Review Paper on Double Pipe Heat Exchanger (Dphex) and Its Versatile Configurations

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***Abstract* - This paper describes the results of research conducted by a community of researchers in order to measure the performance of double heat exchangers. We've gone over the literature section, which includes details on the methodology used for the assessment as well as the outcomes from each methodology. The main objective of this paper is to assist researchers in conducting more in-depth research into the techniques while also utilizing existing techniques by highlighting their benefits and drawbacks.**

Keywords: Double Pipe Heat Exchangers, Parallel Flow, Cross Flow, HEX, Heat Transfer.

I. INTRODUCTION

The mechanism of exchanging the heats of two different liquids at distinct temperatures, takes place in heat exchangers. These devices are applied in several implementations including cooling, heating, AC systems, power plants, etc. Heat exchangers (HEX) devices in power plants include air preheaters, cooling equipment, evaporators, super-heaters, condensers, and cooling systems. Such devices use a conductive shield to transmit or "swap" heat among two streams (liquid or gas) without physically combining them.

Researchers have designed systems that use HEX to proficiently transfer energy among routes because heat is a source of energy. Since there are several ways to accomplish heat transfer, exchangers emerge in a variety of shapes and sizes; this article concentrates on the double pipe heat exchanger (DPHEX), which is one of the most fundamental but versatile configurations.

Double pipe heat exchangers (DPHEX)-The architecture of double pipe heat exchangers is defines as two pipes of different dimensions, that is one big pipe and other pipe is shorter, are arranged in such a way that mechanism of heat transfer within bigger pipe. One liquid flows through small pipe and other fluid flows in between the pipe. Thus inner pipe behaves as a shield which is conductive in nature. The outer side or shell side involves liquid flows on the internal side of the tube. The schematic diagram of double pipe heat exchangers is given below.

Hairpin, jacketed pipe, jacketed U-tube, and pipe in pipe exchanger are all terms for this kind of thermal exchangers. These heat exchangers can only hold single pipe or bunch of pipes (limited to 30), and the external pipe has to be under 200 millimeters in diameter. Sometimes, longitudinal fins in the internal pipe are used to boost the heat transfer rates among operating fluids. The liquid L1 flows in one pipe at definite temperature and liquid L2 flows in another pipe. Each pipe has inlet and outlet from where the liquids are inserted and exited from the pipes.

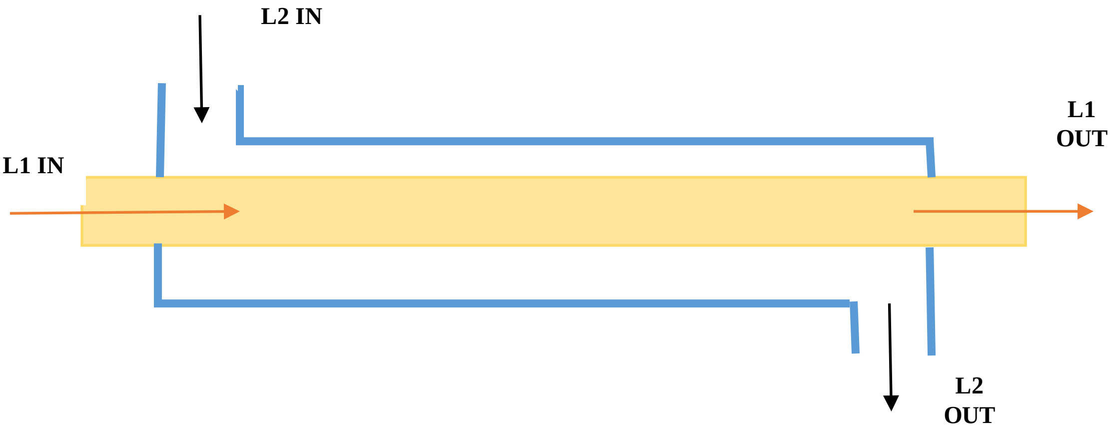

Figure 1: Double pipe heat exchangers (DPHEX)

1.1 Different Types of Double Pipe Heat Exchangers (DPHEX)

The fluid flowing direction of double pipe heat exchangers (DPHEX) can be classified. In these exchanges, both parallel and counter flow can be utilized, and it all depends on where the inlets and out-lets are located. The heat transfer (HEX) and pressure loss in the framework are affected by the parallel and counter flow configurations; however, in certain applications, one should be preferred over another.

1.1.1 Parallel Flow Double Pipe Heat Exchangers

In a equidistant fluid flowing system, the inlets and outlets are located in the same side. The heat transfer (HEX) is below than counter-flow, and also the efficiency is lesser; moreover, in certain implementations, this concept should be used. The two liquids inlet temperature range may be clearly distinguishable, but by the final step, these liquids were close to a certain temperature. According to Thermopedia, with equidistant flow, the sidewalls temperatures during the process of exchanger will become more homogeneous than on other fluid flow trends.

An equidistant fluid flowing shell and pipe heat exchanger might have been the best option whenever the primary objective is to end up with two different types of fluids with a small temperature variation. The cold-fluid temperature will also be lower than the heated fluid temperature if there is not significant temperature difference.It's worth noting that parallel or equidistant flow heat exchangers require more heat exchanging surface area than some other flowing trends because the heat exchange rate is not quite as large. As a result, facility executives must ensure that their equidistant or parallel flowing shell and tube heat exchangers have enough floor area, since they may be greater than just a heat transfer with a various flow rates.Furthermore, the large temperature variation at the inlet can produce overheating, that can induce shaking and severe damage to the tool. Furthermore, the large temperature variation at the inlet can produce overheating, that can induce shaking and severe damage to the tool.

1.1.2 Counter flow shell and tube heat exchangers

The building structure of a counter-flow or counter-current pipe heat exchanger is similar than that of a flowing pipe heat exchanger (HEX) in several aspects. The pipe -side liquid arrive into the exchanger at the extreme side of the shell-side liquid. As an outcome, instead of flowing in the similar direction, the fluid layers collide.

In pipe heat exchanger (HEX), the counter flowing behavior is perhaps the frequent as it is the most effective. The highest temperature difference among liquids is possible with this fluid flowing trends. Furthermore, apart from it parallel fluid flow exchangers, the cold-fluid can attain the boiling fluid's temperature because it departs at the same side where it high temperature fluid entrance.

In counter flow architectures, variation in temperatures is more consistent during whole process of exchanger, reducing overheating that can cause shaking or movements that can damage the hardware. Furthermore, because the variation in temperature is more continuous during the mechanism of exchanger, the rate of heat exchanging process is also more uniform.

In double-pipe heat exchangers, it's simplest to obtain "authentic" counter flow, where both liquids transit excellently parallel to each other in different directions which are opposite in nature, via shell and tube heat exchangers can come close. The shellside liquid travels up or down inside the shell and also from entry to exit (or vice versa) due to the baffles customarily used in design, resulting in a cross fluid flowing trends. The larger the ratio of length and diameter of the exchanger, the nearer it will be to "genuine" counter flow.

1.1.3 Cross flow shell and tube heat exchangers

The cross-flow heat exchanger is constructed in the way such that the two different fluids flows in perpendicular directions. This is common whenever one fluid is in liquid state and another is in gaseous state, such as in a car radiator, where water with high temperature flows left and right is cooled by air travelling upside and downside. In vapor cooling systems, where fluid in liquid state converts into a gaseous form at the final step, cross-flow exchangers are also frequent.

Benefits and Drawbacks of Double Pipe Heat Exchangers (DPHEX)

Double pipe heat exchangers were one of the clearest and simple design features, making them simple to compose and maintain. All gadgets have benefits and drawbacks, and we'll demonstrates whether double pipe heat exchangers are right for the implementation in this part.

1.2 Advantages of Double Pipe Heat Exchangers

• Compared to certain other complex heat exchangers, such an exchanger has some significant benefits. The following are the main advantages of double pipe heat exchangers:

• It is possible to achieve high efficiency while spending less money on investment.

• These devices are small in comparison to the shell and tube, requiring less area for servicing while providing adequate heat transfer. • Because they are so widely known, all of the components have just been normalized, causing inspection and replacement

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• This category of exchanger can withstand high pressures and temperatures.

1.3 Drawbacks of Double Pipe Heat Exchangers

• Be attentive of the flaws in this of exchangers and its structural implementations, including:

• These have restrictions in heat transfer instead of complex structures but used in lower thermal duty applications.

• Such a category is far more prone to leakages.

II. LITERATURE REVIEW

(Setareh et al., 2019)Heat transfer enhanced in a double-pipe heat exchanger (DPHEX) when ultra - sonic waves were present, according to experiments. An ultrasonic transducer bolted to the internal tube was being used to incorporate ultra-sonic vibrations in an inventive test system made of two concentric tubing. Moreover, in the presence of ultrasonic vibrations, OpenFOAM software is being used to perform a mathematical analysis in order to evaluate the origin of heat transfer advancement. The experimental finding showed that as the acoustic power at the assigned Qc and Qh is risen, the low temperature liquid exhaust temperature increases while the high temperature fluid's exhaust temperature decreases.

Accordingly, at consistent Qc and Qh, the upgrade factor ascends as the acoustic force rises. novel trial arrangement made of two concentric lines is built and a darted Langevin ultrasonic transducer is utilized for applying the ultrasonic vibrations to the internal line with a recurrence of 26.7 kHz. The mathematical recreation is completed by OpenFOAM programming to explain the justification behind heat move improvement. The impacts of hot and cold liquid stream rates and acoustic force on heat move and tension drop are concentrated in this work.

(Noorbakhsh et al., 2020)In this review, the impact of utilizing bent tapes in the two containers of a twofold line heat exchanger was mathematically researched. The review comprises of two segments. At the primary area, three unique states of bent tape were thought of and mathematical recreations were performed. At the subsequent advance, one of the tried models from segment one was chosen to make bless. Three distinct angle proportions of honor were examined. The got results comprise of outlet temperature, pressure drop, Nusselt number, and coefficient of execution. The outcomes show that expanding the quantity of contorted tape from one-blade to four-balance prompts an increment in the Nusselt number 3.1%, pressure drop 64%, and coefficient of execution 63.9%. At last, in light of results, four-blade wound tapes gave better coefficient of execution.

(Moradi et al., 2019)an exploratory review was led to research the exhibition of twofold cylinder counter-stream heat exchanger under permeable media conditions. The exhibition of hotness exchanger was tried with MWCNTs–water nano-liquid, with an emphasis because of the volume stream rate and grouping of nanoparticles. The permeable medium made of aluminum plate, utilized all through this examination, with a huge contact surface with the liquid and high warm conductivity, upgraded the hotness move. The improvement coefficient increments significantly with a permeable cylinder surface.

(Aghayari et al., 2014)This review researched the hotness move upgrade of the nanofluid comprising of AlO2nanoparticles and water under the state of violent stream in a twofold line heat exchanger. The hotness move esteems were estimated in the tempestuous progression of a nanofluid containing 20 nm aluminum oxide suspended particles with the volume convergence of 0.1–0.3% (V/V) in water. Properties of nanofluid are acceptable and there is a lot of liquid. Hotness move coefficient and Nusselt number of the nanofluid increment from 15 to 20% contrasted with the base liquid as indicated by the correlation based on fixed Reynolds number.

(Córcoles et al., 2020) Here simulation employs a 3-D numerical model to perform a turbulent mathematical simulation of the flow pattern and heat transfer process in a DPHEX, inspecting and analyzing the various types of inner corrugated spiral corrugated tubes that can be found separate from the exterior or outer construction.With the proposed grid comparisons illustrate the numerical results found from Cases 1 and 2 compared to systematic experiments, better achievement is acquired.Once the thermal performance and the pressure loss have been considered individually, the impact of non-dimensional variables including the severity scale or the corrugation shape aspect was noticeable, with a rise in these variables also raising thermal exchange as well as the loss in pressure.

(Bahmani et al., 2018)Heat exchange, thermal resistance, and temperature fluctuations of the H2O/Al2O3 nanofluid fluid in equidistant or parallel and counter flow DPHEX were analyzed experimentally in this study. A FORTRAN computer software was used to test the impact of solid nano-particle volume fragments and a broad range of Reynolds numbers in turbulent patterns. eThe inlet temperatures of the base fluid (low temperature) and nanofluid (high temperature) are maintained at a constant in all case scenarios researched. The Nusselt number drawings and the slop of the convective heat exchange coefficients are nearly constant. Increasing the Reynolds number of nanomaterials has a greater impact on the thermodynamic properties and Nusselt number.

(Milani Shirvan et al., 2017)This paper mathematically investigates convection heat transfer and HEX effectiveness in a DPHEX loaded with nano-fluid. It is supposed that upper and lower walls of HEX are adiabatic in nature. The research shows the mathematical simulations of the impact of the three variables that is Reynolds number (50 Re 250), nano-particle volume segments (0.01 0.05), as well as the entry situation of nana-fluid S on the performance of HEX and thermal transfer performance. To describe the optimal situation with improved heat transmission and HEX potency, the average Nusselt number and exchangers potency are determined by calculating, and remaining drawings are acquired. Ultimately, the impacts of the above described factors responsible on heat transport performance and exchanger efficiency are investigated employing risk assessment.

(Sheikholeslami & Ganji, 2016)In a liquid-to-gas HEX, the aspects of a removable circle shaped ring on flowing trend and heat processing are investigated. On hydro-thermal behaviour, the effects of PR, k, and Rea are investigated. Nu, f, and g correlations have been supplied. The numbers confirmed that though k is increased, pressure deprivation and Nusselt number reduce. As a result, g is a k-enhancing function. At g = 1.59, the highest values of thermal efficiency was acquired for Re 1/4 6000; k 1/4 0:07; PR 1/4 1:06. An empirical investigation of forced convective turbulent hydrothermal assessment in DPHEX is introduced. In the circumferential area, punctured turbulators were used. The high temperature water warms the low temperature air in the external pipe.

(Sadighi Dizaji et al., 2015)This paper describes the improvement of heat transport in a DPHEX with corrugated external and internal tubes. The purpose of this study has been to make comparisons of a corrugated internal pipe and smooth external pipe of DPHEX to a corrugated internal pipe and corrugated external tube double pipe HEX. Additionally, innovative slightly curved in convex and slightly curved in concave corrugated tube frameworks have been explored. The Nusselt number, friction factor, efficiency, and thermal efficiency component were all used to describe the findings of this research. Through use of corrugated pipes was found to be beneficial in improving the Nusselt number and exchangers achievement.

(Milani Shirvan et al., 2016)In a DPHEX filled with porous materials, a two dimensional simulation analysis and specificity analysis were conducted on turbulent heat transport and exchanger performance. The impacts of the multiple factors responsible of Reynolds number (3000 Re 5000), Darcy number (10-5 Da 10-3), and porous substrate thickness (1/3 1) on heat transfer characteristics and exchanger efficiency within the exchanger are investigated using simulation studies.The optimum conditions are defined which use remaining drawings, and the impacts of this important variable on heat transport achievement and HEX effectiveness are investigated using risk assessment.

III. CONCLUSION

This paper presents the investigational information gathered by numerous of researchers to determine the performance of the double heat exchangers. Here we have covered the literature section with the information of the technique used for the analysis as well as the results from every technique is also discussed. The main motive of this paper is to help the researchers to further investigate the techniques in depth and also utilizes the existing techniques as the advantages and drawbacks are also mentioned.

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