



## REVIEW PAPER ON HEAT TRANSFER ENHANCEMENT IN HEAT EXCHANGER WITH ROTATING TWISTED INSERTS

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### Abstract

**These** An experimental investigation is carried for heat transfer enhancement with the help of rotating twisted insert for heat exchanger applications. This experimental investigation is for measuring tube side heat transfer coefficient friction factor, Reynolds number of water for turbulent flow in circular tube fitted with rotating twisted insert. An experimental setup consist of pump, flow control valve to maintain measured quantity of flow, orifice meter is used for flow measurement, pressure drop is measured along test section and orifice plate with 2 U-tube manometers. A stainless steel tube of SS304 material having 40mm I.D and 50mm O.D and 1250mm length is used. Rotating twist insert is used as the insert. The enhancement devices of the Rotating twist insert show a considerable improvement of Nusselt number and friction factor relative to the plain section without inserts and smooth tube acting alone.

**Keywords:** Heat Transfer, Twisted Tape, Enhancement, Heat Exchanger

### I. INTRODUCTION

The heat exchangers have many applications in the industry. Its performance depends on its design, heat transfer rate, type of medium, pressure drop etc. Its heat transfer rate can be increased by changing the fluid stream inside the heat exchanger. It is done by placing the obstacle in the flow called as insert. Heat transfer rate can be enhanced by using different methods. Those are as follows:

1)Active Techniques: These techniques are more complicated for the design and use point of view. It requires external power source to enhance the heat transfer rate. It has limited application due to requirement of external power source.

3)Passive Techniques: These techniques use surface of geometrical modifications to the flow channel by incorporating inserts or additional devices. This technique does not require any external power; rather they use power form system itself. Ultimately leads into a rise in fluid pressure drop. This method gives higher heat transfer rate as compared with the extended surface.

4)Compound Techniques: It is a hybrid method where both active and passive techniques are combined to increase the heat transfer rate. As this method uses passive technique since it doesn't require any external power source. Due to this advantage it is widely used in the industries.

5)Extended Surface: They provide effective heat transfer enlargement. The new research led to modify the fin surface that also tends to improve the heat transfer coefficient.

6)Treated surface: These are the heat transfer surfaces which have thin alteration on their finish or coating. The alteration could be continuous or discontinuous, where the roughness is much smaller than what affects the single phase heat transfer, and they are used for boiling and condensing. <sup>[3]</sup>

7)Displayed enhancement techniques: This technique includes the usage of inserts in the forced convection. These devices improve the energy transfer rate in the heat exchangers. Inserts are of different shapes and sizes are used.

8) Swirl flow devices: They produce or superimpose the swirl flow or secondary recirculation on the axial flow in a channel. These devices include helical strip or cored screw type tube inserts, twisted tapes. [3]

8) Coiled tube: These techniques are suitable for relatively more compact heat exchangers. Coiled tubes produce secondary flows and vortices which promotes higher heat transfer coefficient in single phase flow as well as in most boiling regions.

Use an inserts is more effective for heat enhancement techniques as compared to other techniques due to following reasons:

- 1) Cost is low.
- 2) Easy to install and removal.
- 3) Maintenance cost is low.

## II. LITERATURE REVIEW

- **Naphon** (2006) studied the heat transfer characteristics and the pressure drop of horizontal tubes with wire coiled inserts. He also examined the effect of coiled pitch and relevant parameters on heat transfer characteristics and pressure drop showing the wire coil insert had a significant effect on the enhancement of the heat transfer especially in laminar flow region. Promvong (2008) reported the thermal performance of the tube with square cross sectioned coiled wire, comparing his experimental results with performance of circular cross sectioned wire. The results revealed that under similar conditions the overall enhancement provided by the square coiled wire inserts was better than the circular one. He also examined the snail entry on thermal enhancement of a tube fitted with circular and square cross sectioned coiled wire. [4]
- **A Klaczak** studied the heat transfer experiment on the twisted type insert of different pitch. The test were conducted for laminar flow within  $1.62 \leq y \leq 5.29$  and  $110 \leq Re \leq 1500$ . Result show that the heat transfer have positive relationship with the pitch value of twisted insert. V Hejazhi M.A Akhavan-Behabadi and A Afshari studies the heat transfer coefficient and pressure drops during condensation of HFC-134a in a horizontal tube fitted with twisted tape. The refrigerant flows in an inner copper and the cooling water flows in the annulus. And

predict smooth tube and swirl flow pressure drop developed and empirical correlation. Garcia Et Al experimentally studied helical wire coils fitted inside the round tube in order to characterize their thermo hydraulic behavior for laminar, turbulent and transition flows.

- **Mr. Paramveer Patil, Prof Lalit S Pawar, Prof. N B Dhamane** Experiments dealing with the heat transfer enhancement in a circular tube by means of cut corrugated twisted type of inserts with air as a working fluid. These experiments were conducted in a circular tube with and without cut corrugated twisted type insert at constant wall heating flux and different mass flow rates. The cut corrugated twisted tapes are of three different

- **Pravin S.Nikam , Prof. R.Y.Patil , Prof. P.R.Patil , Prof.P.N.Borse**

In this paper the we study the various methods of heat transfer and and modes of heat transfer and the performance evaluation criteria and the various techniques such as using delta-winglet twisted ,tapes and pipes with internal threads , perforated twisted tape for these study the performance of enhancement of heat transfer with inserting the various geometry . and conclude that the effect of inserting the various geometry is enhance the heat transfer rate.

- **N. C. Kanojiya V. M. Kriplani<sup>2</sup>, And P. V. Walke** From this review, various ways of enhance the heat transfer rate by generating the swirl flow by passive method can be observed by using various types of inserts. In perforated twisted tape inserts, heat transfer rate increases hence, heat transfer coefficient increases with decreases in pressure drop. In a perforated twisted tape inserts, the friction factor increases in the laminar region and increase the heat transfer coefficient as compares to without perforated twisted tape inserts. In most of the review, nanofluid are not used for examine the heat transfer rate in heat exchanging device. The examination was done in perforated twisted tape insert either in thermal analyses, flow visualization, in heat exchangers, etc... The comprehensive study had been done on heat transfer in heat exchanger using various types of twisted tape inserts. They concluded the twisted tape inserts perform better in laminar flow than turbulent flow. The review shows that in

future the inserts are most desirable function for heat transfer enhancement in various applications. We conclude that from the review if we use nanofluid for heat transfer enhancement with inserts heat transfer rate increases up to four times than that of without using nanofluid.

- **Praful Date and V. W. Khond** Various type of possible and cost effective technique of the heat transfer enhancement were presented in this literature review. It is clear the vortex generator technique is one of the promising approaches of heat transfer enhancement. Lot of work been carried out on various designs and use of simulation software made it easier.
- **Pradip Ramdas Bodade and Dinesh Kumar Koli** In this paper, the following heat transfer intensifiers are described and reviewed: (a) surface roughness, (b) plate baffle and wave baffle, (c) perforated baffle, (d) Inclined baffle, (e) porous baffle, (f) Corrugated channel, (g) Twisted tape inserts, (h) Discontinuous Crossed Ribs and Grooves. Different inventors' works about each one have been reviewed and many methods that assist their augmentation effects have been extracted from the literature. Among of these methods presented in the literature are half porous baffle, found that more attention should be made toward porous baffle heat transfer enhancement. Many researchers work related to Passive enhancement technique.
- **Amar Subhash Mohite, Navnath Sawant, Siddharth Chougale, Dashmeet Oberoi, Prof. Avinash Datarkar** Heat transfer rate with the square cross section gives more value than circular cross section. This is because of higher area to volume ratio. This paper includes the information about the different types of heat transfer enhancement techniques. We have concluded that it is possible to enhance the heat transfer rate by using small inserts in the heat exchangers. We have studied effect of different types of inserts like twisted type insert. It creates the swirl flow inside the heat exchanger. This review paper also discusses the experimental work done on the heat transfer enhancement with different types of inserts. This paper reviews the increased heat

transfer rate, turbulence flow and heat transfer coefficient.

- **Herle, Prof. P. R. Kulkarni** From the literature review it is seen that there is some scope for research work in the area of heat transfer it is proposed to carry out some theoretical, experimental and analytical studies on forced convection heat transfer augmentation using annular blockages. Heat transfer augmentation techniques are commonly used in areas such as process industries, heating and cooling in evaporators, thermal power plants, air-conditioning equipment, refrigerators, radiators for space vehicles, automobiles, also with the growth of the nuclear power industry and need to improve the performance of reactors etc.
- **Akhilesh N. Joshi<sup>1</sup> Prof. S. M. Lawankar** Heat transfer enhancement in a tube inserted with twisted tape and twisted tape with alternate axes is studied experimentally in this present study. The work has been conducted in the turbulent flow regime (Reynolds number in between 9000 to 18,000) using air as the working fluid. The findings of the work can be drawn as follows:

The enhancement devices of the twisted tape with alternate axes show a considerable improvement of Nusselt number and friction factor relative to the simple twisted tape and smooth tube acting alone, depending on twist ratios.

### III. CONCLUSION

The need to develop efficient heat exchangers has been partially fulfilled by using increased heat transfer rates. In the recent years, considerable emphasis has been placed on the development of various augmented heat transfer surfaces and devices.

The heat exchanger industry has been striving for enhanced heat transfer coefficient and reduced pumping power in order to improve the thermo hydraulic efficiency of heat exchangers. A good heat exchanger design should have an efficient thermodynamic performance, i.e. minimum Generation of entropy or minimum destruction of energy in a system incorporating a heat exchanger. The major challenge in designing a heat exchanger is to make the equipment compact and to achieve a high heat transfer rate using minimum pumping power.

1. The scope should be limited in this experiment due to low cost and time. Besides, the insert used is Rotating Twisted Insert . The reason for using this material is regarding to cost limitation and availability. This also includes calculation of the heat transfer enhancement characteristics. The calculation is needed to analyse the result and data collections.
2. Beside, this project hopefully can gain a lot of understanding and get more knowledge about the
3. Responses like heat transfer enhancement using nano fluid are to be considered in future research.  
Mathematical model can be developed with different geometry and insert material.

### REFERENCES

- 1.S vahidifar and m kahrom, "experimental study of heat transfer enhancement in a heated tube caused by wire-coil and rings" vol-8,no.4,pp-885-892,2015,journal of applied fluid mechanics .
2. .amar subhash mohite *et al*, int. Journal of information technology & mechanical engineering - ijitme,vol.2 issue. 3, march-2016, pg. 8-11
3. Sarang .s.hole, prof.yogesh g ingulkar, "a review on heat transfer augmentation using different twisted tapes" volume-2,issue-10,international journal of technological research in engineering.
- 4.Naphon p(2006), "effect of coil wire insert on heat transfer enhancement and pressure drop of horizontal concentric tubes"international communications in heat and mass transfer.
- 5.Promvonge ,p(2008), thermal performance in circular tube fitted with coiled square wires ,energy conversion and management.
- 6.Mr.paramveer patil prof lalit s pawar,prof n b dhamane , "analyzing effect of various pitch of cut corrugated twisted tape insert on augmentation of heat transfer", international journal for technological research in engineering ,vol 2(2015) pp-664-669.
7. Kreith f., timmerhaus k., lior n., shaw h., shah r.k., bell k. J.,etal.."applications." The crc handbook of thermal engineering. Ed. Frank kreith. Arthur e. Bergles. Boca raton: crc press llc, 2000, 408-457.
- 8.Suhas v. Patil and p. V.vijay babu "heat transfer augmentation in a circular tube and square duct fitted with swirl flow generators: a review" international journal of chemical engineering and applications, vol. 2 , no. 5 , october 2011
9. Y.l. he, h. Han, w.q. tao and y.w. zhang. 2012. Numerical analysis of heat-transfer enhancement by punched winglet type vortex generator arrays in fin and tube heat exchanger. International journal of heat and mass transfer. 55: 5449-5458.
- 10.S.s. giri, dr. V.m. kriplani "heat transfer characteristics using inserts in tubes: a review". International journal of engineering research & technology (ijert) (issn: 2278-0181), volume 3 issue 2, february -2014
11. Prof. Rahul a. Lekurwale, prof. Pravin r. Ingole, prof. Yogesh g. Joshi, prof. Pawan r. Ingole, "performance assessment of heat exchanger tubes to improve the heat transfer rate in turbulent flows by using different types of twisted tapes inserts in tubes". International journal of research in advent technology, vol.2, no.5, may 2014 e-issn: 2321-9637.