Research Paper

ANALYSIS OF RADIATOR WITH DIFFERENT TYPES OF NANO FLUIDS

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ABSTRACT:

In cooling system of automobile engine the water is evaporate at high temperature, so we need to add water and also water is low capacity of absorb heat. By using nano fluids in radiator instead of water, we can improve the thermal efficiency of radiator. So cooling effect of the radiator is improved and the overall efficiency of engine will increased.

KEY WORDS: Nano Fluids, Radiator, Cooling, Engine, Thermal Efficiency, Heat Exchanger.

1. INTRODUCTION

A Nanofluid is a fluid containing nanometer-sized particles, called nanoparticles. The main objective of the project is to improve the efficiency of the radiator cooling system. Efficiency of the cooling system can increase by mixing the nano fluids with the base fluids in some ratio. Nano fluid is mixed with the base fluid. The base fluid used in radiator is Water, Ethylene- or ethylene glycols and other coolants. Conventional heat transfer fluids such as Water, mineral oil, and ethylene glycol play an important role in many industries including power generation, chemical production, air conditioning, transportation, and microelectronics. However, their inherently low thermal conductivities have hampered the development of energy-efficient heat transfer fluids that are required in a plethora of heat transfer applications. This new type of heat transfer suspension is referred to herein as a nano fluid. In particular, carbon nano tube-containing nano fluids provide several advantages over conventional fluids, including thermal conductivities far above those of traditional solid/liquid suspensions, a nonlinear relationship between thermal conductivity and concentration, strongly temperature-dependent thermal conductivity, and a significant increase in critical heat flux. An emerging and new class of coolants is nano fluids which consist of a carrier liquid, such as water, dispersed with tiny nano-scale particles known as nanoparticles. Purpose-designed nanoparticles of e.g. CuO, alumina, titanium dioxide, carbon nano tubes, silica, or metals (e.g. copper, or silver nano rods) dispersed into the carrier liquid the enhances the heat transfer capabilities of the resulting coolant compared to the carrier liquid alone. The enhancement can be theoretically as high as 350%.The experiments however did not prove so high thermal conductivity improvements, but found significant increase of the critical heat flux of the coolants.

2. SETUP FOR EXPERIMENT

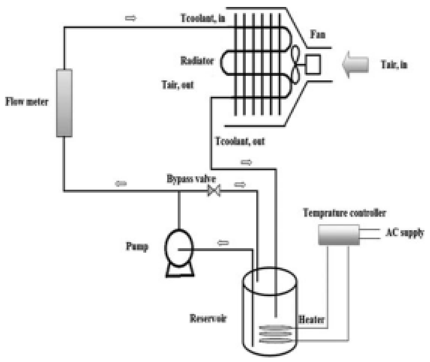

Fig 2.1 setup up for experiment

The experimental setup for the radiator cooling system is shown in fig. it contain

- Radiator
- Coolant Reservoir
- Fan
- Pump
- Heating Element
- Thermocouple

3. COOLING PROCESS

The radiator is part of the cooling system of the engine Automobile radiators utilize mostly a cross-flow heat exchanger. The two working fluids are generally air and coolant. As the air flows through the radiator, the heat is transferred from the coolant to the air. The purpose of the air is to remove heat from the coolant, which causes the coolant to exit the radiator at a lower temperature than it entered at.

Coolant is passed through engine, where it is absorb heat. The hot coolant is then feed into tank of the radiator. From tank of radiator, it is distributed across the radiator core through tubes to another tank on opposite side of the radiator. As the coolant passes through the radiator tubes on its way to the opposite tank, it transfers much of its heat to the tubes which, in turn, transfer the heat to the fins that are lodged between each row of tubes. The radiator acts as a heat exchanger, transferring excess heat from the engine's coolant fluid into the air. The radiator is composed of tubes that carry the coolant fluid, a protective cap that's actually a pressure valve and a tank on each side to catch the coolant fluid overflow. In addition, the tubes carrying the coolant fluid usually contain a turbulator, which agitates the fluid inside. This way, the coolant fluid is mixed together, cooling all the fluid evenly, and not just cooling the fluid that touches the sides of the tubes. By creating turbulence inside the tubes, the fluid can be used more effectively.

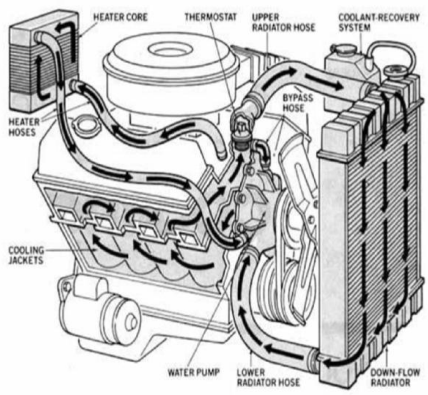

Fig 3.1Working in Engine

When coolant fluid overheats, it expands, causing the fluid to become highly pressurized. When it enters the radiator, the pressure increases even more because it's in an enclosed space. The radiator cap acts as a release valve set to open at the maximum pressure point. Usually this is set at a density of 15 pounds per square inch.[6] When the fluid pressure inside the radiator exceeds 15 psi, it forces the valve open, allowing heat to escape and excess coolant fluid to overflow into the tanks on either side of the radiator. Once the radiator cools down, the coolant fluid in the overflow tanks gets sucked back into the pump, continuing its route through the cooling system. Cars with automatic transmissions cool transmission fluid in the same way with a separate heat-exchange circuit built into the radiator. This two-step process of cooling the transmission fluid is equivalent to a radiator within a radiator. As the heated transmission fluid enters the transmission cooler, the oil's heat is exchanged with the coolant fluid in the radiator, making the transmission fluid cooler while heating the coolant fluid instead. Then the coolant fluid's heat is transferred to air in the radiator itself.

4. CALCULATION FOR MIXING OF NANO FLUID AND HEAT CAPACITY

Estimation of nano particle volume concentration

The amount of nano particles required for preparation of nanofluids is calculated using the formula.

$$\%\ \text{volume concentration} = \frac{\left[\dfrac{W_{CuO}}{\rho_{CuO}}\right]}{\left[\dfrac{W_{CuO}}{\rho_{CuO}} + \dfrac{W_{bf}}{\rho_{bf}}\right]} = \frac{\left[\dfrac{W_{CuO}}{6300}\right]}{\left[\dfrac{W_{CuO}}{6300} + \dfrac{100}{1036}\right]}$$

Specific dissipation

The mass flow rate of air through the radiator is difficult to measure accurately. The cooling performance found by measuring the specific dissipation (sd) of the install radiator. The specific dissipation is a measure of the heat rejection of a radiator and is defined by the maximum temperature difference across the heat exchanger as per equation.

$$SD = \frac{Q}{T_{coolant,in} - T_{air,in}} = \frac{\dot{m}_{coolant} \times C_{p,coolant} \times (T_{coolant,in} - T_{coolant,out})}{T_{coolant,in} - T_{air,in}} \quad [\text{W/K}]$$

5. CALCULATION FOR NANO FLUIDE.

The air-side and coolant side heat transfer rates can be calculated as

$$Qa = ma\ Cpa\ (\Delta ta)$$

(For Air Side)

$$Qc = mc\ Cpc\ (\Delta tc)$$

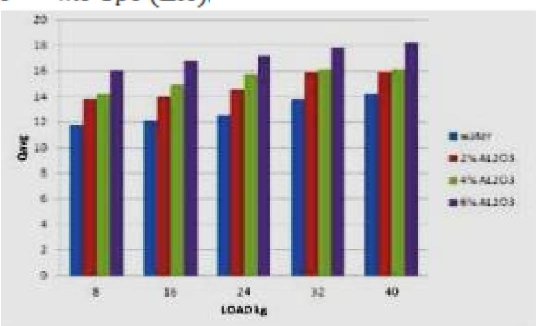

Fig. 5.1 Percentage of Heat Transfer rate vs. Load Coolant

6. CONCLUSION

It has been seen that nanofluids can be considered as a potential candidate for Automobile application. As heat transfer can be improved by nanofluids, in Automobile radiators can be made energy efficient and compact. Reduced or compact shape may results in reduced drag, increase the fuel economy, reduce the weight of vehicle**.** Exact mechanism of enhanced heat transfer for nanofluids is still unclear as reported by many researchers. There are different challenges of nanofluids which should be identified and overcome for Automobile radiators application.

EFFECT ON HEAT TRANSFER RATE

The heat transfer rate in automobile radiator increases by adding nano particles of Al_2O_3 in water. The heat transfer rate in radiator, using water as coolant is 8 kg load at coolant flow rate of 10 lpm. Whereas heat transfer rate is 11.77 KW now adding 2% volume fraction Al_2O_3 in water.

Heat transfer rate increase 14% compare to water. Simultaneously adding 4% volume fraction of Al_2O_3 in water heat transfer rate increase 17% and adding 8 % volume fraction of Al_2O_3 in water. There is an increase of about 26% in heat transfer rate in automobile radiator compare to use water as coolant.

EFFECT ON WEIGHT AND SPACE

By using nanofluid, we get better heat transfer, so we can design compact and lighter heat exchange system with same heat transfer capacity.

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