© June 2019 | IJIRT | Volume 6 Issue 1 | ISSN: 2349-6002

A Review on Investigation of Heat Transfer Ina Double Pipe Heat Exchanger with Coil Insert

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Abstract- **As a result of the global energy crisis, which is one of the most crucial problems due to the large and continuous increase in the consumption and the increment shortage of energy resources as well as the high cost, many researchers have performed to increase the efficiency of thermal systems and reduction of the size and thus energy consumption rates. There has been planned work done in last few decades to develop effective heat exchanger which will effect in cutback in requirement of energy and material which will reduces the cost. There are two ways to improve the heat transfer improvement i.e. minimize the thermal resistance by creating turbulence or by improving the effective surface area. Heat transfer enhancement methods exist on three general classifications which are passive, active, and compound techniques. Active methods require external power to input the process; in contrast, passive methods do not require any additional energy to improve the thermohydraulic performance of the system. Also, two or more passive and active techniques can be used together and that is called compound technique, which is employed to produce a higher augmentation than using one passive or active technique independently. Among the passive techniques, insertion of coil is one of the most effective approaches. Coil intensify turbulence and swirl, which are useful factors for heat transfer enhancement. They also provide a longer flowing path (thereby greater area) and longer residence time, thus more efficient heat transfer. A longer flowing path results in larger tangential contact between the flowing stream and tube surface which results in greater frictional loss.**

Index Terms- Heat transfer, Reynold's numbers, Nusselt number, ANSYS 14.5, Heat Exchanger

I. INTRODUCTION

Heat exchangers have different types with various applications. One of the applicable kinds of them is water to air heat exchanger which can be used for air conditioning and residential heating. There are few publications about water to air heat exchanger due to its expensive equipment studied the turbulent hydrothermal treatment in an air to water double pipe heat exchanger. Experimental investigation has been applied by to find the effect of circular ring on heat and fluid flow in an air to water heat exchanger. They found that opening area ratio has the maximum sensitivity on thermal performance. Due to significance of thermal performance, various methods for improving this parameter have been presented. Utilizing them cause heat transfer rate to augment while at the cost of augment in pressure loss. One of the most popular ways due to its low cost is swirl flow device.

Heat transfer enhancement is a process of increasing the heat transfer rate and thermohydraulic performance of a system using various methods. The methods of heat transfer enhancement are employed for developing the heat transfer without affecting the overall realization of the systems significantly, and it covers a wide range of areas where heat exchangers are used for such functions as air-conditioning, refrigeration, central heating systems, cooling automotive components, and many uses in the chemical industry.

In the passive techniques, any external power is not required; rather, geometry or surface of the flow channel is modified to increase the thermohydraulic performance of the systems. The inserts, ribs, and rough surfaces are utilized to promote fluid mixing and the turbulence in the flow, which results in an increment of the overall heat transfer rate. Passive techniques have also some advantages in relation to the other heat transfer enhancement techniques such as low cost, easy production, and installation.

Examples of passive enhancing methods are: (a) treated surfaces, (b) rough surfaces, (c) extended surfaces, (d) displaced enhancement devices, (e) swirl flow devices, (f) coiled tubes, (g) surface tension devices, (h) additives for fluids, and many others.

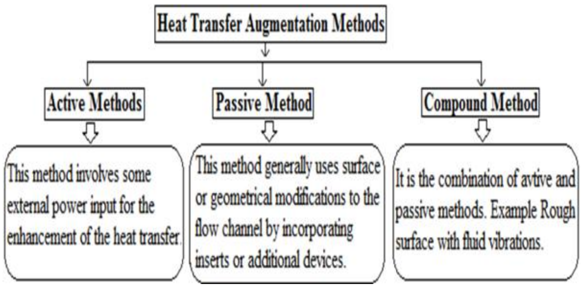

Figure 1 Augmentation methods

In this study the geometrical model of double pipe heat exchanger are generated in design modular which is shown below in figure.

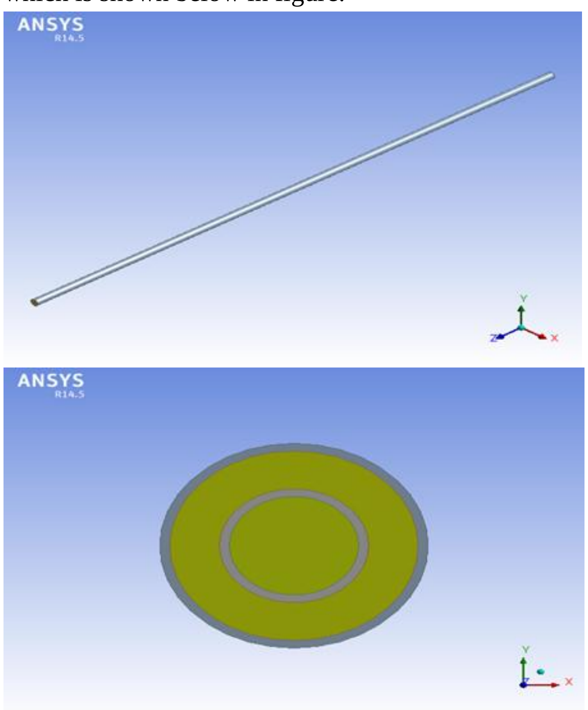

Figure 2 Geometrical model of double pipe heat exchanger.

2. LITERATURE REVIEW

The way to improve heat transfer performance is referred to as heat transfer enhancement (or augmentation or intensification). Nowadays, a significant number of thermal engineering researchers are seeking for new enhancing heat transfer methods between surfaces and the surrounding fluid.

As the need for more efficient heat transfer systems increases, researchers have resorted to various heat transfer enhancement techniques since the mid-1950s. The significant increase in the number of research articles dedicated to this subject thus far shows a noticeable growth and the importance of heat transfer enhancement technology.

A broad review of research in the field of heat exchanger spatially on double pipe heat exchanger are shown below:

Xue Chen, Chuang Sun et.al 2019 A numerical investigation is performed to analyze the high-temperature heat transfer behavior in a double-pipe heat exchanger filled with open-cell porous foam. The Forchheimer-extended Darcy equation and the local thermal non equilibrium model are utilized to simulate the flow and thermal transport inside the foam regions, considering the coupling effects between the inner and annular spaces. The effect of solid wall thickness is incorporated in the modelling process, following the continuity conditions of temperature and heat flux at the porous-solid interface.

Qianmei Fu, Jing Ding et.al, 2019 In this study the effect of structure ratio of heat exchanger and the entrance velocity of S-CO2 on heat transfer and flow resistance are investigated numerically.

A.M. Ali, El-Maghlany, 2018 Three dimensional, steady sate and incompressible CFD model was constructed for investigation of the effect of rotation and eccentricity on the heat transfer rate. A double pipe heat exchanger which was used for this study consists of an inner pipe and an outer pipe of diameter 50 mm and 150 mm respectively with a length of 2000 mm.

Mohamad Omidi, Farhadi, 2017 Growing need to develop and improve the effectiveness of heat exchangers has led to a broad range of investigations for increasing heat transfer rate along with decreasing the size and cost of the industrial apparatus accordingly. One of these many apparatus which are used in different industries is double pipe heat exchanger.

M. Sheikholeslami, D.D. Ganji, 2016 Effect of typical and perforated conical ring turbulators on hydrothermal behavior of air to water double pipe heat exchanger is investigated. Two arrays (Direct conical ring (DCR) array and Reverse conical ring (RCR) array) are considered. Experimental analysis is examined for different values of open area ratio (0–0.0833), Reynolds number (6000–12,000), conical angle (0°–30°) and pitch ratio (1.83–5.83).

Correlations for friction factor, Nusselt number and thermal performance factor are presented.

Hamed Sadighi Dizaji, Samad Jafarmadar et.al 2015 Heat transfer, pressure drop and effectiveness in a double pipe heat exchanger made of corrugated outer and inner tubes have been experimentally investigated in this paper. Both of the inner and outer tubes were corrugated by means of a special machine. New various arrangements of convex and concave corrugated tube were investigated. Heat transfer coefficient was determined using Wilson plots.

H.J. Xu, Z.G. Qu 2014 The self-coupling heat transfer in a counter-flow double-pipe heat exchanger filled with metallic foams is numerically investigated. The Forchheimer extended Darcy equation with a quadratic term is adopted for the momentum equation, whereas the local thermal non-equilibrium model is applied for establishing energy equations with thermal dispersion.

N. Targui, H. Kahalerras 2013 A numerical investigation is carried out to analyze the effect of porous baffles and flow pulsation on a double pipe heat exchanger performance. The hot fluid flows in the inner cylinder, whereas the cold fluid circulates in the annular gap. The Darcy–Brinkman–Forchheimer model is adopted to describe the flow in the porous regions and the finite volume method is used to solve the governing equations with the appropriate boundary conditions.

3. RESEARCH OBJECTIVES

Energy and materials sparing contemplations, and additionally monetary motivations, have prompted endeavours to create increasingly productive heat exchange equipment. Basic thermohydraulic objectives are to diminish the extent of a heat exchanger required for a predetermined heat obligation, to redesign the limit of a current heat exchanger, to lessen the methodology temperature contrast for the procedure streams, or to decrease the siphoning power. The investigation of enhanced heat transfer execution is alluded to as heat transfer enlargement, improvement, or strengthening. All in all, this implies an expansion in heat transfer coefficient. Endeavour's to build "ordinary" heat transfer coefficients have been recorded for over a century, and there is an expansive store of data.

The objective of the present study is to enhancement of heat transfer in the double pipe heat exchanger. In this study the main focus is creating turbulence in the inner tube.

4. METHODOLOGY

Computational Fluid Dynamics (CFD) is the utilization of PC based re-enactment to dissect frameworks including liquid stream, warm exchange and related wonders, for example, compound response. A numerical model is first built utilizing an arrangement of scientific conditions that depict the stream. These conditions are then settled utilizing a PC program with the end goal to get the stream factors all through the stream space.

All business CFD bundles include modern UIs to enter parameters and to look at the outcomes. Henceforth every one of the codes comprise of three principle components:

- Pre-processor
- Solver
- Post-processor

Pre-processor are the contribution of a stream issue to a CFD program by methods for an administrator inviting interface and the resulting change of this contribution to a shape reasonable for use by the solver. The means engaged with this are:

- Definition of geometry.
- Grid age.
- Selection of the marvels or framework to be displayed.
- Definition of liquid properties.
- Boundary conditions determination.
- Approximation of the obscure stream factors by methods for basic capacities.
- Discretization by substitution of the approximations into the overseeing stream conditions.
- Solution of logarithmic conditions.

Post-processor-All the main CFD bundles are outfitted with flexible information representation devices. These incorporate:-

- Domain geometry and lattice show
- Vector plots
- Line and shaded form plots
- Color postscript yield

The scientific displaying of a stream issue is accomplished fundamentally through three stages:

- Developing the overseeing conditions depicting the stream;
- Discretization of the administering conditions; and
- Solving the subsequent numerical conditions.

The geometrical model of double pipe heat exchanger has generated in the design modular by using ANSYS 14.5 as shown in figure. The design model will mesh in the ICEM CFD and the meshed model will be imported to Fluent. The desired boundary condition will be applied and model will be analysed and the result will be compared on the basis of previous study.

5. CONCLUSION

From the study of various researches it can be concluded that the enhancement of heat transfer can be done by creating some turbulence in the inner tube. This will be exercised by inserting a circular coil in the inner tube and create turbulence. All the study will based on the CFD simulation of double pipe heat exchanger.

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