Effect of Different Baffles Profile on Heat Transfer Rate and Pressure Drop in Shell and Tube Heat Exchanger: A Review

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***Abstract*: Heat exchanger device act a mediator for thermal energy between fluids, at different temperatures. The tube diameter, length and shell types are parameters and are available in standard sizes and geometry. Heat exchangers applications areas are petroleum refining, refrigeration, cooling, nourishment industry etc. Construction of shell and-tube type heat exchanger is simple and having versatile applications. This paper aims to conduct a survey for heat exchanger with variety of baffles and its impact on pressure loss and heat transfer.**

***Keywords*: Baffles, Shell and Tube HX, Pressure drop, heat transfer coefficient, fouling, Fold baffles, Baffle shape.**

Introduction

A **Heat Exchanger** is a equipment capable to transfer high temperature fluid energy to a fluid at comparatively lower temperature fluid. Invest is minimum and running cost is also low. Shell and tube type heat exchangers are most versatile; they are used with wide variety of engineering applications.

Heat exchangers are of two types:-

- Where both fluid are in direct contact with each other is Direct contact heat exchanger,
- Where both fluids are separated by a wall, indirect contact heat exchanger.

Shell and Tube Heat Exchanger

A Shell and tube heat exchanger consists of a shell (a large vessel) with a bundle of tubes inside it. Two fluids, of different starting temperatures, flow through tubes (the tube side) and the other flows outside the tubes but inside the shell (the shell side). The fluids can be either liquids or gases on either the shell or the tube side.

Literature Survey

Pranita Bichkar et al., (2018) Numerical model is used to compute and compare the shell side fluid performance of shell and tube heat exchanger. Simulations are performed for different baffles. Number of baffles gives serious effects on pressure drop. Single segmental baffles show the formation of dead zones with no heat transfer. This problem is solved by usage of double segmental baffles. The use of helical baffles increases the overall system efficiency. So, it is concluded that helical baffles are more advantageous.[1]

Swapnil S.Kamthe and Shivprakash B.Barve, (2017) This paper survey for impacts of various baffles sorts on pressure loss and heat transfer in heat exchanger. It was inferred that helical baffles fill in as an all the more encouraging innovation due to having less loss of pressure in shell, better heat exchange execution, less fouling and less liquid incited vibration. [2]

Asif Ahmed et al., (2017) FEM 3D numerical simulation of two segmentally baffled shell-and-tube heat exchangers (STHXs) with plain tube bundle (STHXsPT) and annular-finned tube bundle (STHXsFT) has been performed. Comparative results shows that STHXsFT has around 14% higher shell-side heat transfer coefficient and improved shell-side cross flow characteristics. Besides, STHXsFT has slightly higher heat transfer coefficient per unit pressure drop compared to STHXsPT. [3]

Halil Bayram and Gökhan Sevilgen, (2017) In this present study, numerical and theoretical analysis are used to investigate the effect of the variable baffle spacing on the thermal characteristics of a small shell and tube heat exchanger. The numerical study was performed by using a three dimensional computational fluid dynamics (CFD) method and the computations were performed under steady-state conditions. [4]

Saurabh Sharma and Ritesh Kumar Dewangan, (2017)[5] This paper review design of Baffle plates and its different orientations to improve overall performance of shell and tube heat exchanger. In most cases, 40° baffle inclination angle as well as low baffle spacing will gives best results. [5]

M. Jin et al., (2017) Paper research for influence of baffle curvature radius of the sextant fan baffled shell and tube heat exchanger (SFTHX) on the shell side pressure drop. Based on the numerically simulation results, [6]

A. A. Musilim et al., (2017) In present study, attempts were made to investigate the effects of varying baffle cut sizes at various mass flow rates on temperature and pressure drop of a shell-and-tube heat exchanger for zero degree (0°) baffle inclination angle.

This study has shown that reducing baffle diameters, results in improvement on the flow conditions and overall cooling performance of the heat exchanger. [7]

Swapnil S.Kamthe and Shivprakash B.Barve, (2017) A survey of exploratory research work is performed to test the impacts of various baffles on pressure loss and heat transfer in heat exchanger. It shows that helical baffles is more excellent because it is having lesser loss of pressur, better heat exchange execution, less fouling and less liquid incited vibration. [8]

J. Bala Bhaskara Rao and V. Ramachandra Raju, (2016) In the present study, CFD analysis for circular models and elliptical models of the STHE with various baffle cuts at different tube orientations is conducted. It is found that the elliptical tube geometry with mirror quarter baffle cut at 450 tube orientation is 10 % higher than existing shell and tube heat exchanger and the pressure drop decrement in tube side shows up to 25 %. [9]

Xin Gu et al., (2016) Effect of main structural parameters of shutter baffle heat exchanger is studied in the article. The effects of structural parameters are analyzed. Using the field synergy principle, the heat transfer enhancement mechanisms are analyzed. [10]

Sandeep M and U Sathish kumar (2015) In this paper, a study of triangle, rectangular and round cross sections for a shell and tube heat exchanger is presented. From computational results, it is concluded that there is slight variation in heat transfer performanc. Simulation results have good agreement with analytical results. [11]

Ajithkumar M.S. et al., (2014) In this paper, an effort has made for Computational Fluid Dynamic (CFD) analysis of a single pass parallel flow Shell and Tube Heat Exchanger (STHX) with different baffle inclinations. From the CFD simulation results, the shell side outlet temperature, pressure drop, optimum baffle inclination and optimal mass flow rate were determined. [12]

Neeraj kumar and Pradeep kumar Jhinge, (2014) In present work, single pass, counter flow shell and tube heat exchanger containing segmental baffles with various orientations has been tested to find heat transfer rate and pressure drop at different Reynolds number in laminar flow. It is observed that the angular orientation of baffles and the Reynolds number effects heat transfer rate and pressure drop in the shell and tube heat exchanger. [13]

Amarjit Singh and Satbir S. Sehgal, (2013) In this study, the experimental analysis was performed on the shell-and-tube type heat exchanger containing segmental baffles at different orientations. Three angular orientations (θ) 0∘, 30∘, and 60∘ of the baffles were analyzed for laminar flow having the Reynolds number range 303–1516. It was observed that, with increase of Reynolds number from 303 to 1516, there was a 94.8% increase in Nusselt number and 282.9% increase in pressure drop. Due to increase of Reynolds number from 303 to 1516, there is a decrease in no dimensional temperature factor for cold water (ω) by 57.7% and hot water (ξ) by 57.1%, respectively. [14]

Literature Survey Conclusion

Review focuses on researches analyzed performance of industrial heat exchangers because of its expensive maintenance. In this paper we discuss heat exchanger; its thermal design factors to design the tubes in the heat exchangers. They are tube diameter, tube length, number of tubes, number of baffles, & baffles inclination etc. The characteristics of flow and heat transfer within the shell are not simple. Various experimental analyses were conducted by many researchers to predict the characteristics of difference in temperature and pressure drop, which are the performances of heat exchanger. The diameter of tube, the number of tubes and the number of baffles may be considered as the design factors.

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