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"INVESTIGATE THE EFFICIENCY OF THE HEAT EXCHANGER WITH THE FLOW-DEPENDENT TURBULATOR, VARIATIONS OF THE OVERALL COEFFICIENT OF THE HEAT TRANSFER"

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ABSTRACT

This paper mainly deals with the study of thermal modeling of heat exchanger. Heat exchanger is a device that is used to transfer thermal energy (enthalpy) between two or more fluids, at different temperatures and in thermal contact. used the hybrid nano fluid with a 0.4 percent volume concentration for the initial study of hybrid nanoparticles during heat transmission at Re = 4000. Boundary conditions were same as considered during the analysis of Al2O3/ water in heat exchanger having turbulator. Here in this section we are analyzing the influence of Cu+Al2O3/water based hybrid nanofluid in heat exchanger having turbulator, and try to find out the effect of flow of Cu+Al2O3/water based hybrid nanofluid over turbulator in respect of heat transfer enhancement.

Key Words: *Heat Exchanger, Thermal Power Plant, Fluids, Refrigeration.*

I. INTRODUCTION

Nanotechnology has interested many researchers since its inception, who have recently begun to use nano-fluids in together experimental and theoretical work. Thermo transmitting properties of nanoparticles also contributed to the usage of their respective fields of nanoparticles of industry such as solar Synthesis, gas sensing, biological sensing, nuclear reactors and the petroleum industry to enhance the heat transmission ability of conventional fluids.

Over the last decade the science of nanofluid has grown quite constantly. Although the results were contradictory and the method of heat transfer of nanofluids could not be comprehensible, it emerged as a capable thermal transfer fluid. In the continuity of nanofluid science researchers have also recently attempted to use hybrid nanoparticles, which are built to suspend various nanoparticles in combination or a composite form. The aim of the use of hybrid nanofluids is to improve thermal transmission properties further by improving the pressure drop compensation ratios, enhancing the thermal network and the synergistic impact of nanomaterials on individual suspension benefits and disadvantages.

Heat exchanger is a piece of equipment built for efficient heat transfer from one medium to another. They are widely used in space heating, refrigeration, air conditioning, power plants, chemical plants, petrochemical plants, petroleum refineries, natural gas processing and sewage treatment. Heat exchangers are one of the most common pieces of equipment found in all plants. Heat Exchangers are components that allow the transfer of heat from one fluid (liquid or gas) to another fluid. In a heat exchanger there is no direct contact between the two fluids. The heat is transferred from the hot fluid to the metal isolating the two fluids and then to the cooler fluid. The mechanical design of a heat exchanger depends on the operating pressure and temperature

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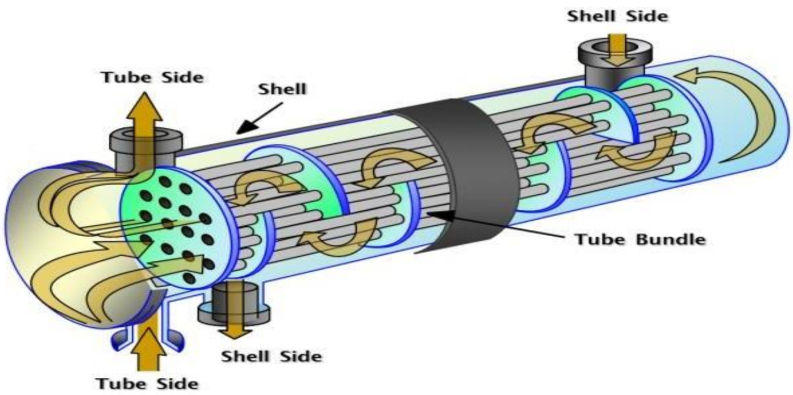

Fig.1 Shell and Tube Heat Exchanger

II. DESIGN METHOD

Shell and tube heat exchangers are designed normally by using either Kern's method or Bell-Delaware method. Kern's method is mostly used for the preliminary design and provides conservative results whereas; the Bell-Delaware method is more accurate method and can provide detailed results. It can predict and estimate pressure drop and heat transfer coefficient with better accuracy. In this paper we have described Kern's method of designing in detail. The steps of designing are described as follows:

1) To find out the values of some unknown temperature first we consider the energy balance. In this energy balance certain some inputs like hot fluid inlet and outlet temperatures, cold fluid inlet temperature, mass flow rates of the two fluids are needed to serve the purpose. The equation may be given as :

Some contents under this heading have been cited from Wolverine Tube Heat Transfer Data Book.

$$Q = m\,h\,Cph\,(Th1-Th2) = mc\,Cpc\,(Tc2-Tc1)$$

2) Then we consider the LMTD equation to find its value:

$$LMTD = \frac{(\Delta T1 - \Delta T2)}{\ln(\frac{\Delta T1}{\Delta T2})}$$

Where, $\Delta T1 = T_{h1}-T_{c2}$ and $\Delta T2 = T_{h2}-T_{c1}$

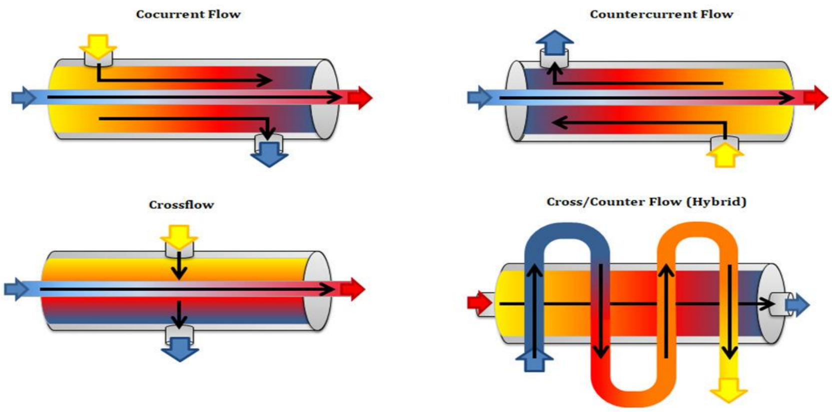

Figure 2 Categorization on the basis of flow direction

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III. METHODOLOGY

- Firstly we design the turbulator double pipe heat exchanger on Workbench of ANSYS 16.0 Software.
- After designing the model it is transferred to ANSYS for CFD analysis.
- Meshing of model is done on CFD pre-processor.
- The boundary conditions are applied on the model and numerical solutions are calculated by using solver.
- In solving the problem, the finite volume approach is used.
- Solution is calculated by giving iterations to the mathematical and energy equations applied on model.
- The results can be visualized in the form contours and graphs by CFD post processor.
- Applying formulas for calculating heat transfer coefficient, Nusselt Number, LMTD and effectiveness of double pipe heat exchanger.
- Result analysis.

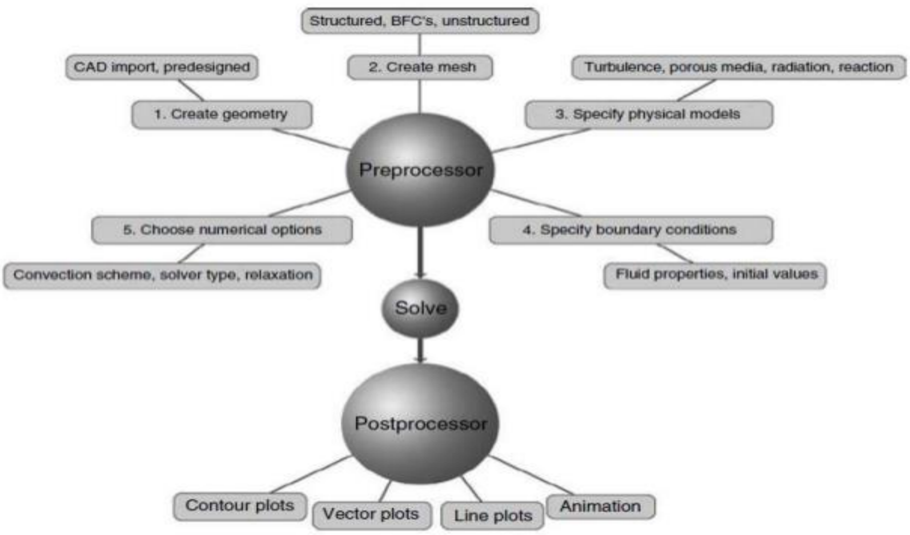

Figure .3. The simulation and analysis within a CFD Stages.

IV. RESULT

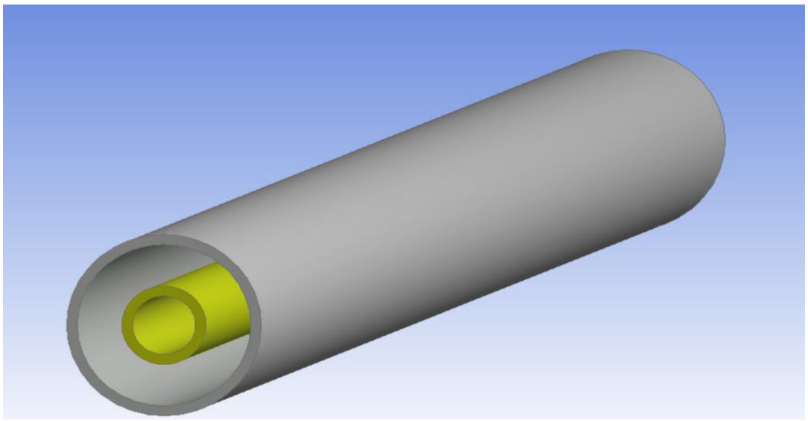

Figure.4 Dual pipe heat exchanger model on ANSYS workbench

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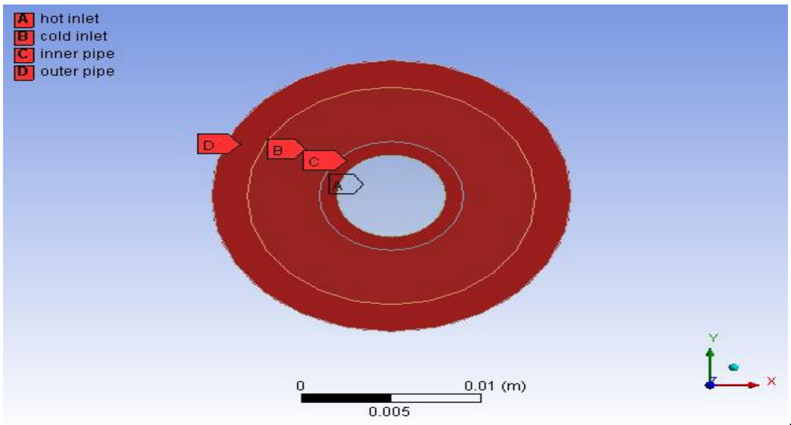

Figure.5 Name selection for inlet and outlet of working fluid.

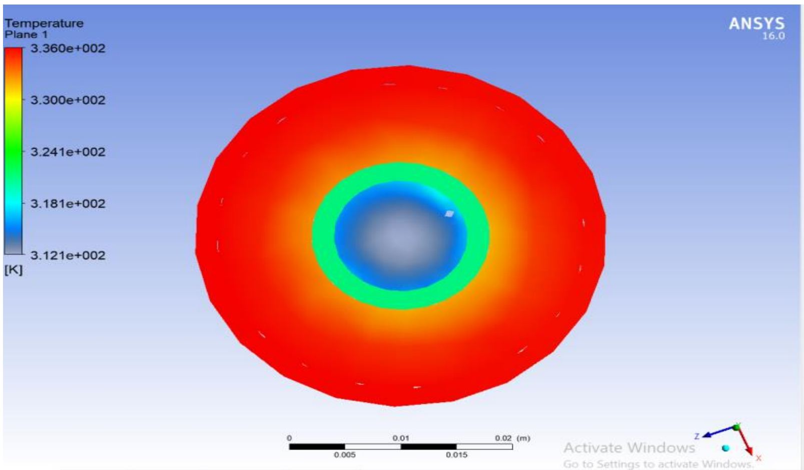

Figure.6 Cold fluid inlet temperature contour for Re = 4000 at 0.401 percent volume fraction for Al_2O_3.

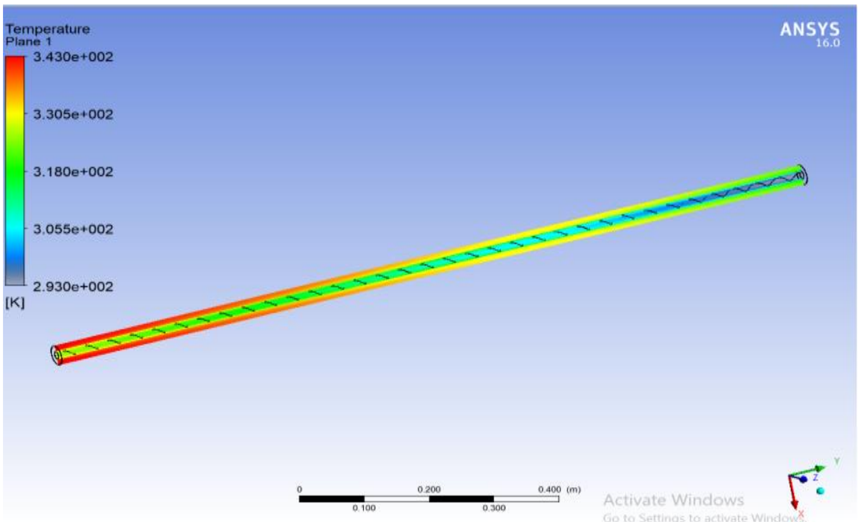

Figure.7 Center plane Temperature contour of heat exchangerat 0.81% volume fraction for Al_2O_3.

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V. Conclusion

CFD turbulent heat flow simulations in a dual pipe heat interchangeable with a turbulator using the nanofluid hybrid, i.e. $Cu+Al_2O_3$ / water was carried out at varying volume concentrations at different numbers of Reynolds. The calculations were performed for variable Reynolds numbers ($4000 \leq Re \leq 20000$), volume fractions (0.4-1.2 percent). Based on the effects of the CFD measurements, it is observed that:

- Ordinarily, the presence of $Cu+Al_2O_3$ nanoparticles in the base fluid increases the properties of convective heat transfer and is thus more efficient than Al_2O_3 nanoparticles (at a steady concentration of volume).
- The findings revealed that the average heat transfer coefficient increases in line with the Reynolds number.
- Analysis has shown that the average thermal transfer coefficient value for hybrid nanofluid is 12.5 percent greater than the average for a single nanofluid.
- In the case of hybrid nanofluid compared to Mono nanofluid, the value of Nusselt is 18 per cent higher.

Investigations revealed the superior thermal efficiency of the hybrid nanofluid in a flow-suitable two-pipe heat interchangeable turbulator

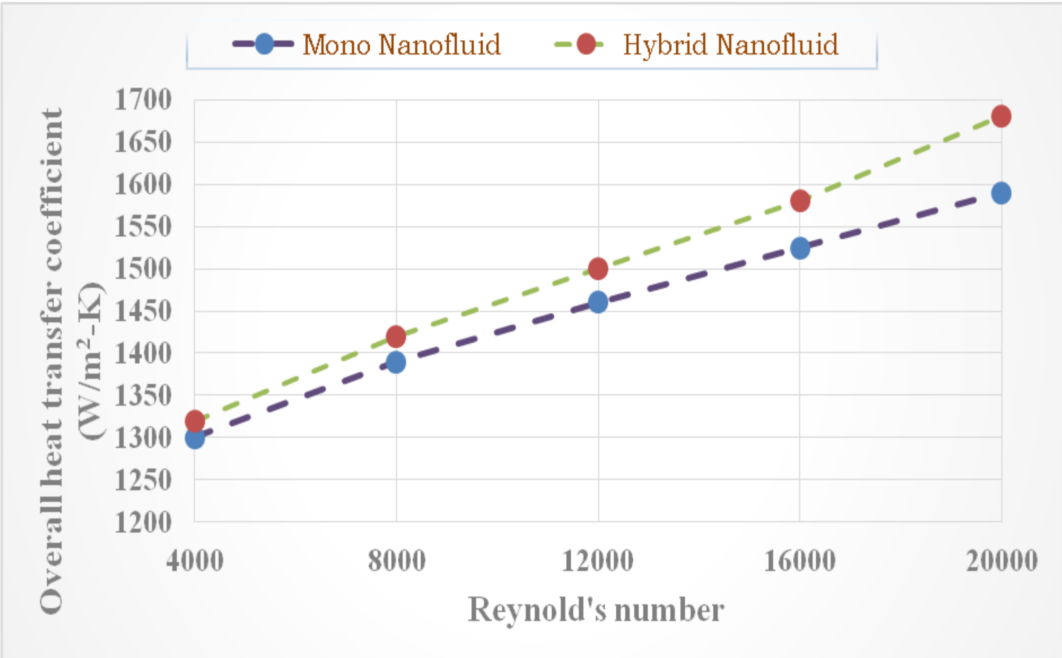

Figure.8 Comparison of Nusselt number between mono and hybrid nanofluid at different Reynolds number for 1.3 % volume concentration.

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