Baffle may be a standard heat transfer improvement device employed in numerous heat-exchanging channels. The flow blockages like baffles increase the pressure drop and ends up in augmented viscous impact owing to reduced fluid flow space. In most of the previous numerical and experimental studies empirical correlations for duct flow with straight channel has been investigated and corresponding heat transfer and pressure drop are reported, only a few paper are presented for channel with turned flow therefore an experimental study is required to be carried during a rectangular channel with turned flow (45^0,60^0, 90^0) varying the Reynolds number which indicates turbulence flow. The Reynold number is in range of 3000 to 28000 which indicates turbulence flow. The Rectangular channel would be heated from bottom with a uniform heat flux. A Independent heater arrangement would be made at the inlet to vary the inlet temperature. Considering the speedy rise in energy demand, most effective heat transfer enhancement techniques became important job worldwide. Theoretical and empirical correlations for duct flow are given for hydro dynamically and thermally developed flow in most of previous studies. However the effect of baffle height and different inlet condition on heat transfer and pressure drop are going to be examined. Finally the comparison of the results of experimental investigation with the results obtained by using correlation method will be done**

Index Terms— **Rectangular channel, Reynolds number, Turbulent, inlet angle, convective heat transfer coefficient, heat transfer enhancement, baffle height, uniform heat flux.**

I. INTRODUCTION

Energy is that the basic ingredient required to sustain life and development. Social, cultural and financial development of the citizens is seen to a good extent by the number of per capita energy consumed and todays concerns about how the world produces and consumes energy are at forefront of public attention. Rectangular channel is one of simplest duct which is widely used device in heat exchangers in which heat is being changed between the heated wall and therefore the air flowing through the system. In this paper, experiments are going to be conducted to study heat transfer enhancement in a rectangular channel with/without baffle with varying inlet angle. The baffle is mounted on the bottom surface with uniform heat flux. Heat exchangers have been widely used in several industrial and engineering usage. The design of Rectangular channel needs exact analysis of heat transfer rate and pressure drop estimations. The major challenge in designing a channel is to make the equipment compact and achieve a high heat transfer rate using minimum input power. Active methods are found more expensive as compared to Passive methods. Baffle is a popular heat transfer enhancement device used in various heat-exchanging channels. The heat transfer rate can be improved by inserting a disturbance like baffle in the fluid flow. Rectangular ducts are mainly used in heat transfer equipment such as in gas turbine cooling systems, compact heat exchangers and nuclear reactors. The flow over baffles has different fluid flow and heat transfer characteristics. Heat-transfer Enhancement strategies has a crucial role to increase the efficiencies of heat exchangers in ducts, pipes and channels. Hardly some studies have been done in inclined or varying inlet geometry other than straight channel. So in this project, introducing a new technique by varying the inlet angle such as 45^0,60^0,90^0 other than formal one 0^0.

II. PLAN OF PROPOSED WORK:

Following kinds of work will be carried out before and during the experimentation:

Theoretical Work:

1) Review of previous literature work on study of forced convection heat transfer in a rectangular a duct or channel with different inlet condition

Experimental Work:

1) Fabrication of experimental set-up i.e. test rig.

2) To conduct experimentation for different Configurations on the test rig are as follows (all experiment will be carried out at Uniform heat flux)

a) Experimentation with straight inlet geometry.
b) Experimentation by using varying inlet geometry.
c) Experimentation by varying inlet temperature and baffle height.

3) To conduct the experiment to calculate Reynolds number, Nusselt number, convective heat transfer coefficient.

4) After performing the experiment, calculation of the heat transfer coefficient of air will be done.

5) Finally the comparison of the results of experimental Analysis with the results obtained by using correlation method will be done.

III. PROPOSED EXPERIMENTAL SET-UP

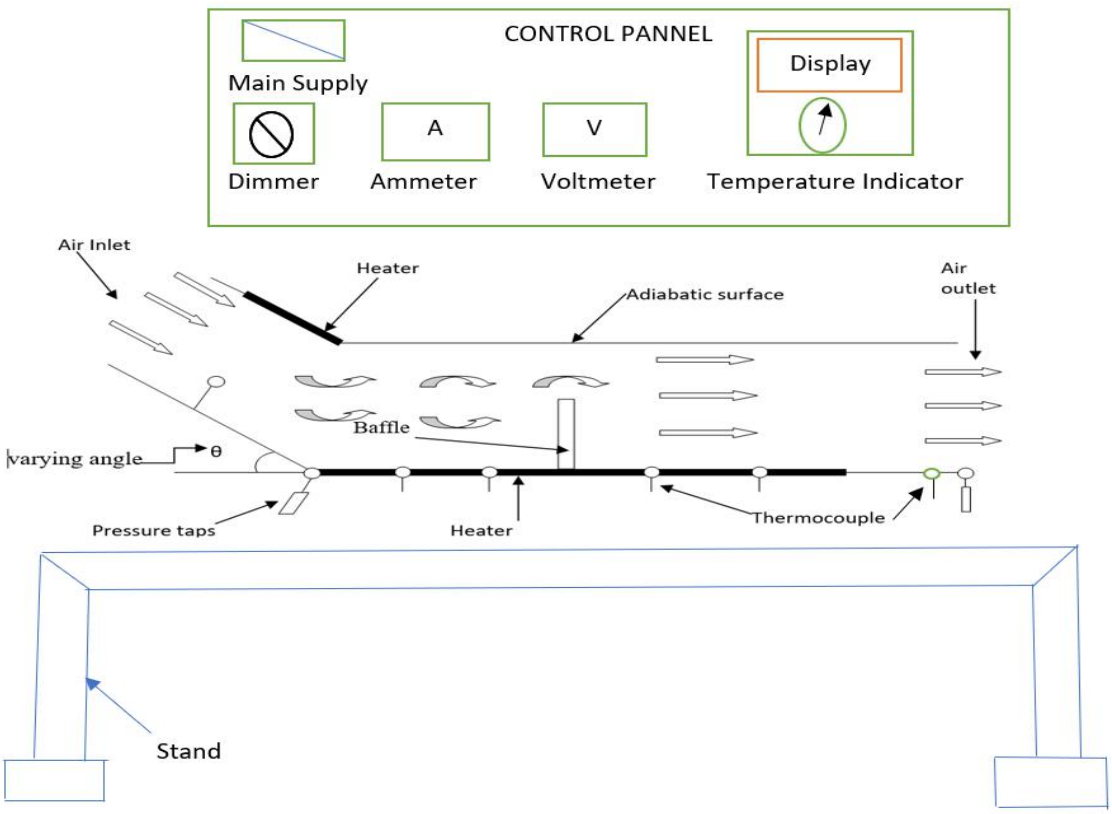

Fig.1- Proposed Experimental Set-up

Fig. shows the schematic diagram of the experimental setup from front view. The baffles with straight angle and same thickness is as shown in fig. The rectangular channel is used for this investigation and Baffle made up of aluminum material. Proposed experimental set-up for investigation of forced convection heat transfer in a rectangular duct provided with baffle for different inlet conditions (0^0,45^0,90^0). In this set-up, Different inlet condition of Rectangular duct will be provided with the different configurations and Height of baffle. The rectangular duct is surrounded by band heater. Four thermocouples are embedded on the test section and two thermocouples are placed in the air stream at the entrance and exit of the test section to measure air inlet and outlet temperature. The temperatures can be read directly from the temperature indicator by using selector switch of temperature channel. Air flow is controlled by a flow control valve and is measured with the help of orifice meter and manometer. Heat input can be set with the help of variac or Dimmer provided on control panel and same can be read out digitally with the help of voltmeter and ammeter. A blower fan is used to draw the air from entrance to exit section. The constant heat flux plate type heater is fabricated from nicrome wire. This heater is connected in series with dimmer stat in order to supply the same amount of heat to heater. The heater is provided at bottom surface and other side are unheated as well as insulated. (i.e. Adiabatic surface). A independent heater arrangement would be made at the inlet to vary the inlet temperature. Insulation is used on external surface to prevent the heat loss due to convection and radiation. For wall temperature measurement, four thermocouples are used at different place of heating surface. Moreover, one thermocouple is fitted at inlet and one thermocouple is fitted at outlet to measure the inlet and outlet bulk temperatures, respectively. Manometer is used to measure the pressure drop within the rectangular channel. In present study both flat solid and porous baffles of straight angle of same thickness and height (t=5mm, h=100 mm,150mm,) are used. Two different height baffles are used in this experiment of same angle at a time. This baffle is in contact with the bottom surface.

IV. COMPONENTS OF EXPERIMENTAL SETUP

1) Centrifugal Fan:- Fan is used to produce air flow.
2) Control Valve : - Control valve is the Fan regulator placed in the flow path of air and is given the knob having graduations in degrees.
3) Thermocouples: -J-type Thermocouples are used to sense the temperature.
4) Heater: - Plate type heater is used. The heater is used to heat the inlet side & test surface of the channel.
5) Rectangular channel: -The whole setup is enclosed in a rectangular channel.
6) Digital Temperature Indicator :-Digital temperature indicator is used in order to get the temperature readings from different place of channel.
7) Ammeter and Voltmeter:- Ammeter and voltmeter are used to get the readings of current and voltage supplied to the heater.
8) U-tube manometer:- One U tube manometer is used to measure pressure drop across the channel.
9) Baffle of different height

Specification of Components

Sr.No.	Name of component	Specification
1	Centrifugal fan	Standard
2	Heater	Plate type Nicrome wire heater
3	Voltmeter	0-500 Volt AC
4	Dimmer/Variac	5A/8A
5	Digital Temperature indicator	Digital 6 Channel range (0-600° c)
6	U tube manometer	0-25 mm Hg
7	Thermocouple	6- J Type

V. CONCLUSION

This paper analyzes the following conclusions:-

1) Heat transfer rate is increased by using varying inlet Rectangular ducts with baffle, because Baffle increase the turbulence of the flow.
2) As the velocity of air increases the rate of heat transfer increases.
3) The heat transfer rate is significantly influenced by geometry of different inlet configuration.
4) Heat transfer Enhancement techniques is a subject of essential importance in increasing heat transfer rate and achieving higher efficiency
5) Changing of the entry angle of channel (θ) results in a heat transfer rate at entrance of the test section.

VI. REFERENCES

[1]. Kang-Hoon Ko, N.K. Anand “Use of porous baffles to enhance heat transfer in a rectangular channel”, International Journal of Heat and Mass Transfer 46 (2003) 4191–4199.

[2]. Yeu-Tzu Yang, Chih-Zong Hwang “Calculation of turbulent flow and heat transfer in a porous-baffled channel”, International Journal of Heat and Mass Transfer 46(2003) 771-780

[3] Mr. S. J. Thikane1 "*Review of Forced Convection Heat Transfer through Rectangular or Square Duct Provided with Different Configurations of Rib Turbulators"*. International Journal of Engineering Research & Technology (IJERT) Vol. 4 Issue 11, November-2015.

[4] Irfan Kurtbas "The effect of different inlet conditions of air in a rectangular channel on convection heat transfer: Turbulence flow" Experimental Thermal and Fluid Science 33 (2008) 140–152.

[5] Reference book *forced convection heat transfer in ducts of non-circular section* by D.D. James.

[6] S. P. WALDE1 "*Analysis of different inlet conditions of air in a rectangular channel on Forced convection heat transfer"* International J. of Engg. Research & Indu. Appls. (IJERIA). ISSN 0974-1518, Vol.5, No. III (August 2012), pp. 273-284.

[7] Colak L.,*Ipek N.E., and Demir G. "*The numerical and experimental analysis of forced convection on the surfaces of a rectangular box with heat generation"* 6th International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics 30 June to 2 July 2008 Pretoria, South Africa.

[8] Md. Asharful Islam and A. K. Mozumder, "*Forced Convection Heat Transfer Performance of An Internally Finned Tube."* Journal of Mechanical Engineering, Vol. ME 40, No. 1, June 2009.

[9] Ganesha B B, G V Naveen Prakash "Forced Convection Heat Transfer through the Rectangular Fins of Different Geometry of Perforations" International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-1S2, May 2019.

[10] Lazarus Godson Asirvatham , Nandigana Vishal, Senthil Kumar Gangatharan and Dhasan Mohan Lal, "Experimental Study on Forced Convective Heat Transfer with Low Volume Fraction of CuO/Water Nanofluid" Department of Mechanical Engineering, Anna University, Chennai, India.

[11] H. Kaya1, R. Ekiciler2, K. Arslan3 "*CFD Analysis of Laminar Forced Convective Heat Transfer For Tio2/Water Nanofluid In A Semi-Circular Cross-Sectioned Micro-Channel"* Journal of Thermal Engineering, Vol. 5, No. 3, pp. 123-137, April, 2019.

[12] Md. Abu Jafar Rasel, Md. Zahirul Islam & Abul Hasanat, "Analysis of heat transfer characteristics under forced convection in a rectangular body with circular fins" American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-5, Issue-10, pp-311-316.