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A Review on Heat Transfer Enhancement Analysis of Tube Inserted with Centrally Hollow Narrow Twisted Tapes

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Abstract **- Nowadays for enhancing the convective heat transfer in various industries such as thermal power plants, chemical processing plants, air conditioning equipment, refrigerators, petrochemical, biomedical and food processing plants heat exchangers are employed with twisted-tape inserts have widely been applied. By employing, twisted tape insert bring together swirl into the fluid flow which subsequently interrupts a thermal boundary layer on the tube surface. The thermal performance of heat exchangers can be improved by heat transfer augmentation techniques. Tape insert is one of the passive heat transfer augmentation technique and used in utmost heat transfer application, for example, air conditioning and refrigeration systems food processes. Therefore various enhancement techniques have been reviewed.**

Keywords **- Heat Transfer, Augmentation Techniques, DPHE, Twisted Tape.**

I. INTRODUCTION

Heat exchangers were used in a wide-ranging of applications including power generation plants, nuclear reactors for generation of electricity, Refrigeration & Air Conditioning (RAC) systems, self-propelled industries, food industries, heat retrieval systems, and chemical handling. The upgrading methods can be distributed into two groups: active and passive methods. The active method requires peripheral forces. The passive methods need discrete surface geometries. Both methods have been commonly used to improve performance of heat exchangers. Due to their compact structure and high heat transfer coefficient helical tubes have been declared as one of the passive heat transfer improvement method and they are broadly used in many industrial applications [1, 4, 16].

The development of high performance thermal systems has stimulated interest in methods to improve heat transfer. In heat exchangers, enhancement of heat transfer is achieved by increasing the convection heat transfer coefficient or by increasing the convection surface area. One of the method to increase the convection coefficient within a heat exchanger is by introduces inserts within the pipes/tubes.

Heat Exchanger is a device in which the exchange of energy takes place between two fluids at different temperature. A heat exchanger utilizes the fact that, where ever there is a temperature difference, flow of energy occurs. So, that Heat will Flow from higher Temperature heat reservoir to the Lower Temperature heat Reservoir. The flowing fluids provide the necessary temperature difference and thus force the energy to flow between them. The energy flowing in ahead exchanger may be either sensible energy or latent heat of flowing fluids. The fluid which gives its energy is known as hot fluid. The fluid which receives energy is known as cold fluid. It is but obvious that, Temperature of hot fluidwill decrease whiles the temperature of cold fluid will increase in heat exchanger. The purpose of heat exchanger is either to heat or cool the desired fluid.

In a special case, when one of fluid undergoes change in its phase, its temperature remains unchanged. These types of heat exchanger are known as condensers or evaporators. Heat exchangers with the convective heat transfer of fluid inside the tubes are frequently used in many engineering application. The techniques of heat transfer enhancement to accommodate high heat flux i.e., to reduce size and cost of heat exchangers have received serious attention passed years. Enhancement of heat transfer Rate in all types of thermos-technical apparatus is of great significance for industry. Beside the savings of primary energy, it also leads to a reduction in size and weight. Up to the present, several heat transfer enhancement techniques have been developed. Twisted-tape is one of the most important members of enhancement techniques, which employed extensively in heat exchangers.

II. LITERATURE REVIEW

Shailesh Dewangan (2018) made helical ribs on the tube surface by machining the surface on the lathe so that artificial roughness can be created. The artificial

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roughness that results in an undesirable increase in the pressure drop due to the increased friction; thus the design of the tubes surface of heat exchanger should be executed with the objectives of high heat transfer rates.N Sreenivasalu Reddy (2017) inspected the heat transfer analysis in the horizontal double pipes with helical fins in the annulus side. The material is copper with inner tube internal diameter 10 mm, inner tube thickness 1 mm, outer tube external diameter 40 mm, outer tube thickness 1.5 mm, helical pitch of 50mm, 75mm and 100mm, heat exchanger length 1100 mm. The experimental results of plain tube are validated with numerical results.

The results obtained for helical fins in the annulus side provide enhanced heat transfer performance compared to the simple double-pipe exchangers.Riddheshwar R. Bilawane (2017) presented a review of one of the passive augmentation techniques used in a concentric tube heat exchanger using inner wavy tube. The performance of counter flow heat exchanger will be studied with inner plain tube and inner wavy tube. Then this enhanced performance due to inner wavy tube will be compared with performance of heat exchanger with inner plain tube and percentage of enhancement will be calculated in different hot fluid temperature input and different mass flow rates of hot as well as cold water. Experimentally, Overall heat transfer enhancement will be studied and also, the experimental results will be validated with CFD simulation.

Patel Yogeshwari (2017) discussed analytical solution of the compartment based double pipe heat exchanger model obtained using Differential Transform Method for parallel flow with theoretical varying initial and boundary condition. The working fluid is transformer oil i.e. hot fluid and water act as coolant. Convergence analysis of solution is also discussed.Pourahmad and Pesteei (2016) experimentally investigated on double pipe heat exchanger by inserting wavy strip tabulators in the inner pipe, their findings are on considerable improvements in enhancement of heat transfer characteristics.

Dhanraj S. Pimple (2016) investigated the heat transfer and friction factor data for single -phase flow in a shell and tube heat exchanger fitted with a helical tape insert. In the double concentric tube heat exchanger, hot air was passed through the inner tube while the cold water was flowed through the annulus. The influences of the helical insert on heat transfer rate and friction factor were studied for counter flow, and Nusselt numbers and friction factor obtained were compared with previous data for axial flows in the plain tube. The flow considered is in a low Reynolds number range between 2300 and 8800. A maximum percentage gain of 165% in heat transfer rate is obtained for using the helical insert in comparison with the plain tube.K.A. Goudiya (2016) presented the literature survey of enhancement techniques in heat transfer using inserts.Ayush Kumar (2015) discussed with different configurations. Here CDD (convergent divergent spring tabulators) CDDSTs were placed in the inner tube of double pipe heat exchanger and effect on heat enhancement and friction factor was experimentally investigated. CDDSTs at various pitches i.e (p=0,p=15,p=16) were used for the different ranges of Reynolds number. For cold water its ranges between 9000to17000 and for hot water 18000 to 24000. Finally results from CDDSTs were compared with plane tube and results showed that Nusselt number increased while friction factor decreased with increased in Reynolds number.

Friction factor was increased by 287% while Nusselt no. increased by 28%. However thermal performance factor was maximum for CDDSTs (p = 15) with value 0.319.Abhishek Tripathi (2015) presented a review on different arrangement of finned tube bundles placed on inline arrangement and staggered arrangement in cross flow. A large number of experimental and numerical works had been performed for enhancement of air-side heat transfer. A brief discussion is done on the effect of local heat transfer behavior of circular finned tube and analysis of geometric and flow parameters included in this paper.

Different parameters like fin height, fin spacing, fin thickness, tube diameter, tube spacing, effects of row and arrangement of tube bundles affect directly on the performance of solid circular finned tube. All these parameters are briefly discussed in this paper. Discussions on some important points which affect the performance of tube bundles (i.e. inline and staggered arrangement) from various authors and their problem and related issues are presented in this paper. The flow profiles and the related heat transfer characteristics in the complex geometries are still needed to be verified. Patnala Sankara Rao (2014) studied the performance of (i) bare tube-in-tube heat exchanger, (ii) tube in tube with twisted tape insert and (iii) helical insert at annulus and twisted tape insert inside the inner tube of the heat exchanger. Numerical results have been compared with the available analytical solution. It has been observed that there is a good agreement between these two results: within ±19.78 percentage error limit for Nusselt number measurement and ±25 percentage error for friction factor.

Antony luki. A (2013) investigated augmented surface has been achieved with dimples strategically located in a pattern along the tube of a concentric tube heat exchanger with the increased area on the tube side. Augmented surfaces to increasing the heat transfer coefficient with a consequent increase in the friction

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factor. In this analysis to modify the inner tube of double pipe heat exchanger using dimpled tube. In this design the inner tubes consider as the hot flue gas and outer tube is nano fluid. Here In this study the properties of nano fluid from the alumina as the nano fluid with ethyl glycol as the base fluid. a. From this design calculation the heat transfer coefficient is increased compared to plain concentric tube heat exchanger. Similarly the effectiveness is 8% increase compared to plain concentric tube heat exchanger. The theoretical results show that the using dimpled tube in concentric tube heat exchanger gives better performance. The modeling and analysis is carried out to vary the dimple tube cross sections, ellipsoidal and spherical shapes using CFD.

Finally the enhanced dimple tube is compare with the theoretical, analytical and analysis the results.M. Kannan (2012) made comparison of different types of heat transfer augmentation techniques or methods in heat exchangers by extended surfaces, obstruction devices and swirl flow device. The system has followed different geometric profiles for attainable heat transferred in experimental result and compare with simulation result. The objective of these Experiments is to assist the general heat transfer processes and the methods and devices that can be implemented to enhance more heat transfer rate. The experimental setup and apparatus required to carry out the double pipe heat exchanger experiment. The apparatus includes tube-within-a-tube heat exchangers with threaded thermometer at each end, measuring flask, a water pump and electric geyser device. Three of the four heat exchangers are modified by one type of the above-mentioned heat transfer enhancement techniques. These methods used to found out the heat loss from the surface and related temperature of fluid motions also used to found the effectiveness, the effectiveness are having to compare the different flow rates for which one is maximum possible heat transfer in double pipe heat exchanger. Annular method is higher rate of heat transfer than other three methods.

III. CONCLUSION

From the above study of various researches on heat transfer enhancement, this can be observed, that many of the authors have used active and passive methods for enhancing the heat transfer rate in a heat exchanger. Most of them have worked on either experimental or numerical analysis but the combined study of both hasn't been performed. In above studies twisted tape inserts of different twisted angles and twisted ratios are taken into considerations. Some of them have also used twin twisted tape inserts inside heat exchanger tubes for heat transfer enhancement.

REFERENCES

[1] Shailesh Dewangan, A Review of Literature on 'Experimental Analysis of Overall Heat Transfer Coefficient in Parallel Flow Heat Exchanger by Using Helical Ribs, International Journal of Emerging Technology and Advanced Engineering, 4(9), 180-192, 2018.

[2] N Sreenivasalu Reddy, Experimental Investigation of Heat Transfer Enhancement of a Double Pipe Heat Exchanger with Helical Fins in the Annulus Side, International Journal of Dynamics of Fluids, 13(2), 285-293, 2017.

[3] Patel Yogeshwari,Numerical and Experimental Investigation of Heat TransferAugmentation in Double Pipe Heat Exchanger with Helical and Twisted Tape Inserts, International Journal of Emerging Technology and Advanced Engineering, 4(9), 180-192, 2017.

[4] Pourahmad S, Pesteei S M, Effectiveness-NTU analyses in a double tube heat exchanger equipped with wavy strip considering various angles, Energy Conversion and Management, 123, 462-469, 2016.

[5] FeiDuan, KeWei Song, Numerical study of laminar flow and heat transfer characteristics in the fin side of the intermittent wavy finned flat tube heat exchanger, Applied Thermal Engineering 103,112–127, 2016.

[6] K.A. Goudiya, Experimental Investigation of Heat Transfer in Heat Exchanger UsingDifferent Geometry of Inserts – A Review, International Journal for Research in Applied Science & Engineering Technology, 4(3), 702-705, 2016.

[7] Ayush Kumar, Performance Analysis of Double Pipe Heat Exchanger using Convergent – Divergent- Divergent Spring Turbulators, International Journal for Innovative Research in Science & Technology, 2(2), 224-228, 2015.

[8] Patnala Sankara Rao, Numerical and Experimental Investigation of Heat TransferAugmentation in Double Pipe Heat Exchanger with Helical and Twisted Tape Inserts, International Journal of Emerging Technology and Advanced Engineering, 4(9), 180-192, 2014.

[9] Parag S. Desale, Heat Transfer Enhancement in Tube-in-Tube Heat Exchanger using Passive Techniques, International Journal of Innovative Research in Advanced Engineering, 1(10)-114-120, 2014.

[10] H. H. Al-Kayiem, Ribbed double pipe heat exchanger: experimental analysis, WIT Transactions on Engineering Sciences, 83, 112-120, 2014.

[11] Nawras Shareef Sabeeh, Thermo-Hydraulic Performance of Horizontal Circumferentially Ribbed Double Pipe Heat Exchanger, Journal of

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Engineering and Development, 18(3), 183-192, 2014.

[12] Melvinraj C R, Comparative Study of Heat Exchangers Using CFD, Int. Journal of Engineering Research and Applications, 4(5), 118-120, 2014.

[13] Antony luki. A, Flow Analysis and Characteristics Comparison of Double Pipe HeatExchanger Using Enhanced Tubes, IOSR Journal of Mechanical and Civil Engineering, 16-21, 2013.

[14] M. Kanan, Experimental and Analytical Comparison of Heat Transfer in Double Pipe Heat Exchanger, International Journal of Automobile Engineering Research and Development, 2(2), 1-10, 2012.

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