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IMPROVING HEAT TRANSFER CHARACTERISTICS OF DOUBLE PIPE HEAT EXCHANGER USING HELICAL BAFFLE ON THE ANNULAR SPACES

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ABSTRACT

In this Project, the Design and Analysis of Performance of Double Pipe Heat Exchangers with and without helical baffles in both shell tube side are investigated by using Analytical Method. The Three Dimensional Computation Fluid Dynamics (CFD) model was designed using Solid Works Flow Simulation to analyze the conjugate Heat Transfer Between the tube side and shell side of the heat exchanger. The analytical model was validated by CFD results. There are four type of heat exchangers analyzed in this work. Heat exchanger with helical baffle on both shell side and tube side gives the better results than the other type of heat exchanger. From the results obtained pressure drop and temperature difference were compared.

Keywords: Heat exchanger, CFD model, helical baffle.

I. INTRODUCTION

Double pipe heat exchangers have an important role in various engineering process. A simple double pipe heat exchanger consist of two pairs of concentric pipes, two fluids that are transferring heat flow in the inner and outer pipes respectively. This type of heat exchanger is commonly used in high pressure and temperature with increase heat transfer rate. There are two types of baffles which are helical baffle and segmental baffle, in this work we using helical baffle which is more convenient than he segmental baffle. The purpose of using helical baffle is to enhance the circulation of water. It is differ from other heat exchanger that is that not allow the laminar flow, the mixture of water then by helical baffle.

II LITERATURE REVIEW

[1] Numerical design and investigation of heat transfer enhancement and performance for an annulus with continuous helical baffle in double pipe heat exchanger-In this work the design and thermo hydraulic function of double pipe heat exchanger with helical baffle in annulus space are examined numerically. The FLUENT software of Computational Fluid Dynamics is used to analysis the fluid flow, heat transfer and pressure drop for various configurations. The end result obtained for helical baffled annulus side provides enriched heat transfer performance. The highest thermo hydraulic implementation is achieved when helical baffles are used in lamina regime. The thermal performance, high pressure drop is an increasing the function of baffle spacing. The effect of baffle spacing and mass flow rate are investigated. The result shows that, compared to the conventional annulus side using helical baffles in annulus side supplements. The numerical model was first validated for simple double pipe heat exchanger by comparison with experimental correlations. The prototype was then used to investigate the helical baffle effects.

The review of the advancements made in helical baffle used in shell and tube heat exchanger-This design gives a review about the major work done on helical baffle to improve the performance of shell and tube heat exchanger[2]. And, in this paper they use the shell and tube heat exchanger which is widely used in the chemical process industries. The shell and tube heat exchanger used in all sorts of industries because they have much lower production cost, are easily cleaned and are considered to have more flexible adaptability compared with heat exchanger. Some of the major influences affecting the function of shell and tube heat exchangers are deliberated. A difference of helical baffle with the traditional segmental baffle was finished. In which helical baffle gives better results than the segmental baffle due to improved heat transfer characteristics. The two-layer helical baffle provides more effectiveness of heat exchanger than the single layer helical baffles. The low helical baffle spacing and 40deg baffle inclination angle will give greatest outcomes. The continuous helical baffles eradicate dead regions. Moreover, fastening floorings are likely to advance the running of shell and tube heat exchanger.

III HEAT EXCHANGER

A heat exchanger is piece of equipment built for efficient heat transfer from one medium to another. The media may be separated by a solid wall to prevent mixing or they may be in direct contact. They are widely used in space heating, refrigeration, air-conditioning, power plants, chemical plants, petro chemical plants, petroleum refineries, natural gas processing. The classic example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as engine coolant flow through radiator coils and air flows past the coils, which cools the coolant and heats the incoming air.

There are three primary classification of heat exchanger according to their flow arrangement. In parallel-flow heat exchangers, the two fluids according into the exchanger at the same end, and travel in parallel to other side. In counter-flow heat exchanger at the same end, and travel in parallel to the other side. In current design is the most efficient, in that it can able to transfer the large amount of heat from the heat (transfer) medium per unit mass due to the fact that average temperature different along any unit length is higher.

TYPES OF HEAT EXCHANGERS

- Double pipe heat exchanger
- Shell and tube heat exchanger
- Plate heat exchanger
- Plate and shell heat exchanger
- Adiabatic heat exchanger

IV PARALLEL FLOW CONCEPT

Parallel flow exists when the two fluids flow in same directions is represented in fig.no:1. Each of the fluid enters the heat exchanger at same ends. In this the hot water passes through the shell side and the cold water is passes through the tube side.

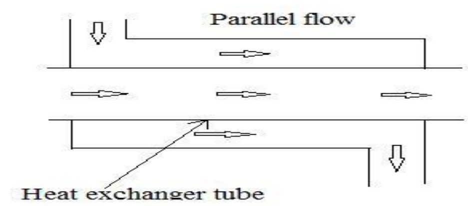

Fig no: 1 Parallel flow

V DIAGRAMATIC REPRENSTAION OF HEAT EXCHANGER

Type-1 Heat Exchanger – Without Baffle

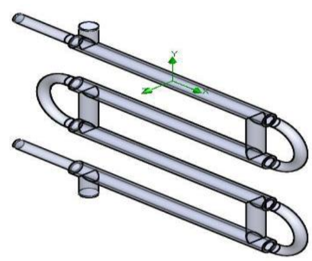

Fig.no:2 Without baffle

Type-2 Heat Exchanger – Baffle on shell side

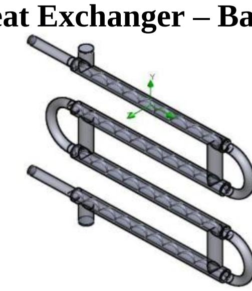

Fig.no:3 Baffle on shell side

Type-3 Heat Exchanger – Baffle on tube side

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Fig.no:4 Baffle on tube side

Type-4 Heat Exchanger – Baffle on both shell and tube side

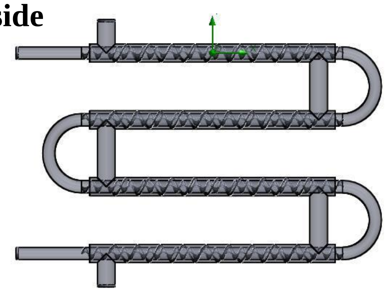


Fig.no:5 Baffle on both shell and tube

VI CFD ANALYSIS

Type 1 – without Baffle

Temperature on Tube side

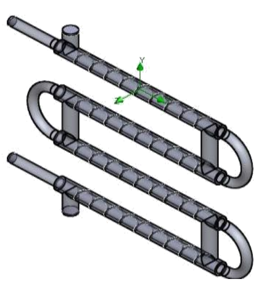


Fig.no:6 Temperature plot on tube side for type 1

Type 2 – Baffle on shell side

Temperature on Tube side

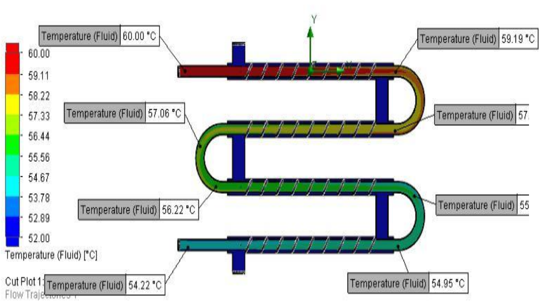


Fig.no:11 Temperature plot on tube side for type 2

Type 3 – Tube side baffle

Temperature on Tube side

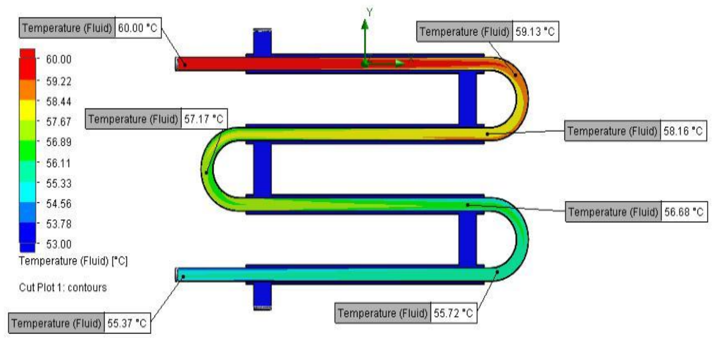
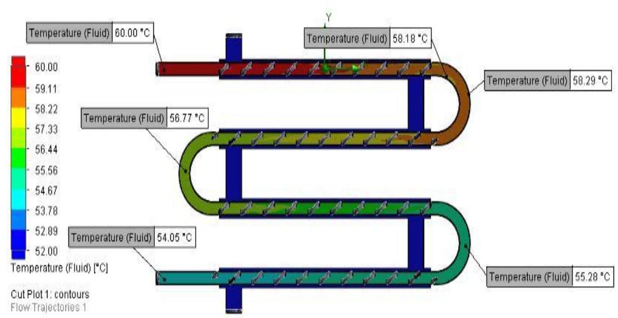


Fig.no:16 Temperature plot on tube side for type 3



Type 4 – Baffles Placed on Both Tube and shell side

Temperature on Tube side

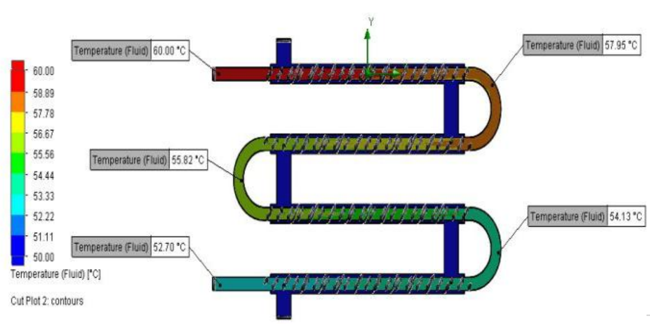


Fig.no:21 Temperature plot on tube side for type 4

VII CONCLUSION

We have analyzed four types of heat exchanger, out of which type IV helical baffle on shell side and tube side is performing well in heat transfer characteristics. Outlet Temp for Type IV is 52°C which is 8% higher than the type I heat exchanger. Pressure drop for Type IV is higher in comparison with the other types, this is inevitable as helical baffles tend to increase the pressure drop.

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