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An Experimental Study on Characterization of CuO/Water Nanofluid

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Abstract - Nanofluids are new class of heat transfer fluids developed by suspending Nano sized solid particles in liquids. Liquids containing suspended Nano sized particles, or nano-fluids, have been found to have dramatically increased thermal conductivities compared to their base liquid such as water, ethylene, glycol, engine oil etc. This rise for thermal conductivity provides new & best application for this class Nano fluid. Currently there is existence of huge database of thermal conductivity measurement where the effect of this Nanofluid characteristics such as particle type, concentration of particle and particle size etc. are studied.

Key Words: **Nanoparticle, base fluid, thermal conductivity, viscosity, density, specific heat, water, copper oxide.**

1. INTRODUCTION

The improvement of Heat transfer is an important concern in the field of thermal engineering. Many efforts have been taken to improve the heat transfer rate of different thermal systems. For decades, adding additives to the Coolant was the practice for improving it also created the g the heat transfer. It was found that while adding additives improved the heat transfer problem of fouling, thereby reducing the life of the components.

Nanotechnology is been highly used among the industries because the particle involve in the whole process are of micro size and it possess the unique properties such as chemical, electrical and optical. A contemporary utilization of the rising technology is the nanoparticle that can transfer the heat fluid such as water and oil in a common way in order to develop a new class of highly efficient thermal exchanger media. Nanofluids are an innovative heat transfer fluid and have been in research over the past two decades. Their heat transfer augmentation is mainly due to a small concentration of nanoparticles that dramatically change or enhance the thermo physical properties of the base fluid.

The present work is aimed at introducing the concept of nanofluids, their manufacturing techniques, characteristics, physical, and thermal properties and their applications in different fields.

2. MATERIALS & METHODS

2.1 Material

The material used in the present research work is copper oxide and water.
Nanoparticle is made by using copper oxide and base fluid is made by using water as a fluid.

2.2 Methods

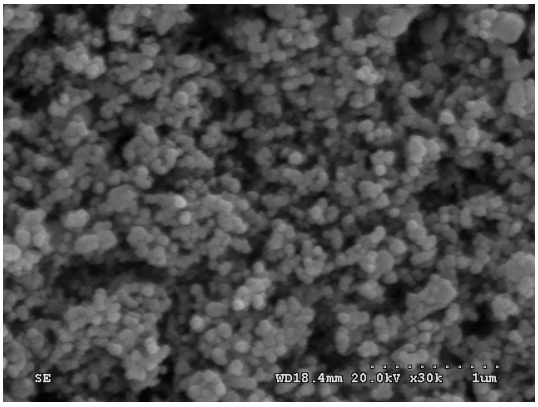
The methodology adopted for the present research work include the preparation of nanofluid followed by the volumetric concentration in different concentration they are 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and mixed with the calculated amount of weight which is calculated by using volumetric formula. After volumetric conc. Evaluation then nanofluid is prepared by mixing obtained nanoparticle of CuO in water based base fluid this method of mixing is preferred as it provide a very poor suspension stability of nanoparticle as the suspended particles settle down by the the action of gravity just in the few time of suspension. Time required for the settling down depend upon the properties of nanoparticles such as density and viscosity in hot fluid.

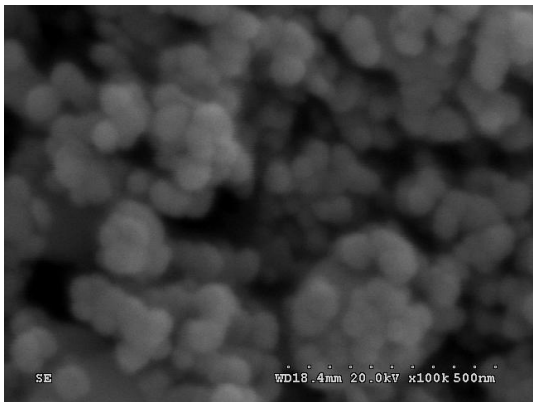
After the preparation of nanofluid the characterization of nanofluid is done. The properties which were analysed are thermal conductivity, viscosity, density and specific heat. The thermal conductivity and viscosity is analysed by using Maxwell-Eucken model and Einstein correlation model. Density is analysed by using Pak & Cho correlation and density ratio formula. Specific Heat is analysed by using specific heat formula and then compared by the standard data obtained by Pak & Cho formula.

3. RESULTS

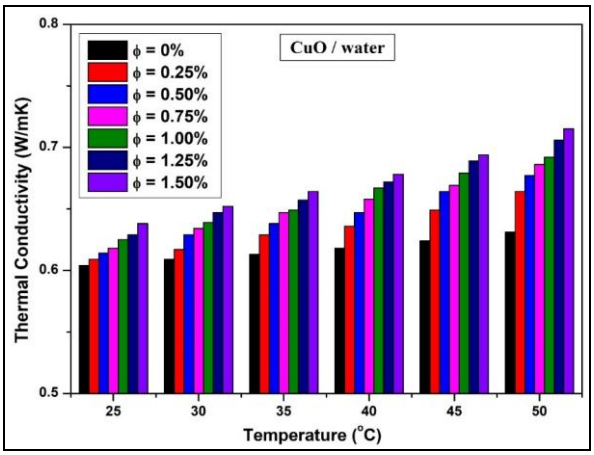
FESEM

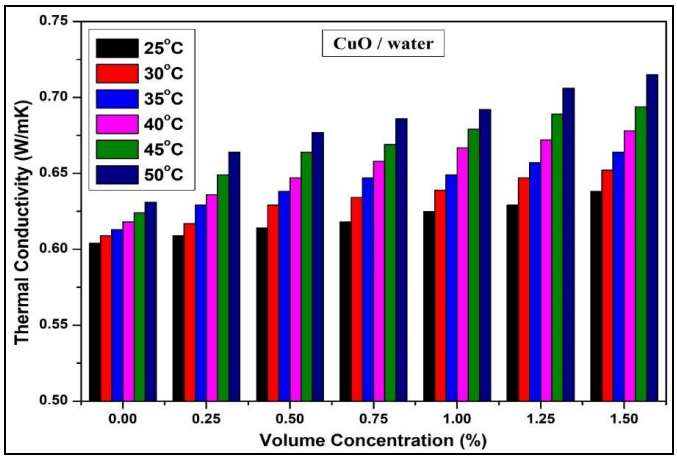
FESEM imaging is used to observe the distribution of nanoscale of nanoparticle the official obtain images of nanoparticle prepared from see you at 1:00 magnification and see you prepared nanoparticle obtained if ISM image at 500 NM scale are shown below Preparing of nanoparticle





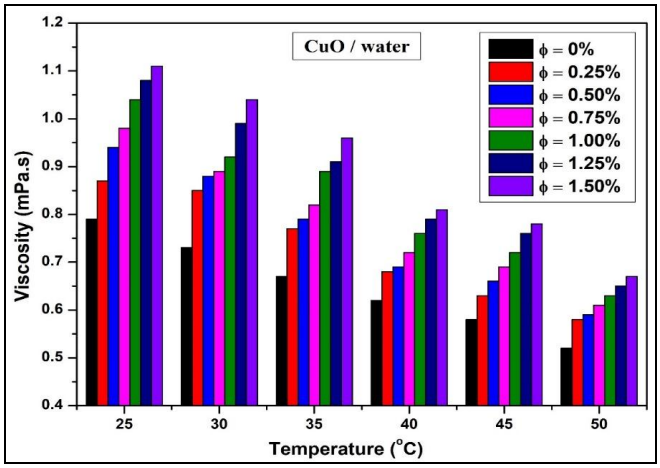
Result for Thermal Conductivity

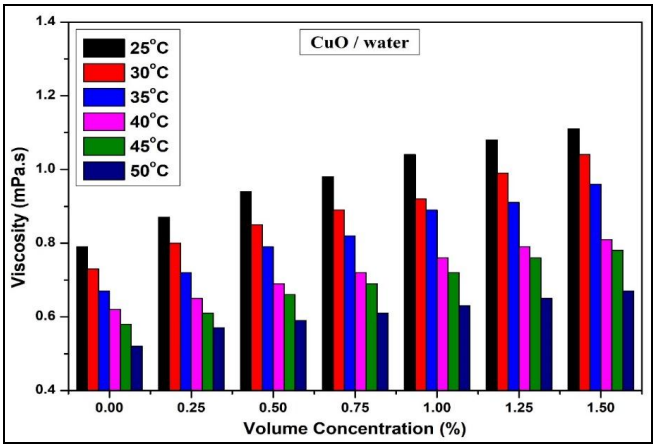




Experimental results reveal that the maximum observed thermal conductivity is 0.715 W/m K for 1.50% volume concentration at 50ºC in comparison with water, for CuO/PG + water nanofluid

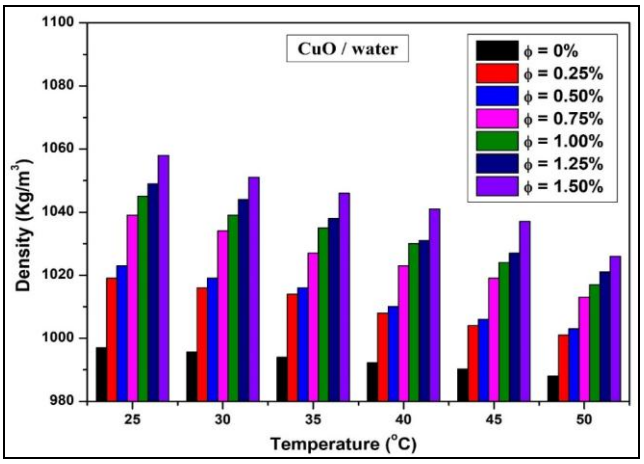
Result for Viscosity

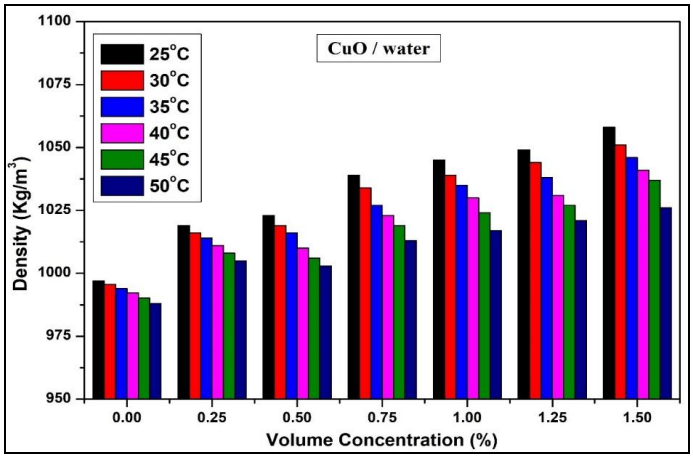




Results reveal that the maximum and minimum viscosity is observed 1.11 mPa.s for 1.50% volume concentration of nanofluid and 0.58 mPa.s for 0.25% volume concentration at 25ºC and 50ºC temperature respectively.

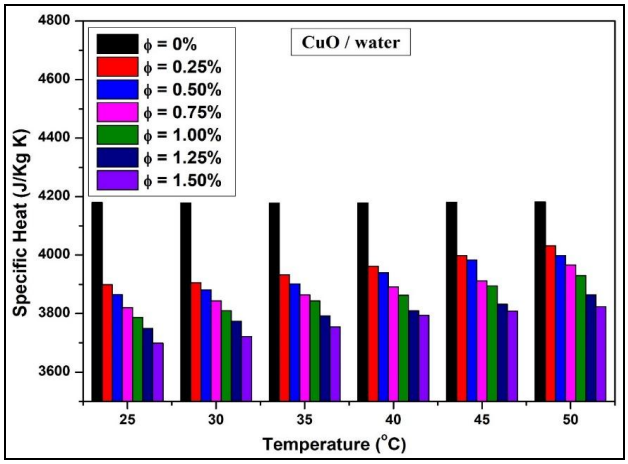
Result for Density

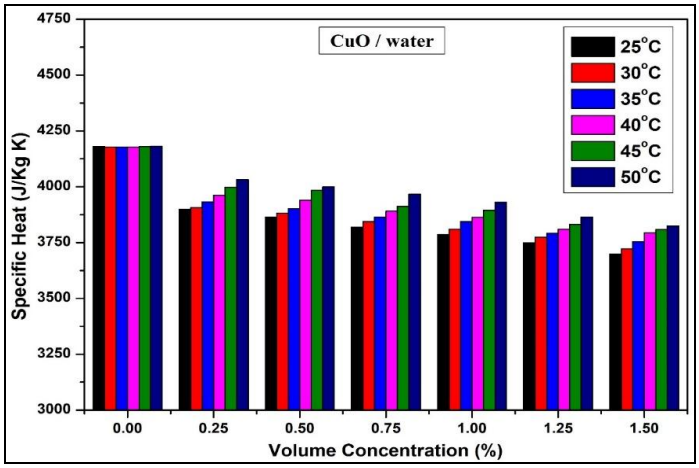




Experimental results reveal that the maximum and minimum density of the nanofluid is measured at 1058 kg/m^3 at 25ºC temperature with 1.50% particle volume concentration and 1001 kg/m^3 at 50ºC temperature with 0.25% nanoparticle volume concentration for CuO/PG + water nanofluid respectively.

Result for specific heat





The maximum and minimum specific heat capacity is measured at 4032 J/kg K at 50ºC temperature with 0.25% particle volume concentration and 3699 J/kg K at 25ºC with 1.50% volume concentration. Specific heat capacity increases with temperature and decreases with particle volume concentration

4. CONCLUSIONS

Various conclusions which are reported during this study are:

- The maximum and minimum thermal conductivity are 0.715 W/m K and 0.609 W/m K when ϕ = 1.50% at t = 50°C and ϕ = 0.25% at t = 25°C, respectively by using nanofluid whereas The maximum and minimum enhancement in thermal conductivity ratio are 13.3% and 0.83% when ϕ = 1.50% at t = 50°C and ϕ = 0.25% at t = 25°C, respectively in comparison to water.
- The maximum and minimum viscosity are 1.11 mPa.s and 0.58 mPa.s when ϕ = 1.50% at t = 25°C and ϕ = 0.25% at t = 50°C, respectively by using nanofluid whereas the maximum and minimum enhancement in viscosity ratio are 40.50% and 11.53% when ϕ = 1.50% at t = 25°C and ϕ = 0.25% at t = 50°C, respectively in comparison to water.
- The maximum and minimum density are 1058 Kg/m^3 and 1001 Kg/m^3 when ϕ = 1.50% at t = 25°C and ϕ = 0.25% at t = 50°C, respectively by using nanofluid whereas the maximum and minimum enhancement in density ratio are 6.11% and 1.31% when ϕ = 1.50% at t = 25°C and ϕ = 0.25% at t = 50°C, respectively in comparison to water.
- The maximum and minimum specific heat are 4032 J/Kg K and 3699 J/Kg K when ϕ = 0.25% at t = 50°C and ϕ = 1.50% at t = 25°C, respectively by using nanofluid whereas The maximum and minimum decrement in specific heat ratio are 11.50% and 3.56% when ϕ = 1.50% at t = 25°C and ϕ = 0.25% at t = 50°C, respectively in comparison to water.

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