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"A STUDY ON PLATE TYPE HEAT EXCHANGER PLATES FAILURE"

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ABSTRACT

Heat exchangers are one of the main intensity move device that track down its utilization in enterprises like oil refining, compound designing, electric power age and so forth. Plate kind of intensity exchangers has been normally and most actually utilized in Enterprises throughout the long term. Plate heat exchangers are utilized routinely in the warming, ventilating, cooling, and refrigeration industry. There is a dire requirement for point by point and methodical examination in regards to warm exchange and the liquid stream attributes of these sorts of exchangers. As an drive in this regard, a writing search is introduced on plate heat exchangers. New relationships for dissipation heat move coefficient and rubbing factor are presented, which are relevant to different framework pressure conditions and plate chevron points. This audit paper presents crafted by different specialists on the heat move upgrade of plate type heat exchanger.

Key Words: *Heat transfer, Plate heat exchanger, Design.*

I. INTRODUCTION

To put it simply, a heat exchanger is a device that allows for the controlled transfer of heat (enthalpy) between two or more fluids, a solid surface and a fluid, or a strong particle and a fluid, all while maintaining the required temperatures and thermal contact. In addition to transferring heat between solids and liquids, heat exchangers may also transmit enthalpy between solids and gases. The use of heat exchangers is ubiquitous in modern, tech-focused industries. A heat exchanger is a device used to transfer heat from one fluid to another. A heat exchanger is an essential component of any system that involves temperature control, whether that be cooling, heating, condensation, boiling, or evaporation. The fluids utilised in the method are often warmed up or cooled down beforehand, or they may pass through a different part of the system. The naming of extraordinary heat exchangers is informed by the devices' intended functions. To provide just two examples, heat exchangers used for condensation are called condensers, while those used for boiling are called boilers. Heat exchangers' total performance and efficiency could be based on the pressure drop that happens in the zone with the least amount of heat transfer (Pa). If you want a more in-depth analysis of its efficiency, you may figure out its total heat transfer coefficient (in W/m2K). One way to estimate the initial investment and operating costs of a heat exchanger is to calculate the pressure drop and location requirements for a given heat transfer rate. When constructing a heat exchanger to specifications, there is a wealth of literature and theory to draw upon.

Plate heat exchangers are one of the most uncommon heat exchanger designs, yet they find widespread use thanks to their compact size, low maintenance requirements, and high accuracy in heat transmission. A corrugated plate heat exchanger is a kind of heat exchanger in which a series of corrugated plates are pushed together in a rigid frame to create a series of drift channels through which hot and cold fluids are circulated in a countercurrent. This heat exchanger design originated in the USA, as its name indicates. Heat exchangers come in numerous forms, such as shell-

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and-tube designs, double-pipe configurations, plate-and-frame designs, condenser-and-evaporator arrangements, and many more. The most common kind of heat exchanger is the shell and tube design, which entails a tube or a series of parallel tubes (i.e., a tube bundle) enclosed inside a sealed, cylinder-shaped pressure vessel. It is common practise to employ shell and tube heat exchangers to transfer heat from one fluid to another (i.e. shell). During the passage of one fluid through the smaller tube(s), the other fluid flows around and between the tubes as they are housed inside the larger shell. Heat exchangers may also make use of finned tubes, single- or two-phase heat transfer, countercurrent flow, cocurrent flow, or crossflow arrangements, and single-, double-or multiple-pass designs. Additionally, finned tubes are a popular use for this heat exchanger.

II. LITERATURE REVIEW

Based on the work of **SalmanAl zahrani et al. [2021] [1]** The thermal performance of plate heat exchangers with different Reynolds numbers is typically improved, and this is reflected in their increased efficiency. Computational fluid dynamics (CFD) is used for a numerical evaluation of the heat exchangers' performance (HEs). It is shown experimentally that increasing the Reynolds number increases the heat transfer rate by 20%. The research was conducted by **DanZheng et al. [2021] [2]** Here, we undertake an experiment to measure how different magnetic fields affect the performance of a plate heat exchanger loaded with ferrofluids. To create ferrofluid, 20 nm-diameter nanoparticles of Fe3O4 are dispersed in di-water. The ferro fluid's overall thermal performance was improved when it passed through the plate heat exchanger, even though its particles were just 0.1 nm in size. This is according to research by **D.K.Rabha et al. [2021.] [3]** This research included building and analysing a prototype of a passive-combined-active dryer that used a biomass fired-heater and a plate heat exchanger. The upgraded dryer consists of a vertical plate heat exchanger, a biomass combustion chamber, and a drying chamber. When compared to the active kind of plate heat exchanger, the passive type is 35% more efficient at transferring heat. **WenzheLi, et al .[2021] [4]** This research defines and presents a theoretical analysis of the stop plate's impact on heat transfer in brazed plate heat exchangers. A strength balance study on a simple part of the stop plate is used to get the governing equations. The plate heat exchanger with the stop structures added for better fluid flow is used in the numerical simulations. Reference: **YanWu et al. [5]** For the aim of this study, a speed correlation version appropriate for PHEs has been implemented. Because fouling is a dynamic phenomenon, it is examined throughout the whole process time horizon, which is then subdivided into many time periods. The Simulated Annealing (SA) algorithm is used in this method of optimization. The plate heat exchanger had its fouling influence reduced by 20%.

According to **WenzheLi et al .[2021] [6]** This article presents the findings of an experimental and numerical study of the single-section waft distribution inside brazed plate heat exchangers; however, the relevance of these findings may be extended to plate-and-frame and plate-and-shell designs as well. The headers are probed in order to evaluate strain profiles within the heat exchanger. Measuring the pressure drop throughout the channels and establishing a correlation between it and the friction experienced inside the channels may help determine the flow distribution.

II. COMMON CAUSES OF PLATE FAILURES

Plate failures in PHEs can be attributed to several factors, including mechanical, thermal, chemical, and operational issues. The following are some of the common causes identified through literature review and case studies:

- **Mechanical Fatigue:** Fatigue failure due to cyclic loading and stress concentrations, particularly at the junctions and corners of the plates.
- **Corrosion:** Chemical reactions between fluids and plate materials leading to corrosion and material degradation.
- **Erosion:** High-velocity flow of fluids causing erosion and wear on plate surfaces.
- **Thermal Stress:** Thermal cycling and temperature differentials causing thermal stress and deformation of plates.
- **Gasket Failure:** Improper sealing or deterioration of gaskets leading to leakage and plate damage.

Each of these factors can interact and exacerbate plate failures, highlighting the complex nature of PHE reliability issues.

III. Methodology & Experimentation

The Finite Volume Method is used to obtain the convergence of the Eulerian equation and the governing equation; it operates on fluid or fractional volumes; it consists of the energy equation, momentum equation, and continuity equations withrespect to pressure force, viscous force, or gravity force; it solves the fluid flow problem in the case of a heat exchanger, radiation, turbulence, laminar flows, acoustics, and aerodynamics. One method that may be used to estimate the impact of external influences on fluid motion is called the finite volume approach. Velocity, pressure drop (Pa), and temperature all have a role in determining a fluid's viscosity at a given volume. Convergence on the fluid flow volume was attained by the calculation of Reynolds stresses, and the Nusselt number was also established. Forces from outside accounted for these developments. The steps to do in order to solve the issue with fluent: Preprocessor, Solver, Postprocessor.

The pressure drop is greater and the efficiency of the heat exchanger is increased when the plate has a pattern that is more constrained. This particular kind of heat exchanger is distinguished by its extensive thermal channel. When the plate has a broad pattern, the pressure drop is lower, and as a consequence, the heat transfer coefficient is considerably lower. This particular kind of heat exchanger has a relatively short length for the thermal channel.

REFERENCES

[1]. NgoctanTran et al. “Performance of thermofluidic characteristics of recuperative wavy-plate heat exchangers”, International Journal of Heat and Mass TransferVolume 170, May 2021, 121027

[2]. DanZheng et al. “Analyses of thermal performance and Pressure Drop (Pa) in a plate heat exchanger filled with ferrofluids under a magnetic field”, Fuel, Volume 293, 1 FEBRUARY 2021, 120432

[3]. SalmanAl zahrani et al. “Heat transfer enhancement of modified flat plate heat exchanger”, Applied Thermal Engineering, Volume 186, 5 March 2021, 116533

[4]. YanWu et al. “Applying plate heat exchangers in crude preheat train for fouling mitigation”, Chemical Engineering Research and Design, Volume 165, January 2021, Pages 150-161

[5]. WenzheLi et al. “Compensating for the end-plate effect on heat transfer in brazed plate heat exchangers”, International Journal of Refrigeration, Volume 126, FEBRUARY 2021, Pages 99-108

[6]. WenzheLi et al. “Single-phase flow distribution in plate heat exchangers: Experiments and models”, International Journal of Refrigeration, Volume 126, FEBRUARY 2021, Pages 45-56

[7]. Mohammad ForuzanNia et al. “Numerical simulation of air heating by the recovered waste heat from the radiating exhaust gas flows in a plate heat exchanger”, International Journal of Thermal Sciences, Volume 161, March 2021, 106728