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Enhancement of Heat Shifting Rate of vehicle Radiator by Using Ethylene Glycol Water Based ZrO_2 & Al_2O_3 Nanofluid

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Abstract:
Upgrade of warmth move coefficient is a significant research regions in different field of building. Warmth move coefficient can be increments by utilizing different nanofluids which will additionally improve the presentation of warmth replacing similar to Radiator. In this paper increasingly centered around the warmth move upgrade of vehicle radiator via utilizing Nano liquid. Numerous scientists have done a great deal of research chip away at nano liquid innovation and its applications in the warmth move gadgets. This paper audits the upgrades of warmth move coefficient of coolents with EGlycol Water dependent ZrO2 Nano fluid & its correlation with Al2O3 Nano fluid. It is the new age liquid, which improves characteristics i.e, thickness, affectionate conductivity, consistency, open warmth of fundamental liquid in which nano particles included. The Reynolds number, Prandtl number with Nusselt number were innate elements of thermo material characteristics of nano fluids and these statistics are firmly impact the convective warmth move coefficient which will additionally choose the pace of warmth move. The thermophysical characteristics may change by temperature with volumetric convergence of nano fluids, for example, Density, explicit warmth, warm execution and consistency. Impacing prandlt number with Reynolds Number, temperature move coefficient of various molecule volumetric fixations arrangements are talked about in this paper.

Keywords: *Nano fluid, Reynolds number, Prandtl number, Nusselt number, thermal conductivity thickness, convective heat transport, heat exchanger, warmer*.

I. INTRODUCTION

Ordinary coolants are used to disperse temperature in larger element of the scheming applications. Run of the grind coolants remember matter for every one of the three states to be specific strong, fluid and gas dependent on the prerequisites of utilization and conceivable method of warmth move. Be that as it may, with the most recent mechanical headways, rising group of fresh coolants in particular (chilling material with spread small-particles) determine its uses in an assortment of building application are required to supplant ordinary coolants sooner rather than later. A run of the mill

Nano liquid is locate awake by spreading particular kinds of select nano-particles in an appropriate base liquid with various amount fixations; a portion of particular favorable position of Nano liquids incorporates upgraded warm properties while contrasted through the base liquid. Blending of added substances in coolants has been being used from decades to upgrade the warmth move and decrease the weight plunge along the brook. There has been more thought toward to grow convective warmth move pace of nanofluid [1]particle having size under 100nm added to base fluid to create warm conductivity delineate as a nanofluid in run of the mill strategy water, ethylene glycol ,used as coolant in vehicle radiator for these situation nanofluid added to base liquid to expand the shine move rate in the event that investigation of nanofluid in vehicle furnace tap in favor of power convection utilized and the warmth move rate determined at various information stream tempo [1-4] this rate was contrast and nanofluid utilized in bottom liquid.

II. LITERATURE REVIEW

Xuan et al. [1] measured the thermal conductivity of Cu/water nanofluids with hot wire method. They studied the effect of various parameters such as particle volume fraction, size and properties of nanoparticles on the thermal conductivity and revealed that thermal conductivity was highly dependent on these parameters. They concluded that for 2.5 % to 7.5 % nanoparticle volume fraction, the thermal conductivity was increased by factor of 1.24 to 1.78.

Kakaç et al. [2] reviewed that heat transfer capabilities of ordinary fluids such as water, oils and ethylene glycol can be increased significantly by addition of nanoparticles. They marked the importance of heat transfer fundamentals for a diverse advancement in the field of nanotechnology. The theoretical and experimental understanding of microscopic particle mechanism is singnificant.

Vajjha et al. [3] studied the effect of Al2-O3 with CuO put together nano fluids with respect en route for exhibition of a car radiator. The bottom liquid utilized by numerous scientist is the blend of irrigate and EG. Radiator viable be utilized by level cylinders. Investigations completed in the laminar stream locale. They reasoned that the normal warmth move coefficient was expanded significantly with molecule volume fixations. They indicated for 10% Al2O3 nano fluid,Normal warmth move coefficient be enhanced by 94 %, as for 6 % CuOnanofluid, it was expanded by 89 %. Likewise, for a fixed channel speed, normal fur erosion coefficient is expanded via expanding the molecule volume fixation. Be that as it may, for a similar measure of warmth move, siphoning power prerequisite concerning base liquid was decreased through 82 % with 77 % in favor of Al2O3 and CuO nano liquid, individually.

III. SYSTEM EXPANSION

3.1 New Model

3.1.1 computation of temperature relocate coefficient

toward temperature transfer coefficient with equivalent Nusselt number.

$$q = m_{air}\, c_{pair}\left(T_{air,out} - T_{air,in}\right) = m_{nf}\, c_{pnf}\left(T_{nf,in} - T_{nf,out}\right)$$

Heat transfer speed calculated as follows:

$$Q = hA\Delta T = hA(T_b - T_w$$

Heat transfer rate can be calculated as follows:

$$Q = mc_p\Delta T = mc_p(T_{in} - T_{out})$$

Regarding the equality of Q in the above equations

$$Nu_{exp} = \frac{h_{exp} * D_h}{k_{nf}} = \frac{mc_p(T_{in} - T_{out})D}{A(T_b - T_w)k_{nf}}$$

Nu is normal Nusselt number for the entire radiator, m is mass flow rate which is the result of thickness and volume stream pace of liquid, Cp is liquid

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explicit warmth limit, An is fringe territory of warmer cylinders, T(input) and T(output) be delta and vent temperatures, Tb is mass temperature be the normal estimations of channel and vent temperature of the liquid traveling throughout the radiator, with Tw is pipe divider temperature altogether can signify an incentive by couple shell thermo couples. For this state, k is liquid warm conductivity along with day is water powered breadth of the cylinder. They have to likewise be referenced that everyone the corporal characteristics were determined at liquid mass temperature. Correlations on behalf of Nusselt number evaluation for on its own stage liquids

Dittuse-Boelter Correlations,

$$Nu = 0.023Re^{0.8}Pr^{0.3}$$

Gnielinski association intended for solo stage fluid

$$Nu = \frac{(\frac{f}{2})(Re-1000)Pr}{1+12.7(\frac{f}{2})^{0.5}(Pr^{\frac{2}{3}}-1)}$$

$$f = (0.79 lnRe - 1.69)^{-2}$$

3.2 Calculating Nano fluid Physical Properties

In this study, Al2o3 and ZrO2 nanoparticles were used for the experiments. By assuming that the nanoparticles were well dispersed within the base fluid, the effective physical properties of studied nanofluid could be measured using some classical formulas, usually used for two phase fluids. The following correlations were used to calculate physical nanofluid properties like density, viscosity, specific heat, and thermal conductivity at different volume concentrations of nanoparticles:

$$\rho_{nf} = (1-\varphi)\rho_f + \varphi\rho_p$$

Whereρ_{nf} = thickness of nanofluid, φ = particles quantity concentration, ρ_f = base fluid thickness and ρ_p= nanoparticles density.

The exact heat is designed commencing Xuan and Roetzel [] as:

$$(\rho cp)_{nf} = (1-\varphi)(\rho cp)_f + \varphi(\rho cp)_p$$

Other method by Yu and Choi [17].

$$K_{nf} = K_f \frac{K_p + 2K_f - 2\varphi(K_f - K_p)}{K_p + 2K_f + 2\varphi(K_f - K_p)}$$

Where

K_{nf} = thermal conductivity,

K_p = nano element thermal conductivity with K_f = thermal conductivity of bottom fluid.

The thickness of the nano fluid Drew and Passman [] recommended the renowned Einstein equation for getting thickness, is defined as follows

$$\mu_{nf} = (1 + 2.5\varphi)\mu_f$$

Where μ_{nf} f = Nano fluid thickness and μ_f= bottom fluid viscosity.

3.3 Training And evaluation Of Nano fluid Properties

The thought behind improvement of nanofluids is to utilize them as thermo liquids in heat exchangers for upgrade of warmth move coefficient and in this way to limit the size of warmth move types of gear. Nanofluids help in rationing heat vitality and warmth exchanger material. The significant parameters which impact the warmth move attributes of nanofluids are its properties which incorporate warm conductivity, consistency, explicit warmth and thickness. The thermo physical properties of nanofluids additionally rely upon working heat of nano fluids. Thus, the exact estimation of temperature subordinate characteristics of nanofluids is fundamental.

3.4 *evaluation of Nano particle amount attentiveness*

Measure of Al2o3 and ZrO2 nano particles necessary for arrangement of nano fluids is determined utilizing the rule of blend equation. A touchy gauging offset by means of 0.001mg goals is

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utilized to gauge the Al2o3 and ZrO2 nanoparticles precisely. The heaviness of the nano particles necessary for planning of 100 ml Al2o3 and ZrO2 nano fluid of a specific volume fixation, utilizing water-ethylene glycol support liquid determined by utilizing the accompanying connection

$$\text{Volume deliberation } \varphi = \frac{\frac{\text{WParticle}}{\rho\,\text{Particle}}}{\frac{\text{WParticle}}{\rho\,\text{Particle}}+\frac{\text{WFluid}}{\rho\,\text{Fluid}}} \times 100$$

The amount of Al_2o_3 and ZrO_2 nano particles required to plan Nano liquids of various rate volume fixation in a 100 ml of base liquid is abridged in the Table demonstrated as follows.

Table. 3.3 Calculation of volumertric concentration for Al_2O_3

Sr. No.	Volume absorption (φ)	Load of Nanoparticles (W_{Al2O3}) Gms
1	0.1	0.4080
2	0.2	0.8160
3	0.3	1.574

Table. 3.4 Calculation of volumertric concentration for ZrO_2

Sr. No.	Volume absorption (φ)	load of Nanoparticles (W_{Al2O3}) Gms
1	0.1	0.583
2	0.2	1.3135
3	0.3	2.2618

3.5 Nanofluid Preparation Using Al_2o_3And Zro_2Nanoparticles

The Al_2O_3 and ZrO2 nano particles having an average size less than 50 nm and having density of 3.97 gm/cm3 and 5.89 gm/cm3 respectively is procured from a INDIA based company (AUTUS NANOLAB PVT. LTD.) also, is utilized for examination in the present test work. In the present work, ethylene glycol-water blend (60:40 by volume) is in use as the base liquid for readiness Al_2O_3 and ZrO2 Nano fluids. mainly three unlike methods are existing for preparation of stable Nano fluids.

3.6 By addition of nano powder in the foundation liquid

In this strategy, the nanoparticles are straightforwardly blended in the base fluid and altogether mixed. Nano liquids arranged in this strategy give poor suspension security, on the grounds that the nanoparticles settle down because of gravity, following a couple of moments of Nano liquid readiness. The hour of molecule settlement relies upon the sort of nanoparticles utilized, thickness and consistency properties of the host liquids.for increasing stability of nano fluid we use sonication process and to achive more stability we stirrers the nanofluid in magnetic stirrers for more 8 hr.

3.7 Sonication

Sonication is a process in which sound waves are used to agitate particles in solution. Such disruptions can be used to mix solutions, speed the dissolution of a solid into a liquid (like sugar into water), and remove dissolved gas from liquids.

Sound is a wave made up of alternating regions of high and low pressure. Imagine yourself as a particle. As a sound wave passes you, you experience moments of high pressure separated by periods of low pressure the frequency of a sound wave is a measure of how often the particles of a substance vibrate. The sound waves used in sonication are usually ultrasound waves with frequencies above what you can hear (above 20 kHz that is 20,000 cycles per second) and as frequency increases the strength of the agitation increases. In solution, the particles vibrate because as they experience cycles of pressure, microscopic vacuum bubbles form and then collapse into solution, a process called cavitation. These vibrations can disrupt molecular interactions (e.g. between

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molecules of water), break clumps of particles apart, and lead to mixing. In the case of dissolved gas, these vibrations can allow the gas bubbles to come together and more easily leave the solution.

Sonicators either produce sound waves into a water bath, where samples are placed, or can be probes that are put directly into the sample to be sonicated.

Figure.3.13 Ultrasonic Cleaner equipment for sonication procedure of Nanofluids

3.8 Magnetic stirrer

Magnetic stirrer or magnetic mixer is a laboratory device that employs a rotating magnetic field to cause a stir bar (also called "flea") immersed in a liquid to spin very quickly, thus stirring it. The rotating field may be created either by a rotating magnet or a set of stationary electromagnets, placed beneath the vessel with the liquid.Magnetic stirrers are often used in chemistry and biology, where they can be used inside hermetically closed vessels or systems, without the need for complicated rotary seals. They are preferred over gear-driven motorized stirrers because they are quieter, more efficient, and have no moving external parts to break or wear out (other than the simple bar magnet itself). Magnetic stir bars work well in glass vessels commonly used for chemical reactions, as glass does not appreciably affect a magnetic field. The limited size of the bar means that magnetic stirrers can only be used for relatively small experiments, of 5 liters or less. Stir bars also have difficulty in dealing with viscous liquids or thick suspensions. For larger volumes or more viscous liquids, some sort of mechanical stirring is typically needed. .Because of its small size, a stirring bar is more easily cleaned and sterilized than other stirring devices. They do not require lubricants which could contaminate the reaction vessel and the product. Magnetic stirrers may also include a hot plate or some other means for heating the liquid.

Figure.3.14 Magnetic stirrer

3.9 Measurement of density of nanofluid

To calculate the density of any fluid, pycnometer or specific gravity bottle is used. Specific gravity is a dimensionless term which is defined as density of the substance to the density of reference material. First weighed the empty bottle, now filled this bottle with the fluid whose Specific gravity has to be found and then again weighed. Calculate the difference between weights and divide it by weight of equivalent volume of water gives the specific gravity of that fluid. As we know density of water is 9810 kg/m^3 at room temperature of 28^{o}C. Thickness of arranged nanofluid was estimated utilizing Pycnometer (Figure 3.23) or explicit gravity bottle. Proportion of thickness of any liquid to thickness of refined water at 4^{0}C temperature is named as explicit gravity. Pycnometer holds a particular volume at a specific temperature. There is a fine opening in the firmly fixed ground glass stopper of Pycnometer. Additional fluid is discharged from the narrow for top filled jug and staying fluid's volume and weight was estimated. Presently weight of void container is estimated, the distinction in weight is separated by the heaviness of refined water of equivalent volume, which will give explicit gravity of given fluid. Thickness of twofold

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refined water and nanofluid of 0.1% to 0.3% (Vol.) focus was estimated utilizing Pycnometer for a temperature scope of 70°C to 80°C.

Figure:3.15 Pyrometer

Figure 3.16**:** Gravity bottle

The base liquid comprises of water-Propylene glycol mix. The thickness of Al2O3 and ZrO2nanofluids for all the volume fixations under scrutiny are estimated by utilizing Hygrometer and the thickness information acquired is contrasted and the qualities got utilizing the thickness relationship condition (Eq.3.2) created by Pak and Cho [1998] for nanofluids, which is expressed as follows

$$\rho nf = \varphi \rho p + (1 - \varphi)\rho bf$$

where a sρnf = Density of Nanofluids, kg/m**3,**
φ=nanoparticle amount concentration,
ρ_p thickness of nanoparticles, kg/m**3,**
ρ_{bf} Density of the bottom fluid, kg/m**3.**

Table. 3.5 evaluation of density of Al_2O_3nanofluid

Sr. No.	Volume concentration (φ)	Calculted density (ρ) (kg/m^3)		Pak and cho correlation (kg/m^3)	
		70°C	80°C	70°C	80°C
1	0.1	1013	1011	1038.9	1035.31
2	0.2	1028	1024	1041.82	1038.23
3	0.3	1048	1045	1044.74	1041.15

Table. 3.6 association of density of ZrO_2 nanofluid

Sr. No.	Volume concentration (φ)	Calculated density (ρ) (kg/m^3)		Pak and cho correlation (kg/m^3)	
		70°C	80°C	70°C	80°C
1	0.1	1056	1054	1040.86	1037.86
2	0.2	1075	1074	1045.72	1042.73
3	0.3	1092	1090	1050.6	1047.601

The density data for ethylene glycol and water (60:40 by volume percent) mix as an element of temperature is determined. The thickness of base liquid and thickness of Al2O3 and ZrO2Nanofluids for various volume portions are determined utilizing the thickness relationships accessible for nanofluids and the qualities are exhibited in the table.

3.9 Measurement of thermal conductivity of nanofluid

Warm conductivity of Al/water nanofluid of 0.1% (Vol.) fixation was estimated at various temperatures. Different strategies are accessible for warm conductivity measurement, similar to; impermanent hot wire procedure, temperature wavering methodKD2 Pro includes sensor needles and hand-worked small scale controller. Sensor comprises of indoor regulator and a warming component. To gauge the warm conductivity of liquids of range 0.2-2.0 W/mK, KS-1 needle can be utilized, having exactness of ±0.5%. Warm conductivity of nanofluid was estimated at various temperatures, which was constrained by PID controller here we use Yu and Choi for calculating the thermal conductivity.

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$$K_{nf} = k_f \frac{K_p+2K_f-2\,\phi(K_f-K_p)}{K_p+2K_f+\,\phi(K_f+K_p)}$$

Table. 3.7 evaluation of density of Al_2O_3nanofluid

Sr. No.	Volume concentration (φ)	Calculated thermal conductivity(K) (w/mk)		Yu and Choi (w/mk)	
		70°C	80°C	70°C	80°C
1	0.1	0.39	0.391	0.45	0.45
2	0.2	0.405	0.411	0.48	0.53
3	0.3	0.41	0.413	0.51	0.60

Table. 3.8 evaluation of density of ZrO_2nanofluid

Sr. No.	Volume concentration (φ)	Experimental thermal conductivity(K) (w/mk)		Yu and Choi (w/mk)	
		70°C	80°C	70°C	80°C
1	0.1	0.39	0.391	0.43	0.43
2	0.2	0.405	0.411	0.45	0.49
3	0.3	0.41	0.413	0.46	0.54

3.10 Viscosity measurement:

Resistance to the adjacent layer of fluid's flow is known as viscosity. A Brookfield Rheometer shown in Fig. was used for measuring viscosity in which spindle is driven by adjusted spring. The spring diversion shows the gooey drag of liquid against shaft. The measuring range of Brookfield Rheometer is determined by the dimension and outline of the spindle, the rotational speed of the spindle, filled level torque of the calibrated spring and the container in which spindle is rotating.

Figure.3.18 Brookfield Rheometer

Viscosity of nano fluid Drew and Passman suggested the familiar Einstein method for scheming viscosity, is as follows

$$\mu_{nf} = (1 + 2.5\varphi)\mu_{bf}$$

Where μ_{nf} f =Nano fluid thickness and μ_f = bottom fluid viscosity

3.11 Specific heat measurement

The specific heat is one of the important properties and plays an important role in influencing heat transfer rate of nanofluids. Specific heat is the amount of heat required to raise the temperature of one gram of nanofluids by one degree centigrade. For a given volume concentration of nanoparticles in the base liquid, the specific heat can be calculated using the mixture formula. This formula is valid for homogeneous mixtures and is given by the Eq.

$$cp_{nf} = \frac{(1-\emptyset)(\rho c_p)_{bf} + \emptyset(\rho c_p)_p}{(1-\emptyset)\rho_{bf} + \emptyset\rho_p}$$

The specific heat of Al_2O_3 ZrO_2Nanofluids at different temperatures are estimated for all the volume concentrations considered in the present work, using the Eq. () of Pak and Cho

$$Cp_{nf} = \emptyset Cp_p + (1-\emptyset)Cp_{bf}$$

3.12 Experimental procedure

An experimental set up was designed to carry out experiment at inlet temperatures and at different mass flow rates of the working fluid. Nanofluid was used as the working fluid. Following procedure was follow to carry out the experiments.Working fluid was heated by using an electric heater to raise its temperature up to the desired value. The pump was switched on and rotameter was adjusted to the required flow rate.During circulation of nanofluid, exchange of the heat takes place through Radiator.

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And temperatures were recorded with the help of thermocouples at particular location at particular mass flow rate.Similar procedure was followed to carry out the experiments at different mass flow rates and with nanofluids at different concentrations.

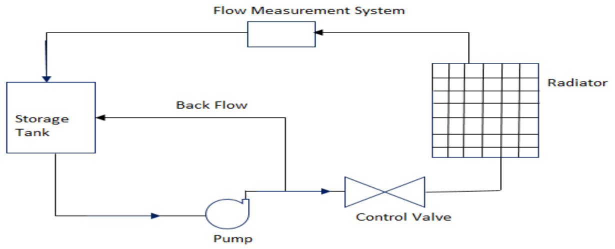
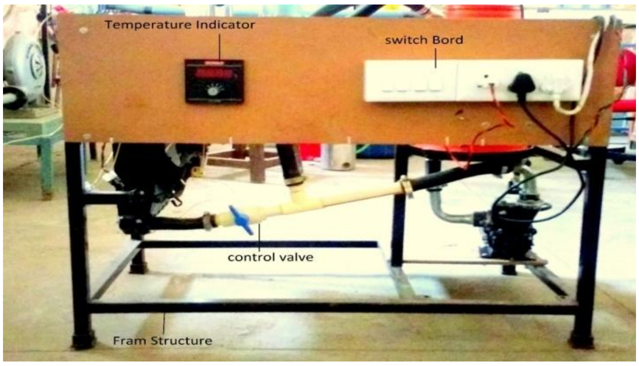


Diagram.1 Experimental set-up



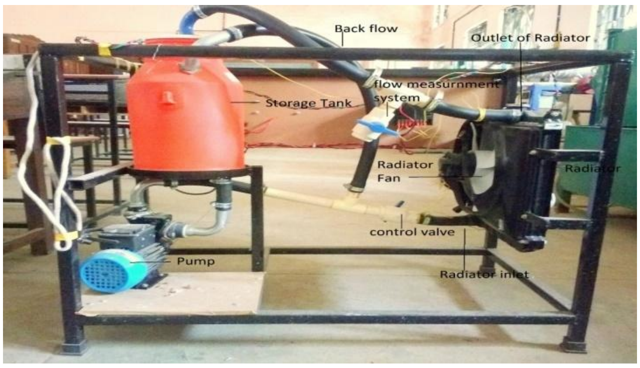


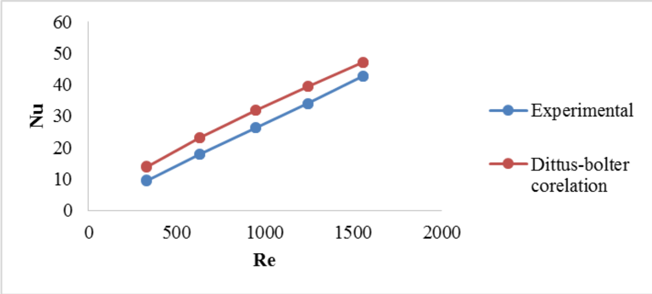
Figure.2 Actual setup front viewFigure.3 Actual setup back view

IV. RESULTS AND DISCUSSION

4.1 Data Validation

A thorough check of the instruments and the test set-up was followed by experimentation on Radiator. The average values of Nusselt number was determined. These values are compared with the values obtained from the standard correlation with Dittus-Boelter equation for Nusselt number in case of Radiator. The standard equations for Nusselt number is given as:

$$Nu = 0.023\mathrm{Re}^{0.8}\mathrm{Pr}^{0.3}$$



Graph.4.1 Nusselt number Vs Reynolds Number

4.2 Experimental Analysis

In this section, variations of temperature with the thermo-physical properties like density, viscosity, thermal conductivity was discussed.

4.2.1 Effect on properties of Nanofluid

4.2.1.1 Temperature versus Density

through boost within absorption of nano particles ranging 0.1% to 0.3% Vol by keeping the same temperature of 70°Cand 80°C, density of Al_2O_3 and ZrO_2water/EG based nanofluids measured. Density decreased by 1.8 % for ZrO_2 from 0.1 vol. % to 0.2% concentration, and 9.1% increase in density of ZrO_2 from 0.1 to 0.3 vol% concentration. While in case of Al_2O_3 3.45% increase in density from 0.1% to 0.3% vol concentration as we can see in graph density of ZrO_2nanofluid in significantly high than Al_2O_3 so we can get higher Renold number in case of $ZrO_{2,}$ as the thickness of nanoparticle is additional than the bottom fluid as well with augment in concentration, the amount of nanoparticle in bottom fluid increased which leads to increase in density with concentration. Increased density of nanofluids results in more pressure drop, more pumping power required.

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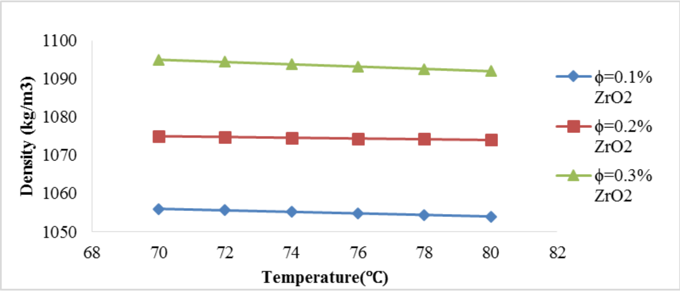
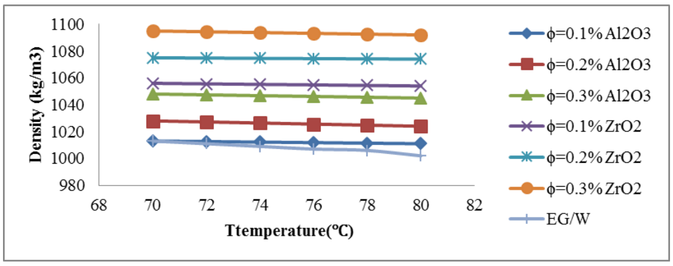


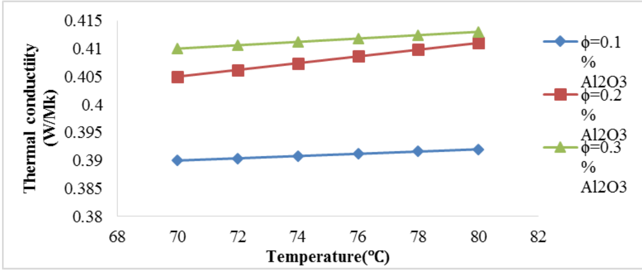
Graph.4.2 For ZrO_2 Temperature (°C) Vs. Density (kg/m$^{3)}$



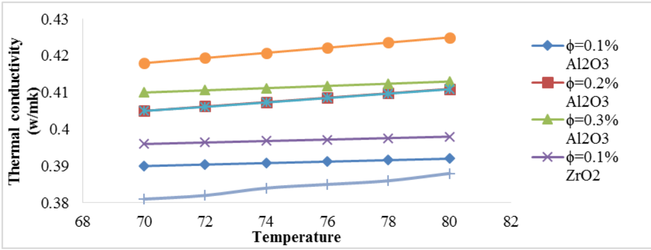
Graph.4.3 For Al_2O_3 ZrO_2 Temperature (°C) Vs. Density (kg/m^3

4.2.1.2 Temperature versus thermal conductivity

Thermal conductivity of nanofluid is measured by KD2 PRO with KS1 sensor needle is preferred for low viscosity fluid at different ranges of temperatures from volume(0.1%,0.2%,0.3%concentration)at (70to 80°C) From fig. 5, 6, it can be conclude that thermal conductivity of nanofluids increases with increase in temperature. As well as with increase in concentrations of particles. The measurement shows that element concentration and temperature are the major parameters of thermal conductivity. the exploratory estimations of warm conductivity of nanofluid expanded essentially with the liquid temperature. The explanation is that, liquid temperature reinforces the Brownian movement of nano particles with furthermore drops the consistency of the bottom liquid. With a fortified Brownian movement, the impact of smaller scale convection in temperature transport rises and in outcome expanded upgrade of the warm conductivity of nanofluids.



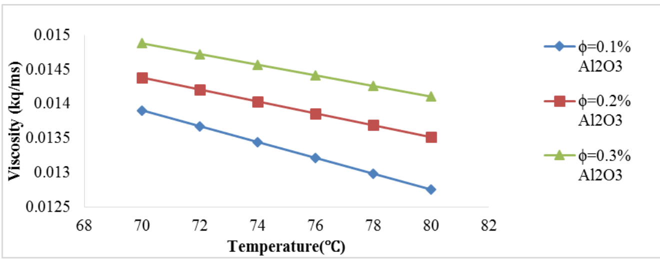
Graph.4.4 Temperature (°C) Vs. Thermal conductivity of nano solution (W/mK)



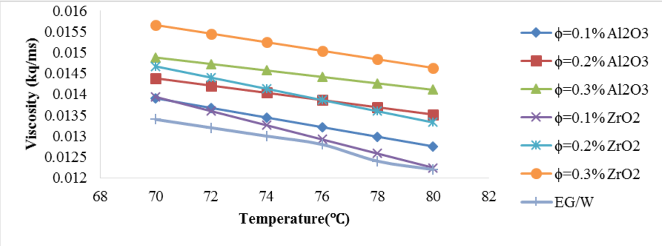
Graph.4.5 Temperature (°C) Vs. Thermal conductivity of nano fluid (W/mK)

4.2.1.3 Temperature versus Viscosity

From above data obtained by experiment and, it is concluded that viscosity of Al_2O_3 and ZrO_2 nanofluid at 0.1% (vol.) focus was somewhat higher than that of base liquid , with temperature 8.1% reduction in consistency for Al2O3 12% decline in consistency for ZrO2 for 0.1% vol fixation just in light of the fact that when strong particles are added to the fluid it builds the thickness of the blend and thusly more power will be required to conquer the inertial powers, accordingly thickness increments aside from here was irrelevant decrement of thickness with temperature.



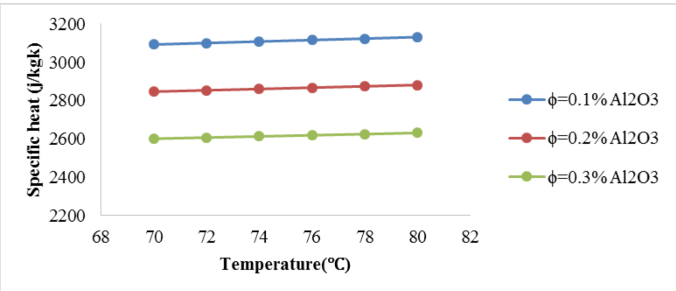
Graph.4.6 Temperature (°C) Vs. Viscosity of nano fluid, (kg/ms)



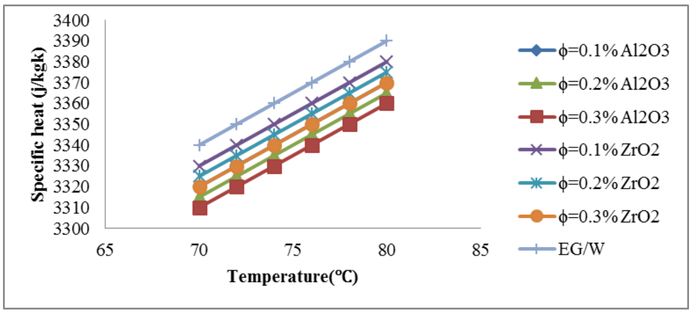
Graph.4.7 Temperature (°C) Vs. Viscosity of Nano fluid,(kg/ms)

4.2.1.4. Temperature versus specific Heat:

Variety of explicit warmth of Al_2O_3 and ZrO_2Nanofluids by means of nanofluid temperature through Al_2O_3 with ZrO_2 molecule dimensions focuses is appeared in Fig. what's more, contrasted and the particular warmth connection considering the particular warmth properties of the base from. The particular warmth of Al_2O_3 and ZrO_2nanofluids diminishes with increment in the dimensions grouping of nanofluids.



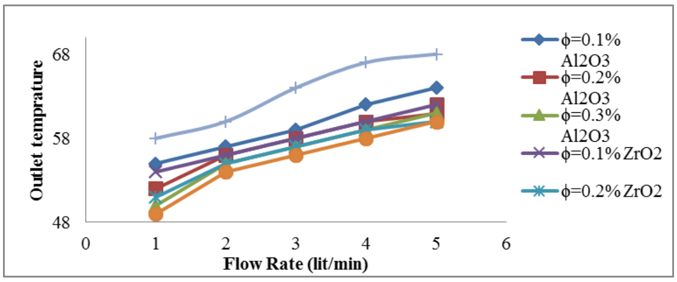
Graph.4.8 Temperature (°C) Vs. Specific heat of nano fluid, (J/kgK)



Graph.4.9 Temperature (°C) Vs. Specific heat of nano fluid, (J/kgK)

4.2.2 outcome going on Radiator production temperature

In request to ensure the impact of nanofluid resting the vent hotness of the radiator, the shape of warmer vent temperatures, hype, like component of liquid quantity stream rate circling within radiator, is given appeared in Figure 4. adding nano particles near bottom liquid diminished radiator vent temperature. It is said that, for each cooling framework, in an corresponding mass stream rate, the more decrease in working liquid temperature demonstrated better the warm presentation towards cooling framework. Also, Fig. 4 depicts the lessening in cooling velocity to increment in the amount stream rate flowing within the radiator. It might be on the grounds that, increment in volume stream rate led to increment in speed of the liquid. In this way, the liquid possessed less energy for associating through air which originates starting the fan thus the vent temperature expanded. It ought to be noticed that every one of the information in Fig. were gotten when the liquid bay temperature of the radiator was 90°C



Graph.4.10 stream % Vs. Radiator vent

4.2.3 Result on high temperature coefficient

In this investigation, the nanofluid was utilized at various Al_2O_3 and ZrO_2concentrations, that is, 0.1-0.3, vol% in a variety of stream paces of 1- 5 lit/min were executed as the operational liquids. test was done at consistent bay temperatures so as to consider the impact of on warm execution temperature of the radiator. Fig. 3 depicts Nu(exp) statistics as an element of Re digit at various groupings of nanofluid. may found in Fig. 3,. Likewise, expanding the fixation nano particles escalated the

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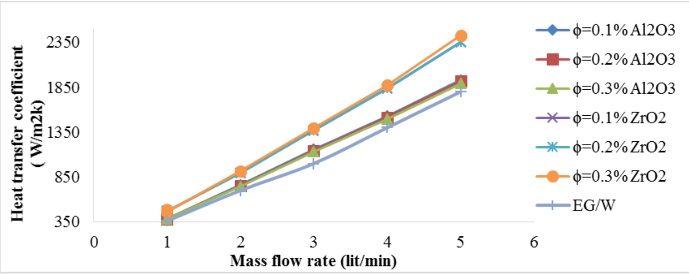
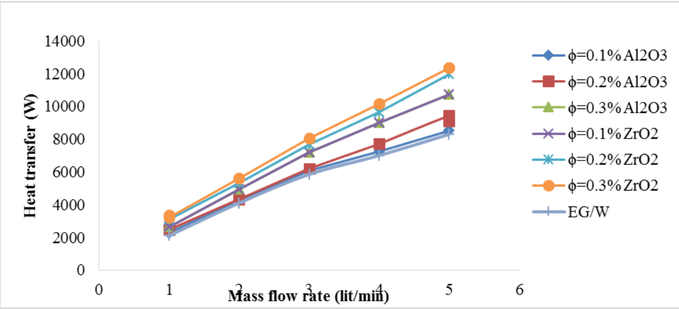
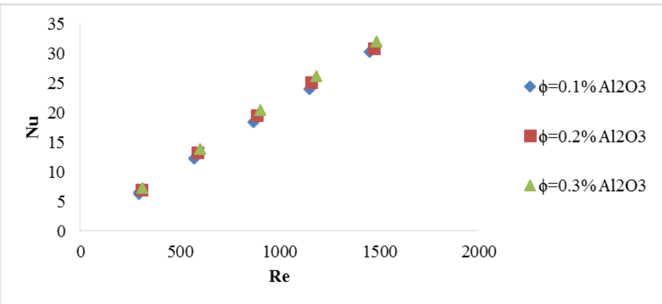
systems liable for the upgraded warmth move. In the event that we look at two nanofluid for same convergence of Al2O3 and ZrO2. ZrO2have more prominent nussult and reynold number so have more prominent warmth move coefficient and warmth move.

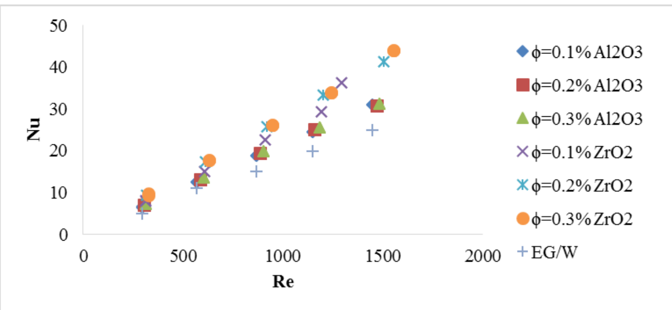


Graph.4.11 Mass flow rate Vs. Heat transfer coefficient





Graph.4.13 ForAl_2O_3Nusselt number Vs Reynolds Number



Graph.4.14 ForAl_2O_3 and ZrO_2 Nusselt number Vs Reynolds Number

CONCLUSIONS

Exploratory heat move coefficients within the vehicle radiator are evaluated with 2 unequivocal operating fluids: Al2O3 EG/W based mostly} nanofluid and ZrO2 EG/W based nanofluid and at numerous fixations and therefore the going with closes were created. update the brightness move pace of the vehicle radiator. the extent of the splendor move improvement depends on the extent of nanoparticle additional to base liquid the update of two hundredth was gotten for zero.3% volume get-together of Al2O3nanofluid unbroken and therefore the zero.1% volume mixture of Al2O3 nanofluid. The closeness of ZrO2 nanoparticle in EG/W will improve the splendor move pace of the vehicle radiator. the extent of the brightness move improvement depends on the extent of nanoparticle additional to base liquid the update of thirty one.25% was gotten for zero.3% volume party of ZrO2 nanofluid restricted and therefore the zero.1% volume mixture of ZrO2 nanofluid.On the off chance that we consider these two nanofluid we get improvement 16.2% of warmth move. These higher warmth move coefficients got by utilizing nanofluid rather than base liquid respect the working liquid in the vehicle radiator to be. Warm conductivity of base liquid was stimulated on an essential level with progress of nano particles. Other than warm conductivity saw to be a solid motivation driving control of temperature. Improvement of 7% in warm conductivity was seen at 70°C while it was 5% at 80°C for Al2O3. From 0.1% to 0.3% of volumetric fixation Enhancement of 7% in warm conductivity was seen at 70°C while it was 5% at 80°C. For ZrO2 From 0.1% to 0.3% of volumetric fixation Density of nanofluid was discreetly higher than the base liquid. With making temperature thickness was diminished. Thickness was diminished by 0.2% as temperature related from 70°C to 80°C.for Al2O3. 0.1% with making temperature thickness was diminished. Thickness was reduced by 0.2% as temperature free up from 70°C to 80°C.for ZrO2 0.1% Viscosity of nanofluid was less higher than that of base liquid, yet it was decreased in a general

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sense with temperature. Thickness of nanofluid was decreased up to 17% as temperature moves from 70°C to 80°C For Al2O3. ZrO2 nanofluids. The particular warmth of Al2O3 and ZrO2 nanofluids decreases with increment in the volume mix of nanofluids. Unequivocal warmth of nanofluids in like way increments with increment in the nanofluid temperature and the relative can be seen.

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