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A Review on Experimental Investigation of Heat Transfer Rate by using Alumina Oxide Nano Fluid in Radiator

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Abstract: ***Experimental study is performed to investigate the effect of particle shape on heat transfer rate of Al2O3 with water based nanofluid. In this work, nanofluid is prepared by two step method in water using probe sonicator. The particles used in this project is alumina (Al2O3) nanoparticles at different concentrations in the base fluid which is water (Deionised).Al2O3-water nanofluid is prepared at 0.5-1.5wt% of concentration with an interval of 0.5wt% and its heat transfer rate is measured in the temperature range of 333K to 353K.In this experiment we used different shapes of nanofluid.***
Keywords: Nano particles, Heat transfer, Radiator, Al2O3.

I. INTRODUCTION

Nanofluid is an emerging branch of nanotechnology, which may resolve some major difficulties in the area of thermal engineering. Nanofluid is a contaminated suspension of nanosize particles in base fluid. Nanosize particles may be metal oxide, metal sulfide, carbides, nitrides and carbonaceous materials like carbon nanotubes, graphene, fullerene ebc. Nanofluids play an important role for effective heat Transfer. In automobile industrial application, water is commonly used to transfer heat through radiator for cooling engine. The conventional heat transfer fluids have poor thermal conductivity compared to solids. In past years many researches have been studying the properties of Nanofluids, and it's expected to be the next generation of heat transfer technology due to the better thermal performance compared to the tradional heat transfer fluids. Enhancement in thermal properties is depends on the method of preparation, particle size, type of particle ebc. Improved thermal properties of nanofluids also allow circulating nanofluids with lower flow rate than the base fluid for the same heat transfer which in turn reduces the pumping power required than the base fluid. Nanofluids give their best results only if they are prepared well. Experimental conditions were tried to keep as close as possible to the conditions of working automotive car radiator. Nanofluids of different volumetric concentration were used and experimentation was done at different liquid flow rates to have through understanding of thermal performance enhancement of nanofluids in radiator. By suspending nanophase particles in heating or cooling fluids, the heat transfer performance of the fluid can be significantly improved.

II. LITRETURE REVIEW

1) *Ng Yee Shian:* He was conclude that the degree of the heat transfer enhancement depends on the amount of nanoparticle added to pure water. Increases the flow rate of working fluid enhances the heat transfer coefficient for both pure water and nanofluid.
2) *Kaufui Vincent:* Nanofluide are important because they can used in many application and improves efficiency.Lower flow rates resultrd in greater heat transfer rates as compared to high flow rates for the same volumetric concentration.
3) *Pratik T Patil:* Increased in % of concentration of nano meterized size particles inside the nanofluid increases the heat transfer rate but it increases the pumping work.
4) *Bharat Ramani, Akhilesh Gupta:* Heat transfer rate by nanofluid coolant is significantly increases with the increase in concentration of nanoparticles.In this paper performance of nanofluids as a car radiator coolant has been experimentally investigated at different coolant inlet temperatures.
5) *Fadhilah Shikh Anuar:* By using nanofluid the heat transfer coefficient has been increases and also the thermal conductivity of nanofluid .Major contribution in heat transfer enhancement is flow rate for nanofluid and volume fraction of nano particles.
6) *S. M. Peyghambarzadh, S. H. Hashemabadi:* The presence ofAl2O3 nanoparticle in water can enhance the heat transfer rate of the automobile radiator.
7) *K . Y leong, R Saidur:* Heat transfer rate is increased with increase in volume concentration of nano particles.
8) *A Renuka Prasad, P S Singh:* It has been increases the stability and properties of nanofluids.
9) *Hasan Ali, Ahmad Saieed:* He conclude that addition of Al2o3 nano particles in water considerably enhances the heat transfer rates as compared to pure water.
10) *Hafiz Mohammad Ali:* Convective heat transfer performance of an radiator is increases.

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III. EXPERIMENTAL SET UP AND PROCEDURE:-

The experimental set up consists of following specifications: Reservoir tank (20-25 Lit), electrical heater (2000 W), pump (0.5 hp), flow meter (0- 25lpm),tubes, valves, forced fan (1500 rpm), digital thermocouple type K type for temperature measurement, heat exchanger (Car radiator) made of aluminium alloy having 22 tubes equally spaced along entire rectangular area. Fig -3.1: Schematic of Experimental Set up.

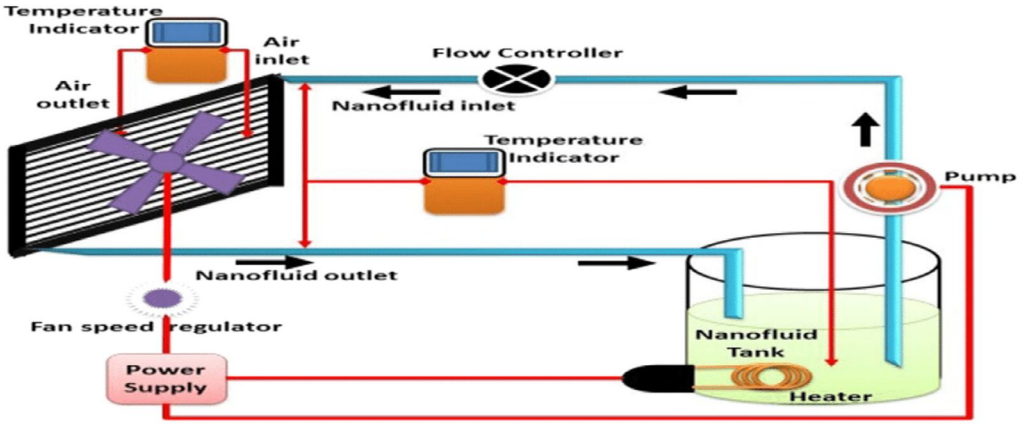


Fig.Schematic of Experimental Set up.



1) *Details:* Collection tank (reservoir) 20 to 25 litres contains a coolant fluid which is heated by electric heater (2 KW) up to a certain suitable temperature allows to pass through a pump (0.5 hP) which provides datum head up to 10-12 m. flow control valve is used to regulate the flow supply and flow meter (0-25 lpm) is used to fix constant flow rate from 5 to 9 lpm. Inlet and outlet temperatures of coolant is noted and simultaneously forced fan i.e. exhaust air fan (1500 rpm) is used to cool down the hot coolant fluid flowing through a radiator tubes. Forced convection fan cools down the temperature of hot coolant and cool fluid again passes to collection tank to complete the cycle. Firstly we used water as a coolant and then different concentrations with volume fractions are used as as a coolant for cooling of car radiator. The observations are recorded for further calculation of thermal performance.

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IV. METHODS FOR PREPARATION OF NANOFLUIDS:-

Preparation of nanofluids is the first key step in applying nanophase particles to changing the heat transfer performance of conventional fluids. Some special requirements are necessary, such as even suspension, stable suspension, durable suspension, low agglomeration of particles, no chemical change of the fluid. In general, these are effective methods used for preparation of suspensios. Nanofluids can be prepared by two methods :single and two step methods.

A. Two - Step Method

It's the most widely used method for preparing nanofluids. Nanoparticles, nanofibers, nanotubes, or other nanomaterials used in this method are first produced as dry powders by chemical or physical methods. Then, the nanosized powder will be dispersed into a fluid in the second processing step with the help of intensive magnetic force agitation, ultrasonic agitation, highshear mixing, homogenizing, and ball milling. Two-step method is the most economic method to produce nanofluids in large scale, because nanopowder synthesis techniques have already been scaled up to industrial production levels. Due to the high surface area and surface activity, nanoparticles have the tendency to aggregate. The important technique to enhance the stability of nanoparticles in fluids is the use of surfactants. However, the functionality of the surfactants under high temperature is also a big concern, especially for high-temperature applications. Due to the difficulty in preparing stable nanofluids by two-step method, several advanced techniques are developed to produce nanofluids, including one-step method.

B. One Step Method

To reduce the agglomeration of nanoparticles, Eastman et al. developed a one-step physical vapor condensation method to prepare nanofluids. The one-step process consists of simultaneously making and dispersing the particles in the fluid. In this method, the processes of drying, storage, transportation, and dispersion of nanoparticles are avoided, so the agglomeration of nanoparticles is minimized, and the stability of fluids is increasd. The one-step processes can prepare uniformly dispersed nanoparticles, and the particles can be stably suspended in the base fluid. The vacuum-SANSS (submerged arc nanoparticle synthesis system) is another efficient method to prepare nanofluids using different dielectric liquids.

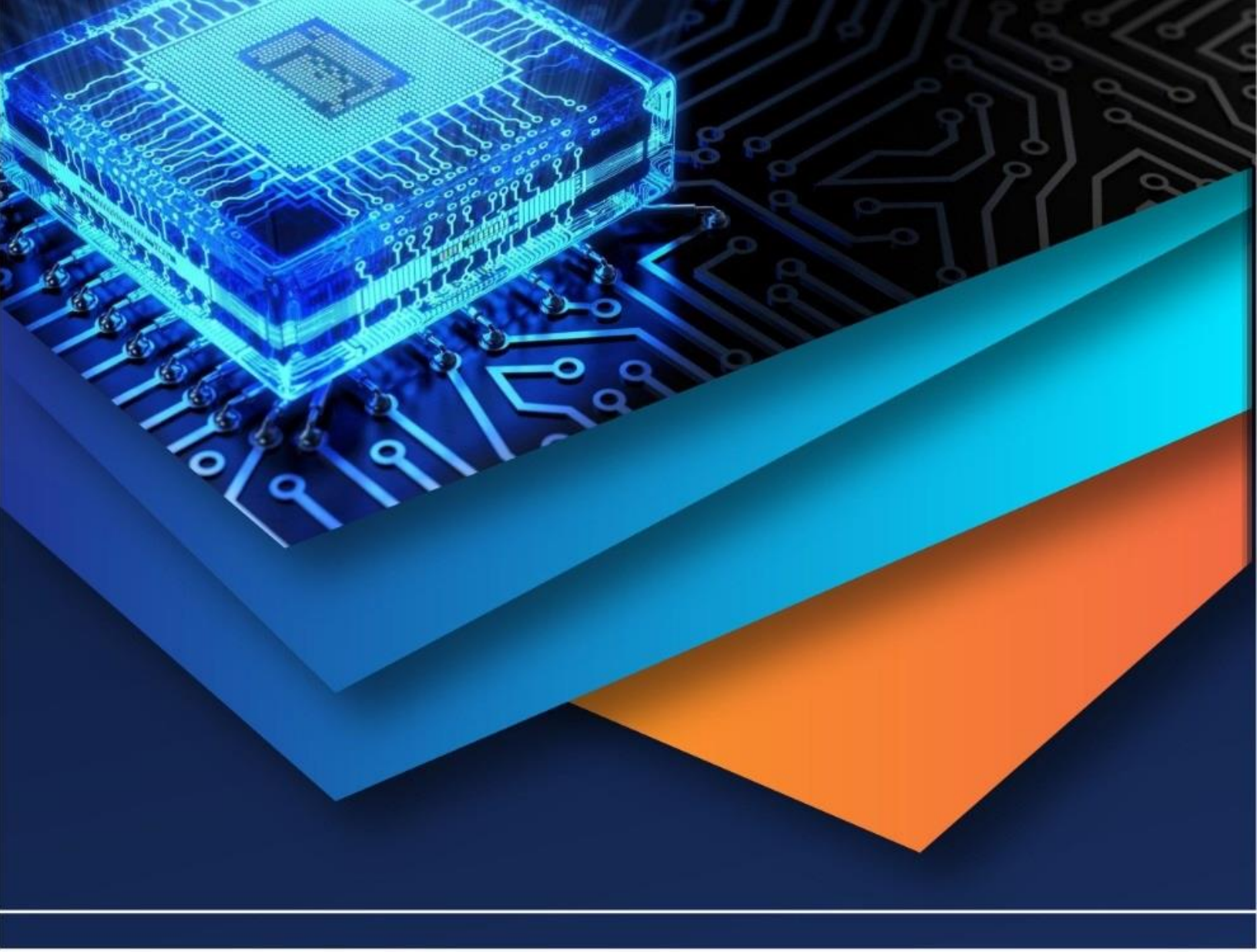
C. Calculation

Heat transfer rate, is calculated from the formula, Q =mCp(Tin-Tout).

V. CONCLUSION

This paper conclude that the degree of the heat transfer enhancement depends on the amount of nanoparticle added to pure water. The presence of Al2o3 nanoparticle in water can enhance the heat transfer rate of the automobile radiator. Major contribution in heat transfer enhancement is flow rate for nanofluid and volume fraction of nano particles. The different techniques for preparation of nano fluids are discussed in this paper.

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