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Experimental Study of Tube and Tube Type Heat Exchanger by Using the Nano Fluid

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Abstract: *Nano fluids have improved thermal properties and possible heat transfer rate. Nano fluids play a major role in various applications which increase heat transfer rate as it contains metallic or non-metallic Nano powders with a size of less than 100mm in base fluids so, it increases the heat transfer potential of the base fluids. Water is the working fluid in the heat exchanger and metal based (Cu or Al) Nano fluid of particular concentration will act as a heat carrier. Experimental set up will be manufactured with minimum possible dimensions to reduce the cost. Thermocouples are used to measure the temperature of water and Nano fluid at the inlet and outlet. The flow control valves are used to control the flow rate. The effect of mass flow rate of fluids on heat exchangers was studied. The CATIA model was drawn. The result & conclusion was drawn after the experimental resting.*

Keywords: Nano Fluids, Heat Exchanger, Mass Flow Rate, CATIA, etc.

I. INTRODUCTION

The energy conservation is one of the vital issues of the twenty-first century, and it will certainly be one of the most significant challenges in the near future. Therefore, scientists, engineers and researchers are considerably trying to address this important concern. The advances made in heating or cooling in industrial devices cause energy saving and heat transfer improvement, and increase the operational life of the equipment. Energy savings can be performed by the efficient use of energy. Energy conversion, conservation and recovery are some routes for energy saving.

II. LITERATURE SURVEY

1) "Experimental study of heat transfer enhancement using Nano fluid in double tube heat exchanger"
This study aims at experimentally investigating the effect of Al2O3 /water Nano fluids on the heat transfer enhancement inside the double tube heat exchanger at variable inlet temperature. Al2O3 nanoparticle with concentration of 0.25% and 0.5% by volume concentration has been used at different inlet temperature. The experimental setup consisted of double tube heat exchanger with Nano fluids on the cold side was used in turbulent regime with Reynolds number ranging from 20000 to 60000. Results from the study shows that the heat transfer increases with the increase in temperature and volume concentration of Nano-particles. Significant improvement over the water is seen with maximum Nusselt number increase up to 24.5% at 50 inlet temperature.

2) "Lattice Boltzmann simulation of Nano fluid flow and heat transfer in a hollow multi-pipe heat exchanger considering nanoparticles shapes"
The two-dimensional natural convection and entropy generation within a hollow heat exchanger are investigated. The heat exchanger is filled with CuO-water nanofluid which its dynamic viscosity is estimated by KKL model. In addition, the influence of shapes of nanoparticles on the heat transfer rate is considered in the simulation, and the most efficient shape of nanoparticle is selected to be used in the further investigation.

The entropy generation analysis and heat line visualization are employed to present a comprehensive study on the considered heat exchanger. The Rayleigh number in range of 103 to 106, nanoparticle concentrations in the pure water (0, 0.01, 0.02, 0.03 and 0.04 vol%) and four different thermal arrangements of internal active pipes are the governing parameters.

There are many investigations about the natural convection fluid flow and heat transfer because of widely applications of this phenomenon. Some of the well-known applications of the natural convection can be mentioned like furnaces, power plants, double-pane windows, ventilation process, etc.

3) "Cu-water Nanofluid Flow and Heat Transfer in a Heat Exchanger Tube Equipped with Cross-Cut Twisted Tape"
This paper presents a numerical analysis for Cu-water nanofluid flow through a circular duct inserted with cross-cut twisted tape with alternate axis (CCTA). Three-dimensional (RNG) k turbulence model is applied to simulate this problem. All simulations are performed for plain tube and nine different CCTA geometries in the range of width ratio (b/w) from 0.7 to 0.9, length ratio (s/w) from 2 to 2.5, Reynolds numbers in the range of 5000 to 15000 and volume fraction of Nanoparticles from 0 to 1.5%.
The calculated results indicate that the swirl flow created by CCTA is transferred from the tube core to the near wall regions. This results in higher fluid mixing, which enhances heat transfer and friction factor near the tube wall. The results show that the heat transfer coefficient increases up to 23.20% with increasing the nanoparticle volume fraction from 0% to 1.5%. Finally, it is shown that the thermal performance increases by increasing the volume fraction of nanoparticles inside the duct.

4) "A novel method to measure thermal conductivity of nanofluids"
To measure the thermal conductivity of nanofluids under flow condition accurately, a novel method defined as the steady flow method (SFM) was employed and improved based on the heat transfer of laminar flow theory under the uniform heat flux condition. Considering the buoyance is existed in the actual pipe flow, Nusselt number would increase rather than a constant value of 4.364 in the fully developed region. The evaluation of Nu was optimized by experimental validation, and the mixed convection equation was used to improve Nu in the thermal conductivity measurement coupled with SFM. Then the thermal conductivities of water-based Nano fluids with 0.2 wt%, 0.5 wt% and 1 wt% Al2O3 were measured respectively by using the improved SFM (ISFM).
Compared to the reference thermal conductivity obtained from REFPROP 9.1, the experimental results show that the maximum relative deviation on measured values of deionized water is reduced from 10.42% to 3.35% by ISFM. The measured thermal conductivities of water based Nanofluids with 0.2 wt%, 0.5 wt% and 1 wt% Al2O3 are increased by 10.5%, 16.7%, 22.8% compared with the base fluid. Moreover, the thermal conductivity of Nano fluids can be enhanced with the fluid temperature, which corresponds with other literatures. The ISFM reduces the influence of natural convection in the processes of measurement, and then leads to improving the measuring accuracy of the thermal conductivity significantly

5) "Borehole heat exchanger with nanofluids as heat carrier"
This paper presents numerical study on the use of Nanofluids to replace conventional ethylene glycol/water mixture as heat carrier in a Bore Hole Heat Exchanger. Nano fluids contain suspended metallic nanoparticles: increasing their concentration, in comparison to the base fluid, the thermal conductivity increases and the volumetric heat capacity decreases. The first effect is positive for the reduction of borehole thermal resistance, since it causes the grow of fluid convective heat transfer coefficient, while the second one is detrimental, due that it decreases the heat transfer between fluid and borehole wall

III. IMPLEMENTATION

- The heat exchanger based on the Nano fluid is shown in fig. above. The hot fluid is pumped with the help of pump from the water tank.

- The flow control valve is attached to the pipe after the pump to control the flow rate of water through the pipe.
- The Nano fluid is passed over the pipes from the downward side as shown in fig. above. When hot water passes through the pipe then the heat will be given to the Nano fluid. So, the temperature of water coming out from the pipe is less than that of the inlet temperature of water.
- The Nano fluid is used to increase the efficiency of the heat exchanger. The thermometers are used to measure the inlet and outlet temperature of water and Nano fluid.
- After measuring the temperature and mass flow rate the efficiency of the heat exchanger will be carried out.
- Similarly, this procedure was carried out by using cold water and then after making the comparison the result & conclusion was carried out.

IV. CONCLUSION AND DISCUSSION

- Heat transfer rate on shell and tube heat exchanger by using aluminium oxide Nano fluid has been investigated experimentally under forced convective flow condition.
- We have shown that improvement of shell and tube heat exchanger effectiveness can be achieved by using nanofluids to substitute the conventional working fluid.

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