Research Article Impact Factor: 4.226 ISSN: 2319-507X
A. V. Deshmukh, IJPRET, 2015; Volume 3 (9): 368-374 IJPRET

INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

HEAT TRANSFER ENHANCEMENT BY USING TWISTED TAPE

A. V. DESHMUKH[1], K. R. GAWANDE[2]

1. M.E. Student (Thermal Engg.), department of mechanical engineering, I.B.S.S. COE Amravati, India.
2. M. Tech., Asst. Professor in Mechanical Engineering department, I.B.S.S. COE Amravati, India.

Accepted Date: 05/03/2015; Published Date: 01/05/2015

Abstract: An experimental and numerical study was conducted to investigate the flow friction and heat transfer performance in tube with twisted tape having circular hole at the centre, Reynolds number range of 25000–95000. The study aims at improving the heat transfer efficiency of heat exchanger. The friction factor, Nusselt number and the overall thermal performance parameters of an align, twisted tape having circular hole at the centre have been obtained and compare with the plain tube. The comparisons showed that, compared with the plain tube, the tube with twisted tape without circular hole has further improved convective heat transfer performance by about 40% and whereas lowered flow friction. The twisted tape having circular hole at the centre tube shows about 50% greater thermal performance than, twisted tape without circular hole. In this paper we are only studying the case of simple forced convection heat transfer, in which we are not using any twisted tape, we are concentrating on finding a level that from which we have to work toward enhancement process by using twisted tape, and by using twisted tape with hole with various geometry.

Keywords: Heat transfer improvement technique, Passive methods, Tape inserts Heat transfer Rate, Heat transfer without twisted tape.

Corresponding Author: MR. A. V. DESHMUKH

Access Online On:

www.ijpret.com

How to Cite This Article:

A. V. Deshmukh, IJPRET, 2015; Volume 3 (9): 368-374

PAPER-QR CODE

INTRODUCTION

Heat transfer enhancement techniques refer to the improvement of thermal performance of heat exchangers. Existing enhancement techniques can be broadly classified into three different categories:

(a) Active method: This method involves some external power input for the enhancement of heat transfer; some examples of active methods include induced pulsation by cams and reciprocating plungers, the use of a magnetic field to disturb the seeded light particles in a flowing stream, etc.

(b) Passive method: These methods generally use surface or geometrical modifications to the flow channel by incorporating inserts or additional devices. For example, use of inserts, use of rough surfaces etc.

(c) Compound method: When any two or more of these techniques are employed simultaneously to obtain enhancement in heat transfer that is greater than that produced by either of them when used individually, is termed as compound enhancement.

In this paper, a review of heat transfer enhancement using twisted tape and its modification is done. This paper also gives the performance criteria of different twisted tape inserts. Finally it is expected to be the pioneer source as an intensive literature review for twisted tape swirl generator

Passive heat transfer enhancement methods:

A passive heat transfer enhancement method as mentioned does not need any external input. In the convective heat transfer good ways to enhance heat transfer rate is to increase the effective surface area and residence time of the heat transfer fluids. The passive methods are based on the same principle. Use of this technique causes the swirl in the flow of air and disturbs the actual boundary layer so as to increase effective surface area, residence time and consequently heat transfer coefficient in existing system.

Following Methods are used generally used,

1. Inserts

2. Extended surface

3. Surface Modifications

4. Use of Additives.

First method as explain bellow.

Inserts:

Inserts refer to the additional arrangements made as an obstacle to fluid flow so as to augment heat transfer as explained earlier. Different types of inserts are

1. Twisted tape and wire coils

2. Ribs, Baffles, plates

Common attributes of tape:

Width: Small width tapes are preferred to minimize pressure drop.

Thickness: Thickness of the tape plays important role in its fabrication and also has contribution in fin effect

Pitch: It is the distance between two consecutive twists measured axially.

Twist ratio: It is the ratio of pitch of tape to tape width. So, if width of the tape considered as a constant (as found generally) twist ratio depends on pitch only. Under this condition if pitch is more it means less number of turns.

Fin effect: If the tape material is conductive then during the flow some heat will be absorbed by the tape material itself till its saturation. This is simply the loss of available heat energy.

Pitch The Pitch is defined as the distance between two points that are on the same plane, measured parallel to the axis of a Twisted Tape.

Twist Ratio The twist ratio is defined as the ratio of pitch length to inside diameter of the tube.

Twisted tape

Twisted tapes are made of from the metallic material. These strips are been twisted with some suitable techniques with desired shape and dimension, inserted in the pipe between air flow. Following are the main categories of twisted tape which are noted.

EXPERIMENTAL SETUP AND PROCEDURE

The apparatus consist of blower fitted with the test pipe. The test section is surrounded by nichrime band heater. Six thermocouple are placed in the air system at the entrance and exit, of the test section and two thermocouple are embedded on the test section to measure the air temperature. Test pipe is connected with the delivery side of the blower along with the orifice to measure flow of air through pipe. Input through the heater is given to a dimmerstat and measured by Voltmeter and Ammeter. A temperature indicator is provided to measure surface temperature of wall in the test section.

Setup Detail Specification:

Blower (1 H.P., single phase with motor.

Copper tube (0.45 m length,0.036 m)

Control panel

(Voltmeter (0-300V), Ameter (0-5A), ON/OFF switch, Dimmer stat),

Heating wire (Nichrome heater).

Insulator material.

Orifice meter. D2=0.014 m

DIAGRAMS:

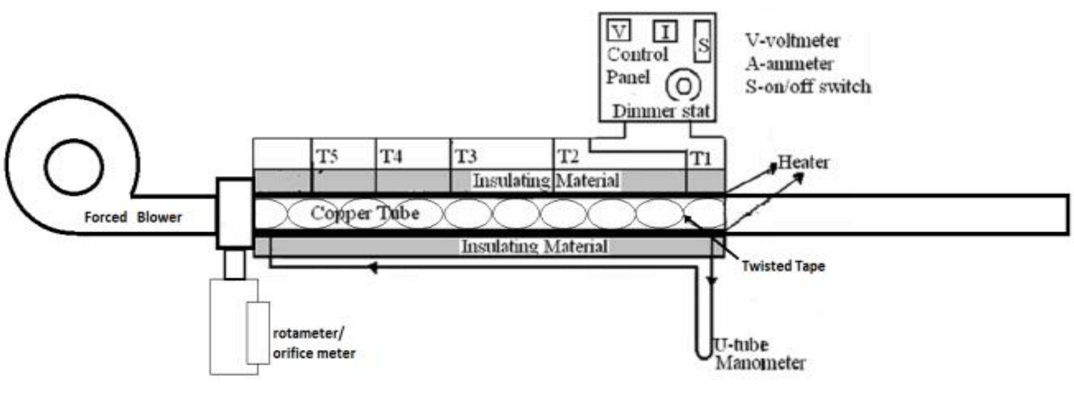

Fig. 1 Experimental Setup.

OBSERVATION

Input Voltage = 90 V

Input current = 0.74 A

Manometer reading = 7.5m

Temp	T1	T2	T3	T4	T5	T6	T7	T8
time								
10	41	43	43	43	43	43	38	39
20	56	58	58	59	60	55	33	44
30	54	63	63	64	66	59	34	46
40	56	67	67	71	71	63	36	48
50	58	71	72	75	75	66	37	48

CALCULATION:-

Bulk Mean Temprature Of Air

TBm = (Ti+To)/2 0K

We Have following properties of air at TBm

ℓa = 1.0782 Kg/m3

Cpa = 1.003 KJ/Kg0K

Take these value from chart which is provided at the end.

Calculation for discharge of air.

Qa (Air) =Cd * a1*a2*√((2g*h*(ρw/ρa))/((a1-a2)))

a1 = Area of delivery pipe in m3 = 1.01*103

a2 = Area of delivery pipe in m3 = 1.01*103

ha = manometer reading

g = 9.81 m/s2

Mean mass flow rate of air(Cm)

M = Qa *ρa Kg/s

Heat of air (q) KW

Q = m* Cpa (To-Ti)

Coefficient of heat transfer (h)

h = q/{A*(Ts-Tbm)}

A = Area of section

d =36 mm

L = 450 mm

T = (T1+T2+T3+T4+T5+T6)/6 0K

RESULT AND DISSCUSSION

In the work carried out during study the first case of finding heat transfer without insertion of twisted tape is done. The heat transfer coefficient of forced convection through pipe for case of no twisted tape insert is found to be 391.72 W/m2 0K

But this is not the end of study. We have studied just simple one case, in which we are on the base only. Now we will start further study for next case of Twisted Tape. In which Full length, Half length, and etc. type of cases will taken under study. After which we will compare them and give or sagest the best case according to study.

REFERENCES

1. M.J.Patel, K.S.Parmar, Umang R. Soni, enhance the performance of heat exchanger with twisted tape insert International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 2 Issue: 2, pp. 202 – 207

2. C.Nithiyesh Kumar, P.Murugesan, Review on Twisted Tapes Heat Transfer Enhancement, International Journal Of Scientific & Engineering Research, Volume 3, Issue 4, April-2012

3. A. Klaczak, Heat transfer by laminar flow in a vertical pipe with twisted-tape inserts, Heat and Mass Transfer, Vol. 36 (2000), pp. 195-199, Springer-Verlag 2000.

4. P. Ferroni, R.E. Block, N.E. Todreas and A.E. Bergles, Experimental evaluation of pressure drop in round tubes provided with physically separated, multiple, short-length twisted tapes, Experimental Thermal and Fluid Science (2011)

5. S. Eiamsa-ard, K. Wongcharee and S. Sripattanapipat, 3-D Numerical simulation of swirling flow and convective heat transfer in a circular tube induced by means of loose-fit twisted tapes, International communication in Heat and Mass Transfer Vol. 36 (2009), pp. 947-955.

6. Paisarn Naphon "Heat transfer and pressure drop in the horizontal double pipes with and without twisted tape insert" 2005 Elsevier Ltd.

7. K. Hataa and S.Masuzakib, Twisted-tape-induced swirl flow heat transfer and pressure drop in a short circular tube under velocities controlled, Nuclear Engineering and Design(2010), NED-5980.