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A Review on Experimental Investigation of Heat pipe using Al_2O_3 & CuO Nanoparticles with water as base fluid

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ABSTRACT

A colloidal blend of nanometric particles (<100 nm) in a base fluid called nanofluid, which is the new era of heat exchange liquid for different heat exchange applications where the vehicle attributes are generously higher than the base fluid. This audit compresses and dissects the exact relationships for the compelling heat conductivity and the dynamic thickness of the nanofluid on the premise of trial information and the hypothetical model accessible in the writing. The examination demonstrates that the warm conductivity proportion of the nanofluid to the base fluid for the circular and round and hollow nanoparticles increments generously with the expansion in the focus and the temperature of the nanoparticles. Additionally, the consistency proportion of the nanofluid to the base fluid likewise increments with the expansion in the grouping of the nanoparticles..

Keywords: Conductivity, Heat pipe, Nanofluid, Particle concentration, Thermal diffusivity.

I. INTRODUCTION

Nanofluid can be defined as a fluid in which solid particles with dimensions of less than 100 nm are suspended and uniformly dispersed in fluid. The base fluid used the same as conventional heat transfer fluids, for example water and ethylene glycol. The nanofluids have properties that make them heat transfer fluids of the next generation because they open up new possibilities to improve heat Transfer to pure fluids. Nanofluids generally consist of oxides, carbides, carbon nano tubes or metals.

The immediate change of heat exchange is an essential factor in numerous ventures, atomic reactors, car, refrigeration, space innovation, microelectronics, and so forth. Nanofluids go about as clever liquids in circumstances where warm. The exchange must be lessened or enhanced freely. For instance, pharmaceutical procedures half breed motors, a local fridge, cooling motor/vehicle warm administration, cooler, heat exchanger, grinding and machining.

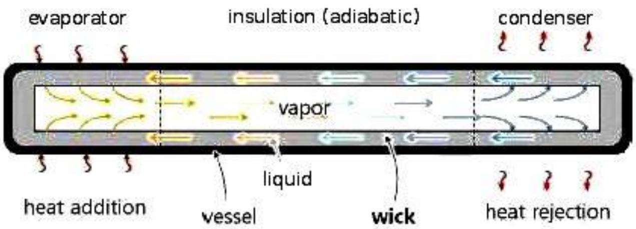

Figure.1 System diagram

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The nanofluids clearly show improved thermo-physical properties such as thermal conductivity, thermal diffusivity, viscosity and Convection heat transfer coefficient. The change in the properties of Nanofluids depends on the volumetric fraction of the nano particles, the shape and the size of nano materials.

Alumina (Al2O3) is the nano particle most used by many researchers in their experimental work. Numerous efforts have it was carried out to study the heat transfer characteristics of Al2O3 Nanofluids with different types of base fluids.

II. HEAT PIPE AND ITS LIMITATIONS

A heat pipe contains three different sections; an evaporator at one end, a condenser at other end and an adiabatic section in-between.. Heat pipe is basically a sealed tube having a wick structure on the inner surface and filled with a fluid at saturated state. Evaporator is the place, where heat is absorbed by the fluid which creates temperature and thus density difference. In the condenser section, heat is rejected to the surrounding medium. The adiabatic section is externally covered with an insulation layer and it is just acting as a flow passage without any heat losses from the working fluid. The addition and removal of

heat in the evaporator and condenser sections respectively, induces a pressure difference thus leading to vapor flow from evaporator to condenser. The liquid is retracted into the evaporator due to the capillary pressure in the wick structure and the process repeats.

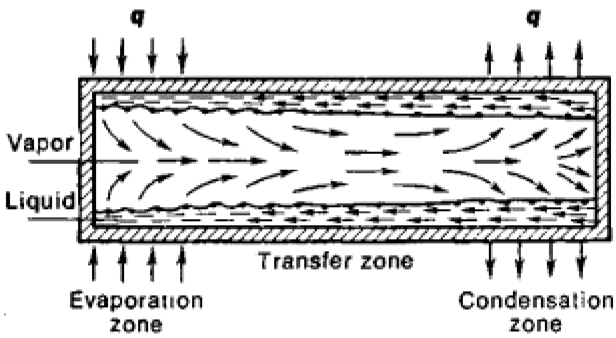

Figure.2 System diagram

III. LITERATURE SURVEY

Various studies on nanofluids were carried out by many researchers in the past. Some of references related to the current experiment were reviewed in the following

Mahbubula *et al* [2][2014]. The experimental results show that, thermal conductivity of the Al2O3/R141b nanorefrigerant increased with the augmentation of particle concentrations and temperatures. Thermal conductivity of ethylene glycol and water mixture based Fe3O4 nanofluid has been investigated experimentally by

Sundara *et al* [3].[2013] Nanofluids were prepared by dispersing nanoparticles into different base fluids like 20:80%, 40:60% and 60:40% by weight of the ethylene glycol and water mixture. Results indicate that the thermal conductivity increases with the increase of particle concentration and temperature. Furthermore, the theoretical Hamilton–Crosser model failed to predict the thermal conductivity of the nanofluid with the effect of

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temperature. the effect of particle size, temperature, and weight fraction on the thermal conductivity ratio of alumina (Al2O3)/water nanofluids.

Yiamsawas et al. [5][2013] studied the viscosity of Al2O3 nano particles (120 nm) and TiO2 (21 nm) dispersed in 20/80% EG-water mixture at 0-4% volume concentrations and a temperature range of 15-60 ° C. Research on the measurement of the viscosity of magnetic nanofluids has been carried out by little research.

Sundar et al. [6][2012] carried out an experimental study on the thermophysical properties of 50/50% EG-water based on Al 2 O 3 and CuO nano-fluids

Tenga *et al* [7][2010].This experiment measured the thermal conductivity of nanofluids with different particle sizes, weight fractions, and working temperatures (10, 30, 50°C).The results showed a correlation between high thermal conductivity ratios and enhanced sensitivity, and small nanoparticle size and higher temperature. In this paper, the effect some parameter on the thermal conductivity ratio of alumina nanofluids were investigated and optimum of thermal conductivity ratio was obtained. using nonlinear optimization methods and artificial neural network for approaching to this aim.

Murshed et al. [8][2010] measured the viscosity of TiO2 (15 nm) and Al2O3 (80 nm) dispersed in water nanofluids at volume concentrations ranging from 1% to 5%. They found a higher viscosity of the nanofluids compared to the base fluids.

Chandrasekar et al. [9][2010] presented some results for viscosity Measurement of water-based nanofluids containing Al 2 O 3 with a particle size of 43 nm and a volume concentration of up to 5% at room temperature. In order to decrease the aqueous freezing point of the heat transfer fluid, a different ratio of ethylene glycol or propylene glycol is mixed with water. These mixtures are used in heat exchangers, automobiles and industrial installations in subzero countries with long winter climatic conditions. Therefore, there is a lot of research on the use of ethylene glycol / water and propylene glycol / water mixture as heat transfer fluid. At low temperatures, the ethylene glycol mixture exhibits better heat transfer properties compared to the propylene glycol mixture

Ghassemia *et al* [10][2010]. They were shown that the results of the proposed model for the blood thermal conductivity agree well with the available data in the literature .Experimental investigations and theoretical determination of effective thermal conductivity and viscosity of Al2O3/H2O nanofluid are reported by

Zhu et al. [11] [2009] demonstrated that stability and Thermal conductivity of Al2O3 nanofluids / water. Depends strongly on pH values and different concentrations of SDBS dispersant Nano suspensions .Effective thermal conductivity of blood with suspension of Al2O3 nanoparticles as a bio-nanofluid was studied by

Kulkarni et al. [12][2009] considered nanofluids containing nanoparticles of CuO, Al2O3 and SiO2 dispersed in a 60/40% mixture of EG-water and measured the coefficient of convective heat transfer and the viscosity of the nanofluids.

L**ee et al. [13][2008]** considered water-based nano-fluids Al2O3 and observed a 2.9% viscosity improvement at a 0.3% volume concentration and a temperature of 21 ° C.

Nguyen et al. [14][2007] studied the effects of temperature, concentration and particle size on the viscosity of water-based nanofluids. They used Al2O3 nano particles of 36 and 47 nm as well as CuO nano particles of 29 nm in diameter. The experimental measurements are carried out at a temperature range of 22 to 75 ° C. and the volume fraction of particles varies between 1% and 12%. They reported that in higher concentrations, larger particles have led to higher viscosity improvements than smaller ones.

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He et al. [15][2007] measured the viscosity of nanofluids containing TiO2 nano particles with average diameters of 95, 45 and 210 nm .Suspended in water. They observed the improvement in the viscosity ratio of the nanofluids with the increase in the particle size of the nano particles.

Li and Xuan [16][2002] Reported that in laminar and turbulent flow regime in forced convection, the heat transfer coefficient of Cu-water nanofluids flowing inside a uniformly heated tube remarkably increased. The heat transfer coefficient increased by around 60% for 2 vol.% nanoparticle concentration compared to that of pure water. Furthermore, it was observed that the increase of nanoparticle concentration would also increase the heat transfer coefficient. Interestingly, the experimental results showed that there is no significant increase in pressure drop compared to that of water. Thus, it is no need to be worried about the drawback of pumping power increase

NP. C. Mukesh Kumar et. al. [17][2000] investigated convective heat transfer and friction factor in a helically coiled tube with Al 2O3/ water nanofluid. In this paper, laminar heat transfer and friction factor of a helically coiled tube with Al2O3 / water nanofluid at 0.1%, 0.4 and 0.8% particle volume concentration were tested. The heat transfer enhancement of nanofluid has been compared with water. They observed that there is no negative impact of presence of nanoparticles on convective heat transfer and formation of secondary flow in coiled tube. These enhancements are due to higher thermal conductivity of nanofluid, better mixing of fluid, and random movement of nanoparticles which carry more heat energy. Therefore, the conventional heat transfer fluid can be replaced at low particle volume concentration of Al2O3 / water nanofluid without getting pressure drop penalty in helically coiled tube heat exchanger.

Pak and Cho [18][1998] studied the viscosity of Al2O3 and TiO2 nano particles dispersed in water. At a volume concentration of 2.78%, an increase in viscosity of 2.5 times that of pure water was observed for the Al 2 O 3 nanofluid. Well, it is obtained as 1.3 times for TiO2 nanofluid at a volume concentration of 3.16%. Masuda et al. [16] estimated the viscosity of water-based TiO2 nanofluids with a particle size of 27 nm and observed a viscosity increase of 60% at a volume concentration of 4.3%

Odenbach and Stork [19][1998] described the effects of interactions between the surfactant, the magnetic particles and the base fluid on the viscosity of the magnetic nanofluid.

Yang et al. [20][1986]. The rheological properties of nanofluid silicon-based magnetic iron oxide at four volume concentrations up to 12.9% were reported

Wusiman Ku-Er-Ban-Jiang Et El [21] conducted experiment for the forced heat transfer characteristics of aqueous copper (Cu) nanofluid at varying concentration of Cu nano-particles in different flow regimes ($300<Re\leq16\ 000$). They said that in laminar flow, the heat transfer coefficient of Cu/water nanofluid increases by two times around Re= 2000 than that of base fluid water, and averagely increases by 62% at 1% volume fraction. In turbulent flow regime, the heat transfer coefficient increases gently with increasing the concentrations as well as Reynolds number. They suggested that the nanoparticle performance in nanofluid such as particle type, size and shape might play important roles in heat transfer enhancement. Above existing results showed that all the nanofluids succeed in the enhancement of heat transfer compared with their base fluids.

IV. METHODOLOGY

This will be an exploratory examination on the heat exchange and by nanofluid comprising of water and diverse volume centralizations of Al2O3 and CuO3 nanofluid (0.3– 2)% streaming in a flat and slanted heat pipe with turbulent stream conditions are researched. Presently as indicated by my innovational thought on the off chance that we blended two nano-particles like Al2O3, and Cuo in three extent (75% + 25%) , (50% + 50%) and (25% +75%) separately then from this blend some unequivocal measure of blend will be blended in cool liquid at that point measured the temperature distinction or warmth exchange rate. The outcome is more compelling than the past outcome measured if there should arise an occurrence of single nano-molecule Al2O3 .

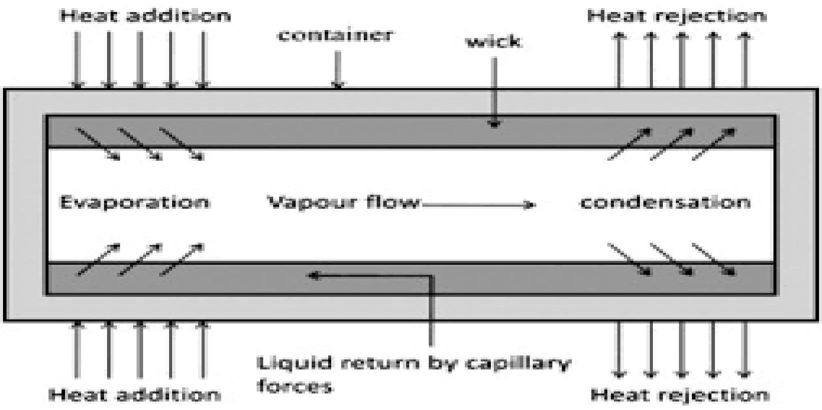

Figure.3 System diagram

The set up will consist of heatpipe of length 60cm with diameter of 2.5cm which is to be set in two positions. First will be in inclined position at an angle of 30˚ . Now with the three mixture of different ratios of nano-fluid as mentioned above is used at a same temperature difference and compared with the data of heat pipe with Al2O3 as nanofluid heat exchanger.

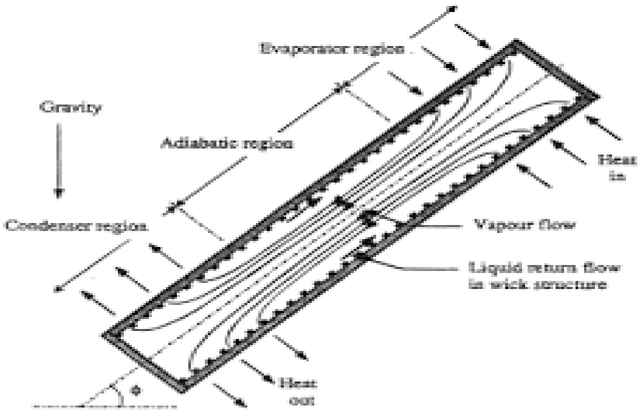

Figure.4 System diagram

V. CONCLUSION

The examination will shows that the thermal conductivity ratio of the nano fluid to the base liquid for the nano particles increases substantially with the increase in the concentration and the temperature of the nano particles. Moreover, the viscosity ratio of the nano fluid to the base liquid will also increases with the increase in the concentration of the nano particles.

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VI. FUTURE SCOPE

As there is a problem with nano fluid heat pipe where the wick porosity reduces due to the blocking of nano particles after a duration of time which further effect the flow of fluid from condenser to evaporator back, that decreases the performance of heat pipe heat transfer.

This problem can be resolved by either changing the wick material or the property of nano particles in the fluid which gives the stability and effective for long time.

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