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Advancement of Heat Exchanger in Chemical Engineering

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ABSTRACT: The different kinds of heat exchanger are used in the country. The objective of this review paper is to study the conventional and new technology heat exchanger. Conventional heat exchanger is costly and has less heat transfer coefficient. The shell and tube heat exchanger and plate heat exchanger is conventional heat exchanger are discussed in this paper. The new technical heat exchanger has proven that reduces the size, cost and increase performance of the heat exchanger. The efficiency, working and performance are main aspect of heat exchanger. This paper compares the conventional and new technology heat exchanger and gives idea about new technological heat exchanger which has more advantages over the conventional heat exchanger.

KEYWORDS: heat exchanger, heat transfer, shell and tube type, heat transfer coefficient, conventional technology.

I. INTRODUCTION

Heat is a form of energy which transfers between bodies which kept under thermal interaction. When temperature difference occurs between two bodies or a body with its surrounding hear transfer occur. A heat exchanger is a device that is used to transfer thermal energy between two or more fluids at different temperature and in thermal contact. In heat exchanger, there are usually no external heat and work interaction.

Heat is transfer by three ways such as, conduction, convection and radiation. Heat exchanger either absorbs the heat or realise the heat. Heat exchanger is used for heating and cooling purpose. Ideally the fluid does not fixed in heat exchanger. The heat is transfer between the two fluids by heat transfer surface. The flow of fluid in heat exchanger may be parallel, counter current or cross current. Cross current flow type exchanger rarely used. Temperature difference and heat transfer coefficient is main important parameter of heat exchanger. The fluid which does not fixed are called recuperate. The heat exchanger is used for air conditioning and refrigerator.

Need of Advancement of Heat Exchanger

- Energy consumption
- High capacity
- Pressure loss
- Cost
- Environment factor
- Cleaning ability

II. LITERATURE SURVEY

Albretch Drackleis a German who invests first plate heat exchanger in 1878 and it is commercially available in 1923. However, the plate heat exchanger development race began in 1930's and these gasket plate and frame heat exchangers

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were mainly used. Industrial plate heat exchanger was introduced in the 1950's and brazed plate heat exchanger developed in 1970's. Koch Heat Transfer Company's innovative twisted tube design avoids the need for baffle. The twisted tube heat exchanger originated in Eastern Europe and became commercially available in Scandinavia in the mid 1980's. It was developed primarily to overcome the limitation inherent with conventional shell and tube technology. In 1991, Koch licensed the technology outright. Twisted tube technology has proven more efficient, reliable and trouble free than any other exchanger

.

In the year 2014, by Danfoss District Energy. Combining resource and energy efficiency, MPHEs from Danfoss meet the needs of today's heating industry like no other heat exchanger can. Micro plate heat exchangers are revolutionary technology from Danfoss. Characterized by their unique pattern, the innovative new micro plate heat exchanger plate design outperforms everything else on the market with significantly lower pressure loss, vastly improved heat transfer and a stronger, more durable design.

III. TYPES OF HEAT EXCHANGER

A. Shell and Tube Heat Exchanger

This heat exchanger is shown in fig. is generally contains of many tubes. Shell and tube heat exchanger consist of series of tubes. A set of many tubes called bundle. The shell and tube heat exchanger contain main important component such as tubes (bundle) shell, front heat, rear end head and baffle. Baffles hold up the tube i to their position. It contain inlet at one end or at front head and outlet at other end or at rear end head. The tubes are assembling in such a way that each tube is parallel to each other.

The hot or cold fluid is send from one end or inlet and this fluid is passed through the series of tubes. On the other hand, the hot or cold fluid is flow over the tube. The heat is transfer between the two fluids, either the heat is absorbed or heat is used as energy. The outlet is given to carry out the fluid. Depend upon the condition the hot or cold fluid id flow from tube and also in shell. The tube used in shell and tube heat exchanger may be straight or u-tube. In many industries this heat exchanger is used.

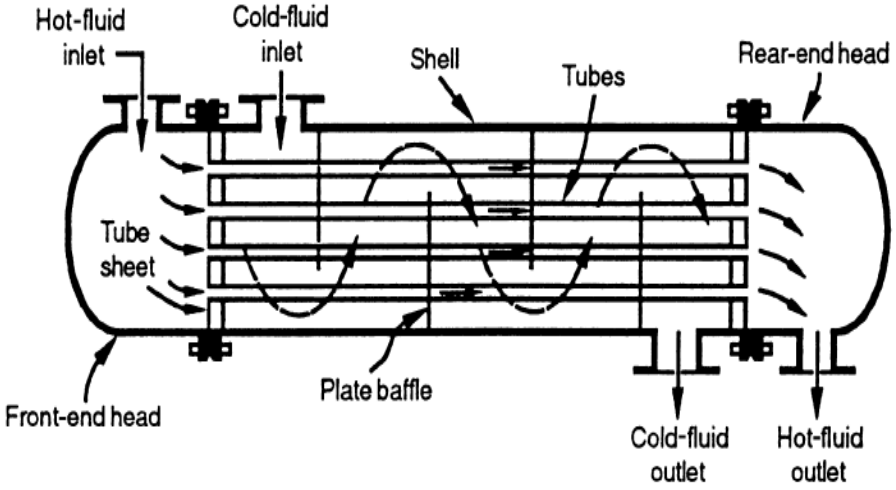

Fig.3.1 Shell-and-tube exchanger [10]

B. Plate Type Heat Exchanger

Another type of heat exchanger is the plate type heat exchanger. The plate heat exchanger consists of number of plates which is arranged in such a way that they form path for fluid. This heat exchanger contains plates, fixed cover, movable cover and gasket. The movable cover is used to arrange the plate or to add the plate to plate heat exchanger. The gasket

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is used for leak proof. It contains inlet and outlet at fixed cover for hot and cold fluid. Generally, hot fluid sends from inlet and passed through the number of plate and cold fluid is also passed through the plate. The heat is transfer the hot and cold fluid.

The fluid is ideally mixed in the plate heat exchanger. The flow pattern may be counter current. The type of plate heat exchanger is gasket or brazed. Other plate type exchanger are spiral plate, lamella and plate coil exchanger. These exchangers are composed of many thin, slightly separated plates that have very large surface areas and small fluid refrigeration flow passages for heat transfer. Advances in gasket and brazing technology have made the plate type heat exchanger increasingly practical.

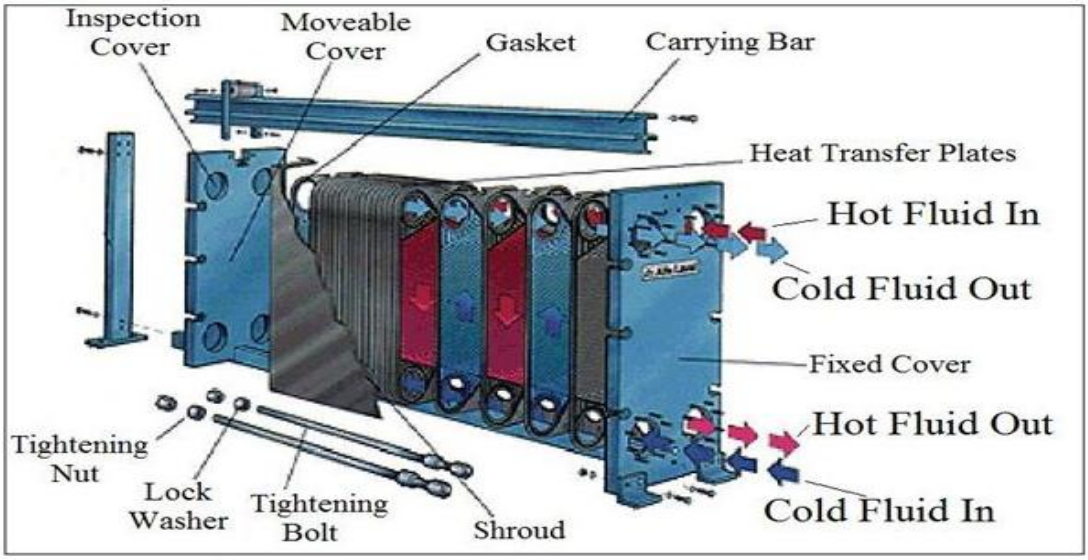

Fig.3.2 Plate heat exchangers [11]

IV. RECENT ADVANCEMENT OF HEAT EXCHANGER

A. Twisted Tube Heat Exchanger

Twisted tube heat exchanger is advancement over conventional shell and tube heat exchanger. It consist of tube assemble together as bundle without use of baffle. The twisted tube heat exchanger is design in such a way that the tube can be over to each other in their position. The design differs from a traditional shell and tube heat exchanger by having oval tubes twisted along the longitudinal axis. The number of twists per unit length can vary from design to design.

The tubes are normally manufactured in a onestep operation ensuring a constant wall thickness and that the material yield id not exceeded. Tube size may vary from ½ inch to 1 inch. The shell side flow path is complex a predominantly axial in nature. Typically, the twist pitch "s" is the tube length between each 360 degree twist. Each twisted tube is manufactured with round ends making it possible to fit them into the tube sheets by conventional methods. Every tube is kept in position by contact points to the surrounding tubes in fig. such fitting technique results in six contact points per each 360 degree twist. Such tube configuration results in very rigid bundle construction. The intensity of the swirl depends on the cross sectional shape and twist pitch to diameter ratio.

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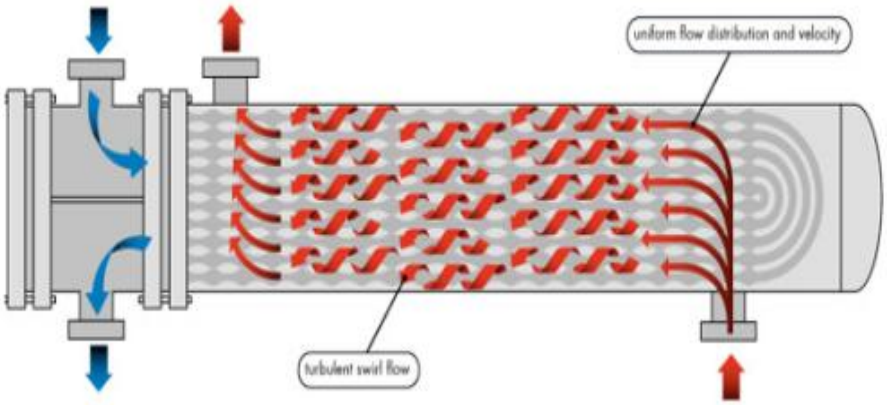

Fig.4.1 Twisted tube heat exchanger [9]

Advantages

- Higher thermal effectiveness
- Increased heat transfer coefficient
- Lower pressure drop
- No vibration
- Reduced fouling

B. Micro Plate Heat Exchanger

The same model of heat exchanger has been used for over 40 years, without any significant development. But now, owing to the Danfoss latest invention, the MPHE, all that is about to change. The new MPHE Danfoss invention gives an excellent route to better performance and lower environmental impact. Danfoss improve fluid flow and increase the heat transfer by using surface area.

The pattern of the plate allows for greater flexibility in application design. Simply by varying the number, size and placement of dimples on the plate, MPHEs can be adapted to give the optimal heat transfer and minimum pressure drop. As a concept, innovation transferred strongly differentiates Danfoss as an innovation leader among global heat exchanger suppliers. Visually, the campaign is built on unique pattern of Danfoss Micro Plate technology. By using the plate pattern to create different images, Danfoss draw attention to specific benefits as well as Danfoss overall USP – the unique plate design itself.

The message innovation transferred is a customer centric proposition conveying that Danfoss heat exchanger not only deliver superior functional performance, but also channel Danfoss vast expertise within application knowledge and creativity on customers through its product and services. Micro plate technology is designed for small, lower duty application with relatively constant pressure, temperature and treated water supplies. Micro plate heat exchangers have a broad, flat brazing surface which adds stability to their construction.

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Fig.4.2 Micro Plate Heat Exchanger [12]

Advantages

- Up to 10% enhanced heat transfer
- Up to 35% lower pressure loss
- Longer life time
- Lower carbon footprint

TABLE I: Difference between new technology and conventional heat exchanger

S/N	New Technology	Conventional Technology
1	Heat transfer rate is high.	Heat transfer rate is low.
2	It is economical.	It is less economical.
3	More eco-friendly.	Less eco-friendly.
4	Less space required.	More space required.
5	Low maintenance.	More maintenance.
6	Less power required.	More p power required.

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V. CONCLUSION

The development of new heat exchanger over old need thoroughly knowledge of basic phenomena and well understood the principal of heat exchanger. Experimental is difficult, modelling of the phenomena techniques are required to get results that are reasonably useful to practicing engineers. Increasing the heat transfer coefficient is difficult work. So, to increase heat transfer coefficient practical as well as theoretical knowledge is required. Many characteristic and function of heat exchangers are reviewed. The technology and economic (cost) is two main aspect of heat exchanger. A more detail study and research is needed to make reliable, economical and feasible heat exchanger. Construction, working and also various parameters such as pressure, temperature and density is discussed. Advance heat exchanger offer more advantages over conventional heat exchanger. Advance heat exchanger reduce baffle requirement, space and has higher efficiency than conventional heat exchanger and also it is cheap. In this way, the advancement of the heat exchanger gives more advantages and become more economic.

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