

Heat Transfer Analysis of a Coil

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Abstract: A helically coil-tube heat exchanger is generally applied in industry applications due to its compact structure, larger heat transfer area and higher heat transfer capability. Several studies from literature have also indicated that heat transfer rate in helically coiled tube are superior to straight tube due to complex flow pattern exist inside helical pipe. The concept behind compact heat exchanger is to decrease size and increase heat load which is the typical feature of modern helical tube heat exchanger. While the heat transfer characteristics of helical coil heat exchangers are available in the literature,

In this project the comparison between the two types of Cone shaped helical coiled Heat exchangers with and without Annular fins is done with three different initial velocities (8 m/s, 10 m/s and 12 m/s). For this purpose, the CAD and CFD tools are used. Catia V5 R19 is used to develop the CAD model of both Cone shaped Helical coil heat exchanger with and without annular fins. This models are further exported to the neutral file format (.igs) to perform CFD analysis. Different Boundary conditions are applied like initial flow velocity, Fluid as a air with its properties, atmospheric and fluid temperature etc. Base on the results generated through the CFD analysis, conclusion is drawn.

Keywords: *Annular Fins, Cone shaped Helical Coil, CFD tool, CAD Tool*

1.INTRODUCTION TO COILED HEAT EXCHANGERS

Helical tubes are universally used in chemical reactors, ocean engineering, heat exchangers, piping system and many other engineering applications. It has been long recognized that heat transfer characteristic of helical tubes are much better than that of straight ones because of the occurrence of secondary fluid flow in planes normal to the main flow inside the helical structure. In the present study an experimental investigation of heat transfer in cone shaped helical coil heat exchanger is reported for various Reynolds number. The purpose of this study is to design and fabricate a non-previously implemented shell and cone shaped helical coil and fitted with a twin cylinder diesel engine to recover waste heat from the exhaust gas to heat water. A “C” program was developed for the easiness of the design and an AutoCAD model of the design was made. For the fabrication of the coil, copper tubes were used. To evaluate the designed value various temperatures have taken for various mass flow rate of the water. The results show that the design value are having a good agreement with the experimentally obtained value. It was found that the heat transfer rates are 1.18 to 1.38 times more for the cone shaped helical coil than that of simple helical coil.

Helical Coil Heat Exchanger (HCHE) is a type of heat exchanger which has a shell called annulus and inside it, there is a helical coil

Heat Transfer Coefficient:

Convective heat transfer is the transfer of heat from one place to another by the movement of fluids due to the difference in density across a film of the surrounding fluid over the hot surface. Through this film heat transfer takes place by thermal conduction and as thermal conductivity of most fluids is low, the main resistance lies there. Heat transfer through the film can be enhanced by increasing the velocity of the fluid flowing over the surface which results in reduction in thickness of film.

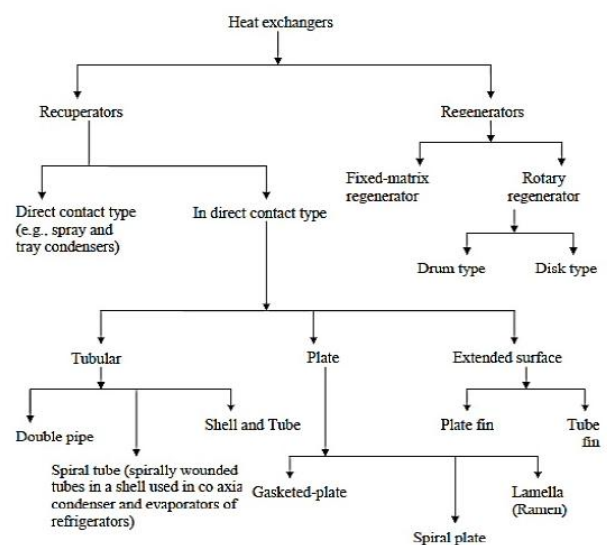


Fig. 1.1: Classification of Heat Exchangers

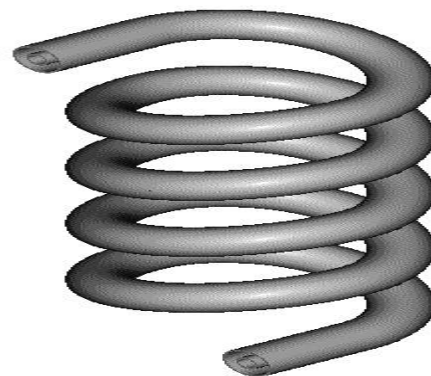


Fig. 1.2: Double pipe helical coil

Solution methods

Energy equation was turned on and the ($k-\epsilon$) model, with standard wall functions was used to model the turbulent behavior.

- Scheme:- SIMPLEC
- Skewness Correction:- 1
- Gradients:- Least Square Cell Based
- Pressure:- Linear
- Momentum:- Power Law
- Turbulent Viscosity $\{\mu\}$:- Power Law
- Turbulent Dissipation $\{\epsilon\}$:- Power Law
- Energy:- Power Law

Performance of CFD Analysis

By applying all the boundary conditions and required properties, CFD analysis is to be performed. It involve following steps.

- 1) Importing of geometry into module.
- 2) Performing meshing operation on imported geometry.
- 3) Applying boundary conditions.
- 4) Applying fluid (water/Air) properties.
- 5) Applying velocity, pressure, temperature, hydraulic diameter etc.
- 6) Performance of solution intervals.
- 7) Result obtaining and saving.

II.CONCLUSION

By observing all the results obtained in both cases, it is concluded that the annular fins provide the better heat transfer as compared with the heat exchanger without annular fins. Hence if Cone shaped helical coil heat exchanger is used for the heat extraction process. Then annular fins mounting on the device will provide more better heat transfer and can improve the efficiency of the heat exchanger. Also, the initial flow velocity will affect the performance of the heat exchanger. Hence to achieve the better performance of the heat exchanger, annular fin mounting along with specific velocity is suggested

III.REFERENCES

- [1] Bagoutdinova Alfiya Gizzetdinovna, "Engineering Calculation and Experimental Study of a Cone-Shaped Coil Heat Exchanger". Department of General Mathematics of the Lobachevsky Institute of Mathematics and Mechanics, Kazan Federal University <https://doi.org/10.29042/2020-10-5-163-173>, Helix (2020) 10 (5): 163-173
- [2] Hitesh Khurana, Rudrodip Majumdar, and Sandip K Saha, "Numerical Investigation on the Performance of the Helical and Conical Coil Heat Exchanger Configurations in the Dynamic Mode of Heat Extraction". Department of Mechanical Engineering,

Indian Institute of Technology Bombay, Mumbai-400076, INDIA., EEP, School of Natural Sciences and Engineering, National Institute of Advanced Studies, Bengaluru-560012, INDIA

- [3] Mukesh Kumar1, Professor Manojkumar Singh, "Heat Transfer Analysis of Cone Shaped Helical Coil Heat Exchanger of Different Pitches and Diameter". International Journal of Advanced research in Science and engineering, Vol. No. 6, Issue No. 7, July 2017, www.ijarse.com
- [4] Yamini Pawar, Ashutosh Zare, Ashish Sarode, "Helically Coiled Tube with Different Geometry and Curvature Ratio on Convective Heat Transfer:A Review". International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763, Issue 10, Volume 3 (October 2016) www.ijirae.com
- [5] Dr. B.Jayachandraiah, H.S.S.K.Praveen, "Heat Transfer Analysis of a Helical Coil Heat Exchanger by using CFD Analysis". International Journal of Computational Science, Mathematics and Engineering, Volume. 3, Issue. 5, 2016, ISSN-2349-8439
- [6] Umang K Patel, Prof. Krupal Patel, "CFD Analysis Helical Coil Heat Exchanger". Vol-3 Issue-2 2017 IJARIE-ISSN(O)-2395-4396
- [7] Sumedh Hajare, P. N. Chaudhari, "Design and fabrication of conical helical coil heat exchanger for waste heat recovery from exhaust of diesel engine.". International Engineering Research Journal, Special Edition PGCON-MECH-2017
- [8] Shinde Digvijay D., Dange H. M., "Heat Transfer Analysis of a Cone Shaped Helical Coil Heat Exchanger". International Journal of Innovations in Engineering and Technology (IJJET)