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REVIEW PAPER ON INVESTIGATION OF PERFOMANCE FOR SHELL AND TUBE HEAT EXCHANGER

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Abstract— *The following review paper shows the different major analysis done by several researchers in the topic of Shell and tube type of heat exchanger. To increase the capacity of heat exchanger is invite the optimization problem which seeks to identify the best parameter combination of heat exchangers.In order to tackle such an optimization problem in present work the optimization technique is applied to perform screening of experiments and to identify the important significant parameters which are affecting the effectiveness of shell and tube type heat exchanger. According to our review we find that majority of the researches used The prefix parameters (tube diameter, mass flow rate and pitch length,baffle angle etc.)are used as input variable and the output parameter is maximum temperature difference of shell and tube heat exchanger.*

Key words: Heat exchangers

I. INTRODUCTION

A heat exchanger is a device built for efficient heat transfer from one medium to another. The media may be separated by a solid wall, so that they never mix, or they may be in direct contact. They are widely used in space heating, refrigeration, air conditioning, power plants, chemical plants, petrochemical plants, petroleum refineries, natural gas processing, cryogenics applications and sewage treatment. One common example of a heat exchanger is the radiator in a car, in which the heat source, being a hot engine-cooling fluid, water, transfers heat to air flowing through the radiator (i.e. the heat transfer medium).

Introduction of shell & tube Heat exchanger

Shell and tube heat exchangers consist of a series of tubes. One set of these tubes contains the fluid that must be either heated or cooled. The second fluid runs over the tubes that are being heated or cooled so that it can either provide the heat or absorb the heat required. A set of tubes is called the tube bundle and can be made up of several types of tubes: plain, longitudinally finned, etc. Shell and tube heat exchangers are typically used for high-pressure applications (with pressures greater than 30 bar and temperatures greater than 260°C). This is because the shell and tube heat exchangers are robust due to their shape.

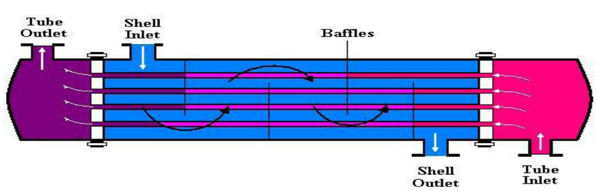

Fig 1. A Shell and Tube heat exchanger

Flow Arrangement

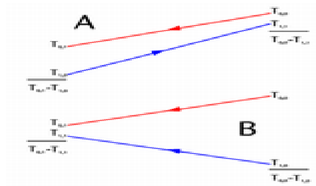

Fig 2. Counter current (A) and parallel (B) flows

There are two primary classifications of heat exchangers according to their flow arrangement. In parallel-flow heat exchangers, the two fluids enter the exchanger at the same end, and travel in parallel to one another to the other side. In counter-flow heat exchangers the fluids enter the exchanger from opposite ends. The counter current design is most efficient, in that it can transfer the most heat from the heat (transfer) medium. See counter current exchange. In a cross-flow heat exchanger, the fluids travel roughly perpendicular to one another through the exchanger. For efficiency, heat exchangers are designed to maximize the surface area of the wall between the two fluids, while minimizing resistance to fluid flow through the exchanger. The exchanger's performance can also be affected by the addition of fins or corrugations in one or both directions, which increase surface area and may channel fluid flow or induce turbulence. The driving temperature across the heat transfer surface varies with position, but an appropriate means temperature can be defined. In most simple systems this is the "log mean temperature difference" (LMTD). Sometimes direct knowledge of the LMTD is not available and the NTU method is used

II. LITERATURE REVIEW OF SHELL AND TUBE HEAT EXCHANGER.

P.S..Gowthaman et al [1], In this paper The work done on the analysis of Segmental and Helical baffle in a heat exchanger and They shows the higher heat transfer and lower Pressure drop is achieved in a helical baffle compare to segmental baffle A virtual model of helical and segmental baffle was Created in a PRO E and analyzed in a FLUENT ANSYS Based on the performance of parameters such as Pressure Drop Heat Transfer Coefficient, Baffle spacing and pitch angle we choose the best one in Baffles. In this work An model has been developed to evaluate analysis of a Helical and Segmental Baffle Heat Exchanger as well as the Comparative analysis between the thermal Parameters between the Segmental and helical angle has been showed. From the Numerical Experimentation Results it is confirmed that the Performance of a Tubular Heat Exchanger can be improved by Helical Baffles instead of Segmental Baffles. Use of Helical Baffles In Heat Exchanger Reduces Shell side Pressure drop, ,pumping cost, weight, fouling etc as compare to Segmental Baffle for a new installation. The Ratio of Heat to increase cross flow area resulting in lesser mass flux through out the shell Transfer Coefficient to Pressure Drop as higher than that of Segmental Baffle. The Pressure Drop in Helical Baffle heat exchanger is appreciably lesser as Compared to Segmental Baffle heat exchanger. Helical Baffle is the much higher than the Segmental baffle because of Reduced By Pass Effect &Reduced shell side Fouling. The Helical Baffle is three times higher than the Segmental Baffle.

Thundil Karuppa Raj et al [2], In this paper presents the study, attempts were made to investigate the impacts of various baffle inclination angles on fluid flow and the heat transfer characteristics of a shell-and-tube heat exchanger for three different baffle inclination angles namely 0°, 10° and 20°. The simulation results for various shell and tube heat exchangers, one with segmental baffles perpendicular to fluid flow and two with segmental baffles inclined to the direction of fluid flow are compared for their performance. The shell side design has been investigated numerically by modeling a small shell-and-tube heat exchanger. The study is concerned with a single shell and single side pass parallel flow heat exchanger. The flow and temperature fields inside the shell are studied using non-commercial CFD software tool ANSYS CFX 12.1. For a given baffle cut of 36 %, the heat exchanger performance is investigated by varying mass flow rate and baffle inclination angle. From the CFD simulation results, the shell side outlet temperature, pressure drop, recirculation near the baffles, optimal mass flow rate and the optimum baffle inclination angle for the given heat exchanger geometry are determined.

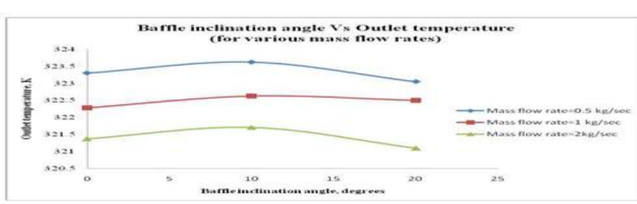

Fig. 3 Variation of temperature with baffle inclination angle (for various mass flow rates)

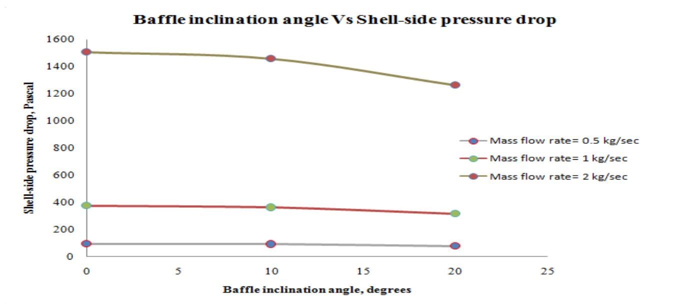

Fig.4 Variation of pressure drop with baffle inclination angle (for 0.5 kg/s, 1 kg/s, 2 kg/s mass flow rates)

The shell side of a small shell-and-tube heat exchanger is modelled with sufficient detail to resolve the flow and temperature fields.The shell side of a small shell-and-tube heat exchanger is modelled with sufficient detail to resolve the flow and temperature fields.For the given geometry the mass flow rate must be below 2 kg/s, if it is increased beyond 2 kg/s the pressure drop increases rapidly with little variation in outlet temperature.The pressure drop is decreased by 4 %, for heat exchanger with 10° baffle inclination angle and by 16 %, for heat exchanger with 20° baffle inclination angle.The maximum baffle inclination angle can be 20°, if the angle is beyond 20°, the centre row of tubes are not supported. Hence the baffle cannot be used effectively. Hence it can be concluded shell and tube heat exchanger with 20° baffle inclination angle results in better performance compared to 10° and 0° inclination angles.

Sunil S. Shinde, et al. [3],This paper presents The concept of helical baffle heat exchangers was developed for the first time in Czechoslovakia. The Helical baffle heat exchanger, also known as Helixchanger, is a superior shell-and-tube exchanger solution that removes many of the inherent deficiencies of conventional segmental-baffle exchangers. Helical baffle heat exchangers have shown very effective performance especially for the cases in which the heat transfer coefficient in shell side is controlled or less pressure drop and less fouling are expected. From the Numerical & experimental results it is confirmed that the performance of tubular heat exchanger can be improved by helical baffles instead of conventional segmental baffles. Use of helical baffles in heat exchanger reduces shell side pressure drop, pumping cost, size, weight, fouling etc. as compare to segmental baffle for new installations. The helix changer type heat exchangers can save capital cost as well as operating and maintenance cost and thus improves the reliability and availability of process plant in a cost effective way. For the helical baffle heat exchangers, the ratios of heat transfer coefficient to pressure drop are higher than those of a conventional segmental heat exchanger. This means that the heat exchangers with helical baffles will have a higher heat transfer coefficient when consuming the same pumping power. It can be concluded that proper baffle inclination angle will provide an optimal performance of heat exchangers

Sandeep K. Patel, Professor Alkesh M. Mavani et al. [4],In this paper There is increase in pressure drop with increase in fluid flow rate in shell and tube heat exchanger which increases pumping power. Genetic algorithm provides significant improvement in the optimal designs compared to the traditional designs. Genetic algorithm application for determining the global minimum heat exchanger cost is significantly faster and has an advantage over other methods in obtaining multiple solutions of same quality. Thus, providing more flexibility to the designer. It also reveals that the harmony search algorithm can converge to optimum solution with higher accuracy in comparison with genetic algorithm. Tube pitch ratios, tube length, tube layout as well as baffle spacing ratio were found to be important design parameters which has a direct effect on pressure drop and causes a conflict between the effectiveness and total cost. In brief, it is necessary to evaluate optimal thermal design for shell and tube heat exchanger to run at minimal cost in industries.

Nasir hayat et al.[5], present the research paper on CFD application in various heat exchanger designs. The main objective of this research paper is that CFD is employed for the following areas of study in various type of heat exchanger ,fluid flow maldistribution, fouling and pressure drop and thermal analysis in the design and optimization phase .finally he concluded that conventional methods are used for the design and development of the heat exchangers are largely tedious and expensive in today's market.CFD has emerged as cost effective alternative and it provides speedy solution to heat exchanger design and optimization.

Lin liu et al. [6],present the research paper on analysis on flow and heat transfer characteristics of EGR (exhaust gas recirculation) helical baffled cooler with spiral corrugated tubes .the main objective for this work is that exhaust gas recirculation which reduces the exhaust gas temperature for reduction of NOx. He used helical baffled tube cooler with spiral corrugated tubes. Finally he concluded that heat performance of spiral corrugated tube is significantly higher than that of s mooth tube.

Gh.S. Jahanmir et al.[7],present the research paper on Twisted bundle heat exchanger performance evaluation by CFD.the main objective for the work is that shell and tube heat exchanger with single twisted tube bundle in five different twist ang les are studied using CFD and compared to conventional shell and tube heat exchanger with single segmental baffles. Heat transfer rate and pressure drop are the main issues investigated in this paper. Finally he concluded that angles of 55 and 65 are the optimum angles that provide the maximum heat transfer capacity at the constant and defined pressure drop. Results is that TTB heat exchanger has a much higher heat transfer coefficient per unit pressure drop compared to the single shell and tube heat exchanger at the same mass flow rate.

Usman Ur rehman et al. [8], represent the paper on Heat Transfer Optimization of Shell-and-Tube Heat Exchanger through CFD Studies. The main objective for this paper is turbulence flow creates higher temperature difference between shell and tube therefore there is a need of modifications of current design to improve the heat transfer. Finally he concluded that model pred icts the heat transfer and pressure drop with an average error of 20% and thus the model can be improved**.**

Lim Eng Aik et al. [9],Represent the paper on Computational Fluid Dynamics Analysis of Shell and-double Concentric-tube Heat Exchanger. the main objective of this paper is to decrase the length of the shell and tube heat exchanger because of that cost, manufacturing time and important factor is space can be reduced. finally he concluded that By using Kern method, the length of the shell-and-double concentric-tube heat exchanger needed to cool the hot water from 100°C to 80°C is *Lsdct* = 0.453 m. Whereas the the outlets of the heat exchanger are found to be at 80°C at the shell-side outlet, 30°C at the annulus outlet, and averaging at 80°C at the tube-side outlet.

Arjun K.S. and Gopu K et al. [10] ,This paper presents the Outlet temperature of shell side was much affected while the baffle inclination angle was increased from 0 to 20. This was because of decrease in shell side pressure decline. The pressure decline was found to decrease by 4 per cent with 10 and 16 percent with 20 baffle inclination. The outlet velocity also increases with increase in baffle inclination and cause a further increase in heat transfer. The prediction of pressure decline and heat transfer of the mode was found to be with an average error of 20 per cent. Rapid mixing and change in flow direction was observed in inlet and outlet region and found to be the only exception for the assumption in geometry and meshing. Reliable results was observed with the model by considering the standard k-e and wall function. It could also be seen that the mass flow rate when increased beyond 2kg/s; the pressure decline suddenly increases with practically nil variation in outlet temperature for the given geometry. The unsupported behavior of center row of tubes makes the baffle use ineffective when the baffle angle is above 20. Hence, the helix baffle inclination angle of 20 makes the best performance of shell and tube heat exchanger.

III. CONCLUSION

The main objective of this paper From the Numerical Experimentation Results it is confirmed that the Performance of a Tubular Heat Exchanger can be improved by Helical Baffles instead of Segmental Baffles. Use of Helical Baffles In Heat Exchanger Reduces Shell side Pressure drop, pumping cost, weight, fouling etc as compare to Segmental Baffle for a new installation.The shell and tube heat exchanger with 20° baffle inclination angle results in better performance compared to 10° and 0° inclination angles.There is increase in pressure drop with increase in fluid flow rate in shell and tube heat exchanger which increases pumping power. Tube length, tube layout as well as baffle spacing ratio were found to be important design parameters which has a direct effect on pressure drop and causes a conflict between the effectiveness and total cost. The unsupported behaviour of centre row of tubes makes the baffle use ineffective when the baffle angle is above 20. Hence, the helix baffle inclination angle of 20 makes the best performance of shell and tube heat exchanger. So Design and changes the some of these parameters (tube diameter, pitch length, mass flow rate etc.)to improve the capicity of heat exchenger and also improve the effectivness of heat exchenger.

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