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IC Engine Fin Simulation using Different Materials

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ABSTRACT

This study models an internal combustion (IC) engine fin using various materials to examine how it performs. The goal is to identify the material that will enhance the fin's capacity to dissipate heat. Numerical simulations and an analysis of the fin's heat transfer properties in relation to various materials are part of the study. The findings offer important knowledge for improving the design of IC engine cooling systems and offer insightful information on the thermal behavior of the fin.

Keywords- Fins, pure aluminum, magnesium AZ31B, malleable CI, heat flux,

INTRODUCTION

For more than a century, internal combustion (IC) engines have served as the main source of power for several applications, including industrial machines and automobiles. Since excessive heat generation can result in decreased engine efficiency, increased wear and tear, and probable mechanical problems, effective cooling is essential for IC engines to operate at their peak performance. The fin is one of the crucial parts of engine cooling since it is crucial for transferring heat from the engine to the environment.

The performance of IC engine fins has been able to be enhanced thanks to developments in material science and engineering throughout time. The choice of a suitable material for the fin can have a big impact on how well it dissipates heat, which affects the longevity and cooling effectiveness of the engine as a whole. Thermal conductivity, specific heat capacity, weight, cost, and environmental considerations are a few of the variables that influence the material choice.The objective of this study is to examine and evaluate the thermal performance of an IC engine fin made of various materials. We want to obtain insights into the heat transfer properties of various materials and determine the best appropriate material that maximizes heat dissipation efficiency through numerical simulations and analysis. The findings of this study will be helpful in optimizing the design of IC engine cooling systems, which will improve engine performance, lower emissions, and use less energy.

PROBLEM STATEMENT

Internal combustion (IC) engines must effectively dissipate heat to achieve peak performance and avoid damage from overheating. Heat transfer from the engine to the surrounding air is significantly facilitated by engine fins, an important part of the engine cooling system. However, the material used to make these fins directly affects how well they dissipate heat, therefore engineers and researchers continue to face a difficult task in choosing the best material.

OBJECTIVES

The objectives of this research work are as follows

- Examine and evaluate the thermal performance of an IC engine fin made of various materials.
- Quantify and understand the variations in different materials heat dissipation capabilities.
- Identify potential design modifications that could further improve the heat dissipation efficiency of the IC engine fin

RESEARCH METHODOLOGY

The research will involve numerical simulations and computational fluid dynamics (CFD) analysis to model the IC engine fin with different materials. The simulations will be based on real-world operating conditions to ensure the results are representative of practical applications. A comparative analysis of the heat dissipation efficiency of each material will be conducted, and key performance parameters will be evaluated.

The numerical results will be validated through experimental testing to ensure their accuracy and reliability. The study will employ data from reputable sources, material databases, and published research papers to obtain material properties required for the simulations.

RESULT AND ANALYSIS

The heat flux for a single fin shape with magnesium (AZ31B) as the fin material is shown in figure 5.1. According to the results of the simulation, the highest heat flux has been measured at 3669.72 w/m^2.

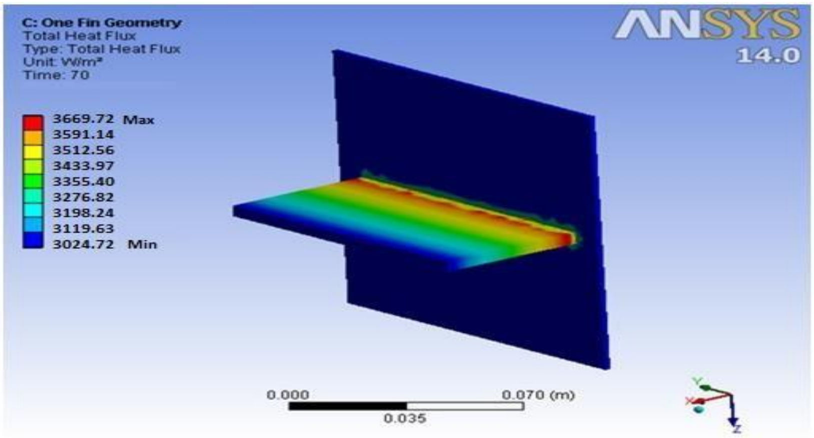

Figure 5.1: Heat flux for single fin geometry using magnesium

Figure 5.2 shows the heat flux for a three-fin configuration with fins made of magnesium (AZ31B). According to the results of the simulation, the highest heat flux has been measured at 4250.91 w/m^2.

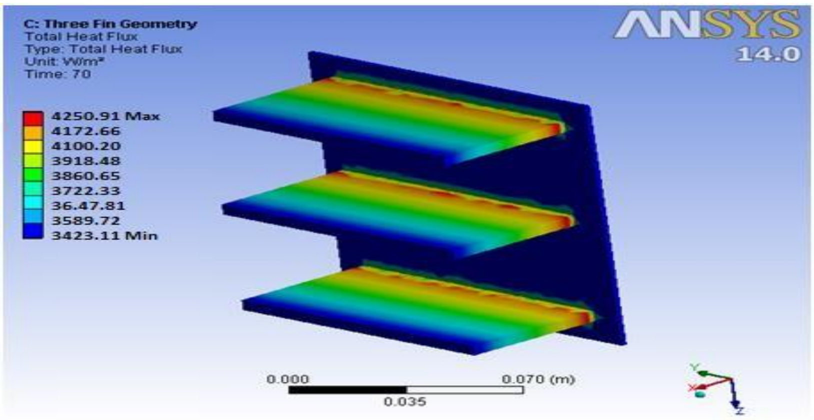

Figure 5.2:Heat flux for three fin geometry using magnesium

Figure 5.3 shows the heat flux for a four-fin configuration with fins made of magnesium (AZ31B). According to the results of the simulation, the highest heat flux has been measured at 4592.51 w/m^2.

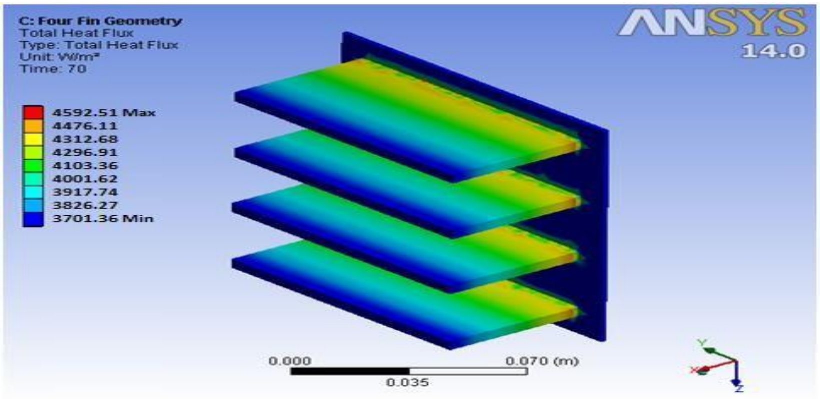

Figure 5.3: Heat flux for Four fin geometry using magnesium

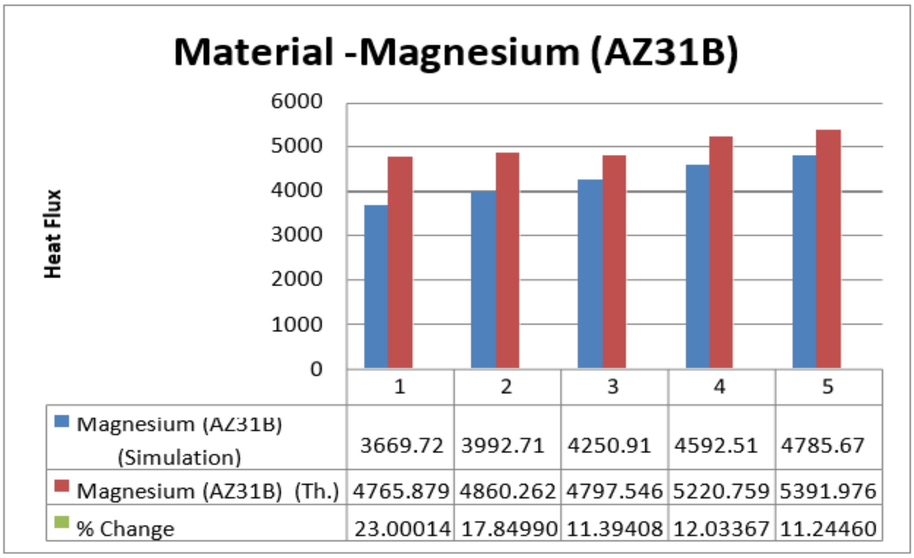

Figure 5.4: Comparative figure between simulation and numerical data showing heat flux values for Magnesium

CONCLUSION

In the end, the study demonstrates how crucial material selection is to an IC engine fin's capacity to efficiently disperse heat. Copper, which also had a high specific heat capacity, had the best performance. Economic and environmental considerations must be carefully taken into account when choosing a final material. The study's conclusions are relevant for engineers and scientists trying to improve the efficiency, performance, and sustainability of IC engine cooling arrangements.

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