REDUCING EFFECT OF FRICTIONAL PRESSURE DROP BETWEEN PLATES TYPE HEAT EXCHANGER BY USING CFD ANALYSIS

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Abstract:- Finding the smallest heat transfer region expected to meet a given heat load is a primary consideration in plate heat exchanger plan. Why? Since this is a vital piece of the plate heat exchanger's total cost. Based on the results of this investigation , the following characteristics of a gas keted plate heat exchanger might be distinguished: square, folded metalor compound plates that are gas keted and shot together to frame a solid shell. Ridged platesimprove the rate at which intensity is traded among hot and cold liquid streams by causingturbulence in the stream when it connects with the liquid. Additionally, the fresh, colorless fluid streams can enter and exit the corrugated plate through the circular openings in each of its four corners. We can more easily regulate fluid flow by installing the gaskets between the plates and permanently connecting them. After prolonged operation, a solitary plate heat exchanger unit might have just 700 plates left, coming about in a total heat transfer area of around2500m2.

I. INTRODUCTION

To put it simply, the regulated transmission of heat (enthalpy) between two or more fluids is made possible by a heat exchanger. 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 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 aheatexchangeristocalculatethepressuredropandl ocationrequirementsforagivenheattransferrate.W henconstructingaheatexchangertospecifications,t here is a wealth of literature and theory to draw upon. They find wide spread use thanks to their compact size, low maintenance requirements, and high accuracy in heat transmission. This heat exchanger design originated in the USA, as its name indicates. Heat exchangers come in numerous forms, such as shell-and-tube designs, double-pipe configurations, plate-and-frame designs, condenser-and-evaporator arrangements, and many more.

II. METHODOLOGY

Creating CAD programming is a laborious and testing The finite volume technique is one way that may be used to quantify the effect of external factors on fluidmotion.Velocity,pressuredrop(Pa),andtempe ratureallinfluencetheviscosity of a fluid at a given volume. By calculating Reynolds stresses, convergence on the fluid flow volume was reached, and the Nusselt number was also determined. Forces from outside accounted for these developments. The finite volume technique is used, for instance, to develop a pressure-based equation on fluid flow. The approach employs the finite volume technique rather than a straight for war implicit pressure related equation.

The steps to do in order to solve the issue with fluent

- Pre-processor
- Solver
- Postprocessor
- Pre-Processor

2.1 Solver

It is used to identify the variance in fluid flow by applyingthegoverningequationinconjunctionwitht hebaseequationonthepreprocessor.

Post-Processor

It is used to figure out the results that were obtained from the fluent solver in the form of contour plots, in the form of velocity and streamline contour plots, and soon.

2.2 Modelling and Analysis

Solid work 2021, a modelling programme, was used to construct the geometry, which was then loaded into ANSYS workbench 15.0, where it was meshed, and then it was exported to Fluent for analysis. Through the use of parameterized case files, the boundary conditions, material characteristics, and surrounding properties are all determined. Fluent will continue to work on the solution to the issue until either the convergence limit is reached or the number of iterations that the user has set has been reached.

2.3 Differences in pressure and the coefficient of heat transfer

When the plate has a more restricted pattern, the pressure drop is larger and the heat exchanger is more efficient. The large thermal channel is a defining feature of this kind of heat exchanger. The pressure drop is less when the plate has a wider pattern, leading to a much smaller heat transfer coefficient. This kind of heat exchanger has a thermal channel that is relatively small in length.

2.4 CFD modeling

First, you must build the geometrical figure. The procedure of meshing the domain. The process of meshing the domain. Boundary and material conditions must be defined. To solve this problem, you'll need some kind of fluid solver. Obtaining the solution.

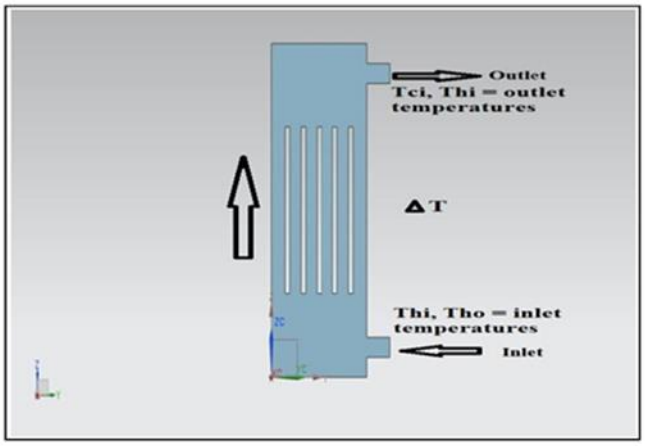

Figure1Plateheatexchangermodelledin2Dasadiag ram(smooth plate)

2.5 Meshing of the Domain

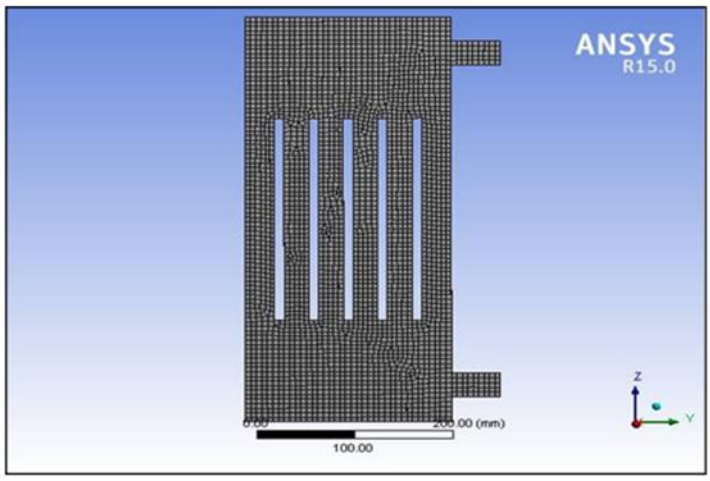

Figure 2Plateheatexchanger with a mesh surface.

The following three parameters of interest have been calculated in order to explore the influence of alternative plate configurations on frictional Pressure Drop (Pa), as well as inlet and output port Pressure Drop(Pa):

III. RESULTS AND DISCUSSION

Theresultsarepresentedinthetablebelow.Plateheat exchangerfrictionfactorparameterincreaseshaveb eendiscussedbycomparingthefindingstopreviouse xperimentalresearchon the same parameter that has been published in the literature [11]. Results have also been compared to those of a numerical model created for this investigation and running under the same circumstances.Traits

Characteristic of Pressure Drop (Frictional Pressure Drop)

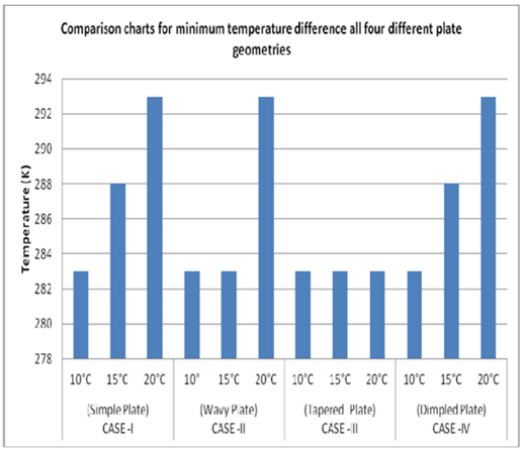

Fig 3 Minimum temperature difference all four geometries

The following formula may be used using the FLUENT solver, we can calculate the temperature difference ,represented by dT .Water mass flow rate is considered to be constant.

$$q=m\ Cp\ dT$$

The heat transmission coefficients in the following table were calculated using CFD. To learn more about how pressure drop and heat transfer coefficient play a role, one might look at reference [25].Calculating the frictional pressure drop requires accessing the FLUENT solver's pressure difference in the flow region between the plates. The following formula may be used to determine the density of water.The table below displays the frictional Pressure Drop (Pa) values for a smooth plate as determined by numerical simulation. These numbers hold true for a broad range of fluid operating temperatures and Reynolds numbers(Re).Effectiveness calculation for plate heat exchanger-

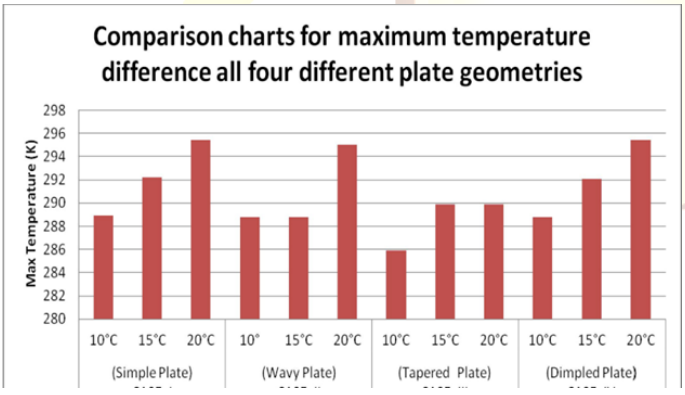

Fig 4 Comparison charts form maximum temperature differenceal four different plate geometries

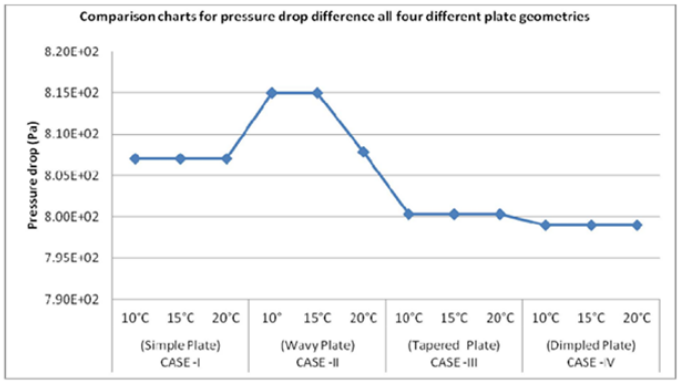

Fig 5
Comparisoncharts forpressuredropdifferenceallfourdifferent plategeometries

IV. CONCLUSION

The tension drop, signified by Pa,increases alongside the better temperature distribution that comes about because of expanding the surface region of the fluid stream course in a plate heat exchanger. Different temperature distribution patterns are produced by a variety of fluid temperatures, including 100C, 150C, and 200C. Taking into account the least worth/setup of gurgling plate heat exchangers yields improved results since the frictional tension drop (Dad) is upgraded in 20ºC inall plate heat exchanger designs. The results for the plate heat exchanger with a bubble-shaped structure have the lowest attainable temperature and frictional pressure drop (Pa). To be exact, we have a pressure of -7.99e+02Pa and a temperature of 295.4K. Different plate shapes can reduce the frictional Pressure Drop (Pa) in a plate-to-plate heat exchanger. Plates'durability isimprovedasa outcome.

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