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Thermo-Acoustical and FTIR Spectroscopic Research of Nanofluids at Different Temperatures

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Abstract—In recent years the greater interest of increase in thermal conductivity have attracted because there is comparison to that of the base fluids by Nano fluids. The wide spread of nano particles of the formation nano fluid of a base fluid, takes place. These nano fluids are very much useful in thermo dynamical applications and in the study of so many physical-chemical studies. The properties of molecular of sound in nano fluids like transmission undergo changes of associated systems in highly dependent and the cohesive properties of liquids. Generally nano fluid is having high thermal conductivity values. Four different temperatures have been studied in this thermo-acoustical work and FTIR Spectrum of Coo Nano fluid at T (303.15, 308.15, 313.15 and 318.15) K. The observed results are explained in the nature of interactions and bond formation.

Key Words: Nano fluid; Coo; Adiabatic Compressibility; Thermal Conductivity; FTIR.

I. INTRODUCTION

The spread area base fluid of Nano particles gives a new class of fluids called Nano fluids. The spread area of nano particles of base fluid shows the enhancement of attractive in the transport, physical-chemical and thermal properties [1-4].The Researchers named of Lee, Choy, Masuda And Eastman performed many experimental studies and thrown the way for measuring nano fluids by thermal conductivity. [5, 6]. The greater interest in recent years of increase thermal conductivity has fluids. Therefore, the nano fluids of heat exchange devices can be better used as heat transfer fluid. These are attracted because there in comparison to that of the base fluids by Nano fluids.

There are variety of application fields in Nano fluids like applications of electronic, transport, cooling applications of industries, reducing pollution and heating buildings and cooling system of nuclear, defence and space, storage of energy, absorption of solar, reduction of friction, sealing of magnetic, activity of antibacterial, delivery of nondrug, flow fluid of brake microbial fluids based on Nanofluid, fuel cell, based on nanofluids optical filters and sensors. Nanofluids are very much useful in the heat transfer applications in industrial and thermal sectors for thermal therapy, manufacturing, ventilation, optoelectronic devices, electronics, transportations, medical field etc [7]. There are various methods to prepare nanofluids, like spreading method. Generally Nanofluids have extremely large surface to volume ratio and hence they have many small sized nanoparticles due to the presence of heat transfer applications. Most of the Nanofluids are prepared by sanitation process which is a very usual and simple method. Ultrasonication is an accepted technique for dispersing aggregated nanoparticles. The experimentally measured for both nanoparticles and Nanofluids are structural, optical and were taken by many researchers' physical properties, structural, and optical. The present paper clarifies interaction present between the solute and solvent molecules using ultrasonic procedure. Using thermo-acoustical parameters interactions are investigated and the results are discussed [8-10].

II. REALTED WORK

Material investigation of segments archived is significant piece of criminological assessment of the addressed reports. For the most part it is used to decide of congruity/difference of unique report segments, to affirm/disprove the genuineness of the archive or dating the hour of record development.

Reports made by the customary way (not electronic archives) comprise of a data transporter, typically paper substrate and a few sorts of recording imply: printing ink, ink-fly ink, toner, stamp ink, composing mean and potentially extra unique – security highlights.

Majority of examined questioned documents uses paper as a traditional carrier therefore it is necessary to have knowledge about the structure, composition and specific properties of paper for the successful process of identifying differences in the substrate. Paper contains mostly cellulose fibres, but variety of improvers are added to the pulp stock to reach the desired quality and depending on the purpose for which it is produced. The improvements of its printing and optical properties are achieved by addition of white pigments or fillers to the paper, for example kaolin, calcium carbonate or titanium dioxide. Printing and copying papers are subject to high standardization in their manufacture.

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This process makes it difficult to identify differences between the various types of paper; on the other hand these components can help in finding differences between the two samples of the questioned documents.

The various group of record means differ in ink composition and principleof supplyingwriting materialson a substrate[3, 4].

Recording means comprise dyes or mixture of dyes dissolved in the viscous liquid which may be a mixture of natural or synthetic polymers or oils.

These are also present in resins, lubricants, biocides, emulsifiers and other additives to adjust the pH, viscosity, the ability of the polymerization, etc. Their detailed recipes are mostly patented; therefore it is not possible to find out information about the exact composition of these recording means in the literature or in the description of products. On the other hand, differences in the composition of the recording equipment of the same type, allow their differentiation or identification in examined questioned documents.

During assessment of the archive typically routine examination, for example, optical tiny techniques are applied first. Their starter results can encourage the decision of different strategies which are expected to present an example. The generally utilized are spectroscopic, for the most part non-ruinous strategies, for example, XRF, UV-VIS, VIS-NIR and FTIR spectroscopy. At times it is important to utilize likewise dangerous techniques, for example chromatographic (TLC, HPLC, GC-MS), electrophoresis and mass spectrometry.

In scientific investigation of records with structure proof during the assessment, there is a reasonable utilization of expository techniques without the utilization of forceful synthetic compounds that could be considered as material harm or devastate. Fourier Transform Infrared Spectroscopy – FTIR satisfies the condition of non-destructivity or micro-destructivity of examined materials. This method can be used to: identification of the functional groups in the sample which may indicate the presence of specific compounds in paper and recording means; identify differences in the composition of the compared documents; monitor degradation processes over time (oxidation, shortening of the polymer chains, the fading of dyes).

FTIR gives us information about the presence of all organic groups in the examined samples. However, in the spectrum obtained the bands originating from the ink often overlap with the strong absorption bands of the paper. Therefore, it is necessary to further mathematical processing of results and using a database of reference spectra of record means[11]. The ability to scan the selected points of the record by microscope with FTIR and the examination without the need of prior preparation of the sample are important advantages of this method. It is always appropriate to verify the results of FTIR analysis with other analytical methods e.g. Raman spectroscopy, XRF spectroscopy and microscopy methods.

III. MATERIALS AND METHODS& RESULTS

Nano fluids of Coo were prepared in two steps by dispersing the Coo nanoparticles uniformly in distilled water with the aid of sanitation. Coo the Central Drug of 99.5% has been obtained from Mumbai House of India. Nano fluids of Coo were dispersed in distilled water to obtain Coo nanofluids of five different concentration (0.3% - 1.5%) in steps of 0.3.Mittal enterprises make interferometer frequency of Ultrasonic (3 MHz, F-81 model) is used for the speed of sound measurements at different temperatures with respect to temperature bath. Density measurements are done with Specific gravity bottle. The viscosity measurements are done using Digital Viscometer (BROOKFIELD make).

Fig. 1: Ultrasonic Interferometer with Temperature Bath Setup
(a) different concentration of cuonano fluids (b) speed of sound measurements (c) brookfieldvisometer

IV. DISCUSSION AND RESULTS

The measurements of Experimental of Coo like speed, sound, viscosity and density nanofluids of many thermo-acoustical is used to determine adiabatic compressibility of parameters like, acoustic impedance, thermal conductivity and absorption coefficient and they are represented in Table-1.

Table s1: Values of thermo-acoustical parameters in Coo Nano fluid at T (=303.15, 308.15, 313.15 and 318.15) K

Concentration In %	At temperature T=303.15K	At temperature T=308.15K	At temperature T=313.15K	At temperature T=318.15K
	Speed of sound (m S^{-1})			
0.3	1515.3	1517.1	1518.9	1520.7
0.6	1517.9	1519.7	1521.5	1523.3
0.9	1521.7	1523.5	1525.3	1527.1
1.2	1524.6	1526.4	1528.2	1530
1.5	1528.2	1530.0	1531.8	1533.6
	Adiabatic Compressibility ($x10^{-10}m^2 N^{-1}$)			
0.3	4.6128	4.6005	4.5882	4.5759
0.6	4.5823	4.5700	4.5577	4.5454
0.9	4.5591	4.5468	4.5345	4.5222
1.2	4.5212	4.5089	4.4966	4.4843
1.5	4.4943	4.4820	4.4697	4.4574

	Acoustic Impedance ($x10^6$ kg m^{-2} s^{-1})			
0.3	1.5219	1.5357	1.5495	1.5634
0.6	1.5498	1.5636	1.5774	1.5913
0.9	1.5632	1.577	1.5908	1.6047
1.2	1.5899	1.6037	1.6175	1.6314
1.5	1.6172	1.631	1.6448	1.6587
	Thermal Conductivity ($X10^{-3}$W/m/K)			
0.3	2.9891	3.1136	3.2381	3.3626
0.6	3.1213	3.2458	3.3703	3.4948
0.9	3.4376	3.5621	3.6866	3.8111
1.2	3.4698	3.5943	3.7188	3.8433
1.5	3.4991	3.6236	3.7481	3.8726
	Absorption Coefficient ($x10^{-14}$ $m^{-1}S^{-2}$)			
0.3	1.3992	1.3171	1.2349	1.1528
0.6	1.6921	1.61	1.5278	1.4457
0.9	1.6592	1.5771	1.4949	1.4128
1.2	1.2123	1.1621	1.1212	1.0981
1.5	1.1121	1.0912	1.0543	1.0231

The related value of compressibility is observed that of the fluid mixture decreases with increase molar concentration from 0.0% to 1.5% and the increased temperature increases the observed value of compressibility. The compressibility decrease the molecules closer and brings to one another, resulting the existence of strong interactions between the molecules of the fluid mixture and increase of adiabatic compressibility with respect to temperature and the interaction clearly reveals that the higher temperature becomes weaker because as the temperature increases then in molecules move freely away from each other and results in making the interactions weak. In the study of liquid mixtures the observations of similar are made by Ali and Nain ` [11] in 2000.

As like in the present study, Eyeing and Kincaid [12] in 1938 proposed that speed of sound should increase if the adiabatic compressibility decreases which is represented in figure 1(b). The variation of relating of effective resistance with resspect to the molar concentration of Coo Nano fluid at four temperatures T= (303.15, 308.15, 313.15 and 318.15) K is given in figure 1(c). Generally the opposition presents the relating effective resistance and specific relating effective resistance are measures of the relative flow resulting from a system to relative pressure applied to the system, the materials of Sound travels through pressure of sound. The solid atoms or molecules are bounded elastically with another, because of the results of wave propagating of pressure in a solid. And the relative effective resistance of the defined material product of the density and velocity of relativity and this is observed from the figure that acoustical impedance increases with the molar concentration.

This supports that there is a strong nature of interactions between molecules of fluid mixture which is helpful for understanding the applications of the present fluid in different fields and this is also supported by Oswald [13] in 1998. It is observed from figure 1(d) that; the conductivity of thermal increases in molar concentration of Coo Nanofluid and increases with of Nanofluid at all the four different temperatures. Generally the liquids and solids are essential in many chemical process engineering fields of applications of Thermal conductivity where the transfer of heat is widespread. In simple organic liquids, the conductivities of thermal are between 10 and 100 times larger than the gases of low pressure at the same temperatures, and the effect of pressure of it is minimum.

In case of increasing the temperature additionally, it decreases the conductivities of thermal and the characteristic of the liquid resistance. The dependence of occurring the temperature is noticeable and the conductivities of thermal is nearly exponential weak and linear. From figure 1(e), It was observed that absorption co-efficient first increases and then decreases as the molar concentration increases. This decrease in absorption co-efficient values is caused by hydrogen bond formation at higher level of concentration of the Coo Na-nofluids [14-17].

The FTIR-Spectrum of Cu0 Nano fluid is represented in figure 1(f). Generally the method of infrared analysis collects samples of fluids and the transmission of infrared spectrum of a contained liquid in the windows of a liquid infrared cell between them. All liquids can't be analyzed in the manner of infrared spectroscopy. The symmetric bands of 2933 cm belong to À1 and the stretching of vibration asymmetric bands of 3432 cm also belong to À1 of the O-H bond respectively. And the bands of 523 cm in presence of À1 and 1011 cm and the indication of bending vibration of different modes of Cu- O bond.

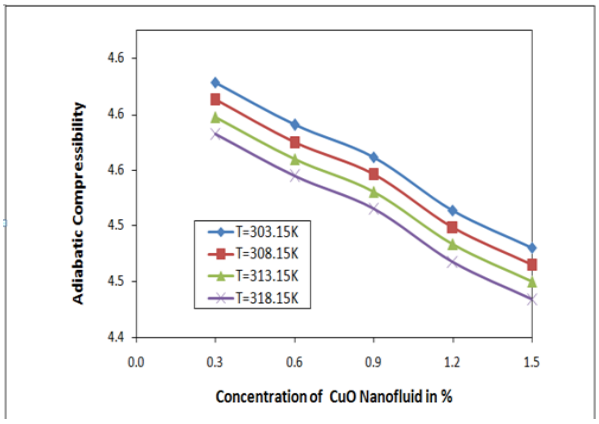

Fig. 2(a): Variation of Adiabatic Compressibility With Concentration of Cuo Nano Fluid

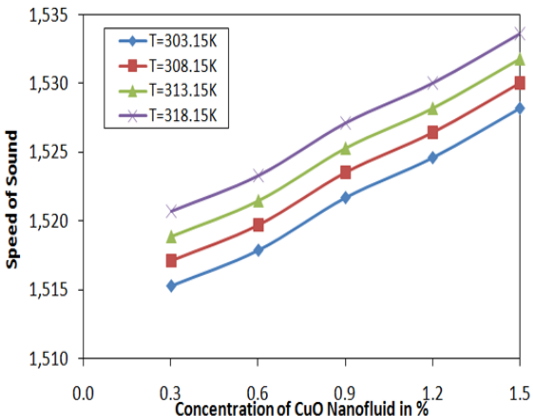

Fig. 2(b): Variation of Speed Of Sound With Concentration of Cuo Nano Fluid

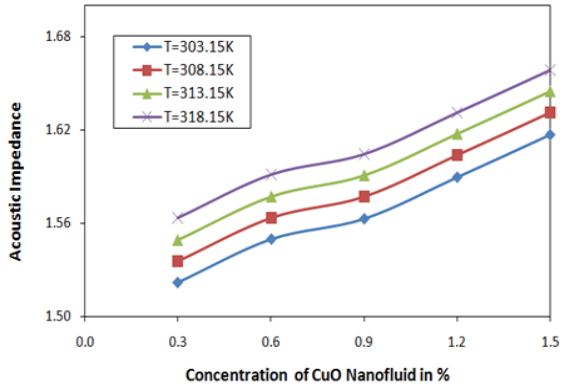

Fig. 2(c): Variation of Acoustic Impedance With Concentration of Cuo Nano Fluid

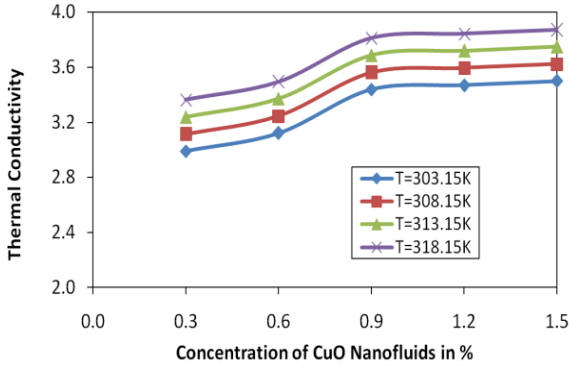

Fig. 2(d): Variation of Thermal Conductivity With Concentration of Cuo Nano Fluids

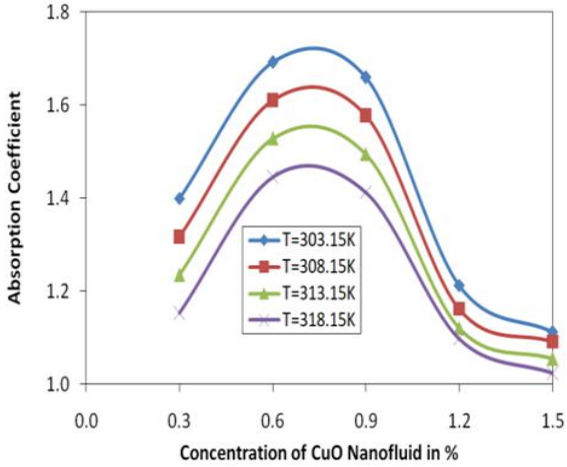

Fig. 2(e): Variation of Absorption Coefficient With Concentration of Cuo Nano Fluid

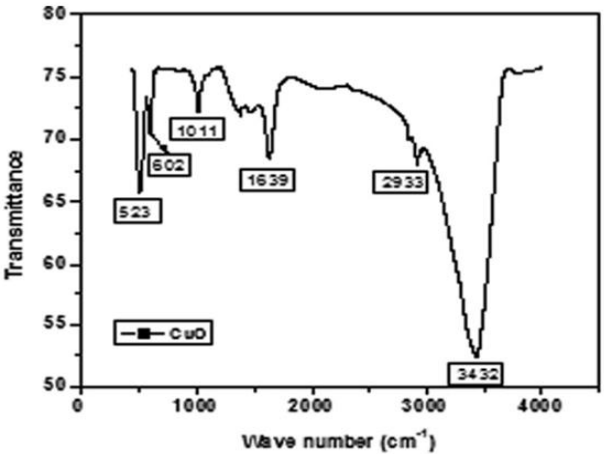

Fig. 2(f): FTIR-Spectrum of Coo Nano Fluid

V. CONCLUSION

The ultrasonic velocity, density and viscosity of Nanofluid have been studied for different concentration of nano particles in the distilled water. The particle-fluid interaction is examined from the increase in ultrasonic velocity as the concentration increases. It is clear that ultrasonic velocity is elevated for nanofluids when related with the base liquid and provide enrichment of nano suspension that can be used for many industrial applications. The acoustical parameters and thermal conductivity was studied for the Nanofluid at room temperature. The acoustical study shows the strong molecular interaction among Thermo acoustic Nano particles and fluid. The enhancement in the thermal conductivity of nano fluid with higher level of particle concentration is caused by the presence of nano particle suspension in the base fluid is due to Brownian motion.

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