

A Study on Use of Alternative Pipe Arrangement for the Evaluation of Plate Type Heat Exchanger

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Abstract

The purpose of this paper is to investigate the notion of thermodynamic rules and heat replacement methods. The warmth exchanger is a device that follows thermodynamic laws to transfer warmth and temperature from one material to another. The heat exchanger generation used in the preceding several decades was traditional and inefficient. However, technological advancements have resulted in novel heat exchanger designs. In recent years, plate-fin warmth exchangers have been used in strength flowers and other thermal plants. When compared to shell and tube heat exchangers, these warmth exchangers are made up of corrugated plates, which enhance their efficiency and overall performance. Plate warmth exchangers are simple to construct and disassemble. As a result, inspection, preservation, and cleaning are all spotless. When compared to shell and tube exchangers, fouling in plate type warmth exchangers is reduced by 10 to 25% due to the existence of shear fees and shear stresses, strong turbulence, secondary flow and mixing, and plate corrugation sample. Warmth exchanger friction is significantly smaller in this case.

Keywords: *Heat Exchanger, Pipe Arrangement, Thermodynamic laws*

INTRODUCTION

A heat exchanger is a device that either uses hot process fluid to heat cold process

steam or uses cold process fluid to cool hot process steam. Heat exchangers are a word used to describe many types of heat

transfer equipment. Cooler, heater, condenser, vaporizer, and re boiler are some of the tasks of this device. Heat exchangers have a variety of practical uses, including coolers that remove heat from a liquid or gas using water, and heaters that supply heat to a liquid or gas using condensed steam and other heat sources. The vaporizer heats the liquid, turning it into a gas, while the re boilers heat the

liquid at the bottom of the distillation tower.

Plate heat exchangers are made up of a number of big rectangular thin metal plates fastened together to produce narrow parallel plate channels. These have heat transfer area per unit volume is $100 \text{ to } 200 \text{ m}^2/\text{m}^3$.

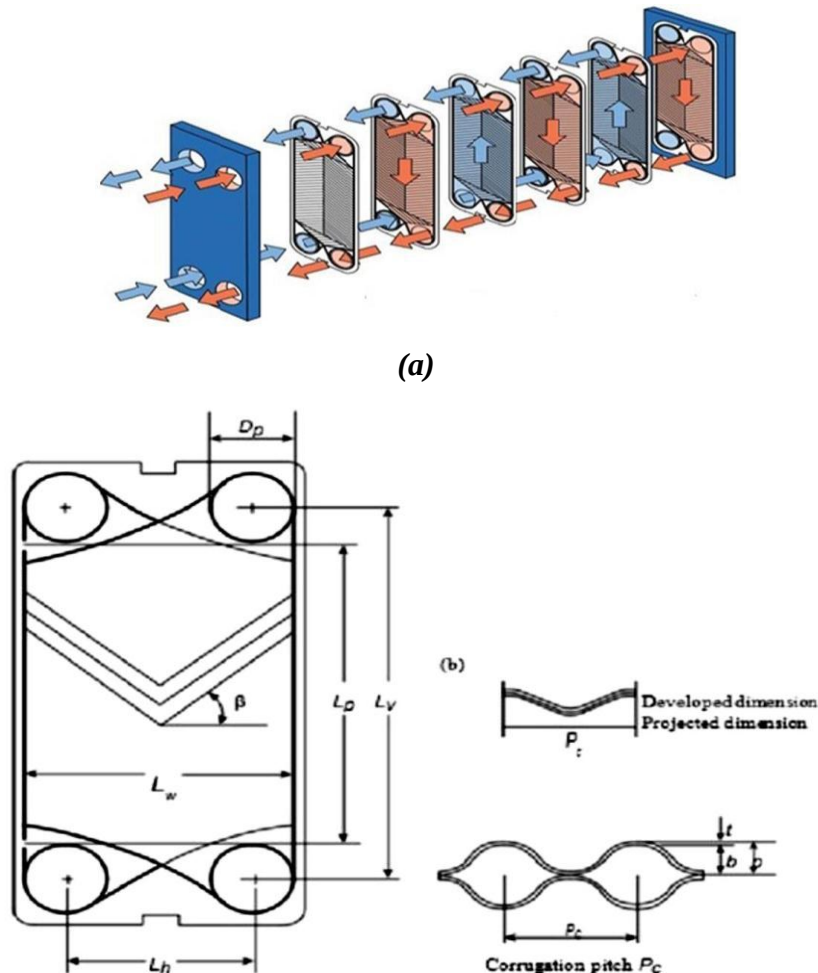


Figure (b) 1: Flow principle of plate Type HE

Benefits and Restrictions of Plate Type H.E

The following are some of the advantages of plate type H.E; they may easily be included into their character components for cleaning, inspection, and protection. Breakup and reattachment of boundary layers, swirl or vortex waft production, and tiny hydraulic diameter waft channels are used to achieve extremely high heat transfer coefficients (h) in this H.E. One 0.5 to at least one 0.33 to shell and tube exchangers is required for plate type H.E surface proximity. In compared to other H.E plate types, plate type H.E requires less space. Plate type H.E exchangers are nearly one-sixth the weight of shell and tube exchangers. Leakage does not occur until the development of holes is no longer possible.

The aim of plates and gaskets is to overcome a few intrinsic barriers within the plate type H.E. The maximum strain coping capability of plate type H.E is approximately 3 Mega Pascal gauge or 435 psi, however it only functions at 1.0 Mega Pascal gauge or 150 psi. The use of plate Mega Pascal in very corrosive packaging is limited by the gasket materials. The maximum operating temperature is almost 2608 degrees Celsius or 5008 degrees Fahrenheit,

although it generally always operates below 1508 degrees Celsius or 3008 degrees Fahrenheit to avoid using expensive gasket materials. In the plate type H.E., tracking pinhole leaks is a difficult task. Fluids with fibrous elements don't work well with plate type H.E. Viscous fluids may be handled; however cooling is difficult due to the very viscous fluids' maldistribution. Plate exchangers are ideal for usage with toxic fluids. Total floor region of biggest unit has nearly 2500 m² or 27000 ft² per frame.

Applications of Plate Type Heat Transfer

In 1923, the first off-plate type heat exchanger was discovered for milk pasteurisation. It's far utilised for liquid-liquid heat switch jobs throughout the holiday season (viscosities up to 10 Pascal). These are often used in the dairy, juice, beverage, alcoholic beverage, modern food processing, and pharmaceutical sectors. Plate type heat exchangers are also used in a variety of areas, most notably in industries and for closed circuit cooling systems in major petrochemical and power plant operations. Plate warmth exchangers are not suitable for low-density fuel-to-fuel operations. Table 1 discusses some of H.E's other uses.

Table 1: Other heat exchanger applications in different industries

Industries	Applications
Food and Beverages	Ovens, cookers, Food processing and pre-heating, Milk pasteurization, beer cooling and pasteurization, juices and syrup pasteurization, cooling or chilling the final product to Desired temperatures.
Petroleum	Brine cooling, crude oil pre-heating, crude oil heat treatment, Fluid interchanger cooling, and acid gas condenser
Hydro carbon processing	processing Preheating of methanol, liquid hydrocarbon product cooling, feed pre-heaters, Recovery or removal of carbon dioxide,
Polymer	Production of polypropylene, Reactor jacket cooling for the Production of polyvinyl chloride.
Pharmaceutical	Purification of water and steam, For point of use cooling on Water For Injection ring.
Automotive	Pickling, Rinsing, Priming, And Painting
Power	Cooling circuit, Radiators, Oil coolers, air conditioners and Heaters, energy recovery.
Marine	Marine cooling systems, Fresh water distiller, Diesel fuel

Previous Study on Heat Transfer

No. of studied have been done by Authors on various kinds of heat Exchanger, Which is discussed in Table 2.

Table 2: Study on Heat Transfer

Sr. No.	Authors	Types of Heat Transfer	Outcomes
1.	Hessam Mirgolbabaie et al.	Vertical helically coiled tube heat exchangers	A conjugate thermal boundary condition for the tube wall fluid-to-fluid heat transfer mechanism, is considered
2.	Muhammad Ansab et al.	Novel tubular manifold heat exchanger	The experiments are Performed using water as the working fluid and the manifold side heat transfer coefficient up to $9538 \text{ Wm}^{-2}\text{K}^{-1}$ with a low flow rate of 4.25 lpm is achieved.

3.	J. Camilo et al.	Plate type heat exchangers	Experimental assessment, the heating water was supplied to the generator at temperatures between 85°C and 105°C, for condensation/absorption temperatures between 20°C and 32°C.
4.	Hamidreza Najafi et al.	Plate and blade type heat exchanger	The fundamental favorable position of this work is giving a lot of ideal arrangements every one of which can be chosen by the planner dependent on as far as possible and the accessible speculation.
5.	Kushwah A et al.	Wire and Tube Type Heat Exchanger	Study about the Thermal Modeling of different types of Heat Exchanger.

Designing and Modeling of Plate type Heat Exchanger

Solidworks 2014 was used to design and model the corrugated plate Type H.E. The shape is designed such that sharp edges are replaced with curved surfaces for ease of use. Because of the simple meshing that is necessary, this aids in the thermal analysis.

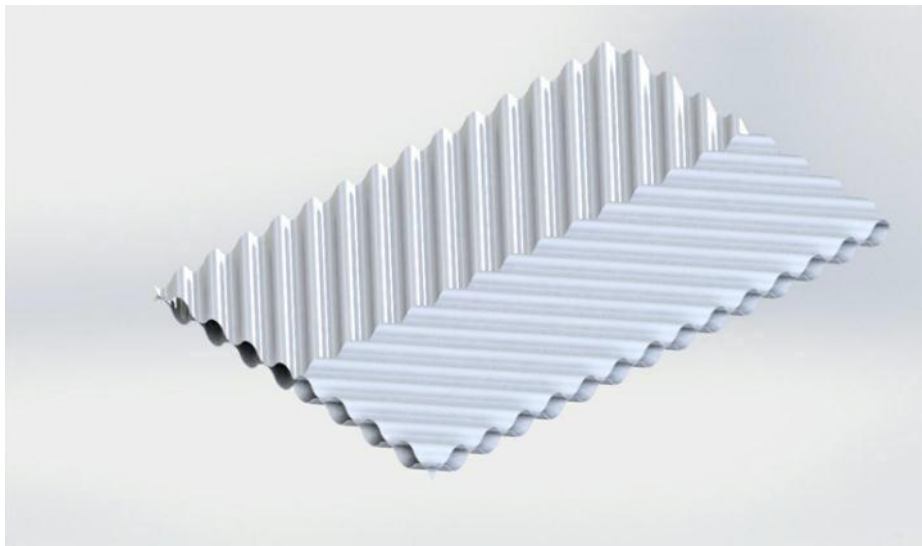


Figure 2: Model of tainted plate Type H.E

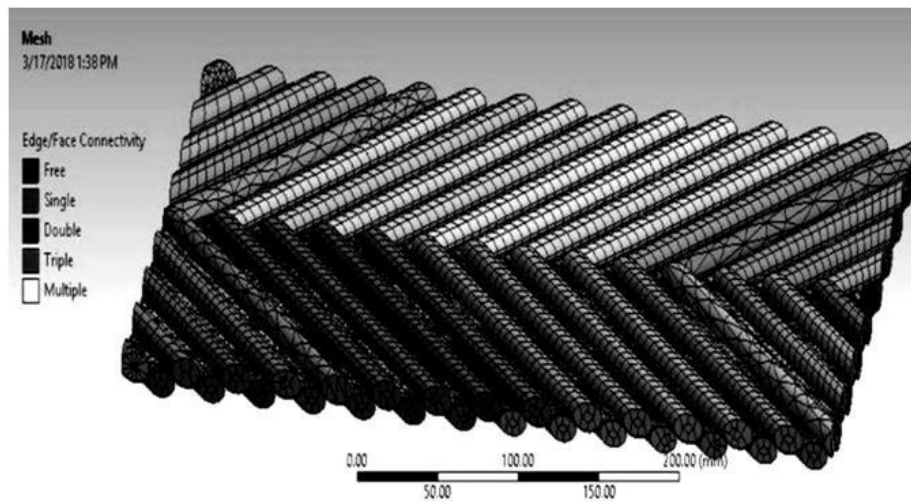


Figure 3: Meshing of plate type H.E

RESULT AND DISCUSSION

The effects depict the temperature variation over the corrugated H.E. It is clear that the temperature on the bottom plate is higher than on the top plate.

This results in proper heat dissipation since the upper floor drops heat at a faster rate than the lowest plate. The temperature difference is around forty degrees Celsius.

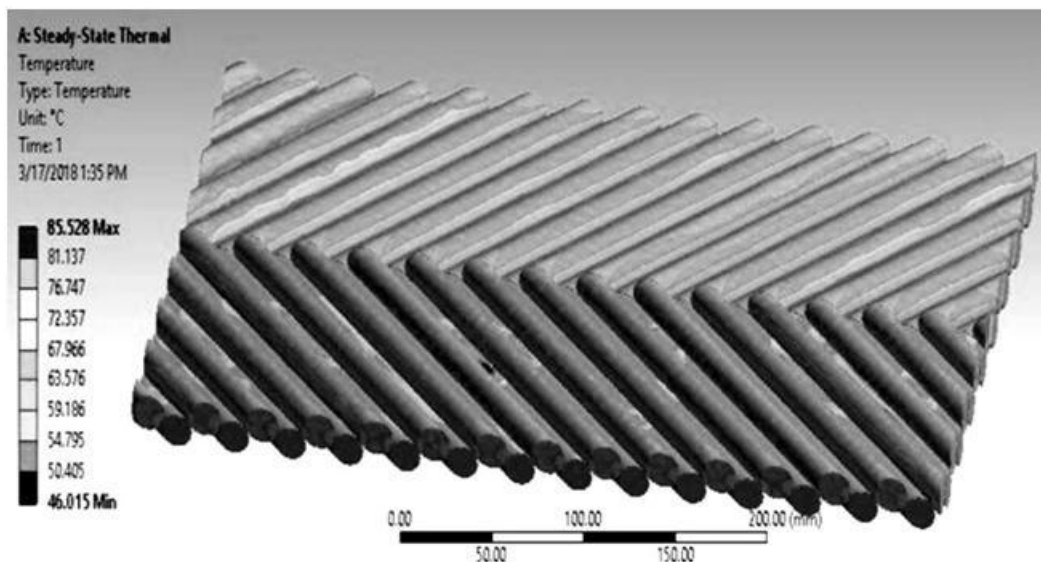


Figure 4: Result of ANSYS with respect to temperature variation v/s. H.E

CONCLUSION

Because of the low weight drop and high heat switch coefficients, plate-fin type H.E is more efficient than shell-and-tube type H.E. Plate-fin type H.E has a small size, therefore it's often used as part of a depth plant instead of shell-and-tube type H.E, which has a big structure and can't be wiped clean and maintained as well as plate fin type H.E. Plate type H.E. has a small size, expandable limits, and lower approach temperatures.

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