Issue ISSN: …..-…..

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

HEAT TRANSFER ENHANCEMENT IN PIPE FLOW USING DIFFERENT GEOMETRIES OF STRIPS INSERTS IN FORCED CONVECTION: A REVIEW

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Abstract

Present work is extensively focused on the experimental study on convective heat transfer enhancement using different geometries. Over five decades, there has been concerted effort to develop design of heat exchanger that can result in reduction in energy requirement as well material and other cost saving. Different numbers of geometric strips are used and it inserts in pipe section or fitted property in pipe section. Strips have different size, shape and different material can be used for improve the heat transfer enhancement. In this paper, we are discussed about the different geometries strips to improve the heat transfer rate. We have compared the various types of strips geometries. Geometrical parameter of the inserted strips their direction, width, length , thickness, twist ratio etc. affect the heat transfer rate.

Index Terms: Heat transfer enhancement, Geometries of strips inserts, Heat exchanger, Passive enhancement techniques.

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1. INTRODUCTION

In this paper we have study the different geometry of strips to increase convective heat transfer coefficient. The purpose of this paper study the active technique and passive technique for the heat transfer enhancement in force convection. Different numbers of geometric strip are used and it inserts in pipe section or fitted property in pipe section. Strips have different size, shape and different material can be used for improve the heat transfer enhancement. In this Review paper we are discussed about the different geometries strips to improve the heat transfer rate. We have compared the various types of strips geometries. Geometrical parameter of the inserted strips their direction, width, length; thickness, twist ratio etc. affect the heat transfer rate. The more experimental work on the thermodynamic performance of the twisted tapes, regularly twisted tapes or the different cuts, different angles and taps with different surface modification.

Sivashnmugam and suresh [6] studied circular tube fitted with a full length of helical screw element with different ratio. There is no heat transfer coefficient enhancement by increasing OR decreasing a twist ratio. Magnitude of swirl generated at inlet and outlet same in the both of two cases.

k. wangcharec and s. Eiamsa-ard [7] The combination of twisted tape with corrugated tube caused significant improvement in heat transfer. The achieved result of twisted tape and corrugated tube in a single device in the counter arrangement is more efficient in terms of heat transfer compared to the parallel arrangement.

Paisarn nephon et.al (2006)-[5], He studied heat transfer characteristics on wire coil and this coil is inserted in double

pipe with coil wire and according to him the heat transfer rate and heat transfer coefficient is directly depend on mass flow rate and also the effect of coil wire inserted in heat transfer tends to decrease as Reynolds number decreases .

k.n.Agrawal , A. Kumar(1998)-[8], According to him the maximum heat transfer enhancement can be achieved for tube with thickest wire which is discovered by an investigation on different coiled wire thickness of heat transfer enhancement during force convection. When the wire coiled thickness increased then the Nussle Number is also increased and decreased the pitch ratio.

P. Sivashanmugam. (2010), Studies on heat transfer characteristics in a circular tube fitted with helical twist inserts were carried out. The diagram of helical tape inserts .The heat transfer enhancement increased with increase of Reynolds number and decreased with the increase of twist ratio. Compared the heat transfer rates of water and nano fluids; the increaseinNusseltnumberwas5% to 31%fordifferenthelicalinserts. A greater heat transfer enhancement was also observed for all fluids compared as twist ratio decreased.

Suhas V. Patil et al (2011), this paper is a review of research work in last decade on heat transfer enhancement in a circular tube and square duct. In this paper emphasis is given to works dealing with twisted tape, screw inserts because according to the resent studies, these are known to be economical tool in the field of heat transfer enhancement.

M. K. Bhuiya (2012), investigated experimentally the enhancement of heat transfer of tube fitted with double helical tape inserts with different helix angles. It was clearly noted that the Nusselt number, friction factors, and thermal enhancement efficiency were increased by decreasing of helix angles under the same operating conditions. As shown in figure__, the maximum thermal e enhancement efficiency () of 215% was found with use of double helical tape inserts with helix angle 9* at high Reynolds number. It was also shown that, as the inserts widths increased, the heat transfer characteristics improved.

Fig.1.1 Helical Screw

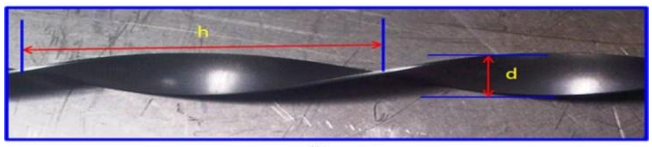


Fig.1.2 Twisted Tape

Fig.1.3 Coil wire

2. METHODOLOGY

In this paper the different geometries that are wire, coil, helical screw, twisted tape, and by varying the dimension and twist ratio, helix angle and pitch length. We can produce swirl and create turbulence in the flow of air and convert the flow from laminar to turbulent which leads to increase in convective heat transfer rate. Using a passive technique for enhancement of heat transfer rate in a pipe flow by using different geometries of strips inserted in force convection.

The force convection devices are categorise into coating, rough surface, turbulent or swirl flow, twisted tape[1,2] , helical screw I and wire coil[3]

Fig.2.1 Experimental Setup

Different enhancement techniques: In heat transfer enhancement, techniques have different advantages and limitations. They are vary in different geometrical strip configuration and they represents the important research task in heat transfer field. The enhancement techniques can be classified into two main categories:

Active Technique & Passive Technique.

Active Technique: An Active Technique includes Mechanical aids and the use of magnetic field to disturb the light seeded particles in a flowing stream etc. The Active Technique requires an external power input for enhancement of heat transfer.

Passive Technique: In this technique heat transfer method does not need any external power input. By using Passive Technique the swirl causes in the bulk of the fluids. Insert the required additional arrangements to make the fluid flow which enhance heat transfer rate.

i. The annular blockage is determine by considering experimentation by taken with respect to using different strips geometry like shape and size.

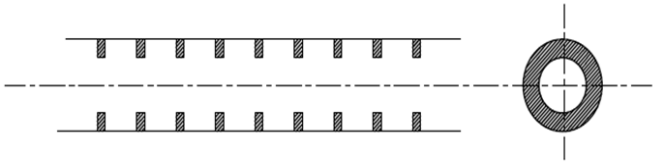


Fig.2.2 Annular Blockages

ii. During experimentation measure the pressure drop across the test section and also measure the pressure difference in orifice meter, temperature of the surface, outlet and inlet of the test section. The number of thermocouple are inserted in test section and measure the temperature. The orifice meter is fitted at inlet and outlet and determine the pressure drop inside the test section.

Fig.2.3 Test Section

iii. Determine friction factor and useful heat gain of air and also Nusselt number. From experiment, the heat transfer thermal performance with different geometry of strips is calculated and also determines the heat transfer rate is increases or not.

3. SUMMARY OF IMPORTANT TECHNIQUES

The below table are shows the various review paper for the observation between the different geometrise strips of Helical screw, Twisted tape, Coil wire, etc.

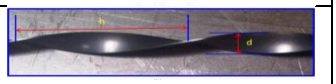
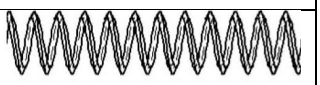
Author	Modification	Image
Sivashnmugam and suresh	Helical screw	
k.wangcharec and s. Eiamsa-ard	Twisted tape	
Paisarn nephon et.al	Coil wire	

Table no.3.1

4. CONCLUSION

From the present Review Paper, it can be concluded that the heat transfer enhancement occurs an increase in the turbulence intensity by inserting various geometric strips inside the pipe and create turbulence for better heat transfer enhancement after studying the different geometries like twisted tape, wire coil, helical screw tape. In twisted tape more swirl is produced because of its twist ratio it is more helpful in increasing the rate of heat transfer enhancement. We have concluded that twisted tape are better than the wire coil and helical tape, because it can produce better swirling in the direction of air flow which lead to the turbulence and increases the rate of heat transfer.

5. ACKNOWLEDGEMENT

We thanks to all the member of mechanical department for their kind co-operation and encouragement which help us in completion of this project .Last but not the least we would like to thanks to all colleagues who help us directly or in directly and encourage us for the completion of this project.

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