|| Volume 6 || Issue 2 || February 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS

# COMPUTATIONAL ANALYSIS OF HEAT EXCHANGERAND MAXIMIZED HEAT TRANSFER RATEBY USING THE DOUBLE TUBEHELICAL COIL

**S. SIVA SANKARA VARA PRASAD [1], P. KUMAR BABU[2]**

*II. M. Tech, DEPARTMENT OF MECHANICAL ENIGINEERING, SRI MITTAPALLI COLLEGE OF ENGINEERING[1].*

*Ph.D., Prof, DEPARTMENTOF MECHANICAL ENIGINEERING, SRI MITTAPALLI COLLEGE OF ENGINEERING[2].*

---------------------------------------------------- ***--------------------------------------------------

**Abstract:- Operating with regards to the goal of consuming energy and creating look forplants and chemical and mechanical devices.The warmth transfer improvement isthe one of the key factors within the style of warmth exchangers. During this method, while not the appliance of external power, we will enhance the rate of transfer by modifying and contributing the volute tubes, extended surface, or swirl flow devices. volute tube device finds applications in automobile, aerospace, power station, and food industries thanks to sure blessings like compact structure, larger heat transfer area, and improved heat transfer capability. during this paper numerical study of a volute coil, the tube-in-tube device is completed for various boundary conditions, and optimized condition of warmth transfer is distinguished various D/d magnitude relation. The flow model with a counter-flow device is taken into account for analysis functions. The impact of the D/d magnitude relation on heat transfer rate and pumping power is distinguished various boundary conditions. The D/d magnitude relation is varied from ten to thirty with Associate in Nursing interval of five. Nusselt range, friction issue, pumping power needed, and log mean temperature difference, LMTDvariation of inner fluid regarding Reynolds range was distinguished for various D/d ratios. The optimized Reynolds range for minimum power loss&optimum heat transfer will distinguish by the intersection of graph strategies. After the effect of fluid flow, the whole behaviour is captured, fluid flow within the tube. With will increase in D/d magnitude relation (inverse of curvature ratio) the Nusselt range can decrease and also the outer wall condition doesn't have any vital impact on the inner Nusselt range. The Darcy friction issue decreases with increase in Reynolds range. The Pumping power will increase with a rise in Reynolds range for all the conditions of D/d magnitude relation and every one the boundary conditions. Log mean temperature distinction (LMTD) will increase at a gradual rate with a rise in Reynolds range. The improvement purpose between letter and f regarding Re; shifts toward the lower Reynolds range with a rise in D/d magnitude relation.**

**KEYWORDS:** *D/d magnitude relation, Nusselt range, friction issue, LMTD, pumping power.*

---------------------------------------------------- ***--------------------------------------------------

## I INTRODUCTION

Heat exchanger can also work as a tool, we used it to transfer the heat in b/w the two fluid bodies, through the direct contact to cold flow on a private basis in the two tubes or channels. we disposed to discover various applications of heat exchangers in the everyday life. For an instance unit of measurement by the help of condensers& evaporators, it would be utilized in refrigerators and air conditioners. In thermal station heat exchangers unit of measurement utilized in various purposes. Comparably the heat exchangers are used in automobile industries, the regular intervals of unit measurement to radiators and oil coolers engines. Heat exchangers space unitare used on huge scale in chemical and technical industries for transferring the heat between two fluids that square measure at one or two states.

## II. RELATED WORK

Kumar et al. (2006) had explored the fluid mechanics and warmth transfer characteristic of tube, at pilot plant scale in whorled tube. they'd experimented a counter flow device. Overall heat transfer coefficients were evaluated. Nusselt variety and friction issue constant for inner and outer tube was found and compared with numerical price got from CFD package (FLUENT). They ascertained the general heat transfer constant. It would increased with inner coil tube head variety for constant rate within the annulus region.

Kharat et al. (2009) after the completion of good examination gave a review on warmth transfer rate on a coaxal whorled coil device, and develop the correlation for warmth transfer constant. Heat transfer constant has improved for the tube containing flue gas of the warmth money handler by mistreatment CFD simulation and also the experimental study. The result of various operational variables was studied. The variables they'd thought-about ar gap between the coaxal coils, diameter of tube and coil diameter.

## III.METHODOLOGY

The invention of high speed computers, combined with the correct numerical that} at intervals which for resolution physical problems, has revolutionized the set up of action we've associate inclination to envision and observe fluid dynamics and heat transfer problems. This could be named as machine Fluid Dynamics (CFD), and it's created it realizable to sophisticated analysis, the flow geometries of identical ease as that two-faced varied resolutions and ideal problems. CFD might so be thought of a study zone, it combines the fluid dynamics and numerical analysis. Historically, the development of CFD among Sixties and Seventies was driven by the necessity of the [*fr1] industries. In Modern CFD, has applied across all disciplines – it can applicable in ocean science, civil, mechanical and medicines engineering being several of them. CFD substitutes analytical studies and experimental testing, and reduces the whole time of testing and arising with.All the CFD code can accommodate three basic parts Kumar et al. (2006) had investigated the mechanics and warmth transfer characteristic of tube in tube whorled device at pilot plant scale. they'd experimented a counter flow device. Overall heat transfer coefficients were evaluated. Nusselt choice and friction issue constant for inner and outer tube was found and compared with numerical value got from CFD package (FLUENT). They determined that the general heat transfer constant increase with inner coil tube Dean choice for constant rate among the annulus region.

1. Kharat et al. (2009) had completed the experiments to review heat. The rate of heat transfer on a concentric whorled coil helps to makes the correlation of heat transfer constant. Heat transfer constant has improved for the tube containing flue gas of the warmth individual by observe CFD simulation and place on the experimental study. The results of various operational variables was studied. The variables they'd thought-about are the flaws b/w the concentric coils, diameter of tube and coil are Main thinker.

2. Post processor

The CFD modeling originsthe degree identifies the draw backs and helps to understand the machine domain. the mesh structure follows, the foremost important portion of the pre-processing activity. every computation time and accuracy of resolution settle for the mesh structure. that is finer the grid is additionally lots of correct the result is. but the grid size should not generate unnecessarily fine that the computation takes overtime for computing, there need to be degree best grid size among that each one the computation need to be completed. CFD procedure: For numerical analysis in CFD following five stages unit of measurement

## IV.EXPERIMENTAL RESULTS

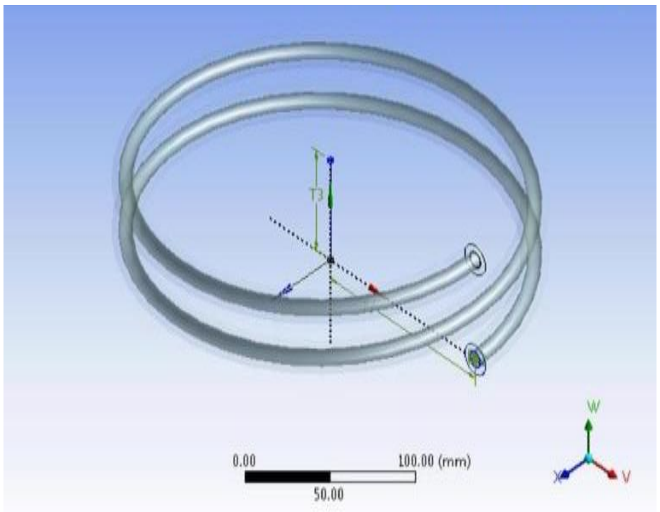
Geometry creation

In pure mathematics creation we've got to make the coiling pipe. For this we've got to open the ANSYS thirteen, move to CFD fluent package and open the planning creator then amendment the property to 3 dimensional. In DM initial we've got to make the profile for our downside circle is he profile. therefore to make the circle choose the XY-plane then set the unit to the mm. Then move to sketching and draw the circle then specify the dimension as an example its radius, and distance of the circle from the XY-axis. Then generate the circle. Compar generate different 2 circles for outer tube. For generating the trail draw a line perpendicular to XY-plane. Provides it dimension as mention within the downside.

For generating the coiling tube we've got to try and do the SWEEP procedure. For sweep we've got to pick the profile and also the path, then the operation ought to be ADD FROZEN. Then specify the quantity of turns, for this downside we have a tendency to choose 2 numbers of turns. Then generate it to make the coiling pipe. Same procedure is followed for generating the 2 annulus coiling tubes. when generating the 3 tubes specify the habitus that's whether or not it's FLUID or SOLID. The outer and innermost tubes square measure in a very FLUID condition and middle tube is within the SOLID state.

|| Volume 6 || Issue 2 || February 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS

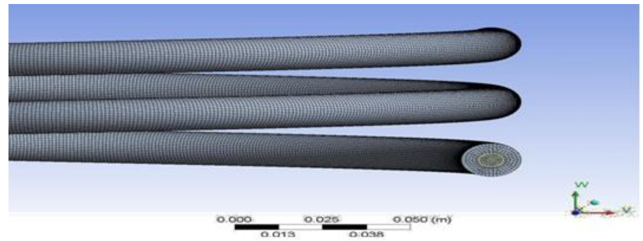
To supply the rounded tube choose the operation and reckon the tube from the outer tube whiling protecting the tool body. In FLUENT for warmth transfer we tend to want conjugate heat transfer condition for this we've to form 3|the three} components three bodies to a minimum of 1 [*fr1] three bodies. For this choose 3 bodies and right-click on it then kind NEW [*fr1]. Then save the project and shut the planning creator.




**Showing the geometry of double tube helical coil heat exchanger created in ANSYS 13 work bench.**

**Grid generation**

In grid generation first attend the MESH selection settled in FLUENT tree then press the GENERATE MESH button. it's going to turn out the machine-controlled grid. Then we have got to vary the grid or produce the grid finer thus correct results will come back. For generating fine mesh opt for the filler selection then opt for the sting for making the division. Then specify the number of divisions. For generating the uniform mesh we have got to MAP the face, for that we have got {to pick|toselect|to opt for} out the MAPPED FACE selection and choose the face that we have got to undertake and do the operation. this will turn out uniform mesh throughout the face of the math. Compare in MESHING technique we tend to ar ready to specify the sort of mesh we tend to want to form as Associate in Nursing example QUAD, TRI, QUAD/TRI etc. After that we have got to decision each face of the math. For that right click on the face and attend turn out NAME selection then name each face (for example water, outlet, wall etc.,). Then update the project.




Generation for the double tube helical coil heat exchanger

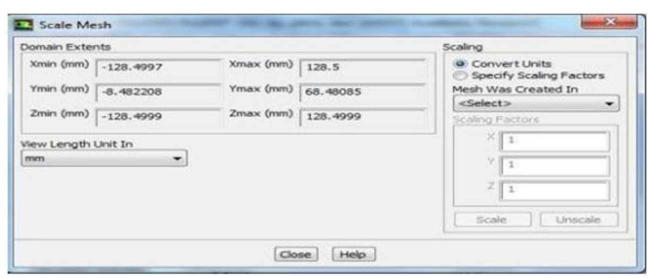
**SETUP AND FLOWSPECIFICATION**

In SETUP we generally set the operating conditions, flow specifications, boundary conditions, define the appropriate model for solving the problem.

First open the SETUP and specify it DOUBLE PRESSION for more accurate answer.


Then in the problem set up tree go for the GENERAL option and change the scale form meter to millimeter.

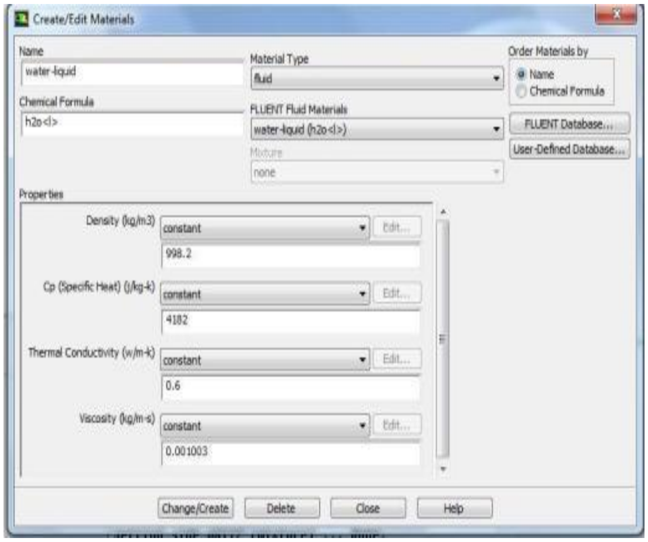
In the MODEL tree selection the energy equation have to be compelled to be turned on for conniving the temperature profile




For the heat money dealer. For turbulent model traditional traditional model was used. For this viscous model traditional traditional model was turned on. For opt foring the material we have got to travel for draw back known tree

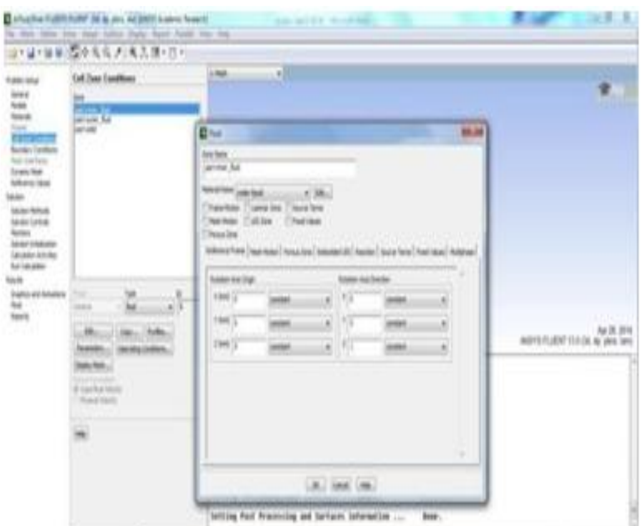
|| Volume 6 || Issue 2 || February 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

then opt for the material selection then choose modification and edit option where we tend to are ready to choose the material from fluent info.




Once selecting the suitable material (copper for solid and water for fluid), we tend to ar ready to modification their property in step with our wants.

Then we have got to specify the domain or the cell zone condition. For inner and outer fluid it have to be compelled to be water-fluid and for solid it have to be compelled to be copper.



For setting the precondition attend precondition selection in draw back known tree then elite the varied precondition zone with specifying the sort of boundary (velocity inlet/pressure outlet/wall) etc. Then in each precondition opt for the EDIT selection then specify the values in step with the wants.

Grid independence check is that the one all told the foremost necessary ensure have to be compelled to be completed inside the numerical analysis of a tangle. Grid independence check was completed to check the final word results have to be compelled to be inrelyent of the number of grids. In numerical draw back the results ar constantly relyent on the number of grids generated. so if we tend to alter the number of grids the results were changed. whereas dynamic the number of grids a stage might come back once the results arinrelyent of the number of grids. These minimum style of grids once .which there is no modification in results were determined was spoken as optimum grid size and additionally the results were inrelyent of grids.

In this draw back first the grid independence check were assigned for varied D/d magnitude relation. starting from D/d=10; considering outer wall insulated condition and keeping the water rate of hot fluid at one.5072m/sec (Re=10000) and temperature at 355K the grid size was varied from 64770 to 138775. The properties thought-about for checking the grid independence ar the temperature of cold and hot fluid at the outlet, pressure at water and outlet of hot fluid.

|| Volume 6 || Issue 2 || February 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

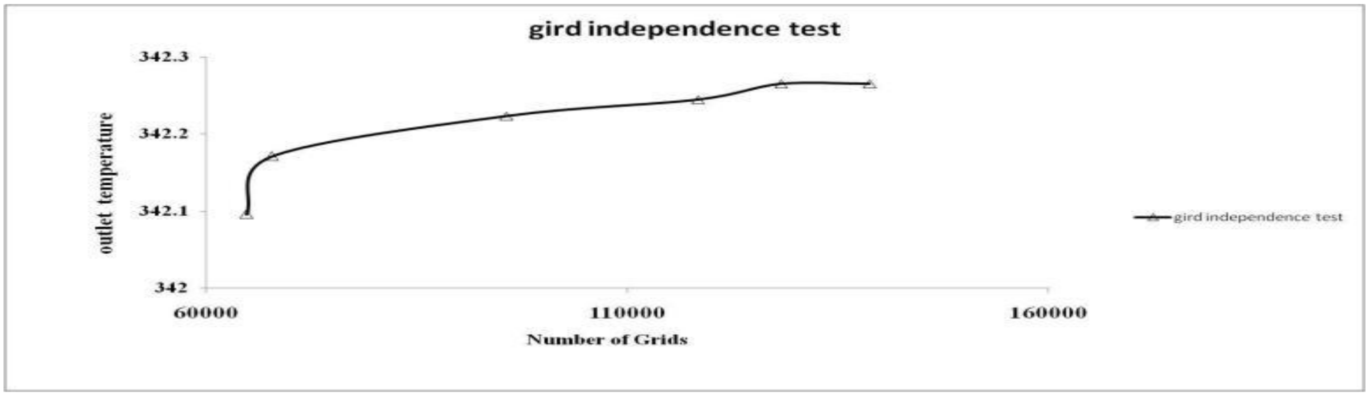



Fig.Grid independence test based on the outlet of hot fluid temperature

In the on top of two graphs outlet fluid temperatures were taken in axis and style of grids in the axis. The grids divisions were exaggerated and additionally the corresponding temperature of hot fluid in Fig.4.3 (a) and outlet of cold fluid temperature in Fig. 4.3 (b) were shown. once 138700 numbers of divisions the results did not suppose grids thus result's grid ingredient.Compare for different D/d magnitude relation the grid independence check has been completed on the concept of outlet temperature of hot fluid and cold fluid and optimum grids were chosen for any numerical analysis

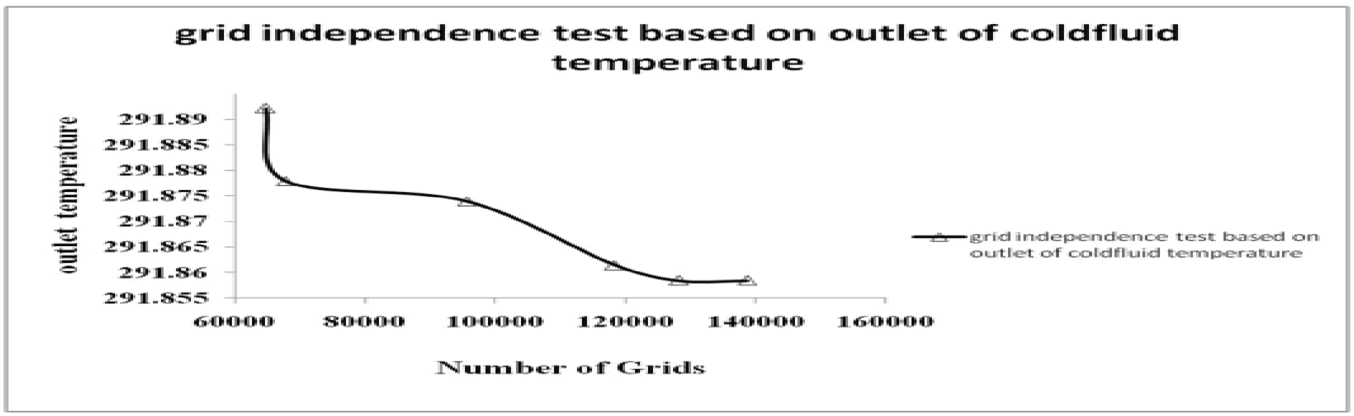



Fig. **Grid independence test based on the pressure of hot fluid at inlet**

## V.CONCLUSION

•With increase within the painter variety, the Nusselt variety for the tubing increase. However, with will increase in flow turbulence between the fluid component will increase which is able to enhance the blending of the fluid and ultimately the Nusselt variety or the warmth transfer rate will increase.

•With will increase in D/d magnitude relation (inverse of curvature ratio) the Nusselt variety can decreases; for a selected worth of painter variety. Nusselt variety has most worth for D/d=10.

• The outer wall stipulation doesn't have any vital impact on the inner Nusselt variety, which might be confirmed from the results.

• Friction issue decreases with increase in painter variety thanks to relative roughness of surface, and rate of flowing fluid.

• Pumping power will increase with increase in painter variety for all the condition of D/d magnitude relation and for all the boundary conditions. this is often thanks to increase in pressure loss caused by additional flow. Pumping power is freelance of the outer wall boundary conditions. Log mean temperature distinction will increase at a gradual rate with increase in painter variety.

•As long because the heat transfer thinks about from the recent fluid any stipulation may be assumed for outer wall of external tube as a result of it doesn't have an effect on considerably the warmth transfer rate.

•From the improvement graph shown between letter of the alphabet and f with relevancy Re; the intersection shifts toward the lower painter variety with increase in D/d magnitude relation. It indicates that lower painter variety is needed to urge maximize condition for higher D/d magnitude relation as a result of the ability demand is additional as we have a tendency to move towards higher D/d magnitude relation.

•The optimum painter variety decreases with increase in D/d magnitude relation.

## REFERENCE

•Eiamsa-ardSmith.,PromvongePongjet., Enhancement of heat transfer in a tube with regularly- spaced helical tape swirl generators, Solar Energy, vol.-78 (2005) 483–494.

•Eiamsa-ardSmith.,PromvongePongjet., Heat transfer attribute in a tube fitted with helical screw-tape with/without core-rod inserts, International Communications in Heat and Mass Transfer, vol.-34 (2007) 176–185.

•Ferng Y.M., Lin W.C., Chieng C.C., Numerically investigated effects of different Dean number and pitch size on flow and heat transfer attribute in a helically coil-tube heat exchanger, Applied Thermal Engineering, vol.-36 (2012) 378-385.

•Genic Srbislav B., JacimovicBranislav M., Jaric Marko S., Budimir Nikola J., DobrnjacMirko M., Research on the shell-side thermal performances of heat exchangers with helical tube coils, International Journal of Heat and Mass Transfer, vol.-55 (2012) 4295–4300.

•Ghorbani Nasser., TaherianHessam.,GorjiMofid., MirgolbabaeiHessam., An experimental study of thermal performance of shell-and-coil heat exchangers, International Communications in Heat and Mass Transfer, vol.-37 (2010) 775–781.

•Huminic Gabriela., Huminic Angel., Heat transfer attribute in double tube helical heat exchangers using nanofluids, International Journal of Heat and Mass Transfer, vol.-54 (2011) 4280–4287.

•JahanmirGh.S.,Farhadi F., Twisted bundle heat exchangers performance evaluation by CFD, International Communications in Heat and Mass Transfer, vol.-39 (2012) 1654–1660.

•JamshidiNaghmeh., FarhadiMousa., SedighiKurosh., GanjiDavoodDomeiry., Optimization of design parameters for nanofluids flowing inside helical coils, International Communications in Heat and Mass Transfer, vol.-39 (2012) 311–317.

•Rennie Timothy J., RaghavanVijaya G.S., Numerical studies of a double-pipe helical heat exchanger, Applied Thermal Engineering, vol.-26 (2006) 1266–1273.

•San Jung-Yang., Hsu Chih-Hsiang., Chen Shih-Hao., Heat transfer attribute of a helical heat exchanger, Applied Thermal Engineering, vol.-39 (2012) 114-120.

•Yang Zhen., Zhao Zhenxing., Liu Yinhe., Chang Yongqiang., Cao Zidong., Convective heat transfer attribute of high-pressure gas in heat exchanger with membrane helical coils and membrane serpentine tubes, Experimental Thermal and Fluid Science, vol.-35 (2011) 1427– 1434.

•Zachar A., Investigation of natural convection induced outer side heat transfer rate of coiled-tube heat exchangers, International Journal of Heat and Mass Transfer, vol.-55 (2012) 7892–7901.

•Jamshidi N., Farhadi M., Ganji D.D., Sedighi K., Experimental analysis of heat transfer enhancement in shell and helical tube heat exchangers, Applied Thermal Engineering, vol.-51 (2013) 644-652.

•NaphonPaisarn.,WongwisesSomchai., A study of the heat transfer attribute of a compact spiral coil heat exchanger under wet-surface conditions, Experimental Thermal and Fluid Science, vol.-29 (2005) 511–521.

•PaisarnNaphon., Study on the heat transfer and flow attribute in a spiral-coil tube, International Communications in Heat and Mass Transfer, vol.-38 (2011) 69–74.

•Pawar S.S., SunnapwarVivek K., Experimental and CFD investigation of convective heat transfer in helically coiled tube heat exchanger, CHERD-1475 (2014) Article inpress.

•JayakumarJ.S.,Grover R.B., Two phase natural circulation residual heat removal, In Proc. 3rd ISHMT-ASME Heat and Mass Transfer Conference, Kanpur, India. 1997.

•Jayakumar J.S., Mahajani S.M., Mandal J.C., Vijayan P.K., BhoiRohidas., Experimental and CFD estimation of heat transfer in helically coiled heat exchangers, International journal of Chemical Engineering Research and Design, Vol.-86 (2008):221-232.

•Jayakumar J.S, Mahajani S.M., Mandal J.C., IyerKannan N., Vijayan P.K., CFD analysis of single-phase flows inside helically coiled tubes, Computers and Chemical Engineering, vol.- 34 (2010) 430–446

•Kumar V., Saini S., Sharma M., Nigam K.D.P., Pressure drop and heat transfer in tube in tube helical heat exchanger, Chemical Engineering Science, vol.-61 (2006): 4403–4416.

•Lee Tzong-Shing ., Wu Wu-Chieh., Chuah Yew-Khoy., Wang Sheng-Kai., An improvement of airflow and heat transfer performance of multi-coil condensers by different coil configurations, International journal of refrigeration, vol.-33 (2010) 1370-1376.

•Li Yan., Jiang Xiumin., Huang Xiangyong., JiaJigang., Tong Jianhui., Optimization of high- pressure shell-and-tube heat exchanger for syngas cooling in an IGCC, International Journal of Heat and Mass Transfer, vol.-53 (2010) 4543–4551.

•Lu Xing., Du Xueping., Zeng Min., Zhang Sen., Wang Qiuwang., Shell-side thermal-hydraulic performances of multilayer spiral-wound heat exchangers under different wall thermal