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"A REVIEW ON SHELL AND TUBE HEAT EXCHANGER USING VARIOUS DESIGN ARRANGEMENT OF BAFFLE"

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ABSTRACT

A heat exchanger is a device that allows heat from a fluid (a liquid or a gas) to pass to a second one (another liquid or gas) without their mixing or direct contact. The efficiency of the heat exchanger depends directly on the heat transfer coefficient of the material. This paper provides a review about major work done on different designs of baffle as well as its arrangement as like segmental baffle, helical baffle, plate baffle etc to improve overall performance of shell and tube heat exchanger. Major factors which affect performance of shell and tube heat exchanger are shown in this paper and also comparisons between different baffle design arrangements are shown. Now a day's mostly research done on helical baffle arrangement which gives better performance compared to segmental baffle and researcher gives some more design arrangement of baffles like trefoil-hole baffles, plate baffles, ladder-type fold baffle etc which gives better overall performance of shell and tube heat exchanger.

KEYWORDS: *Shell and tube heat exchanger, baffle, segmental baffle, helical baffle*

I. INTRODUCTION

A device whose primary purpose is the transfer of heat energy between two fluids at different temperature is named a heat exchanger. A heat exchanger may be defined as equipment which transfers the energy from a hot fluid to a cold fluid, with maximum rate and minimum investment and running costs. There are various types of heat exchangers available in the industry, however the Shell and Tube Type heat exchanger is probably the most used and widespread type of the heat exchanger's classification. It is used most widely in various fields such as oil refineries, thermal power plants, chemical industries and many more. This high degree of acceptance is due to the comparatively large ratio of heat transfer area to volume and weight, easy cleaning methods, easily replaceable parts etc. Shell and tube type heat exchanger consists of a number of tubes through which one fluid flows. Another fluid flows through the shell which encloses the tubes and other

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supporting items like baffles, tube header sheets, gaskets etc. The heat exchange between the two fluids takes through the wall of the tubes.

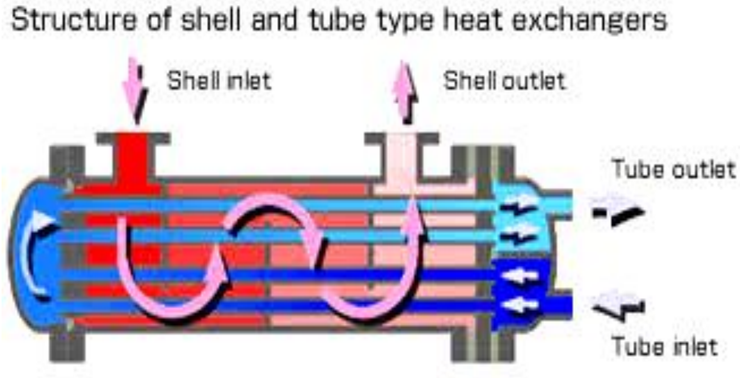

Fig.1

II. DESIGN METHODS

Shell and tube heat exchangers are designed normally by using either Kern's method or Bell-Delaware method. Kern's method is mostly used for the preliminary design and provides conservative results whereas; the Bell-Delaware method is more accurate method and can provide detailed results. It can predict and estimate pressure drop and heat transfer coefficient with better accuracy. In this paper we have described Kern's method of designing in detail. The steps of designing are described as follows:

1. To find out the values of some unknown temperature first we consider the energy balance. In this energy balance certain some inputs like hot fluid inlet and outlet temperatures, cold fluid inlet temperature, mass flow rates of the two fluids are needed to serve the purpose.

The equation may be given as :

Some contents under this heading have been cited from Wolverine Tube Heat Transfer Data Book.

$$Q = m\,h\,C_{ph}\,(Th_1 - Th_2) = mc\,C_{pc}\,(Tc_2 - Tc_1)$$

2. Then we consider the LMTD equation to find its value

$$LMTD = \frac{(\Delta T1 - \Delta T2)}{\ln(\frac{\Delta T1}{\Delta T2})}$$

Where, $\Delta T1 = T_{h1} - T_{c2}$ and $\Delta T2 = T_{h2} - T_{c1}$

II. LITERATURE REVIEW OF PREVIOUS WORK

While reviewing the works of renowned scholars it has been seen that significant amount of works has been done in field of STHE. Some important works have been described in detail as under:

Rajeev Mukherjee [1] explains the basics of exchanger thermal design, covering such topics as: STHE components; classification of STHEs according to construction and according to service; data needed for thermal design; tube side design; shell side design, including tube layout, baffling, and shell side pressure drop; and mean temperature difference. The basic equations for tube side and shell side heat transfer and pressure drop. Correlations for optimal condition are also focused and explained with some tabulated data. This paper gives overall idea to design optimal shell and tube heat exchanger. The

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optimized thermal design can be done by sophisticated computer software however a good understanding of the underlying principles of exchanger designs needed to use this software effectively.

V.K. Patel and R.V. Rao[2] explore the use of a non-traditional optimization technique; called particle swarm optimization (PSO), for design optimization of shell-and-tube heat exchangers from economic view point. Minimization of total annual cost is considered as an objective function. Three design variables such as shell internal diameter, outer tube diameter and baffle spacing are considered for optimization. Two tube layouts viz. triangle and square are also considered for optimization. The presented PSO technique's ability is demonstrated using different literature case studies and the performance results are compared with those obtained by the previous researchers. PSO converges to optimum value of the objective function within quite few generations and this feature signifies the importance of PSO for heat exchanger optimization.

Hari Haran [3] proposed a simplified model for the study of thermal analysis of shell and tube type heat exchangers of water and oil type is proposed. The robustness and medium weighted shape of Shell and Tube heat exchangers make them well suited for high pressure operations. This paper shows how to do the thermal analysis by using theoretical formulae and for this they have chosen a practical problem of counter flow shell and tube heat exchanger of water and oil type, by using the data that come from theoretical formulae they designed a model of shell and tube heat exchanger using Pro-E and done the thermal analysis by using ANSYS software and comparing the result that obtained from ANSYS software and theoretical formulae. For simplification of theoretical calculations they have also done a C code which is useful for calculating the thermal analysis of a counter flow of water-oil type shell and tube heat exchanger. The result after comparing both was that they were getting an error of 0.0274 in effectiveness.

A.Gopichand[4] proposed a simplified model for the study of thermal analysis of shell and tube type heat exchangers of water and oil type is proposed. This paper shows how to do the thermal analysis by using theoretical formula and for this they have chosen a practical problem of counter flow shell and tube heat exchanger of water and oil type, by using the data that come from theoretical formulae they designed a model of shell and tube heat exchanger using Pro-E and done the thermal analysis by using FLOEFD software and comparing the result that obtained from FLOEFD software and theoretical formulae. For simplification of theoretical calculations they have also done a MATLAB code which is useful for calculating the thermal analysis of a counter flow of water-oil type shell and tube heat exchanger.

Vindhya Vasiny Prasad Dubey[5] proposed a simplified model for the study of thermalanalysis of shell and tube type heat exchangers. This paper shows heat exchanger has been designed using kern’s method to cool the water from 55C to 45C by using water at room temperature. Then they carried out thermal analysis on ANSYS14.0 to justify the design. After that they fabricated working model with same dimensions that have been derived from theoretical calculation and then tested under different condition to see its effect on the performance of the heat exchanger.

Sandeep k patel[6] proposed a simplified model of shell and tube heat exchanger. This paper shows a simple but accurate method to calculate thermal parameter in a single segment shell and tube heat exchanger. In this paper attempt is made to overcome some theoretical assumptions and serve practical approach as much as possible for shell and tube heat exchanger design and optimization. Number of iteration and their comparisons as well as analysis is performed in HTRI software. The final results are helpful to run the shell and tube heat exchanger water cooler at optimal mass flow rate and baffle spacing.

IV. CONCLUSION

After the study and above discussion it is to be said that the shell and tube heat exchanger has been given the great respect among all the classes of heat exchanger due to their virtues like comparatively large ratios of heat transfer area to volume and weight and many more. And in this work An model will be 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.

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