A Review on Thermal Performance of Double Pipe Heat Exchanger

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Abstract - Double pipe heat exchangers are among the most widely used and simple heat exchangers. In the food, chemical, and oil & gas sectors, this kind of heat exchanger is commonly used. Many exact studies have also firmly maintained that this kind of heat exchanger is used in high-pressure applications due to its comparatively modest diameter. They are also crucial in situations when a large temperature range is required. This kind of heat exchanger is also well-documented to play a major role in the processes of pasteurization, reheating, preheating, digester heating, and effluent heating. Due to its inexpensive design and maintenance costs, DPHEs are also used by a large number of small companies. Consequently, we deduced that the earlier studies conducted on this kind of heat exchanger have to be grouped in order to get over the difficulties associated with selecting the most relevant approaches.

Keywords: Double pipe heat exchanger, heat transfer, fins, tapes, Renould no .

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I. INTRODUCTION

Power plants, nuclear reactors for energy production, refrigeration and air conditioning (RAC) systems, self-propelled enterprises, the food industry, heat retrieval systems, and chemical handling are just a few of the many uses for heat exchangers. There are two categories of upgrading techniques: active techniques and passive techniques. Peripheral forces are needed for the active approach. Discrete surface geometries are required for the passive approaches. Both techniques are often used to enhance heat exchanger performance.

Helical tubes are widely employed in several industrial applications and have been recognized as one of the passive heat transfer enhancement methods due to their compact construction and high heat transfer coefficient. The creation of high-performance thermal systems has sparked curiosity in ways to enhance heat transport. Increasing the convection surface area or the convection heat transfer coefficient in heat exchangers results in an improvement in heat transmission. Adding inserts to the pipes or tubes is one way to raise the convection coefficient in a heat exchanger.

A heat exchanger is a device that allows two fluids of different temperatures to exchange energy. A heat exchanger makes use of the fact that energy flows wherever there is a temperature differential. in order for heat to go from a heat reservoir with a higher temperature to one with a lower temperature. The energy must go between them because the moving fluids provide the required temperature differential.

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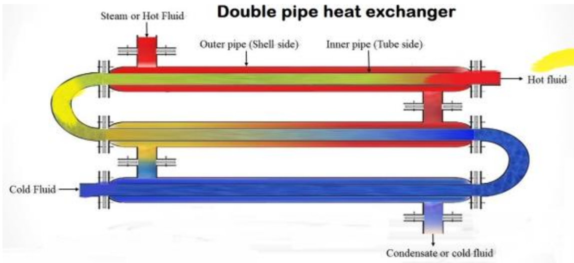

Figure 1: Double Pipe Heat Exchanger

Sensible energy or the latent heat of moving fluids may both be the source of energy in a heat exchanger. Hot fluid is the term for the fluid that provides the energy. A fluid that absorbs energy is referred to as a cool fluid. It goes without saying that in a heat exchanger, the temperature of the hot fluid will drop and the temperature of the cold fluid will rise. A heat exchanger's function is to either heat or cool the required fluid. Over the years, there has been a significant focus on improving heat transfer systems to handle high heat flow, or to decrease the size and cost of heat exchangers. Improvement of thermal conductance Rate is very important to industry in all kinds of thermo-technical equipment. In addition to reducing basic energy, it also results in weight and size reductions. Many methods for improving heat transmission have been developed up to this point. One of the most significant components of the improvement strategies used often in heat exchangers is twisted tape.

II. LITERATURE REVIEW

Idario (2022) conducted tests to use shallow square dimples in flat plate tubes to increase the heat transfer rate in compact heat exchangers. It increased the heat transfer augmentation factor by employing dimple flat tubes. The observed and projected internal coefficient of friction were found to be well correlated. The process is an improvement approach for passive heat transfer. to heat exchanger with fins and tubes. The research looks at how well fin and tube heat exchangers using basic dimple vortex generators operate on the air side.

2020 Nwabunwanne Nwokolo Heat exchangers are extensively used in several industrial applications, including gasification systems, for the goal of heat recovery. Syngas cooling in a biomass gasification system located in Melani village, Eastern Cape, South Africa, wastes a large amount of heat energy. This is explained by the fluids' relative directions in the two flows' arrangements.According to the research, a two pipe heat exchanger can effectively recover heat from the gasification system.

The many forms of fluid flow, ranging from laminar flow to turbulent flow and beyond, were discussed by Bhattacherjee (2020). Steel was chosen for the pipe because to its superior conducting qualities, and water was chosen as the fluid for the investigation. According to Naik et al. (2020), heat transmission may be improved by using various nanofluids that incorporate nanoparticles.

Sathish, M. 2019 – Because of its straightforward construction, double pipe heat exchangers are extensively utilized in a variety of heat transfer applications, from oil refineries to car radiators. Using a variety of heat transfer augmentation strategies, dimples have been shown to be the passive way with the least amount of pressure loss when compared to other techniques, increasing the rate of heat transfer in a twin pipe heat exchanger. In this study, the CFD software ANSYS FLUENT 18.2 is used to evaluate the performance of twin pipe heat exchangers with and without dimples. The configuration that provides effective heat transfer is discovered via the use of CFD findings.

2018's P. Sankar Ganesh The only thing that has inspired individuals to pursue this line of inquiry is the pursuit of greater efficiency. Research has been done to examine the many varieties of dimple tube heat exchangers. The dimples may be square, almond, or hemispherical in shape. The circumstances can also be changed to examine the system's performance and compare the outcome with that of the standard setup.

The time constant of a shell and tube heat exchanger and a DPHE was investigated by Lachi et al. (2018). This investigation's specific goal was to categorize these heat exchangers' properties under transient conditions, particularly when sudden variations in intake velocities are taken into account.

Aicher and Kim (2017) looked at the impact of counterflow in a DPHE's nozzle section that was fixed to the shell side wall. It was discovered that heat transfer and pressure loss were significantly impacted by the counter flow in the nozzle portion.

Yogeshwari (2014) spoke about the analytical solution of the differential transform method-obtained compartment-based double pipe heat exchanger model for parallel flow with theoretically variable starting and boundary conditions. Transformer oil, or hot fluid, serves as the working fluid, while water serves as the coolant. Additionally included is the solution's convergence analysis. By adding wavy strip turbulators to the inner pipe of a double pipe heat exchanger, Pourahmad and Pesteei (2016) conducted an experimental investigation and found that the heat transfer properties were significantly improved.

Experimental research on the properties of heat transmission in a horizontal rectangular heat exchanger with five triangular baffles angled at a constant 200-degree angle along the channel was conducted by Kumar S. (2014). Vibration is also used to study the same heat exchanger. Three distinct vibration intensities are used in the experiment. A comparison is made between the effects of varying vibration intensities on heat transfer and various heat transfer properties, such as the total heat transfer coefficient, effectiveness, and heat transfer rate in the absence of vibrations. It has been discovered that heat transfer properties may be somewhat enhanced by increasing vibration intensities.

According to H. Patel (2013), a double pipe heat exchanger is among the most basic types of heat exchangers and is often used for practical heating or cooling. This report outlines many methods that might improve the pace of heat transmission. Heat exchangers in the annular area are altered and compared to traditional heat exchangers while additionally using nanoparticles in water. Ansys CFX software is used to verify the practical investigation and validation of the double pipe heat exchanger findings.

III. CONCLUSIONS

The current work examined the thermohydraulic performance of several gas-to-liquid double-pipe heat exchanger topologies with helical fins using a numerical model that was built using computational fluid dynamics (CFD). We performed a numerical simulation and examined the heat transmission, pressure drop, unit weight, and overall performance of configurations with helical fins and longitudinal fins. Additionally, the effects of Reynolds number and number fin increase on thermohydraulic performance were investigated. This study uses numerical analysis to examine the thermohydraulic performance of a suggested design for an air-to-water twin pipe heat exchanger with helical fins on the annulus gas side. Utilizing the FLUENT program, three-dimensional computational fluid dynamics (CFD) simulations are run to examine the gas side fluid flow, turbulence, heat transfer, and power consumption for various heat exchanger topologies. For configurations, a CFD performance investigation was carried out under turbulent flow conditions. Nevertheless, by raising the fin height and adjusting the space between the helical insert and the heat exchanger surface, the work may be prolonged.

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