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DESIGN AND ANALYSIS OF SHELL AND TUBE TYPE HEAT EXCHANGER USING ANSYS FLUENT

V. Santhi[1], Dr. Syed Kamaluddin[2]

[1]*V. Santhi, M.Tech(MACHINE DESIGN), Vignan's Institute of Information Technology.*
[2]*Dr. Syed Kamaluddi, Department of Mechanical Engineering(Professor), Vignan's Institute of Information Technology.*

Abstract

Modern-day processing industries require heavy equipment for theirbatch production. One of the commonly used equipment is heat exchangers, which takes and gives heat to the two streams flowing through them. Any procedure which includes cooling, heating, evaporation, boiling, or condensation requires a heat exchanger. liquids, as a rule, are heated or cooled before it changes its physical state. A study is conducted to seek the best material for the heat exchanging processes using CATIA and ANSYS FLUENT. The results are concluded and presented in the study.

Keywords: Heat Exchangers, CATIA, ANSYS FLUENT

1. Introduction

There are many heat exchangers used for other applications.H.E's that are used to take out heat from a substance is called condenser and the ones who add the heat energy are called boilers.Usually, the performance of any particular heat exchanger that may be a condenser or boiler is calculated by evaluating the amount of heat transferred from the least measurable area keeping in mind that pressure change is minimal. The overall coefficient of heat transfer gives the end-user the best knowledge about the quality of an H.E. Pressure drop and region required for a specific measure of heat transfer gives an understanding about the capital expense and force necessities (Running expense) of a heat exchanger.

Normally H.E. comes in two builts,

• The mediums are mixed for the trade-off of heat and are known as Direct Contact H.E.

• The mediums are kept in one vicinity but are isolated using tubes to seek a trade-off of heat using the convection, and are known as InDirect Contact H.E.

The most commonly built of heat exchangers for the indirect heat transfer application comprised of Shell and numerous Tubes inside. It can carry up to 552 bars that take a cold media from one end to another while the media that is used for heating passes through the tubes in between them and extracted out. The shell holds the liquid that is to be used later. For the most part, it is round and hollow fit as a fiddle with a roundabout cross-segment.This investigation is done on a shell where the liquid stays for a time and is extracted out making it a one pass shell. A reason to use a shell or a cylinder type heat exchanger is due to the fact that is a commonly used design and it has superb log-mean temperature constant. The tubes are either one or are several in a shell, for just one shell, the tube has its opening and closing on either end of the shell. For several tubes the tubes are interlinked and the liquid travels in between them till it reaches the other end of the tube.

1.1Objective:

The heat constant we discussed above changes for every material. So a comprehensive result for studying the few materials that are used in the production of these heat exchangers is the first objective of this study. The study is done using CAD software and heat exchanging simulation software, where one can easily change the properties of a material forseveral tubes, and to contemplate the stream and temperature inside these.s

2. Literature Review

2.1 A Short Brief

This is a brief introductory passage that is written to give a short history of the studies and research done in this particular area of academics. This section will cover the basics of Computations fluids and their dynamics using a computer model that can either be in 2 dimensions or 3 dimensions.

2.2 A look into CFD

The study of the flow of various fluids and their interactions with atmospheric variables like temperature, pressure, and volumes is defined and explored in **"**Computational Fluid Dynamics**"**or CFD. A better definition for this term can be an advanced "computational and investigation" strategy to calculate, compute, and predict the effects a fluid can cause on to the other fluids or material. CFD helps display the effects on various materials in any shape using the properties of the reacting gases or fluid which contains, rate of progressions, the warmth of the fluid it is mass in the setup.Due to the fact that it is costly to design a specific material and then check its efficiency, the computational software is widely used to model and simulate the product design on a computer and then give permission for actual construction.

2.3 Application Of CFD:

CFD just not is used for heat exchangers or any other chemical industry, but it is used widely in many industrial and non-industrial areas:

• Structure of marine designing.

• Polymer moldings in synthetic procedure building.

• Streamlined features of airplane and vehicle.

• In Biomedical engineering to help flow the blood in veins and arteries.

• Ventilation framework.

• Rotation and flow inside the passages of a turbo-hardware.

• Weather expectation in meteorology.

• IC motors combustion

• Distribution of contaminations and gushing in ecological design.

2.4 ANSYS

ANSYS is a product that is used by several users not necessarily for CFD. It is not only limited to CFD but it can also be used for various properties like stress, diffusion, and even electromagnetic waves. ANSYS programming helps us to develop computer 2D and 3D models of various equipment design or even a simple part design.

3.Model Design for H.E.

3.1 Design Sketch

The ground zero for this study is to design and produce a model of anSTHX configuration. The design will be made on CFD specifically with the helical baffle tool. Once the model is produced, the CFD will be simulated and the results of the various variables like the pressure of the fluid inside of the shell, the temperature across the tubes of the exchanger will be displayed under varying flow rates.

3.2 Computational Model:

The experimentation is needed to be carried out on a Shell and Tube Exchanger. It is abbreviated to STHX. The model needs to be built using 10 helix angles.The figure 2 shows an exchanger model also meshed within the ANSYS environment. 5 baffles can be seen on both ends of the exchanger. The calculation settings are done to limit the workload of the processor only to the internal side of the exchanger so everything is contained inside the shell of the exchanger.The number of tubes inside the body of the exchanger is 7 and the tube sheet is protecting the fluid to go outside the parameters.

The assumptions made and used in this procedure is done to make sure that the numerical recreation is an improved version of the real world scenario, and are listed below,

1. The thermal properties of the fluid that has to be flowing in the shell are kept constant.
2. The turbulent setting while being in steady-state is kept for the heat tradeoff during the fluid flow process.
3. The leakage during the whole process from any component of the exchanger is nullified. Plus good insulation is installed for any other heat loss.
4. The density variation among the mediums in the convection process is of no such importance.
5. The temperature of the shell sides for the exchanger is kept constant for the process.

3.3 "Navier-Stokes" Equation:

The software would analyze the aforementioned model using an equation provided by Claude-Louis Navier. He is among the leading researcher and mathematicians to design fluid motions and their dynamics study.

Navier's equation in generalized taking the inertial frame as a reference and can be seen below, which the world knows as the fluid motion equation.

$$\partial_x u + \partial_y v = 0, \tag{1}$$

$$\partial_t u + u\partial_x u + v\partial_y u = -\partial_x p + \frac{1}{\mathrm{Re}}\left[\partial_x(\mu\partial_x u) + \partial_y(\mu\partial_y u) + \partial_x\mu\partial_x u + \partial_y\mu\partial_x v\right], \tag{2}$$

$$\partial_t v + u\partial_x v + v\partial_y v = -\partial_y p + \frac{1}{\mathrm{Re}}\left[\partial_x(\mu\partial_x v) + \partial_y(\mu\partial_y v) + \partial_y\mu\partial_y v + \partial_x\mu\partial_y u\right], \tag{3}$$

$$\partial_t T + u\partial_x T + v\partial_y T = -\frac{1}{\mathrm{Re}\ \mathrm{Pr}}\left[\partial_x(\kappa\partial_x T) + \partial_y(\kappa\partial_y T)\right], \tag{4}$$

FIGURE 1 GENERALIZED FORM OF FLUID MOTION EQUATION

3.4 Geometry and Mesh:

The geometry of the heat exchanger is created using the guideline of TEMA.

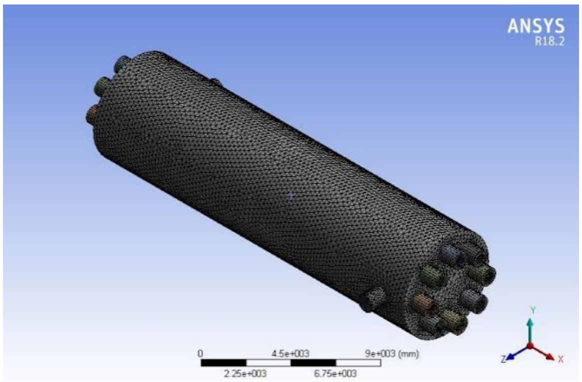


FIGURE 2 MESH

3.5 2D Model Of H.E.

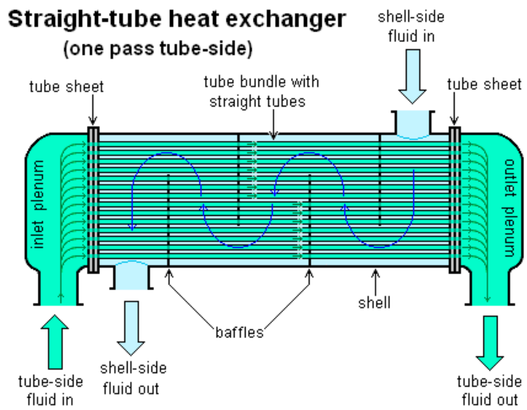


FIGURE 3 A SHELL & TUBE H.E.

The above-mentioned exchangers as discussed cool or warms a liquid inserted in the tubes.Another liquid that is either cooled before or is in boiling form is inserted in the shell and the tubes will take or give its heat to the liquid. These are the variables that are essential for the calculation of an exchanger,

- Length
- Corrugation
- Diameter
- Thickness
- Pitch
- Design of Baffles
- Piping.

In this experimentation, we will study the number of tubes that are changedin the heat exchangers contains 8, 10, and 12 tubes respectively.

4. MATERIAL SELECTION

Heat exchangers are normally utilized in different procedures, for example, fertilizers, chemical, petrochemical, atomic force creation and fossils, refrigeration, desalination, and others. They are consistent with extraordinary significance and their hugeness has expanded with expanding vitality requests. While following the system for choosing up-and-comer materials, the primary and extensive components are cost and unwavering quality. It implies utilizing efficient materials, settling issues when they happen, and picking the most dependable material independent of the cost.

Main factors that influence material selection are:

- High heat move coefficient.
- Low coefficient of warm development and fit with the materials utilized in tube sheet, tube backing, and shell to oppose warm cycling.
- Good pliable and creep qualities.
- Good weakness and consumption weariness and creep-exhaustion conduct.
- High weakness durability and effect solidarity to forestall quick breaking.

4.1 Aluminium

Aluminum is found abundantly worldwide. Interestingly this particular metal is the 3rd most readily available material on earth. The crust of earth comprises various metals and the crust has eigh percent of aluminum in it.The adaptability of this material makes it widely and commonly used material for the production of unlimited types of equipment and products. the vessel of airplanes is preferred to be made by this metal due to its quality and low weight.

Appendix C-10 *Mechanical Properties, Characteristics, and Typical Uses of Some Wrought Aluminum Alloys*

Alloy	Brindl Hardness, H_B	Tensile Strength Ultimate, S_u ksi	Ultimate, S_u MPa	Yield, S_y ksi	Yield, S_y MPa	Elongation in 2 in. (%)	Corrosion Resistance	Cold Work	Machine	Braze	Gas Weld	Arc Weld	Resistance Weld	Typical Uses
1100-0	23	13	90	5	34	45	A	A	E	A	A	A	B	Spinnings, drawn shapes, heat
-H14	32	18	125	17	115	20	A	A	D	A	A	A	A	exchangers, cooking
-H18	44	24	165	22	150	15	A	B	D	A	A	A	A	utensils, tanks
2011-T3	95	55	380	43	295	15	D	C	A	D	D	D	D	Screw machine parts
-T8	100	59	405	45	310	15	D	D	A	D	D	D	D	
2014-0	45	27	185	14	97	18	—	—	D	D	D	D	B	Heavy-duty forgings, aircraft
-T4	105	62	425	42	290	20	D	C	B	D	D	B	B	structures and fittings,
-T6	135	70	485	60	415	13	D	D	B	D	D	B	B	truck frames
2024-0	47	27	185	11	76	22	—	—	D	D	D	D	D	Aircraft structures, truck wheels,
-T4	120	68	470	47	325	19	D	C	B	D	C	B	B	screw machine parts
6061-0	30	18	125	8	55	30	B	A	D	A	A	A	B	Boats, rail cars, pipe, flanges,
-T6	95	45	310	40	275	17	B	C	C	A	A	A	A	trailers
6063-0	25	13	90	7	48	—	A	A	—	A	A	A	A	Furniture tube, doors, windows,
-T6	73	35	240	31	215	12	A	C	C	A	A	A	A	pipe, fuel tanks
7075-0	60	38	230	15	105	16	—	—	D	D	D	C	B	Aircraft structures and skins,
-T6	150	83	570	73	505	11	C	D	B	D	D	C	B	skis, railings

Note: Values are approximate median expectations for sizes about [illegible] in. The H_B values were obtained from 500-kg load and 10-mm ball. Letters A, B, C, D indicate relative ratings in decreasing order of merit.
Source: ASM Metals Reference Book, American Society for Metals, Metals Park, Ohio, 1981.

FIGURE 4 PROPERTIES OF ALUMINIUM

Aluminum in Space

presents great erosion obstruction because of the development of a boundary oxide film that is fortified firmly to its surface (latent layer) and, that at whatever point hurt, re-shapes rapidly as a rule.

Properties of Aluminium

- Light-weighted compared to copper/steel.
- Excellent characteristics of corrosion
- Perfect reflector of light and heat
- Welded easily
- Highest weight ratio
- High conductivity in both thermal and electrical.

4.2 Copper

One material that can be found in each household or building without any doubt is copper. It is the most commonly used metallic element in the world. Its utilization goes back to ancient occasions.

Copper among other fascinating properties has a standout property of heat conduction. The best in terms of heat exchanging material. The others are,

- Erosion
- Weight efficient
- Under the obstruction of biofouling
- Stiffness
- High-pressure resistant
- Elasticity
- Many others.

The above qualities on one side and just its cost-effectiveness on the other side tags this material to be used as the favorite material for any heat-related equipment. Whether it is HVACS, coolers, or Computer drives. Many companies produce cookwares that are comprised of copper and other metal alloys to get the heat distribution property of the item equally.

Thermal conductivity of some common metals[6]

Metal	Thermal conductivity (Btu/(hr-ft-F))	Thermal conductivity (W/(m•K))
Silver	247.87	429
Copper	231	399
Gold	183	316
Aluminium	136	235
Yellow brass	69.33	120
Cast iron	46.33	80.1
Stainless steel	8.1	14.0

4.3 Steel

High requests are made on the material in heat exchanger development. Warmth worries because of the huge temperature contrasts can make splits in the material. Mechanical impacts, for example, vibrations, steam pounds just as high weight inside the gadgets present a major test on the material utilized.

Consumption and stores from limestone or different buildups, for instance, are additionally basic. They increment the support prerequisites of the warmth exchanger if not considered.

Treated steel such as stainless steel is the go-to material when durability is required. Many exchangers made from these materials are still operational in many industries despite those being 40 years old.

Mechanical Properties	Type 316L stainless stee
Yield Point, MPa	332
Tensile strength, MPa	673
Modulus of Elasticity, GPa	165
Strength at break, MPa	586
Elongation at break, mm	35.5

5. CATIA

5.1 Introduction ToCatia

CATIA is one of the main 3D programming utilized by associations in numerous enterprises extending from aviation, vehicle to shopper items.

CATIA is a 3D programming suite. It was created by Dassault Systems as multi-stage 3D enveloping CAD, CAM just as CAE. Dassault is a French building goliath dynamic in the field of aeronautics, 3D plan, 3D computerized models, and item lifecycle the board (PLM) programming.

CATIA is a strong displaying device that joins the 3D parametric highlights with 2D instruments and addresses each plan to-assembling process. Notwithstanding making strong models and congregations, CATIA likewise gives creating orthographic, segment, helper, isometric or itemized 2D drawing sees. It is additionally conceivable to produce model measurements and make reference measurements in the drawing sees. The bi-directionally acquainted property of CATIA guarantees that the adjustments made in the model are reflected in the drawing perspectives and the other way around.

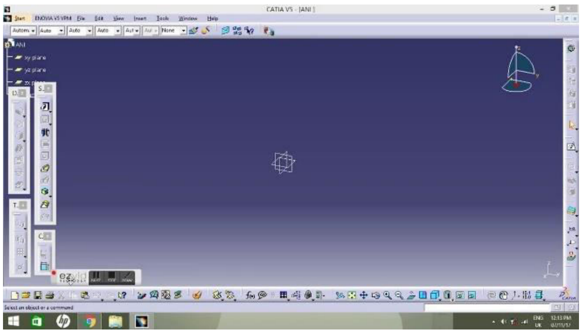


FIGURE 5AN INTERFACE OF CATIA

5.2 PARAMETRIC MODULES IN CATIA

CATIA offers numerous workbenches that can be inexactly named as modules. A couple of the significant workbenches and their concise usefulness portrayal is given beneath:

Part Design: The most fundamental workbench required for strong displaying. This CATIA module makes it conceivable to structure exact 3D mechanical parts with an instinctive and adaptable UI, from drawing in a get together setting to an iterative definite plan.

Generative Shape Design: permits you to rapidly demonstrate both basic and complex shapes utilizing wireframe and surface highlights. It gives a huge arrangement of apparatuses for making and altering shape plans. Even though not basic, information on Part Design will be exceptionally helpful in better usage of this module.

Assembly: The bolts and nuts of item structure, imperatives, and moving congregations and parts can be adapted rapidly. This is the workbench that permits interfacing all the parts to shape a machine or a segment.

Kinematic Simulation: it includes a gathering of parts that are associated with a progression of joints, alluded to as an instrument. These joints characterize how a get together can perform movement. It tends to the plan audit condition of computerized models. This workbench shows how a machine will move into reality.

Four of the workbenches that CATIA offers have been discussed. A couple of different modules incorporate Machining, Equipment and System, Infrastructure, and Ergonomics Design and Analysis. Furthermore, there are numerous other CATIA workbenches, each significant in its particular manner.

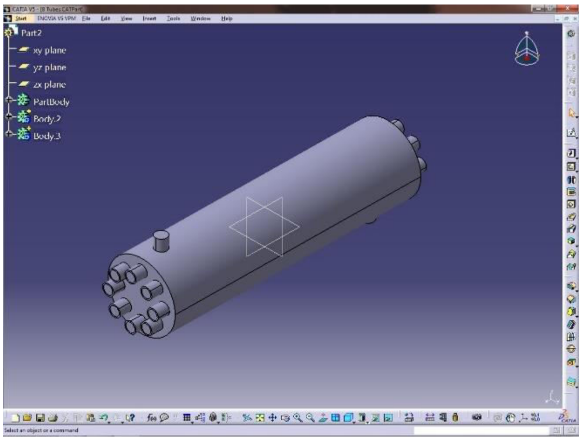


FIGURE 6DESIGN OF H.E. IN CATIA

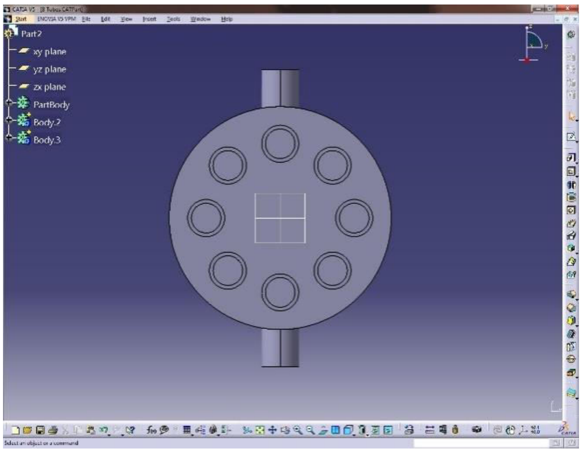
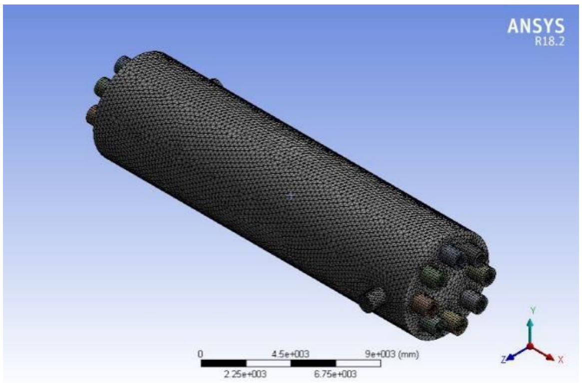


FIGURE 7DESIGN OF H.E.IN CATIA

6. Finite Volume Method

6.1 Explore FVM

The 'Finite Volume Method (FVM)' is a frequently usedflexible discretization procedure in CFD. The very first phase is to construct a very small partition named as cells, and the centroid is assigned an intriguing value.The next stage will require to assign all other conditions to every control volume cell. This is called the discretization of the cells. The win condition for such a method is that the computation will require to calculate each cell situation iteratively until they are reached to the desired value or a prescribed value.



6.2 Need For Finite Volume Method:

FVM was First used in 1972 in CFD. The equation below is given to the system.

$$\frac{\partial}{\partial t}\int_{\Omega} \boldsymbol{W} \,\mathrm{d}\Omega + \oint_{\partial\Omega} (\boldsymbol{F}_C - \boldsymbol{F}_v)\,\mathrm{d}S = \int_{\Omega} \boldsymbol{Q}\,\mathrm{d}\Omega$$

$$\boldsymbol{W} = \begin{bmatrix} \rho \\ \rho u \\ \rho v \\ \rho w \\ \rho E \end{bmatrix} \qquad \boldsymbol{F}_C = \begin{bmatrix} \rho \boldsymbol{V} \\ \rho u \boldsymbol{V} + n_x p \\ \rho v \boldsymbol{V} + n_y p \\ \rho w \boldsymbol{V} + n_z p \\ \rho H \boldsymbol{V} \end{bmatrix}$$

where $\boldsymbol{V} = \boldsymbol{v} \cdot \boldsymbol{n}$ is the "contravariant velocity"

The outcome acquired through the explanatory strategy is right and takes less measure of time. This strategy can't be utilized for unpredictable segments and shapes that require extremely complex numerical conditions. Then again, the exploratory technique is utilized for finding the obscure boundaries of intrigue. In any case, the experimentation requires a bit of testing gear and an example for every conduct of the examination. This, thus, requires a high starting venture to get the gear and to set up the examples.

6.3 The Process Of FVM

The Finite Element Method (FEM) is utilized to take care of physical issues in building examination and plan. The physical ordinarily include a real structure segment exposed to preciseloads.

6.4 Steps FVM:

Following are the basic steps for any FVMs

1. Pre-Processor(Modelling)
2. Solution (solving techniques)

3. and the last is Post Processor (Reviewing of results)

6.4.1Preprocessor:

1. Geometry

- Can be created or importedwithin ANSYS.
- Information on both methods will be covered later.

2. Meshing

- Define element attributes: element type, material, properties, and real constants.
- Element type
- The table displays the most frequently used thermal element types.
- There is only one DOF per node: TEMP.

3. Material properties

- The minimum requirement is thermal conductivity, KXX.
- Specific heat (C) will be needed if internal heat generation is to be applied.
- ANSYS-supplied material library (/ansys56/matlab) contains both structural and thermal properties for a few common materials, but we suggest that you use your material library.

4. Real constants

- Mainly needed for shell and line elements.

5. Then mesh the geometry.

Save the database.

Mesh Tool is used to creating the mesh. The smart-size level on default of 6 always produces a good mesh.

6. This completes the pre-processing step. The solution is next.

Commonly used thermal element types

	2-D Solid	3-D Solid	3-D Shell	Line Elements
Linear	PLANE55 ■	SOLID70 ■	SHELL57 ■	LINK31,32,33,34
Quadratic	PLANE77 ■ PLANE35 ▲	SOLID90 ■ SOLID87 ▲		

6.4.2Solution:

Loading

1. Prescribed Temperatures

- DOF constraints for a thermal analysis
- Solution > -Loads-Apply > Temperature
- Or the D family of commands (DA, DL, D)

2. Convections

- These are surface loads
- Solution > -Loads-Apply > Convection
- Or the SF family of commands (SFA, SFL, SF, SFE)

3. Adiabatic Surfaces

- “Perfectly insulated” surfaces where no heat transfer takes place.
- This condition is the default condition, any surface without boundary conditions specified is automatically treated as an adiabatic surface.

4. Other possible thermal loads:

- heat flux
- heat flow
- heat generation
- radiation

5. Solve

- First of all, save the database.
- Then issue SOLVE or click on Solution > -Solve- Current LS.
  – The results can be saved in ‘rth’ format and can also be used as it is in memory for calculation purposes.
- This completes the solution step.
- Post-processing is next.

6.4.3Post-Processor:

The calculation is done in the previous step so the first thing that will be shown in this stage is the result. The results can be in tabular format or one can view it graphically and can be saved in both formats. These results can be used for further calculations also.

1. Review Results

- Can be any plots a person desire, stress distribution, residuals, strain distribution, and displacements.
- General Postproc> Plot Results > Nodal Solu… (Or Element Solu…)
- Or use PLNSOL (or PLESOL)

- A useful option for contour plots in 3-D solid models is isosurfaces — surfaces of constant value.

2. **Validate the Solution**

1. Are temperatures within the expected range?

- You can generally guess the expected range based on prescribed temperatures and convection boundaries.

2. Is the mesh adequate?

- Just as in the case of stresses, you can plot the unaveraged thermal gradients (element solution) elements with high gradients. These areas are a possibility of work refinement.
- If there is a huge distinction between the nodal (arrived at the midpoint of) and component (unaveraged) warm angles, the work might be excessively coarse.

7. ANSYS

7.1 ANSYS- CFD

ANSYS Workbench is another age arrangement from ANSYS that gives incredible strategies to cooperating with the ANSYS solver's usefulness. This condition furnishes a one of kind incorporation with CAD frameworks, and your structure procedure, empowering the best CAE results.

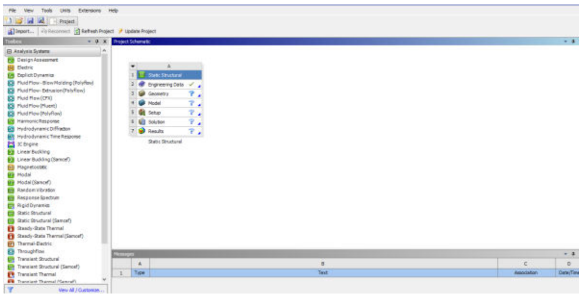


FIGURE 8ANSYS OVERVIEW

7.2 Step-By-Step Procedure Of Analysis

CFD demonstrating depends on principal overseeing conditions of liquid elements: the protection of mass, force, and energy.CFD assists with foreseeing the liquid stream conduct dependent on the numerical displaying utilizing programming tools.It is presently generally utilized and is worthy as a legitimate building apparatus in the business.

The CFD reenactment process comprises of a few stages that are associated with the examination of the liquid stream. For instance; on the off chance that we are discussing move through a funnel twist.

CFD Process Consists of Three Primary Steps:

• **Pre-Processing**: There are distinctive mainstream tools provided within or 3rd party software. Some of them are,

- Gridgen,
- CFD-GEOM,
- ANSYS Meshing,
- ANSYS ICEM CFD,
- TGrid, and so forth.

• **Solver:** There are well-known CFD programming present within the ANSYS environment few of them are,

- ANSYS FLUENT,
- ANSYS CFX,
- Star CCM,
- CFD++,
- OpenFOAM, and so on.

• **Post-Processing:**To seek the results, some of the tools to view the results are.

8. RESULTS

8.1 Design (Cad) Catia Model Of Heat Exchanger (H.E.)

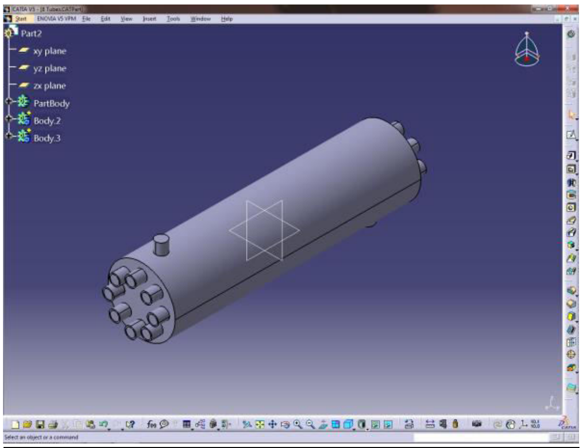


FIGURE 13H.E.

8.2 Meshing Model OfH.E.

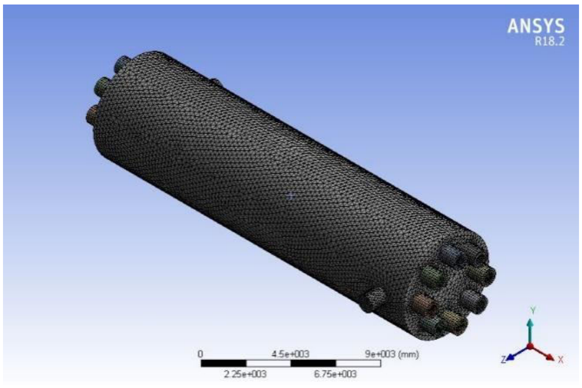


FIGURE 14MESHING OFH.E.

8.3 Analysis of Heat Exchanger WithAluminium Material (8 Tubes)

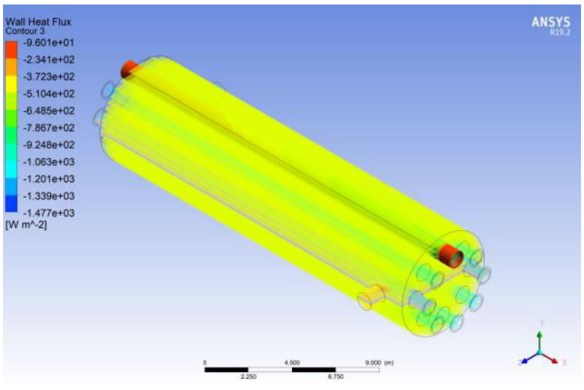


FIGURE 15HEAT FLUX IN HE (8-TUBE AL)

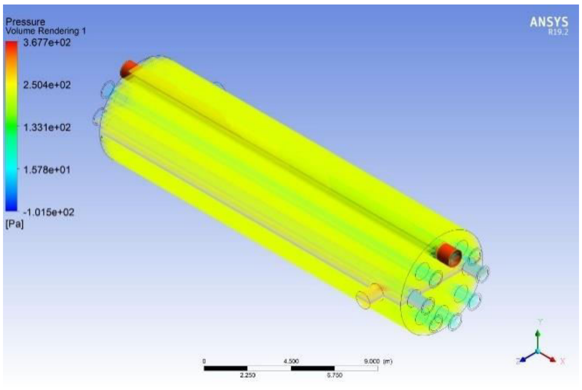


FIGURE 16PRESSURE IN H.E. (8-TUBE AL)

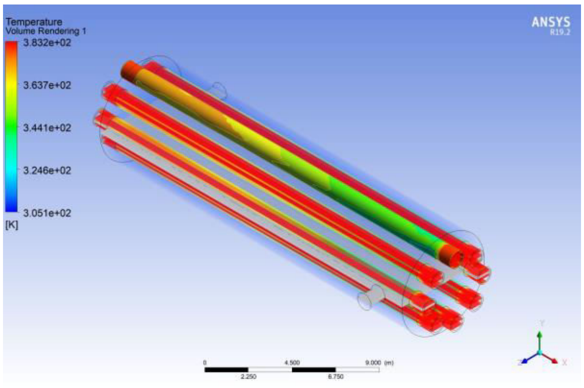


FIGURE 17TEMPERATURE INH.E. (8-TUBE AL)

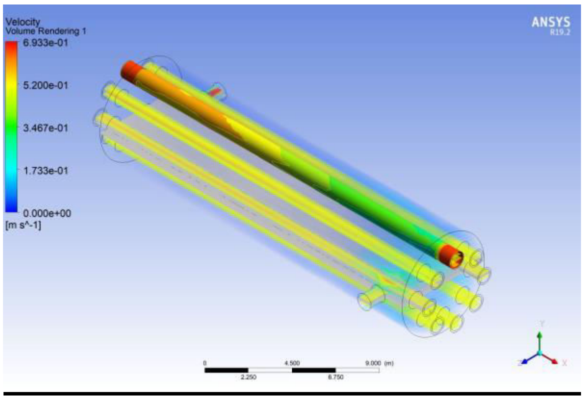


FIGURE 18VELOCITY IN H.E. (8-TUBE AL)

8.4 Analysis Of Heat Exchanger With Aluminium Material (10 Tubes)

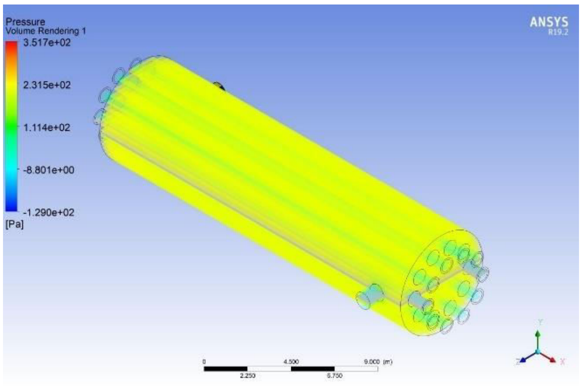


FIGURE 19 HEAT FLUX IN H.E. (10-TUBE AL)

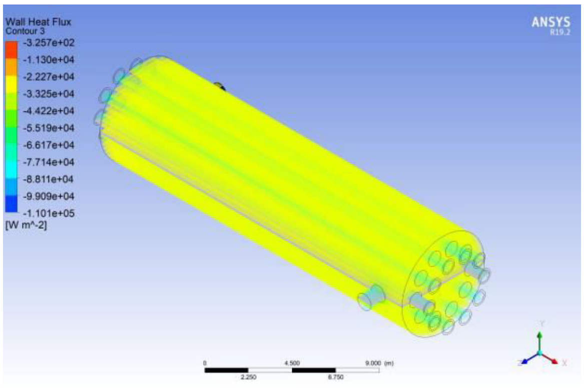


FIGURE 20 PRESSURE IN H.E. (10-TUBE AL)

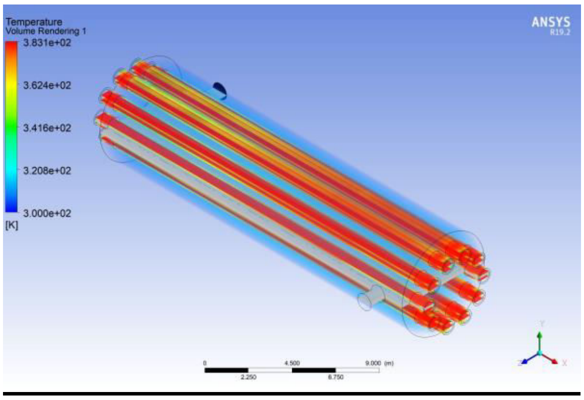


FIGURE 21TEMPERATURE INH.E. (10-TUBE AL)

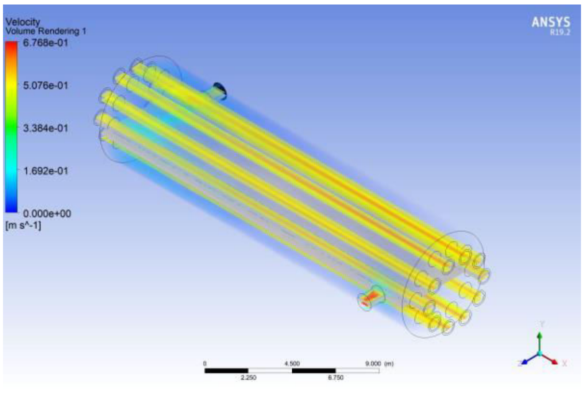


FIGURE 22VELOCITY IN H.E. (10-TUBE AL)

8.5 Analysis Of Heat Exchanger With Aluminium Material (12 Tubes)

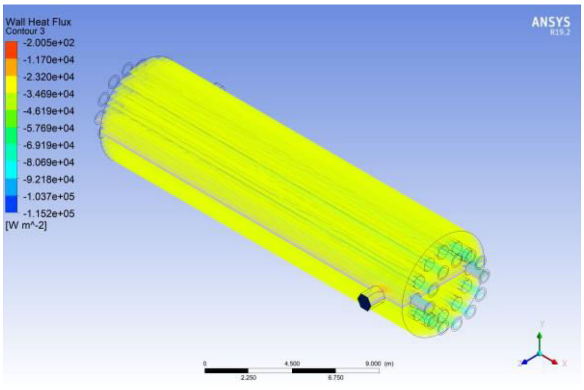


FIGURE 23HEAT FLUX IN H.E. (12-TUBE AL)

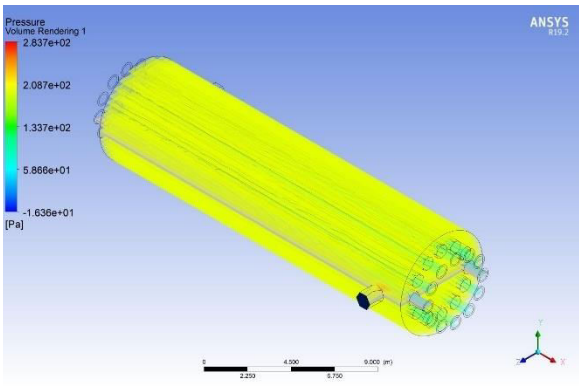


FIGURE 24PRESSURE IN H.E. (12-TUBE AL)

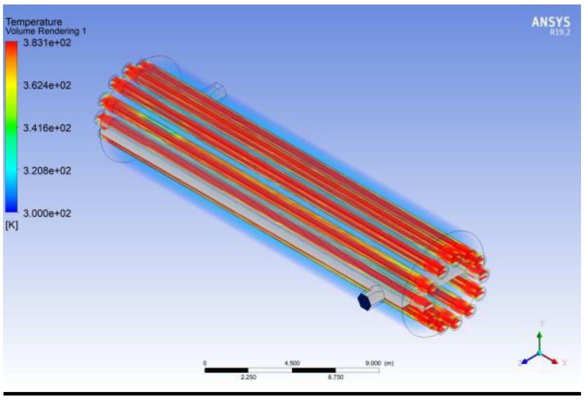


FIGURE 25TEMPERATURE INH.E. (12-TUBE AL)

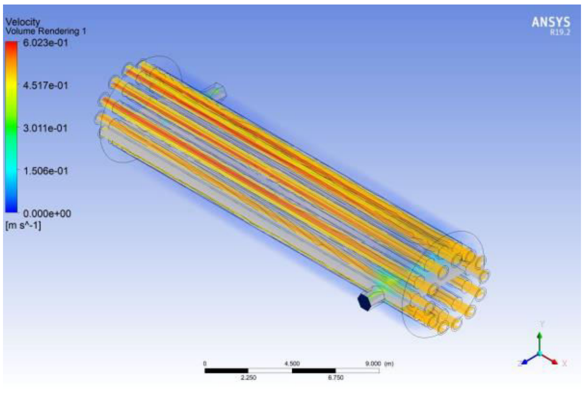


FIGURE 26VELOCITY INH.E. (12-TUBE AL)

8.6 Analysis Of Heat Exchanger With Copper Material (8 Tubes)

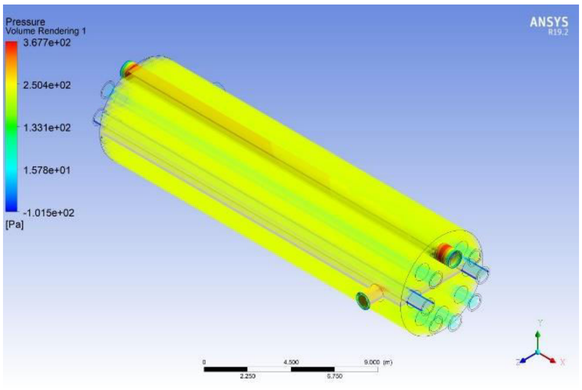


FIGURE 27HEAT FLUX IN H.E. (8-TUBE COPPER)

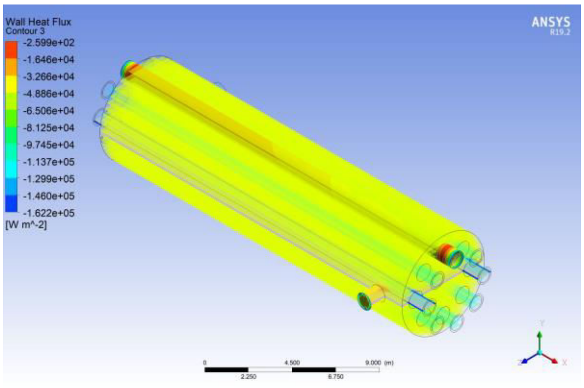


FIGURE 28PRESSURE IN H.E. (8-TUBE COPPER)

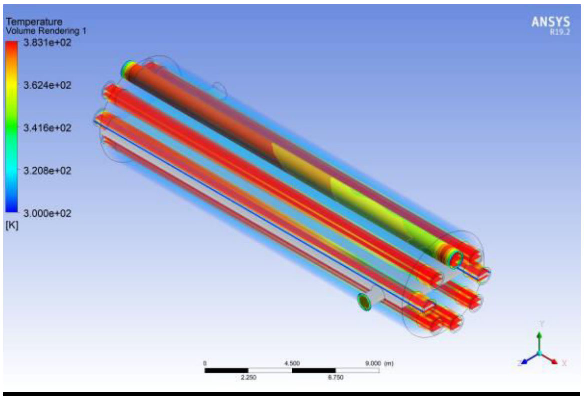


FIGURE 29TEMPERATURE IN H.E. (8-TUBE COPPER)

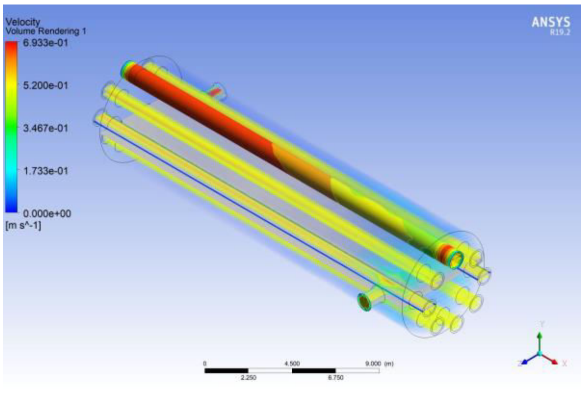


FIGURE 30VELOCITY IN H.E. (8-TUBE COPPER)

8.7 Analysis Of Heat Exchanger With Copper Material (10 Tubes)

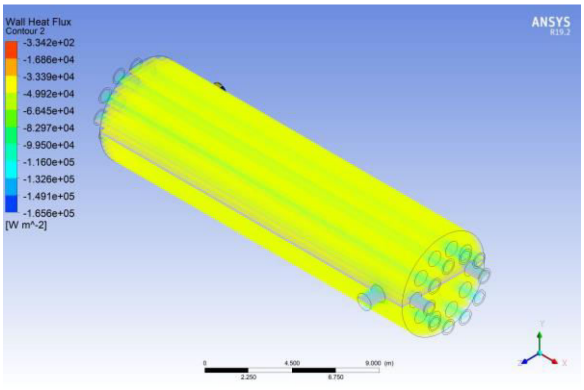


FIGURE 31HEAT FLUX IN H.E. (10-TUBE COPPER)

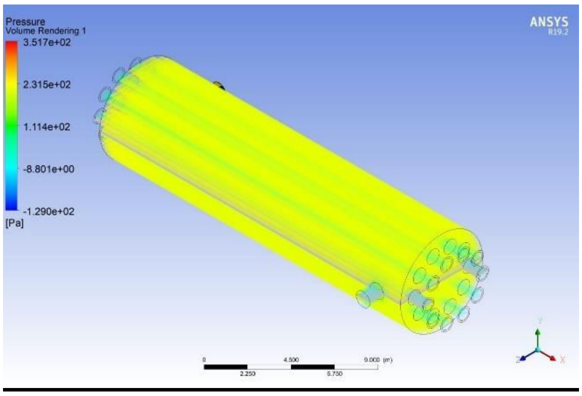


FIGURE 32PRESSURE IN H.E. (10-TUBE COPPER)

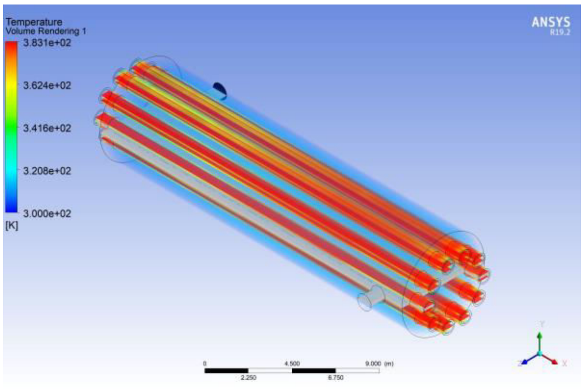


FIGURE 33TEMPERATURE IN H.E. (10-TUBE COPPER)

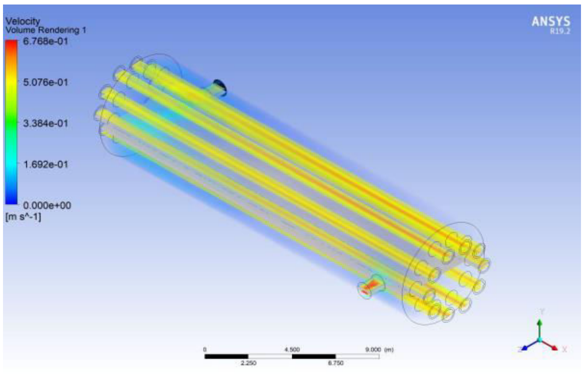


FIGURE 34VELOCITY IN H.E. (10-TUBE COPPER)

8.8 Analysis Of Heat Exchanger With Copper Material (12 Tubes).

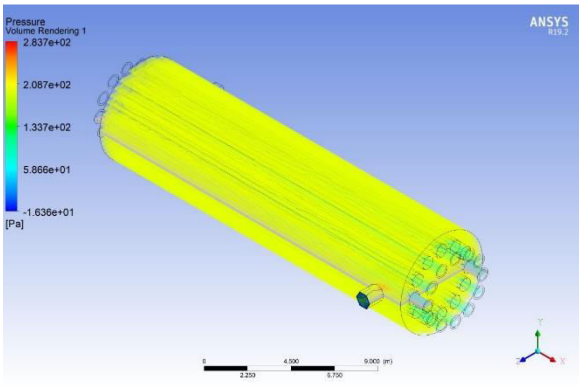


FIGURE 35 HEAT FLUX IN H.E. (12-TUBE COPPER)

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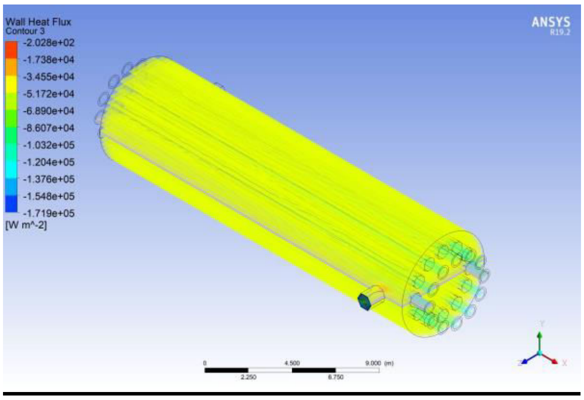

FIGURE 36 PRESSURE IN H.E. (12-TUBE COPPER)

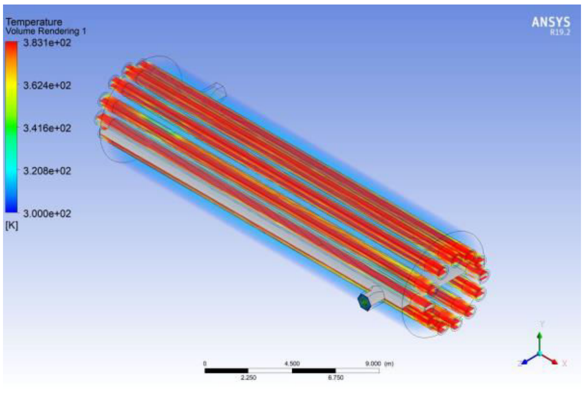

FIGURE 37 TEMPERATURE INH.E. (12-TUBE COPPER)

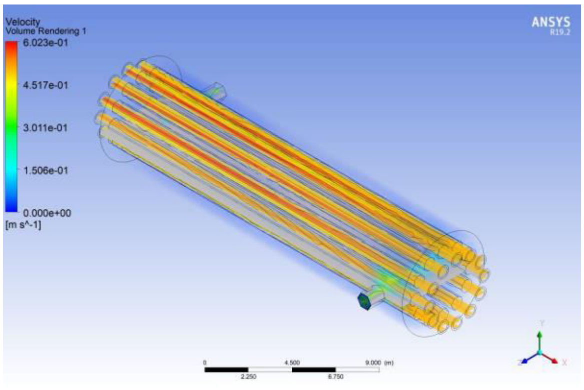

FIGURE 38VELOCITY INH.E. (12-TUBE COPPER)

8.9 Analysis Of Heat Exchanger With Steel Material (8 Tubes)

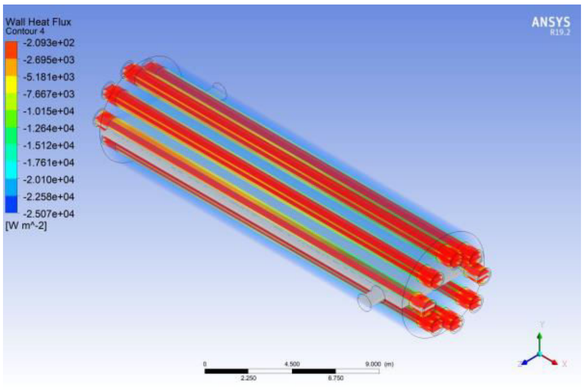

FIGURE 39 HEAT FLUX IN H.E.(8-TUBE STEEL)

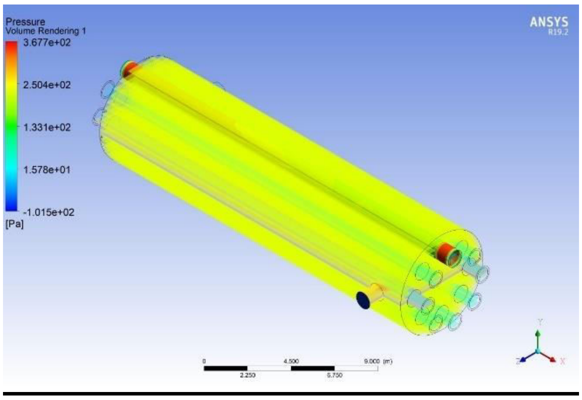

FIGURE 40 PRESSURE IN H.E.(8-TUBE STEEL)

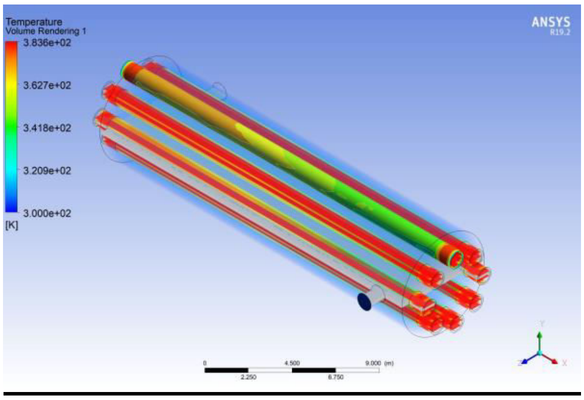

FIGURE 41 TEMPERATURE IN H.E.(8-TUBE STEEL)

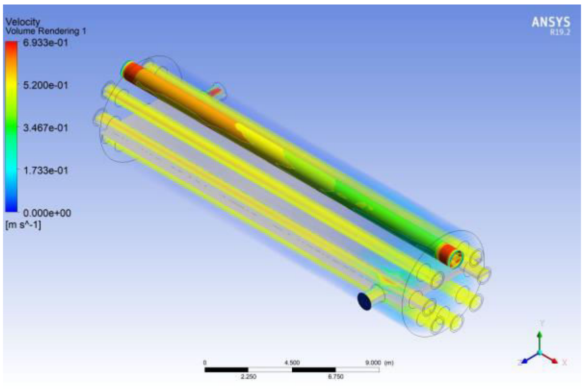

FIGURE 42 VELOCITY IN H.E.(8-TUBE STEEL)

8.9 Analysis Of Heat Exchanger With Steel Material (10 Tubes)

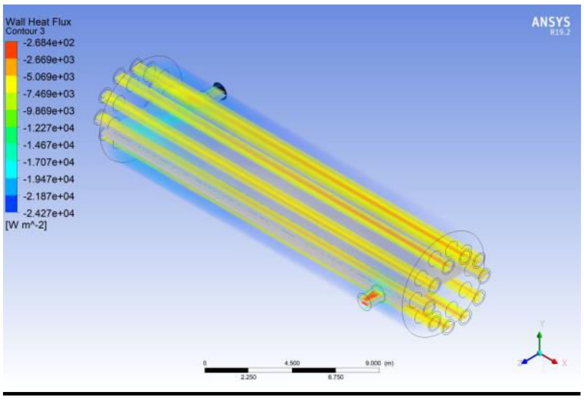

FIGURE 43HEAT FLUX IN A HEAT EXCHANGER (10-TUBE STEEL)

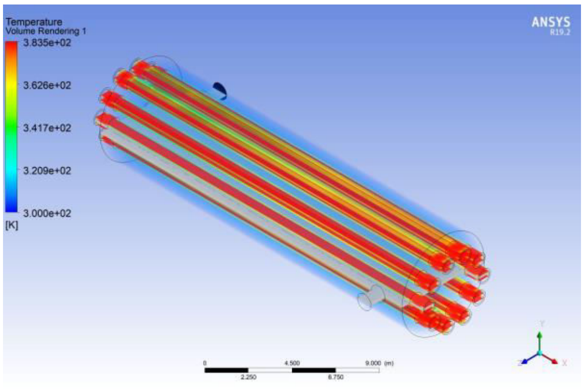

FIGURE 45TEMPERATURE IN A HEAT EXCHANGER (10-TUBE STEEL)

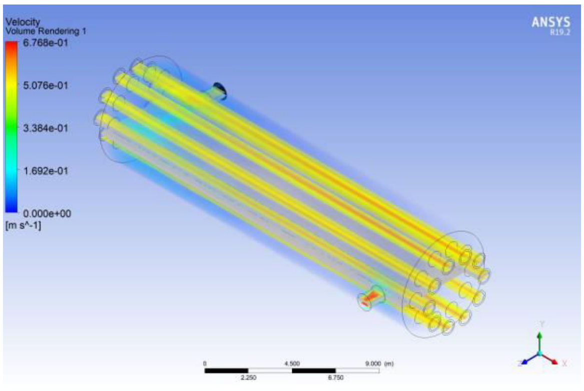

FIGURE 46TEMPERATURE IN A HEAT EXCHANGER (10-TUBE STEEL)

8.10 Analysis Of Heat Exchanger With Steel Material (12 Tubes)

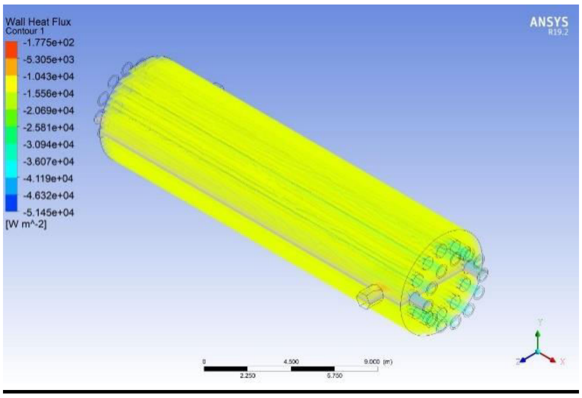

FIGURE 47HEAT FLUX IN A HEAT EXCHANGER (12-TUBE STEEL)

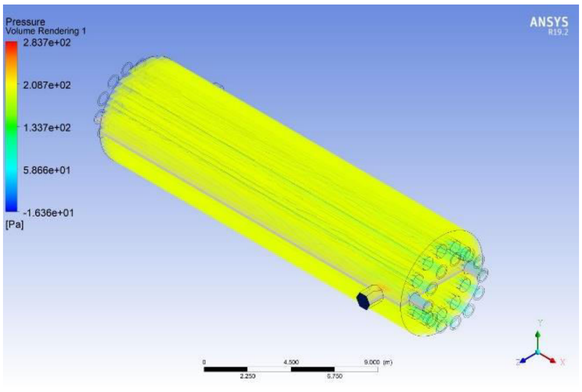

FIGURE 48PRESSURE IN A HEAT EXCHANGER (12 -TUBE STEEL)

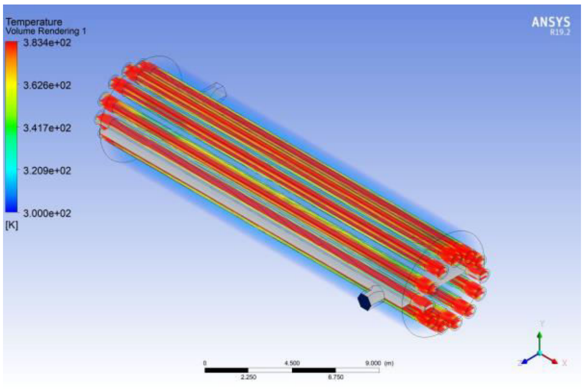

FIGURE 49TEMPERATURE IN A HEAT EXCHANGER (12-TUBE STEEL)

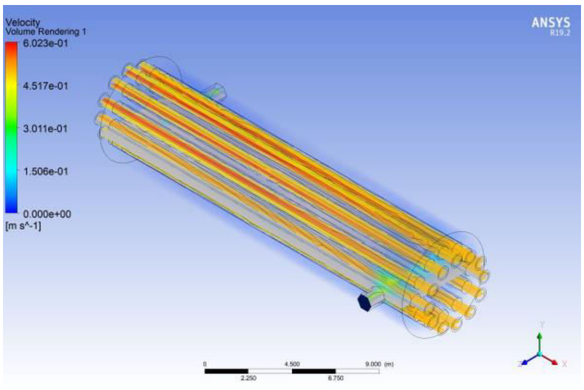

FIGURE 50TEMPERATURE IN A HEAT EXCHANGER (12-TUBE STEEL)

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8.10 GRAPHS:

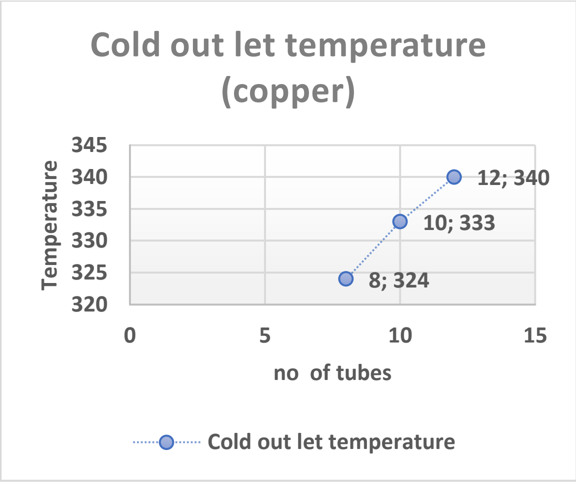

FIGURE 51NO. OF TUBES VS TEMPERATURE (COPPER)

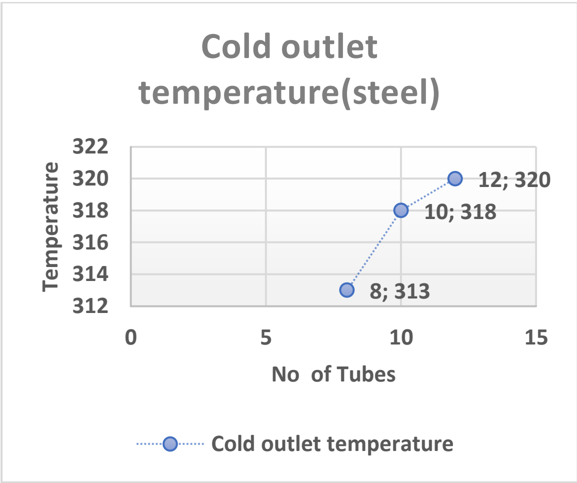

FIGURE 52NO. OF TUBES VS TEMPERATURE (STEEL)

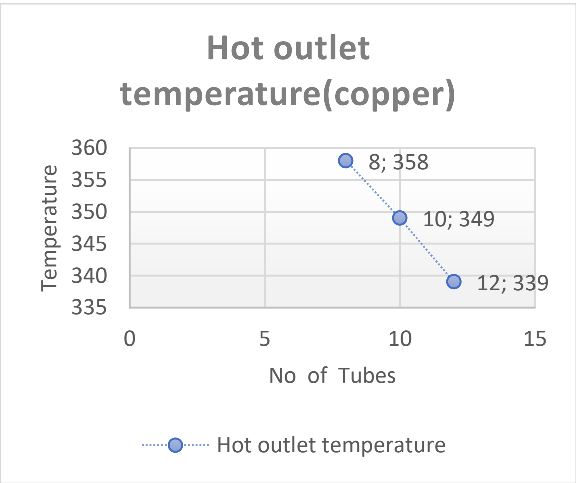

FIGURE 53NO. OF TUBES VS TEMPERATURE (COPPER)

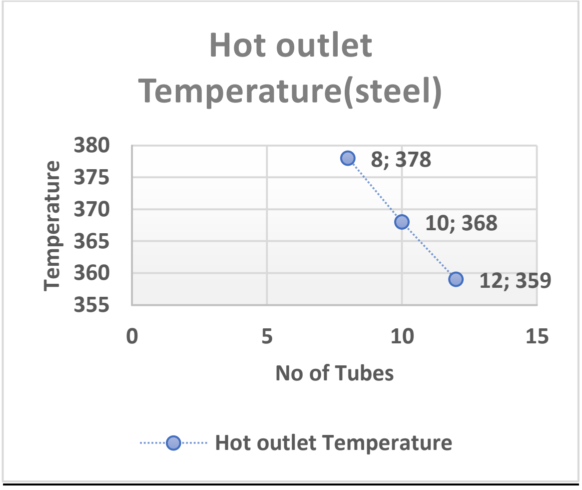

FIGURE 54NO. OF TUBES VS TEMPERATURE (STEEL)

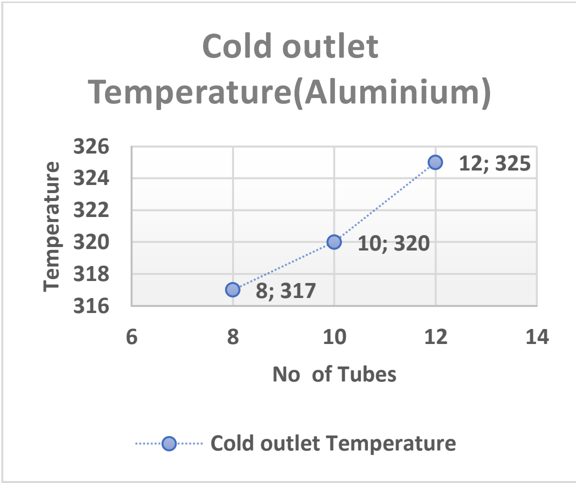

FIGURE 55NO. OF TUBES VS TEMPERATURE (ALUMINIUM)

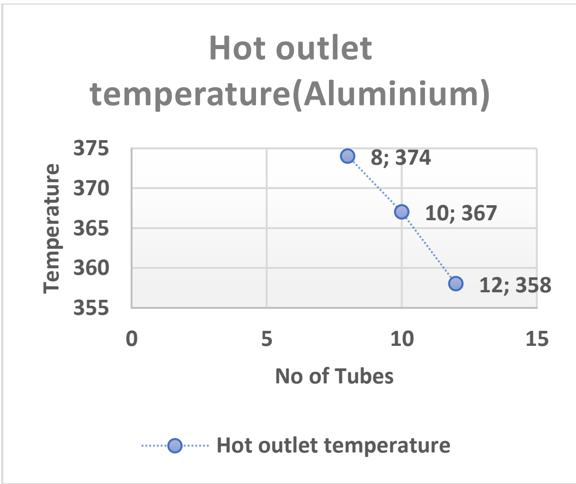

FIGURE 56NO. OF TUBES VS TEMPERATURE (ALUMINIUM)

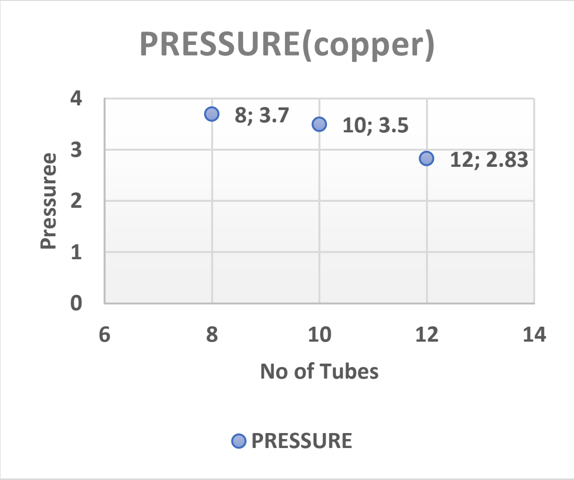

FIGURE 57NO. OF TUBES VS PRESSURE (COPPER)

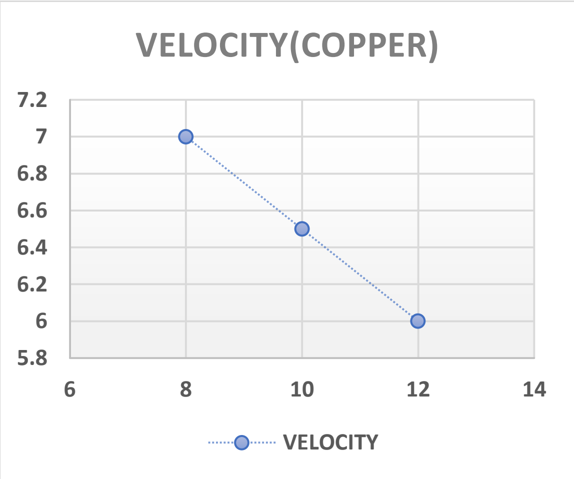

FIGURE 58NO. OF TUBES VS VELOCITY (COPPER)

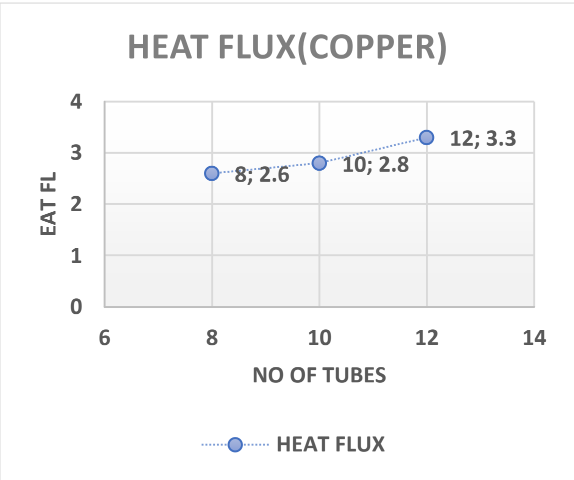

FIGURE 59NO. OF TUBES VS HEAT FLUX (COPPER)

9. CONCLUSION

1.The heat transfer and pressure drop calculated the shell and heat exchanger by using ansys software .

2.In this experiment I use 3 different materials such as aluminium ,copper,and steel and also change the no of tubes .

3.By this experiment i found the very high efficient material and also found the no of tubes are increased cold outlet increases.I can calculate the best thermal conductivity material.

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