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Experimental Study of the Comparison of Thermal Conductivity of Al_2O_3-Alpha Nanofluid with Lubricating Oil (160-HZ)

Inderdeep Singh

Assistant Professor, Mechanical Engineering, Yogananda College of Engineering and Technology, Jammu, India

***Abstract* - Discovery of Nanofluids leads to the revolution in Thermal conductivity process. Nanofluids are of small size basically 1 to 100 nm in size. This unique property of Nanofluids make it is a great property for Thermal Enhancement. Nanoparticles used in Nanofluids are made up of metals, oxides, carbides etc. Nanofluids are mixed with base fluid like lubricating oil, different Refrigerants, chemicals and water. In this present work Alumina (Alpha) Nanofluids mixed with lubricating oil (160-HZ) at different Temperature range (30 to 70°C) with varying different volume concentration (0.1 to 5%) with 20 nm nanoparticles size to study the Thermal conductivity behavior. In short Alumina (Alpha) Nanofluids with base fluid lubricating oil (160-HZ) is prepared and then their Thermal conductivity is compared with base fluid i.e. Lubricating oil (160-HZ). Result shows that Alumina (Alpha) Nanofluids with base fluid lubricating oil (160-HZ) Shows superior Thermal conductivity as compared to Thermal conductivity of base fluid (160-HZ).**

Keywords: Nanoparticles, Thermal Conductivity, Lubricating oil (160-HZ).

I. INTRODUCTION

Enhancement in Thermal conductivity leads to greatest Thermal process. Efficiency of many processes becomes sky high with the help of Thermal Enhancement. So with the discovery of Nanofluids these things comes into true. Nanofluis are the fluids that range between 1 to 100 nm in size. They are so small in size that they can easily mixes with small powders, and different base fluids. The unique property is that they can easily vissible with naked eyes one to one nanoparticle. They exhibit excellent Thermal properties as compared to their base fluids. It coinsists of Engineered Colloidal suspension of nanoparticles in a base fluid. It's hard to imagine how small the size of nanometer is one nanometer is a billionth of a meter, or 10-9 of a meter. S.choi discovered Nanofluids in 1995 for Thermal conductivity enhancement. This revoloution makes way for different process for higher energy efficiency. Different Processes like in Boilers, Thermal plants, Refrigeration plants exhibit higher Efficiency due to Nanofluids. In refrigeration plants when used Nanorefrgerant (Nanoparticles + Refrigerant) efficiency or COP increases due to anofluids Thermal propertes. The naoparticle used in nanofluids are metals, oxides,, carbides with base fluid include lubricating oil, refrigerant and msinly water. Certain base fluids like water, different lubricating oil lie (160-SZ) (160-HZ), enhanced Their Thermal properties when Nanofluids are used. Nanofluids are used in very small volume concentration starts from (0.01 to 5%). These small concentrations make Thermal properties to a higher level due to Nanofluid or Nanoparticles Thermal properties.

II. LITERATURE REVIEW

S. Dinarvand Et.al [1] [2019] : In this study, paper they investigate semi-analytically the steady laminar incompressible two-dimensional boundary layer flow of a TiO_2-CuO/water hybrid nanofluid over a static/moving wedge or corner that is called Falkner-Skan.

W. Safiel Et.al [2] [2020]: Published paper on preparation, wettability and synthesis of nanofluid in a review manner.

Z. Alhajal Et.al [3] [2020]: Presented paper on comparative study on best configuration for heat enhancement using nanofluid. In this present study, three different configurations (porous block, porous straight channel and porous wavy channels) setups were investigated numerically using four different types of nanofluids mainly, 0.5% vol Al_2O_3/Water, 0.5% vol TiO_2/Water, 0.5% vol Al_2O_3/Ethylene Glycol and 0.5% vol TiO_2/Ethylene Glycol.

T. Elnaqeeb Et.al [4] [2020] Discuss Unsteady natural convective flows of nanofluids in a vertical channel with circular cross-section have been investigated using the integral method transforms.

Vijaya Lakshmi Et. al (5 [2020]) The present research explores the features of thermal and solutal transport of a 3D micropolar liquid stream on an elongated convectively heated inclined sheet taking Soret effect. Mathematical modelling is designed with the aid of suitable scaling analysis on the

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governing PDEs conceiving the small magnetic Reynolds number.

P. Sridevi ET. AL (6) [2020]: In the current study, we have scrutinized the sway of non-linear thermal radiation and Biot number on boundary layer flow along a continuously moving thin needle filled with carbon based nanotubes by considering water as regular fluid. The main system of partial differential equations is first reduced to the system of ordinary non-linear differential equations with the help of similarity conversion technique.

Hindebu Et. al (7) [2021] : Heat transfer characteristics and hydrodynamical properties of ferrofluid through microchannels with non-uniform permeable walls temperature and filled with porous media plays an important role in modern microfluidic applications, such as solar collectors, nuclear reactors, micro-electro-chemical cell transport, micro heat exchanging, microchip cooling, and electronic equipment. Therefore, this paper presents the investigation of ferrofluid (Fe3O4-H2O) heat transfer characteristics as well as hydrodynamical properties in a permeable microchannel with non-uniform permeable walls.

OKAFAR Et. al (8) [2022] Traditional heat transfer base fluids, such as ethylene glycol, ethanol, kerosene, oil, methanol, water etc. are normally used to enhance the heat transfer performance in many industrial applications. These traditional heat transfer fluids have many limitations. One of the limitations is the poor thermophysical properties of each of the base fluids and this result in a lower heat transfer rate in Thermal Engineering systems. Nanofluids are considered a new generation heat transfer fluid with higher thermal conductivity. Nanofluids have enhanced thermophysical properties compared to single-phase traditional heat transfer fluids. This paper highlights detailed reviews of the various methods of preparation, characterization, stability and thermophysical properties of bio, non-bio and hybrids nanofluids. Thermophysical properties such as density, viscosity, thermal conductivity and specific heat capacity from different works of literature were summarized, discussed and presented.

Archie Thakur Et.al (9) [2023]: Tri-hybrid nanofluids are formed by involving three different types of nanoparticles in the base fluid. In recent years, studies have been done to properly understand the factors that affect the heat transfer properties of these tri-hybrid nanofluids under various circumstances. The purpose of this study is to execute a study on an advanced tri-hybrid nanofluid model for heat transfer. No previous analysis has been executed for the flow of tri-hybrid nanofluid TiO_2–Al_2O_3–SiO_2/H_2O past a variably thickened stretching sheet with the inclusion of Newtonian heating, magnetic field, mixed convection, thermal radiation, and viscous dissipation. This investigation confronts the heat transfer characteristics of boundary layer mixed convective flow of TiO_2–Al_2O_3–SiO_2/H_2O tri-hybrid nanofluid on a variably thickened stretching sheet along with the inclusion of thermal radiation, viscous dissipation, and Newtonian heating. The ruling boundary layer equations are manipulated into an arrangement of ODEs using appropriate similarity transformations which are worked out with the bvp4c program in MATLAB for solutions.

C. Manoj Kumar ET. al (10) [2024] : This study presents a comprehensive numerical and statistical analysis of the flow, heat/mass transfer management of Newtonian and non-Newtonian nanofluid over a bidirectional Darcy-Forchheimer stretching sheet. The external effects of MHD, Joule heating, thermal radiation, heat generation/absorption, Brownian motion, thermal diffusion and chemical reaction are taken into account. It is presumed that the thermal conductivity of fluid varies linearly with temperature. The non-linear coupled P.D.Es are converted into nonlinear coupled O.D.Es using similarity transformation. These equations are solved using MATLAB by implementing four-stage Lobatto IIIa formula and the outcomes of numerous flow parameters are presented graphically. In addition to numerical investigations, a comprehensive statistical analysis is performed using R-software to evaluate the sensitivity of key input parameters towards variable thermal conductivity.

A. Samanta Et.al (11) [2024] Presented paper on Mathematical modelling on Nusselt number studied Copper Nnanofluid Lubricating oil.

Amlal Et. al (15) [2025]: The significance of nanofluids is increasingly acknowledged due to their application across various fields to enhance the properties of mixtures. A significant challenge lies in accurately calculating their thermophysical properties, as no theoretical formula currently exists that can estimate these with precision conductivity and dynamic viscosity.

III. PREPARATION OF NANOFLUID

Different types of methods are used in prepsration of nanofluids. Out of these single step and double step methods are widely used. Most of the research used these two types of methods for the preparation and synthesis of these fluids.

Single Step Method

This Method is the simplest method it makes the formation and dispersion of nanboparticlkes in a simulteaneous way. In this method synthesis of nanoparticles as well as the nanofluid is done in a single step. It is a process

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combining the preparation of nanoparticles with the synthesis of nanofluids for which the nanoparticles are directly prepared by physical vapour deposition (PVD) technique or liquid chemical method. Choi and Eastman produced this method in 2001. It is used in small scale Nanoproduction.

Two Step Method

This method is commonly used worldwide as it is de most famous method in nanofluids. The simple principle of this method is first make nanoparticles in dry powder form using techniques like CVD (chemical; vapour deposition), thermal spray and spray pyrolysis. Most process using nanofluids are produced by this methiod. It is also used in high scale nanoscale production. Following techniques are used in this method for the effieciency of nanofluids.

a) High shear
b) Ultrasonication
c) Microemulsion

These prepartion method is extreme important for making an Nanofluid. These steps whether one step or two step makes an important role in making an Nanofluid, their different efficiency, capabiliies ans superior heat transfer. These methods are based on Nanofluid structure, shape and base fluid. For example most nanofluid with base fluid water are prepared by one step method while those of Lubricating oil like 160-SZ, 160-POE, 160-SO & 160-SZ and kersone oil are preapared by two step method.

Two step is the edge over one step method over his suspension, heat capacities and absorptioon propeties. The Two step method is the best method for nanofluid when base fluid is lubricating oil. This method Enhances Thermal Properties. In this Research Methodology Two step Method is used.

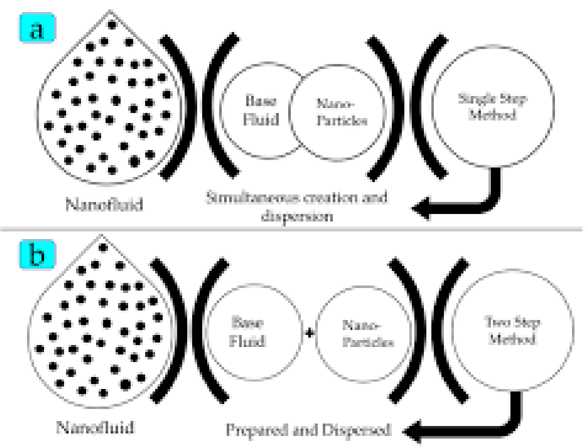

Figure 1: Shows Single Step and Double Step Nanofluid Method

Figure 1 shows layout of single step and double step method. Single step shows dispersion and creation in a simultaneous way. Figure 2 shows Prepartion and dispersion in different way in two step method by this layout. Some advantages of Nanofluid are 1) Best utilized for large scale nanofluid production, 2) It is mostly cost effective and in budget limit, 3) Best application is it is used for oxide nanoparticles, 4) Base fluids used is lubricating oil, water etc, 5) Provide greater flexibility, 6) Stability enhanced by the use of Surfactants, 7) Nanoparticles easily aggregates due to high surface area and property.

IV. METHOD OF STABILITY FOR NANOFLUID

Methods used in the stability of nanofluids are

1) Analysis by zeta potential
2) Using surfactants as a stabilizer
3) Ultraviolet-Visible Spectroscopy

1) Zeta potential

Research shows when zeta potential is higher it indicates higher stability of nanofluid mixtures. When zeta potential is low colloidal suspension stability is lowered. Further it shows from the experimental data when zeta potential values are in the range of -41 to -50mv the stability is extreme high. On the other sides when zeta potential value is in -11 mv to -20 mv the stability is lowered. Further research shows values for the stability of nanofluid depends on zeta potential values .

Rapid coagulation occurs when zeta potential falls +_ 5mv.
Incident stability occurs wen zeta potential is in 10 to 30 mv.
Moderate stability occur when value of zeta potential is 30 to 40 mv.
Good stability of nanofluid occur when zeta potential is in the range of 40 to 60 mv
Excellent stability of nanoflyid when zeta potential falls to +-61mv.

2) Surfactants

These are the stabilizing agent to prevent nanoparticles agglormetion and settling. It works on the principle that creates layer around the nanoparticles that helps to improve dispersion in fluid (base fluid). Different types of various surfactants are used in various nanofluid for eg Al_20_3 water, Cuo Water, Al203 lubricating oil for the proper dispersion and stability. Surfactants are the molecules like amphiphile molecules that consists of hydropholic and hydrophobic ends. It's principle Is to break the intermolecular bonds that further leads to the decrease in surface tension nd density. These surfactants wen added to the nanofluid the chances of

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agglomeration and coagulation of nanoparticles decreases gradually.

Surfactants can be classified as

1) Anionic surfactants
2) Ammonium and amines
3) Sodium dodecyl sulphates

3) Ultraviolet-Visible Spectroscopy

It increases the stability of nanofluid by calculating the absorbence. It is de modern method. It is based on principle that absorbence is directly proportional to the fluid tested via its concentration. It is based on beer lambert law. Single-step method and two-step methods are used for the preparation of Nano fluids. Stable suspension of nanoparticles in conventional heat transfer fluids are produced by these two methods. Out of these two methods two-step method is commonly used for the preparation of nanofluids. The two-step method first makes nanoparticles in dry powder form using nanoparticle processing technique such as Chemical vapour deposition (CVD), chemical precipitation, microemulsion, thermal spray and spray pyrolysis. The next step is the dispersion of nanosized powder form into the base fluid. For nanofluids prepared by the two step method dispersion techniques such as high shear and ultrasonication can be used to create various particle-fluid combinations. Most nanofluids containing oxide nanoparticles, are produced by two step method. Wang et al. [5], Zhu et al. [6] explained that two step method is mostly used for the oxide nanoparticles. Preparation of nanofluid in one step is carried by one step method. The single step method simultaneously makes and diisperses nanoparticles directly into base fluids. In this method synthesis of nanoparticles as well as the nanofluid is done in a single step. It is a process combining the preparation of nanoparticles with the synthesis of nanofluids for which the nanoparticles are directly prepared by physical vapour deposition (PVD) technique or liquid chemical method. Nanofluid Stability is increased & agglomeration of these particles are extend to neglible extend due to missing of Process like, Transportation, storage & drying. The cons of this method are that only low vapour pressure fluids are compatible with this process. This method is much more costlier as compared to the double step method. In this research work Al_2O_3/lubricating oil nanofluid is prepared by two step method.

Table 1: Properties of Nanoparticle

Particle	**Aluminium Oxide nanopowder ($A1_2O_3$)(Alpha)**
Avg. particle diameter	20 nm (gamma)
Density	3950 Kg/m^3
Purity	99.99%
Colour	Ivory/White
Crystal Structure	Hexagonal
Ph value	7-9
Surface Area	Low Surface Area
Applications	Wear Resistant part, Cutting tool

Table 2: Properties of Base fluid i.e. lubricating oil (160-HZ)

OIL	**160-HZ**
Viscosity	30-34cst
Density	0.975-0.981
Pour Point	-45
Flash Point	260
Dieletric strength	25kv
Colour	0.5

V. THERMAL CONDUCTIVITY MEASUREMENT

The Thermal Conductivity of nanofluids are measured by KD2 Pro method. This method is most accurate and fast method for the measurement of Thermal conductivity of nanofluids. KD2 Pro is a hand held device used to measure thermal properties. It consists of handheld controller and two sensors one is single and other is dual that can be inserted into the medium.

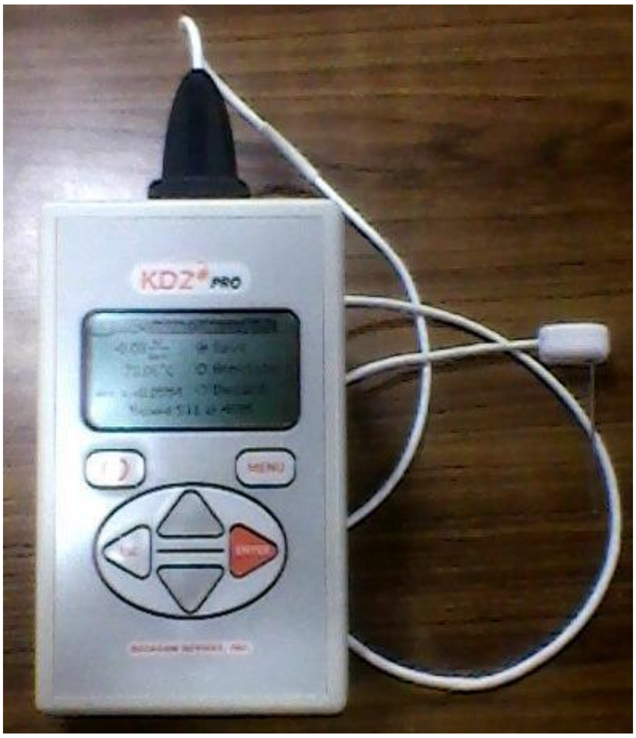

Figure 2: KD2 Pro Method

The Thermal conductivity and resistivity is measured by single needle sensors while the dual neele sensors determines Specific heat, Thermal diffusivity etc. FeiDuan [7] and

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Murshed et al [8] explained that the KD2 Pro method is best and easy methods for measuring Thermal conductivity of nanofluids and it is designed in such a way for easy to use and maximum functionality. KD2 Pro device consists of a handheld microcontroller and sensor needles. The KD2's sensors needle contains both a heating element and a thermistor. At the end of the reading, the controller computes the thermal conductivity using the change in temperature:

(T)- time data from

$$K = \frac{q\,(\ln t_2 - \ln t_1)}{4\pi\,(\Delta T_2 - \Delta T_1)}$$

Where q is constant heat rate applied to an infinitely long and small line source in W/m^2.

VI. STABILITY OF ALUMINA NANOFLUID

The preparation and stability of these lubricant and nanoparticle mixture are very important. The size of Alumina nanoparticles is about 20 nm as mentioned by the company. Nanofluids are not simply liquid solid mixtures. Nanofluids are prepared by using single step or two step method. In the present study two step method is used. The Alumina(Alpha) nanoparticles corresponding to volume fraction 0.1%, 0.25%, 0.5%, 1%, 2% and 3% is weigh in exact amount with the help of digital weighing balance machine. In this way six samples of the Alumina(Alpha) Nanofluids in lubricating oil (160- HZ) were prepared with different concentration of alumina alpha and alumina gamma (0.1%, 0.25%, 0.5%, 1%, 2% and 3%) by volume in base fluid i.e. lubricating oil(160-HZ). Then, take 60 ml lubricating oil in a beaker, and pour the calculated amount of alumina Alpha nanoparticles in the beaker very gently, avoiding the sticking of nanoparticles on the beaker wall. Then place this beaker in ultrasonicator for at least 2-3 hours for proper mixing. Standard density of Alumina nanoparticles were taken to be 3.72gm/cc. Table 2 shows the required weight of alumina powder for the preparation of 60 ml nanofluids of different concentration by volume.

Table 2: Percentage of Alumina per weight as per volume concentration

% of Alumina by volume in base fluid	Required weight of Alumina in gm.
0.1%	0.23 gm
0.25%	0.58gm
0.50%	1.164gm
1 %	2.328gm
2%	4.656gm
3%	6.984 gm

VII. SONICATION

Nanoparticles cannot easily disperse into the liquid i.e. their base fluids like water, ethylene glycol, oil and lubricating oil. Nanofluids with the same nanoparticles and base fluids can behave differently due to different Nanofluids preparation methods. This will lead to agglomerate sizes in Nanofluids that can impact the thermal conductivity of Nanofluids and lead to a different heat transfer performance. So, a common way to break up agglomerates and promotes dispersion of nanoparticles into their base fluids Sonication is required. In this research work Alumina Alpha Nanofluids have gone to sonication for 3 hrs for:

Figure 3: Ultrasonic Vibrator

The proper settling of Alumina nanoparticles into the base fluid. Sonication is done for the dispersion of nanoparticles into their base fluids with the help of Ultra Sonication, different nanoparticles have taking different time for the dispersion of nanofluids depending upon their chemical properties, some nanofluids doesnot dispersed easily in that cases some surfactants have been added for the dispersion of nanofluids. Sonication is commonly used in nanotechnology for evenly dispersing nanoparticles in their base fluids.

VIII. NANOFLUID PHASE, STABILITY

Phase of Alumina (ALPHA) NANOFLUID IS Checked by XRD Technique. It indicates the phase identification by using XRD Machine. Different graphs have been made for different Nanofluids. Alumina (ALPHA) Nanofluid graph have been identified through machine that shows peak, curve and their reflection. Peas show different angles to which Phase of Nanofluid has been Rectified. Peak of Alumina (Alpha) Nanofluid has been verified through XRD Machines. It catches certain coordinates and angle value through material of Nnaofluid occurs. Similarly XRD (X-ray diffraction) is a technique used to characterize the crystalline structure of nanoparticles before they are used to create nanofluids. It confirms the phase purity and determines the crystallite size of

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the nanoparticles dispersed in the base fluid to study their properties. Analyzing the dried solid component of the nanofluid with XRD reveals the diffraction pattern of the constituent nanoparticles, like metal oxides XRD is used with nanofluids.

Nanoparticle characterization:

Before being added to a base fluid, the nanoparticles are analyzed using XRD to confirm their crystal structure and phase purity.

Crystallite size determination:

XRD data can be used to calculate the average size of the nanocrystals.

Phase confirmation:

In hybrid nanofluids, which contain multiple types of nanoparticles, XRD confirms the presence of each crystalline component by showing the combined diffraction peaks from each phase.

Different Phase analysis is done by XRD technique it analysis the phase of different Nanofluids.

Nanofluids like Al_20_3, Copper Nanofluids, Gold Nanofluids phase identification is done by XRD Technique.

IX. RESULTS AND DISCUSSION

The Thermal conductivity of Alumina (Alpha,) Nanofluids with base fluid lubricating oil (160 -HZ) has been compared with different volume concentration 0.1, 0.25, 0.5, 1% , 2% and 3% to shows that which Alumina (Alpha) nanofluid has better Thermal conductivity with base fluid lubricating oil (160-Hz). The fig 5 shows the thermal conductivity of the different volume concentration of Alumina (Alpha) Nanofluids mixed with the base fluid (160- HZ) i.e. Lubricating oil.

Graph 1 shows Thermal conductivity of Lubricating oil (160-HZ) in volume concentration starts from 0.01 to 5% with respect to Temperature.

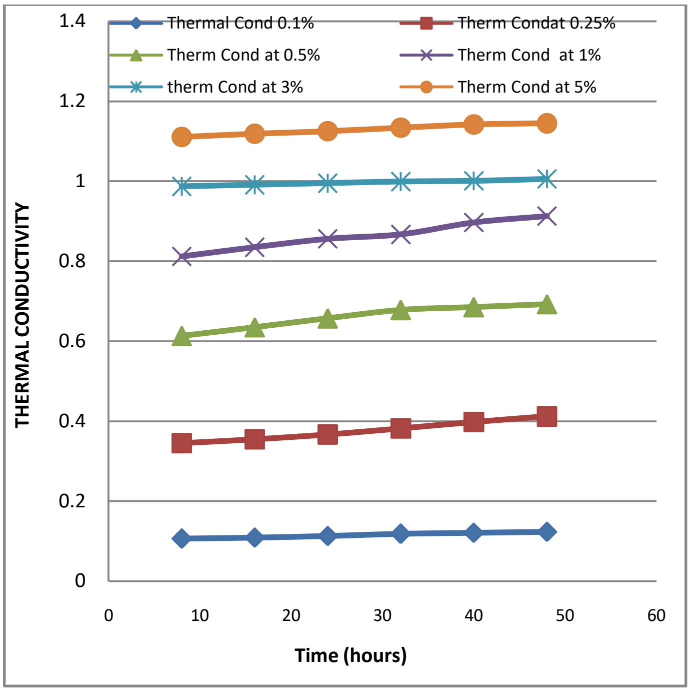
Graph II SHOWS Thermal conductivity of Alumina (ALPHA) Nanofluid with base fluid Lubricating oil (160-HZ).

Graph II Shows that Thermal Conductivity of Alumina (Alpha) Nanofluid with base fluid (160-HZ) exhibit Superior Thermal Properties as compared to Thermal conductivity of Lubricating oil (160-HZ). It is due to Superior Nanoparticles properties that Enhances Thermal properties to the Higher level.

Basically Nanofluids are the mixture of nanosized particles (1-100nm) in size, this small particle properties play a greater role in Enhancing Thermal Conductivity.

So Result of Graph I & Graph II is Alumina (Alpha) Nanofluid with base fluid lubricating oil (160-HZ) Shows better Thermal Conductivity as compared to base fluid i.e. Lubricating oil (160-HZ).

Graph I: Thermal Conductivity of Lubricating Oil (160-Hz) With Respect to Temperature at Various Volume Concentrations



Graph I

Graph I shows Thermal conductivity of Lubricating oil (160-HZ) With respect to Temperature at various volume concentration. For 0.1% Volume concentration the 0.105 to 0.123. Similarly for 5% Volume concentration The Thermal; Conductivity goes from 1.111 to 1.145.

Graph II Shows Thermal Conductivity of Alumina (Alpha) Nanofluid with base fluid lubricating oil (160-HZ). Graph II indicates that Thermal Conductivity of Alumina (Alpha) Nanofluid with base fluid lubricating oil (160-HZ) is very much higher than the Thermal Conductivity of Lubricating oil (160-HZ). Reason for it The Thermal properties of Nanofluid that Enhances Thermal Conductivity. Graph II shows at 0.01% Volume concentration Thermal Conductivity goes from 2.14 to 2.34. Similarly for 0.25% Volume concentration goes 2.75 to 3.35.

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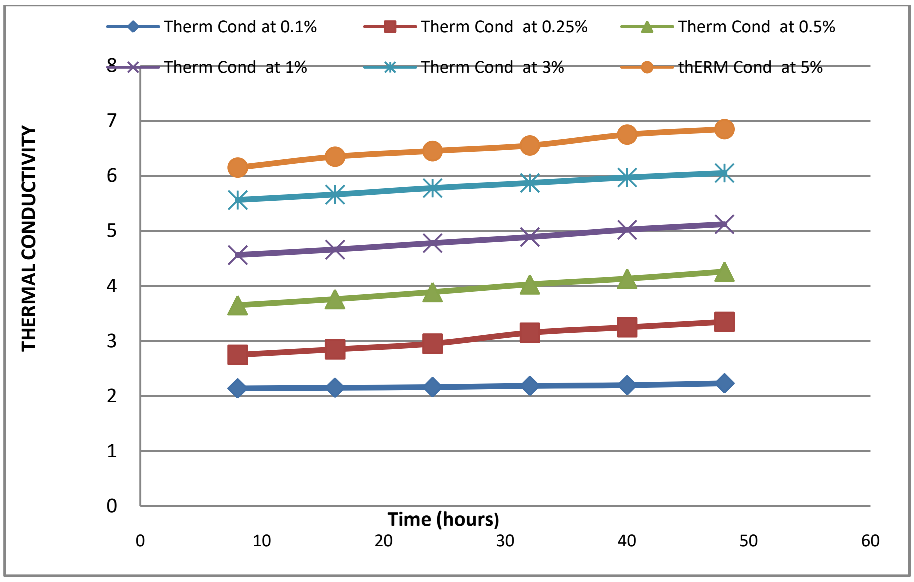
Graph II: Thermal Conductivity of Alumina Alpha Nanofluid with Base Fluid Lubricating Oil (160-HZ)



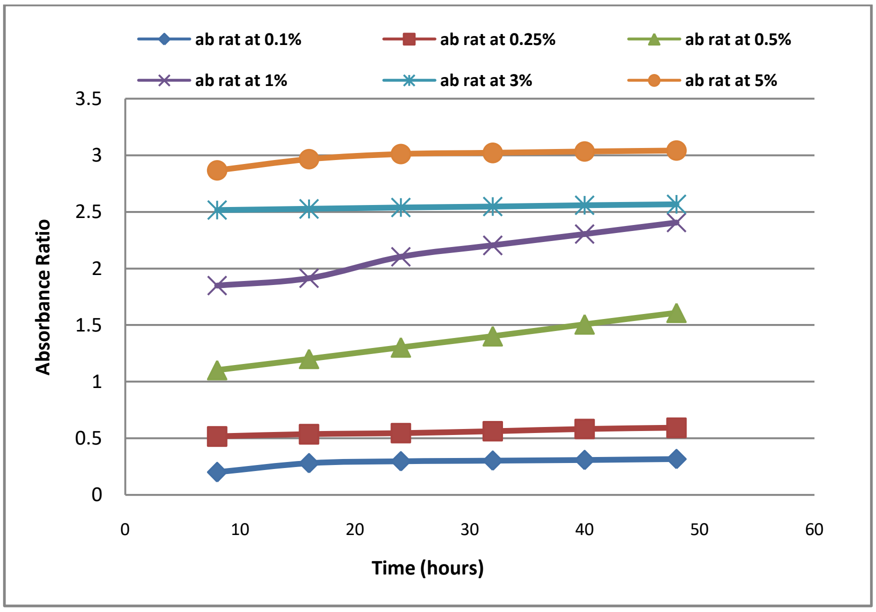
Graph II

For 0.5% Volume Concentration Thermal Conductivity goes from 3.65 to 4.26. For 1% Volume concentration Thermal Conductivity went from 4.56 to 5.12. Similarly for 3% and 5% Thermal conductivity ranges from 5.56 to 6.05 and 6.15 to 6.85.

Reason for Increase in Thermal Conductivity is Alumina (ALPHA) Nanofluid following properties;

1) **Concentration:** Higher concentration or weight percentage generally leads to greater Thermal Conductivity enhancement.
2) **Particle size:** Nanofluid having smaller particle size lead to greater Thermal Enhancement it depends on other factor also.
3) **Temperature:** Nanofluids generally increase with Temperature due to their unique property.
4) **Base Fluid:** Selection of base fluid like lubricating oil, water, ethylene glycol lead to greater Thermal Enhancement.
5) **Phase:** The phase played a vital role in Thermal Conductivity. Alumina (ALPHA) Phase has a porous structure that results from XRD. It contributes to Thermal conductivity.

Graph III: Absorption Ratio of Lubricating Oil (160-Hz) with Respect to Time



Graph III

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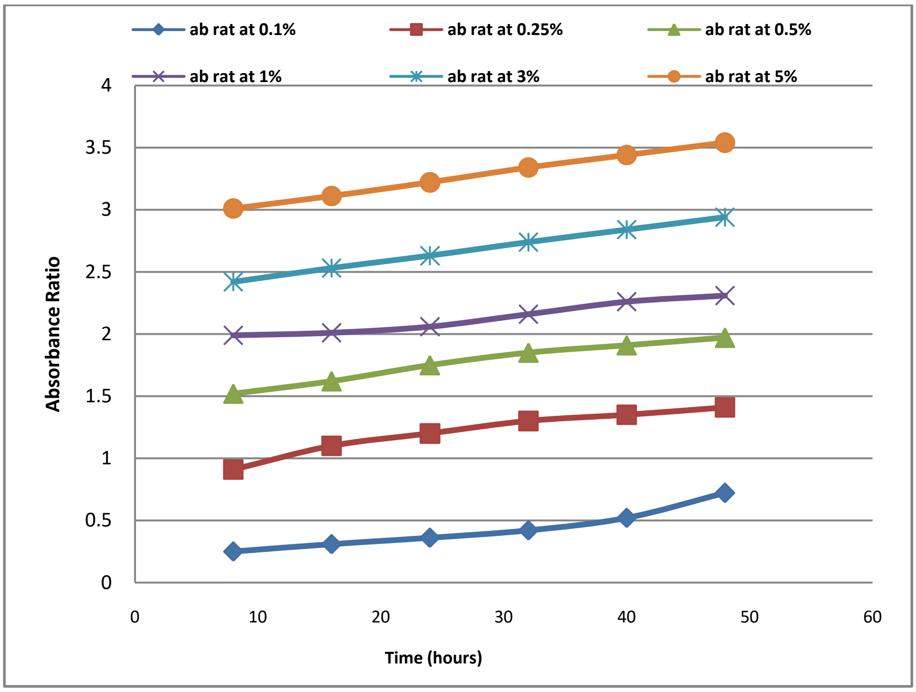
Graph III Shows Absorption ratio of Lubricating oil (160-HZ). It indicates there is less absorption ratio of Lubricating oil (160--HZ). For 0.1% volume concentration the Absorption ratio goes from 0.2 to 0.316. For 0.25 % volume concentration Absorption Ratio goes from 0.516 to 0.593. Similarly for 3% and 5% Volume Concentration Thermal Conductivity goes from 2.517 to 2.569 and 2.867 to 3.044.

Graph IV Indicates Absorption ratio of Alumina (Alpha) Nanofluid absorption ratio of Aluina (alpha) nanofluid with base fluid lubricating oil (160-HZ) is higher than Thermal Conductivity of Lubricating oil (160-HZ).

Reason for Higher Absorption Ratio when Base Fluid Lubricating oil (160-HZ) is mixed with Alumina (Alpha) Nanofluid.

1) Structure: Alumina (ALPHA) Nanofluid has a Solid structure as compared to Alumina (Gamma) nanofluid that inherits thermal properties which result in better haet transfer enhancement.

Graph IV: Absorption Ratio of Alumina (Alpha) Nanofluid with Base Fluid Lubricating Oil (160-HZ)



Graph IV

2) Phase Porosity: Phase structure of Alumina (Alpha) nanofluid has higher value of phase fraction and the porosity result in a lower mass based specific heat capacity. Thus generally a sample with a higher fraction of α phase and a lower porosity possesses a higher thermal conductivity.

3) Easily Dispersed into Surfactants: Alumina (Alpha) nanofluid has a property to easily disperse into surfactants. The addition of surfactants to the nanofluid generally increases Thermal conductivity. Result shows that Alumina (Alpha) nanofluid with surfactants enhances thermal conductivity to 13% as compared without surfactants. So this property of Alumina (ALPHA) Nanofluid of dispersion of surfactants to its base fluid lead to the enhancement of Thermal conductivity as compared to Alumina (Gamma) Nnaofluid.

4) Fluid Stability and Agglomeration: Stability is a great factor in enhancing Thermal conductivity. Nanoparticles can cluster together due to van der Waals forces, which can lead to settling and decreased heat transfer performance. Agglomeration can be mitigated with surface-active agents (surfactants) or by adjusting the nanofluid's pH. So fluid stability and agglomeration plays a vital role in Thermal conductivity. Alumina (ALPHA) nanofluid has better aggloromeration that leads to enhancement in Thermal conductivity.

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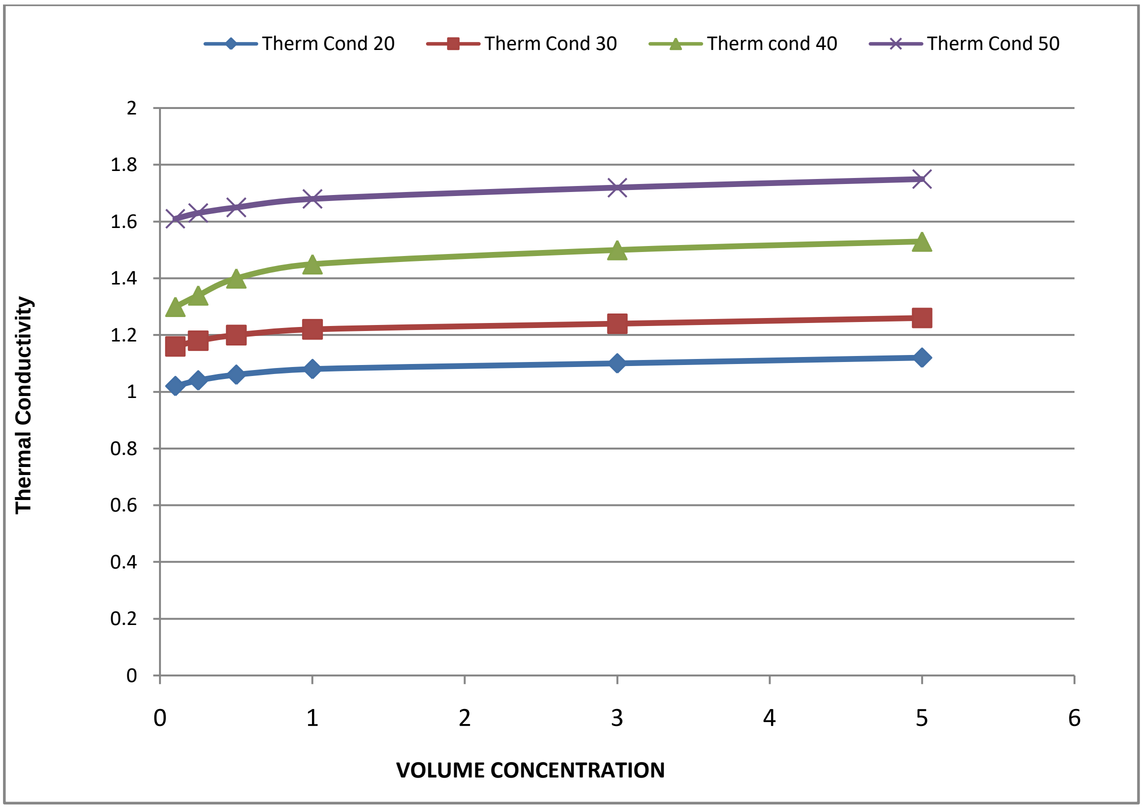
5) Prepartion Method: Preparation method plays a vital role in enhancement of Thermal Conductivity. One step method has a greater tendancy for enhancement of Thermal conductivity. So Alumina (Alpha) nanofluid has mostly prepared by one step method that automatically leads to enhancement of Thermal conductivity. Actually one step method has greater Stability, suspension, better aggloromettion that leads to great Thermal conductivity.

Graph V and Graph VI shows Effect of Volume Concentration of Lubricating oil (160-HZ) and Volume Concentration of Alumina (Alpha) Nanofluids



Graph V

Graph 5 shows Effect of volume Concentration on Thermal conductivity of Lubricating oil (160-HZ).

Volume concentration at 0.01 %, Thermal conductivity Ranges from 1.02 to 1.12 at Temperature 20^0.

Thermal Conductivity at Temperature 30^0 By Volume Concentration 0.1 to 5% at that range Thermal conductivity falls from 1.26 to 1.36.

Value of Thermal conductivity at 40^0 when volume concentration ranges from 0.1 to 5% are as under 1.3 to 1.53

Similarly at Thermal conductivity at Temp 50^0 values fall between 1.61 to 1.75.

This graph shows Range of Thermal Conductivity at different temperature with respect to volume concentration ranges from 0.1 % to 5%.

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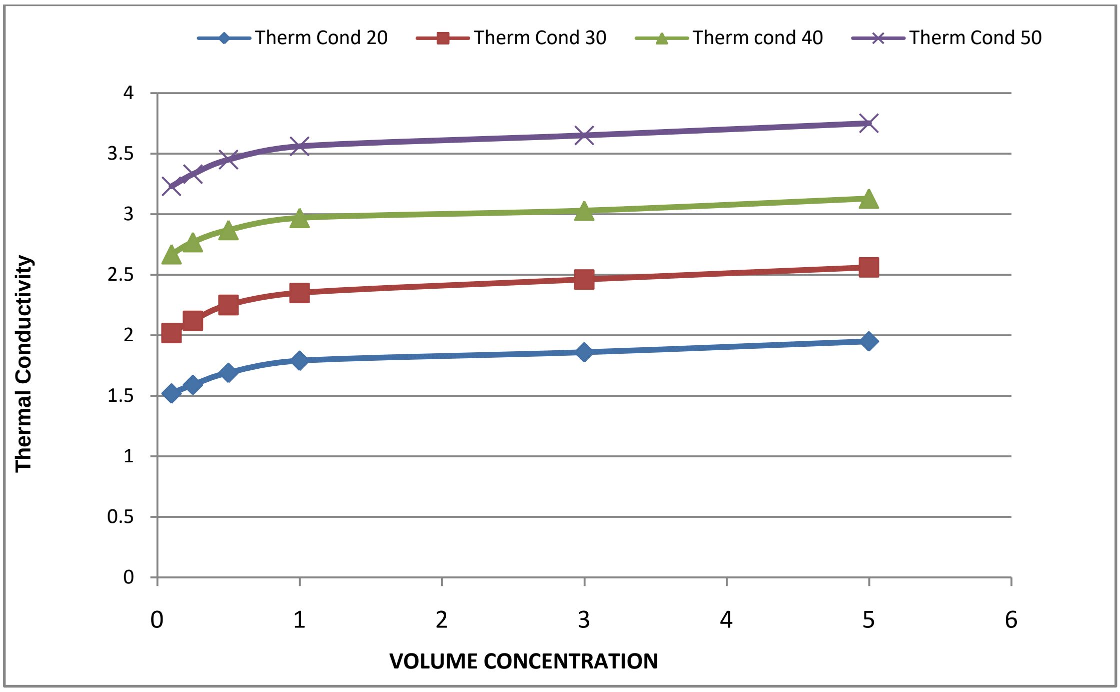
Graph VI shows Effect of Volume Concentration of Alumina (Alpha) Nanofluids with base fluid lubricating oil (160-HZ)



Graph VI

Graph VI Shows Effect of Volume Concentration of Alumina (Alpha) Nanofluid with base fluid lubricating oil (160-HZ). At different Temperature of Thermal conductivity.

At Thermal Conductivity at Temperature 20 ^{0} Value of Thermal Conductivity from volume concentration ranges from 0.1 to 5 % lies between 1.52 to 1.95.

At Thermal Conductivity at Temperature 30^{o} value of Thermal Conductivity falls between 2.02 to 2.56.

Similarly at Temperature of Thermal Conductivity at 40^{0} and 50^{0} its value falls between 2.67 to 3.13 and 3.23 to 3.75.

X. CONCLUSION

From Experimental study of comparison of Thermal Conductivity of Al_2O_3 Alpha Nanofluid with Lubricating oil (160-HZ). It is concluded that

1) Thermal Conductivity of Alumina (Alpha) Nanofluid with base fluid Lubricating oil (160-HZ) is very much higher than Thermal Conductivity of Lubricating oil (160-HZ).
2) Absorption Ratio of Alumina (Alpha) Nanofluid with base fluid Lubricating oil (160-HZ) is higher Than the Absorption Ratio of Lubricating oil (160-HZ).
3) Volume Concentration of Alumina (Alpha) Nanofluid with base fluid Lubricating oil (160-HZ) at different Temperature is higher than the volume concentration of Lubricating oil (160-HZ).

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