ANALYSIS OF ENGINE GASKET TO IMPROVE SEALING PERFORMANCE

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ABSTRACT- Engine gasket is the main component. It is seated in the middle of the engine head and block. Its function is to make an adequate seal in middle of the engine components without leakage and to avoid the leakage of gas from the engine which affects the overall performance of the engine during operation.

In this project a multi-layer cylinder head gasket of single cylinder is considered. The modelling of gasket will be done in CREO 2.0.Static analysis and thermal analysis will be done in ANSYS 14.5. These analysis results will be compared with the analytical results to achieve maximum strength.

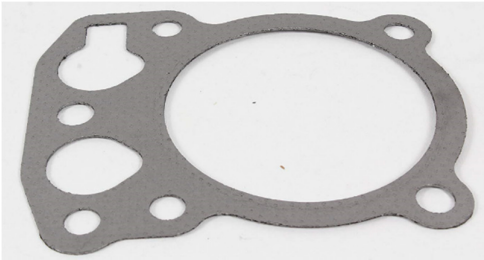
I. INTRODUCTION

The head gasket is the most important passive sealing element in the internal combustion engine. It is positioned between the cylinder head and block. Its purpose is to provide a gas tight seal between the cylinder(s), the water jackets, oil passages and the ambient air, liquids and gases. The area of the gasket around the cylinder must be robust enough to withstand the same pressures that are exerted on the pistons while ensuring that there is no leakage of coolant or combustion gases among the three volumes. It must be able to accomplish this at all engine temperatures and pressures without function, as a failure of the engine gasket usually results in a failure of the full engine.

The complex arrangement of components in the diesel engine is often joined together with the help of gaskets. The gaskets serve as seals to prevent the leakage of the various fluids and gases in the oil engines but these seals do wear out with constant usage of the engines. Additionally the constant heating and cooling creates expansion and contraction that is detrimental to the various seals. Leakage of gases through these seals can cause minor or very dangerous oil leak which might cause serious accidents or incidents.

Cause of Failure

1) Overheating on 3-layer metal gaskets.
2) Failure of the cylinder-head gasket in Oil engines due to gas blow-by.
3) Failure due to pressure build-up in the cooling system as a result of gas blow-by.
4) Failure of the cylinder-head gasket due to pressure build-up in the cooling system as a result of gas blow-by.
5) Destructive heat



Gasket Model

CREO INTRODUCTION

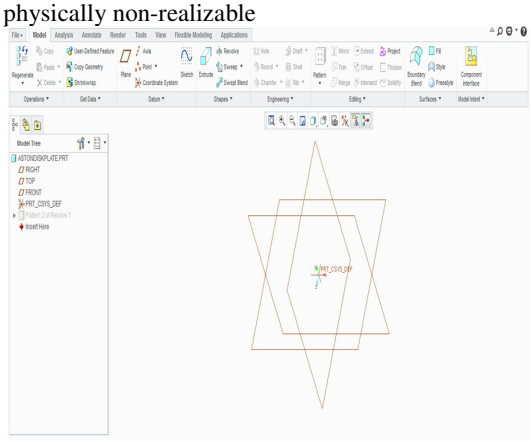
CREO is a suite of programs that are used in the design, analysis, and manufacturing of a virtually unlimited range of product.

CREO is a parametric, feature-based solid modeling system, "Feature based" means that you can create part and assembly by defining feature like pad, rib, slots, holes, rounds, and so on, instead of specifying low-level geometry like lines, arcs, and circle& features are specifying by setting values and attributes of element such as reference planes or surfaces direction of creation, pattern parameters, shape, dimensions and others.

"Parametric" means that the physical shape of the part or assembly is driven by the values assigned to the attributes (primarily dimensions) of its features. Parametric may define or modify a feature's dimensions or other attributes at any time.

"Solid Modeling" means that the computer model to create it able to contain all the information that a real solid object would have. The most useful thing

about the solid modeling is that it is impossible to create a computer model that is ambiguous or physically non-realizable



Part modeling in CREO

II. LITERATURE REVIEW

Tusharjadhav, D.G. Kumbahar [1] (2013) in this Finite element analysis of gasket predicts non-linear behavior of gasket under working conditions. Analysis is done considering two non-linear methods i.e. contact, and geometric non linearity. Contact behavior of gasket under pressure provides further enlightenment for design of gasket Customer demands have greatly increased quality needs during past few years. The engine has to run for long hours in harsh conditions with minimum or no maintenance. Gasket Plays an important role in oil and water sealing in engines. The design requirements of gasket state that there should be no leakage of oil or water. It requires 100% sticking contact between the gaskets and sealing surface. Paper mainly focuses on the analysis of sealing behavior of the Gasket.

M. GHASEMI [2] (2009) in these Multi-layer steel (MLS) cylinder head gaskets (CHG) is widely used to seal the engine cylinder head. Therefore, The interaction between the engine cylinder head, cylinder block and the cylinder head gasket is very important from technical point of view. To avoid the escaping gas from the engine affecting the overall performance of the engine during operation, both the pre-stressing force of the bolts as well as the gasket design are critical factors in enhancing the efficiency of the sealing of the gasket. In this paper the finite element method (FEM) is used to investigate the interaction between the cylinder head and the cylinder block. Furthermore the distribution of the contact pressure on the gasket and the cylinder head and the cylinder block stresses at different condition, such as cold assembly, hot assembly, cold start, firing, engine cooling down to 20°(c) and -25°(c) are calculated. The validation is performed using Fuji paper test and thermal survey test. The results revealed that the sealing pressure on the gasket strongly depends on the pre-stressing force of the bolts. However, the location of minimum contact pressure on the gasket is changed by considering the thermal loading.

III. PROBLEM DEFINITION & SOLUTION METHODOLOGY

PROBLEM DEFINITION

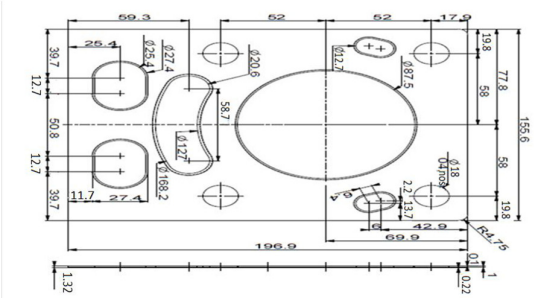
The engine head gasket are mainly used to avoid the leakage of gas from the combustion chamber and also to avoid leakage of oil and coolants. If the oil mix with the coolant in the radiator then the coolant does not work properly. Automatically the engine does not work properly due to excess heat. And also if the leakage occurs the engine does nor achieve maximum efficiency.

Here the problem in this paper is to select a suitable material and design of engine gasket with which it can withstand the temperatures and pressure.

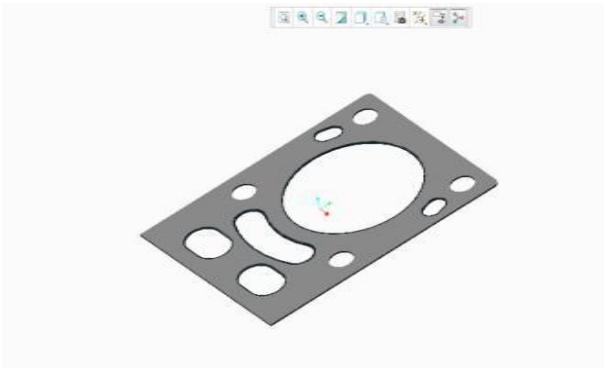
METHODOLOGY

- Designing of head gasket using CREO software based on accurate dimensions.
- Calculating the pre-stressing force on bolts
- Computing the thermal analysis of head gasket using aluminum-asbestos-aluminum and copper-asbestos-copper
- Calculating the thermal stresses and strains using different materials.
- From thermal analysis of head gasket results, best optimized geometry and best material of head gasket was proposed.

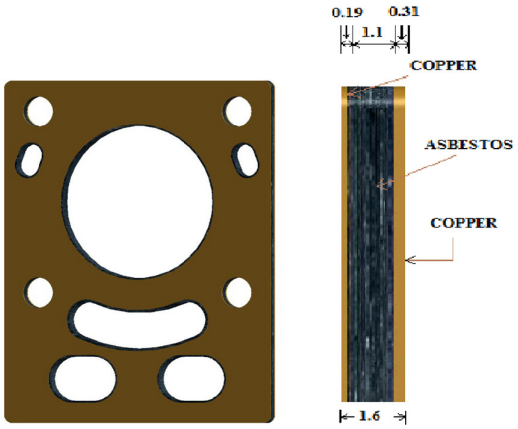
IV. MODELLING OF HEAD GASKET



2D model of head gasket in CREO software



3D model aluminum head gasket in CREO software



Design of copper head gasket in CREO software

CHAPTER-V
THERMAL ANALYSIS OF CYLINDER HEAD GASKET

Properties of aluminium are

Young's modulus = 70 GPA

Thermal conductivity = 237 W/m-k

Poisson ratio = 0.35

Density = 2.7 g/cm^2

Properties of asbestos are

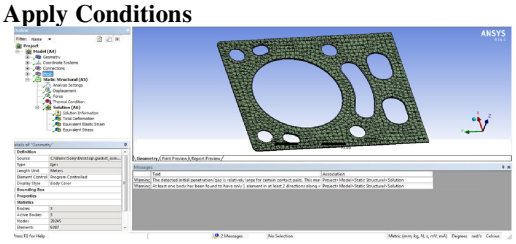
Young's modulus = 70 GPA

Thermal conductivity = 110 - 118 W/m-k

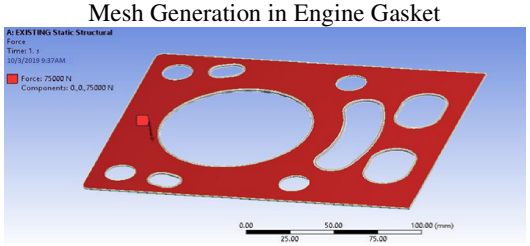
Poisson ratio = 0.34

Density = 8.96 g/cm^2

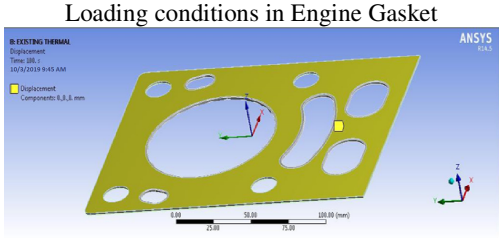
Apply Conditions



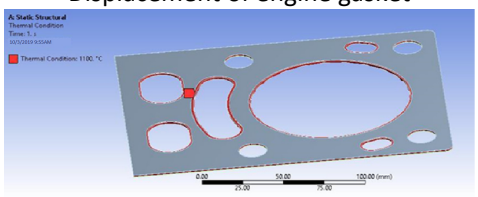
Mesh Generation in Engine Gasket



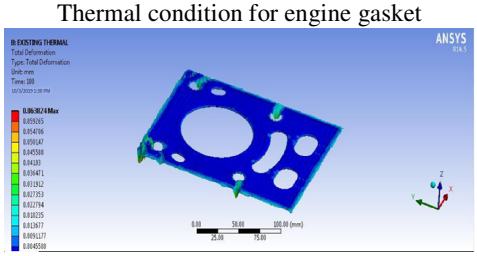
Loading conditions in Engine Gasket



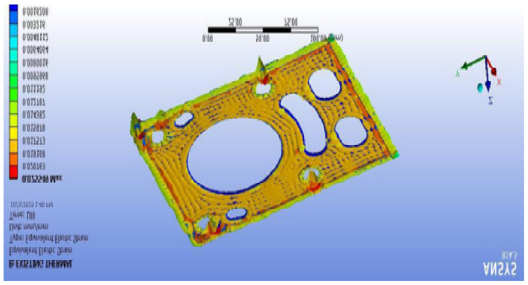
Displacement of engine gasket



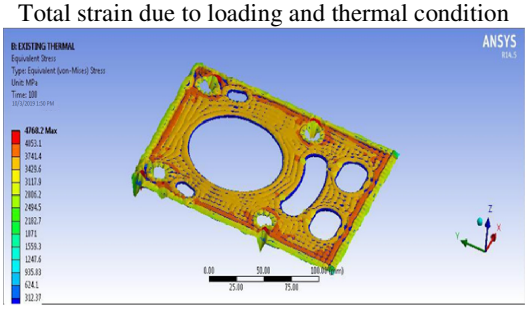
Thermal condition for engine gasket



Total deformation due to loading and thermal condition



Total strain due to loading and thermal condition



Total thermal stress due to loading and thermal condition

Properties of copper are

Young's modulus = 117 GPA

Thermal conductivity = 401 W/m-k

Poisson ratio = 0.36

Density = 8940 kg/m^2

Properties of asbestos are

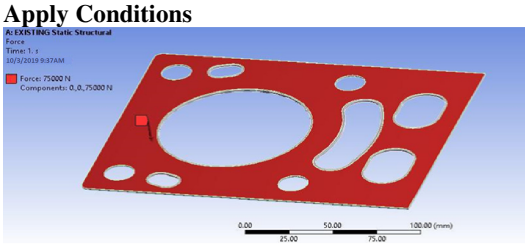
Young's modulus = 70 GPA

Thermal conductivity = 110 - 118 W/m-k

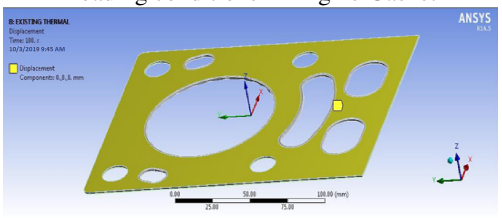
Poisson ratio = 0.34

Density = 2450 kg/m^2

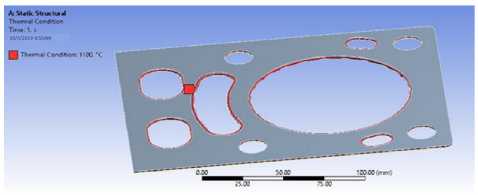
Apply Conditions



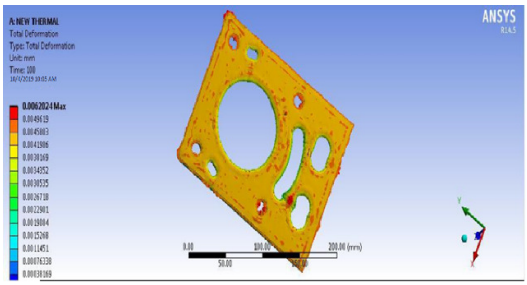
Loading conditions in Engine Gasket



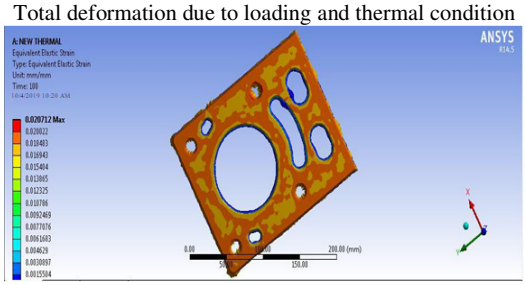
Displacement of engine gasket



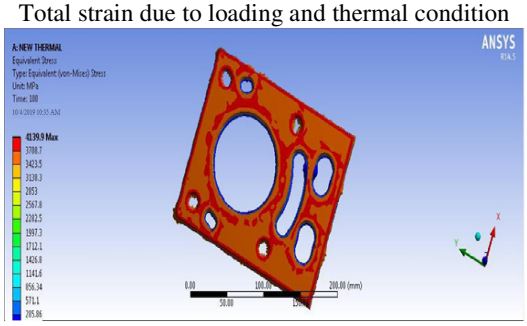
Thermal condition for engine gasket



Total deformation due to loading and thermal condition



Total strain due to loading and thermal condition



Total thermal stress due to loading and thermal condition

CHAPTER: VII

RESULTS AND CONCLUSION

Thermal analysis of cylinder head gasket was studied briefly in this paper. Here geometry of cylinder head gasket using aluminum-asbestos-aluminum and copper-asbestos-copper materials was analyzed and total deformation, thermal strain and thermal stress are tabulated below.

Gasket Material	Analysis Results		
	Total Deformation (mm)	Total Strain	Equivalent Stress (Mpa)
Aluminium -Asbestos-Aluminium	0.0638	0.0255	4768.2
Copper-Asbestos-Copper	0.00620	0.020712	4139.9

Here we can see that the results obtain for Copper from the ANSYS for thermal stress is better than the Aluminum material.

In which the thermal stress generated in copper is 4139.8 N/mm2. So in copper material thermal stress is reduced by 628.2 N/mm2.

Hence from the above results, it can be concluded that copper is the best suited material for head gasket.

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