Investigating the Effect of Nano -Alumina and Nano graphic (Diamond) On performance Turbine

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Abstract

In the present study, the effect of nano -alumina and nanograph additives on the performance optimization and improvement of fluid characteristics was investigated by the turbine denial. In this study, nanoparticles were 0.5, 0.5, 0.75, 1, 1 percentage. The variety of nanoparticles was evaluated by the scanning electron microscopy (SEM) and the passing electron microscopy (TEM).,
The results indicate that the thermal properties of the base oil and thus the fluid of the base oil will be improved by the addition of nano particles in the volume. Given the function of the turbine lubrication fluid, increasing the surface tension of the fluid helps to improve its performance in the coating of surfaces against friction.
The phases of the nanoparticles were diagnosed by X -ray beam analysis (XRD). The thermal conductivity. Surface tension and dynamic viscosity of hybrid nanoparticles were measured and compared to the base fluid.
As a result, it enhances fluid performance. Based on the results of the Dynamics of Dynamics of Hybrid Nanocyte Basic Oil/ Nanographic - Nano -Alumina, Adding nanoparticles during the volume fraction of 0 to 0.5 %, more on increased viscosity, non -neyotenic behavior, non -diluted thinning. The main function of the turbine fluid maintains, and the hybrid nanoparticles are leaned for non -uninhilated behavior. Therefore, adding these two types of nanoparticles in volume fraction of 0.5 % to strengthen the fluid function. it helps.

Keywords: Lubricant Nano Fluid, Hybrid Nano, Nanoparticles Al2O3. Nano -graphene plate

: First type (32 -typee), second type 46 type), third type (64 -Type) and fourth type (100 -Type)
Hybrid nano -fluid by adding particles in nano -nanometers (100 nm) to the base quality used in the turbine aimed at improving heat transfer as well as reducing friction and abrasion, which is the main cause of rolling motion and thin strip on the fluid flow surface in the turbine. , Achieved . Be. Mixed solids are solid -liquid that contains a base fluid and nano particles
One of the applications of nanofibers is the use in heat conductivity applications. Research shows that the thermal conductivity coefficient of nanocrystals is significantly increased compared to conventional fluids. This behavior has factors such as nanoparticles, size distribution and volume fraction, temperature, thermal conductivity coefficient of nanoparticles and base fluid.
Various studies show that the smaller nanoparticles increase in the thermal conductivity of the nanoparticles by increasing the nanoparticles. .

The thermal conductivity of nanocvings and their bronch movements with rising temperatures, over the past decade, has been specifically investigated. This has been taken into consideration by using nano -system systems for various applications. Nanocyte viscosity is very important in the heat transfer issues. However, further research, especially in order to increase heat transfer rate, is conducted at medium and high temperatures. It's been. In this study, for the first time, using nano -additives, the possibility of improving the properties and rheology of the turbine lubrication fluid was investigated.

The effects of nanotechnologies (compatible with the inner body of the turbine), including the fi and plum -mined, were studied on the base fluid containing a mixture of 40: 60 % volume. Based on study information

There is no basis on the nano-nano-nanographic hybrid nanocrystry system. Therefore, by studying other research on the field of nanoparticles, the nanoparticles are partially determined by nanoparticles.

- 1 - Nanosyal preparation

The first step in the present study is to prepare the nano -nanoparticles and suspension of nanoparticles within the basic fluid. The two -step method is used in this study to prepare nanosyal. To do it, they are less likely to have sustainable and homogeneous samples. There are ways to prevent this phenomenon. Surfactant is one of the use of research methods in this field. In this study, in laboratory studies, the synthesized hybrid oil fluid was studied as a base fluid. The base of the vegetable oil or lubricant of the grade 46 synthesized with 50: 50 percent volume ratio at 800 Kelvin was considered as the base fluid. Sulfonate (SDS) was added to the base fluid as surfactant for stabilization and dispersion of nanoparticles.

Table 1 - Specifications of oleic acid

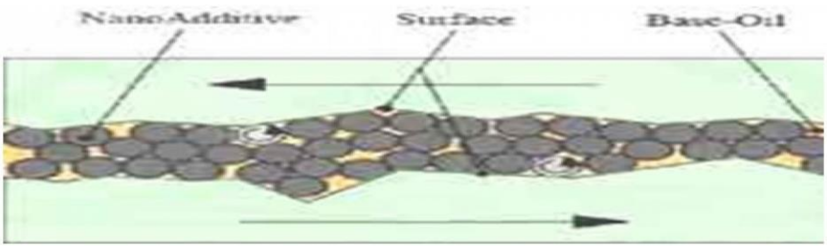
the amount of	characteristic
C 18 H 34 O 2	chemical formula
K 15/286	melting point
K 15/277	Freezing point
1 ± 293/15K	Clouding point10
1 ± 273/15K	Drop point11
38/80 mPa.s	viscosity

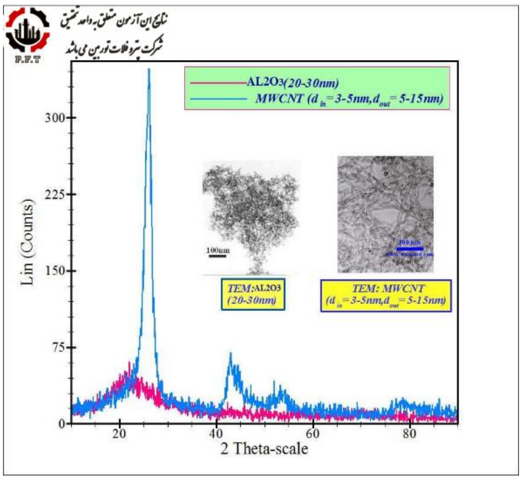
Nanoparticles in this study, 0.25, 0.5, 0.75, 1, volumetric percentage, and also to test the effects of the temperature, temperatures tested during the temperature range of 392 - 352 Kelvin. The nanoparticles consisting of equal volumes of Nano -alumina and graphene were suspended in a certain amount of synthesized oil base. The required company of 3 AL2O3 and graphene nanoparticles was obtained for the preparation of nanoparticle samples of equation 1:

m p / ρ p

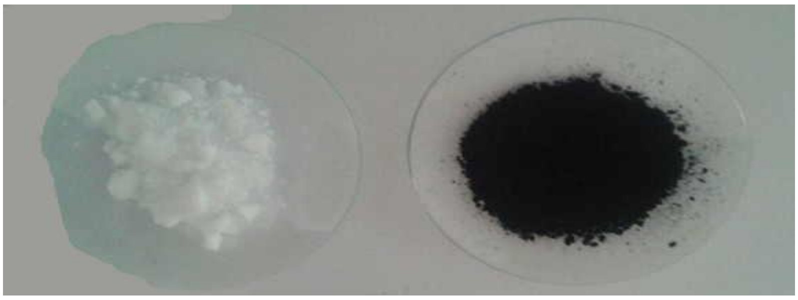
φ = m p × 100 (1)
+ V bf

Where the volume percentage of nanoparticles (the total volume of alumina and graphene nanoparticles), the density is in weight in cubic meters and w in water. Hybrid nanosyal liters are calculated and reported in Table 2. Surfactant - It was fixed for all examples. In the present study, nanoparticles were prepared using two -stage method. In this method, the nanoparticles or other nanomaterials that are to be scattered in the fluid are prepared in the form of dry powders and subsequently nano. Production is scattered inside the fluid. Direction





characteristics of	graphene	AL2O3	used lubricant/EG
Size, nm	-	13	-
Color	black	white	+ yellow white
Thickness, nm	5	-	-
land per ,‹ Density meter3^3	2200	4000	-



2 - The characteristic of nanoparticles

It was used to identify the phases of the XRD with 01 and 04 kV voltage, 52 and 30 ml of amps, 1.45 angstrom and copper cathode lamp and nickel filter. The device used is the Philips PW1730. For this purpose, samples intended for fuzzy and surface reviews have been analyzed.
Finally, the X -ray pattern is prepared from the surface of the samples and is based on the identification pattern obtained from the phases using standard cards.
From the Vega Electron Microscopy (SEM) Model Vega Tuscany, Majr -Haza to Inca Oxford) EDS)
Were used to investigate and shed the size of the nanoparticles. The output of this analysis is images that can be used at better topographic level. The device used to make this analysis is TE-SCAN and is of great accuracy. The images obtained from the analysis of the transcript electron microscopy (TEM) were used to investigate the microstructure of the nanoparticles. The device used for this analysis is Philips CM120.

2 - 3 - 1 - Nanosyal Stability Analysis

In this study, Zeta's potential was used as one of the stability evaluation methods. Nanocya was used. Hybrid nanoparticles at 892 Kelvin temperatures were made using Zetasizer Nano SZ100, written by Huriba Japan.

2 - 3 - 2 - Measurement of thermal conductivity coefficient

In this study, the KD2 Pro thermal analizer and KS-1 sensor were used to determine the nano-heating coefficient. The device was equipped with a water bath to keep the temperature constant as well as the water circulation around the double-walled container. The KS-1 sensor was selected with a diameter of 1.3 mm and 60 mm in length. By selecting this sensor, the nanoparticular thermal conductivity rate (W / (MK 20/20 to W / (MK) 2/2 Carefully

(W / (MK 0.01 0.01 was measured.
Prior to measuring the thermal conductivity of the hybrid nanoparticles, the calibration of the machine was performed to accurately measure the nanosyal thermal conductivity. To ensure the accuracy of the KD2 Pro tool, before measuring the thermal level of hybrid nanocrystals, the ethylene glycol heating compound was measured by KD2 Pro at different temperatures and compared to the data provided in Ashrae. In the aforementioned range, the thermal conductivity of the base fluid, which is designated to the laboratory, corresponds to the ASHRAE data and the minor difference (less than 0.5 %) is observed with the data. As a result, the device's error rate is acceptable in the range. The report was reported.

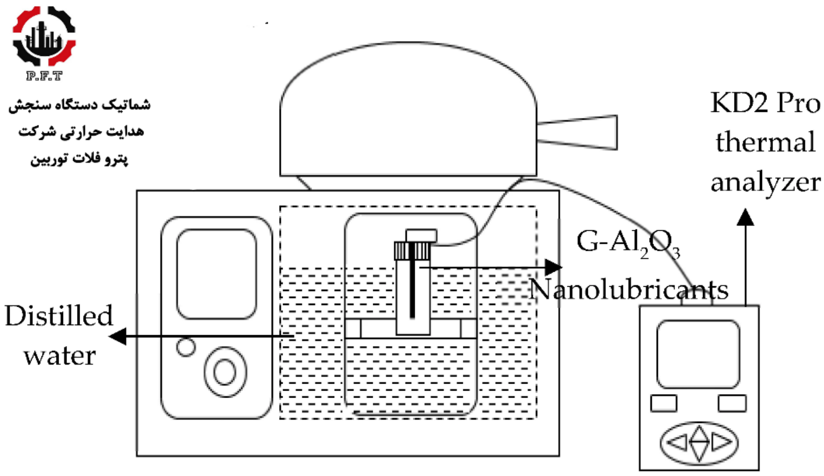


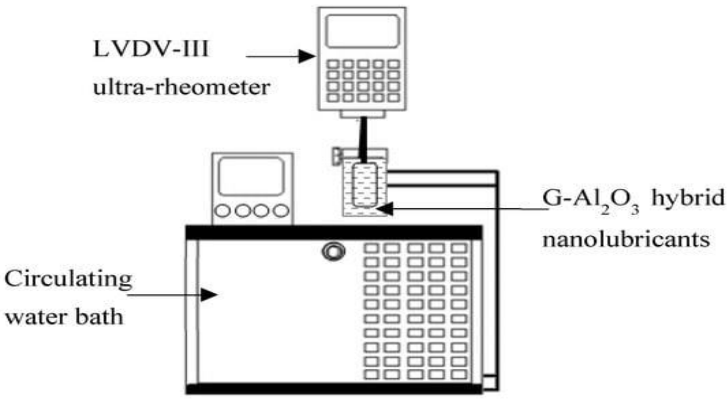
Figure 4. Schematic of
heat conduction measurement

2 - 3 - 3 - Measurement of Nanosyal Visco

The viscosity of hybrid nanoparticles was measured by solid volume fraction from 0.5 to 2 percent in the temperature range from 263 to 303.19 Kelvin. A brukfield viscometer with a clear tank was used to measure nanocrystallic viscosity in the cut range of 0.3 rpm to 70 rpm. The repetition and accuracy of the viscometers are 0.2 and 1 0.1, respectively. _

Prior to using a viscosity to measure the dynamic viscosity of hybrid nanoparticles, viscometers were tested with pure water mixture and ethylenglicol at different temperatures. There is a logical match between measured data and report data written in the Ashrae source.

Ashrae data and experimental data in this study is less than 2 %.



Surface nano -fluid stretching measurement

In the present study, the surface tension of the nanofluids was measured using Surf-S1 equipment. The device was first adjusted and closed by measuring acetone surface tension at 892.51 Kelvin. The surface tension of the ready -made nanoparticles written at different temperatures from 852.51 to / 15 382 Kelvin was measured. Surface tension is measured at different temperatures using a chamber, which includes a fixed fixed chamber, water circulation bath and water chamber. It was taken. Any amount of reports on average is the result of three measurements with a non -definitive 0.1 mA per meter.

3. Results and Discussion

3 - 1 - Nanoparticles specified results

The X -ray pattern of the X -Mine Mine Powder nanoparticles is presented in Figure 1 with standard peaks. / 63 degrees, 54.83 degrees and 76.42 degrees at intervals of 2.627, 2.644, 1.699 and 1.93. These peaks correspond to the crystallography (220), (311), (400) and (440), respectively.

Using the Sherr Equation (equation 2), the crystal size is 12/1 nanometers for alumina nanoparticles:

.

= (2)

In which the X -ray wavelength, the peak width at half the maximum height (FWHM) and the 2 angle of the Bragg.

The XRD pattern of nano -graphene plates is shown in Figure 1 - B. A sharp and narrow peak at 62.24 degrees and some short peaks at 34.843 degrees, 484.45 degrees, 124.77 degrees and 478.83 ° C can be seen in the Graphene's XRD plants. 62/62 = θ with the interval of D = 370/3 å relates to the crystal plate (200) of the main characteristics of bread and graphene plates.

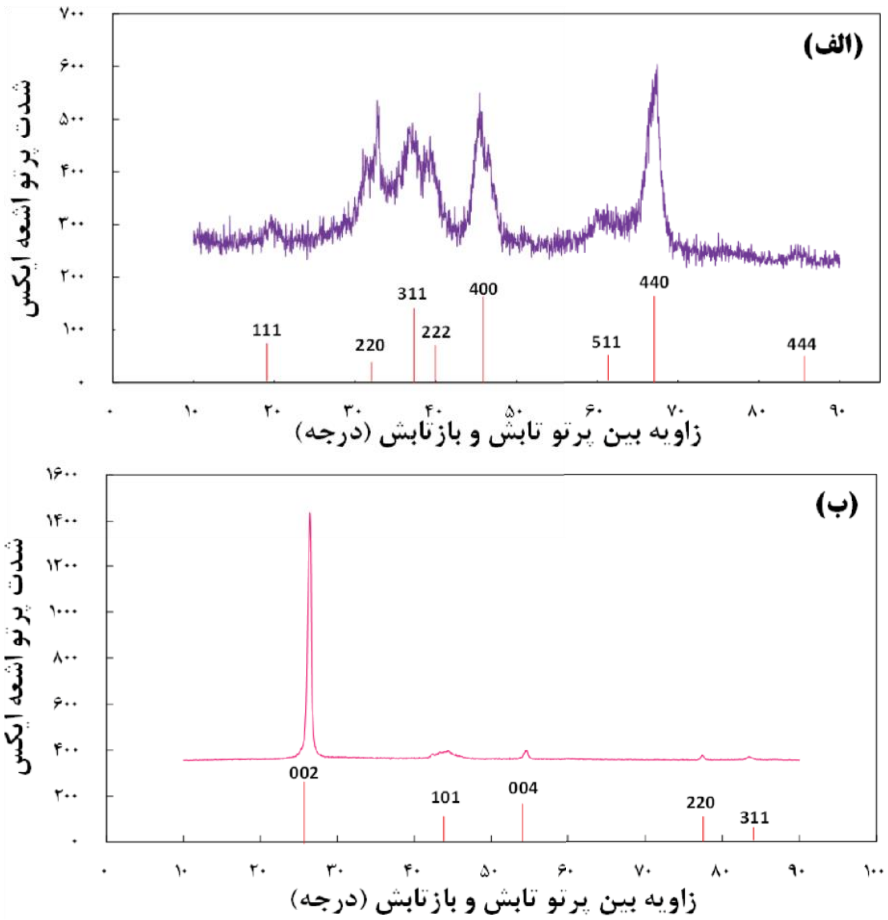
Nanoparticles ١٠ Al 2 O and graphene nano -plates were checked by SEM (figure 2).

Figure 2 shows the SEM image of nanoparticles al 2 o 3 - G.

As shown in this form, the form of aluminabe nanoparticles is more spherical. The form seen in Figure 2-A, the nano-powders are partially aglomra. The formation of particle accumulation (aglomination) is due to the surface to volume ratio of nanoparticles.

SEM observations

Figure 2 (B) indicates that graphene nanoparticles consist of short clapen layers of graphene.



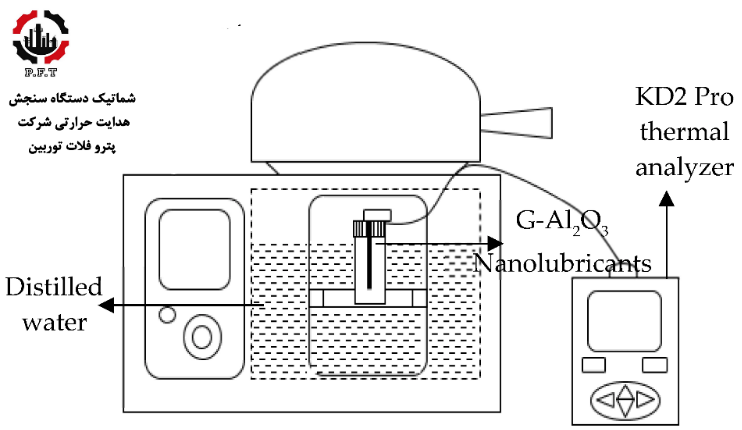
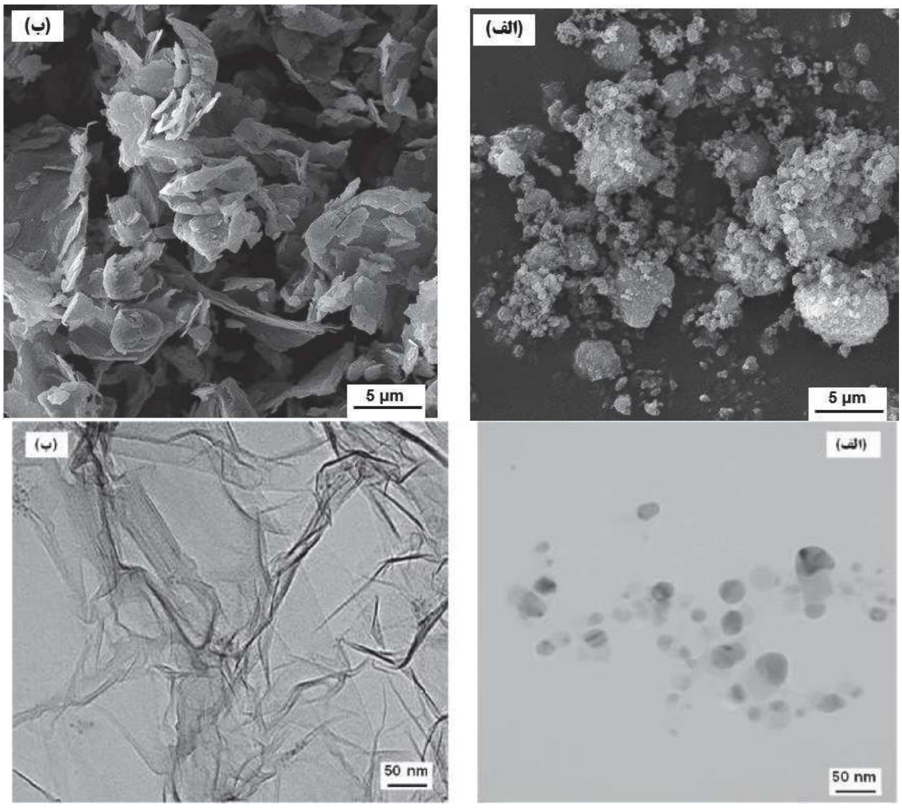


Figure 4. Schematic of
heat conduction measurement

Further reviews of nanotechnology size and shape were obtained using TEM images. TEM images of 3 γ -Al 2 o nanoparticles are shown in Fig. 3. All the spherical particle shows the provider.
Figure 2 - Pictures of electronic microscopy a) AL 2 o 3 -γ and b) graphene nanoparticles.

Figure 3 - TEM images of a) nanoparticles al 2 o 3 -γ and b) graphene nanoparticles.

Figure 3 -The TEM image is a fan -oriented nanopard that shows a lot of folds and wrinkles and the relentable brain, which represents the structure of the graph of the graph



3 - 2 - Nanosyal stability survey results

For sustainability - hybrid nanoparticles, Zeta's potential analysis was performed. The boundary of sustainability and instability of the suspension can be determined by Zeta's potential. Particles whose potential is more than 30 mg more or less than -0 -mV is stable [81].

The potential of hybrid nanoparticles is shown as a function of solid volume and time at 298 Kelvin in Figure 4.The mode is seen in Figure 4, the potential of hybrid zetineanocyes from - to -30 billion volts, which indicates acceptable nanoparticle stability and proper performance in preventing 1 nanoparticle.

In accordance with Figure 6 - Bus, the potential of nanoparticles decreases with increased time. Due to the gravity and movement of Brown, the nanotechnology is at the end of time in agroceral and formation.

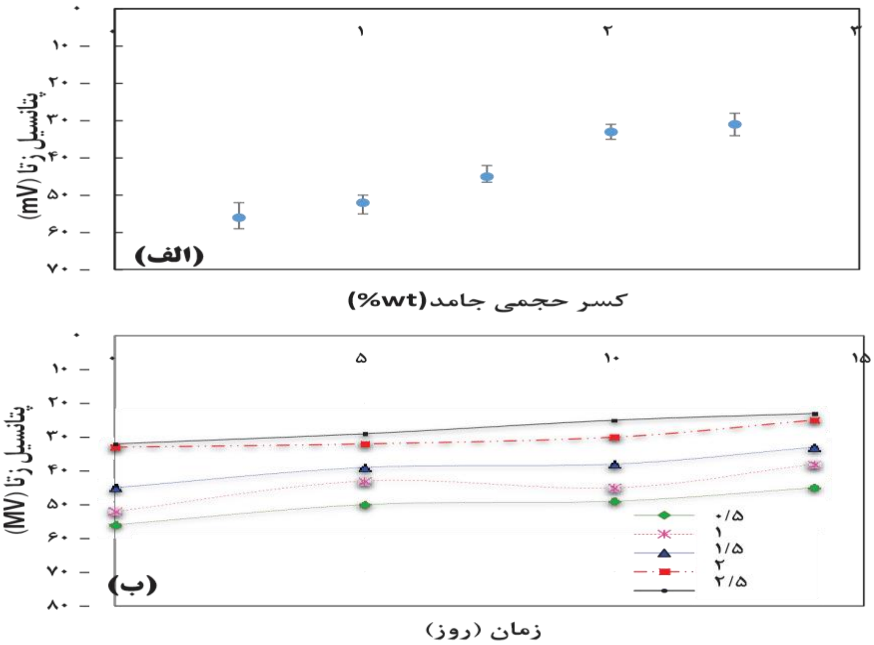
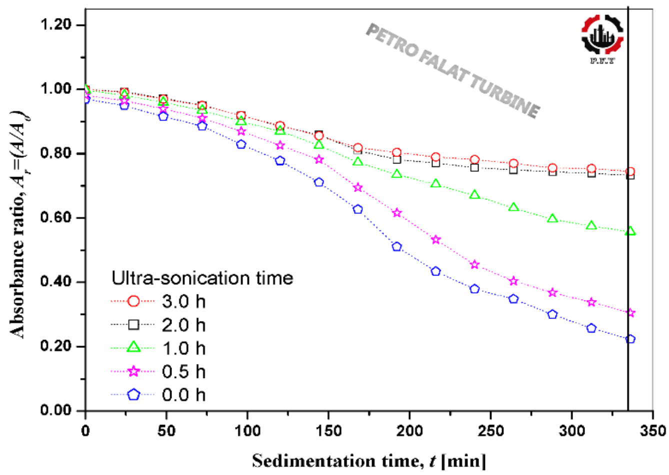


Figure 6 - The potential of hybrid nanoparticles in terms of a) a volumetric deduction and b) time



- 3 - The Nanosyan thermal measurement results

Nanosyal thermal conductivity, due to its high stability, particle size, and the intrinsic nature of thermal conductivity in the solids can be improved. For this reason, the application of the thermal converters is very suitable. In this study, the heat measurements of the hybrid nanoparticles in the temperature range of 273.51 to 303.51 Kelvin for subsidiaries with solid volumetric deduction of 0.5, 0.5, 0.75, 1, 1, The percentage was done.

Figure 7 shows the thermal conductivity of hybrid nanoparticles in terms of solid volume at different temperatures. Because this form is observed, Nano particular thermal conductivity increases with a volume deduction of nanoparticles. Assuming a uniform suspension, in the high volume of solid volume, the number of particles in a certain volume is higher than the hybrid nanoparticles and the distance between the solid particles in the

base fluid is lower than that. Are lower. As the temperature rises, the movement of the particle has increased, and the number of random collisions between the particles increases to increase the collision of nanoparticles. This increases the thermal of the base fluid. This increase is higher in hybrid nanoparticles. High particle distance prevents significant increase in thermal conductivity at the same time.

Increasing nanoparticles increases thermal conductivity, but on the other hand, it can cause the possibility of nanoparticles agrocers. The greater the accumulation of particles, the greater the composition

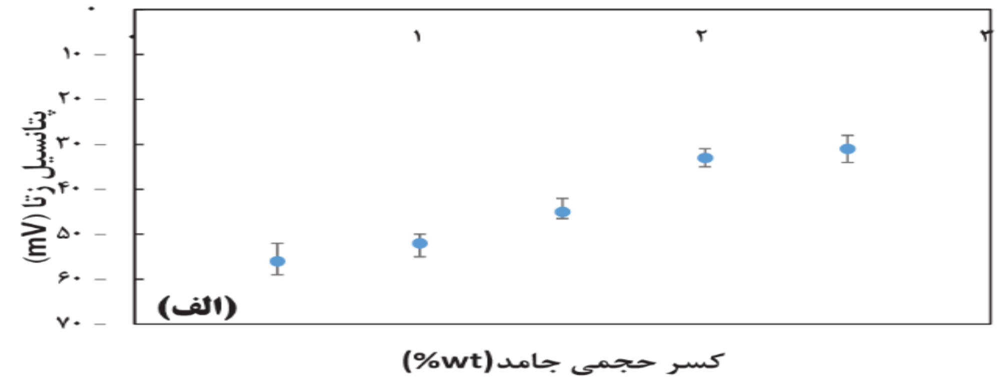
The chains increase and improve the thermal.

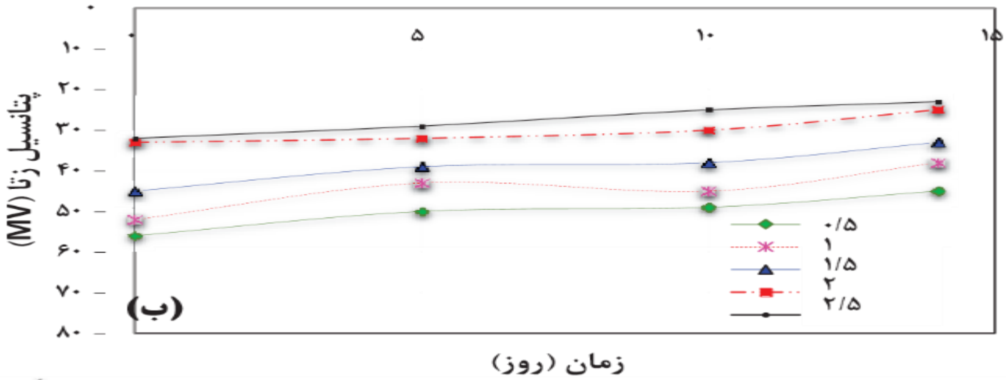
This increase exists as long as the nanosyal has a sustainable suspension of particles. The particles are attached to the compound and form their clusters that remain stable and precipitate it reduces the thermal coefficient.

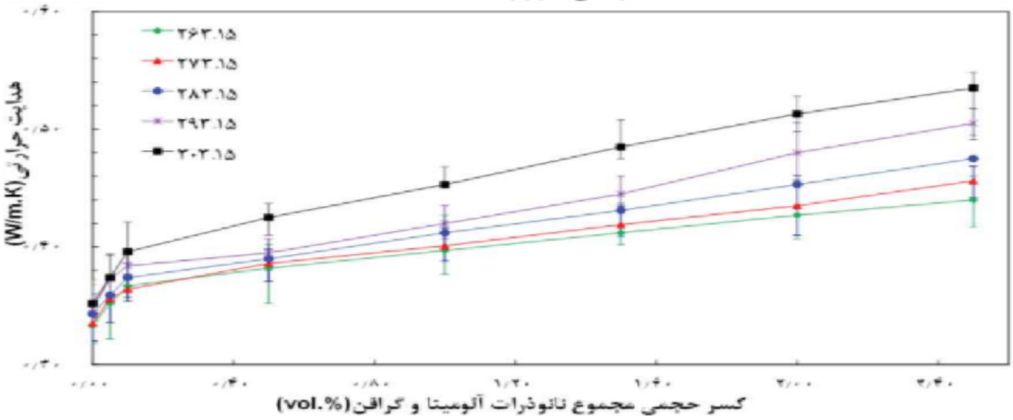
The nanoparticry aglomination reduces the thermal conductivity shown in Figure 7, with increased. Temperature increases heat. At higher temperatures, the slope of this change is greater. This means that at higher temperatures, the combined nanocyte thermal efficiency has improved. As can be seen in Figure 7, in higher solid volume fraction (1.2 % volume), the effect of temperature on guidance

The hybrid nanoparticular thermal is more significant. The thermal conductivity is based on bryonic movement and the collision between nano particles. There is a lot of temperature effects.

The Nano -Crafenant Nano -Allectamina thermal conductivity results indicate that the thermal conductivity properties and thus fluid performance by adding nanotechnology in the range of 0.5, 0.5, 0.75, 1, volume improvement. It points to this increase as long as it is clear that the main nanoparticle is possible, the sustainable suspension of particles.







3 - 4 - Viscidium Measurement Results

Measurements of hybrid nanopartic nanoparticitis dynamic viscosity were performed in the temperature range of 261.51 to 291.51 Kelvin for nanoparticles with a solid volume of 0.5, 0.5, 0.75, 1, 1, 1. To examine the viscosity of a hybrid nanoparticle, nanotechnology must first be studied.

Newtonian fluids adhere to Newton's viscosity law. Shear stress in this form of independent fluids is the amount of cut. Relation (3) its characteristic:

In which viscosity, shear tension and ! The incision rate is 1 - S. Non -uninholid liquids do not comply with Newton's law, and their shear tension has no linear relation to shear rates. Relationship (4)

For 1 ≠ n indicates non -Newtonian behavior:

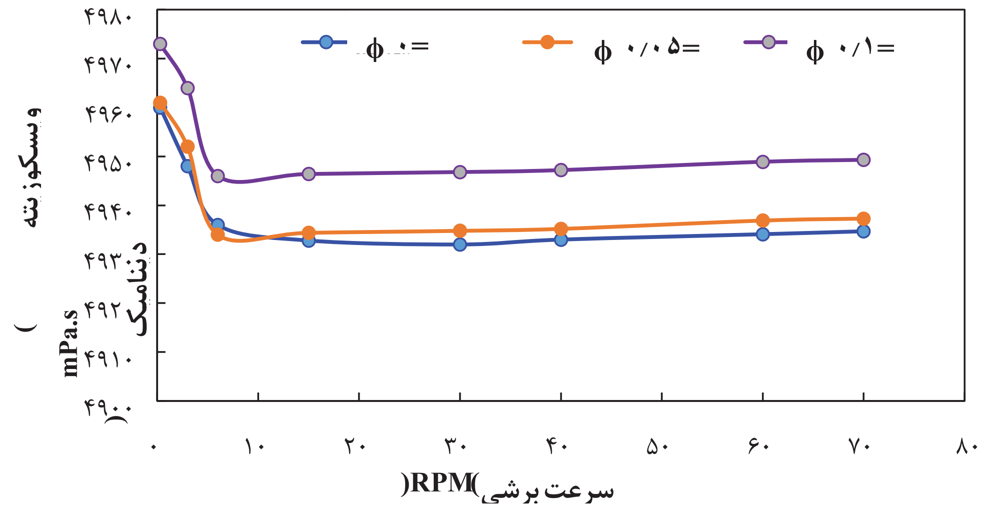
(3) ˙ = In which shear stress, ˙ cut rates, M is the index of fluid stability 2 and n ≠ 1) N) The current behavioral behavior index is 3. The thickening fluid of the cut is associated with n> 1. Figure 8 shows dynamic viscosity in terms of shear speed at 0 89 Kelvin for downloading different volumes. As you can see, in nanoparticles with a volume of 0 to 0.5 %, when the temperature is constant, the shear rate increases to nonlinear viscosity. It is indicative of the non -Newtonian behavior of the studied fluid. I can also get that the n is less than 1, which indicates that hybrid nanoparticles are high in the high cutting behavior. Examples show more than 5.0 % of different rooological behavior with solid volumes. In samples with a solid volume deduction of 0.5-5 %, the shear rate increases to relative increase in viscosity, and the hybrid nanoparticles show the sheer -throaching behavior.
According to the AMS 1428 Standard, the second type of lubricant (synthesized fluid synthesis in this study) is a non -neyotonian fluid of sodoplastic, which in order to survive, increase the number of nanoparticles (increased nanoparticles) reduces the distance

between nano -particles and the possibility of accumulating nano -particles can be accumulated. Become. With an increase in the volume of nanoparticles, the collision between the particles increases and the probability of aglumming is increased. Increases viscosity and constant fluid stability.
Adding nanoparticles even in low volume deduction to the base fluid can significantly increase viscosity. Become. Viscussia is the main factor in the transmission of movement between the layers of the fluid. Due to the interactions between nanotechnology and base fluid, with the addition of nano particles, the base fluid viscosity is increased. The effect of

nanoparticles on viscosity has been specifically studied. You should also keep in mind that the relationship between viscosity and nanoparticles is unclear.

Most of the existing empirical studies show that the increase in particles is increased by the increase in hybrid nanocoes. However, some reports claim that some compounds effect

They have lubrication and thereby reduce viscosity. be. It was found that the effect of lubrication is that it is less prominent [22].
Temperature is the most important and effective point in viscosity. As shown in Figure 9, nanoparticles decrease with increased temperature. This is because with the rise of temperature, the inter -molecular gravity between


ϕ ۰=
ϕ ۰/۰۵=
ϕ ۰/۱=
ویسکوزیته دینامیک (mPa.s)
۴۹۸۰
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۴۹۶۰
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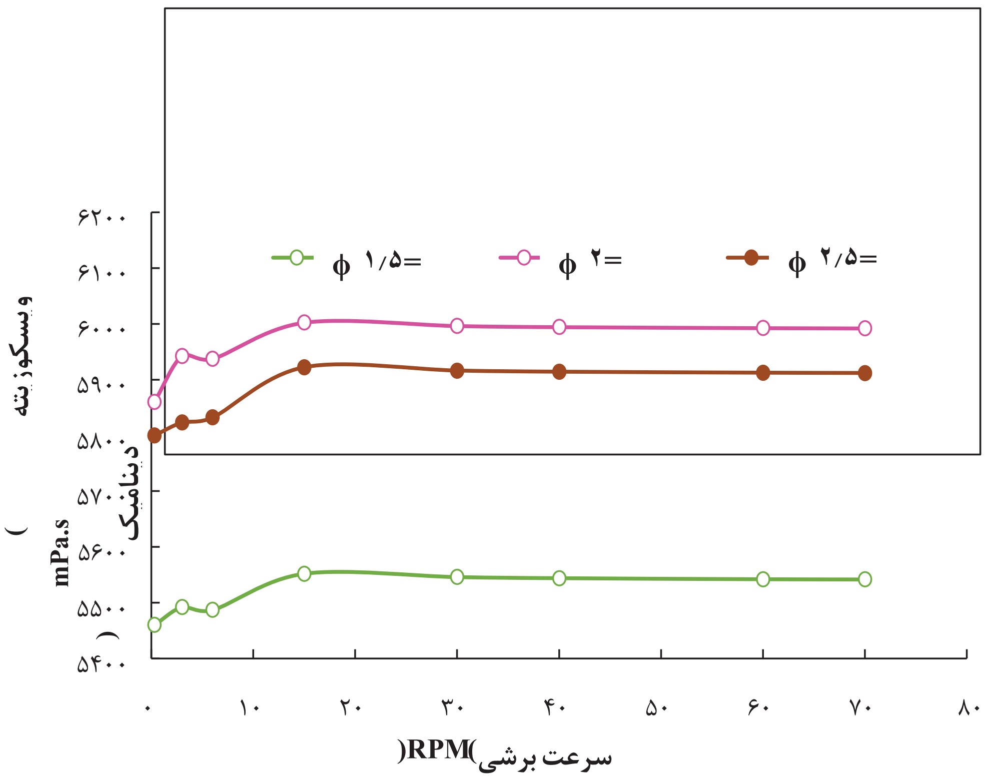
سرعت برشی (RPM)


ϕ ۱/۵=
ϕ ۲=
ϕ ۲/۵=
ویسکوزیته دینامیک (mPa.s)
۶۲۰۰
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سرعت برشی (RPM)

Figure 7 - Heat conductivity of hybrid nanoparticles in terms of solid volume at different temperatures

This increase exists as long as the Nanosyal has a sustainable suspension of particles. The particles are attached to the compound and form their clusters that remain stable and precipitate it reduces the thermal coefficient.
The nanoparticry agglomeration reduces the thermal conductivity shown in Figure 7, with increased. Temperature increases heat. At higher temperatures, the slope of this change is greater. This means that at higher temperatures, the combined nanocyte thermal efficiency has improved. As can be seen in Figure 7, in higher solid volume fraction (1.2 % volume), the effect of temperature on guidance

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In accordance with the AMS 1428 Standard [12] CIA

The internal surface of the turbine engine is designed to prevent it. This layer gradually develops a thin film over time and when the fluid circulation speed is objective. Don't have a turbine life. Adding nanoparticles in the volume fraction of 0 to 0.5 %, in addition to

increasing viscosity, maintains non -neyoten dilution behavior of the base nano -nanocyte cut, which is essential to the fluid function of the aircraft body, but in the highest kind of fluid behavior tendency to thicken behavior. Is cut. Therefore, the addition of these two types of nanoparticles in volumetric fraction of 0.5 % helps to enhance the function of the antifreeze / glacier fluid.

According to Figure 8, the number of nanoparticles increases with an increase in solid volume, resulting in spontaneous movements. Nanoparticles and collision with base fluid molecules occur. In the ratio, increased number of nanoparticles (increased nanoparticles) reduces the gap between nanotechnology and the possibility of accumulation of Nano - particles.

By increasing the volume of nanoparticles, the collision between the particles increases and the probability of agroceration increases, increasing the viscosity and the fluid remaining constant.

Adding nanoparticles even in low volume deduction to the base fluid can significantly increase viscosity. Viscose is the main factor in the transmission of movement between the layers of the fluid. Due to the interactions between nanotechnology and base fluid, the basic fluid viscosity is increased by adding Nano particles. The effect of nanoparticles on viscosity has been specifically examined. You should also keep in mind that the relationship between viscosity and nanoparticles is unclear. Most of the existing empirical studies show that the increase in particles is increased by the increase in hybrid nuances. However, some reports claim that some compounds have a lubrication effect and thus reduce viscosity. It was found that the effect of lubrication is that it is less prominent [22].

Temperature is the most important and most effective point in viscosity. As shown in Figure 7, nanoparticle viscosity decreases with increased temperature. This is because with the rise in temperature, the interstitial attraction between the nanoparticles and their base fluid becomes weakened. Most studies expressed the decrease in viscosity by increasing temperature 23 [, 42]. Some researchers have found that rising temperatures have an impact on viscosity. Zao et al. [32] have studied Nanosyal -etb / alumina viscosity with

different volumes (1.3 %, 2.27 %, 4.52 %, 5.29 %= φ) at different temperatures from 296 to 313 Kelvin and It has reported that the viscosity is highly dependent on the volume of nanoparticles ، Al 2 O, but with the change of temperature, the viscosity remains constant. Chen et al. [62] in their studies on nanosyal ethylene glycol 2 Tio at the temperature range of 293 to 333 Kelvin did not report any difference in relative viscosity with increased temperature.

3 - 5 - the results of superficial stretching measurement

Surface tension is a force that operates per unit length of the fluid surface perpendicular to the force. Surface tension is an important factor determining in hybrid nanoparticles, Umabe Andert has been studied 16 [, 72] In studies in the change in surface tension caused by the addition of nanoparticles, contradictory results have been reported 27 [92] .

It is unclear whether an increase in the volume of wardrobe will decrease or increase surface tension and what is the cause of this behavior.

The purpose of this section is to address this.

Hybrid nano -nano -nanographic surface tension - nano -alumina in the volume of nanoparticles in a solid volume of 0.05, 0.5, 0.5, 1.5, 2.5 % and 5.5 % and different pains from 253.51 to 51 / 283 Kelvin was measured. Figure 7 shows the surface tension of the base fluid with a surfactant, the base fluid without surfactan and hybrid nanoparticles as a function of the volume of nanoparticles and temperature.

According to Figure 8, the presence of surfactan reduces the base fluid surface. The effect of Gibbs's gravity on the surfactan molecules is in the solution and tries to produce a layer in the common season and reduces the surface of the system. The properties of the absorption of surfactants have been reported in sources 16 [, 03, 13]. The results of the

reduction of traction by the addition of surfactants are compatible with the findings if et al., 16 [, 23]. The study by Banisharif et al. 16] [23] OA and SDS results on the stability of 3 Fe 2 O nanoparticles in the base fluid consisting of water and ethylslicles have been studied and reported that surfactants are significantly stretching of the base fluid surface. . reduces . Radium et al. [92] examined the effect of OA on the stability of 2 TIO nanoparticles in water and found similar results. The written will be explained below to determine how nano - particles can change the surface energy of the common season of liquid and gas,

resulting in surface tension. The amount of particles is at the gas level/ higher than the

nanosyal because nano particles appear to be accumulated in the joint gas-liquid season. The forces of gravity and repulsion
From the surfactant between a particle and the surrounding fluid molecules, it can potentially change the surface of the surface in the joint gas-change season. This increases free levels of the surface, resulting in an increase in hybrid nanoparticles for solid volumes of less than 2 % volume.
The following explanations can be provided by reducing surface nanoparticles by more than 2 %.
Due to the graphene hydrophobic properties, nanotechnology is absorbed in the joint season of gas and liquids, which decreases with increased, nanosyal surface tension. [34] It should also be noted that the ratio between surface tension and nanoparticles is not specified. In studies conducted

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Surface tension is a force that operates per unit length of the fluid surface perpendicular to the force. Surface tension is an important factor determining in hybrid nanoparticles,

Umabe Andert has been studied In studies in the change in surface tension caused by the addition of nanoparticles, contradictory results have been reported
It is unclear whether an increase in the volume of wardrobe will decrease or increase surface tension and what is the cause of this behaviour.

The purpose of this section is to address this.
Hybrid Nano -Nano -monographic surface tension - Nano -alumina in the volume of nanoparticles in a solid volume of 0.05, 0.5, 0.5, 1.5, 2.5 % and 5.5 % and different pains from 253.51 to 51 / 283 Kelvin was measured. Figure 7 shows the surface tension of the base fluid with a surfactant, the base fluid without surfactan and hybrid nanoparticles as a function of the volume of nanoparticles and temperature.
According to Figure 8, the presence of surfactan reduces the base fluid surface. The effect of Gibbs's gravity on the surfactan molecules is in the solution and tries to produce a layer in the common season and reduces the surface of the system. The properties of the absorption of surfactants have been reported in sources 16 [, 03, 13]. The results of the reduction of traction by the addition of surfactants are compatible with the findings if et

al., 16 [, 23]. The study by Banisharif et al. 16] [23] OA and SDS results on the stability of 3 Fe 2 O nanoparticles in the base fluid consisting of water and ethylslicles have been studied and reported that surfactants are significantly stretching of the base fluid surface. . reduces. Radium et al. [92] examined the effect of OA on the stability of 2 TIO nanoparticles in water and found similar results. The written will be explained below to determine how Nano - particles can change the surface energy of the common season of liquid and gas, resulting in surface tension. The amount of particles is at the gas level/ higher than the nanosyal because Nano particles appear to be accumulated in the joint gas-liquid season. The forces of gravity and repulsion

From the surfactant between a particle and the surrounding fluid molecules, it can potentially change the surface of the surface in the joint gas-change season. This increases free levels of the surface, resulting in an increase in hybrid nanoparticles for solid volumes of less than 2 % volume.

The following explanations can be provided by reducing surface nanoparticles by more than 2 %.

Due to the graphene hydrophobic properties, nanotechnology is absorbed in the joint season of gas and liquids, which decreases with increased, nanosyal surface tension. [34] It should also be noted that the ratio between surface tension and nanoparticles is not specified. In the studies, patterns are reported to identify nanoparticles on nanosyal surface tension [53, 63]. The results of the study of the Zhou et al. [82] on the nano -nano -3 o - AL 2 o with different volume fraction of 2.5 % volume and different temperatures from 81 ° C to 03 ° C showed that the higher the volume of nanoparticles. , Reduces surface tension. Experiments carried out by Banisharif et al. [61, 23] on the nanoparticles mixed on the

mixture of ethilnglicol -hawi nanoparticles ۱ fe ۲ ۱ with a volume of 0.10, 0.50 and 0.1 % in the scale of 51/352 to 392/51 It came to the conclusion and claimed that with the increase in the carcasses, the surface tension of the nanoparticles increased. This is with the findings of Bhuiyan et al., Which is the effect of various surfactants nanoparticles or different bases. 3 Al 2 O, 2 TIO and 2 SIO in the distilled water in different volumes of different nanoparticles from 0.50 to 0.52 in 100 percent consistent. This contradiction in the results reported by researchers may be due to the use of nanoparticles with different surface stretching, multiple nanoparticles,

The difference in surface tension is caused by nanotechnology.

Hydrophobic nanoparticles can be attached to the joint season and accumulate on the free surface. As a result, the repulsive force between water molecules and nanoparticles increases, increasing the molecular gap in the common season and reducing the gravity of water molecules inside the fluid and on the surface and thus reducing surface reduction. Due to Brown's movement, they have higher water -loving nanoparticles that remain in the base fluid, only the number of these particles are transferred to the area between the surface. When there is a hydrophobic nanoparticles, interactions and

The passion of nanoparticles with water increases between water molecules. The inter - molecular distance decreases due to the absorption between nano -particles and water molecules and increases surface tension. Figure 8 shows that the surface tension increases by adding nano particles to the base fluid. By adding nano particles to the base fluid, the nanowable and base fluid molecules interact with the composition. As a result, the forces between the nanoparticles and adjacent particles as well as the forces are liquid molecules at the environment. Therefore, the forces of gravity forces appear that increases free levels and improves surface tension [33].

According to Figure 8, hybrid nanoparticles increase and decrease by up to 2 %. This means that the surface increase has an optimal limit. When the volume of nanoparticles reaches the threshold, the surface tension increases, but when it is more critical, the opposite happens. The trends are observed. According to the results above, it can be suggested that there is a critical crisis for nanoparticles. At a given temperature, the surface tension of the base fluid is increased by the addition of nanoparticles, and when the solid nanoparticles increase from the corresponding crisis, the fluid surface decreases. At

The shape shown in Figure 8 decreases with the rise in temperature, the hybrid nanoparticle surface tension. Due to the rise in temperature, the molecular thermodynamic movement and bronch movements are exacerbated and reduced the nanosyal surface muscle. Surface tension is determined by inter -molecular forces. If the temperature rises, the base fluid molecules are more involved and move faster.
As a result, gravity forces between molecules are weakened and decreased between nanotechnology.

4 - Conclusion
In the present study, the effect of nanotechnologies can be examined as particle that can be optimized. For the synthesis of hybrid nanosyal, the synthesized paraphitic fluid was used in the first phase of the research. In the preparation of hybrid nanosyal, the base fluid mixture with a 50: 50 percent volume ratio at 800 Kelvin is considered as the base fluid. The nanoparticles, composed of equal volume of alumina nanoparticles and graphene nanoparticles, were suspended in a certain amount of the base fluid. Also, 0.2 % volume of oleic acid (OA) and 2.0 % weight sodium sulfonate (SDS) as surfactant for stabilization and dispersion of nanoparticles were added to the base fluid. Nonocytes were prepared using two stages. Nanoparticles in this study were 0.25, 0.05, 0.5, 0.5, 0.5 and 1, volumes were formed and also designed to evaluate the effect of temperature, temperature test temperatures during the temperature range of 392 - 352 Kelvin.

• Investigated and microstructure of nanoparticles was conducted by a scanning electron microscopy (SEM) and passive electron microscopy (TEM). After the synthesis of nanocyte / nanographer -nano -alumina, thermal conductivity, surface stretching and dynamic viscosity of the hybrid nanoparticles were compared with the base fluid, and the following results were obtained:

1. The results showed that the thermophysical properties of the nanotechnical nanograph - nanograph -nanographic nanographic nanographic nanograms at temperatures below zero were highly dependent on temperature and nanoparticles.

2 hybrid nanoscience / nanograph -nanographic conductivity depends on nanoparticles and temperature. The results showed that increasing the temperature and volume of nanoparticles increased the heat of the nanoparticles. It becomes hybrid.

3 The results of superficial stretching measured that by adding surfactant to the basic fluid, surface tension decreases, but then increases the surface tension with increasing nanotechnology.

4 Results of Solid Volume Dynamic Volume Measurement less than 0.5 % Non-Outgrown Non-Outline, while specimens with the highest (2.5)-0.5 = f) were non-kettle non-iconing behavior and from Newton's law followed.
5 Hybrid Hybrid Nanosyal - Anti -Antimony: Iceless / Nanographic - Nano -Alumina at a temperature below zero and slightly nanoparticles, the amazing thermophysical and

thermophysical behavior shows motivation to other temperature and existential range of existence that causes acidic and nanoparticles. Graphene.
The results of the thermal conductivity of Nanosyal / nomograms - Nano -alumina indicate that the thermal conductivity properties and thus the fluid of the base oil improves with the addition of nanotechnology.

Considering the fluid function of the oil tape of the turbine, increasing the fluid surface, helping to improve its performance in the combined coating of the engine against efficiency, thereby enhancing fluid performance.
The base nanocyte, which is essential to the function of the base of the gas turbine, maintains but changes in any type of fluid recoological behavior. Therefore, the addition of these two types of nanoparticles in volumetric fraction of 0.5 % helps to enhance base oil fluid function.

This research is under the auspices of the intellectual and scientific ownership of the turbine Petro PlateauEngineering in Petro Plateau turbine
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Investigating Nano Al 2 O 3 and Nano Graphene
Ceramic additives on Nano lubricant fluids
Type of Article: Scientific Research: Hamed Gazor*1
Khadijah mahdavi*2. Ebrahem emami*3, dr Amirreza hekmat Nia*4

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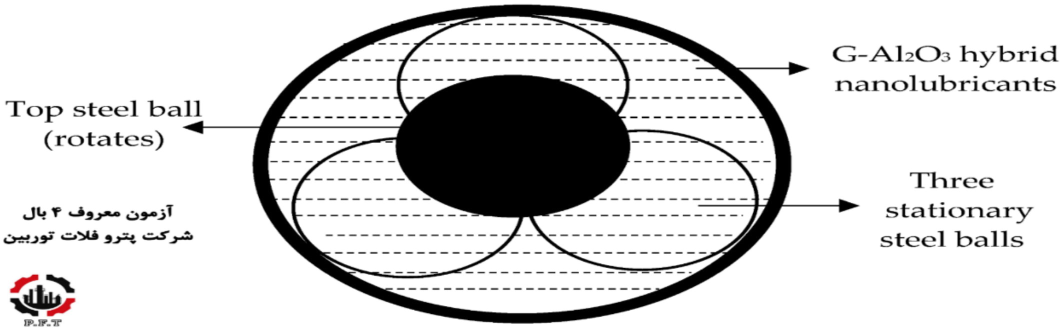
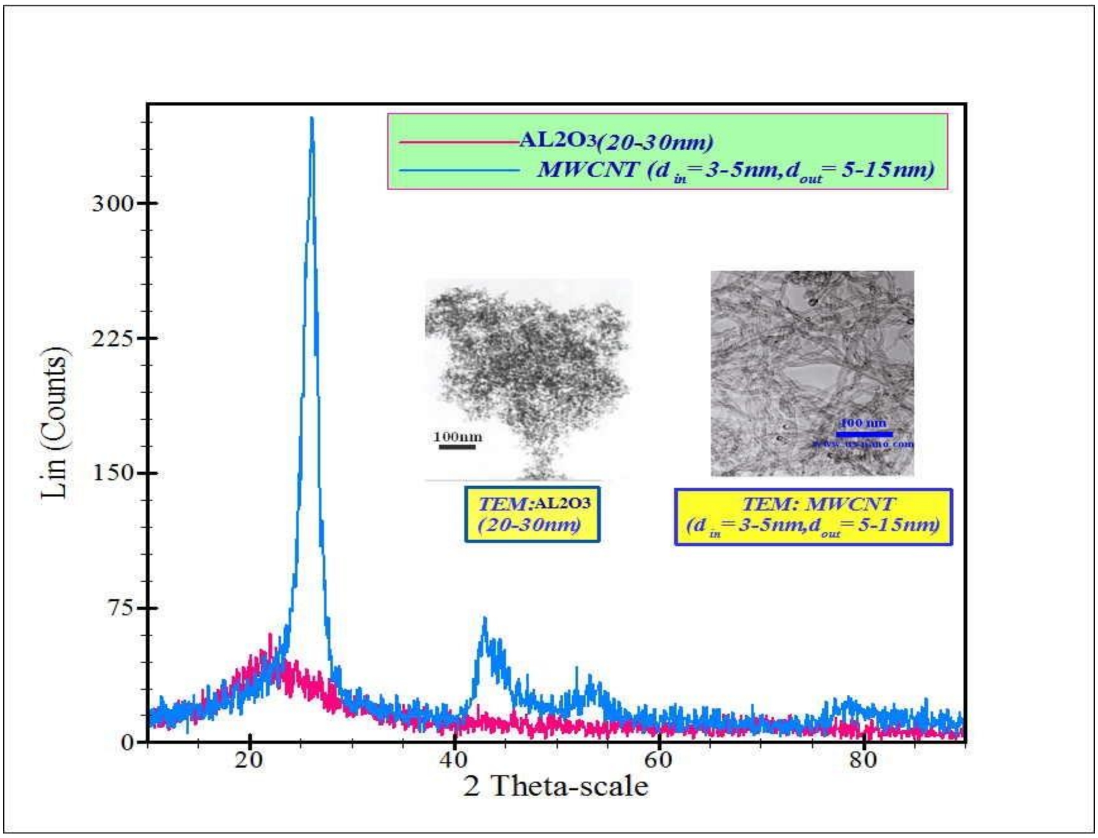
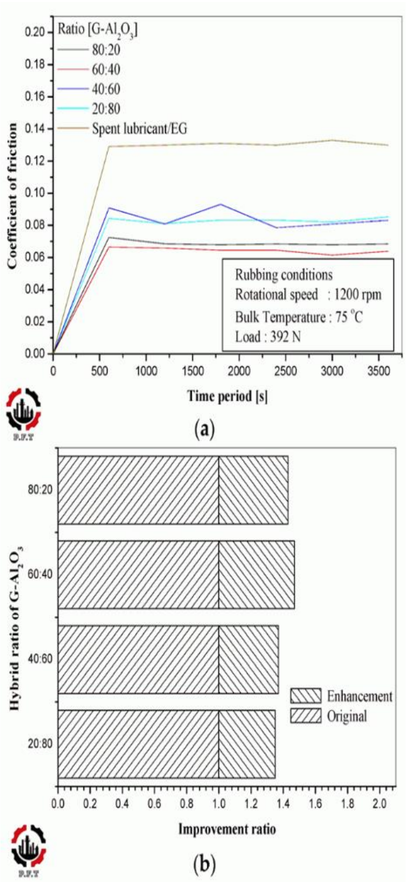
In the present study, the impact of Nano -2 O 3 ceramic additives and Nano -graphene in performance optimization and improved the thermophysical properties of lubricant -Nano fluids were investigated. The nanoparticles were marked by TEM, SEM and XRD methods. The thermal conductivity, surface tension and dynamic viscosity of the hybrid fluid were empirically evaluated for temperatures between 253 and 303 Kelvin, and the results were compared with some existing theoretical models. The results showed that the thermal conductivity properties and consequently the efficiency of the film information in the turbine fluid improved by adding nanoparticles. Due to the performance of the turbine fluid, increasing the surface tension of the fluid helps improve its performance in the coating of the turbine information against rainfall and thus better the fluid performance. According to the results of the dynamic viscosity of the graphene nanotube in the lubricant hybrid Nano-fluid,

the addition of nanoparticles in a volume of 0 to 0.5 % shows non-petty in addition to increasing viscosity. The basic shear thinner Nano -fluid behavior is the main need for the function of the thugs. However, at higher concentrations, the Nano -hybrid fluid tends to be a non -nylon shear thickening behavior. Therefore, the addition of these two types of nanoparticles in a volume deduction of 0.5 % helps increase the performance of the turbine fluid.

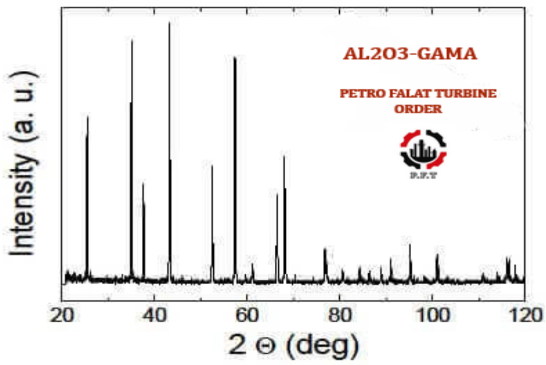
Keywords: Lubricant Nano Fluid, Hybrid Nano Fluid, Al 2 O 3 nanoparticles. Nano -graphene plate.







Aluminum Oxide Nanoparticles (Al_2O_3)



بسمه تعالی

سازمان انرژی اتمی ایران

پژوهشگاه علوم و فنون هسته‌ای

آزمایشگاه مرکزی

NACI 282

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ردیف	کد نمون	کد آزمایشگاه	نتیجه	واحد
۱	NanoDiamond Powder	I01-2067/001	به پیوست	----

ملاحظات

۶ صفحه تکمیلی به پیوست می باشد

تهیه کننده:کارشناس	تایید کننده:کارشناس ارشد	تصویب کننده:مدیر فنی

محل الصاق مهر

پژوهشگاه علوم و فنون هسته‌ای آزمایشگاه مرکزی

توضیحات: این گواهی بدون مهر آزمایشگاه فاقد اعتبار است.
نتایج تنها مربوط به اقلام آزمون است و این گزارش به معنای گواهی انطباق نیست.
نمونه ها در صورت پایدار بودن، بعد از انجام آزمون به مدت دو هفته در آزمایشگاه نگهداری خواهند شد.
هرگونه کپی‌برداری از این گواهی باید با اجازه مکتوب آزمایشگاه به صورت کامل و از تمامی صفحات باشد.

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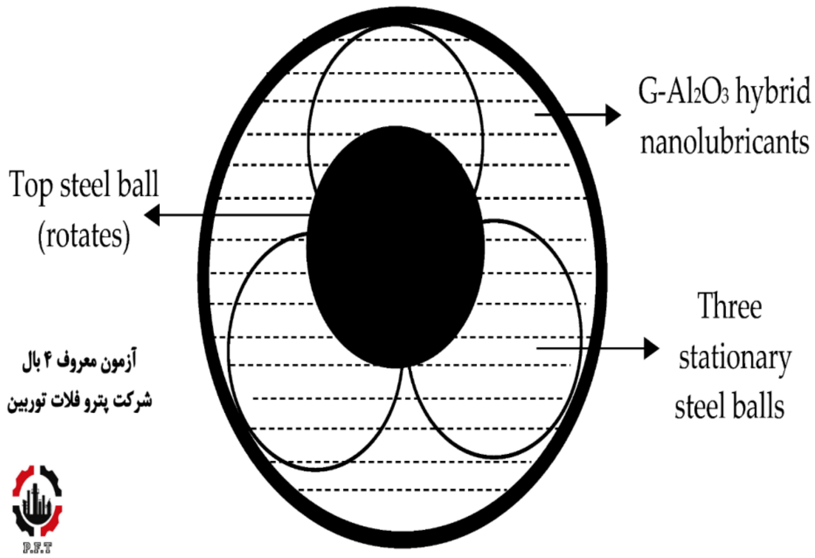

Reference

۱) به عنوان عامل پخشکننده SDBS با استفاده از-Al2O3 ارزیابی تجربی اثر در پایداری و خواص ترموفیزیکی نانوسیالهای مبتنی بر آب

۲) و نانوسیال هیبریدی مبتنی بر آب: یک ارزیابی تجربی MWCNT با CeO2 برای هدایت حرارتی (سنتز، فراصوت، سورفکتانت، پایداریS (در نظر گرفتن ٤

۳) تجزیه و تحلیل فیزیکی اثرات ترموفورز و چگالی متغیر بر ارزیابی انتقال حرارت در امتداد یک ورق کششی متخلخل و کاربرد آنها در روانکاری نانوسیال

٤) سنتز و خصوصیات نانوسیال های هیبریدی و استفاده از آنها در مبدل های حرارتی مختلف برای بهبود نرخ انتقال حرارت: یک بررسی انتقادی

٥) EG/TiO2-ZnOاندازه گیری هدایت حرارتی نانوسیال هیبریدی

٦) با تمرکز بر هدایت حرارتی (SWCNTs 60-(MgO%)/40 EG%) یک مطالعه تجربی کاربردی جدید بر روی رفتار حرارتی نانوسیال هیبریدی

۷) C تجزیه و تحلیل تجربی نانوسیال های مبتنی بر آب با استفاده از نانولوله های نیترید بور با خواص حرارتی بهبود یافته u-Al2O3همبستگی تجربی جدید برای هدایت حرارتی اتیلن گلیکول حاوی نانوذرات هیبریدی

۸) تاثیر نانولوله های کربنی بر خواص فیزیکی یک نانوسیال دوتایی

۹) جریان از طریق شریان تنگی کاتتر شده با ترومبوز (خون) GO-Au/اثرات لغزش هال و یون بر روی نانوذرات هیبریدی

۱۰) با شبیهسازی دینامیک مولکولی Al2O3/CuO بررسی عملکرد اتمی و حرارتی متیل استر بیودیزل سویا در حضور نانوذرات هیبریدی

۱۱) آب با نانوذرات با شکل های متفاوت برای افزایش ویژگی های قانون اول و دوم جریان با در نظر گرفتن رویکرد دو فازی MWCNT-SiO2/انجام نانوسیال هیبریدی

۱۲) بررسی تطبیقی نانوذرات مس روی ورق کششی شعاعی با آب و روغن سیلیکون

۱۳) و تک: یک همبستگی جدید (۸۰:۲۰ GO-Al2O3) اندازه گیری تجربی هدایت حرارتی و ویسکوزیته نانوسیاالت هیبریدی

۱۴) در جریان اتیلن گلیکول TiO2-Cu جنبه های حرارتی جدید نانوذرات هیبریدی

۱۵) بر روی سطح کششی قابل نفوذ EG%در جریان ورودی نانو خنک کننده هیبریدی ۲۰ %آب + ۸۰ -Cu Al2O3 تاثیر

۱۶) انتقال حرارت نانوسیال هیبریدی از یک سطح صاف نفوذپذیر با کسرهای حجمی متفاوت عبور می کند

۱۷) روی یک محیط متخلخل () Al2O3-Cuبرای سیال گرد و غبار میکروقطبی حاوی نانوذرات هیبریدی MHD تجزیه و تحلیل الیه مرزی

۱۸) مبتنی بر آب بدون سورفکتانت CNT-Cu سنتز، خصوصیات و پایداری پراکندگی نانوسیال هیبریدی

۱۹) مدلسازی انتقال حرارت همرفتی مخلوط با استفاده از نانوسیال در یک محفظه درب دوگانه با تولید حرارت داخلی

۲۰) مجله بین المللی انتقال حرارت و جرم آوریل ۲۰۱۸ ۶

۲۱) مهندسی غیر خطی ژانویه ۲۰۲۳ ۱

۲۲) مجله بین المللی علوم غیرخطی و شبیه سازی عددی سپتامبر ۲۰۱۴ ۱۲

۲۳) ارتباطات بین المللی در انتقال حرارت و جرم اکتبر ۲۰۲۱ ۲۹

۲۴) بازیابی، استفاده، و اثرات زیست محیطی :A منابع انرژی، بخش اوت ۲۰۲۰ ۲۱

۲۵) مکانیک کاربردی و محاسباتی اکتبر ۲۰۱۹ ۱۶

۲۶) مجله مایعات مولکولی ژوئیه ۲۰۱۸ ۲۹

۲۷) میکروسیال و نانوسیال ژانویه ۲۰۲۱ ۲۰

۲۸) ۲۴/۳۱/۳, ۱۲:۴۶ AM Research project assistant | Editage

۲۹) https://www.editage.com/research-solutions/projects/my-research/284384/literature 3/18

۳۰) جریان چسبناک همرفتی مخلوط غیر مغناطیسی غوطه ور در نانوذرات هیبریدی اکسید تیتانیوم و اکسید تیتانیوم آلومینیوم به سمت سطح استوانه

۳۱) مطالعه تجربی بر روی هدایت حرارتی و ویسکوزیته نانوسیال مبتنی بر اتیلن گلیکول حاوی مواد هیبریدی الماس-نقره

۳۲) هدایت حرارتی نانوسیالات هیبریدی: یک بررسی انتقادی

۳۳) آزمایش و مطالعه مدل پیش‌بینی‌شده انتقال حرارت جوشان استخر نانوسیال معلق مجدد تحت میدان الکتریکی

۳۴) آب-EG/CuO بررسی تجربی و توسعه همبستگی‌های جدید برای هدایت حرارتی نانوسیال

۳۵) جریان ناپایدار و انتقال حرارت نانو مایع شبه پلاستیک در یک الیه نازک محدود بر روی یک سطح کششی با هدایت حرارتی متغیر و اتالف ویسکوز

۳۶) دی سولفید مولیبدن و نانوسیال هیبریدی اکسید سیلیکون در نزدیکی سطح سه بعدی نامنظم MoS2 اثرات سرعت لغزش و جهش دما بر روی نانوسیال هیبریدی

۳۷) گرافن/آب پایدار و توسعه یک همبستگی جدید برای هدایت حرارتی-TiO2 تهیه نانوسیالات هیبریدی

۳۸) جریان سیال ;amp مجله بین المللی روش های عددی برای گرما و دسامبر ۲۰۱۳ ۲۰

۳۹) ارتباطات بین المللی در انتقال حرارت و جرم نوامبر ۲۰۲۰ ۲۱

۴۰) الماس و مواد مرتبط مه ۲۰۱۹ ۱۱

۴۱) مجله بین المللی انتقال حرارت و جرم مه ۲۰۱۸ ۱۱

۴۲) ارتباطات بین المللی در انتقال حرارت و جرم دسامبر ۲۰۲۱ ۲۷

۴۳) ارتباطات بین المللی در انتقال حرارت و جرم آوریل ۲۰۱۵ ۱۹

۴۴) فناوری پودر ژانویه ۲۰۱۵ ۲۶

۴۵) مجله مهندسی اسکندریه نوامبر ۲۰۲۰ ۲۸

۴۶) فناوری پودر مارس ۲۰۲۱ ۱۰

۴۷) ۲۴/۳۱/۳, ۱۲:۴۶ AM Research project assistant | Edit age

۴۸) https://www.editage.com/research-solutions/projects/my-research/284384/literature 4/18

۴۹) ارزیابی تجربی و مدلسازی شبکه عصبی مصنوعی هدایت حرارتی نانوسیال مبتنی بر آب حاوی نانوذرات مس مغناطیسی

۵۰) آب با سورفکتانت های مختلف-TiO2 سنتز و خصوصیات نانوسیال های

۵۱) و انتقال حرارت نانوسیالات شبه پلاستیک روی محیط متخلخل با مدل اصالح شده Marangoni MHD جریان الیه مرزی

۵۲) جریان دو فازی نانوسیال و فیزیک حرارتی: مرز تحقیقاتی جدید نانوتکنولوژی و چالشهای آن

۵۳) خون به سمت یک ورقه کششی متخلخل/Cu-CuO بهبود سیستم گردش خون ریز دارورسانی با الگوی جدیدی از جریان نانوسیال هیبریدی

۵۴) در روغن موتور برای افزایش سرعت انتقال حرارت AL2O3 شناسایی نانو ذرات

۵۵) نقش میدان مغناطیسی بر جابجایی اجباری نانوسیال در کانال انشعاب

۵۶) بررسی به روز در مورد سنتز و خواص ترموفیزیکی نانوسیالات هیبریدی

۵۷) R141b بر خواص ترموفیزیکی مبرد TiO2 مطالعه تجربی اثر نانوذرات

۵۸) فیزیک الف: مکانیک آماری و کاربردهای آن ژانویه ۲۰۲۰ ۱۵

۵۹) ارتباطات بین المللی در انتقال حرارت و جرم مه ۲۰۱۶ ۱۲

۶۰) مکانیک مواد وابسته به زمان اوت ۲۰۱۵ ۱۱

۶۱) مجله علوم و نانوتکنولوژی ژوئیه ۲۰۰۸ ۱

۶۲) مجله بین المللی روش های عددی برای جریان حرارت و سیال ژوئن ۲۰۱۹ ۲۵

۶۳) مجله بین المللی مهندسی & فن آوری مه ۲۰۱۸ ۳۱

۶۴) مجله بین المللی روش های عددی برای جریان حرارت و سیال ژانویه ۲۰۱۹ ۲۵

۶۵) مجله تولید پاکتر آوریل ۲۰۱۸ ۱۹

۶۶) ۲۴/۳۱/۳, ۱۲:۴۶ AM Research project assistant | Editage

٦٧) https://www.editage.com/research-solutions/projects/my-research/284384/literature
5/18

٦٨) ANN از طریق دما و کسر حجمی جامد با استفاده از دادههای تجربی و روشهای COOH آب دارای/MWCNTs ارزیابی هدایت حرارتی

٦٩) (%۷۰٪:۳۰ EG) مبتنی بر آب Zona-SWCNT مطالعه تجربی و توسعه مدل بهبود هدایت حرارتی و ارزیابی هزینه و حساسیت نانوسیال هیبریدی

۷۰) یک مدل پیشبینی مبتنی بر شبکه عصبی برای هدایت حرارتی نانوسیالهای هیبریدی

۷۱) به عنوان عامل پخشکننده SDBS با استفاده از -Al2O3ارزیابی تجربی اثر در پایداری و خواص ترموفیزیکی نانوسیالهای مبتنی بر آب

۷۲) به عنوان خنک کننده PCM بررسی مبدل حرارتی میکروکانال مخالف با نانوذرات هیبریدی و تعلیق

۷۳) و نانوسیال هیبریدی مبتنی بر آب: یک ارزیابی تجربی MWCNT با CeO2 برای هدایت حرارتی (سنتز، فراصوت، سورفکتانت، پایداری) Sدر نظر گرفتن ٤

۷٤) تجزیه و تحلیل فیزیکی اثرات ترموفورز و چگالی متغیر بر ارزیابی انتقال حرارت در امتداد یک ورق کششی متخلخل و کاربرد آنها در روانکاری نانوسیال

۷٥) بهبود انتقال حرارت در جریان نانوسیال هیبریدی روی یک ورق متحرک با دوقطبی مغناطیسی تجزیه و تحلیل تجربی نانوسیال های مبتنی بر آب با استفاده از نانولوله های نیترید بور با خواص حرارتی بهبود یافته

۷٦) مسائل ریاضی در مهندسی مارس ۲۰۲۱ ۱۸ مسائل ریاضی در مهندسی مارس ۲۰۲۱ ۲۳ علم و فناوری مهندسی،

۷۷) مجله بین المللی ژوئن ۲۰۲۳ ۳۰

۷۸) مجله آنالیز حرارتی و کالریمتری آوریل ۲۰۱٦ ۱۳

۷۹) فناوری پودر اکتبر ۲۰۱۸ ۲ مجله مایعات مولکولی آوریل ۲۰۱۸ ۲۲ م

۸۰) جله آنالیز حرارتی و کالریمتری سپتامبر ۲۰۱۷ ۲۱

۸۱) امواج در رسانه های تصادفی و پیچیده اکتبر ۲۰۲۱ ۲

As a spreading agent of SDBS using Al2O3- experimental evaluation of the effect on the stability and thermophysical properties of water-based Nano fluids

2) and water-based hybrid nanofluid: an experimental evaluation of MWCNT with CeO2 for thermal conductivity (synthesis, sonication, surfactant, stability) S consideration 4

3) Physical analysis of the effects of thermophoresis and variable density on the evaluation of heat transfer along a porous tensile sheet and their application in Nano fluid lubrication
4) Synthesis and characterization of hybrid Nano fluids and their use in different heat exchangers to improve the heat transfer rate: a critical review
5) EG/TiO2-ZnO hybrid Nano fluid thermal conductivity measurement
6) focusing on the thermal conductivity of EG%)/40 (MgO%)-60 (SWCNTs) a new applied experimental study on the thermal behavior of hybrid Nano fluid
7) C Experimental analysis of water-based Nano fluids using boron nitride nanotubes with improved thermal properties u-Al2O3 New experimental correlation for thermal conductivity of ethylene glycol containing hybrid nanoparticles

8) The effect of carbon nanotubes on the physical properties of a binary nanofluid

9) Flow through thrombus catheterized stenotic artery (blood/GO-Au (Hall and ion slip effects) on hybrid nanoparticles

10) By simulating the molecular dynamics of Al2O3/CuO, investigating the atomic and thermal performance of soybean methyl ester biodiesel in the presence of hybrid nanoparticles.

11) Water with nanoparticles of different shapes to increase the characteristics of the first and second laws of flow by considering the two-phase/MWCNT-SiO2 approach to perform hybrid nanofluid

12) Comparative study of copper nanoparticles on radial tensile sheet with water and silicone oil

13) and Tak: a new correlation (20:80 (GO-Al2O3) experimental measurement of thermal conductivity and viscosity of hybrid nanofluids

14) in the flow of ethylene glycol TiO2-Cu new thermal aspects of hybrid nanoparticles
15) Effect on the permeable tensile surface of EG% in the inlet flow of hybrid nano cooling 20% water + 80 Cu-Al2O3
16) Hybrid nanofluid heat transfer passes through a smooth permeable surface with different volume fractions
17) on a porous medium (Al2O3-Cu) for micropolar dust fluid containing hybrid nanoparticles MHD boundary layer analysis
18) Water-based CNT-Cu surfactant-free synthesis, properties and stability of hybrid nanofluid dispersion

19) Modeling mixed convective heat transfer using nanofluid in a double door chamber with internal heat generation
20) International Journal of Heat and Mass Transfer April 2018 6
21) Nonlinear Engineering January 2023 1
22) International Journal of Nonlinear Sciences and Numerical Simulation September 2014 12
23) International communication in heat and mass transfer October 2021 29
24) Recovery, use, and environmental effects: A energy resources, section August 2020 21
25) Applied and computational mechanics October 2019 16
26) Journal of Molecular Liquids July 2018 29
27) Microfluid and nanofluid January 2021 20
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29) https://www.editage.com/research-solutions/projects/my-research/284384/literature 3/18
30) Convection viscous flow of non-magnetic mixture immersed in hybrid nanoparticles of titanium oxide and aluminum titanium oxide towards the surface of the cylinder
31) Experimental study on thermal conductivity and viscosity of nanofluid based on ethylene glycol containing diamond-silver hybrid materials
32) Thermal conductivity of hybrid nanofluids: a critical review
33) Testing and studying the predicted model of boiling heat transfer of resuspended nanofluid pool under electric field
34) Water-EG/CuO experimental investigation and development of new correlations for nanofluid thermal conductivity
35) Unsteady flow and heat transfer of quasi-plastic nanofluid in a limited thin layer on a stretching surface with variable thermal conductivity and viscous loss
36) Molybdenum disulfide and silicon oxide hybrid nanofluid near the irregular three-dimensional surface of MoS2, the effects of sliding speed and temperature jump on the hybrid nanofluid
37) Stable graphene/water and development of a new correlation for thermal conductivity-TiO2 preparation of hybrid nanofluids
38) Fluid flow; International Journal of Numerical Methods for Heat and December 2013 20
39) International communication in heat and mass transfer November 2020 21
40) Diamonds and related materials May 2019 11
41) International Journal of Heat and Mass Transfer May 2018 11
42) International communication in heat and mass transfer December 2021 27
43) International communication in heat and mass transfer April 2015 19
44) Powder Technology January 2015 26
45) Alexandria Engineering Magazine November 2020 28
46) Powder Technology March 2021 10
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49) Experimental evaluation and artificial neural network modeling of thermal conductivity of water-based Nano fluid containing magnetic copper nanoparticles
50) Water with different surfactants-TiO2 synthesis and properties of nanofluids
51) and the heat transfer of quasi-plastic nanofluids on porous media with the modified Marangoni MHD model of boundary layer flow
52) Nanofluid two-phase flow and thermal physics: the new research frontier of nanotechnology and its challenges
53) Blood towards a porous tensile sheet/Cu-CuO, improvement of blood circulation system, micro-drug delivery with a new pattern of hybrid nanofluid flow.
54) Identification of nanoparticles in engine oil to increase the heat transfer rate AL2O3
55) The role of magnetic field on the forced displacement of nanofluid in the branching channel
56) An up-to-date review on the synthesis and thermophysical properties of hybrid nanofluids

57) R141b on the thermophysical properties of TiO2 refrigerant, an experimental study of the effect of nanoparticles
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59) International communication in heat and mass transfer May 2016 12
60) Mechanics of time-dependent materials August 2015 11
61) Journal of Science and Nanotechnology, July
62) International Journal of Numerical Methods for Heat and Fluid Flow June 2019 25
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67) https://www.editage.com/research-solutions/projects/my-research/284384/literature 5/18
68) ANN evaluation of thermal conductivity through temperature and solid volume fraction using experimental data and COOH methods of water containing MWCNTs
69) (70%: 30% (EG water-based Zona-SWCNT) experimental study and development of thermal conductivity improvement model and evaluation of cost and sensitivity of hybrid nanofluid
70) A prediction model based on neural network for thermal conductivity of hybrid nanofluids
71) as dispersing agent of SDBS using Al2O3-experimental evaluation of effect on stability and thermophysical properties of water-based nanofluids
72) as a PCM cooling investigation of the opposite microchannel heat exchanger with hybrid nanoparticles and suspension
73) and water-based hybrid nanofluid: an experimental evaluation of MWCNT with CeO2 for thermal conductivity (synthesis, sonication, surfactant, stability) S consideration 4
74) Physical analysis of the effects of thermophoresis and variable density on the evaluation of heat transfer along a porous tensile sheet and their application in nanofluid lubrication
75) Improving heat transfer in hybrid Nano fluid flow on a moving plate with a magnetic dipole, experimental analysis of water-based Nano fluids using boron nitride nanotubes with improved thermal properties
76) Mathematical problems in engineering March 2021 18 Mathematical problems in engineering March 2021 23 Engineering science and technology,
77) International Journal June 2023 30
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79) Powder Technology October 2018 2 Journal of Molecular Liquids April 2018 22
80) Thermal analysis and calorimetry September 2017 21
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