Review: CFD Analysis of Shell & Coil Heat Exchanger by Using Different Mass Flow Rate for Hot & Cold Fluid

Ajit Kumar¹, Vijaykant Pandey²
¹M-Tech Research Scholar, Bhabha Engineering Research Institute, Bhopal (M.P.), India.
²Assistant Professor, Bhabha Engineering Research Institute, Bhopal (M.P.), India.

How to cite this paper:
Ajit Kumar¹, Vijaykant Pandey², Review: CFD Analysis of Shell & Coil Heat Exchanger by Using Different Mass Flow Rate for Hot & Cold Fluid², IJIRE-V3I06-189-191.

Abstract: For many years, large-scale commercial enterprises have been interested in the treatment of waste heat. This recovery not only makes an operation more environmentally friendly, but it also allows for cost savings. Furthermore, it may lower the amount of resources required to power a facility. Many industries have implemented one-of-a-kind waste warmth recovery solutions. A warmth exchanger is a common option. This work describes the investigation of silica and alumina nanofluids in shell and helical coil heat exchangers. In this present paper, attempts are made to recall how the nanofluid will supply strain decrease in hot and cold fluid, as well as what becomes the alternate in Reynolds’ number, by evaluating the results/researched by various authors.

Key Word: Shell and Helical Coil, Nano-fluid, Heat Exchanger, CFD, Pressure Drop, Temperature Distribution, Reynolds’ number.

I. INTRODUCTION

Because of its compact construction and excellent heat transfer coefficient, shell and helical coil heat exchangers are widely used in commercial applications such as power generation, nuclear industry, system vegetation, heat recuperation systems, refrigeration, food industry, and so on. Due to their ease of manufacture, helical coils with circular move phases were widely employed in a variety of package styles. Because of the existence of centrifugal forces, floating in a curved tube differs from floating in a straight tube. These centrifugal forces form a secondary flow parallel to the primary direction of flow, with circulatory results that raise both the friction factor and the fee of heat switch. The amount of secondary drift advanced within the tube is proportional to the tube diameter (d) and coil diameter (D). Because of the more desirable warmth switch in shell and helical coiled configurations, the investigation of flow and warmth switch characteristics in the curved tube is critical. Creating fluid-to-fluid helical warmth exchangers (fluid is available on both sides of the tube wall) necessitates a thorough understanding of the warmth switch mechanism on both sides of the tube wall. Despite extensive research on the warmness transmission coefficients within coiled tubes, little work has been documented on the outside warmness transfer coefficients. One of the severe problems is warmth switch fluid, which disrupts the scale and value of warmth exchanger structures. Traditional fluids such as oil and water have partial heat switch potential. It is our first priority to produce unique types of fluids in order to reduce fees and fulfil the growing demand of industry and commerce. Through threat, advances in nanotechnology make it possible to achieve improved performance and cost savings in heat transmission technologies. Nanoparticles are occupied as the dazzling establishment of materials with potential applications in the warmth transfer place.

Nano Fluid

Nano fluid is nothing more than a fluid debris with a diameter of less than a micron (9-10 times smaller) and a highly reactive and gifted cloth that can be utilized to increase features like rate of response, heat conductivity of any metal or fabric.
and they are that much reactive and robust.

While the nano fluid circulates the nano debris, the following benefits are anticipated: [3]
- Heat conduction is higher
- Stability
- Choking not occurs in Micro passage cooling
- Probabilities of erosion reduced
- Pumping power is reducing

**ILLITERATURE REVIEW**

Because shell and helical coils are very compact in structure and have a high heat switch coefficient, they are widely used as heat exchangers. According to the literature, the heat transfer rate of a shell and a helical coil is greater than that of a straight tube.

R. Patil et.al. [1] advised on helical coil heat exchanger designing approach The heat transfer coefficient is computed based entirely on the interior coil diameter hi, using either one of the Sieder-Tate equations or a plot of the Colburn problem, JH vs Re. The outside heat switch coefficient is derived based entirely on the Reynolds number. When space is limited and under the conditions of low waft charges or laminar glide, the helical coil warmth exchanger is the better option.

Lei et al. [2] Using a periodic model, a numerical research of various baffle inclination angles on fluid flow and heat switch of non-stop helical shell and tube warm temperature exchangers was carried out. Based on the computed outcomes, it was determined that the -incorporated ordinary performance occurs about 45° helix mindset normal overall performance of heat exchanger also depends on strain drop. Leakage can reduce strain drop and, as a result, the compartment common warmth transfer coefficient.

Jyachandraiah et.al.[3] His work on CFD analysis of HCHE is highlighted by shifting unique volume float prices at the coil facet with a constant flow fee at the shell facet. The gliding price values are 40, 60, eighty, one hundred and forty LPH. The final result reveals that when the drift price at the coil aspect increases, so does the dean quantity in the coil side flow price and the general heat transfer coefficient. At forty LPH, a higher efficiency of zero.eighty was obtained.

N. Ghorbani et.al. [4]carried out experimental examination of thermal performance shell and coil warmth exchanger The purpose of this article is to discover the influence of tube diameter, coil pitch, shell facet, and tube aspect mass waft charge on the modified effectiveness and overall performance coefficient of vertical helical coiled tube warmth exchanger. The computation for the consistent condition was completed, and the experiment was carried out for both the laminar and turbulent glide inner coils. It was discovered that the mass glide price of the tube side to shell ratio had a significant impact on the axial temperature profiles of the warmth exchanger. He concluded that when the mass flow charge ratio increased, the logarithmic mean temperature distinction decreased and the modified effective's decreased with increasing mass flow rate.

K. Abdul Hamid et. al. [5] has carried out research on strain drop for an Ethylene Glycol (EG)-based nanofluid. The nanofluid is created by dilution of TiO2 in a base completely fluid of combination water and EG in a quantity ratio of 60:forty, at three concentrations of 0.5%, 1.0%, and 1.5%. The experiment was carried out in a flow loop with a horizontal tube test section at various values of waft rate for a range of Reynolds numbers less than 30,000. The experimental outcome of TiO2 nanofluid strain decrease is compared to the Blasius equation for primary fluid. It was discovered that pressure drop increases with increasing nanofluid awareness and decreases with increasing nanofluid temperature insignificantly. He discovered that TiO2 had little effect on EG fluid. Because the nanofluid viscosity decreases as the temperature rises, the strain drop decreases.

Saket A Patel et.al. [6] CFD analysis of heat transfer enhancement in a helical coil heat exchanger by modifying helix attitude was done. His attempts are made to improve the overall warmth transmission coefficient in HCHE by altering helix attitude. Warm water travels via the helical coil, while bloodless water flows through the shell facet. Three great perspectives are looking into it. CFD analysis is used to determine the best helix viewpoint. The results indicate that the most frequent heat switch coefficient rises by 33% at 20 helix versus 00 helix.

Kannaadasan et.al.[7] Experiment with warmness switch and stress decline in horizontal and vertical positions. CuO/water-based nanofluids were employed in the experiment. The graph shows that the cost of the friction component decreases as the dean variety increases. He eventually concludes that warmness transfer enhancement is greater in vertical positions than in horizontal positions.

**III.PROBLEM FORMULATION**

There may have been less work done on the heat switch fee of the shell and helical coil warmth exchanger. In my work, I'm attempting to demonstrate the CFD analysis of silicon dioxide Nanofluid with ethylene glycol as its base fluid at
0.02 m/s & 0.05 m/s mass waft charge for hot and cold fluid in shell and helical coil heat exchangers while keeping in mind that Nano fluid should produce the maximum heat transfer fee with the least amount of strength consumption. Because in certain cases, in order to improve the heat transfer coefficient, we spend more power without knowing the economic cost. Consider a 3D CAD model of a helical coil with a tube outer diameter (do) of sixteen mm, an internal diameter of helical coil (di) of 12 mm, a pitch of 26.3 mm, a pitch coil dia. of 86 mm, a tube length of 235 mm, a shell diameter of 110 mm, and a shell period of 215 mm generated with ANSYS fluent 18.2. In my investigations, I’m employing Silicon dioxide Nano fluid as the basis fluid.

IV. CONCLUSION

For numerical simulations, the unique boundary circumstances for shell and helical coil warmth exchangers are used. The numerical examination addresses the impact of Nano fluid silicon dioxide and ethylene glycol as its base fluid at mass flow rates of 0.05 m/s and 0.02 m/s on the drift and warmth transmission features of tube. Fluid thermal homes are lower in comparison to Nano fluid. We can build a shell and helical coil with tube outer diameter (do) 16 mm, internal diameter of helical coil (di) 12 mm, pitch of 26.3 mm, pitch coil dia. 86 mm, tube period of 235 mm, shell diameter 110 mm, and shell period 215 mm.

References
18. JaafarAlbadi, SatinderTayal, MushitahAlasad 2013 —warmth transfer through heat exchanger the usage of Al2O3 nanofluid at exceptional concentrationsElsevier, quantity-1, web page 38-44.