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EXPERIMENTAL STUDY OF ENHANCEMENT OF TRIPLE TUBE HEAT EXCHANGER WITH THE HELP OF CuO AND Al_2O_3

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Abstract - *The triple Tube Heat Exchanger is advancement to improve the heat Transfer rate of Heat Exchanger as compare to double tube Heat Exchanger. In this article Report CuO and Al_2O_3 nanoparticles were used for increase the Effectiveness of the Triple Tube Heat Exchanger. The experiment result indicate that Effectiveness of Triple Tube Heat Exchanger was increases With the use of CuO with volumetric concentration 0.016%, CuO with volumetric concentration 0.033%, Al_2O_3 with volumetric concentration 0.016% and Al_2O_3 with volumetric concentration 033% Respectively.*

Key Words: **Triple Tube Heat Exchanger**, **Nanofluid, Al203 Nanofluid, CuO Nanofluid, Enhancement of Heat Exchanger etc.**

1.INTRODUCTION

Heat Exchanger is device which used in industry and engineering application. Enhancing the thermal characteristics of Heat Exchanger is most challenging task which directly contribute in plant output and efficiency. Different technique have been invented for enhancement of Heat Transfer Rate, reduce the size and cost of Heat Exchanger.

Heat Transfer augmentation technique involve different methods used to increase Heat Transfer Rate without affecting the the overall performance of system. In this project for increasing Effectiveness of Triple Tube Heat Exchanger we used CuO and Al_2O_3 nanoparticle. Reducing of particle size continued in the search for new type of fluid suspensions having enhance thermal properties as well as enhancement in effectiveness of Heat Exchanger. Modern technology provide physical and chemical routes to prepare nanometer particles with enhance thermo-physical properties.

2. REVIEW OF LITRATURE

2.1 Review of Book

1. R. K. Raj put, 2012, Heat and mass transfer [1]
The book has provided extensive overview regarding the concept of heat exchanger and also effect of various parameters onto the heat exchanger. This covers all the aspects regarding basics of heat exchanger.

2.2 Review of Research Paper

1. Saurabh R. Verma, Prakash M. Khanwalkar, Sandeep S. 2009. [4]
This paper concluded that the dimple tubing having lower pitch ratio increases the heat transfer rate. Also there is rise in turbulent flow which increases the effectiveness of heat exchanger. They carried out the effect of pitch ratio on Nussle number. As pitch ratio decreases Nusselt number increases.

2. Rajasekar.K, Palanisamy .S, 2010 [8]
This paper conclude that Triple tube heat exchanger to increase heat transfer area with fins and reduce the cooling time and increases the effectiveness with compact size. The determinationof variable temperature, mass flow rate of fluid is taken. Maximum effectiveness of the heat exchanger is 72%. So it is recommended to implement in this new design compact size in industries.

3. N.R.parthasarathy, S.Yogeswari, 2015 [2]
This paper concludes that the triple U tube heat exchanger occupies less space and provides greater effectiveness. The triple tube heat exchanger provides large heat transfer rate per unit length of heat exchanger.

4. Mr. Sunil S. Khandagale1, Prof. V. N. Kapatkar2, Prof. P.M. Khanwalkar [9]

This paper concludes that using nano fluid increased the heat transfer rate heat transfer coefficient and increased in Nusselt number value by 81% however there is increase in friction factor by only 27.3% as compared to the smooth tube values.

3. EXPERIMENTAL APPARATUS

The test rig consists of tube in tube type concentric tube heat exchanger. First tube is made up of copper of *16mm* in diameter and *850mm* in length. Second tube is made up of aluminium of *32mm* in diameter and *750mm* in length. Dimples of *2mm* depth are provided on aluminium tube. Third tube is made up of stainless steel of 44mm in diameter and 650mm in length. In this heat exchanger hot fluid flows through the annulus between aluminium tube and copper tube. Cold fluid flows through the copper tube and annulus between aluminium tube and stainless tube. The apparatus is mounted on a board & provides a system of pipes & valves

Temperature Indicator along with selector switch is provided for temperature measurement of hot fluid & cold fluid. An electric geyser is used to heat the water. Flow rates of hot & cold water sides are measured with the help of rotameter. Outer tube of the heat exchanger is provided with adequate insulation to minimize the heat the heat losses. Test rig is provided with two reservoir tank. Pump of 0.5hp power is used to pump the water.

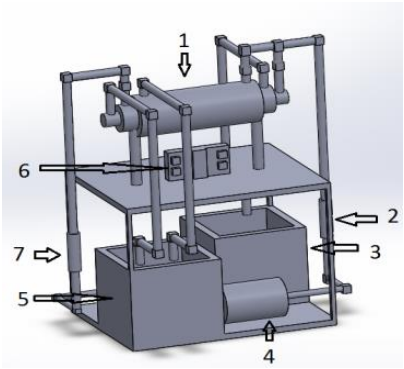

Fig-1: CAD model of test rig

4. PREPARATION OF NANOFLUID

We purchased Nanofluid from Fume Chemicals, Kolhapur. The physical properties of Nanofluid CuO and Al_2O_3 Nanofluid was shown in table. The nanofluids of different volume concentration were prepared by dispersing different volume of CuO & Al_2O_3Nanoparticles

Table-1: Properties Of Nanoparticles

Sr.No.	Nanoparticle	Density (Kg/m³)	Thermal Conductivity (W/mK)	Specifc Heat (J/KgK)
1	CuO	6310	32.9	550.5
2	Al2O3	3970	40	765

Formula for calculate Volumetric concentration

$$\text{Volumeconcentration}(\text{ØV}) = \frac{\text{Volu\% me of Nanofluid}}{\text{Volume of nanofluid + volume of water}} \times 100$$

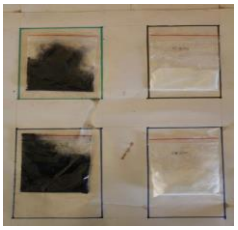

Image-1: Aluminium oxide and Copper Oxide 5gm and 10gm each

5. RESULT AND DISSUCSSION

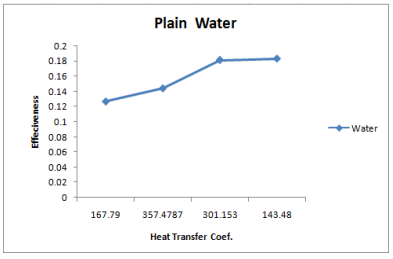

Chart-1: Effectiveness v/s Heat Transfer coeff. For Plain Water

Above Fig shows that from plain water at 30°C passing opposite direction of hot water in Heat Exchanger, as the flow rate increases effectiveness of Heat Exchanger and Heat Transfer coeff. Increases linearly.

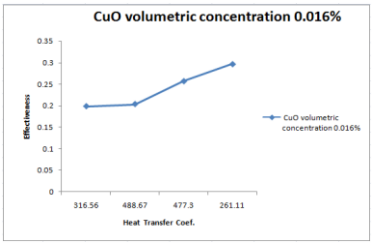

Chart-2: Effectiveness v/s Heat Transfer coeff. CuO with volumetric concentration 0.016%

With the use of CuO with volumetric concentration 0.016%. Because of this concentration Effectiveness of Heat Exchanger was increases from the range of 0.19% to 0.29 %

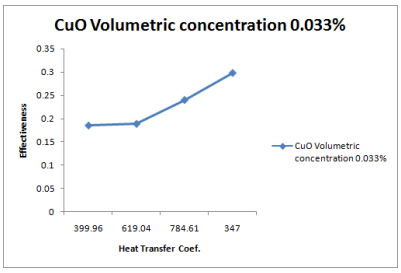

Chart-3: Effectiveness v/s Heat Transfer coeff. CuO with volumetric concentration 0.033%

Further addition of CuO with volumetric concentration 0.033% increase effectiveness of Heat Exchanger from the 0.1857% to 0.2975%

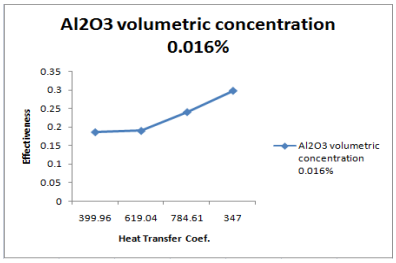

Chart-4: Effectiveness v/s Heat Transfer coeff. Al_2O_3 with volumetric concentration 0.016%

Al2O3 with volumetric concentration 0.016% was increase a Effectiveness of Heat Exchanger ranges from 0.28% to 0.3% which is higher than CuO with volumetric concentration 0.033%

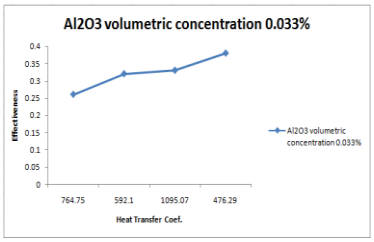

Chart-6: Effectiveness v/s Heat Transfer coeff. Al_2O_3 with volumetric concentration 0.033%

Further adding of Al2O3 with concentration 0.033% was increase effectiveness of Heat Exchanger ranges from 0.26% to 0.38% which is higher as compare to other.

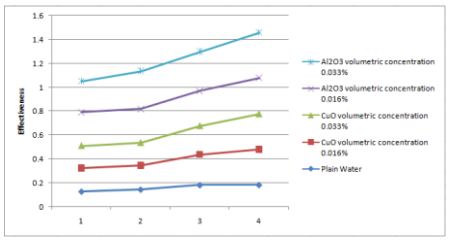

Chart-6: Comparison of Effectiveness v/s Heat Transfer coeff. For Plain Water, CuO and Al_2O_3 with different volumetric concentration

Above graph shows comparison between plain water, CuO with volumetric concentration 0.016%, CuO with volumetric concentration 0.033%,Al2O3 with volumetric concentration 0.016%, Al2O3 with volumetric concentration 0.033%.As graph shows the effectiveness of HEX was increases respectively. But copper Oxide Nano particle ware expensive and give less effectiveness as compare to Aluminium Oxide. While Aluminium Oxide gives maximum effectiveness at volumetric concentration 0.033%

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