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A Review on Design & Thermal Analysis of Double Pipe Heat Exchanger by Changing the Mass Flow Rate

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Abstract- Whenever one of the fluids experiences a phase shift, the temperature of the other fluid remains unaltered. Condensers and evaporators are two different types of heat exchangers. Heat exchangers featuring convective fluid heat transfer inside tubes are commonly used in a variety of technical applications. Heat transfer improvement strategies to accommodate high heat flux, i.e., to minimize the size and expense of heat exchangers, has gotten a lot of attention in recent years. Heat transfer improvement the rate of all sorts of thermos-technical apparatus is extremely important to the industry. It results in reduced in size and weight in addition to conserving basic energy. Many heat transfer improvement techniques have been developed up to this point. Twisted-tape is among the most essential members of an improvement techniques used in heat exchangers.

Keywords:- Double Pipe Heat Exchanger, Mass Flow Rate, heat transfer.

I. INTRODUCTION

Heat exchangers are employed in a variety of applications, included power plants, and nuclear reactors in energy production, RAC systems, self-propelled industries, food industries, heat retrieval systems, & chemical handling. The techniques of upgrading can be divided into two categories: active and passive ways. The active approach necessitates the use of peripheral forces. Discrete surface geometries are required for passive approaches.

These strategies are commonly utilized to increase heat exchanger performance. Helical tubes have already been designated as among the passive heat transfer enhancement materials. Due the short construction and high heat transfer coefficient, and they will be widely employed in various industrial applications.

The development of high-performance thermal systems has sparked interest in heat-transfer technologies. In heat exchangers, raising the convection heat transfer coefficient or expanding the convection surface area improves heat transmission. Inserts inside these pipes/tubes are one means of increasing the convection coefficient within such a heat exchanger.

Heat exchangers are devices that allow energy to be transferred between two fluids of different temperatures. A heat exchanger takes the use of fact that energy flows when there has been a difference in temperature. As a result, heat will be transferred from the higher-temperature heat reservoir to the lower-temperature heat reservoir. The temperature differential created by the circulating fluids forces the energy to move between both.

The energy passing through a heat exchanger might be sensible or latent heat of flowing fluids. The fluid that provides the energy is referred to as hot fluid. Cold fluid is a type of fluid that receives energy." In such a heat exchanger, the temperature of the hot fluid should drop whereas the temperature of the cold would increase. The goal of a heat exchanger would be to either heat or cool the fluid. Whenever one of the fluids experiences a phase shift, the temperature of the other fluid remains unaltered.

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Heat transfer improvement strategies to accommodate high heat flux, i.e., to minimize the size and expense of heat exchangers, has gotten a lot of attention in recent years. Heat transfer improvement the rate of all sorts of thermos-technical apparatus is extremely important to the industry. It results in reduced in size and weight in addition to conserving basic energy.

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II. REVIEW OF PAST WORK

Lachi et al. (2018) A DPHE and a shell and tube heat exchanger's time constants were investigated. The goal of this study has been to identify the features of the heat exchangers in a transient state, particularly where sudden variations in inlet velocities are taken into account.

A model containing two parameters of time delay and time constant was used to conduct this research. So it is worth noting that the analytical term were calculated using the energy balance equation. Furthermore, it seemed that the numerical data were validated using an experimental approach, with the maximum recorded discrepancy being less than ten percent.

Aicher and Kim (2018) the effect of counter flow with in nozzle portion of a DPHE installed upon that shell side wall were explored. The counter flow with in nozzle portion turned out to have a considerable impact on heat transfer or pressure decrease. It was also determined that when the heat exchanger were small and the ratio of free cross section regions was low enough, the effect is more noticeable. Researchers also demonstrated experimental correlations for predicting the rate of heat transfer in turbulent flow.

Ma et al. (2018) the impacts of supercritical carbon dioxide (SCO2) in a DPHE was researched experimentally, with the impacts of pressure, mass flow, and buoyancy force on the SCO2-side being studied extensively. On just one hand, it must have been discovered that increasing the gas-side pressure significantly reduced both of the overall as well as gas-side heat transfer rates. But at the other hand, it really was clear that now the waterside flow rate, as opposed to the gas-side flow rate, was the most important factor in the heat transfer rate. Furthermore, for predicting heat transfer rate, a mathematical correlation based on Genetic Algorithm has been presented.

Raghavan (2018) in both parallel & counter flow configurations, a two pipe helical heat exchanger was examined. Wilson plots have been used to compute the equivalent heat transfer rates of the inner tube or annulus. It really is worth mentioning that the performance evaluation criteria for both configurations were equal, despite the fact that now the heat transfer for such counter flow design was unquestionably larger than just its counterpart due to a bigger temperature differential.

“The comparison of heat transfer coefficients between both the improved tube and smooth tube under another pumping power condition is the performance evaluation criterion (PEC) discussed above.”

Dizaji et al. (2018) In a DPHE, I conducted an experimental research of heat transmission and pressure drop of corrugated tubes that proved out to be really important in the area. Concave and convex corrugations were used on both the inner and outer tubes. The working fluids inside the trials was hot and cold water, which went through the heat exchanger's inlet section, respectively. The best efficacy was attained whenever the inner and outer tubes featured convex and concave corrugated designs, accordingly, according to research findings.

Bhadouriya et al. (2018) Heat transfer and pressure drop of such a DPHE were explored both experimentally and statistically, with the main goal being to determine the influence of the inner tube twist ratio and flow parameters. A boundary criterion for the outer flow had been a consistent wall temperature there at inner wall of the annulus. The working fluids with in studies were water and air that ran via the heat exchanger's inner (square duct) and annulus, respectively.

In all flow regimes, the results revealed that such a geometry adjustment resulted in an increase in heat transfer rate and just a pressure decrease. The findings of this article will aid engineers in designing more compact heat exchangers. “Nusselt number in the laminar flow regime, unlike smooth tube, was found to be reliant on flow characteristics including physical factors such as Reynolds number or twist ratio.

Tang et al. (2018) the consequences of a twisted inner tube inside a DPHE were explored both experimentally and numerically. The inner tube exhibited three various cross section configurations inside the experimental process: circular, oval, and tri-lobed, but the outer tube was just a conventional cylindrical tube. With such a higher performance assessment criterion, above - the tri-lobed cross section, and the basic outer tube, received a lot of attention. Furthermore, a wide range of investigations was carried out from the study's numerical procedure, particularly in different cross-section forms.

Dewangan (2018) made helical ribs on the tube surface by machining the surface on the lathe So that artificial roughness can be created Because artificial roughness causes an undesirable increase throughout pressure drop resulting in increased friction, the design of both the tubes surface of such a heat exchanger should indeed be carried out for the goal of achieving high heat transfer rates.

Reddy N. S (2017) the heat transfer analysis for horizontal twin pipes having helical fins on the annulus side was explored. The material comprises copper, with just an inner tube diameter of 10 mm and a thickness of 1 mm, an outer tube diameter of 40 mm and a thickness of 1.5 mm, helical pitches of 50, 75, and 100, as well as a heat exchanger length of 1100 mm. The plain tube experimental results were backed up by numerical data. In comparison to basic double-pipe exchangers, the results gathered for helical fins inside the annulus side give improved heat transfer performance.

III. CONCLUSION

The growing really has to create and boost the effectiveness of heat exchangers has prompted a slew of studies aimed at enhancing heat transfer rate while reducing the size and cost for industrial equipment. The double pipe heat exchanger is also one of the numerous devices utilized in many sectors. Because of its simplicity and wide variety of applications, this form of heat exchanger had gotten a lot of attention.

“Many precise & useful investigations in twin pipe heat exchangers have been conducted in recent years. The development process for with this type of heat exchanger has already been thoroughly examined inside this review, as well as the heat transfer enhancement methods used in the aforementioned heat exchangers.

The authors gathered information on the use of various techniques, including such active, passive, and compound methods, in order to give a thorough research. It is worth mentioning that studies about the use of passive methods with double pipe heat exchangers having mostly been mentioned.”

Researchers can trace the history of twin pipe heat exchanger publications all the way back to the late 1940s [3, 4]. The investigations all point to the fact that this form of heat exchanger is making significant development. Over the years, a slew of studies have been undertaken that fall into several categories. In certain circumstances, just the features of the working fluids and their alterations were investigated. Several researchers looked at active, passive, compound, geometry change, as well as other heat enhancement approaches.

REFERENCES

[1] J. Mozley, Predicting dynamics of concentric pipe heat exchangers, Ind. Eng. Chem. 48 (1956) 1035–1041.
[2] W.C. Cohen, E.F. Johnson, Dynamic characteristics of double-pipe heat exchangers, Ind. Eng. Chem. 48 (1956) 1031–1034.
[3] 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.
[4] 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.

[5] Patel Yogeshwari, Numerical and Experimental Investigation of Heat Transfer Augmentation in Double Pipe Heat Exchanger with Helical and Twisted Tape Inserts, International Journal of Emerging Technology and Advanced Engineering, 4(9), 180-192, 2017.
[6] 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.
[7] 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.
[8] K.A. Goudiya, Experimental Investigation of Heat Transfer in Heat Exchanger Using Different Geometry of Inserts – A Review, International Journal for Research in Applied Science & Engineering Technology, 4(3), 702-705, 2016.
[9] 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.
[10] PatnalaSankara Rao, Numerical and Experimental Investigation of Heat Transfer Augmentation in Double Pipe Heat Exchanger with Helical and Twisted Tape Inserts, International Journal of Emerging Technology and Advanced Engineering, 4(9), 180-192, 2014.
[11] 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.
[12] H. H. Al-Kayiem, Ribbed double pipe heat exchanger: experimental analysis, WIT Transactions on Engineering Sciences, 83, 112-120, 2014.
[13] Nawras Shareef Sabeeh, Thermo-Hydraulic Performance of Horizontal Circumferentially Ribbed Double Pipe Heat Exchanger, Journal of Engineering and Development, 18(3), 183-192, 2014.
[14] Melvinraj C R, Comparative Study of Heat Exchangers Using CFD, Int. Journal of Engineering Research and Applications, 4(5), 118-120, 2014.
[15] Antony luki. A, Flow Analysis and Characteristics Comparison of Double Pipe Heat Exchanger Using Enhanced Tubes, IOSR Journal of Mechanical and Civil Engineering, 16-21, 2013.
[16] 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.