

# Bibliometric Study of Double Pipe Helical Coil Heat Exchanger

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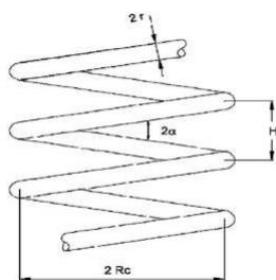
**Abstract:** *Bibliometric analysis is a statistical representation of publications to identify the most governing sources of research that prevail in the specified area of research. This paper focuses the various researches on helical tube heat exchangers. The helical tube heat exchanger gives certain advantages over a straight tube, shell and tube heat exchangers because of its dense structure, large area of heat transfer, and large heat transfer capability. In this, the relevant journals, authors, institutions, and countries to research helical tube heat exchangers with different models and different mass flow rates of fluids and their heat transfer rate have been analyzed. This Bibliometric data has been taken from Scopus. The main aim of most researchers is how to increase the heat transfer rate by varying some input given. From the few years of analysis, this research has been increased and was studied through CFD which gives accurate results.*

**Keywords:** Bibliometric analysis, Double pipe, Helical coil, Heat exchanger, study.

## 1. Introduction

A heat exchanger is a device that transfers thermal energy between two or more fluids, and they are used in a wide range of technical applications. The goal of building a heat exchanger is to achieve an effective way of heat transfer from one fluid to another.

A double pipe heat exchanger, also known as a tube in tube heat exchanger, is made up of one pipe inserted concentrically inside another pipe with a larger diameter. There are two forms of flow in this configuration: parallel flow and counter - flow. It can be configured in a variety of series and parallel configurations to satisfy a variety of heat transfer needs, as shown in fig.



**Figure:** A basic double pipe helical heat exchanger

The inner diameter of the pipe is  $2r$ , while the coil diameter is  $2Rc$ . Pitch is the distance between two adjacent turns ( $H$ ). Curvature ratio is the ratio of inner pipe diameter to coil diameter. The tubes' curvature provides a secondary flow that is perpendicular to the primary axial flow direction. The heat transmission between the wall and the flow is improved by this secondary flowing fluid. They also provide a larger heat transfer surface in a smaller space, as well as higher heat transfer coefficients. The coil's projection in a plane that passes through the coil's axis. The helix angle is the angle formed by one turn of the coil projected onto a plane perpendicular to the axis.

### Advantages:

Helical coil heat exchangers have the following rate as compared to others, as per current improvements in various industries that require effective heat transfer systems. The primary advantages of the helical pipe heat exchanger are:

- 1) It has a larger surface area than a straight tube, so the heat transfer rate is higher.
- 2) Because of its small footprint, it takes less floor space.

### Applications:

- 1) Because of their greater heat transfer coefficient values, they are commonly utilised in chemical reactors and agitated vessels.
- 2) Helical coils may be easily used in steam generators and other industrial locations due to their compact configuration. .
- 3) And, because the secondary motion contained in the helical coil removes the radial concentration gradient, it's also useful for analysing the properties of plug flow reactors in reaction kinetic investigations.
- 4) Helical coils have a self - induced radial acceleration field, which makes them unique.

### Bibliometric analysis:

Bibliometric analysis is a most used research technique for determining the state of the art in a specific topic. The method can be used to describe trends of publishing within a certain period or body of literature using quantitative analysis and statistics.

Bibliometrics is the study of books, papers, and other publications using statistical methods. In the subject of library and information science, bibliometric methods are extensively utilized. Scientometrics is a sub - discipline of bibliometrics that deals with the examination of scientific publications.

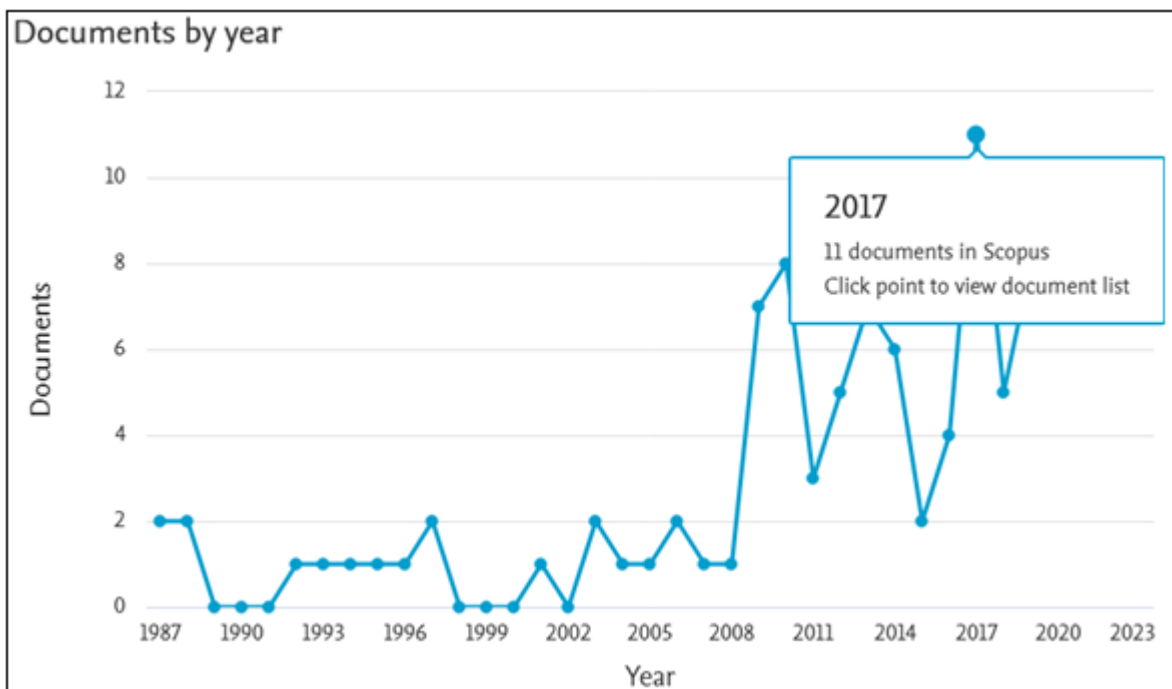
In this Bibliometric analysis, keywords are taken as "helical pipe heat exchanger". The data has been taken from Scopus, found 107 documents from it and the following data has been rewritten according to the order in relevance.

Most of the keywords used by the Authors are Double - pipe transfer intensification; Helical tube; Laminar flow; heat exchanger; Exergy analysis; Helical tape insert, Heat Twisting structure.

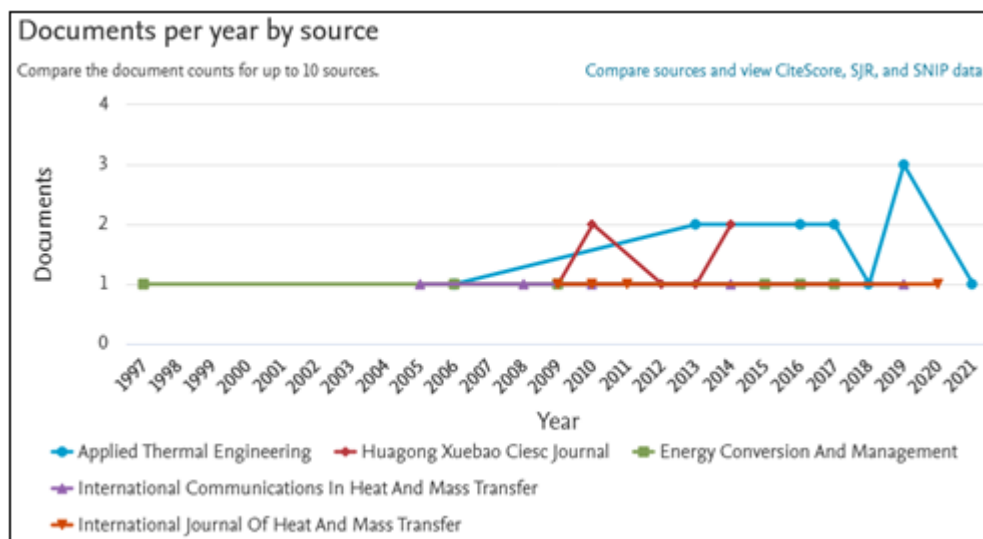
Ref. No.	Year	Significance	Outcome
1.	2017	Heat exchanger properties by different cross sectional area, taper angles	Optimum design has been designed and compared with double pipe straight heat exchanger
2	2010	In this, the outer side of the heat exchanger's wall has a helical corrugation that creates a helical rib on the inner side of the tube wall, causing extra fluid particle spinning. .	Heat exchangers with helically corrugated walls have an increased inner side heat transfer rate of 80 - 100 percent due to more developed swirling motion, whereas the relative pressure drop is 10 - 60 percent higher than standard helically coiled heat exchangers.
3	2011	For enhancement of heat transfer helical baffles are used compared with ones with a smooth inner tube in a heat exchanger	To further improve its heat transfer effectiveness, various more improvement measures should be implemented, such as a heat exchanger with a big pitch angle to augment the secondary flow at the helical channel's centre.
4	2010	In this, some pin fins were installed along the centre line of helical channel formed by helical fins on the outer shell of inner pipe. This enhancement of heat transfer mechanism was analyzed by applying the field coordination theory	By reducing the pitch of pin fins by half, the heat transfer was much better. And at the same pressure drop and pumping power, the heat transfer with odd - numbered pin fins within one pitch was a little better than that with even - numbered pin fins.
5	2017	The design and thermo - hydraulic performance of a double pipe heat exchanger with helical baffles on the annulus side were explored and compared with CFD results in this paper.	Compared to simple double - pipe exchangers, it has better heat transfer performance and a lower pressure drop. And it's a function of baffle spacing and Re that gets bigger.
6	2016	The inner wall is helically corrugated and has alternating ridges and grooves, which makes it geometrically unusual. The pipe wall provides a swirl flow component overlaid on an axial flow inside both fluid streams due to the continual helical twist.	Counter - flow operation increased heat transfer rates, although it was dependent on whether the fluid characteristics were temperature - dependent or constant. For the examples studied, Reynolds numbers varied from 420 to 2000.
7	2018	A copper - wire fin is soldered on the exterior portion of the internal tube to boost the rate of heat transmission in the annulus section.	The final results demonstrate the validity of the proposed correlation as well as the increased overall heat transfer coefficient due to the fin in the annulus.
8	2019	Two main convective heat transfer factors, the Dean number and torsion, are taken into account while studying heat transfer and flow characteristics.	With increasing Dean number, the Nusselt number in the inner tube and annulus rises and is affected by pitch and has a maximum value. To determine Nusselt number in terms of Dean number, Prandtl number, and dimensionless pitch, a correlation is proposed. .
9	2021	The heat transfer and fluid flow in a swirl generator - equipped double - coil heat exchanger with a curved structure in the inner channel were quantitatively investigated. To produce swirl flows, the suggested turbulator comprises a curved frame with 12 blades. In addition, two holes were proposed in the turbulator's semi - conical section. .	The turbulator - generated swirl flows had a considerable impact on heat transfer enhancement. Enhance the inner radius of the turbulator by 26.7 percent to expand the efficacy by 80%, and increase the radius of the turbulator's hole by 133.34 percent to increase the effectiveness by around 50%.
10	2021	Laminar flow's hydrothermal and exergy features are numerically investigated. In the tube side of the heat exchanger, helical screw - type tape inserts are used, with four distinct configurations in the annulus.	Due to more uniform nanoparticle distribution, the rate of overall heat transfer enhancement is discovered and may be higher in setups with more intensive mixing. To determine exergy efficiency, an exergy analysis is carried out.
11	2021	The single helical tube has been widely investigated in both smooth and corrugated wall designs. This study, on the other hand, is the first to propose and test a helical tube - in - tube heat exchanger with corrugated inner and outer tubes.	The findings show that corrugating the outer tube in addition to the inner tube considerably boosts the heat exchanger's thermal capacity while reducing the weight, area, and dimension of the heat exchanger.
12	2021	This paper presents an entropic analysis of a double helical tube heat exchanger having circular depressions on both the inner and outer tubes. An experimentally validated 3D numerical simulation is employed to fulfil the study's goal. The entropic features of four examples are investigated and presented.	The results reveal that while adding circular depressions to both tubes improves the heat exchanger's heat transmission capabilities, it also increases the entropy generation level. Case "d, " in which any circular depression of the outer tube is positioned between any two continuous depressions of the inner tube, achieves the best thermal performance.
13	2021	In this study, the effect of fins on flow behaviour and heat transfer in a shell and tube heat exchanger was investigated. In this regard, published experimental data for a helical tube without fins back up the current findings.	The results show that using extended surfaces boosts the heat transfer rate substantially. The projected results also demonstrate that the fin material has no effect on heat transfer.

14	2021	Numerical analysis of the hydrothermal and exergy properties of laminar flow in tiny double - pipe heat exchangers (DPHXs) with tube - side helical insert and annulus - side helical strip. Helical screw - type tape inserts are employed in the tube side of the heat exchanger, and four distinct helical strip designs are used in the annulus side.	Due to more uniform nanoparticle distribution, the rate of overall heat transfer enhancement is observed to be higher in configurations with more intensive mixing. To determine the exergy efficiency of DPHXs with various configurations, an exergy analysis is carried out. .
15	2021	The goal of this work is to investigate heat transport in a helical tube with twisted tape insert that is subjected to a constant wall temperature numerically.	Nu and f correlations are used in this work to forecast heat transfer and pressure drop based on a set of characteristics. This study paves the way for the development of a high - performance heat exchanger for industrial applications.

The following data has been taken from Scopus by taking the key words as ‘Helical pipe heat exchanger’.



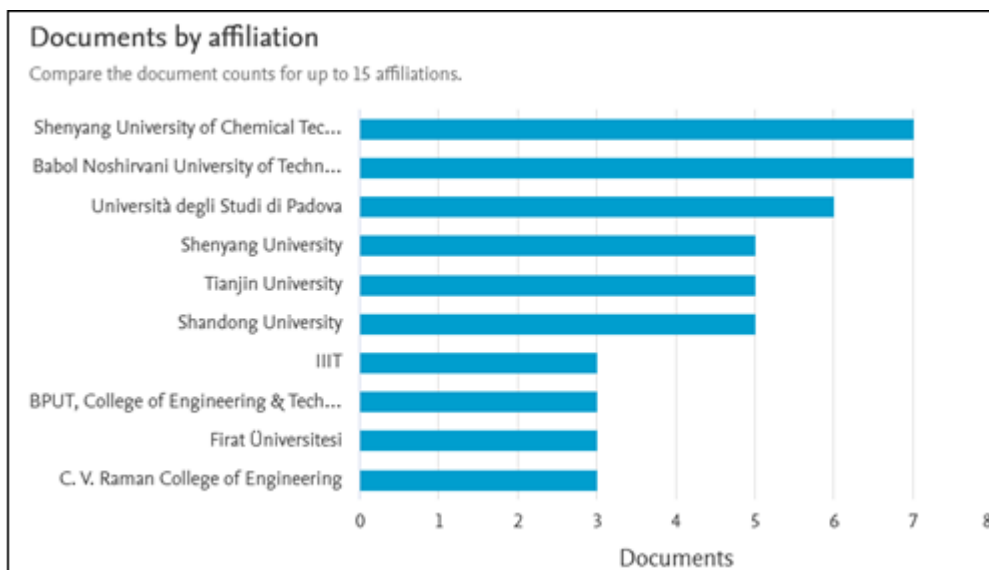
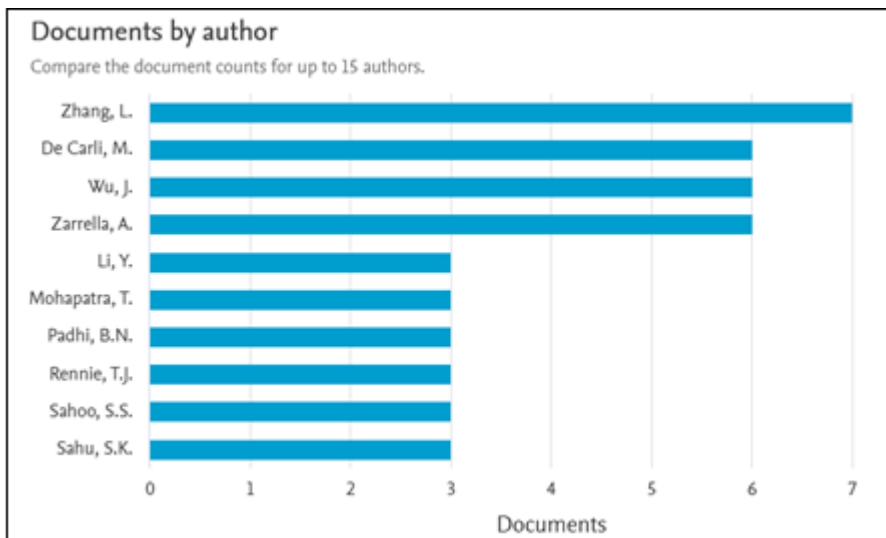
The graph above depicts the number of documents published on this topic from 1987 to the present. Since 2007, the number of papers published has grown. The year 2017 saw the highest number of research articles published.



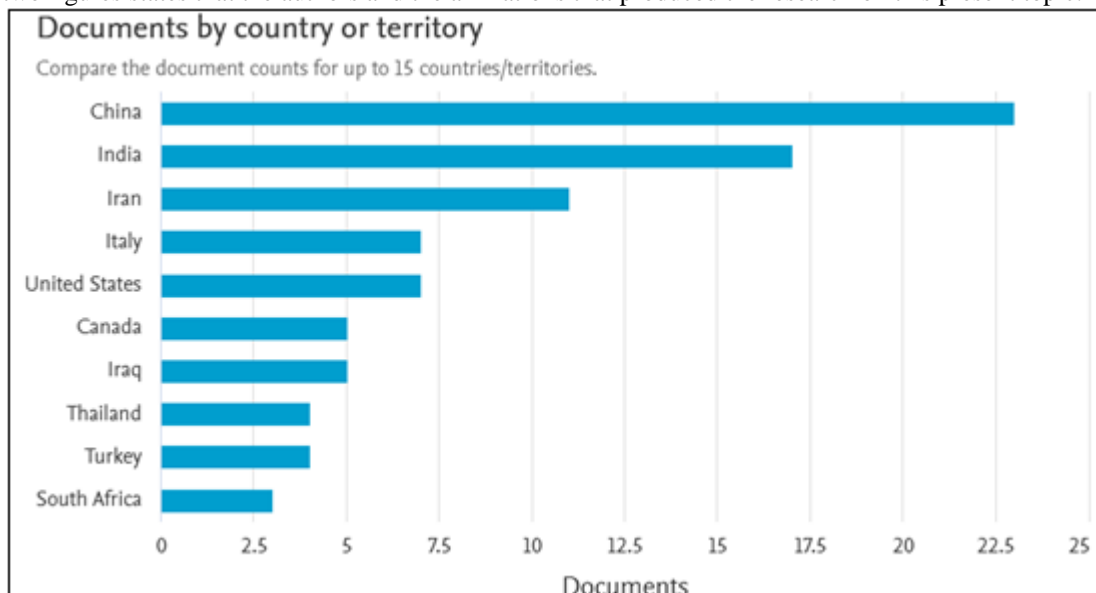
The major sources of publishing documents for the present topic are

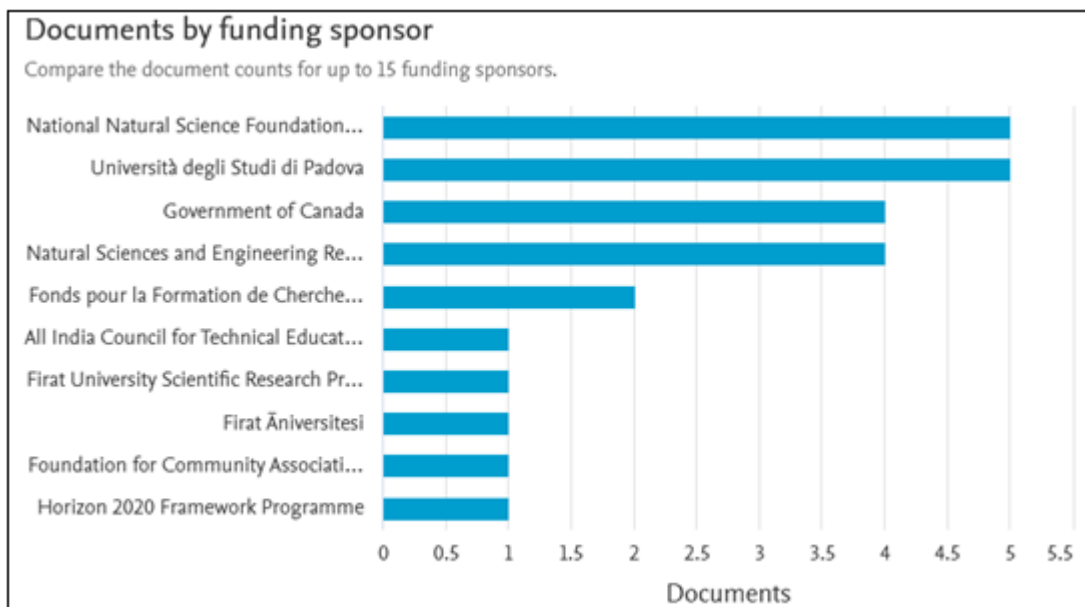
- 1) Applied thermal engineering
- 2) International Journal of Heat and Mass transfer
- 3) International communication in Heat and Mass transfer
- 4) Energy Conversion and Managements.

So according to the year the data has been retrieved in the form of a graph as shown in above fig. papers was published in the year 2017.



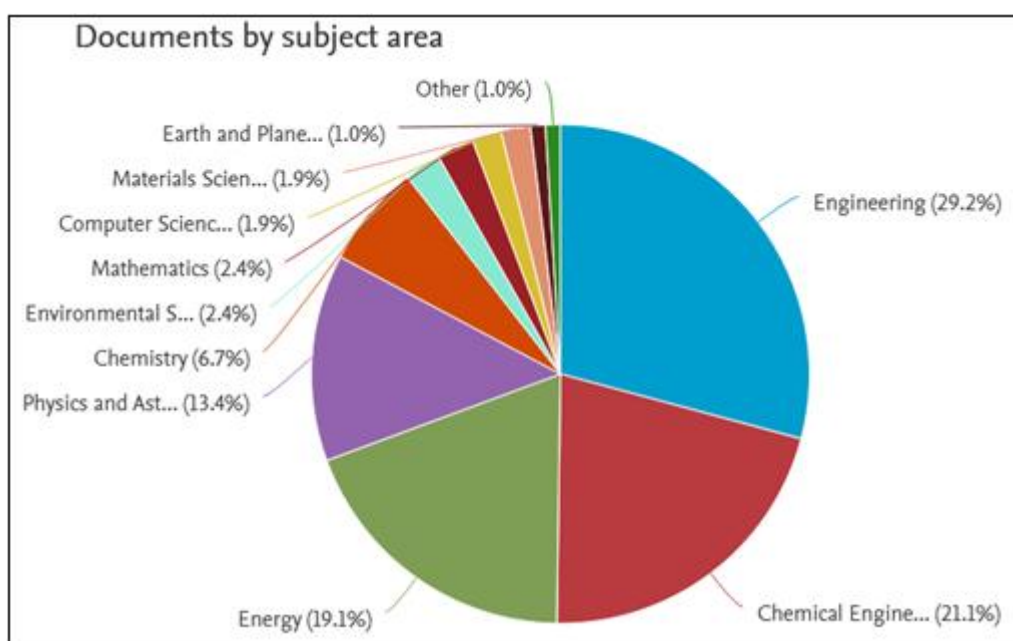
The above two figures states that the authors and the affiliations that produced the research on this present topic.





From the above two figures we can note that, most of the research has done by China. The National Natural Science foundation, China has sponsored maximum number of

documents related to this. And India is the second most country to do research in this area because of Industrialization.



The majority of the documents are about engineering for industrial refrigeration as well as power generating. Heat exchangers are extensively used in the chemical industry for heat recovery and to exhaust hot gases. Heat is transferred from a gas to a liquid to accomplish this (usually water or thermal oil). In the chemical sector, ACHEs are extensively used for petrochemical and steam cooling applications.

## 2. Conclusions

There is a substantial quantity of study on Helial pipe heat exchangers and their uses accessible. There have been some fascinating attempts to increase the rate of heat transmission. Exploration of critical mechanical, thermal, and physical qualities is a major focus in these. The findings of this study have been published in prestigious journals such as the

International Journal of Heat and Mass Transfer and the International Journal of Refrigeration.

- The bibliographic analysis demonstrates that there has been a substantial amount of research on heat exchangers, notably on improving heat transfer rates.
- This investigation also assisted in identifying significant research organisations that are actively involved in refrigeration research.
- It was discovered by examining many publications that the double tube helical coil heat exchanger has a higher heat transfer rate than the straight double tube heat exchanger.
- It is compact and takes up less area for the same temperature drops. This is really important because it may be used in plants with limited space.
- Outside, high velocity and temperature are noticed due to

centrifugal action.

- CFD was determined to be a highly valuable technique for the investigation of double tube helical coil heat exchanger findings were within close tolerance with realistic values.

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