International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 6 June 2023, pp: 679-681 www.ijaem.net ISSN: 2395-5252

Review: Compact Helical Counter-Flow Heat Exchanger Numerical Analysis

Ghanshyam[1] and Vijaykant Pandey[2]
[1](M-Tech Research Scholar, RKDF College OF Technology, Bhopal (M.P.), India
[2](Assistant Professor, RKDF College OF Technology, Bhopal (M.P.), India

Date of Submission: 14-06-2023 Date of Acceptance: 24-06-2023

ABSTRACT: The execution of compact counter stream warm exchangers with helically formed sections is inspected employing a 1-D explanatory show and compared with a high-fidelity 3-D numerical reenactment. The 1-D show is able of evaluating the common patterns related with the warm exchange execution and liquid weight misfortunes, though the tall constancy 3-D numerical model is required to supply more precision .Warm exchange rate and weight drop on straight and helical blades warm exchangers were compared by keeping the length of the blade and the water powered breadth of the channel consistent

Key Word:Helical Fin Heat Exchanger, Counter Flow, Thermal Conductivity, Hot fluid, Cold fluid, Fins, Annular Fin Heat Exchanger.

I. INTRODUCTION

Because of its compact construction and excellent heat transfer coefficient, 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.

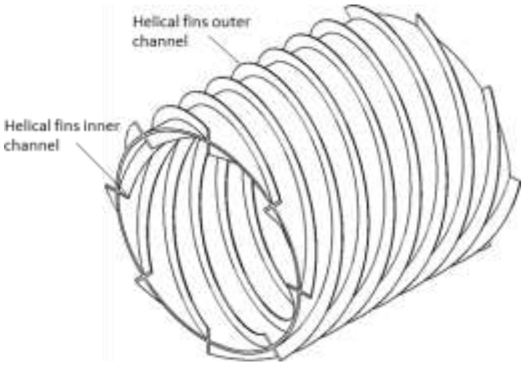

Figure 1Helical Fin Heat Exchanger

Heat exchanger execution can be progressed by choosing higher warm conductivity working liquids or increment the warm exchanger surface range or modifying the introduction of the channel and changing the geometry. In his think about the warm exchanger execution was made strides by expanding the warm exchange surface region by spiral blades.

To extend the warm exchanger execution straight outspread blades were included between the mid pipe and external pipe as well as deepest pipe.

II. LITERATURE REVIEW

Yinhai Zhu et.al [1]The heat transfer behaviors in developed and developing region son four basic fins of plate fin heat exchanger was numerically analyzed by Yinhai Zhu andYanzhong Li. Three dimensional geometries such as plain fin, strip offset fin and wavy fin were investigated for the Reynolds number range of132.3 to1323.Data reduction method was used to calculate the local Nussel t number and pressure drop. Heat transfer characteristics were obtained using j and f factors.

Lingadi Tang et al [2] Flow characteristics inside the helical pipe was analyzed by Lingadi Tang. In this study, the numerical simulation was carried out to find velocity distribution, pressure field and secondary flow variation by varying coil parameters. It also stated that secondary flow is the major factor in pressure loss, however, increase in curvature radius and coilpitchcan reduces friction factor. The numerical method was validated by experimental analysis and found that the deviation between the numerical and experimental analysis was 2.9%.

Vinous M. Hameed etal.[3]The characteristic of flow inside the helical coil, pressure drop, and heat transfer have been studied by many investigators. The performance of triangular finned tube heat exchanger was performed experimentally and numerically investigated by Vinous M. Hameed Experimental work carried out by designing and manufacturing of triangular fins using copper material and the results showed that the enhancement of heat dissipation for triangular finned tube is 3 to 4 times than smooth tube. Numerical simulation was carried out using COMSOLCFD package model and reported that the numerical results showed good agreement with experimental work.

Pranita Bichkar et.al. [4] doing research on the impact of various types on Shell and Tube Heat Exchangers This research offers numerical simulations of unmarried segmental, double segmental, and vertical arrangements. This implies that the shell has an influence on the pressure drop of the shell and tube warmth exchanger. Unmarried-segmented blocks exhibit the creation of dead zones in which the warmth switch cannot be turned green. When compared to single segment beams, double section beams lessen vibration damage. Because dead zones are eliminated when using a vertical shell, pressure is reduced. Fewer dead zones result in a greater heat switch. Reduced stress results in less pump energy, which boosts system efficiency. The comparison results reveal that the vertical is more beneficial than the horizontal.

Vidula Vishnu Suryawanshi et.al. [5] carried out research on the designing and assessment of helical coil heat exchangers CFD analyses are performed in this work on several compounds with varying sizes. The following tasks must be completed to further develop the helical heat exchanger: wall temperature and consistent wall warmness flux in both laminar and turbulent drift. To maximise the heat transfer coefficient, examine the results and alter the spiral winding pitch.

The Mohamed Ali et.al. **[6]** The experimental inquiry of herbal convection created to examine, constant type natural Convection became obtained from turbulent herbal convection to water. The experiments were carried out with a coil diameter to tube diameter ratio of four for five and ten coil tubes, as well as a pitch outer diameter ratio of five. He correlated Rayleigh amount for two distinct coil sets and discovered that the warmth switch coefficient falls with coil length for tube diameter do =.012m but increases with coil length for do=.008m. For a most heat switch coefficient, a tube diameter of zero.012 m with either five or ten coil turns yields a significant D/d0.

III. PROBLEM FORMULATION

Experimental analysis on a 3D printed helical heat exchanger was complicated by size limitations. In addition, the experimental work is mainly focused on measuring pressure and temperature at the outlet and inlet of the heat exchanger, while the 3D numerical simulation allows a clear understanding of the flow phenomenon inside the helix. screws as well as calculate the heat exchanger's efficiency.

IV CONCLUSION

This work determined the flow characteristics in the spiral segment using 3D computer analysis. The numerical results of four different cases with mass flows of 0.01 kg/s and 1 kg/s of hot and cold liquid mass flows, respectively, were calculated and compared with the model. one-way analysis. The finite volume method is used to solve the conservation of mass, momentum and energy equations. The K-omega SST model was taken into account to model turbulence in a helical heat exchanger. Analytical modeling can be used as a tool to quickly define and optimize new heat exchanger designs with a

now defined level of accuracy (compared to a detailed 3D CFD model).)
Maximum outlet temperature and pressure drop difference between 3-D CFD 1-D analysis results have been determined for several HEX concepts

REFERENCES

[1] Y. Z. Y. Li, "Three-Dimensional Numerical Simulation on the Laminar Flow and Heat Transfer in Four Basic Fins of Plate-Fin Heat Exchangers," Journal of Heat Transfer, pp. Vol. 130 / 111801-1, 2022.

[2] L. W. Y. H. Yongheng Zhang, "Study of Heat Transfer Performance of Tube-Fin Heat Exchanger with Interrupted Annular Groove Fin," IEEE, pp. 978-1-61284-459-6/11, 2011.

[3] PranithaBichkar*, OjasDandgawal, 2021 "Investigation of shell and tube warmness exchangers with baffle type effect,". Manufacturing 20 (2021) 195-200 Elsevier lawsuits

[4] Vidula Vishnu Suryawanshi, Nikhil Ghodake, OnkarPatil, Sham Lomate, Shital.G.Nerkar, 2021, “Design and analysis of Helical coil Heat Exchanger”, International Journal of Engineering Research in Mechanical and Civil Engineering volume 6 Issue 8.

[5] Vishal Momale, AdityaWankhade , PrajaktaKachare, 2019, “ Performance analysis of conical helical tube heat exchanger with straight and conical shell using cfd”, Journal of Emerging Technologies and Innovative Research, Volume 6, Issue 1.

[6] Alok Kumar, VijaykantPandey, “Analysis and Comparison of Shell & Helical Coil Heat Exchanger by using Silica and Alumina” International Journal for Research in Applied Science & Engineering Technology, 2022, Volume 10.

[7] Hamid Abdi, SoheilAsadi, Hamid AzimiKivi, Seyed Mehdi Pesteei, “ A comprehensive Numerical Study on Nanofluid Flow and Heat Transfer of Helical, Spiral and Straight Tube with different Cross section” International Journal Of Heat & Technology, 2019, Vol 37, 991031-1042.

[8] Hemasunder Banka, Dr. V. Vikram Reddy, M. Radhika 2016, ―CFD Analysis of Shell and Tube Heat Exchanger using Titanium Carbide, Titanium Nitride and Zinc Oxide Nanofluid‖ International Journal of Innovations in Engineering and Technology, Special Issue, Page 315-322.

[9] K. Abdul Hamid, W. H. Azmi, RIzalmanMamat, N. A. Usri and GohalamhassanNajafi 2015, ―Effect of Titanium Oxide Nanofluid Concentration on Pressure drop‖ ARPN Journal of Engineering and Applied Sciences, Volume 10, Page 7815-7820.

[10] Palanisamy, K. P.C. Mukesh Kumar 2019, ―Experimental investigation on convective heat transfer and pressure drop of cone helically coiled tube heat exchanger using carbon nanotubes/ water nanofluids‖, Elsevier – Heliyon 5. Sunil Kumar, Dr. DK Gupta 2020, ―Optimising Design and analysis on the Helically Coiled Tube Heat Exchanger carrying Nanofluids by providing fins‖ Smart Moves Journal IJO Science, Volume 6, Page 23-31.

[11] Shiva Kumar, K VasudevKaranth 2013, ―Numerical analysis of a Helical Coiled Heat Exchanger using CFD‖ International Journal of Thermal Technologies, Volume 3, Page 126-130

[12] Sunil Kumar, Dr. DK Gupta 2020, “Optimising Design and analysis on the Helically Coiled Tube Heat Exchanger carrying Nanofluids by providing fins” Smart Moves Journal IJO Science, Volume 6, Page 23-31.

[13] B. ChinnaAnkanna, B. Sidda Reddy 2014, ―Performance Analysis of Fabricated Helical Coil Heat Exchanger‖, International Journal of Engineering & Research, Volume 3, Page 33-39.

[14] M. Balachandaran 2015, ―Experimental and CFD study of a Helical Coil Heat Exchanger using Water as Fluid‖ International Journal of Mechanical and Production Engineering, Volume 3, Page 87-91.

[15] AshkanAlimoradi 2017, ―Study of thermal effectiveness and its relation with NTU in Shell and helically coiled tube heat exchanger‖ Elsevier Case Studies in Thermal Engineering, Volume 9, Page 100–107.