Issue 1 vol 4 ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

TITLE: DESIGN OF TWISTED AND HELICAL STRIPS WITH VARING GEOMETRIES TO INCREASE CONVECTIVE HEAT TRANSFER RATE.

Dr. U.V. Kongre[*]. Siddhartha D. Shrungare [1], Pranay N. Patil[2], Sonali D. Nakhate[3],

[*]Dr. U.V. Kongre, Mechanical engineering Department, Jawaharlal darda institute of engineering and technology, MH, India, **ukongre@gmail.com**

[1]Siddhartha Shrungare, Mechanical engineering Department, Jawaharlal darda institute of engineering and technology, MH, India, **sshrungare994@gmail.com**

[2]Pranay Patil, Mechanical engineering Department, Jawaharlal darda institute of engineering and technology, MH, India, **ppranay885@gmail.com**

[3]Sonali Nakhate , Mechanical engineering Department, Jawaharlal darda institute of engineering and technology, MH, India, **sonalinakhate231197@gmail.com**

Abstract:

The device which enables the exchange of heat between two surfaces which are at the different temperature this are applicable in many industrial applications such as in air conditioning and refrigeration ,preservation of food and dairy products in process plant, in chemical plants etc. To increase the performance of any heat exchanger it's important to increase the heat transfer rate from the sides ,for this purpose various technique are used in which the strips of different geometries and dimensions are inserted into the test section. The heat transfer rate can be increase by varying the twist ratio of the inserted strips. The effect of variations two non-dimensional parameters such as Nusselt number and Reynolds's number are studied. The twisted strips inserted in test section will create swirl or turbulence in the section, because of which the maximum air will comes in contact with the inner surface of test section leads to the increase in area of contact and give maximum pressure drop. The length and width of strips is 400 mm and 20 mm respectively. The external and internal diameter of test section 30mm and 25mm respectively and length is 400 mm. The effect of variation of twist ratio is compared with test section without strips. Its observed that the maximum heat transfer rate will obtained by insertion of strips, with increase in the twist ratio there is increase in the heat transfer rate.

Key words: Twisted strips insert twisted strips with different twist ratio, pressure drop, Reynolds's number, Nusselt number.

-- *** --

1. Introduction:

The device which is use for the heat transfer purpose between two or more fluids .It has a numerous applications in the industries. Thermal power plants, chemical processing plants and in air conditioning also. In the turbulence flow maximum intensity of turbulence will enhance the rapid mixing of fluid properties and because of this there is increase in the effective area of heat transfer which gives high heat transfer rate. In many engineering applications the high performance thermal system is required, for this purpose various methods of improvement of heat transfer is extensively developed. The conventional heat exchangers are design with several types of enhancements, 1) By increase in the turbulence intensity of fluid. 2) Increase in the surface of contact between fluid and surface. 3) Generation of swirling effect in section. The effectiveness of heat transfer enhancement techniques can be evaluated by thermal performance factor. It's the ratio of change in heat transfer to the change in friction factor.

$$\acute{\eta} = \frac{Nu/Nu_0}{(f/f_0)^{1/3}} \text{ (Thermal performance factor)}$$

1.1 Design of geometries:

To enhance the effective heat transfer rate we have used two types of geometries a) twisted strips b) helical strips both are made up of same material. The actual design is created by using the CAD software specially CATIA. The geometries are made in the proper dimensions.

a) **Twisted strips:** The twisted tapes inserted in the test section cause the flow of fluid in spiral manner through the tube. This strips inserted in the tube do not have contact with the surface of tube hence it dose nota acts as a fins**.** The design of twisted strips shown in fig.1. For the insertion and removal of strips the clearance is provided which reduce the thermal contact. The twisted strips are made up of aluminium having thickness (4mm), length (400mm) breadth (20mm). By the variation of twist ration we obtained the maximum heat transfer rate with increase in the twist ratio leads to the decrease in the thermal performance factor (TPF).

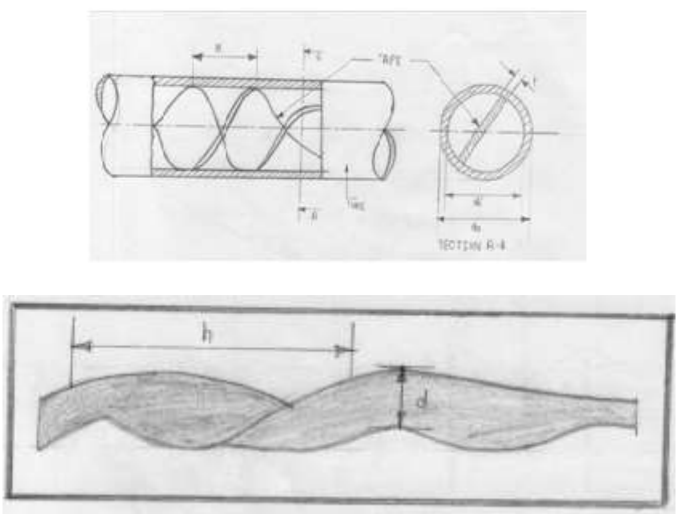


Fig: Twisted strip

1.2 Analysis:-

The analysis of designed strips is done with the help of computer aided engineering software (CAE) i.e. computational fluid dynamics (CFD). The analysis is done by varying different parameters like twist ratio, pitch length, twist angle and helix angle in case of helical strips and its effects on the heat transfer coefficient is studied.

Analysis of twisted strips:-

In the analysis of twisted strips instead of using short length we used full length strips which will give better heat transfer rate by creating the swirling throughout the length of the test section. The effect of twist ratio, space ratio, strip width, phase angle on heat transfer conclude that the decrease in the strip width gives the poor heat transfer. Heat transfer coefficient will increase with decrease in twist ratio and space ratio. The strips having short length will generate swirl at the inlet of test section only. In this the value of thermal performance factor will obtained more than one. The thickness of strips used also increase the heat transfer rate and thermal performance factor (TPF), it is observed that the heat transfer rate and TPF increase with decrease in twist ratio.

Velocity of air = 7.16 m/sec

Density of air = 1.22kg/m^3

Thermal conductivity = 205.0 W/m K

Thickness of twisted strips = 3mm

Length = 400mm

Width = 20mm

Outer diameter of test section (D) =30mm

Inner diameter of test section (d) =25mm
Proposed twist ratio = 3.78

2. Design of helical strip:

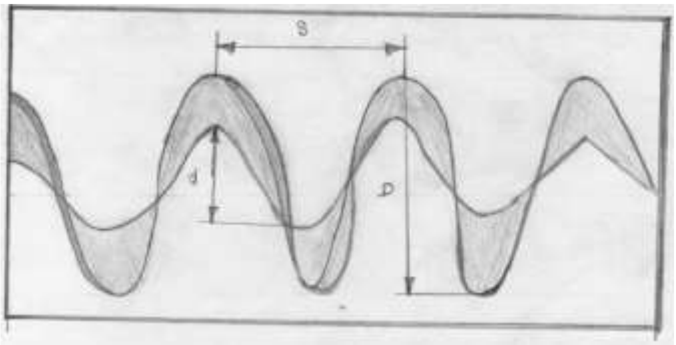
The helical twisted tape of aluminium material are also used to enhance the heat transfer rate by using the different pitch ratio and twist ratio along with the variation of helix angle. With variation of helix angle there is a decrease in power consume by blower giving minimum back flow. The increase in the twist ratio leads to the back flow of air and there is reduction in mass flow rate which leads to decrease in convective heat transfer rate.

2.1 The dimensions of helical strips:-

Thickness (t) = 3mm

Length (L) = 400mm

Width= 20mm



.

Fig: Helical strip

2.2 Analysis of helical strips:

The heat transfer characteristics with helical strip insert is studied in the circular tube. The heat transfer rate increase with increase in the non-dimensional numbers and decrease with increase in twist ratio due to the back flow of air. The increase in the Nusselt number was 4% to 30% for different helical insert with different twist ratio, helix angle and pitch length. The rate of heat transfer will increase with decrease in twist ratio. Instead of using the short length helical strips, the full length strips are preferred.

Actual setup:

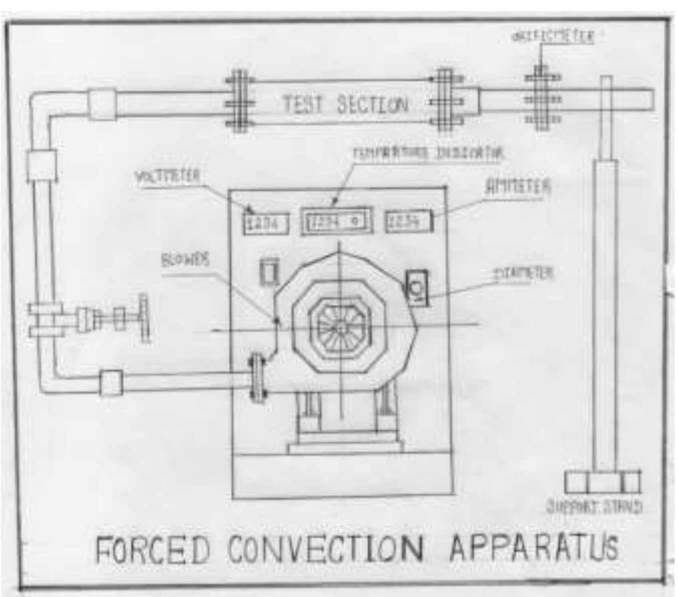
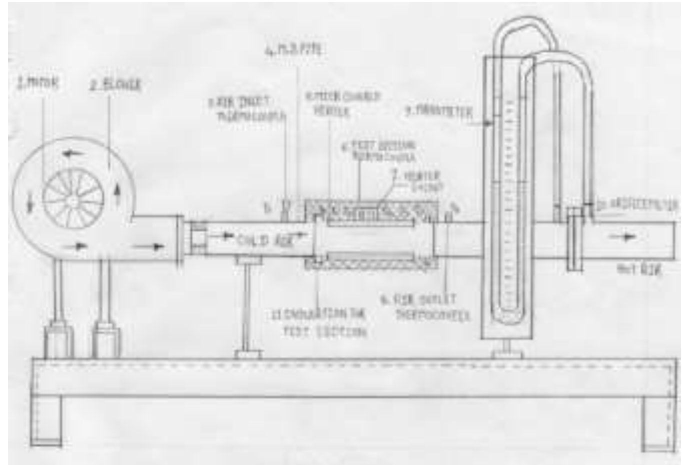


Fig-Forced convection apparatus



3. CONCLUSION

From the present study, it can be concluded that the design of the twisted strip or helical strip with varying geometries to increase the convective heat transfer rate. If we consider the twisted strips in which the heat transfer and the pressure is drop in the twisted strip is placed in heat exchanger device by using the modified twisted strip geometry when we insert the modified the twisted strip the flow is good well and performed the better in laminar flow the path is also straight. In the helical strip design the heat transfer coefficient is higher because of the cut passage and developed the non-swirling flow. The highest momentum ratio is obtained of the local heat transfer coefficient. Hence, the enhancement in the heat transfer decreases in the tube due to the reduced in swirling flow.

We have concluded that the twisted strip with the modified geometry is more effective and there is more amount of the turbulence is created. Swirling of the fluid in the tube passage of twisted strip which gives highest heat transfer rate.

4.ACKNOWLEDGEMENT

We are thankful to our collage J.D.I.E.T, Yavatmal. who gave us lot of courage during this paper work as well as for providing necessary information regarding the paper and support in completing the design paper.

We would like to express our gratitude toward all the member of mechanical department for their kind co-operation and encouragement which help us in completion of this design paper.

Last but not the least we would like to thanks to our colleagues who help us directly or indirectly and encourage us for the completion of this paper work.

5. REFERENCES

[1]. A.W. Date, Prediction of fully developed flow in tube containing a twisted tape, Int. J. Heat Mass Transfer 17 (1974) 845–859.

[2]. S. Eiamsa-ard, P. Promvonge, Enhancement of heat transfer in a tube with regularly spaced helical tape swirl generators, Solar Energy 78 (2005) 483–494

[3]. L. S. Sundar and K. V. Sharma, "Turbulent heat transfer and friction factor of Al2O3 Nanofluid in circular tube with twisted tape inserts," *International Journal of Heat and Mass Transfer*,vol. 53, no. 7-8, pp. 1409–1416, 2010.

[4]. J. Guo, A. Fan, X. Zhang, and W. Liu, "A numerical study on heat transfer and friction factor characteristics of laminar flow in a circular tube fitted with center- cleared twisted tape," *International Journal ofThermal Sciences*, vol. 50,no. 7, pp. 1263– 1270, 2011.

[5]. S. Eiamsa-ard and P. Promvonge, "Performance assessment in a heat exchanger tube with alternate clockwise and counterclockwise twisted-tape inserts,*International Journal of Heat and Mass Transfer*, vol. 53, no. 7-8, pp. 1364–1372, 2010.

[6]. K. Wongcharee and S. Eiamsa-ard, "Friction and heat transfer characteristics of laminar swirl flow through the round inserted tubes with alternate clockwise and *Communications in Heat and Mass Transfer*, vol. 38, no. 3, pp. 348–352, 2011.

[7]. G. Pathipakka and P. Sivashanmugam, "Heat transfer behavior of nanofluids in a uniformly heated circular tube fitted with helical inserts in laminar flow," *Superlattices and Microstructures*, vol. 47, no. 2, pp. 349–360, 2010.

[8]. M. Chandrasekar, S.Suresh and A.Chandra Bose, " Experimental studies on heat transfer and friction Factor characteristics of Al203/water nanofluid in a circular pipe under laminar flow with wire coil inserts. "Experimental Thermal and Fluid Science, vol.34, no. 2, pp. 122-130,2010

[9] K. N. Agrawal, A. Kumar, M. A. A. Behabadi, and H. K. Varma, "Heat transfer augmentation by coiled wire inserts during forced convection condensation of R-22 inside horizontal tubes," *International* 650, 1998 *Journal of Multiphase Flow*, vol. 24, no. 4, pp. 635–.

[10]. M. A. Akhavan-Behabadi, R. Kumar, A. Mohammadpour, and M. Jamali-Asthiani, "Effect of Twisted tape insert on heattransfer and pressure drop in horizontal evaporators for the flow of R-134a,"*International Journal of Refrigeration*, vol. 32, no. 5, pp. 922–930, 2009.