

EXPERIMENTAL STUDY OF THE COMPARISON OF THERMAL CONDUCTIVITY OF Al_2O_3 -ALPHA & Al_2O_3 -GAMMA NANOFLUID WITH LUBRICATING OIL (160-SZ) .

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ABSTRACT : Miracles Fluid or Nanofluids comes under advanced kind of working fluid that attracts special attention due to their capabilities in heat transfer enhancement. Nanofluids or Miracles fluids consist of ultra fine particles (1-100 nm) it is so small like salt or powder but their unique property is that each of their particles is disperse from each other. Nanofluids are mixed with base fluid like water, Lubricating oil due to their ultra fine particle size (1-100) nm in diameter. An experimental investigation has been done at different temperature range (30-70°C) with varying different volume concentration (0.1% to 5%), with 20 nm size of Al_2O_3 (Gamma) & Al_2O_3 (Alpha) nanoparticles to study the behaviour of Thermal conductivity of Nanofluids and compare it with the base fluid i.e Lubricating oil.(160-SZ.)

KEYWORDS – Nanoparticles, Thermal Conductivity, Lubricating oil(160-SZ).

I. Introduction

The discovery of Miracles lead to the formation of Nanoparticles. Year 1995 has been termed as the year of Nanoparticles when Stephen Choi and his team introduced nanofluid. Nanofluids is defined by them as a promising fluid that produces heat transfer fluid that shows excellent Thermal properties high surface area, to those of their host fluid or simple conventional fluid. Now the question arises what is nanofluid, why are they so special, what makes them different from other fluids. The answer to this question is nanoparticles which is nanometer sized particles. The size of nanoparticle is about 1 to 100 nm in size. It consists 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. This unique property of nanofluid technology makes this field a very hot burning topic for the research scholars where all the three fields nanoscience, nanotechnology and thermal engineering meet. The nanoparticle used in nanofluids are metals, oxides, carbides with base fluid include lubricating oil, refrigerant and mainly water. What makes these fluids a great fluid is that they are superior thermal conductivity that enhances excellent thermal properties and excellent heat transfer rates. **Main** Aim of Nanofluids to achieve the highest thermal properties at very small, all to small volume concentration. It starts from 0.01%, 0.02%, 0.03% etc. In this way highest thermal properties are achieved by using small to small volume concentration. It is possible due to their superior thermal properties as compared to their base fluids like water, Lubricating oil (160-SZ), Kerosene and different fluids etc. These great quality of extreme thermal conductivity in

various small possible concentration makes this fluid a great and superior as compared to other fluid. In refrigeration and air conditioning it enhances extreme Thermal conductivity properties which makes its efficiency or COP extent to a greater extent. Various Refrigerant Like R1345A, R404a, R410 a mixes with different nanoparticles eventually they become Nanorefrigerant (Nanoparticles + Refrigerant) which enhances their COP as compared to their Refrigerant.

II. LITERATURE REVIEW

Sarah sampson Et.al Published paper on enhancing Thermal Conductivity by using various parameters.

Shri Harjendo Et.al (2) Published paper on characterisation of nanofluid by using Quench Medium.

Rudrdeep goutam Et.al (3) Discuss studies of nanofluid in various cooling system.

Digilo Et.al (4) Discuss Nanofluid in vertical Single tube by discussing various parameters.

Z.said Et.al (5) discuss nanofluids in turbulotors

KM Nihaal[6] Et.al .Analysis of Hybrid nanoparticles by using flow equation.

SAA Shah [7] Et.al studied Non Newtonian nanofluid.

PK DAS Et.al (8) Present a paper on the Stability of Nanofluid Preparation and application.

Zheng Et.al(9) : Studied Absorbance ratio of Alumina (gamma) Nanofluid.

Z.SAID ET.AL (10) Nanaofluid turbulators and novel working of fluids.

H.R Behrami Et.al (11) Presnted paper on review, cost and environmental impact of Nanofluids.

B.Devakki Et.al (12) Prediction of Properties And Stabilities Of Nanofluids Using Artificial Neural Network

S.Muynne Et.al (13) Discuss Thermophysical properties of Nanofluid with their base fluid.

A.samanta Et.al (14) Presented paper on Mathematical modelling on Nusselt number studied Copper Nnanofluid Lubricating oil

K.Ghacham Et.al (15) Studied MHD flow and Thermal analysis of Copper and Aluminium oxide Nanofluids.

III. PREPARATION OF NANOFLUID

Different types of methods are used in the 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 nanboparticles in a simulteanous way.. In this methods 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. Choi and Eastman produced this method in 2001 . it is used in small scale Nanoproduction. In this Experimental work Single step method is used due to its unique properties.

TWO STEP METHOD :

This method is commonly used world wide as it is the 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 effeciency of nanofluids

- a) High shear
- b) Ultrasonication
- c) Microemulsion

These preparation 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, capabillies ans superior heat transfer. These methods are based on Nanofluid structure , shape and base fluid. For example most nanofluid with base fluid water and are prepared by ONE STEP METHOD While those of Lubricating oil like (160-SZ), (160-SO), (160-SZ) and kersone oil are prepared 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.

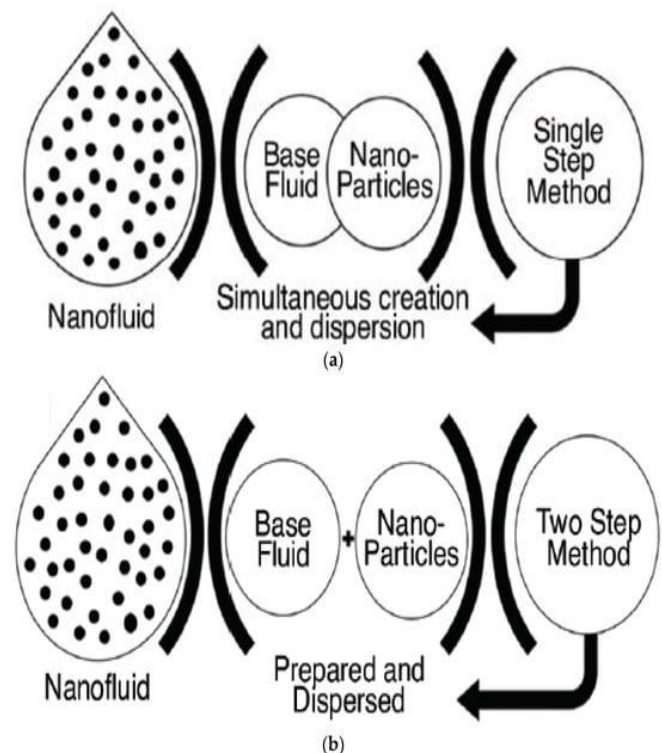


FIG :1

FIG 1 SHOWS SINGLE STEP AND DOUBLE STEP NANOFLUID METHOD

Fig a shows layout of single step and double step method. Single step shows dispersion and creation in a simultaneous way . Fig b shows Preparation 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 is 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 ± 5 mv .

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 ± 61 mv.

2) SURFACTANTS :

These are the stabilizing agent to prevent nanoparticles agglomeration 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_2O_3 water, CuO Water, Al_2O_3 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 and density. These surfactants when added to the

nanofluid the chances of agglomeration and coagulation of nanoparticles decreases gradually.

Surfactants can be classified as

- 1) Anionic surfactants
- 2,) Ammonium and amines
- 3) sodium dodecyl sulphates

III) Ultraviolet-Visible Spectroscopy:

It increase the stability of nanofluid by calculating the absorbence . It is the modern method . It is based on principle that absorbence is directly proportional to the fluid tested via it's concentration. It is based on beer lambert law.Single-step method and two-step method 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 combination. 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 are carried by one step method. The single step method simultaneously makes and diisperses nanoparticles directly into base fluids. In this methods 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 is 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 (160-SZ) nanofluid is prepared by two step method

Table 1: Properties of Nanoparticle

Particle	Aluminium Oxide nanopowder (Al_2O_3)(Alpha)	Aluminium Oxide nanopowder (Al_2O_3)(Gamma)
Avg. particle diameter	20 nm (gamma)	20 nm (gamma)
Density	3950 Kg/m ³	38800 Kg/m ³
Purity	99.99%	99.99%
Colour	Ivory/White	/White
Crystal Structure	Hexagonal	Porous structure
Ph value	7-9	7-9
Surface Area	Low Surface Area	High Surface Area
Applications	Wear Resistant part, Cutting tool	Catlatic Support, Adsorption

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.

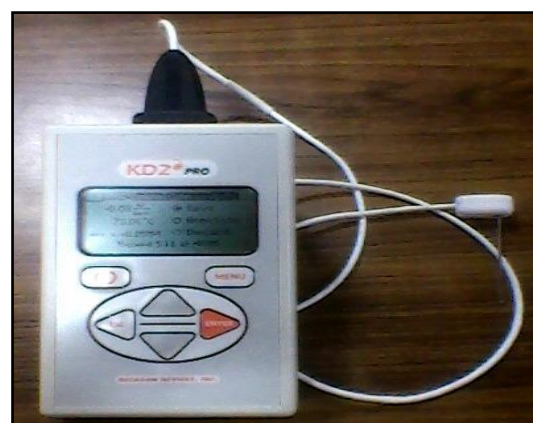


Fig 2: KD2 PRO METHOD

The thermal conductivity and resistivity is measured by single needle sensors while the dual needle sensors determines Specific heat, Thermal diffusivity etc. FeiDuan [7] and 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/m².

VI. Stability of Alumina Nanofluid

The preparation and stability of these lubricant and nanoparticles 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 procedure is used. The Alumina(Alpha) & Alumina (Gamma) 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)& Alumina (Gamma) nanofluids in lubricating oil (160- SZ) 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- SZ). Then, take 60 ml lubricating oil in a beaker, and pour the calculated amount of alumina Alpha and alumina gamma 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 dispersed 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 nanofluid 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 with base fluid Lubricating oil (160-sz) and Alumina gamma Nanofluid with base fluid lubricating oil (160-sz) have gone to sonication for 3 hrs for



Fig 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 does not 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. Results and discussion

The Thermal conductivity of Alumina (Alpha,) and Alumina (Gamma) with base fluid lubricating oil (160sz) has been compared with different volume concentration (0.1, 0.25, 0.5, 1% , 2% , 3% 5%) to shows that which Alumina (Alpha) nanofluid or Alumina (Gamma) nanofluid has better Thermal conductivity with base fluid lubricating oil (160-sz). The Various graph shows the thermal conductivity of the different volume concentration of Alumina (Alpha)& Alumina (Gamma) nanoparticles mixed with the base fluid (160- SZ) i.e. Lubricating oil.

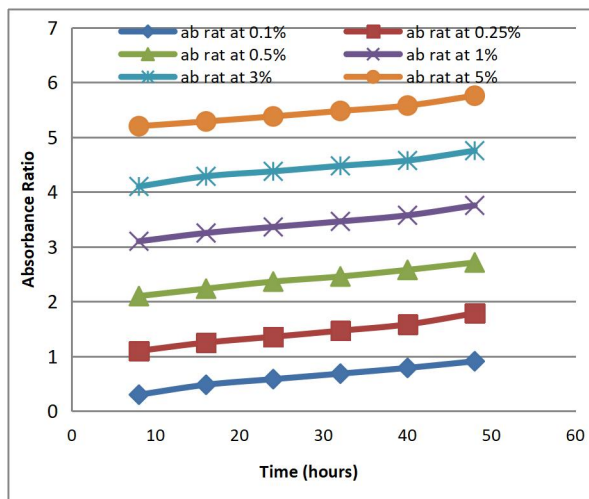
GRAPH 1 ABSORBANCE RATIO :

GRAPH 1 & GRAPH II SHOWS ABSORBENCE RATIO of Alumin (Alpha) and Alumina (Gamma) nanofluid with lubricating oil (160sz) .

Graph 1 shows the characteristics of suspension of different volume concentration of Alumina an particles mixed with the lubricating oil(160-SZ).It indicates the ratios of absorbence of the sample with different concentration of alumina (Alpha) &(Gamma) Nanofluid with base fluid l;ubricating oil (160-sz) the characteristics of suspension of different volume concentration of Alumina Nanoparticle mixed with the lubricating oil(160-SZ). It indicates the ratios of absorbence of the samples with different concentration of alumina nanoparticles measure every 12 hour with the 48 hours stay

to the initial absorbance of the corresponding Samples.

Graphs shows that Absorbance ratio of Alumina (Gamma) nanofluid has much absorbance as compared to Alumina (Alpha) Nanofluid .

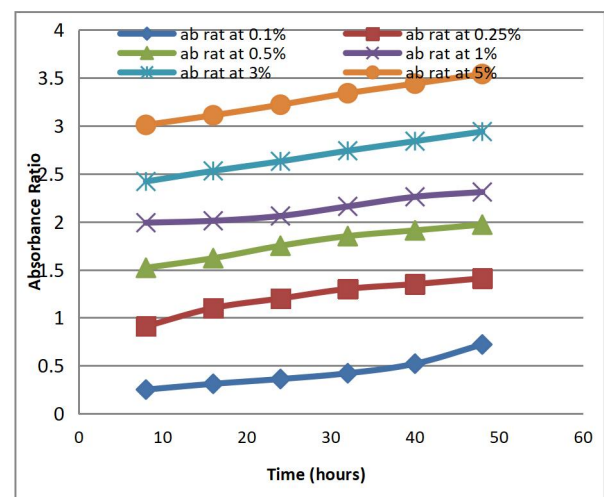


GRAPH 1

ABSORBANCE RATIO OF ALUMINA (GAMMA) NANOFLUID WITH RESPECT TO TIME

Graph I shows the characteristics of suspension of different volume concentration of alumina nanoparticles mixed with the lubricating oil (160-SZ). It indicates the ratios of absorbance of the samples with different concentration of alumina nanoparticles measured every 12 hours within the 48 hours stay to the initial absorbance of the corresponding samples. The graph in the figure 8 shows that the absorbance ratio for 0.1% concentration goes to 0.3 to 0.91, similarly the absorbance

ratio for 0.25% concentration goes to 1.1 to 1.785. The absorbance ratio for 0.5%, 1%, 3% and 5% volume concentration goes to 2.1 to 2.713, 3.1 to 3.754, 4.1 to 4.753, and 5.2 to 5.756. It is observed that the absorbance ratio varies with time for the sample of 0.1% to 3% under the condition with no surfactant added. Beside it is found that no powdered is gathered to deposit. It indicates that the absorbance ratio of nanoparticles increased with the increased in particle volume concentration.



Graph II

ABSORBANCE RATIO OF ALUMINA (ALPHA) NANOFLUID WITH RESPECT TO TIME

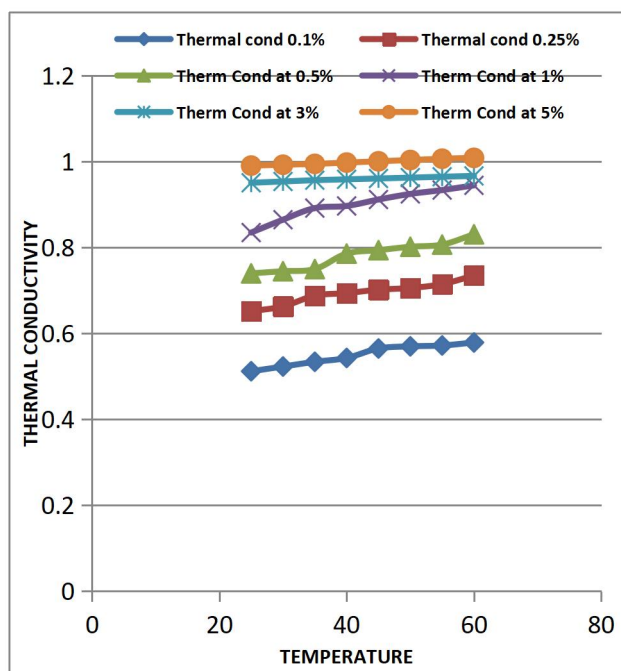
The graph in the figure 8 shows that the absorbance ratio for 0.1% concentration goes to 0.25 to 0.72, similarly the absorbance ratio for 0.25% concentration goes to 0.91 to 1.41. Absorbance ratio of 0.5% goes from 1.52 to 1.97. Absorbance ratio for 1 % goes from

1.99 to 2.31. Absorbance ratio for 3 & 5% goes from 2.42 to 2.94 and 3.01 to 3.54

So from the Graph 1 and Graph 2 it is observed that the Absorbance ratio of Alumina (Gamma) Nanofluid with base fluid lubricating oil (160-sz) is better than Alumina (Alpha) Nanofluid with base fluid lubricating oil (160-sz) due to the following reasons :

- 1) Alumina (Gamma) nanofluid has a higher surface area due to its porous structure which enhances Absorption efficiency.
- 2) Alumina (Gamma) nanofluid has a higher surface area due to its orientation structure that lead to the heat absorption property.
- 3) Surface property In Alumina (Gamma) nanofluid it has a porous active surface that has an edge for the better absorption property.
- 4) Alumina (Gamma) nanofluid has a rhombohedral structural that leads to higher surface area which enhances Absorption in a better way.:

COMPARISON OF THERMAL CONDUCTIVITY OF ALUMINA (ALPHA) AND ALUMINA (GAMMA) NANOFLUID WITH LUBRICATING OIL 160-SZ.



GRAPH III

GRAPH III SHOWS THERMAL CONDUCTIVITY VS TEMPERATURE OF ALUMINA (ALPHA) NANOFLUID WITH LUBRICATING OIL 160-SZ

Thermal conductivity at Temperature range from 25 to 60° degree via volume concentration 0.1% ranges from 0.512 to 0.579.

Thermal conductivity at temperature range 25 to 60° via volume concentration 0.25 goes from 0.652 to 0.735.

At 0.50 volume concentration with same temperature value of Thermal conductivity goes from 0.74 to 0.831.

AT 1% volume and 3% volume concentration thermal conductivity goes from 0.835 to 0.945 & 0.951 to 0.967.

Thermal conductivity at 5% volume concentration with temperature range from 25 to 60°. 0.991 to 1.009

REASON FOR THIS THERMAL CONDUCTIVITY of ALUMINA (ALPHA) NANOFLUID :

- 1) **Concentration** : Higher concentration or weight percentage generally lead 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 .

in thermal conductivity is from 0.832 to 0.895

Thermal conductivity at 5% volume concentration for the temperature range from 25 to 60° result of thermal conductivity is falls between 0.912 to 0.98.

GRAPH III SHOWS THERMAL CONDUCTIVITY VS TEMPERATURE OF ALUMINA (ALPHA) NANOFLUID WITH LUBRICATING OIL 160-SZ.

So from Graph iii It is concluded that Thermal Conductivity of Alumina (Alpha) nanofluid at various volume concentration starting from 0.1 to 5% Volume concentration. Graph result shows that it exhibit excellent Thermal conductivity properties . With the increase of volume concentration The graph of Thermal conductivity increases with volume concentration. Different parameters like Concentration, Particle size, Temperature exhibit to enhancement of Thermal conductivity.

Graph IV Shows THERMAL CONDUCTIVITY VS TEMPERATURE OF ALUMINA (GAMMA) NANOFLUID WITH LUBRICATING OIL 160-SZ.

Thermal conductivity at Temperature range 25 to 60 degree for volume cocentartion 0.1% falls between 0.502 to 0.569.

Similarly Thermal conductivity at 0.25% vol concentration from temp 25 to 60° range between 0.602 to 0.661.

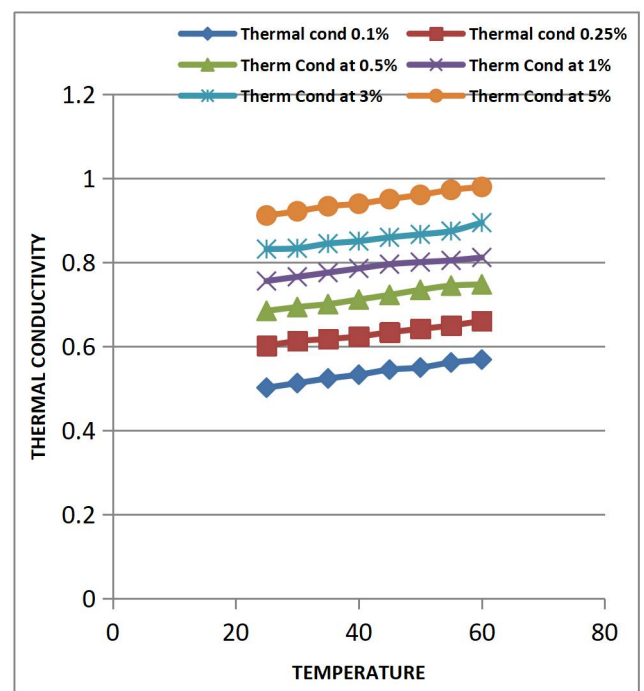
For volume concentration 0.5% Range of Thermal conductivity ranges from 0.685 to 0.748.

At 1% Volume concentration at temp range from 25 to 60 degree Thermal conductivity varies to 0.756 to 0.812.

At 3% Volume concentration and the temperatrure range from 25 to 60° variation

From The Graph 3rd and 4th it is observed that the Thermal conductivity of Alumina (ALPHA) Nanofluid with Lubricating oil (160-SZ) is better than Thermal Conductivity of Alumina (gamma) nanofluid With Lubricating oil (160-SZ). There are certain reasons for it

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



GRAPH IV

GRAPH IV SHOWS THERMAL CONDUCTIVITY VS TEMPERATURE OF ALUMINA (GAMMA) NANOFLUID WITH LUBRICATING OIL 160-SZ.

- 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 dispersed into surfactants. The addition of surfactants to the nanofluid generally increase Thermal conductivity. Result shows that Alumina (Alpha) nanofluid with surfactants enhance 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) Nnanofluid.

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

agglomeration that leads to enhancement in Thermal conductivity.

5) **PREPARATION METHOD :**

Preparation method plays a vital role in enhancement of Thermal Conductivity . One step method has a greater tendency 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 agglomeration that leads to great Thermal conductivity.

VII. Conclusions

After performing this experiment it is concluded :

- 1) Absorbance ratio of Alumina (Gamma) Nanofluid with lubricating oil (160-SZ) is higher than the Absorbance ratio of Alumina (ALPHA) Nanofluid with Lubricating oil (160-sz). This is due to Alumina (Gamma) nanofluid has a higher surface value to its porous structure which enhances Absorption efficiency.
- 2) Alumina (Gamma) nanofluid with lubricating oil (160-sz) has a higher surface are due to its orientation structure that lead to the heat absorption property.
- 3) Surface property In Alumina (Gamma) nanofluid it has a porous active surface that has an edge for the better absorption property.
- 4) Alumina (Gamma) nanofluid with base fluid lubricating oil (160-sz) has a

rhombohedral structural that leads to higher surface area which enhances Absorption in a better way.:

The variation in Absorption Ratio in Alumina (Gamma) Nanofluid with base fluid (160-sz) as compared to Alumina (Alpha) Nanofluid with base fluid lubricating oil (160-sz) is of 10%, sometimes it is of 11%.etc. It clears from the experiment that Absorption ratio of Alumina (Gamma) nanofluid is better than Absorption ratio of Alumina (Alpha) nanofluid.

It is Also Concluded that the Thermal conductivity of Alumina (ALPHA) Nanofluid with base fluid lubricating oil (160-sz) is better than Thermal Conductivity of Alumina (gamma) nanofluid with base fluid lubricating oil (160-sz). There are certain reasons for it .

1) **Structure** : Alumina (ALPHA) Nanofluid with base fluid lubricating oil (160-sz) has a Solid structure as compared to Alumina (Gamma) nanofluid with lubricating oil (160-sz) that inherit thermal properties which result in better heat transfer enhancement.

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

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5) **Preparation Method** : Two step method lead to better Thermal conductivity due to its surface absorption, easiness for base fluid etc.

So from the Experimental Investigation it is concluded that Thermal conductivity of Alumina (ALPHA) Nanofluid is better than Alumina (Gamma) Nanofluid,

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