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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Performance Analysis of Automobile Radiator Using Different Nano Fluids

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ABSTRACT

The automotive sector is a huge arena for research work for passenger comfort. There are numerous study areas available in the world of automobile such as suspension system, steering system, break system, engine design, and many more. The engine of any vehicle is regarded as the heart of the vehicle. Furthermore, an engine can only function properly if its cooling system is properly cooled. Overheating and overcooling will result in engine damage. As a result, proper engine cooling is a critical study subject in every vehicle industry. Engine cooling is made up of numerous components such as a radiator, a pump, and so on. The engine is cooled by coolants that pass via the radiator tubes. Coolants take heat from engine and reject it to atmospheric air while passing through radiator tube. Coolants is a mixture of water and ant freezing agent mostly ethylene glycol. Water is one of the most effective coolants due to its thermo physical properties. But when we mix ant freezing agent in water its cooling capacity gets decrease. Now to increase its cooling capacity we have to make bigger radiator which further increase the weight of the automobile which decrease engine performance. So, there is a need of new technology for coolants which increase the cooling capacity without increase the size of radiator.

Keywords-Coolant, Radiator, Anti freezing agent, Cooling Capacity

1.INTRODUCTION

Heat transfer has been a significant difficulty for the automobile in terms of improving performance and efficiency. Convection heat transfer is critical in car cooling systems. Heat must be added, removed, or transported from one operation to another throughout the automobile component manufacturing process. A radiator is an important component of an engine. Radiators are heat exchangers that are used to cool internal combustion engines and are also found in aircraft, locomotives, and other vehicles. It is typically utilised as a cooling system in an engine. The majority of liquid cooling systems include radiators, water pumps, electric cooling fans, thermostats, and storage tanks. As a cooling medium, water and ethylene glycol are commonly utilised. However, the limited thermal ability of traditional fluids limits heat transmission to provide the optimal performance. As a result, it is critical to develop a new heat transfer fluid capable of outperforming common fluids in terms of thermal performance. The most recent technical innovation is the emergence of a new class of coolants known as NANO FLUIDS (Nano particles with base materials). Choi developed nanofluids for the first time as a suspension of nano-sized particles in ordinary fluids such as water, ethylene glycol, propylene glycol, oil, and so on. Nano fluids exhibit higher heat transfer, effective thermal conductivity, diffusivity, and Brownian motion than ordinary fluids. Nano fluids are employed in many different applications such as microelectronics, transportation, manufacturing, and bio engineering.

2.PROBLEM IDENTIFICATION

A high efficiency engine demonstrates improved fuel economy as well as lower emissions, all of which are priorities in modern vehicular transportation. Efforts have been made in the past to improve vehicle design in terms of compacting essential components, primarily engine heat sink/transfer units like radiators, which can still be improved on certain grounds, as they fall back in terms of improved cooling efficiency/rate currently required in the modern age of motor transportation. The issue related with them might be stated in the following points:

- The radiator's typical design philosophy/concept limits its cooling rate/efficiency.
- •The general heat transfer fluids utilised in cooling systems have low thermal conductivity.

3.OBJECTIVES

The main objectives in this research work are

a. To numerically analyzes the heat transfer rate and Second law efficiency of an automotive radiator.
b. To compare the cooling capacities and Second law efficiency of the aforementioned radiator considering four different nano-sized

particles in the base fluid.

c. To assess the effects of various operating parameters on radiator cooling capacity and Second Law efficiency, such as inlet temperature of air, inlet temperature of coolant, mass flow rate of air, mass flow rate of coolant, and volume concentration of nano-particles.

4.RESULTS AND ANALYSIS

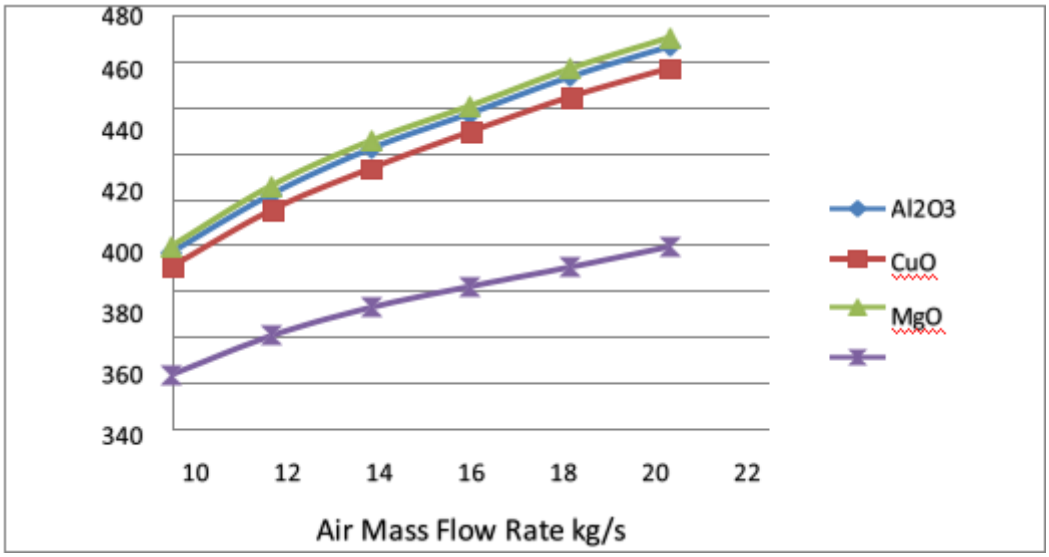

Figure 4.1 Variation of air mass flow rate on heat transfer.

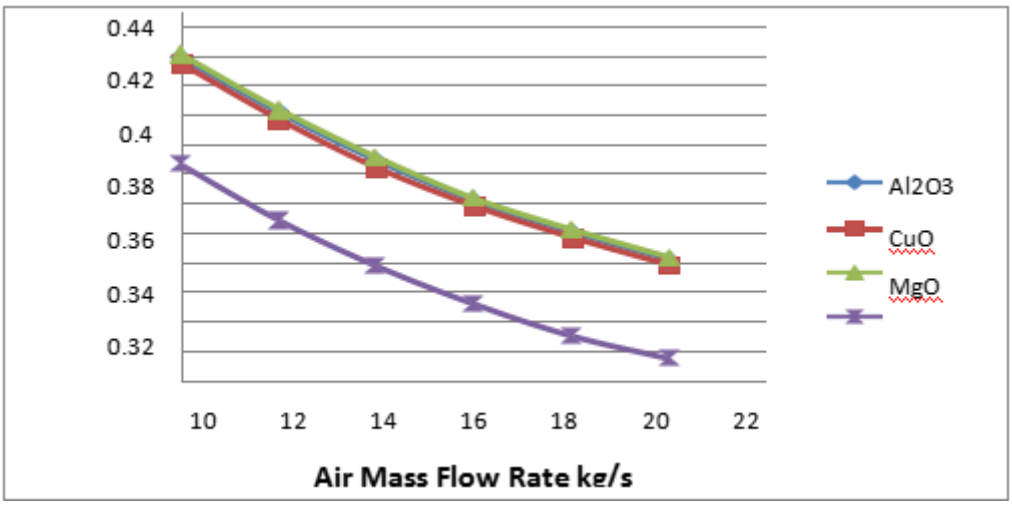

Figure 4.2 Variation of air mass flow rate on second law efficiency.

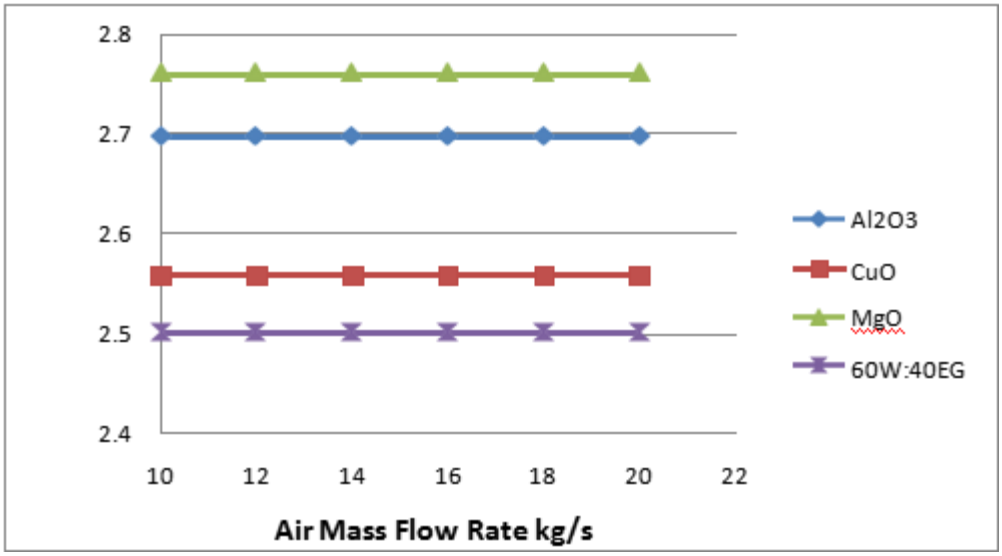

Figure 7.3 Variation of air mass flow rate on pumping power.

CONCLUSION

The following conclusions can be brought from the study:

- When nano-fluids were employed as coolants instead of only base fluids, the total heat transfer rate of the radiator was found to be greater. The total heat transfer rate of the radiator increased by 15% to 18% when nanoparticles were added to the base fluid. Nano fluids based on MgO, Al2O3, and CuO have higher total heat transfer rates than base fluid coolants at 18%, 17%, and 15%, respectively. When compared to other nano fluids, MgO-based nano fluids have the highest total heat transfer rate.
- The radiator's second law efficiency was shown to be higher when nanofluids were employed as coolants rather than just base fluids. The use of nanoparticles in the base fluid increased the radiator's second law efficiency by 19% to 21.5%. Nano fluids based on MgO, Al2O3, and CuO have a second law efficiency grater than 21.42%, 20.95%, and 19.75% of base fluid coolant, respectively. When compared to other nano fluids, MgO-based nano fluids have the highest second law efficiency.

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