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Performance Testing of automobile Radiator Using Nano-fluids of Different Concentration

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ABSTRACT

Nanofluids are good replacements for cooling fluid in radiators and thermal exchangers.Materials with higher thermal properties are required to increase the performance of radiator. The use of nanofluids is one of the methods to increase heat transfer in radiators. In this research, cooling of car radiator has been investigated by using nanofluids. Results of the research indicated that the used nanofluid can increase heat transfer up to 50%. Reduction in size and weight of the radiators are among the achievements of this research. In addition to reducing the production cost, better designation of cars are possible when the radiator becomes smaller in size. On the other hand, better cooling has positive effects on fuel consumption and the amount of fuel consumption decreases.Nanofluids are produced by stable dispersing of nanoparticles in heat transfer fluids that are usually water or ethylene glycol. In this research, a system similar to car radiator cooling system has been designed and produced. Nanofluid (2 to 8 mixture of water to CuO) was used instead of radiator cooling fluid. CuO-WATER is used as nanoparticles in this project.CuO-water nanofluids consisting of 20±2 nm diameter particles at three different particle mass concentrations of 1%, 2% and 3% are used as working fluid.

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I. INTRODUCTION

Convectional heat transfer fluids such as water, minerals oil and ethylene glycol play an important role in many industrial sectors including power generation, chemical production, air-conditioning, transportation and microelectronics. Although various techniques have been applied to enhance their heat transfer capabilities, their performance is often limited by their low thermal conductivities which obstruct the performance enhancement and compactness of heat exchangers. With the rising demand of modern technology for process intensification and device miniaturization, there was a need to develop new types of fluids that are more effective in terms of heat exchange performance. To achieve this, it has been recently proposed to disperse small amounts of nanometer-sized (10–50 nm) solid particles (nanoparticles) in base fluids, resulting in what is commonly known as nanofluids.

Types of Nanofluids:-
There are several types of the Nanofluids Important among them are as follows-

- Metallic Oxides ($Al2O3$,CuO)
- Nitride Ceramics (AIN,SiN)
- Carbide Ceramics (SiC,TiC)
- Metals (Cu,Ag,Au)
- SWCNT,DWCNT
- Semiconductors ($TiO2$,Sic)

Objective:-

- An engine coolant is mixture of ethylene glycol and water in various ratios like30:70, 40:60 and 50:50 respectively are mostly used in auto-mobiles.
- Water andethylene glycol as conventional coolants have been widely used in an automotive carradiator for many years.
- These heat transfer fluids offer low thermal conductivity. An innovative way of improving the heat transfer performance of common fluids is to suspend various types of small solid particles (metallic, nonmetallic and polymeric particles) in conventional fluids to form colloidal
- However, suspended particles of the order of µm or even mm may cause some severe problems in the flow channels like; increased pressure drop, quickly settling of particles suspension, erosion etc.
- The problem associated with suspended particles also it will improve the heat transfer rates, improve engine efficiency and reduce the size of the radiator.

II. LITERATURE REVIEW

Shuichi Tori,[1]Investigated convective heat transfer coefficient of diamond based nanofluid by using heat tube apparatus. Specification of tube is 4.3mm,4mm outer and inner diameter respectively, and applied 100W power uniformly. They are showed the heat transfer coefficient is increases with increasing concentration and Reynolds numbertofn Nano fluid, but at the same time increased the pressure drop with increasing concentration of nano particle.

S.J Kim et al,[2] Investigated formation of porous layer and wet ability of nanofluid using critical heat flux experiment and SEM images. They are used three different types of nanoparticles with different diameters such as Al_2O_3 (110-220nm) SiO_2(20-40nm) Zno(110-210nm). They are showed boiling is main factor to affect the heat transfer rate of nanofluid. Due to nucleate boiling nanoparticle deposited on wall, so the porous layer is formed on the wall. Porous layer directly consequence for creating wettablity, cavity and roughness of surface wall. So heat transfer rate decreased due to boiling of nanofluid.

L.B mapa et al,[3]Measured enhanced thermal conductivity of Cu- Water based Nano fluid using a shell and tube heat exchanger. Where the dimensions of heat exchanger is 240X24X0.25mm, using 37 tubes. The outcome of analysis is rate of heat transfer is increases with increasing flow rate and also its concentration. By nanoparticle dispersed into de-ionized base fluid a better enhancement is achieved.

PaisamNaphon et al,[4] Investigated the thermal efficiency of heat pipe using titanium –alcohol Nanofluid, heat pipe dimensions are 60mm and 15mm length and outer diameter respectively. The Thermal efficiency increases with increasing tilt angle within 600 angle and concentration of nanoparticle.

Anilkumar et al,[5] Studied the heat transfer enhancement of fin, using Al2o3- water nano fluid analyzed using CFD. Reyleigh number increases due to Brownain motion, ballistic phonon transport, and clustering and dispersion effect of nanoparticle. At high Rayleigh number flow rate at center circulation is increasing, so temperature is drop from center of fin. Volume of the circulation increases the velocity at centre is increases as the result of increasing the solid fluid heat transportation. Low aspect ratio fin is suitable for heat transfer enhancement, because heat affected zone is less .

III. METHODOLOGY

1. Feasibility of Object
2. literature Survey
3. Study About Project Title
4. Selection of Component
5. Design Calculation
6. Project Modelling

IV. RADIATOR WITH NANOFLUID

In recent years, with the advancement in nanotechnology, it has been become possible to produce suspension of nanoparticles based suspensions, called nanofluids. Nanofluid term was first introduced by Choi in 1995 at the Argonne National Laboratory. The ultrafine nanoparticles are normally smaller than 100 nm and have remarkably higher thermal conductivity than base liquids. Various Researchers expect that these fluids may offer higher thermal conductivity compared to that of conventional coolants. Major properties of nanofluids make it suitable to be used in Radiator coolant one already seen is high thermal conductivity, low viscosity, high convective heat transfer coefficient, high area per unit volume.

The nanofluids project will help to reduce the size and weight of the vehicle cooling systems by greater than 10% despite the cooling demands of higher power engines. Nanofluids can help to enable the potential to allow higher temperature coolants and higher heat rejection in the automotive engines. It is estimated that a higher temperature radiator could reduce the radiator size approximately by 30%. This translates into reduced aerodynamic drag and fluid pumping and fan requirements, leading to perhaps a 10% fuel savings. It is interesting idea in these years which humans involved in the energy and fuel shortage crisis

V. DESIGN OF EXPERIMENTAL SETUP

The experimental setup is designed in CATIA software. The CATIA and actual model is as shown in following fig.

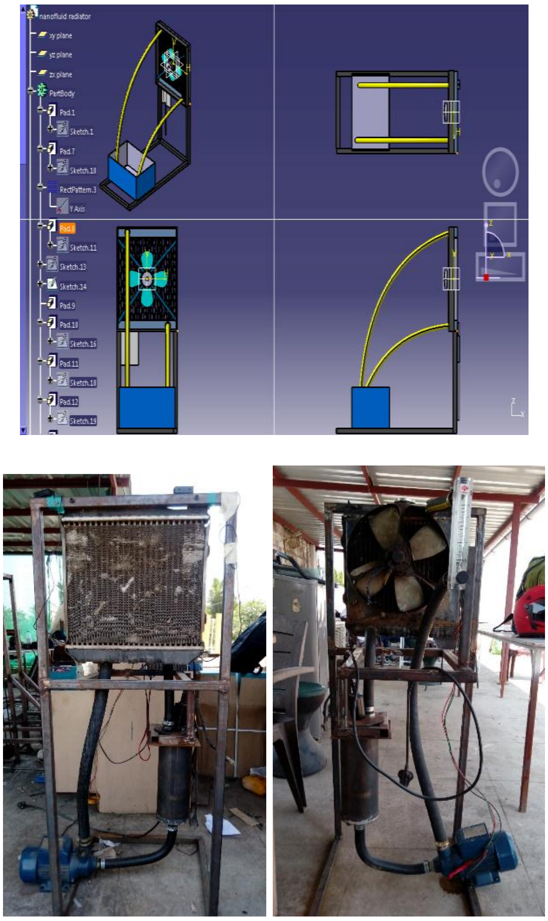

Fig. 3D CAD Model and manufacturing unit

Advantage:

- High specific surface area and therefore more heat transfer surface between particles and fluids.
- High dispersion stability with predominant Brownian motion of particles.
- Reduced pumping power as compared to pure liquid to achieve equivalent heat transfer intensification
- Reduced particle clogging as compared to conventional slurries, thus promoting system miniaturization.
- Adjustable properties, including thermal conductivity and surface wet ability, by varying particle concentrations to suit different applications.

Application:-

- Space and Defense.
- Heat transfer intisification.
- Transportation.
- Electronic Application.
- Nuclear systems cooling.
- Industrial cooling.

VI. CONCLUSION

1) With decrease in mass flow rate, temperature difference between inlet and outlet temperature of coolant increases.

2) With increase in time in min, temperature difference between inlet and outlet temperature of coolant increases.

3) With decrease in mass flow rate, average heat transfer rate of coolant increases. In the graph nanofluid is having better average heat transfer rate as compared to water and water + ethylene glycol.

4) Among the different concentrations of CuO taken, 3% vol, concentration of Nanoparticles show highest effectiveness.

5) With increase in time in min, average heat transfer rate of coolant increases. In the graph nanofluid is having better average heat transfer rate as compared to water and water + ethylene glycol.

It is concluded that nanofluids are having better heat transfer rate as compared to other coolants and they can be considered as a potential candidate for numerous applications involving heat transfer and their use will continue to grow. It is also found that the use of nanofluids appears promising, but the development of the field faces several challenges. Nanofluid stability and its production cost are major factors in using nanofluids. The problems of nanoparticle aggregation, settling, and erosion all need to be examined in detail in the applications. We can say that once the science and engineering of nanofluids are fully understood and their full potential researched, they can be reproduced on a large scale and used in many applications.

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REFERENCES

[1] Gur CH, Pan J: Handbook of Thermal Process Modeling of Steels New York: CRC Press Publication; 2008.

[2] Murshed SMS, Leong KC, Yang C: Enhanced thermal conductivity of TiO2- water based nanofluids. Int J Thermal Sci 2005, 44:367-373. .

[3] Masuda H, Ebata A, Teramae K, Hishinuma N: Alternation of thermal conductivity and viscosity of liquid by dispersing ultra-fine particles (dispersion of γ-Al2O3,

SiO2 and TiO2 ultra-fine particles). NetsuBussei 1993, 4:227-233. .

[4] Lee S, Choi SUS, Li S, Eastman JA: Measuring thermal conductivity of fluids containing oxide nanoparticles. Trans ASME J Heat Transfer 1999, 121:280-289.

[5] Assael MJ, Chen CF, Metaxa I, Wakeham WA: Thermal conductivity of suspensions of carbon nanotubes in water. Int J Thermophys 2004, 25:971-985.

[6] . Li CH, Peterson GP: Mixing effect on the enhancement of the effective thermal conductivity of nanoparticle suspensions (nano fluids). Int J Heat Mass Transfer 2007, 50:4668-4677.

[7]. Xie H, Wang J, Xi T, Liu Y: Thermal conductivity of suspensions containing conductivity of suspensions containing nanosizedSiC particles. Int J Thermophys 2002, 23:571-580.