INTERNATIONAL JOURNAL OF INNOVATIVE TRENDS IN ENGINEERING (IJITE) ISSN: 2395-2946
ISSUE: 63, VOLUME 43, NUMBER 02, JULY 2018

Analysis of the Effect of the Fins in Concentric Double Tube Heat Exchanger Using Numerical Technique

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Abstract-A heat exchanger is a device used to transfer heat between a solid object and a fluid, or between two or more fluids. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact heat exchanger is a device used to transfer heat between a solid object and a fluid, or between two or more fluids. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact heat exchanger is a device used to transfer heat between a solid object and a fluid, or between two or more fluids. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact There number of method to increase the heat transfer in the heat heat exchanger .to increase surface area of the heat exchanger is one of them. Enhanced surfaces, such as fins, can add a significant amount of surface area in the same package space. Heat exchangers are typically held to tightly constrained package envelopes, so adding enhanced surfaces is a common practice to improve performance. In this work performance of the heat exchanger with fins judged of the basis of the LMTD and over heat transfer coefficient using CFD technique .As expected manually it is very difficult that's why ANSYS Fluent 16.0 used to analyze. At end of the work it is found heat transfer of the heat exchanger is increased after applying the fins.

Keywords: heat exchanger, CFD , ANSYS FLUENT , LMTD , FINS.

I. INTRODUCTION

A heat exchanger is a device used to transfer heat between a solid object and a fluid, or between two or more fluids. The fluids 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 stations, chemical plants, petrochemical plants, petroleum refineries, natural-gas processing, and sewage treatment. The classic example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as engine coolant flows through radiator coils and air flows past the coils, which cools the coolant and heats the incoming air. Another example is the heat sink, which is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant.

A heat exchanger is a device to transfer heat from a hot fluid to cold fluid across an impermeable wall. Fundamental of heat exchanger principle is to facilitate an efficient heat flow from hot fluid to cold fluid. This heat flow is a direct function of the temperature difference between the two fluids, the area where heat is transferred, and the conductive/convective properties of the fluid and the flow state. This relation was formulated by Newton and called Newton's law of cooling, which is given in Equation (1.1)

$$Q = H * A * T$$

Where h is the heat transfer coefficient [W/m2K], where fluid's conductive/convective properties and the flow state comes in the picture, A is the heat transfer area [m2], and T is the temperature difference [K].Figure. 1.1 shows the basic heat transfer mechanism.

Figure 1.1 Basic heat transfer mechanism

Heat exchangers are one of the vital components in diverse engineering plants and systems. So the design and construction of heat exchangers is often vital for the proper functioning of such systems. It has been shown in [Barron, 1985] that the low temperature plants based on Linde – Hampson cycle cease to produce liquid if the effectiveness of the heat.

exchanger is below 86.9%. On the other hand in aircrafts and automobiles, for a given heat duty, the volume and weight of the heat exchangers should be as minimum as possible.

So the main requirement for any heat exchanger is that it should be able to transfer the required amount of heat with a very high effectiveness. In order to increase the heat transfer in a basic heat exchanger mechanism shown below in Figure 1.1, assuming that the heat transfer coefficient cannot be changed, the area or the temperature differences have to be increased. Usually, the best solution is that the heat transfer surface area is extended although increasing the temperature difference is logical, too. In reality, it may not be much meaningful to increase the temperature difference because either a hotter fluid should be supplied to the heat exchanger or the heat should be transferred to a colder fluid where neither of them are usually available. For both cases either to supply the hot fluid at high temperature or cold fluid at lower temperature extra work has to be done. Furthermore increasing the temperature difference more than enough will cause unwanted thermal stresses on the metal surfaces between two fluids. This usually results in the deformation and also decreases the life span of those materials. As a result of these facts, increasing the heat transfer surface area generally is the best engineering approach.

The above requirements have been the motivation for the development of a separate class of heat exchangers known as Compact heat exchangers. These heat exchangers have a very high heat transfer surface area with respect to their volume and are associated with high heat transfer coefficients. Typically, the heat exchanger is called compact if the surface area density (β) i.e. heat transfer surface area per unit volume is greater than 700 m2/m3 in either one or more sides of two-stream or multi stream heat exchanger [R.K Shah, Heat Exchangers, Thermal Hydraulic 1980]. The compact heat exchangers are lightweight and also have much smaller footprint, so they are highly desirable in many applications.

II. SYSTEM MODEL

Fig :2.1 concentric duble tube heat exchanger with internal fins

III. PREVIOUS WORK

In our study on concentric double tube heat exchanger there is different fin profile like triangular, rectangular and concave etc for internal fins should be used. The width and length of the fin is changed to increase the heat transfer rate. Mostly researchers mainly focus on how to change the fins shape to achieve the desired heat transfer rate.

IV. PROPOSED METHODOLOGY

1) Analyze the double tube heat exchanger by passive method.

2) With the help of four fins sample of blossom shape fins numerically analyzed.

3) The effects of geometric structure on different temperature analyze.

4) To develop the mathematical modelling.

5) See the effect of temperature on different mass flow rate.

6) The heat transfer rate on different mass flow rate is calculated.

7) The dimensionless number that is Reynolds number is regressed.

8) Friction factor on the changing of different mass flow rate were analyzed.

V. CONCLUSION

01) According to analysis of the double tube heat exchanger with fins and without fins it is found that it is always beneficial to use heat exchanger which is equipped with fins.

02) Heat transfer in concentric double tube heat exchanger with fins is more than the without fins.

03) The shape of fin is change the heat transfer rate is increased if effectiveness of the fins should be more than 1.

04) The mass flow rate is changed then the heat transfer rate should be increased.By changing the mass flow rate friction is minimize.

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