A Research Paper on Heat Exchanger

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ABSTRACT: Heat exchangers are one of the most important heat transfer instruments used in industries such as oil refining, chemical manufacturing, electrical power generation, etc. Over the years, the Shell-and-Tube heat exchangers have been widely and most successfully used in the manufacturing field. In this paper we see an analysis of Outline and Forms of Heat Exchangers, Thermal Design and Mechanical Design using the ASME standard, TEMA takes a case study of Current Shell & Tube style Heat Exchanger.

KEYWORDS: Modern Heat exchanger, Shell and Tube heat exchanger, Thermal Design, Mechanical Design, HTRI Software.

INTRODUCTION

The heat exchanger is a mechanism used to transfer thermal energy between two or more fluids, between the solid surface and the air, or between the solid particles and the fluid, at varying temperatures and in thermal contact [1]. There are typically no exterior heat and function experiences in heat exchangers. Typical applications require heating or cooling of the related fluid stream and evaporation or condensation of single or multi-component fluid streams. In other applications, the goal may be to recover or refuse heat or to sterilize, pasteurize, fractionate, distil, concentrate, crystallize or monitor process fluids. In a few heat exchangers, heat exchange fluids are in direct co-operation. In most heat exchangers, the heat transfer between fluids takes place in a temporary manner through a dividing wall or in and out of a wall. In a lot of heat exchangers, the fluids are isolated by a heat transfer surface and, preferably, do not blend or spill. Such an exchanger is referred to as a direct transfer form, or simply a recuperator.

On the other side, the exchangers of which there is intermittent heat exchange between hot and cold fluids—through the accumulation of thermal energy and through the exchanger surface or matrix—are referred to as indirect 5 transfer type, or simply regenerators [2]. These exchangers typically provide fluid leakage from a single flow of fluid to a single flow of fluid. Popular examples of heat exchangers are shell and tube heat exchangers, automotive radiators, condensers, evaporators, pre-heaters and coolers.

Towers, man. If a phase shift happens between any of the fluids in the heat exchanger, it is often referred to as a sensible heat exchanger. Internal thermal energy sources could be found in heat exchangers, such as electrical heaters and nuclear fuel elements [3]. Combustion and chemical reactions can take place inside the heat exchanger, e.g. in boilers, heaters and fluid-bed heat exchangers. Mechanical systems can be used in certain exchangers, such as scraped surface exchangers, agitated vessels and stirred tank reactors. The heat exchanger is a piece of equipment designed for effective heat transfer from one medium to another [4]. The media can be isolated by a concrete wall so that they may never overlap or be in close contact with each other. They're commonly used in Room heating, refrigeration, air conditioning, electric stations, chemical plants, petrochemical plants, fuel refineries and natural gas refining and sewage disposal. The classic example of a heat exchanger can be found in the internal combustion engine, in which the circulating fluid known as the engine coolant flows through the radiator coils and the air flows past the coils, cools the coolant and heats the incoming air.

1.1 Classification of Heat Exchangers

1.1.1 Indirect-Contact Heat Exchanger: Fluid streams remain distinct and heat is transferred constantly across an impervious dividing wall or in and out of a wall in a temporary fashion. Ideally, however, there is no immediate interaction with thermally interacting fluids. This type of heat exchanger, also referred to as a surface heat exchanger, can be further categorized as a direct transfer type, storage type, and Fluid-bed exchangers.

1.1.2 Direct-contact heat exchanger: In a direct-contact exchanger, two streams of fluid come into direct contact, exchange heat, and are then separated. Popular applications of a direct-contact exchanger include, in addition to heat transfer, mass transfer, such as evaporative cooling and rectification; applications requiring only sensible heat transfer are rare. In addition, the enthalpy of phase shift in such an exchanger constitutes a large portion of the overall energy transfer [5]. The change of process usually increases the rate of heat transfer.

1.2 Efficiency of Heat Exchanger

The efficiency of heat exchangers can be described in several ways, and there are several main factors to consider in terms of thermal performance:

1.2.1 Temperature differential: As stated in paragraph 3 (temperature cross-over) the distinction between hot fluid and coolant is very significant when constructing a heat exchanger. The coolant must still be at a lower temperature than the hot material. Higher coolant temperatures can draw more heat out of the hot fluid than warm coolant temperatures. If, for example, you have a glass of cold water at room temperature, it is much more convenient to cool down with ice rather than simply cool water, the same idea applies to heat exchangers.

1.2.2 Flow rate: Another significant aspect is the flow of fluids on both the main and secondary sides of the heat exchanger. A higher flow rate can improve the heat transfer capacity of the exchanger, but a higher flow rate often means a higher density, which may make it more difficult for the energy to be removed, as well as an increase in velocity and pressure loss.

1.2.3 Installation: The heat exchanger can always be mounted on the basis of the manufacturer's instructions. Generally speaking, the most effective way to build a heat exchanger is for the fluids circulating in a counter-current configuration (so if the coolant flows from left to right, the hot fluid travels from right to left) and for the heat exchangers of the shell and tube, the coolant can reach the lowest inlet location (as seen in the diagrams above) to ensure that the heat exchanger is still full of water. In the case of air-cooled heat exchangers, it is necessary to remember the air flow when building a cooler, any part of the centre that is blocked will impair the cooling power.

LITERATURE REVIEW

Mr. Irfan Aiyubbhai Vohra et al in their paper discusses about the heat exchanger which commonly used in Room heating, refrigeration, air conditioning, electric stations, chemical plants, petrochemical plants, fuel refineries, natural gas refining and sewage disposal. The classic example of a heat exchanger can be found in the internal combustion engine, in which the circulating fluid known as the engine coolant flows through the radiator coils and the air flows past the coils, cools the coolant and heats the incoming air [6].

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DISCUSSION

In the manufacturing process, heat exchangers are used to recover heat from two process fluids. Shell-and-tube heat exchangers are the most commonly used heat exchangers in process industries due to their comparatively quick production and adaptability to diverse operating conditions. Nowadays, however, a variety of companies are looking for more competitive and less time Consuming alternatives for building heat exchangers for shells and tubing. According to literature and industrial studies, there is a need for successful design solutions for STHE.

The construction of STHE requires a vast number of geometric and operational variables as part of the quest for an exchanger geometry that satisfies the necessity for heat duty and a series of design constraints. Typically the reference geometric configuration of the equipment is selected first and the permissible pressure drop value is set. The values of the design variables are then specified on the basis of the design requirements and the assumption of certain mechanical and thermodynamic parameters in order to provide a satisfactory coefficient of heat transfer leading to an acceptable use of the heat exchanger surface. The designer's selections are then verified on an iterative basis.

CONCLUSION

The construction of STHE, i.e. thermal and mechanical design, was carried out by means of TEMA/ASME specifications, both manually and using software. It is noticed that the construction of STHE accomplished by both methods is very straightforward, basic advancement and time-consuming as a modern heat exchanger.

REFERENCES

[1] D. P. Sekulic, “Compact heat exchangers,” in *Handbook of Thermal Science and Engineering*, 2018.

[2] Nptel, “Lecture 1: Heat Exchangers Classifications,” *Chem. Eng. Des. - II*, 2006.

[3] I. Horvath, “HEAT EXCHANGER DESIGN.,” *Glas. Int.*, 1983, doi: 10.13182/nse66-a12015184.

[4] K. Thulukkanam, *Heat Exchanger Design Handbook*. 2013.

[5] A. G. McDonald and H. L. Magande, “Fundamentals of Heat Exchanger Design,” in *Introduction to Thermo-Fluids Systems Design*, 2012.

[6] P. Chen, "Data Model Conceptual Model-*The basic concept of Er model*," vol. 2, no. 3, pp. 1–10, 2013.

[7] “What is a Heat Exchanger?” http://www.thermex.co.uk/news/blog/160-what-is-a-heat-exchanger.