

THERMAL ANALYSIS OF PISTON USING ANSYS

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Abstract - A piston is a main component of reciprocating engines, reciprocating pumps, compressors and pneumatic cylinders. It is the moving component that is contained by a cylinder and it is made gas-tight by piston rings. The piston transforms the energy into mechanical energy by expanding gases. The piston reciprocates in the cylinder liner or sleeve. Pistons are commonly made up of aluminium or cast-iron alloys. By observing the analysis results, we can decide whether our designed piston is safe or not under applied load conditions. The thermal flux and thermal temperature distribution is analyzed by applying temperatures on the piston surface in Thermal analysis. The structural and thermal analysis was also done on the piston and piston rings model using Cast iron, Aluminium Alloy A360. By comparing materials is better for manufacturing of Piston and piston rings. Structural and Thermal analysis were also performed in ANSYS software.

Key Words: Piston, Piston-Ring, CATIA, ANSYS.

1. INTRODUCTION

The piston is a significant component of a cylindrical engine. It reciprocates inside the cylinder bore. The piston acts as a moveable end in the cylinder. The piston converts the energy of the expanding gases into mechanical energy. Pistons are commonly made of aluminium or cast-iron alloys. To avoid the combustion gases from bypassing the piston and to keep friction to a minimum, each piston has several metal rings around it. The piston rings are usually made up of cast iron and coated with chrome or molybdenum. Most of diesel engine pistons have several rings, usually 2 to 5. The top ring acts primarily as the pressure seal. The intermediate ring acts as a wiper ring to remove and control the amount of oil film on the cylinder walls. The bottom ring is an oiler ring and ensures that a supply of lubricating oil is evenly deposited on the cylinder walls. The main objective of this research work is to inspect and analyze the stress distribution of piston at actual engine condition.

In order to increase the efficiency of operation and better functionality, the piston material should satisfy the following requisites: Light weight, Good wear resistance, Good thermal conductivity, Higher strength to weight ratio, Rust free, Easy to cast, Easy to machine, Non-magnetic, Non-toxic .

Piston ring must be provided with a radial fit between the cylinder wall and the surface of the piston for an efficient seal. Piston rings vary depending upon the size of the engine.

2. LITERATURE REVIEW

We searched and studied some of the published research papers to understand scope for their project and their conclusion. AR. Bhagat et. al. in the year 2012 found that piston deforms during works, due to stress concentration. A.R. Bhagat used mesh optimization to try & reduce stress concentration. He concluded that mesh optimisation helps to developed optimal mathematical model & reduce the stress concentration in piston. M. Srinadh et. al. in the year 2015 conducted experimental analysis on 1300 cc diesel engine. Piston considering (cast iron, aluminium (A360) & zamak). He concluded that Zamak is better than CI & aluminium A360 in almost all aspect & can give better performance. But it has high cost than CI and Al. G. Siva Prasad et. al. in the year 2016 started his research for design & analysis of piston of IC engine of different material using ANSYS using materials A 4032, AISI 4340 & Titanium Ti-6Al-4V. The results were that Aluminium alloys provide better thermal conductivity & heat transfer rate but with development in material science. Lighter material can be used to reduce fuel consumption. Anupkumar Shetty et. al. conducted his research in the year 2017. He performed static analysis of pistons using aluminium alloy alloys for Bajaj pulsar 220 cc. Using following alloys, A 2618, A4032, Al G45 1300 he found that in Von mises equivalent stress A 4032 has least stress and Aluminium GHS has maximum because of high yield strength.

After referring the research journals related to our topic, we come to a conclusion that we can improve the performance of a piston and piston ring by improvising the materials. But we aim to obtain sustainable performance at optimum costs. Zinc alloys have better properties but also have high cost, hence we consider Cast Iron and Aluminium Alloy for optimization. Also mesh optimization can be applied to further improve the performance of the piston.

3. PROBLEM IDENTIFICATION

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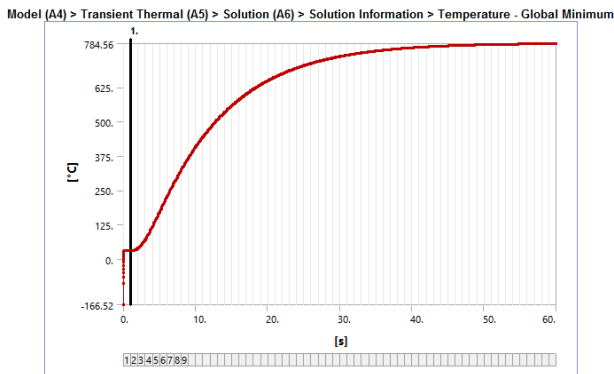


Fig -4: Temperature Distribution Graph (Aluminium A360)

CAST IRON

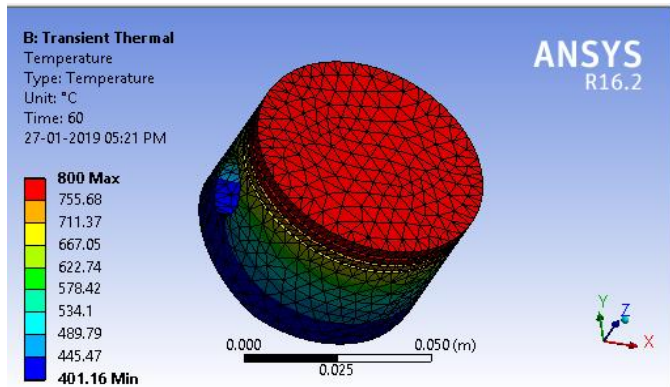


Fig -5: Temperature (Cast Iron)

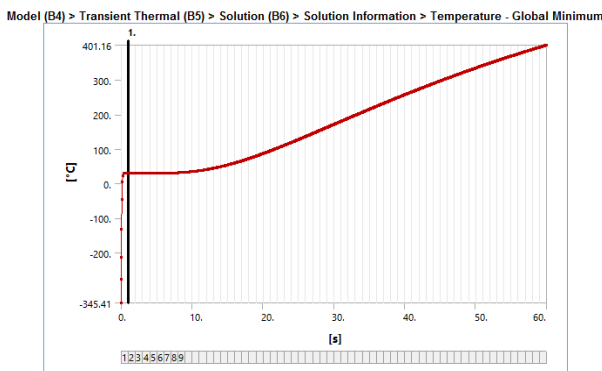


Fig -6: Temperature Distribution Graph (Cast Iron)

7. CONCLUSION

By comparing results of both materials, i.e. Al. Alloy and Cast Iron, there is difference between temp. In one minute Aluminium is more heated as compared to Cast Iron. But Cast Iron is heavier in weight. So, for better performance we can combine both materials.

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