

A REVIEW: ON DIFFERENT TYPES OF TURBULATORS USED INSIDE THE TUBE IN TUBE HEAT EXCHANGER

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Abstract: This paper is reviews about the enhancement of heat transfer through different heat transfer techniques. A Heat exchanger is equipment built for efficient heat transfer from one medium to another or from one body to other. The medium may be separated or in direct contact by a solid wall, so that it never mix or may be in direct contact. Different heat exchangers are widely used in petroleum refineries, natural gas processing, sewage treatment, space heating, refrigeration, air conditioning, power plants, chemical plants, petrochemical plants. The requirement of the current manufacturing and production industries directs the researchers in finding an alternative system which should be effective in the most efficient way. This paper revels the different methods and type of heat exchangers used to enhance the heat transfer. It also review different types of baffles used inside the heat exchanger to increase the heat transfer.

Keywords: heat transfer enhancement, heat exchanger configurations, compact heat exchangers, Baffles type

1. Introduction

A Heat Exchanger may be stated as a device which transfers energy from a hot fluid to a cold fluid, either maximum or minimum rate within least investment as well as operating cost. In this process never two fluids mixed with each other. Heat exchanger is the main unit in action that gives the efficiency as well as security to numerous of the processes. In such type of job we have to estimate the enactment of the heat exchangers of different types that is tubular, plate and shell & tube. All these heat exchangers may be functioned in both parallel as well as counter flow arrangements. The heat exchanger is accomplished amongst hot and cold water. This device offers a thermal energy flow among two or more fluids at some temperatures. Shell and tube heat exchangers are most useful type of heat exchanger likewise utilized in an extensive range of industrial uses like power generation, heat recovery in wastage system, engineering firms, cooling and refrigeration, space applications, petrochemical activities and many different areas.

2. Turbulators

Turbulators are flow leading or impeding blades or pieces utilized in some industrial process vessels (tanks), such as tube in tube heat exchangers, chemical reactors, and static mixers. Turbulators are used to increase the performance of heat exchanger. A turbulators is analysed to maintain tube packs as well as swing the stream of fluids for maximum efficiency. Outer tube roundness is significant to attain effective fastening alongside unnecessary bypass. Turbulators must be prepared from a range of resources well-matched with the outer tube side liquid. They can be perforated or machined. Some of the turbulator are prepared by a press which offers a lip nearby the tube hole to give extra surfaces alongside the tube as well to remove tube wall cutting from the turbulator verge. Turbulator are categorized as discontinuous as well as continuous.

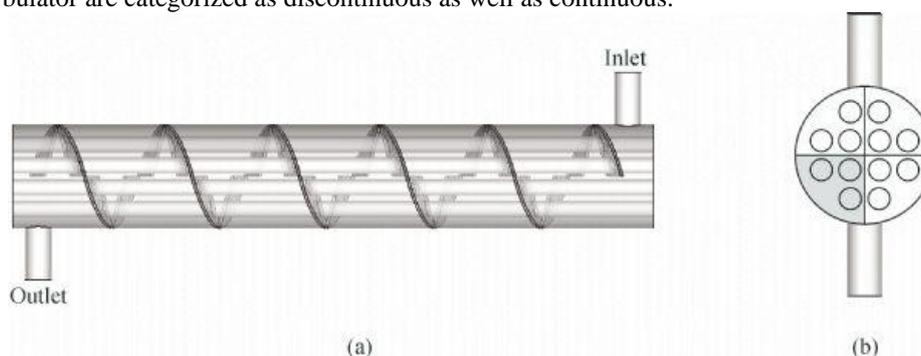


Fig.1 Tube in tube heat exchanger with turbulators [7]

Many people optimize the different process parameters of heat exchanger with turbulators; some of the research work is concluded here in the below section.

3. Existing Researcher work

Many of the researchers have work on heat exchanger to increase the performance of heat exchanger using different methods. Many of the researchers use different type of turbulators to increase the performance of heat exchanger.

- Zhouhang Li et.al (2017)** Helical coils have gained ever more interest in the area of carbon dioxide of supercritical range with Rankine cycles through the past era due to the dense assembly and great rate of heat transfer. Previous analyses basically

concentrated on influence of operational conditions and with the gravitational up thrust, and are not satisfactory to properly comprehend the behavior of supercritical carbon dioxide gas heaters with helically coiled. Impact of few different main elements, such as the alignments of coil and roughness of inner wall, on full enactment that's been rarely stated and is still uncertain to date.

2. **Pawar et.al (2016)** In past few eras many of the mechanical, practical and mathematical models are being existed on shell with tube in combination tube heat exchanger by several scholars. In the firms where shell and tube heat exchangers are utilized for various applications example for heat recovery waste, oil refineries and so on. This analysis concentrated on the practical research of shell and tube heat exchanger with distinguished type of baffles. The shell and tube heat exchanger with segmental baffles and flower baffles are calculated, made-up and verified. In a shell and tube heat exchanger associated to segmental and helical baffle, flower baffle provides recovered thermal as well as hydraulic performance.
3. **Murthy et.al (2016)** Improving surfaces of heat transfer are utilized in many engineering functions such as, air conditioning equipment, heat exchangers and many more areas. Both active and inactive methods that is being examined on improvement of heat transfer. Passive heat transfer method is one of the utmost important methods that are utilized. In the zone of heat transfer, studies have been made out over numerous of years for the growth of convective heat transfer improvement methods. The additives used in the base fluid as water or ethylene glycol is one of the methods functioned to expand the heat transfer.
4. **Ali et.al (2017)** This paper defines the thermal analysis of reclined parallel to surface of the ground and upright at right angle to surface of the ground, slinky horizontal ground heat exchangers with changed water rates of mass flow in the reheating manner of constant and discontinuous actions. A copper tube like an outer area secured with low density polyethylene has been designated as the tube material of the heat exchanger identified as ground. The practical thermal enactments of slinky horizontal ground heat exchangers standing and reclined orientation being taken into account in altered modes of heating. The practical outcomes defines the differences of the enactments of standing and reclined orientation, impacts on temperature of ground about the sprawled horizontal ground heat exchangers due to extraction of heat, as well as the influence of deviation in temperature of ground on reclined horizontal ground heat exchangers performance.
5. **Sheikholeslami et.al (2016)** The turbulent hydrothermal study of forced convection in a heat exchanger of double pipe is existed practically. Now perforated turbulators are used in annulus area. Hot water generates the cold air in the outer tube warmer. Different quantities of ratio of pitch, ratio of open area and Reynolds number are deliberated. Relationships for Nusselt number, performance of thermal and darcy factor of friction are tested. Impacts of perforated circular ring on stream type and thermal treatment in a heat exchanger of water to air are observed. The effect of PR; k and Rea on hydrothermal activity are calculated. Relationships of Nu, f and g have been provided. The Outcomes point out that loss in pressure and Nu no. reduces with supplement of k. So, g is improving parameters of k. optimum value of thermal conditions are obtained.
6. **Bandos et.al (2016)** The method to get the key to the determinate source as cylinder model for the heat exchangers with ground at a distinct concealed depths that are taking into account the capacity of heat inside them and permits random rate of heat changes are obtained. Logical evaluations for the temperature of the ground taking average are justified by integrating the particular results over the cylinder source as depth for vertical and time dependent modifications of the heat rate. Fresh results for mean temperature replies from ground heat exchanger modeled as finite cylinder source of uniform heat flow implanted into the semi-infinite zone on a distance D from its surface being existed in a solo integral pattern.
7. **Sheikholeslami et.al (2018)** Impact of distinctive and perforated uneven helical turbulators on flow and in transfer of heat in an air to water double pipe heat exchanger are practically analyzed. According to the practical facts, relationships among Nusselt number, friction factor and performance of thermal parameter are accessed as functions of distinct constraints. Non-dominated Sorting Genetic Algorithm II is in action to get the maximum high efficiency of designed heat exchanger. Practical steps are being showed to examine flow to be turbulent and transfer of heat in an air to water heat exchanger prepared with usual and perforated intermittent helical turbulators. Impacts of the Reynolds number, ratio of open area and ratio of pitch on loss in pressure and transfer of heat enhancement are observed.
8. **Patel et.al (2013)** In a double pipe heat exchanger where one of the easiest kind of heat exchanger, usually utilized for the function of sensible heating or cooling. In present work heat exchanger of double pipe is practically investigated at industry and collected necessary data like rate of mass flow, inlet-outlet temperatures, and dimensions of heat exchanger with double pipe. Heat exchanger running at industry is with fix rate of mass flow and aim of present work to advance the properties of heat exchanger. So analysis with changed discharge is necessary. From the above results and graphs it may conclude that for both heat exchangers with as well as without fins the heat transfer raises linear manner with the rise of discharge.
9. **Sheikholeslami et.al (2016)** Effect of perforated and distinctive helical fin on hydrothermal action in water to air heat exchanger is obtained. Water as well as air moving over inner and outer pipes, correspondingly. Influence of ratio of pitch, Reynolds number and ratio of open area are studied. Empirical formulations for performance of thermal parameter, Darcy factor and Nusselt number are achieved. Impacts of perforated fins with helical coil on current type as well as thermally treated water to air heat exchanger are scrutinized. The impacts of PR and Rea on hydrothermal behavior are analyzed. Relationships among Nu, f and h have been estimated. Results reveal that loss in pressure and Nusselt number reduces with enhance of PR. The slope of temperature over the hot wall rises with rising in velocity of the inlet air.
10. **Serageldin et.al (2016)** In the current paper we analyses the thermal behavior of an Earth-Air Heat Exchanger utilized for heating as well as cooling purposes and is explored under Egyptian weather situations. The soil temperature contour as well as the temperature variation of moving air through horizontal Earth-Air Heat Exchanger is practically examined. Also, a calculated model based on non-uniform, one-dimensional and quasi-state is established for conservation of energy equation while, the standard model is useful to find the turbulence kinetic energy of the moving fluid. The statistically advanced model and

computational fluid dynamics calculation conclude the validation against investigational outcomes. In this analysis, the variation in temperature of moving air from side to side horizontal Earth-Air Heat Exchanger practically considered.

11. **Wang et.al (2016)** In the analysis of multi stream plate-fin heat exchangers, selection of surface and layer pattern maximizing are examined as two self-determining issues and still continue at the experimental phase, that develops an impediment for maximizing the performance. The layer maximization model with eleven constraints for the geometrical space is assembled by utilizing an inherited procedure hybrid with an eccentric search procedure. There are two cases that have been maximized in firms with this model, and the consequences are estimated by three tools. The chief inferences of the current work are as follows, The difference in temperature and drop in pressure are familiarized into the optimization model of the corresponding layer arrangement ring, by means of which the impact of the drop in pressure on the multi stream plate-fin heat exchangers is considered with the heat transfer efficiency.
12. **Huertas et.al (2014)** This exploration represents a practical analysis of the heat transfer and drop in pressure features of a solar collector of flat plate with two dissimilar shape of helical wire coil supplements. This gives us by recognizing the distinct flow systems that each wire coil endorses, and helps as a base for the analysis of the outcomes of heat transfer. Two wire coil enclosures with changed geometry are considered practically to read the liberated influence of tube side improvement of heat transfer on the temperature dissemination of the absorber plate in a heat transfer rig for the analysis of flat plate liquid solar collectors.
13. **Vahidifar et.al (2015)** This analysis examines characteristics of heat transfer and the drop in pressure of a horizontal double pipe heat exchanger with wire coil enclosures. The magnification of coefficient of heat transfer in the heat exchanger decreases the weight, size and heat exchanger cost. When an article is engaged in a boundary layer, it disturbs the flow pattern and changes the velocity as well as temperature contours. The change is influenced by the development of jets and stirs in the boundary layer as it varies transfer and coefficients of friction on the wall. The current investigational analysis concentrated on the analysis of the transfer of heat and drop in pressure among the wire coil and rings insert in smooth tube with $Re = 5000-25000$ and $Pr = 0.7$.
14. **Lahiri et.al (2013)** Due to complete numbers of heat exchanger with shell and tube in any natural process firm, small development in their analytical policies deals high saving chances. Conventional design tactics are established on iterative processes that progressively vary with the design as well as mathematical functions until given heat duty and geometric series and working limits are contented. While well confirmed type of method is time taking and are not discover the exact answer of space to be fully examined. The present study has demonstrated positive submission of hybrid DEACO technique for the top design of heat exchanger with shell and tube from profitable approach. The hybrid DEACO technique boosts the applicability of the DE technique and converges quickly than individual DE or ACO algorithm. Implementations.
15. **Roslim et.al (2015)** This object informs about the inquiry on the things of porous twisted plate as enclosure to improve performance of heat transfer and flow parameter for a single fixed tube. The real fixed tube of the boiler is utilized and implanted with simple and porous twisted plates. The accumulating outcome is associated with the simple tube without any supplement. The final consequences describe that formation of holes changed the flow pattern and then creating secondary flow and forthcoming to turbulence flow. The temperature variation and characteristic of heat transfer of the porous surface twisted plate as inserts in fitted tube are presented in this article. The result obtained was discussed and proved that porous surface twisted plate enhanced the rate of heat transfer inside the tube.

4. Conclusion Drawn from the literature survey

It is found that the value of heat transfer depends on different parameters of heat exchanger. Different types of baffles were used to increase the performance of heat exchanger. Heat transfer rate depends on the mass flow rate of working fluid and it also depends on the temperature of working fluid at the inlet of heat exchanger. Heat transfer also depends on the type of flow behavior of working fluid inside the heat exchanger, different types of baffles were used to enhance the flow of working fluid so that heat transfer get enhance.

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