International Journal of Research in Advent Technology, Vol.3, No.4, April 2015
E-ISSN: 2321-9637

Heat Transfer Augmentation Techniques for the Tube with Different Inserts-A Review

A.N.Mahure [1], P.A.Hatwalne [2]
1,2 Assistant Professor Department of Mechanical Engg., JDIET, Yavatmal

Abstract:- Different enhancement techniques are used to increase the heat transfer rate. This techniques are mostly applicable in the areas such as process industry, Automobiles, Power sector, Aerospace ,Air conditioning etc. This techniques are divided in to three category 1.Active Technique 2.Passive Technique 3.Compound Technique. In present paper importance is work related to circular tube with inserts and how this inserts are helpful in increasing the heat transfer rate.

Index Terms—Heat transfer Augmentation, circular tube, inserts

1. INTRODUCTION

The methods are used for improving the working performance of heat transfer system is known as heat transfer enhancement techniques. In current scenario the increased material and energy cost need in improvement in efficient heat transfer equipment. The heat transfer can be raised by using following methods.

1.1 Passive techniques:-In this techniques mostly use of geometrical modification in the flow channel by using various shape inserts or other devices. These method do not require any external power. They promote high heat transfer coefficient by disturbing the flow behavior. Following methods are generally used.

- Rough surface
- Extended surface
- Additives for gases
- Additives for liquid

1.2 Active Techniques:-This techniques need some external power to enhance the heat transfer rate. Following methods are generally used.

- Surface vibration
- Fluid vibration
- Suction and Jet Impingement
- Using mechanical aid

1.3 Compound Techniques:-This technique is the combination of active and passive technique.

The present paper contributes for the review of heat transfer in circular tube with different inserts

2.REVIEW WORK

Shashank S. Choudhari , et.al [1] In this paper the experimental investigation were carried out on horizontal double pipe heat exchanger with coil wire inserts with different materials are used. These different materials are copper, aluminum, and stainless steel with different pitches used. Effect of this coil wire inserts with different material on heat augmentation and friction factor were studied. He found maximum Nusselt number obtained for copper wire inserts than aluminum and stainless steel inserts. The copper, aluminium and stainless steel coil wire insert cause heat transfer enhancement up to 1.58,1.41 and 1.31 resp. compared to plain tube.

Bodius salam, et.al [2] In this paper experimental investigation was carried out for the measurement of tube side heat transfer coefficient ,friction factor, heat transfer enhancement efficiency of water for the tube fitted with rectangular cut twisted tape inserts. The Reynolds number varied in the range of 10000-19000 with heat flux variation 14-22kw/m^2 for the smooth tube and 23-40kw/m^2 for the tube with inserts. At a comparable Reynolds number Nusselt number in tube with rectangular cut twisted tape inserts were enhanced by 2.3 to 2.9 times compared to those smooth tube with 2.6 times average enhancement. Heat transfer enhancement effectiveness were found to be in the range 1.9 to 2.3 and found to be increased with Reynolds number.

Smith Eiamsa-ard, et.al [3] In this paper experimental investigation have been conducted to study the heat transfer in a circular tube equipped with regularly spaced helical tape swirl generators. The flow rate of in the tube is considered in the range of Reynolds number between 2300 and 8800.The swirling flow devices consist of

1.Full length helical tape with and without centre rod.
2.Regularly spaced helical tube are insert in the inner tube of concentric tube heat exchanger

Found that the maximum Nussle number may be increased by 160% for full length helical tape with

centered rod,150% for full length helical tape without rod, 145% for regularly spaced helical tape.

Smith Eiamsa-ard , et.al [4] Investigated the heat transfer**,** friction loss and enhancement in heat exchanger tube with propeller type swirl generator at several pitch ratio for investigation purpose Reynolds number used in the range 4000-21000 under the uniform heat flux condition. The experiment is also undertaken for different blade number i.e 4, 6, 8 and different blade angle 30°,45°,60° and for pitch ratio 5, 7and 10 and effect of this parameter on heat transfer studied. They found heat transfer in test tube enhanced by insertion of propeller type swirl generator. Heat transfer and enhancement efficiency are found to be increased with increase in blade number and blade angle but decreases with pitch ratio. Depending on Reynolds number increase in heat transfer rate are about 113%,90%,73% above plain tube without insert.

Webb , et.al [5] Investigated heat transfer characteristics of internally helical ribbed tubes. For experimental purpose uses the liquid water as test fluid experiment were carried out in double pipe heat exchanger. Experiment were carried out in range of 20000 to 80000 Reynolds number and 5.08 to 6.29 Prantle number. Total eight tubes with wide range of variation in geometry (helix angle 25°-45°,rib height 0.327mm-0.554mm, and number of fin start 10-45) were used.

Naga S. Sarda , et.al [6] Investigated the heat augmentation of turbulent flow heat transfer in horizontal tube by means of mesh inserts with air as working fluid. Sixteen types of mesh inserts with screen diameter of 22mm,18mm,14mm and10mm for varying distance between the screens of 50mm,100mm,200mm in porosity range of 99.73 to 99.98 considered for experimentation. The Reynolds number varied in the range of 7000-14000.They found that for a constant diameter, further enhancement in heat transfer can be attained by using porous insert with smaller porosity.

Smith Eiamsa-ard , et.al [7] Investigated the heat transfer and friction factor characteristics of fully developed turbulent air flow through tube fitted with diamond shaped turbulators in tendam arrangements. For experimental purpose Reynolds number used in the range 350 to 16500 the inclined cone angle 15°,30°,45°.The variation of Nusselt number and friction factor with Reynolds number under the effect these parameters are determined. He found that both heat transfer rate and friction factor increases with cone angle 45°.The increase in heat transfer rate with increasing the cone angle and decreasing with tail length ratio. For the tube with turbulator at 45°,the heat enhancement is found to be 67%,57% and 46% respectively.

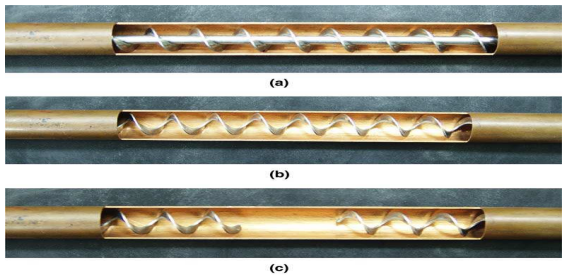

Fig. 1. The inner tube fitted with various helical geometries insert: (a) Full-length helical tape with a rod; (b) Full-length helical tape without a rod; (c) Regularly-spaced helical tape without a rod.

Fig. 2. Twisted tape insert.

Fig. 3 mesh inserts.

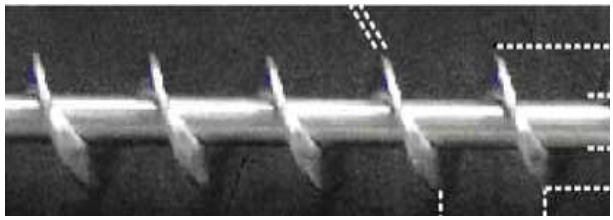

Fig. 4 Screw tape insert

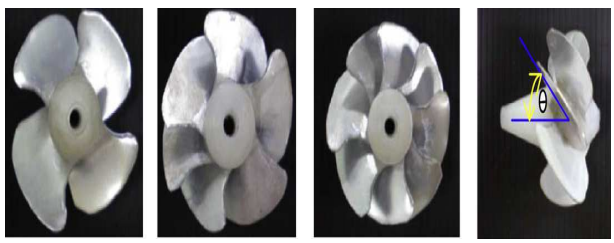

Fig.5 Propeller inserts with varying number

3. CONCLUSION

Heat transfer enhancement in circular tube increased as compared to plain tube or tube without any inserts. Inserts help in increasing heat transfer rate as inserts creates turbulence in the flow path. This review paper discusses the experimental work which has been done on heat transfer augmentation through different inserts in circular tube.

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