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A comparatively analysis of plate type H.E. and helical type H.E. using ANOVA method

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Abstract - *The bulk of the chemical industry places a high priority on heat transfer from one fluid to another. The most typical use of heat transfer is in the design of machinery that involves transferring heat from one fluid to another. They are effective heat transporters, these heat exchangers. A heat exchanger's efficiency is frequently categorized based on the transfer process that takes place in it. Using the ANOVA approach, this study analyses two different heat exchangers. programming for design.*

Key Words: HE and design, ANOVA, CATIA V5.

1. INTRODUCTION

Using heat exchangers, heat is transported from one medium to another. These media can be composed of liquids, gases, or a combination of the two. The medium may be in close proximity to one another or separated by a thick wall to prevent mixing. By moving heat from systems where it is unnecessary to systems where it may be used, heat exchangers can increase the energy efficiency of a system.

1.1 Plate-type heat exchanger

Plate and Frame - By stacking thin parallel plates, it is feasible to produce broad, parallel channels. Heat and cold fluids can exchange positions through a variety of channels. The plates can be built to promote turbulent flow and are separated by welding or by employing a gasket[2].

To increase heating capacity, more plates might be added to the stack of plates using gasket designs. The flow can be arranged both parallel and anticlockwise.

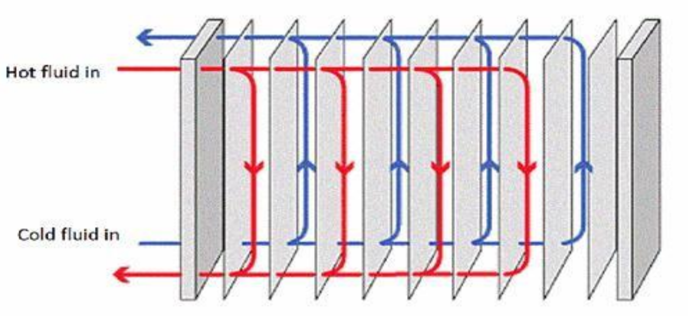

Figure 1.1 Plate type heat exchanger

1.2 HELICAL COIL HEAT EXCHANGER

Figure 1.2 depicts the schematic of a helical coil. In the pipe, there is a 2r diameter. The coil has a diameter of 2RC and a pitch of H, where RC is the distance between the centers of the pipes. The coil diameter is another name for the pitch circle diameter (PCD). The curvature ratio is calculated using the pipe diameter to coil diameter ratio (r/Rc). By dividing the developed length of one turn by the pitch, or H/2rRc, the non-dimensional pitch is determined. Take into account that the coil is being reflected onto a plane that is perpendicular to the coil's axis. The helix angle may be created by extending one coil around in a plane perpendicular to the axis. As with Reynolds Number, Dean Number may be used to describe the flow in helical pipes.

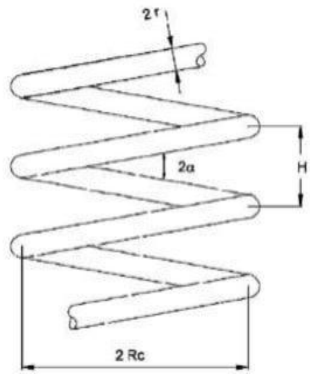

Figure 1.2 Basic helical pipe geometery

2. Literature Review

Yanhui Han et, al. (2009) have shown The micro-channel heat exchanger (MCHX) has become more popular in the HVAC&R (Heating, Ventilation, and Air Conditioning & Refrigeration) field because of its higher heat transfer efficiency, more compact design, and lower cost. This study provides an overview of the properties of fluid dynamics and micro-channel heat transfer. The technique's pros and cons of the MCHX are examined together with information on optimizations (i.e., geometry and thermodynamic performance).

Rongshui Rao et. al. (2015) have Shown are four different types of microchannel heat exchangers used in domestic air conditioners. . Nearly all automobiles have air conditioning, but domestic air conditioners have not yet utilized microchannel heat exchangers. Additionally, in order to address the issue of frost and de-frost in heat pump outdoor units, we created a new micro-channel condenser in 2012 that switched the corrugate fin for a flat fin. In the end, we developed four different types of microchannel heat exchangers that may be used in all domestic air conditioner devices.

Oana Giurgiu et al. (2015) Comparative research was done on how the geometrical properties of the two examined plates had an impact on how intense the heat transfer process became. This involved investigating the distribution of velocity, temperature fields, and convection coefficient along the active tiny channel. The inclination angles of the examined microchannels were 30° and 60°, respectively, and the Reynolds flow number was 3500.

3. Methodology

3.1 COEFFICIENT OF HEAT TRANSFER

A change in density over a layer of surrounding fluid over the hot surface causes convective heat transfer, which is the process of heat being moved from one location to another by moving fluids. The largest resistance is found in this layer since most fluids have low thermal conductivity, which is how heat is transmitted through it. Heat transmission through the film can be enhanced by increasing the fluid flow rate across the surface while lowering the film thickness. The equation for the rate of heat transfer by convection in a steady condition is displayed below:

$$Q=ha\ (Tw-Tatm)$$

where h is the film surface coefficient. a Stands for the wall's area, TW for the wall's temperature, and Tatm for the surrounding air's temperature.

3.2 ANOVA

Finding a good treatment plan frequently involves looking at how long it takes patients to recover. To determine how different these three treatment samples are from one another, statistical methods may be used to compare them. An ANOVA is a statistical technique for comparing samples based on their means.

If two or more groups' means differ significantly from one another, it may be determined using the statistical method known as analysis of variance (ANOVA). An ANOVA analyses the means of several distinct samples to investigate the influence of one or more factors. By distinguishing between systematic and random components, the statistical analysis method known as ANOVA account for the observed overall variability within a data set. The presented data set exhibits systematic impacts that are statistically more important than random influences. The ANOVA test is used in regression analysis to evaluate the impact of independent factors on the dependent variable.

4. RESULT AND ANALYSIS

CATIA is the name of a piece of software used for mechanical design. It is a Windows-based parametric design tool for solid modeling with a user-friendly graphical user interface. It is possible to represent design intent through automatically produced or user-defined relations by creating completely associative 3D solid models with or without restrictions. Consider the user interface.

- Solid 3D geometry may be made using the Part Design workbench. From the Part Design workbench, go to the Sketcher workspace to build 2D profiles that will eventually become 3D models.

- You can put the components together on the Assembly Design workbench to make the finished product. Use strategies for creating assemblies that will help with concurrent engineerings, such as skeleton models and publishing elements, while designing pieces inside the framework of an assembly.

To create surface and wireframe geometry, utilize the Generative Shape Design workbench. Surface and wireframe geometry gives you more control over the form of the object and allow you to design more intricate solid models.

4.1 HELICAL COIL HEAT EXCHANGER DESIGN

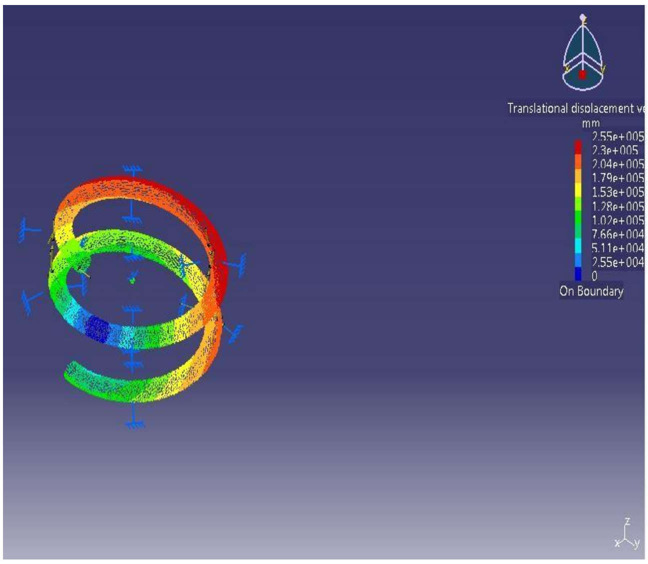

Figure 4.1 Helical coil heat exchanger

4.2 PLATE TYPE HEAT EXCHANGER DESIGN

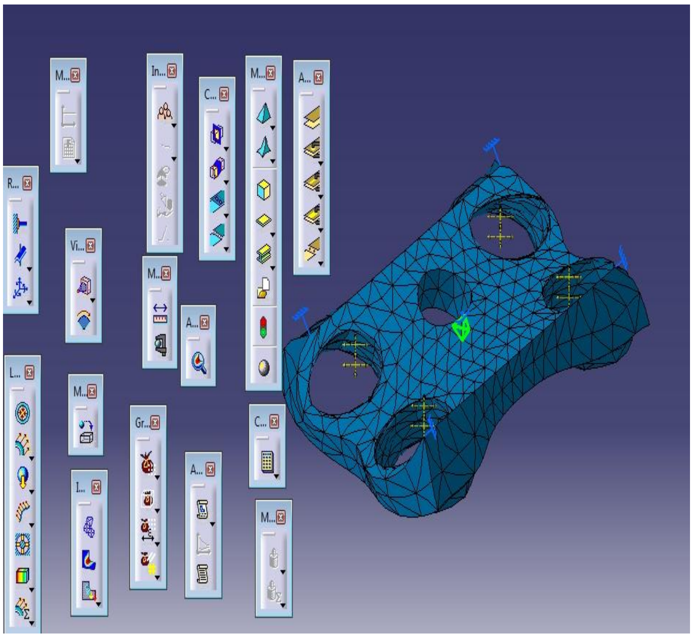

Figure 4.2 Pressure Drop.

Fig. 4.3 Plate-type Heat exchanger design

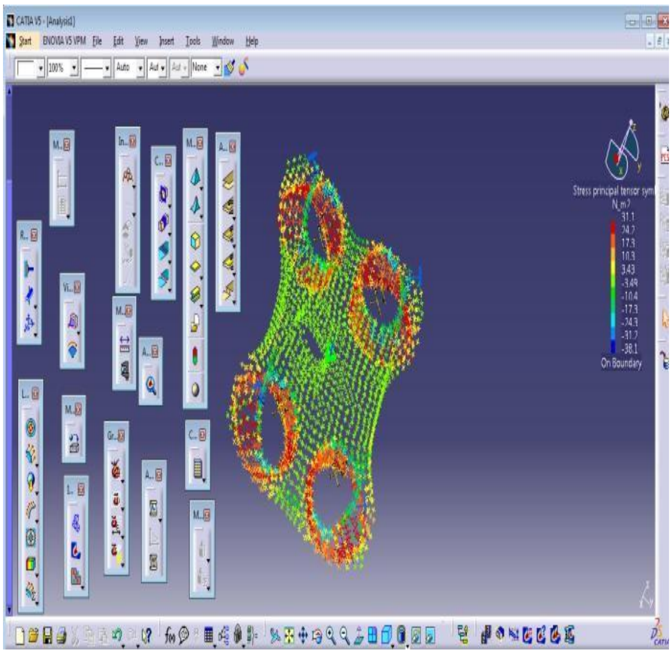

Figure 4.4 Pressure drop.

4.4 R^2 REGRESSION FACTOR COMPARISON

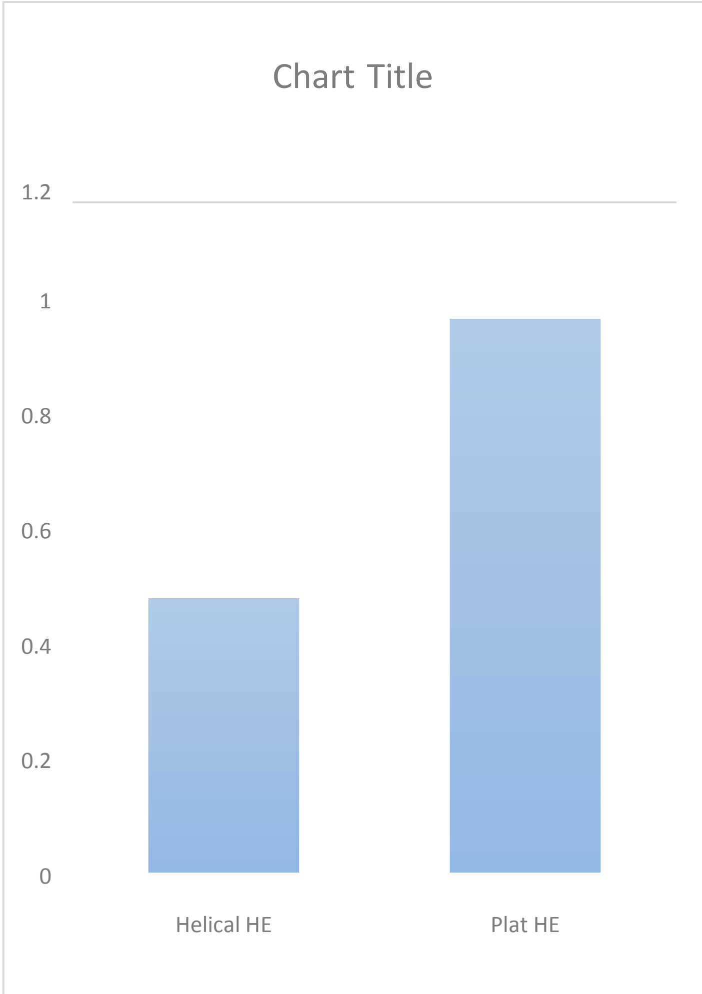

Figure 4.5 R^2 Regression factor comparison.

5. CONCLUSIONS

When examining heat exchangers in this booklet, it is possible to ignore temperature losses from radiation. There are various primary forms of indirect heat exchangers (plate, shell-and-tube, spiral, etc.). The most effective heat exchanger is often the plate kind. It provides the largest pressure and temperature limits within the limitations of the present technology, often providing the greatest solution to thermal concerns. A plate heat exchanger's most significant benefits are:

- Uses substantially less room than a conventional shell and tube-type heat exchanger.

- A surface for the heat transmission using a thin substance —since the heat only needs to pass through thin material, this results in the best heat transmission.

• Significant medium-level turbulence – More convection is thus produced, enabling more efficient heat transfer across the mediums. A lesser amount of surface area is required and operation is more efficient as a result of the improved per-unit-area coefficient of heat transmission. High turbulence also has a self-cleaning characteristic. As a result, the heat transfer surfaces are substantially less likely to become fouled than they would be in a traditional shell-and-tube heat exchanger. This translates into a much longer plate heat exchanger lifespan between cleanings.

• Flexibility - The building that contains numerous heat transfer plates is known as the plate heat exchanger. To increase capacity, it may be easily expanded. For cleaning purposes, it is also simple to open. (Brazed or fusion-bonded elements are unaffected; the only problematic components are gasketed heat exchangers.

• Adjustable thermal length – The majority of Alfa Laval plate heat exchangers come with one of two pressing patterns. Heat exchanger efficiency is higher when the plate has a thin pattern because it causes a bigger pressure drop. This kind of heat exchanger has a very lengthy thermal channel. Wide plate designs have a somewhat lower heat transfer coefficient because they have a smaller pressure drop. This kind of heat exchanger has a thermal channel that is only a little bit longer. Long and short channels, as well as pressure drop and efficacy, are all compromised by the pairing of two plates with various pressing patterns.

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