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Thermal performance of Heat Exchanger- A Review

[1]Monu Kumar, [2]Surjeet Singh Rajpoot

[1]M. Tech. Research Scholar, SCOPE College of College of Engineering, Bhopal
[2]Associate Professor, SCOPE College of College of Engineering, Bhopal

ABSTRACT-

In a heat exchanger, increasing the rate of heat transmission is crucial. A heat exchanger performs less well because of numerous heat losses caused by convection, conduction, and radiation from the fluid to the atmosphere or to the building material. The development of a model for energy balancing accounting the different energy losses based on experimental findings is the primary goal of this work. It is investigated how different factors, such as mass flow rate and intake temperature, affect the total heat transfer rate. The created parameters are optimised for improved performance based on the model's results.

Keywords: Effectiveness, Temperature, Heat Transfer, Reynolds Number, Nusselt Number.

INTRODUCTION

A heat exchanger is a device used to transfer heat between two or more fluids at different temperatures. It is commonly used in various industrial processes as well as in heating, ventilation, and air conditioning systems. The primary purpose of a heat exchanger is to efficiently transfer thermal energy from one fluid to another without direct contact between the fluids. This allows the transfer of heat while preventing the mixing or contamination of the fluids.

Heat exchangers can come in different designs and configurations, but they generally consist of a series of tubes or plates through which the fluids flow. The hot fluid transfers its heat to the cold fluid as they pass through the heat exchanger. The direction of flow can be parallel or counter flow, depending on the design and efficiency requirements.

Heat exchangers find applications in various industries, including chemical processing, power generation, oil and gas refineries, HVAC systems, food and beverage production, and automotive cooling systems. They play a crucial role in energy efficiency, heat recovery, and maintaining desired temperature conditions in many processes and systems.

LITERATURE REVIEW

The heat transfer from primary fluid to secondary fluid is more than the without modification system. It permits the temperature of fluid increase for some useful purposes in manufacturing process. Various experiments were done in this area to enhance the rate of heat transfer to improve the efficiency of the system.

Kifah Sarraf et al This article presents a detailed analysis of the thermo-hydraulic transfers for single-phase flow in brazed plate heat exchangers (BPHE) using numerical simulations. The comparison of the simulation and experimental results show similar trends on the variations of the global thermo-hydraulic quantities, as the friction and convective heat transfer coefficients, with respect to Reynolds number.

Caner Turk et al In this study, experiments are performed to test the thermal and hydraulic performance of gasketed plate heat exchangers (GPHE). A heat exchanger composed of two different plate types is used for the experiments, for a Reynolds number range of 500e5000. The results are compared to the experimental results obtained for plate heat exchangers which are composed of plates that have the same geometry instead of mixing two different plates. Two methods are used to investigate the thermal and hydraulic characteristics based on the obtained experimental data.

Jan Waj et al The experimental analysis of passive heat transfer intensification in the case of plate heat exchanger has been carried out. The metallic porous layer was created on the heat transfer surface of analyzed unit. The experiment was accomplished in two stages. In the first stage the commercial stainless steel gasketed plate heat exchanger was investigated, while in the second one – the identical heat exchanger but with the modified heat transfer surface.

Ya-Nan Wang et al Generally, heat exchanger is a thermodynamic system which has been employed to transfer thermal energy between two or more fluids, between a solid surface and a fluid, or between solid particulates and a fluid, at different temperatures and in thermal contact. Recently, the growing requirements to save energy and reduce overall environmental impacts has placed greater emphasis on the use of heat exchangers with better thermal efficiency.

Chirag Maradiya et al Heat transfer devices have been used for conversion and recovery of heat in many industrial and domestic applications. Over five decades, there has been concerted effort to develop design of heat exchanger that can result in reduction in energy requirement as well as material and other cost saving. Heat transfer enhancement techniques generally reduce the thermal resistance either by increasing the effective heat transfer surface area or by generating turbulence.

Zhe Wang et al As a novel coolant, the ethylene glycol-water (50 wt.%:50 wt.%) with graph platelets fluids (GnPEGW) were prepared at four weight concentrations (0.01, 0.1 0.5 and 1.0 wt.%), and heat transfer and pressure drop characteristics in a miniature plate heat exchanger (MPHE) were investigated. All fluid samples were prepared and diluted by ultrasonic vibration, and their thermal conductivity and dynamic viscosity were measured by a transient plane source method and a rotational rheometer, respectively.

Atul Bhattad et al In the present study, numerical as well as experimental investigations have been done on the plate heat exchanger using hybrid fluid at different concentration to investigate its effect on heat transfer and pressure drop characteristics. Discrete phase model has been used for the investigation using CFD software and results have been compared with the experimental result as well as result of the homogenous model.

Abhishek Nandan et al Plate heat exchanger has found a wide range of application in various industries like food industries, chemical industries, power plants etc. It reduces the wastage of energy and improves the overall efficiency of the system. Hence, it must be designed to obtain the maximum heat transfer possible. This paper is presented in order to study the various theories and results given over the improvement of heat transfer performance in a plate heat exchanger.

PROBLEM FORMULATION

A heat exchanger is a device that is used to transfer thermal energy between two or more fluids, between a solid surface and a fluid, or between solid particulates and a fluid, at different temperatures and in thermal contact. In heat exchangers, there are usually no external heat and work interactions. This facilitates the transfer of heat, and greatly increases the rate of the temperature change.

1. Investigating the existing heat exchanger working characteristics, effectiveness, effectiveness, efficiency, losses etc.

2. Generating 3D model of existing heat exchanger using Solid-works software.

3. Theoretical calculations for new models.

4. Selecting of parameters for CFD analysis.

5. Obtaining its CFD model and simulating its working condition.

6. Implementing methods that are ought to improve the performance of heat exchanger.

7. Performing CFD analysis in ANSYS Fluent on new models

8. Comparing the results with the original model.

Theoretical Calculation

The amount of heat transferred in any process can be defined as the total amount of transferred energy excluding any macroscopic work that was done and any energy contained in matter transferred. For the precise definition of heat, it is necessary that it occur by a path that does not include transfer of matter. As an amount of energy (being transferred), the SI unit of heat is the joule (J). The conventional symbol used to represent the amount of heat transferred in a thermodynamic process is Q. Heat is measured by its effect on the states of interacting bodies, for example, by the amount of ice melted or a change in temperature.

Heat transfer is a fundamental energy engineering operation. Hot water loops are commonly used to transfer heat in district heating networks and on industrial sites. The capital & operating cost of many hot water loops are higher than they should be. This post will explain why this is happening in the context of the foundational energy engineering equation $Q = m * Cp * dT$.

Conclusion

Heat exchangers are used to transfer heat from a hot fluid to a cool fluid. They play a crucial role in the process by adjusting the temperature of the more precious fluid that will be utilized later on. A hydraulic oil cooler, for instance, will remove heat from heated oil by utilizing cold water or air. A heat exchanger is a device that transfers heat from one medium to another. As an alternative, a pool heat exchanger warms the pool water using hot water from a boiler or a solar heated water circuit.

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