Testing and Analysis of Shell and Tube Heat Exchanger by Using Nanofluid Al2O3

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Abstract - *Cooling is indispensable for maintaining the specified performance and responsibility terribly huge type of product like automotive, computer, high power optical device system. Whenever there is a increase the warmth load and warmth fluxes caused by a lot of power and smaller size for these product cooling is one of the technical challenge faced by the industries like as microelectronics, transportation, manufacturing. There are many single-phase liquid cooling techniques such as micro channel heat sink and two-phase liquid cooling technology like heat pipes, thermosyphones, direct immersion cooling and spray cooling. Development of the nano materials technology has made it possible to structure a new type of heat transfer fluid formed by suspending nanoparticles (dia. < one hundred nm).In conventional base fluid like water and ethylene glycol choi coined the term NANO FLUID to refer the thermal properties superior to those of their base fluids. Due to rapid fluid mixing effects strengthens the energy transport inside the nano fluids by modifying the temperature profiles. Experimental knowledge indicates that particle size, volume fraction and properties of the nanoparticles influence the heat transfer characteristics of nano fluids. This paper shows the analysis work on mini Heat Exchanger Al2O3- Water based mostly nano fluid.*

Key Words: **Nanofluid, Shell and Tube Heat Exchanger, Thermal Conductivity, Al2O3, Nano Particles.**

1.INTRODUCTION

Heat exchanger mistreatment nano fluid may be a device during which the warmth transfer takes place by using nano fluid. In this the working fluid is nano fluid. Nano fluid is made by the suspending nano particles within the fluid like water, antifreeze and oil, hydrocarbons, fluorocarbons etc.

1.1 Introduction to Nano Fluids

Nano fluid, first suggested by S.U.S. Choi of Argonne National Lab in 1995, innovative operating fluid for warmth transfer created by dispersing extremely thermal conducting solid particles smaller than fifty nanometers in diameter in ancient low thermal conducting heat transfer fluids like water, engine oil, and ethanediol.

1.2 Introduction of Heat Exchanger

It is associate instrumentation that transfer the energy from a hot fluid to a cold fluid, with maximum rate and minimum investment and running costs. The heat transfer in a heat exchanger typically involves convection on all sides of fluid and conductivity through the wall separating the two fluids.

1.3 Why we use Nanofluid

The main goal or plan of mistreatment nano fluids is to achieve highest attainable thermal properties at the smallest possible concentrations (preferably. $<1\%$ by volume) by uniform dispersion and stable suspension of nano particles (preferably<10 nm) in hot fluids. A nano fluid is a mixture of water and suspended metallic nano particles. Since the thermal conductivity of aluminous solids square measure usually orders of magnitude beyond that of fluids it's expected that a solid/fluid mixture can have higher effective thermal conduction compared to the base fluid.

2. Project Work

2.1 Principal of Operation

Heat exchangers work as a result of heat naturally flows from higher temperature to lower temperatures. Thus if a hot fluid and a chilly fluid ar separated by a heat conducting surface heat is transferred from the new fluid to the cold fluid. Where, Nanofluids ar a brand new category of fluids built by dispersing metric linear unit sized materials (nanoparticles, nanofibers, nanotubes, nanowires, or droplets) in base fluids.

2.2 Analysis of Heat Exchanger

The thermal analysis of warmth money dealer is formed by taking outlet temperature of fluid and it's then associated with freelance parameters as follows,

$$T_{h,o}, T_{c,o} \text{ or } q = f\{Th,i, Tc,i, Cc, Ch, U, A, \text{flow arrangement}\}$$

Six independent and one variable which may be Th,o , Tc,o,or q dependent variable as given within the on top of equation for a given flow arrangement transferred into 2 freelance and one dependent groups which are dimensionless. By combining Differential energy conservation equations for the control volume we get

$$dq = q''dA = -C_h\, dT_h = \pm C_c\, dT_c\,.$$

Where, sign depends upon whether or not dTc is increasing or decreasing with increasing prosecuting officer or Dx (i.e cross sectional surface area and length). The overall rate of warmth transfer equation on a differential base for the extent prosecuting officer

$$dq = q''dA = U(T_h - T_c)_{local}\, dA = U\Delta T dA.$$

Integrating the 2 higher than equations across the warmth money dealerarea,weget

$$q = C_h\,(T_{h,i} - T_{h,o}) = C_c(T_{c,o} - T_{c,i})$$

$$q = UA\Delta T_m = {\Delta Tm}/{R_o} \text{ Where, } 3^{rd}\ ]$$

parameter is the actual mean temperature difference that depends upon the money dealer flow arrangement and degree of fluid mixture among every fluid stream.

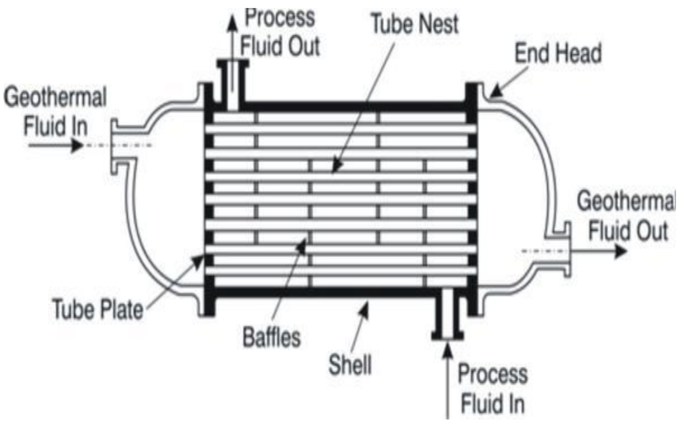

Fig -1: Shell and Tube Heat Exchanger

2.2 Mechanisms of Heat Conduction of Nano Fluid

Nano fluid is nothing but fluid particles which are less than even a micron(nearly 10-9 times smaller) in diameter and highly reactive and efficient material which can be used to increase issue like rate of reaction, thermal conductivity of any metal or material, they are that much reactive and strong. Keblinski bestowed four doable ways in nano fluids which can contribute to thermal conductivity.

(a) Brownian motion of nano particles.

(b) Liquid layering at the liquid/particle interface.

(c) flight nature of warmth transport in nano particles.

(d) Nano particle clustering in nano fluids.

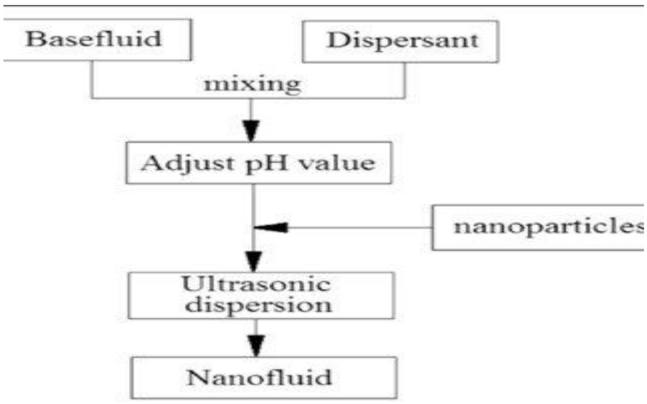

Fig -2: Preparation of Nano Fluid

2.3 Preparation of Nano Fluid

Nano fluids are mainly made up of metals, oxides, carbides and carbon nano tubes that can simply be distributed in heat transferring fluids, like water, glycol, hydrocarbons and fluorocarbons by addition of stabilising agents.

Alumina-based nanofluids ar necessary as a result of they will be employed in various applications involving heat transfer and alternative applications. Most of the Al2O3-based nanofluids ar ready by mistreatment Associate in Nursing supersonic vibrator that isn't stable for a extended time.Researchers so had targeting making ready stable nanofluids by mistreatment different surfactants, optimizing pH, temperature for various nanofluids, and by surface modification of the particles. The thermal conductivity enhancement observed for Al2O3 nanofluid by different researchers is not consistent; the reason for this enhancement is not clear in the available literature. Very few literatures ar on the market on the sweetening of thermal conduction because of expanse, acidic or basic media, and due to the shape factor. The nanofluids ready with acidic and basic media might not be helpful for the warmth transfer application, since it may cause adverse effects on the heat transfer properties. The effect of temperature observed by different authors demonstrates different degrees of enhancement for the same volume fraction. The technique for the activity of thermal conduction may alter the values. The impact of temperature on thermal conduction at lower volume fractions, which has been measured up to 400 K, has been reported . No work has however been according with experiments coping with the activity of thermal conduction at low (sub-zero)-range temperatures. The behavior of the thermal conductivity at low temperatures are yet to be found out and can point a new direction in this field of research.

3. CONCLUSIONS

The convective heat transfer performance and flow characteristics of Al2O3 Nanofluid flowing in a very horizontal shell and tube heat exchanger has been experimentally investigated. Experiments have been carried out under turbulent conditions. The result of particle concentration and therefore the painter variety on the warmth transfer performance and flow behavior of the Nanofluid has been determined. Important conclusions have been obtained and are summarized as following:

1. Dispersion of the nanoparticles into the distilled water increases the thermal conductivity and viscosity of the Nanofluid,
this augmentation will increase with the rise in particle concentrations.
2. At a particle volume concentration of 2% the use of Al2O3/water Nanofluid gives significantly higher heat transfer characteristics.
For example at the particle volume concentration of 2% the overall heat transfer coefficient is 700.242 W/m2 K and for the water it is 399.15 W/m2 K for a mass flow rate of 0.0125 L/s so the enhancement ratio of the overall heat transfer coefficient is 1.754, this means the number of the general heat transfer constant of the Nanofluid is fifty seven larger than that of water. As for Nusselt variety, the value of Nusselt number for 2% volume concentration is 587 and for the distilled water it is 367.759 so the maximum improvement quantitative relation at zero.0125 L/s is 1.596, this means that Nusselt number of the nanofluid is 62.6% greater than that of distilled water.
3. Friction issue will increase with the rise in particle volume concentration. This is because of the increase in the viscosity of the nanofluid and it implies that the nanofluid incur very little penalty in pressure drop.

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