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Enhancement of Performance on Automobile Radiator Fin by Nano Fluids

Jatin Sahare[1], *Dr Satyendra Sharma*[2]

[1]PG scholar, Department of Mechanical Engineering, SAGE University, Indore
[2]Assistant Professor, Department of Mechanical Engineering, SAGE University, Indore

ABSTRACT

The latest technology coolant known as Nano Fluids is nothing more than a mixture of nano-sized particles in a mixture of water and an anti-freezing chemical. Nano fluids will produce better cooling than conventional coolants due to their superior thermophysical properties.The current study used 60% water and 40% ethylene glycol as the base fluid, together with three nano particles: Al2O3, CuO, and MgO. The radiator is a cross flow heat exchanger with unmixed fluid that is used with a TBD-232 type diesel engine. A computer programme in C++ was written to calculate the total heat transfer rate and second law efficiency. The current study indicated that using nano-fluids as coolants instead of base fluids increased the total heat transfer rate of the radiator. 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.Total heat transfer rate increases as air mass flow rate increases, whereas second law efficiency decreases. On the other hand, when coolant mass flow rate increases, so does total heat transfer rate and second law efficiency.

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

1.INTRODUCTION

The scientific community has made substantial and rapid progress in discovering many practical applications for nanofluids. Dispersing nano-sized particles in a base fluid yields nanofluids. Nanofluids have nearly limitless applications. They can, for example, be used to cool electronic gadgets, medical applications, fuel cells, solar energy systems, and engine lubrication. Measuring thermophysical properties of nanofluids such as thermal conductivity and dynamic viscosity is an important topic for using nanofluids in high-temperature heat transfer systems such as heat exchangers and vehicle engines. The viscosity of a coolant in heat exchangers is a major factor in the necessary pump power. Thermal conductivity also influences coolant flow characteristics. It is important to note that vehicle engine lubricants must keep their viscosity at high temperatures. Furthermore, the thermophysical properties of fluids used as coolants in automotive applications might influence system size and give a smaller engine. Many investigations on the thermophysical properties of nanofluids have been done. In addition, novel correlations for predicting the behaviour of nanofluids have been proposed in several investigations. The majority of these connections are temperature and solid volume fraction dependent. Although these models lack a theoretical foundation, they are widely used in engineering applications due to their ease of correlation of experimental data. In order to estimation of dynamic viscosity and thermal conductivity from experimental data, another method which has been used in recent years is artificial neural.

2.OBJECTIVES

The main objectives in this research work are

To numerically analyzes the heat transfer rate and Second law efficiency of an automotive radiator.

To compare the cooling capacities and Second law efficiency of the aforementioned radiator considering four different nano-sized particles in the base fluid.

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.

3.RESEARCH METHODOLOGY

Furthermore, developing a mathematical model that can be used for every type of nano particle as well as variable fin geometry is a difficult task in the study. To perform this work, numerous publications on energy and exergy computation are studied. A universal mathematical model has been developed after gathering all of the formulas required to compute total heat transfer rate and second law efficiency.

To compute total heat transfer rate and second law efficiency, one must go through mathematical modelling and calculate more than fifty parameters for a single working situation, which is time-consuming and labour-intensive. To address this issue, a C++ software was created in which one click would calculate all parameters in less than a second. Now, after evaluating various operating conditions, one may quickly tabulate the readings and generate an X-Y chart to deliver the best nano fluids.

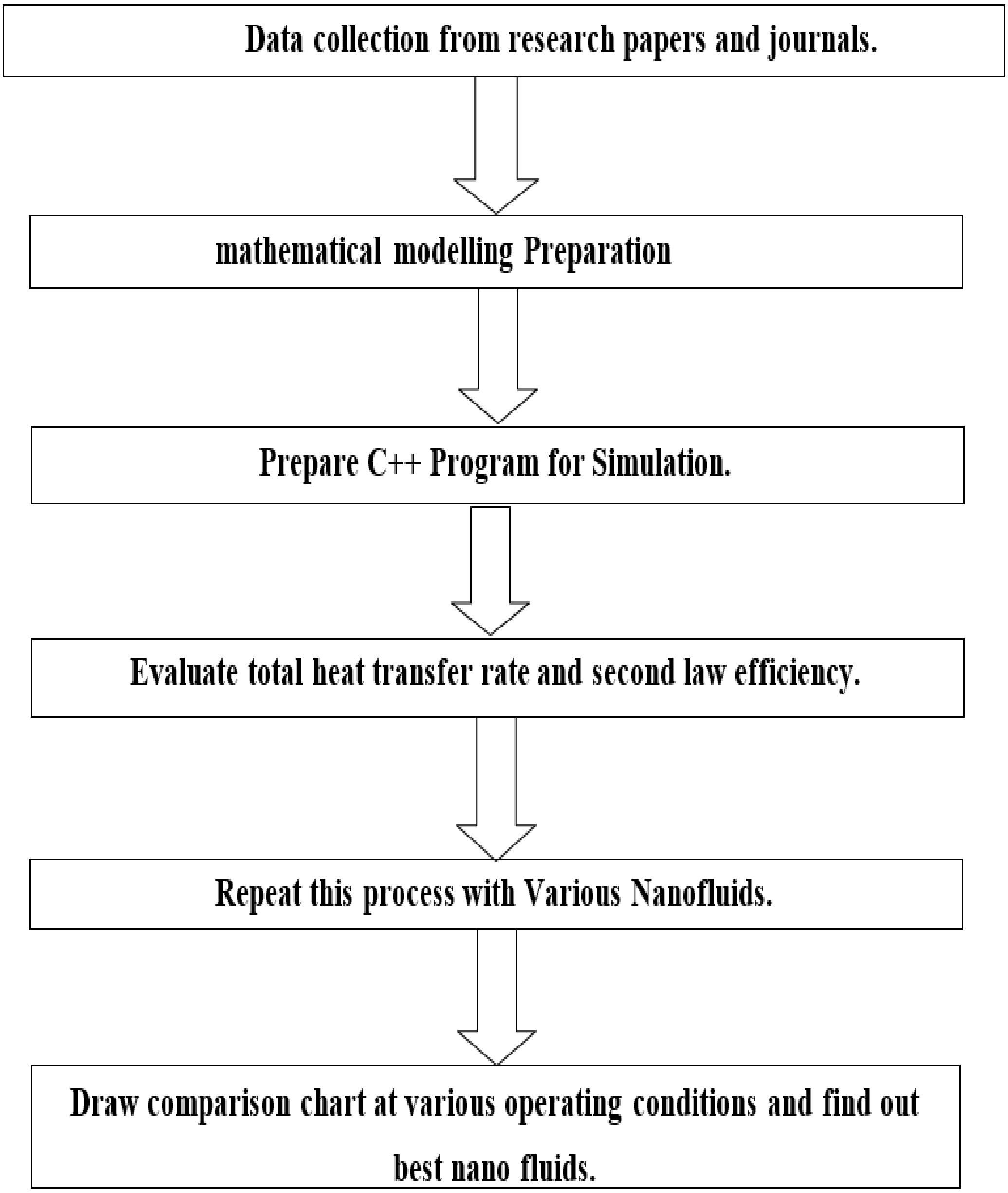

Figure 3.1 Methodology Flow chart

RESULT AND ANALYSIS

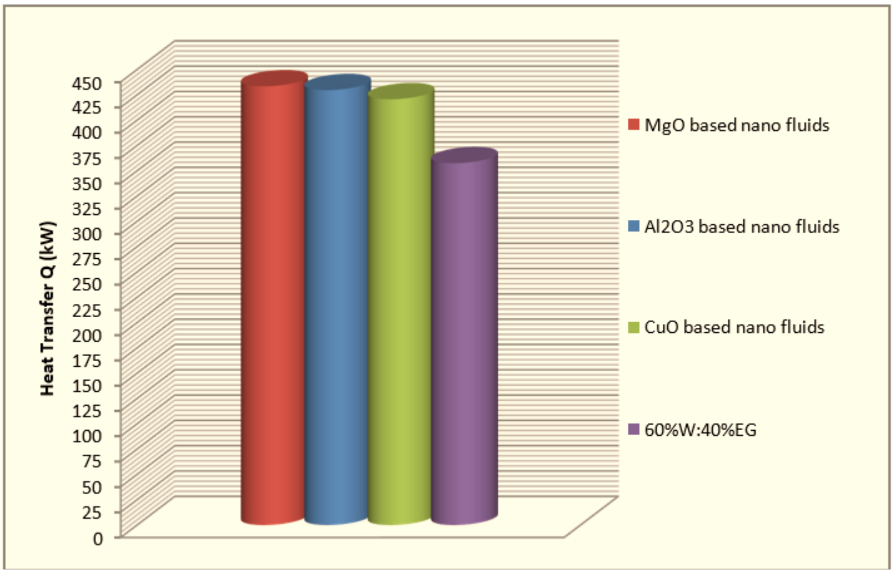

Figure 4.1 Comparison of total heat transfer rate

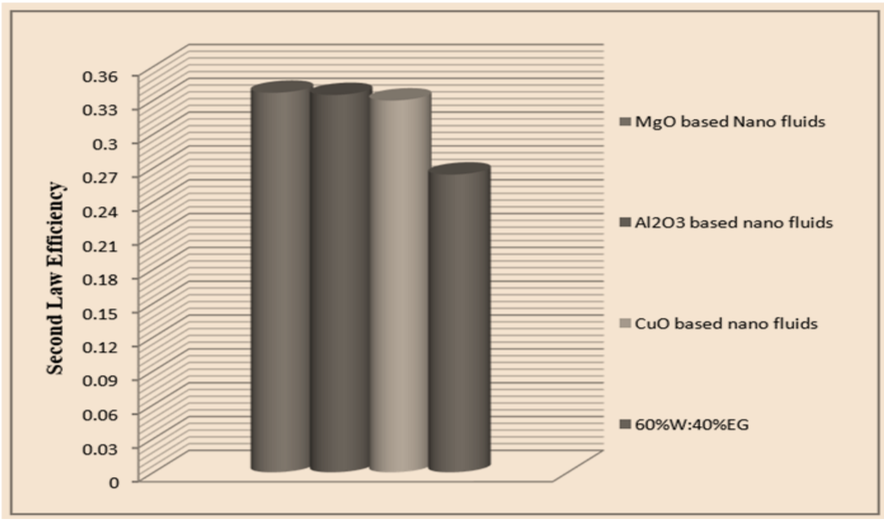

Figure 4.2 Comparison of second law efficiency

CONCLUSION

The effectiveness of the radiator's second law was shown to be higher when nanofluids were used as coolants rather than merely base fluids. The addition of nanoparticles to the radiator's base fluid raised its second law efficiency by 19% to 21.5%. The second law efficiency of nano fluids based on MgO, Al2O3, and CuO is greater than 21.42%, 20.95%, and 19.75% of base fluid coolant, respectively. MgO-based nano fluids have the best second law efficiency when compared to other nano fluids.
As the mass flow rate of air increases, so does the overall heat transfer rate, while second law efficiency decreases. On the other hand, when coolant mass flow rate increases, so does total heat transfer rate and second law efficiency.

Total heat transfer rate and second law efficiency both decrease as air inlet temperature rises. On the other hand, when coolant inlet temperature rises, so does the overall heat transfer rate and second law efficiency.

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.

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