ISSN : 2455-9679
Impact Factor : 3.340

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"THERMAL ANALYSIS OF SIMPLE AND TUBULAR TYPE HEAT EXCHANGER USING FEA SOFTWARE"

Manish Kumar [1], Rajneesh Gedam [2]

[1 1] PG, Scholar, Department of Mechanical Engineering, Bhabha Engineering Research Institute, Bhopal, Mp, India
[2] Associate Professor, Dept. of Mechanical Engineering, Bhabha Engineering Research Institute, Bhopal, Mp, India

ABSTRACT

The present thesis deals with the overall heat transfer study in simple tube and twisted tubular tube heat exchanger. The heat transfer rate, thermal performance and friction factor characteristics of corrugated twisted tape inserted tube are investigated experimentally. The experiments have been performed for the tube fitted with corrugated twisted tapes with different pitches and also for different wave numbers. Based on the experimental results, it is observed that simple tube and twisted leaf tubes are used and various thermal results are calculated. When simple tube heat exchanger used then streamline velocity, pressure, wall heat flux, wall shear, and temperature results are 7.48 m/s, -7e+7 Pa, 0.009 w/m^2 and 336.6 K while in case of twisted leaf tube heat exchanger used then streamline velocity, pressure, wall heat flux, wall shear, and temperature results are 1.8 m/s , 5.603 Pa, 0.19w/m2 and 339.6 K. Here this is observed twisted leaf heat exchanger pressure, temperature and heat flux is more than simple tube.

Key Words: *Heat, CFD, Pressure, Flux, Tubular, Shear, Velocity, Twist Tape.*

I. INTRODUCTION

Heat exchanger is a device that continuously transfers heat from one medium to other medium in order to carry process energy. A Double pipe heat exchanger (DPHE) is for the most part utilized in moderate weight application ventures. Twofold pipe heat exchanger in its straightforward one pipe inside the another bigger pipe. Twofold pipe heat exchanger application are Pre-heating , petrochemical, nourishment preparing businesses , pharmaceutical, power and electric age. In the Double pipe type heat exchanger one fluid move through the annulus between two pipe and another fluid stream inside the internal pipe. An Outer Tube is an enormous weight vessel and internal cylinder and turned tape are significant parts in DPHE,.In twofold pipe heat exchanger the diverse kind of enhancements are utilized like Twisted tapes ,balances, baffles. Here in my investigation I utilized contorted tapes for the upgrades.

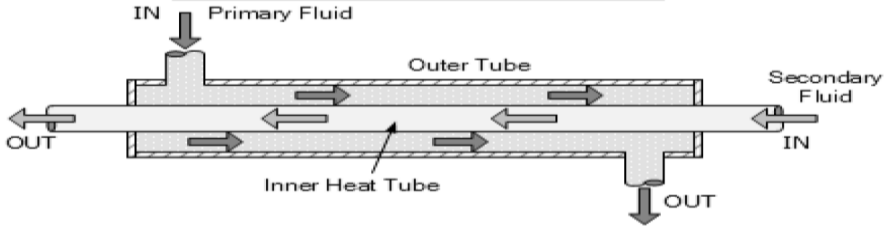

Fig.1.1 Double pipe heat exchanger

ISSN : 2455-9679
Impact Factor : 3.340

II. METHODOLOGY

CFD is a sophisticated computationally-based design and analysis technique. CFD software gives you the power to simulate flows of gases and liquids, heat and mass transfer, moving bodies, multiphase physics, chemical reaction, fluid-structure interaction and acoustics through computer modeling. This software can also build a virtual prototype of the system or device before can be apply to real-world physics and chemistry to the model, and the software will provide with images and data, which predict the performance of that design.

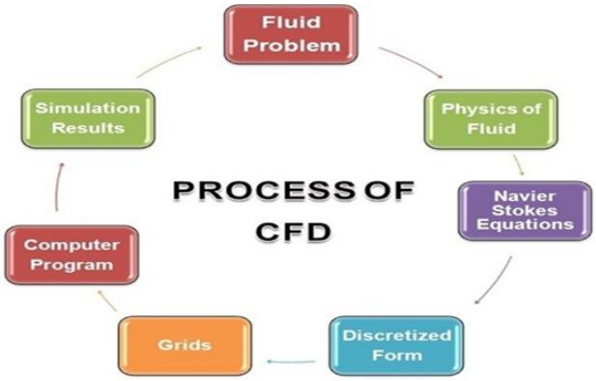

Fig.2.1

CFD analysis of helical coil heat exchanger using Ansys 17.0, Cad model Generation of 3D model by using CATIA V 5R20 and exporting to the IGES. and then import in ANSYS fluent 17.0.

- **PRE PROCESSING**:

Create geometry and mesh for solving problem

- **CAD model**
  - ✓ Generation of 3D model by using CATIA ver 5.0

- **FVM approach:-**

By this method we can solve algebraic equation to get initial solution.

- ✓ Set the transportation equation that needs to be solved. This can be solved by using ANSYS Fluent 14.0 in Fluent setup
- ✓ Set the fluid property
- ✓ Set the boundary conditions
- ✓ Set the Source term (Pressure)

- **SOLUTION:**

Solution Method

- **Pressure Velocity coupling scheme**

  For 2D Problem we use Stream Function Vortices approach.
  For 3D Problem we use Primitive variable approach.
  Collocated grid should be used to solve pressure velocity coupling scheme.

- **Turbulence Modeling:-**

ISSN : 2455-9679
Impact Factor : 3.340

K-ε turbulence model for turbulent flow equation Momentum second order Turbulence Kinetic energy second order (K)

- Turbulence dissipation rate second order(ε)

- **SOLUTION INITIALIZATION:-**

Initialized the solution to get the initial solution for the problem.
By using SIMPLE solver (Semi – implicit method for pressure linked equation).

- **RUN SOLUTION:-**

Run the solution by giving 300 no of iteration for solution to converge.

- **POST PROCESSING:-**

❖ Post Processing:- For viewing and interpretation of Result, the result can be viewed in various formats like graph, value, animation etc.

Table. 1 Geometric dimensions of shell and tube heat exchanger

Sr. no	Part name	Specification
1	Inner pipe (inner diameter) (di)	25 mm
2	Inner pipe (outer diameter) (do)	26.5 mm
3	Outer pipe (inner diameter) (Di)	54.5 mm
4	Outer pipe (outer diameter) (Do)	56 mm
5	Pipe length (L)	2000 mm

III. SIMULATION AND MODELLING

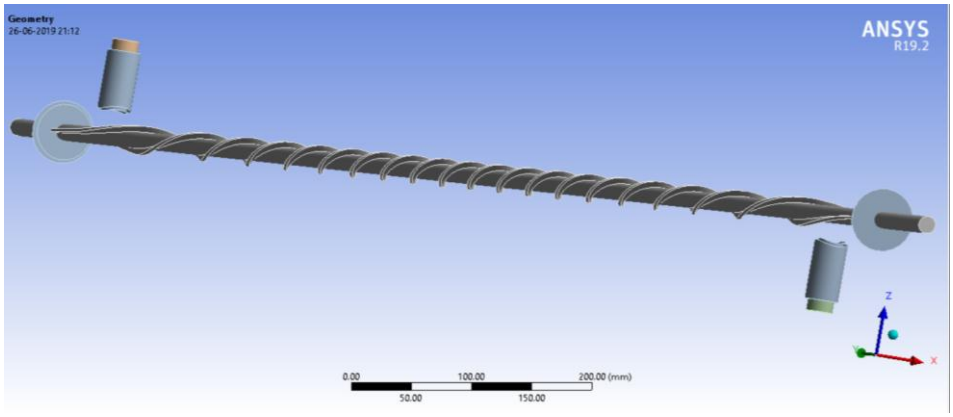

Fig.3.1 Twisted leaf Tube Heat exchanger model imported to ANSYS

ISSN : 2455-9679
Impact Factor : 3.340

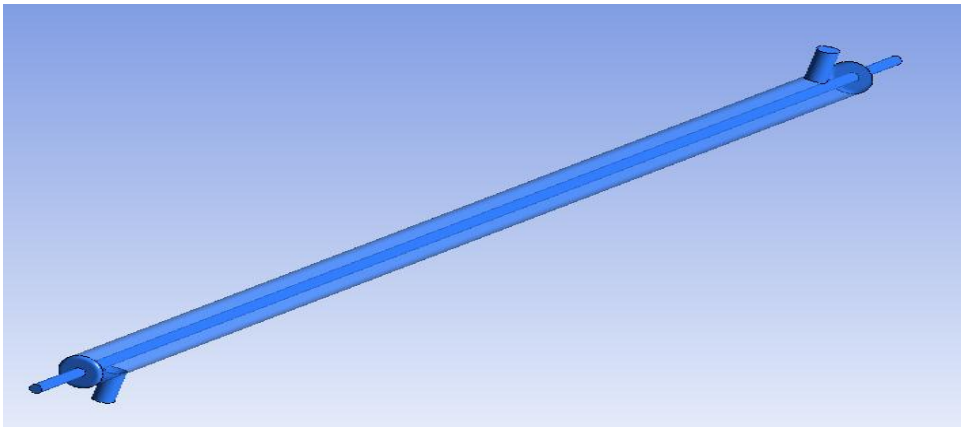

Fig 3.2 Simple Tube Heat exchanger model imported to ANSYS

Boundary condition :

MODEL CALCULATIONS:

1. Hot water inlet temperature, t_{hi} = 327 K

2. Hot water flow rate, m_h

Let time required for 1lit of water be x_h sec

Mass of 1lit water = 1kg

Therefore, m_h = 1/ x_h kg/s = 1/15.6 = 0.064 kg/s

3. Cold water inlet temperature, t_{ci} = 303K

4. Cold water flow rate, mc

m_c = 1/ x_C kg/s = 1/15.2 = 0.066 kg/s

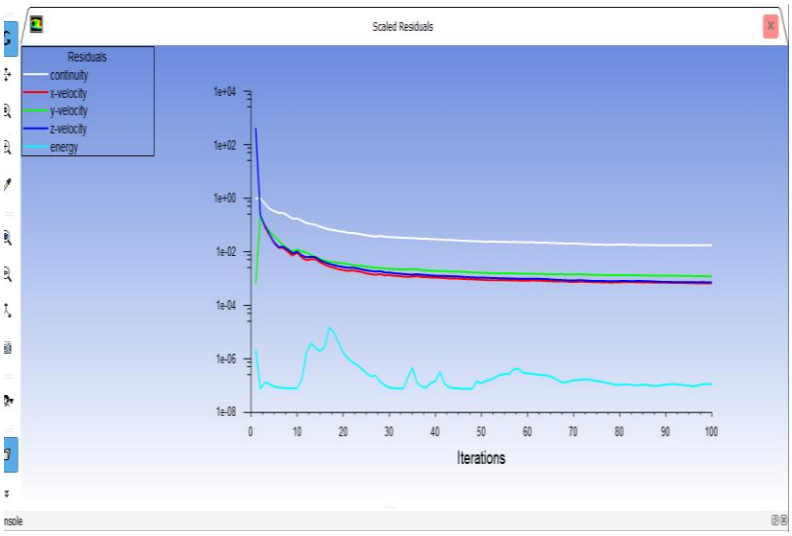

Fig.3.3 Twisted leaf Tube Heat exchanger applied iteration

ISSN : 2455-9679
Impact Factor : 3.340

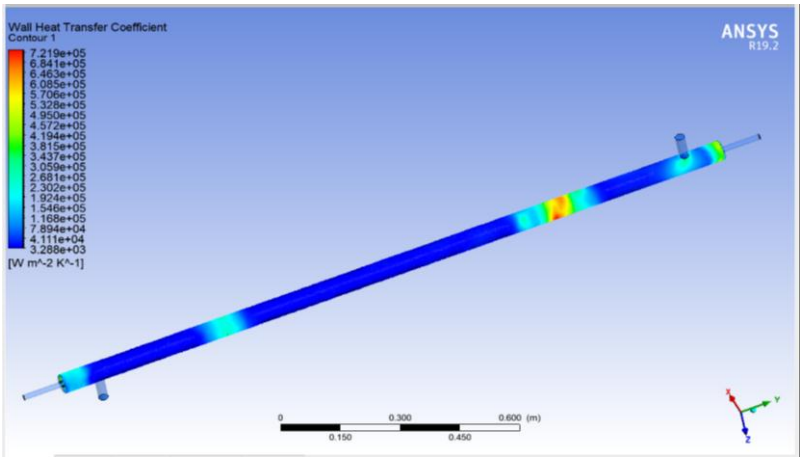

Fig 3.4 Heat flux on helix tube heat exchanger

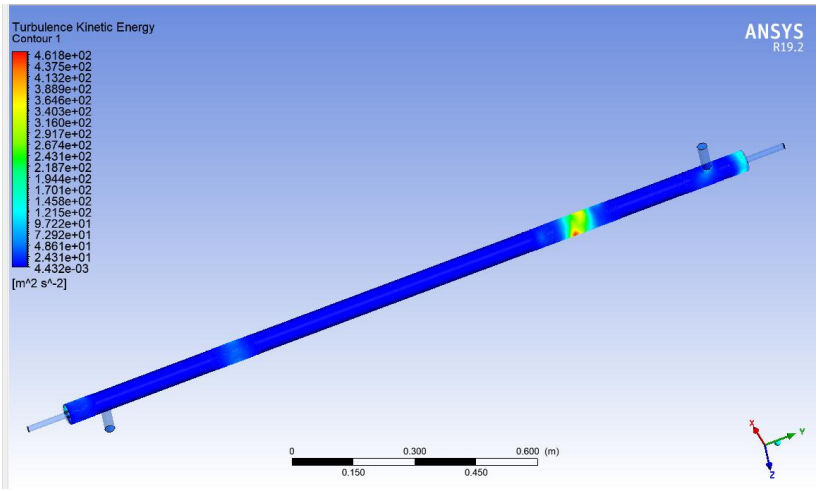

Fig.3.5 Turbulence kinetic energy result helix tube heat exchanger

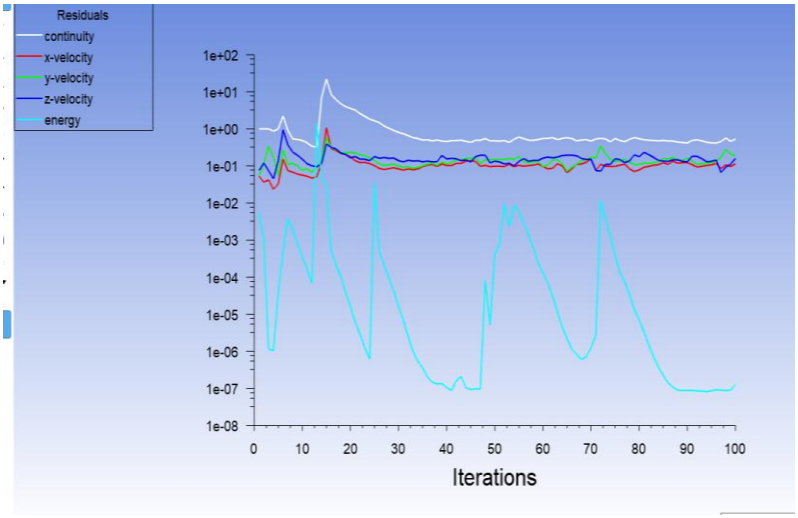

Fig.3.6 Simple Tube Heat exchanger applied iteration

ISSN : 2455-9679
Impact Factor : 3.340

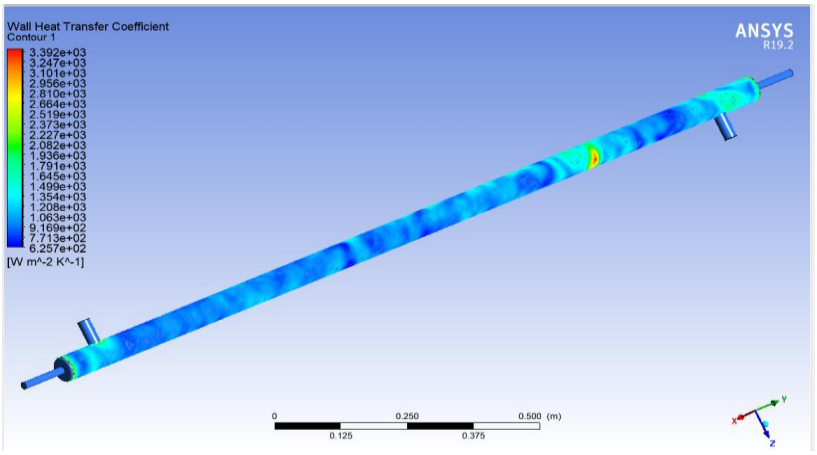

Fig. 3.7 heat transfer result at simple tube heat exchanger

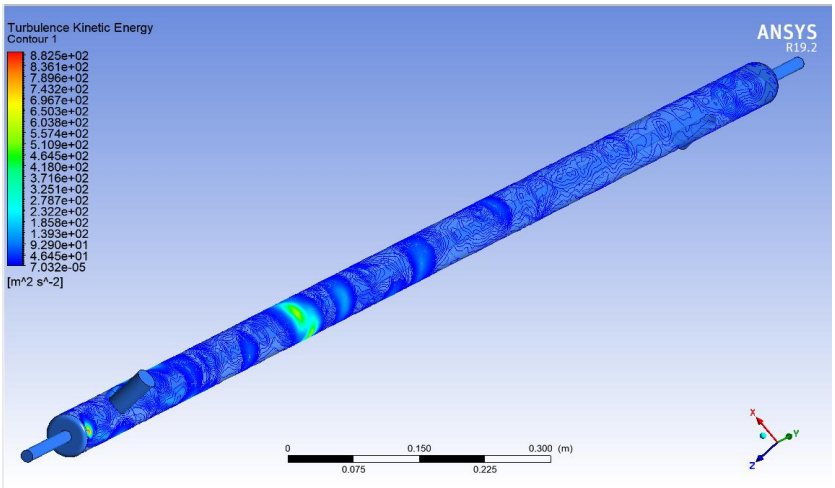

Fig. 3.8 Turbulence kinetic energy result at simple tube heat exchanger

IV. RESULT AND DISCUSSION

The heat transfer enhancement, thermal performance and friction factor characteristics of corrugated twisted tape inserted tube will be investigated computational experimentally set up ANSYS used and perform CFD analysis 19.2 version. The computational experiments will be performed for the tube fitted with corrugated twisted tapes. Based on the computational set up experimental results, following will be parameters which could be summarized as follows:
In this project simple tube and twisted leaf tubes are used and various thermal result find out.
When simple tube heat exchanger used then find out Simple Tube , Turbulence kinetic energy $8.825e^{+3}$ m^2/s^2, Heat flux 3390 w/m²
When twisted leaf tube heat exchanger used then find out Twisted tubular Tube, Turbulence kinetic energy $4.618\ e^{+2}$ m^2/s^2 , Heat flux 720000 w/m²
Here this is observed twisted leaf heat exchanger heat flux and heat exchanger effectiveness is more than simple tube and Here this is observed Turbulence kinetic energy twisted leaf heat exchanger is less than simple tube So this is suggested in future for more efficiency

ISSN : 2455-9679
Impact Factor : 3.340

Table 4.1 Results comparison table

S.NO	Geometries	Turbulence kinetic energy (m^2/s^2)	Heat flux (w/m^2)
01	Simple Tube	$8.825e^{+3}$	$3.39e^{+3}$
02	**Twisted tubular Tube**	**$4.618\ e^{+2}$**	**$7.2\ e^{+5}$**

V. CONCLUSION

The heat transfer enhancement, thermal performance and friction factor characteristics of corrugated twisted tape inserted tube will be investigated computational experimentally. The experiments will be performed for the tube fitted with corrugated twisted tapes with different pitches and also for different wave numbers . Based on the experimental results, following will be parameters which could be summarized as follows:

- To simulate the concentric heat exchangers with plain tube and Twisted Tape Inserts to determine effectiveness of both heat exchanger by CFD analysis.
- To investigate the effect on heat transfer rate in concentric heat exchangers with plain tube and Twisted Tape Inserts.
- The highest heat flux among the inserts tested and amount by which it is higher than the value of the plain tube.

REFERENCES

[1] **R.Santhaseelan , Dr. C. Mathalai Sundaram, T. Sudarsanan**" Numerical Analysis of Heat Transfer in a Pipe Using Twisted Tape Inserts" International Journal of Recent Trends in Engineering & Research (IJRTER) Volume 05, Issue 01; January- **2019**

[2] **Hardik V Solanki, Jignesh M Barot" CFD Analysis of Double Pipe Heat Exchanger with Twisted Tape Insert in Inner Pipe"** International Journal for Research Trends and Innovation, Volume 3, Issue 4 | ISSN: 2456-3315, **2018**

[3] **V Manikanta, D V N Prabhakar, N V S Shankar** "**Effect of Twisted Tape Insert On Heat Transfer During Flow Through A Pipe Using CFD"** International Journal of Engineering Research & Science , Vol-3, Issue-5, May- **2017**

[4] **S. Tamna, Y. Kaewkohkiat, S. Skullong, and P. Promvonge**, "Heat transfer enhancement in tubular heat exchanger with double V-ribbed twisted-tapes," *Case Stud. Therm. Eng.*, vol. 7, pp. 14–24, 2016.

[5] **P. N. Shrirao, S. S. Gaddamwar, and P. R. Ingole,** "Convective Heat Transfer and Friction Factor Characteristics in Internally Threaded Tube with Constant Heat Flux for Al_2O_3 / Water Nanofluid," *Int. J. Sci. Res.*, vol. 5, no. 2, pp. 1407–1411, **2016.**

ISSN : 2455-9679
Impact Factor : 3.340

[6] **T. Mohan and K. Rajan,** "Investigation of Heat Transfer and Friction Factor Characteristics of Two Phase Nano Fluids by Inserting Twisted Tape and Helical Inserts in the Tube," *IOSR J. Mech. Civ. Eng.*, vol. 13, no. 5, pp. 9–16, **2016**

[7] **R. Bunker and R. Vishwakarma**, "Analysis of Heat Transfer in Semifluid Tube Heat Exchanger Equipped with Spiral Coiled Insert Using CuO-H2O Based Nanofluids," *Int. J. New Technol. Res.*, vol. 2, no. 2, pp. 117–121, **2016.**

[8] **Sisodiya and A. Geete**, "Heat Transfer Analysis of Helical Coil Heat Exchanger With Al2O3 Nano Fluid," *Int. Res. J. Eng. Technol.*, vol. 3, no. 12, pp. 366–370, **2016.**

[9] **Bianco, O. Manca, and S. Nardini,** "Numerical simulation of water/ Al2O3 nanofluid turbulent convection," *Adv. Mech. Eng.*, vol. 10, no. October **2016**

[10] **K. Sivakumar and K. Rajan"** Experimental Analysis Of Heat Transfer Enhancement In A Circular Tube With Different Twist Ratio Of Twisted Tape Inserts" **International Journal of Heat And Technology Vol.33 (2015)**

[11] **Avinash Savekar, Dhiraj Jangid, Madhura Gurjar, Vikrant Patil, C. M. Sewatkar" Analysis of Heat Transfer in Pipe with Twisted Tape Inserts"** International Conference on Fluid Flow, Heat and Mass Transfer Ottawa, Ontario, Canada, April 30 – May 1, 2015

[12] **Ranjitha, Shaji K** "Numerical analysis on a double pipe heat exchanger with twisted tape induced swirl flow on both sides," Procedia Technology 24 436 – 443, 2015