FEA of Cylinder Head Gasket of Oil Engine

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Abstract— *The gas linkages from the engine can affect the overall performance of the engine during operation. The proper pre-stressing force of the bolts as well as the multi-layer head gasket design is critical factors for efficiency of engine. So to accurately calculate the stresses in Multi-Layer Steel (MLS) head gasket analysis for the normal and relative shear motions between cylinder head and gasket, gasket and block, as well as between gasket layers have to be understand in the analytical model. In this study, an analytical method was developed to effectively calculate the MLS head gasket stresses during engine operating condition. The gasket sealing between the cylinder head and the cylinder block it's totally depending on pre-stressing forces of bolts. Therefore, the applied approach of the pre-stressing force is significant for the calculation of the numerical simulation. In the analysis model, each layer of the MLS head gasket is modeled in CREO PARAMETRIC 2.0 using GASKET element, analyze by Ansys SOFTWAR, and the GASKET element layers were stacked together according to the configuration of the head gasket. Due to the physical modeling of each gasket layer in the stacked GASKET element model, the relative shear motion between gasket layers can be analyze. Analysis, mating & meshing criterions along with comparison of results with the practical condition to achieve maximum strength with minimum weight & cost.*

Keywords— Ansys, Cylinder head, gasket, Pro E, Structural Analysis, Stresses

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.

Fig: 1.1: Gasket Model

A. 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 Failure of the cylinder-head gasket 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

The design and the development of the automobile engine are complicated processes. To acquire the best performance of an engine in any operating condition in harsh natural environments, many analytical tools and experimental methods are used to find the optimum parameters for engine design. However, numerous measured results point out that the gas escaping from the engine not only affects the output efficiency of the horsepower substantially, but also pollutes the environment. Therefore, the guarantee that the assembly between the cylinder head, bolts, and gasket is reliable and effective, through proper analytical procedures and tests becomes extremely important. Forsolving these foregoing issues, the thermal and structural analyses must be adopted in the engine design to save the time of actual modifications. In addition, in order to allow for the thermal stresses, which need to be blended into the structural analysis of the engine, the heat transfer analysis must take place prior to the structural analysis in order to calculate the results under loading conditions, such as hot firing.

II. LITERATURE SURVEY

Chang chun lee, cuoningchiang [1] "design and analysis of gasket - journal" in this paper avoid the escaping gas from the engine affecting the overall performance of the engine during operation, both the proper 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 investigation, both the distribution of the contact pressure on

the gasket, and the stresses of the cylinder head at Different loading conditions, such as cold assembly, hot assembly, cold start, and hot firing, are explored by numerical calculation based on the finite element method (FEM). The results reveal that the efficiency of the sealing of the head gasket depends on the pre-stressing force of the hold-down bolts, without taking into consideration any thermal stresses resulting from the temperature distribution in the cylinder head. However, the location of maximum contact pressure on the gasket is transformed when the thermal loading is taken into account. In addition, this research also conducts the parametric analyses for the pre-stressing force of the bolts and compares the differences between cold assembly and cold start conditions.

Jerry e. Kashmerick [2] "small engine head gasket design consideration" in this Different cylinder head gasket materials are in use today, primarily due to the elimination of the standard asbestos millboard, new engine designs, requirements on compressed thickness, and increasing durability and sealing standards. The history of small engine cylinder head gaskets is reviewed. Current and future head gasket requirements and gasket material and types are outlined. The affect of these materials on heat transfer is summarized. Design considerations directed to attaining and maintaining clamp loads and clamp load loss are addressed. Static and dynamic testing to improve and verify the suitability of designs is explained. A smooth transition from a tested prototype to production product requires attention to clamp load related details.

Tusharjadhav, d.g. kumbahar [3] "Non linearfea of rocker cover gasket" 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 [4] "Analysis of Contact Stresses and MLS Cylinder Head Gasket Behavior Using FEM" 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. Conclusion

As per the project work, can conclude, with the help of design, modeling and analysis work can increase the efficiency of the existing cylinder head gasket of oil engine with the help of change in material selection. Also, we increase the working life of the gasket.

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