Ultrasonic and Thermal Conductivity Study of CuOnanofluid

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Abstract— Ultrasonic and thermo physical properties of the nanofluid of binary mixtures of ethylene glycol with CuOnano particle were studied for various concentrations at constant temperature. Several acoustic parametric quantity specified squeezability(β), Inter molecular free length (Lf), acoustic impedance (Z), Molar sound fraction(R) and Wada's constant (W) and thermal conductivity (K) have been measured. The acoustical parametric quantity on composing by the assortment assists us to interpret the fundamental interaction between the contrary to molecules and a thermal conduction analysis gives us the heat transfer behavior of CuOnano-fluid

Keywords —Nanofluid, Acoustical parameters, Ultrasonic velocity, Molecular interaction, Thermal conductivity,.

1 INTRODUCTION

Nanofluids is a kind of novel engineering material formed by the suspension of nano sized solid particle of size typically of 1nm -100nm in to a base fluids like Water, Ethylene Glycol, Coconut oil and other organic liquids . These fluids offer excellent scope of enhancing thermal conductivity of common heat transfer fluids. Nanofluid was coined by Choi and colleagues [1-3] in 1995 at Argonne National Laboratory of the USA. Ionic liquids are adorning green solvents and a fresh assort from liquids primarily ascribable their special features, such as non-volatility, high polarizability and are able to dissolve compounds of varying polarity. They are elementarysalts that are liquidity at a lower place100 ◦C or at room-temperature and entirely composed of different organic ions [4–7]. Mixed solutions are nearly ubiquitous in the industry in identical different areas arraying from petro chemistry to pharmaceutical industries. Thermo physical attributes of assorted solvents accept comprised especially enlightening in elucidating the solute–solute and solute–solvent fundamental interactions that subsist in this solutions**.** Empiricaldata of thermodynamic and thermo physical properties of liquidities and fluid assortments are captivating and by eminent fundamental, functional/practical importance for the industry. In the acquaint work we accepted mixed ionicnano fluids and report the molecular interaction and thermal conductivity studies of binary mixtures of ethylene glycol with CuOnano particle for various concentrations ranging from 0.02 to 0.06 at room temperature. We prepared stable nano fluids containing copper oxide nano particles suspended in the base fluid ethylene glycol and measured acoustical parameters and thermal conductivity[11-13]. In recent days, copper oxide nano particles are eminent interestingness because of their heat transfer applications.

2 PREPARATION OF NANOFLUIDS

In this work, CuOnano fluid was prepared in two step method. In first step CuOnano particles are synthesized by using wet Chemical Method.

$$CuCl_2 + 2NaoH = CuO + NaCl + H_2O.$$

In next step, nano particles suspended in the basefluid Ethylene Glycol, with three different concentrations of CuOnano fluids ranging from 0.02 to 0.06 were prepared and then the test samples were subjected to ultra-sonication for 30 minutes. After ultrasonication process, no nanoparticle sedimentation is observed. No surfactant was added, as addition of surfactant reduces the thermal conductivity of nano fluids.

2.1. EXPERIMENTAL METHOD

Density of the nano fluid samples were determined by using specific gravity bottle made of Borosil Glass with an accuracy of0.01 kgm-3, and the weight of the sample was measured by using digital balance with an accuracy of 0.1mg .The velocity values of ultrasonic wave propagation through prepared samples were measured using multi frequency ultrasonic interferometer (Model FX-83, Mittal Enterprises, India) with an accuracy of ± 0.05 % at frequency of 2MHz at room temperature. Thermal conductivity of nano fluids was also measured using KD2 PRO Method. And all the measured values for various concentrations were tabulated.

Ultrasonic velocity measurements have been used to determine the acoustical parameters and extent of complication and compute the constancy constant quantity of so many complexes [8]. Nano fluids are suspensions of nano particles in fluids that demonstrate significant enhancement of their attributes at modest nano particle concentrations. Nano fluids are conceived to extend significant advantages all over schematic heat transfer fluids. Nano fluids contain suspended metallic and metal oxide nano articles, which gains the thermal conductivity of the base fluid enhancing heat transfer properties by a substantial amount [9, 10].

3. RESULT AND DISCUSSION

Nano fluids are considered to offer important advantages over conventional heat transfer fluids. To understand the molecular interactions of CuOnanofluids with the base fluid Ethylene Glycol, here we have measured the Acoustical parameters like Densiy(ρ), Ultrasonic velocity (V) Compressibility (β), Intermolecular free length (Lf), Acoustical Impedance (Z), and thermo physical properties such as Rao's Constant (R), Wada's Constant (W), and thermal Conductivity (K) for different concentration samples ranging from 0.02 to 0.06 at room temperature. Heat transfer application could represent by

using thermal conductivity study

Table 1:-Variation of Concentration with Density (ρ), Ultrasonic sound velocity (v), Compressibility (β), Inter molecular free length (L_f),

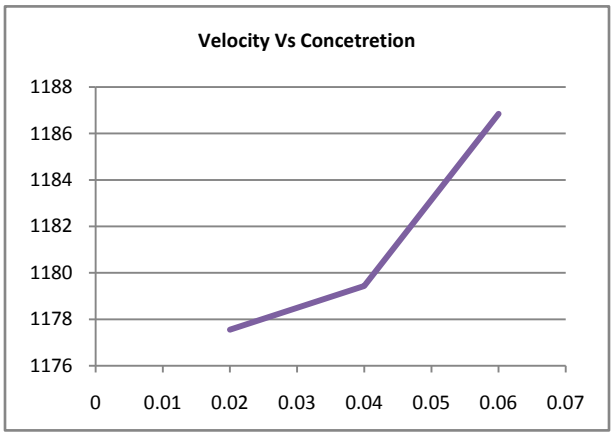
Concentration	*(ρ) Kg/m3*	*V m/s*	*(β) x10-7 N-1 m2*	*(Lf)x10-8 m*
0.02	*0.8731*	*1177.551*	*8.2603*	*1.7963*
0.04	*0.8678*	*1179.431*	*8.2837*	*1.7994*
0.06	*0.8708*	*1186.847*	*8.1630*	*1.7893*

Table 2:Rao's constant (R), Wada's Constant (W), Acoustic Impedance (Z) and Thermal Conductivity (K) at Room Temperature.

Concentration	*(R) (m3/mol) (m/s)1/3*	*(W) (m3/mol) (N-1m2)1/7*	*(Z) Kgm-2 s-1*	*(K) W/m-K*
0.02	*60.4621*	*42.3825*	*1.0281*	*0.148*
0.04	*60.4944*	*42.3655*	*1.0235*	*0.151*
0.06	*60.5998*	*42.4389*	*1.0358*	*0.162*

Graph 1: Variation of Ultrasonic sound velocity with different Concentrations of CuOnano fluid,

From the graphical information, it was observed that Ultrasonic velocity and Rao's constant increases gradually with addition of nano particle. Wada's constant and acoustic impedance drop-offs on the addition of nano particle but there is a sudden increase presents the supremacy of particle – fluid fundamental interaction.



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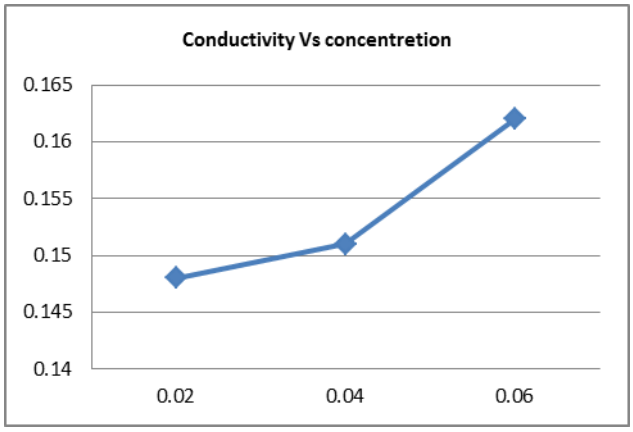
The variance from Compressibility, inter molecular free length with the absorption increases although particle loading up and sudden decrease is due to the variation of density it is also depicted in the graph.



This acoustical study shows the strong molecular interaction among nano particles and fluid. The thermal conductivity of nano fluid increases on the increment from particle concentration which may be due to the suspension of nano particle in base fluid.

4. CONCLUSIONS

Nano particles of CuO dispersed in base fluid Ethylene Glycol prepared for various concentrations without using any surfactant. The acoustical parameters and thermal conductivity was studied for the nano fluid at room temperature. Sudden increment shows the Particle- fluid interaction is more at 0.06 concentrations, it was observed from the parameters Wada's Constant, Rao's constant, acoustic reactance, density and ultrasonic velocity. The persisting acoustical study also implies the molecular interaction between the particle and fluid. These analyses acquaint aside to improve the thermal conductivities of schematic heat transfer fluids along dispersing metal nano particle in small concentration. Fluids comprising inactive solid metal nano particles thus accept eminent potential for practical application in heat exchange system.

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