Design and Analysis of Triple Tube Ribbed Heat Exchanger for Optimizing Heat Transfer

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Abstract— The main goal of this work is to design a three-tube compact heat exchanger for better heat movement, using a sum of four extensions to verify its warm appearance under similar boundary conditions. For this reason, the second flow condition is specified for heavy-duty dividers where the heat flow for the outer side divider is concentrated to achieve an adiabatic state while the inner cylinder dividers and wings are coupled. The deltas for the outside and inside of the line are characterized as mass flow trees. The power source is marked as an outlet with a pressure factor. By programming the flow rate it is possible to determine the movement of the liquid and the flow of heat in the measurement zones. The applicable conditions are iteratively governed by the limited volume details with the SIMPLE calculation. The RNG-k-epsilon model is used for storm currents because the influence of eddies on strong currents is more accurate than the standard k-epsilon model and the second supplementary graph method is used for the deviation of the eruption energy and its propagation speed used. The results show that computer examination of the liquid elements of a concentric three-tube heat exchanger with inclined scales at 45 ° C provides the circulation temperature, the rate of thermal displacement and, in general, a coefficient of thermal displacement. over 11.74% higher than inclined fins are at 30 ° C and 28.96% higher than straight stairs, 9 mm high and 42.22% higher than concentric fins with three tube heat exchangers..

Keywords — *Heat Exchanger, Rib, Temperature, TCTHE.*

I. INTRODUCTION

In the new decade, the increased demand for the energy has led many researchers to research the ideal uses of energy to overcome of the concern. Improving the performance of thermo fluidic devices is one of the answers to achieve this goal. Perhaps the most commonly used hot gear is a three-tube heat exchanger which is widely used in various mechanical applications with the ultimate goal of increasing its performance to moderate energy. Three-tube heat exchangers are used to remove obstacles from triple tube heat exchangers by inserting the extra flow and increasing the heat displacement of the area per unit of length. An absurd decade, the growing interest in energy has led many researchers to conduct a focused study on the ideal use of energy to address these concerns. Perhaps the most commonly used hot device is the double cylinder heat exchanger, in which is widely used in various modern application. An increase in its productivity therefore saves energy. Three-tube heat exchangers know the disadvantages of two-tube heat exchangers as they allow for additional flow to pass through and widen the range of heat movement per unit of the length.

II. LITERATURE REVIEW

Cao X et al. [1] In the cooling system, condensation from the refrigerant gives off a lot of heat. Using condensation heat from cooling systems to store heat for water heating and industrial hot water supply promotes energy saving and latent heat storage (LHTES) offers unique benefits. Compared to the shell and tube heat exchanger, the triplex tube heat exchanger (TTHE) can realize heat storage and hot water preparation at the same time, but only a few studies have looked at the heat output. A mathematical model of TTHE is performed by the enthalpy method and the dynamic properties were investigated. The results show that liquid sensible heat transfer, latent heat transfer and solid sensible heat transfer are three stages of the whole process. The rate of heat accumulation increases and the rate of heat release gradually decreases with the reverse trend, but eventually reaches equilibrium with a stable value.

Z. Li et al. [2] To solve the problem of the low thermal conductivity of phase change materials (PCM), three different methods are being studied, including the modification of the geometry, the addition of nanoparticles and metal foam in a latent heat storage system (LHS) with three tubes. The PCM is trapped in the central tube, while the water flows through the inner and outer tubes as heat transfer fluid (HTF). Different concentrations of nanoparticles and metal foam porosities are examined. Different directions of the HTF flow in the inner and outer pipes are evaluated with respect to the direction of gravity. The results show the interest of the HTF counter flow flow system when the HTF flow in the outer tube is in the direction of gravity. The addition of 5% copper nanoparticles reduces the melting / solidification time by 25.9 / 28.2%. Adding 95% porous metal foam reduces melt / solidification time by 83.7 / 88.2%, which shows the advantage of adding metal foam over adding nanoparticles.

Vo Tuyen et al. (2020) [7] The highly efficient heat transfer characteristics of a three-pipe heat exchanger were applied to the liquid suction heat exchanger of an R410A refrigerator. A one-dimensional analytical model was created and validated against numerical and experimental models. The aim of the study was to determine the optimal proportion of the refrigerant flow rate and the optimal diameter of the three pipes in terms of heat transfer rate and pressure drop. The results showed that the three-pipe liquid suction heat exchanger had much higher heat transfer and lower pressure drop than the dual-pipe heat exchanger. The TOPSIS decision-making technique revealed that the three-tube heat exchanger with diameters of 1, 1-1 / 4 and 1-1 / 2 inches and a mass flow fraction of 0.66 achieved the maximum pressure drop and at maximum heat transfer.

Abdelmagied M (2019) [8] In the present work, the thermal fluid properties of a new curved tube design called the Triple Spiral Tube Heat Exchanger (TSTHE) were obtained with a bold comparison to a Double Spiral Tube Heat Exchanger (DSTHE) as a special reference. A dynamic three-dimensional computational fluid model was developed using the ANSYS 14.5 software package. The Realize k - ε model was applied with an improved wall treatment to simulate the properties of the thermal fluid. The results for the Dean number were in the turbulent range between 1100 and 10500, corresponding to the Reynolds number between 6400 and 57400. The results showed that the Nusselt number obtained from a TSTHE was greater than the DSTHE value under the same conditions as flow. The results also showed that the incoming hot water temperature had a significant effect on the Nusselt index, while the increase in pressure drop could be considered to be roughly negligible. The use of alumina-water nanofluids in 20.8% of TSTHE improves heat transfer. New correlations were presented for the Nusselt number, efficiency and friction factor of the heat exchanger in the inner ring.

III. OBJECTIVE

There are following objective are to be expected from the present work:

- To perform of study about various heat exchangers and its mathematical relations.
- To prepare different computational model of triple concentric tube heat exchanger.
- To perform of computational fluid dynamics analysis on all designs of TCTHE.
- To compare the results of all designs of TCTHE (Triple concentric tube heat exchanger) [2].

IV. METHODOLOGY

A. *Mathematical analysis of concentric triple tube heat exchanger*

The numerical examination of concentric triple cylinder heat exchanger has been led in present turn out included for cooling. The chilly liquids stream in the internal cylinder and external cylinder at a temperature of T_(c1(in)) and ways out at temperatures T_(c1(out)) where T_(c2(out)) in the inward cylinder and external cylinder, individually. The hot liquid which must be cooled enters from the internal annulus of the triple cylinder heat exchanger at a temperature of T_(h(in)) and ways out at a temperature of T_(h(out)) as demonstrated in fig.1.

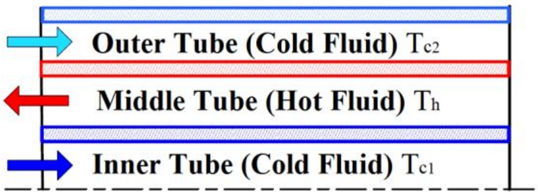

Fig. 1: Arrangement of fluid flow in triple tube heat exchanger

Appearing of the heat move in a triple chamber heat exchanger is certainly not something similar for the situation where the hot liquid streams equivalent way as the cool liquid and the condition where the hot liquid streams the backup course of action as the fresh liquid. In that capacity, the definitions for these two undeniable outlines are bankrupt down self-rulingly.

B. *Overall heat transfer coefficient of the concentric triple tube heat exchanger*

$$U = \frac{q_h}{A \times LMTD_{avg}}$$

Where

A = Inner tube area

$LMTD_{avg}$ = Average logarithmic mean temperature differences

$$LMTD_{avg} = \frac{LMTD_{h\&c} + LMTD_{h\&nf}}{2}$$

Where

$LMTD_{h\&c}$= Logarithmic mean temperature differences of hot & cold fluid

$LMTD_{h\&nf}$= Logarithmic mean temperature differences of hot & nano-fluid

$$LMTD_{h\&c} = \frac{\Delta T_1 - \Delta T_2}{ln\left(\frac{\Delta T_1}{\Delta T_2}\right)}$$

And

$$LMTD_{h\&nf} = \frac{\Delta T_3 - \Delta T_4}{ln\left(\frac{\Delta T_3}{\Delta T_4}\right)}$$

Where

$$\Delta T_1 = T_{h,in} - T_{c,out}$$
$$\Delta T_2 = T_{h,out} - T_{c,in}$$

$$\Delta T_3 = T_{h,in} - T_{nf,out}$$
$$\Delta T_4 = T_{h,out} - T_{nf,in}$$

Effectiveness of concentric triple tube heat exchanger

$$Effectiveness = \frac{q_h}{q_{max}}$$

Where

q_{max}= Maximum possible heat transfer rate.

Execution list or productivity of the concentric triple cylinder heat exchanger can be the proportion of the heat move pace of the heat exchanger to its pressing factor drop.

$$\eta = \frac{q_h}{\Delta P}$$

Bulk mean temperature of cold fluid

$$T_{b1} = \frac{T_{c1,in} + T_{c1,out}}{2}$$

Bulk mean temperature of hot fluid

$$T_{b2} = \frac{T_{h1,in} + T_{h1,out}}{2}$$

Liner velocity

Liner velocity of nano fluid

$$v_{nf} = \frac{\dot{m}_{nf}}{\rho_{nf} A_{cross\ mid}} \ m/sec$$

Liner velocity of cold water

$$v_{cold} = \frac{\dot{m}_{cold}}{\rho_{cold} A_{cross\ inner}} \ m/sec$$

Liner velocity of normal water

$$v_{normal} = \frac{\dot{m}_{normal}}{\rho_{normal} A_{cross\ normal}} \ m/sec$$

Reynolds No.

Reynolds No. of GNPs

$$R_{e,nf} = \frac{\rho_{nf} v_{nf} D_2}{\mu_{nf}}$$

Reynolds No. of cold water

$$R_{e,cold} = \frac{\rho_{cold} v_{cold} D_1}{\mu_{cold}}$$

Reynolds No. of normal water

$$R_{e,normal} = \frac{\rho_{normal} v_{normal} D_3}{\mu_{normal}}$$

Calculation of Nusselt no. of GNPs:

$$Nu_{nf} = \frac{h_{nf} D_{h,nf}}{k_{nf}} = 0.023 R_{e,nf}{}^{0.8} \times Pr_{nf}{}^{0.4}$$

Calculation of Nusselt no. of cold water:

$$Nu_{cold} = \frac{h_{cold} D_{h,cold}}{k_{cold}} = 0.023 \times R_{e,cold}{}^{0.8} \times Pr_{cold}{}^{0.4}$$

Calculation of Nusselt no. of normal water:

$$Nu_{normal} = \frac{h_{normal} D_{h,normal}}{k_{normal}} = 0.023 R_{e,normal}{}^{0.8} Pr_{normal}{}^{0.4}$$

Heat transfer coefficient for GNPs, Normal and cold water:

$$h_{nf} = \frac{k_{nf} . Nu_{nf}}{D_{hnf}} \ W/_{m^2.k}$$

Heat transfer coefficient for cold water:

$$h_{cold} = \frac{k_{cold} . Nu_{cold}}{D_{h,cold}} \ W/_{m^2.k}$$

Heat transfer coefficient for Normal water:

$$h_{normal} = \frac{k_{normal} . Nu_{normal}}{D_{h,normal}} \ W/_{m^2.k}$$

Darcy-Weisbach factor for Newtonian fluids:

$$f_D = \frac{64}{Re}$$

Blasius rubbing factor for violent stream in roundabout cylinders

Blasius built up a declaration of rubbing factor in 1913 for 2100 < Re < 10^5

$$f = \frac{0.0791}{Re^{0.32}}$$

Koo friction factor

Koo introduced another explicit formula in 1933 for a turbulent flow for 10^4< Re < 10^7

$$f = 0.0014 + \frac{0.125}{Re^{0.32}}$$

The expression for drop through both sides

Pressure drop for GNPs

$$\Delta p_{nf} = 4 f_{nf} \frac{L}{D_2} \rho_{nf} \frac{\mu_{nf}{}^2}{2}$$

Pressure drop for cold

$$\Delta p_{cold} = 4 f_{cold} \frac{L}{D_1} \rho_{cold} \frac{\mu_{cold}{}^2}{2}$$

Pressure drop for normal

$$\Delta p_{normal} = 4 f_{normal} \frac{L}{D_3} \rho_{normal} \frac{\mu_{normal}{}^2}{2}$$

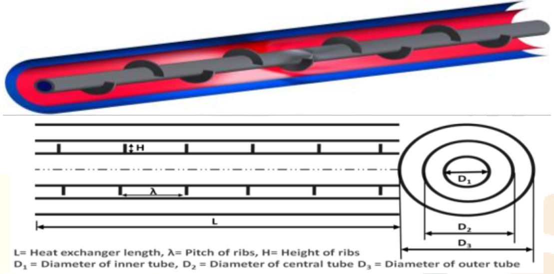

Fig. 2 Conceptual diagram of concentric triple tube heat exchanger

The properties of water classified in SI units, for temperatures somewhere in the range of 0°c and 100°c at 101.325 kPa of climatic pressing factor.

C. Algorithm used for Computational fluid dynamics analysis

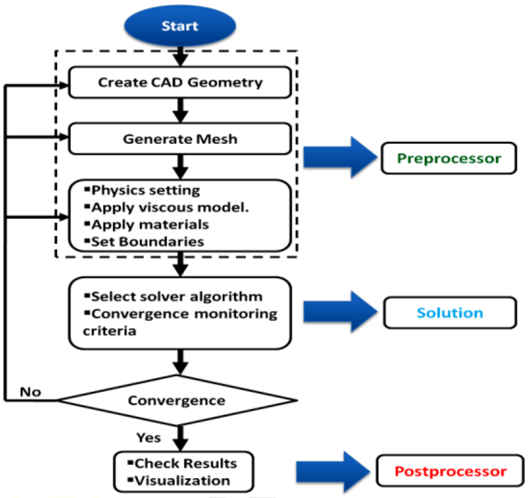

Fig. 3 Algorithm used for Computational fluid dynamics analysis

D. Governing Equations

For the CFD examination the administering incomplete respectful conditions, in consistent state structure, The overseeing conditions are settled by utilizing the mathematical recreations considering a few presumptions are,

- The nano-liquid is thought to be a homogenous and in consistent state condition.
- Flow is viewed as violent and incompressible.

E. Conservation of mass or continuity equation

The condition for preservation of mass, or progression condition, can be composed as follows:

$$\frac{\partial u_i}{\partial x_i} = 0$$

Where x is the axial coordinate and u is velocity of fluid

F. Computational fluid dynamics analysis for concentric triple tube heat exchanger

1. CAD model of without baffle of concentric triple tube heat exchanger:

In the current work a three dimensional CAD model of concentric triple cylinder heat exchanger with straight confuse is made with the assistance of plan measured of ANSYS workbench. The inward cylinders measurement 13.51 mm, middle cylinder breadth 45.26 mm, external cylinder distance across 70.66 mm, length of 500 mm as demonstrated in figure no. 4.

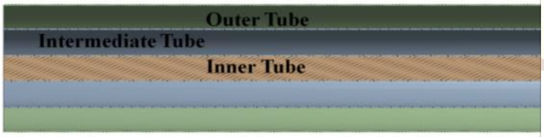

Fig. 4 CAD model without baffles for concentric tube triple tube heat exchanger

2. Meshing:

Fig. 5: Meshing of concentric tube triple tube heat exchanger with straight baffles

Meshing is a basic activity in computational liquid elements examination in this interaction CAD calculation is separated into enormous quantities of little pieces called network. The all out no of hubs created in the current work is 3918427 and all out no. of components is 3059523 as demonstrated in figure 5. Kinds of component produced in this meshing is tet4, Hex8 and Wed6 with component size is 0.5 mm

3. CAD model of with straight baffle for concentric triple tube heat exchanger:

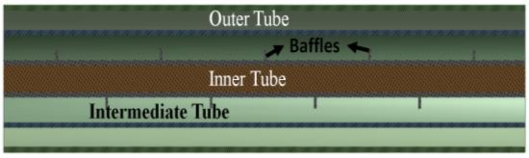

Fig. 6: CAD model for with straight baffles

4. Meshing:

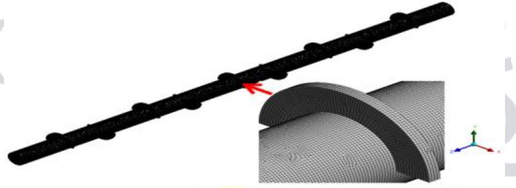

Fig. 7: Meshing of with straight baffles

Meshing is a basic activity in computational liquid elements investigation in this cycle CAD math is partitioned into enormous quantities of little pieces called network. The complete no of hubs created in the current work is 984253 and all out no. of components is 1000308 as demonstrated in figure 5.5. kinds of component produced in this meshing is tet4, Hex8 and Wed6 with component size is 0.5 mm

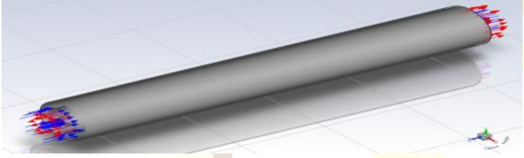

Fig. 8: Concentric tube triple tube heat exchanger with straight baffles of Boundary Condition

G. CAD model of concentric triple tube heat exchanger with inclined baffles at 30^O

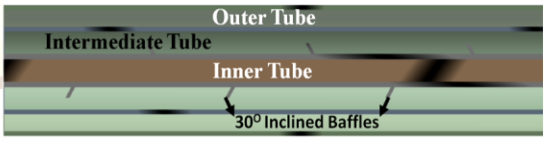

Fig. 9: CAD model with inclined baffles at 30^O

1. Meshing

The complete no of hubs produced in the current work is 2243493 and absolute no. of components is 6580394 as demonstrated in fig. 10. Sorts of component produced in this meshing is tet4, Hex8 and Wed6 with component size is 0.5 mm,

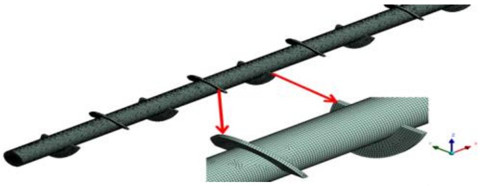

Fig. 10: Meshing with inclined baffles at 30^O

H. *CAD model of concentric triple tube heat exchanger with inclined baffles at 45^O*

Current work a three-dimensional CAD model of triple chamber heat exchanger with skewed puzzles is made with the help of plan separated of ANSYS workbench. The internal chambers distance across 13.51 mm, widely appealing cylinder estimation 45.26 mm, outside chamber width 70.66 mm , length of 500 mm and the skewed baffles at 45O with befuddles isolating of 50 mm as shown in figure no. 11.

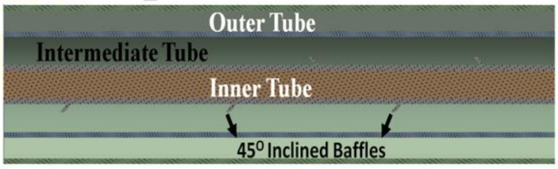

Fig. 11: CAD model with inclined baffles at 45^O

1. Meshing:

Irrefutably the no. of centers created in the present of work is 2228509 and full scale no. of parts is 6491592 as shown in figure 5.7. Kinds of part delivered in this lattice is tet4, Hex8 and Wed6 with segment size is 0.5 mm,

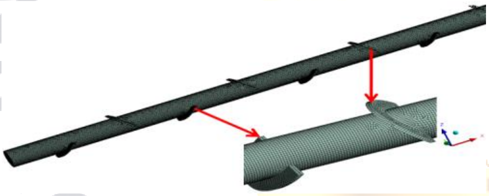

Fig. 12: Meshing of concentric tube triple tube heat exchanger with inclined baffles at 45^O

I. *Boundary condition*

1. need of the energy condition of the decide the temperature dispersion.
2. RNG k-epsilon model is utilized for violent stream on the grounds that the twirling impact on fierce stream having higher exactness as contrasted and standard k-epsilon model.
3. Working liquid grapheme nanoplatelets–platinum nanofluid with thickness of 984.3203kg/m3 and heat exchanger pipe material is aluminum having warm conductivity is k =15.2W/mk.
4. Outer container of concentric cylinder heat exchanger is totally protected henceforth no heat move between the external cylinder and air, hear heat transition is set as zero for the external side divider to make adiabatic condition.
5. The inward cylinder and transitional cylinder dividers with ribs are coupled for heat collaboration among liquid and line.
6. Cold and ordinary liquid gulf having mass stream rate is 0.1 Kg/sec at temperature 283K and 291K.
7. Nano liquid delta having mass stream rate 6 lit/min (0.1086 Kg/sec) at temperature 343K
8. For the power source limit condition the measure constrain should be set as zero in light of the fact that the liquid streaming inside the heat exchanger is climatic
9. Rest of all surface treated as divider with no slip conditions set for strong dividers.
10. Coupled plane for pressure speed coupling for pressure The SIMPLE scheme is used, and the following demand increase plane is used for the force-energy disturbance, energy, and its propagation speed.
11. The Fluent solver is utilized for CFD examination.

V. RESULTS

A. *Model validation*

In order to validate the results of this work, a comparative analysis was carried out with selected background documents. "*Nima Mazaheri et al. "Analyzing performance of a ribbed triple-tube heat exchanger operated with graphene nanoplatelets nanofluid based on entropy generation and exergy destruction" Kermanshah University of Technology, Kermanshah, Iran, International Communications in Heat and Mass Transfer 107 (2019) 55–67.*

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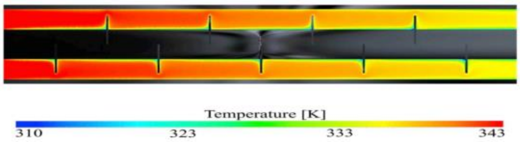
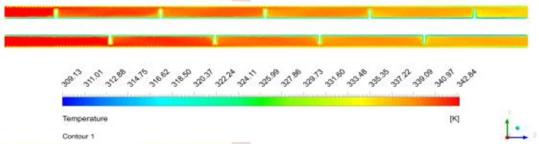


(a) Nima Mazaheri et al (2019)



(b) Present of work

Fig. 13: Temperature distribution along the inner tube at 9 mm rib height (a) NimaMazaheri et al. (2019) and (b) Present of work

Rate variety examination of Nima Mazaheri et al. what's more, present work with form outline and temperature appropriation along tube length show less variety going from 0.04% for greatest to 0.28% least temperature as fig.14

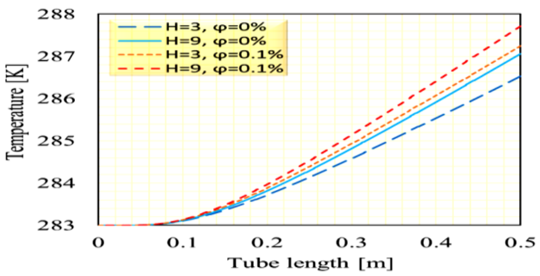


Fig. 14: Temperature distribution along tube length Mehdi Bahiraei et al.

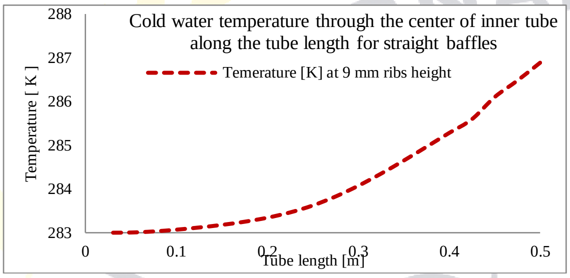


Fig. 15: Temperature distribution along tube length present work

B. *CFD analysis for concentric triple tube heat exchanger without ribs*

To perform a computational study of liquid elements on a three-cylinder concentric heat exchanger without fins, cold water and normal water flow at 0.1 kg / s and nano-liquid at 0.1086 kg / s. The shaft temperature of the nano-liquid, cold water and typical water is 343K, 283K, and 291K separately, while the source temperature for the inner, middle and outer cylinders is 294.71K respectively, 323.15K and 313.92K.

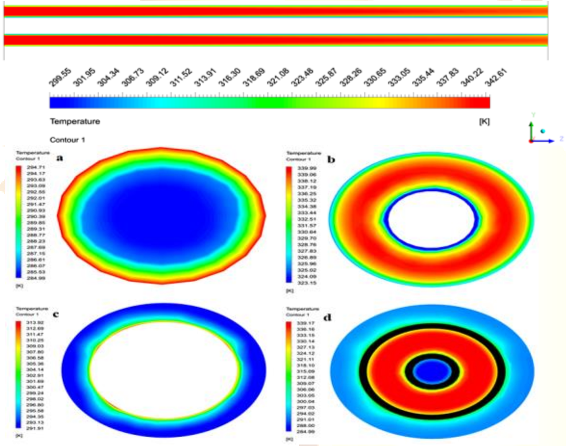


Fig. 16: Temperature distribution along the tube length without ribs and its different outlets (a) cold water (b) nano fluid (c) normal water and (d) concentric triple tube

C. *Computational fluid dynamics analysis for concentric triple tube heat exchanger with straight ribs of 9 mm height*

After performing a computerized study of the liquid elements on a concentric three-cylinder heat exchanger with straight fins 9 mm high. The channel temperatures of nano-liquid, cold water and plain water are 343K, 283K and 291K separately, while the source temperature for the inner, middle and outer cylinders is 298.936. K, 321.83 K and 317.499 K.

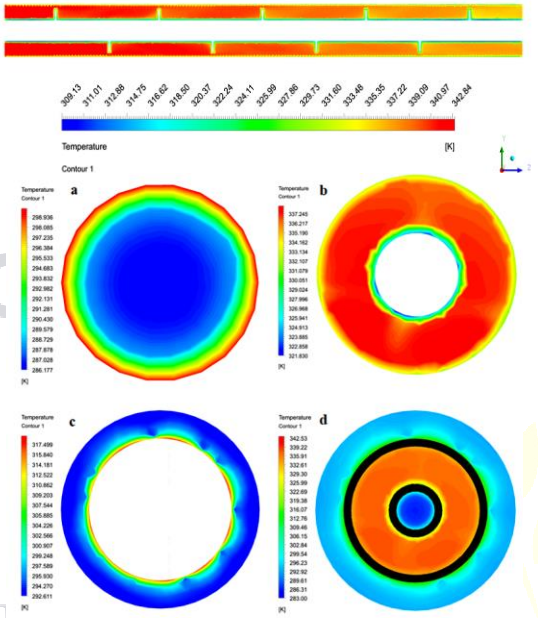


Fig. 17: Temperature distribution along the tube length with straight ribs of 9 mm height and its different outlets (a) cold water (b) nano fluid (c) normal water and (d) concentric triple tube

D. *Computational fluid dynamics analysis for concentric triple tube heat exchanger with inclined ribs at 30^{O}:*

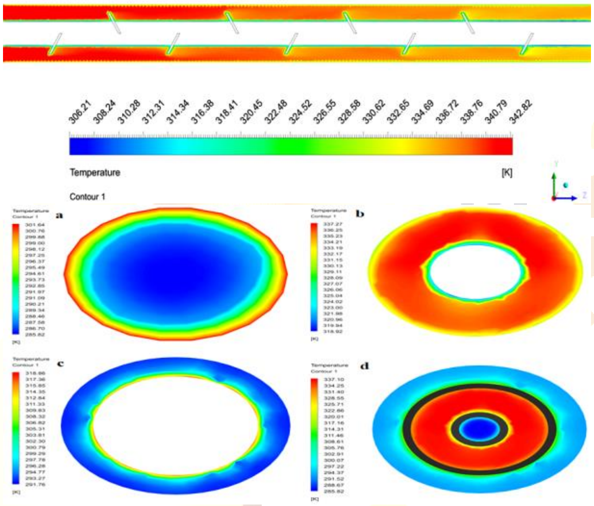
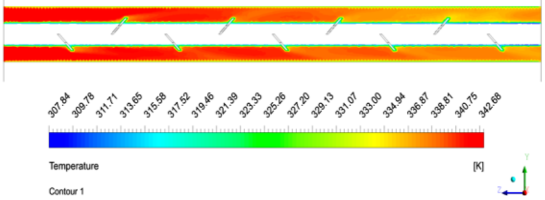


Fig. 18: Temperature distribution along the tube length with inclined ribs at 30O and its different outlets (a) cold water (b) nano fluid (c) normal water and (d) concentric triple tube

E. *Computational fluid dynamics analysis for concentric triple tube heat exchanger with inclined ribs at 45^{O}*



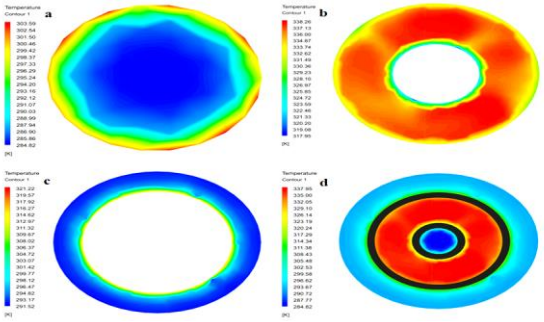


Fig. 19: Temperature distribution along the tube length with inclined ribs at 45O and its different outlets (a) cold water (b) nano fluid (c) normal water and (d) concentric triple tube

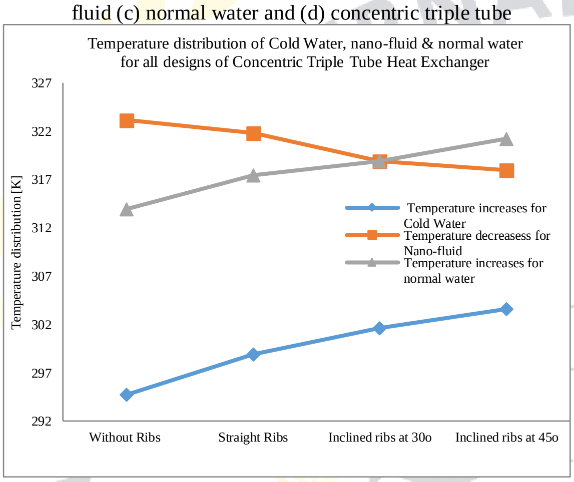


Fig. 20: Temperature distribution of Cold Water, nano-fluid & normal water for all designs of Concentric Triple Tube Heat Exchanger

To decide the heat move pace of the hot nanofluid, cold water and typical water following relations are have been utilized:

$$q_{nf} = m_{nf}.C_{p,nf}.(T_{nf,i} - T_{nf,o})$$

$$q_{c1} = m_{c1}.C_{p,c1}.(T_{c1,out} - T_{c1,in})$$

$$q_{c2} = m_{c2}.C_{p,c2}.(T_{c2,out} - T_{c2,in})$$

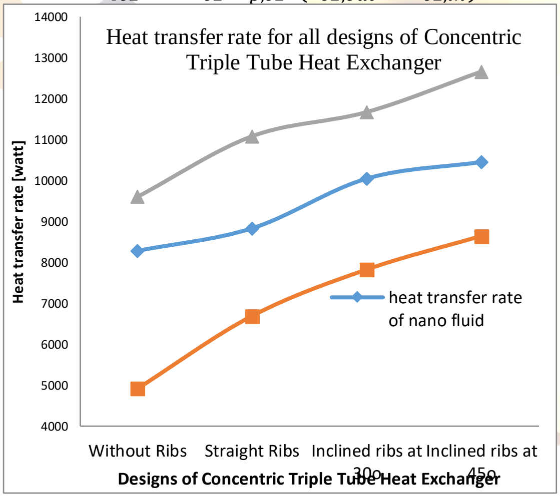


Fig. 21: Heat transfer rate for all designs of Concentric Triple Tube Heat Exchanger

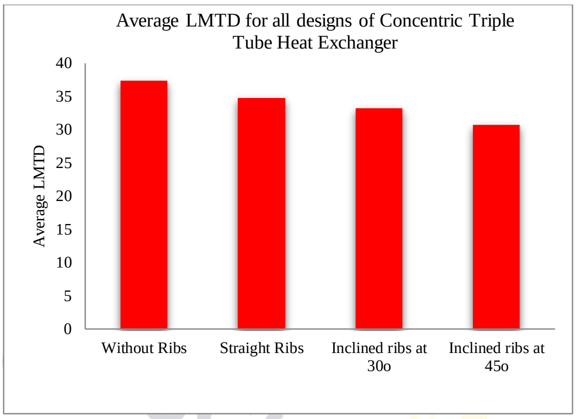


Fig. 22: Average LMTD for all designs of Concentric Triple Tube Heat Exchanger

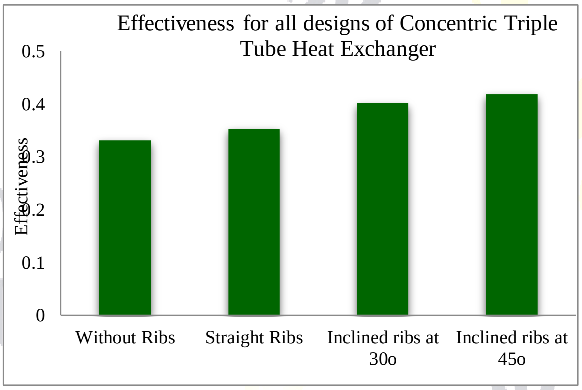


Fig. 23: Effectiveness for all designs of Concentric Triple Tube Heat Exchanger

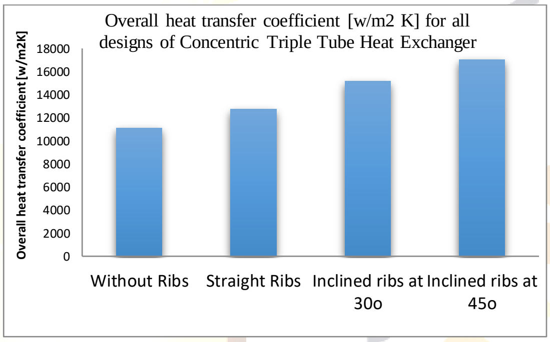


Figure 24: Overall heat transfer coefficient [w/m2 K] for all designs of Concentric Triple Tube Heat Exchanger

VI. CONCLUSION

In the present work, a digital and modernized study of liquid elements was carried out for several developments of a concentric three-cylinder heat exchanger in order to improve heat generation. In total, four developments were used to verify heat recovery for similar boundary conditions. For this reason, the second non-slip breaking point is established for the strong dividers, with the heat flow for the outer divider concentrated to maintain an adiabatic state while the inner cylinder dividers and fins are coupled. The deltas for the outside and inside of the line are characterized as mass flow trees; the power source is marked as an outlet with a pressure factor. Flow programming is used to determine liquid flow and heat movement in the measurement zones. The related conditions are managed iteratively by the limited volume plan with the SIMPLE calculation. The RNG-k-epsilon model is used for strong currents because the impact of eddies on storm currents is more accurate than the standard k-epsilon model and the second demand updraft diagram is used for d disturbances. Accidental energy and their dispersion rate. The different ends result from the numerical and computerized study of the liquid elements for the concentric three-tube exchangers.

- After a PC study of liquid elements on a bladeless three-tube concentric heat exchanger, cold water and typical flow rate at 0.1 kg / s and nanofluid at 0.1086 kg / s. The temperature of the nanofluid bay, cold water and normal water individually is 343 K, 283 K and 291 K, while the temperature at the power source of the inner, focal and outer conductors was found to be 294.71 K, 323 , 15 K and 313.92 K. The heat movement rates for nanofluids, cold water and clean water are individually 8.29 kW, 4.92 kW and 9.6 kW with an absolute thermal displacement coefficient of 11.1 kW / m 2K.
- After PC examination of the liquid elements on a concentric three-tube heat exchanger with straight fins 9 mm high. The temperatures of the nanofluid, cold water, and typical water delta are 343 K, 283 K, and 291 K separately, while the temperatures on the inner, focal and outer line paths were individually 298.936 K, 321., 83 K and 317.499 K. the heat displacement rates for nanofluids, cold water and clean water are individually 8.83 kW, 6.69 kW and 11.08 kW, the full thermal displacement coefficient of 12.73 kW / m2 K is of the 13.68% higher than that of heat exchangers with three concentric tubes without fins.
- After performing an automatic liquid element analysis on a three-blade concentric cylinder heat exchanger, which has been moved 30 ° C. Typical nanofluid, cold water and water well temperatures are of 343 K, 283 K and 291 K, while the temperatures of the power source of the inner, middle and outer containers were determined to be 298.57 K, 318.92 K and 318.13 K. The thermal motion for nanofluid, water cold and typical water is 10.05 kW, 7.83 kW and 11.67 kW separately, coefficient of movement of absolute heat equal to 15.15 kW / m2 K, which is 17.36% higher than with tall straight blades 9 mm and 30.86% higher than a continuous heat exchanger with three concentric cylinders.
- After performing a mechanized liquid element study on a 45 ° C compensated three-blade concentric cylinder heat exchanger. The temperatures of the nanofluid shaft, cold water and typical water are 343 K, 283 K and 291 K , while the temperatures of the power source of the inner, middle and outer containers were found to be 303.59 K, 317.95 K and 321.22 K. The rate of heat movement for nanofluid, cold water and plain water is separately 10.45 kW, 8.65 kW and 12.66 kW, the total coefficient of thermal movement equal to 17.04 kW / m 2 K, which is 11.74% higher than with blades inclined at 30 ° C, higher 28.96% compared to straight stairs with a height of 9 mm and 42.22% higher than the triple concentric cylinder heat exchanger without stairs.

From the end above, it was seen that the computational study of the liquid elements of a concentric three-tube heat exchanger, with blades tilted at 45 ° C, provides the maximum appropriation of temperature, a speed of movement of heat, and a coefficient by 11.74% in general heat loss with inclined scales at 30 ° C, 28.96% more than straight stairs with a stature of 9 mm and 42.22% more than three shiftless concentric resistance heat exchangers. With this in mind, a concentric three-tube heat exchanger is proposed with scales calculated at 45° for better heat circulation.

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