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Performance analysis of IC engine with introduction of HTC material.

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Abstract – *Now a days automobile manufacturers are developing better performance engine, But some new issues are faced like rise in operating temperature of engine. This leads to inefficiency of engine at higher rpm. when the engine runs at higher rpm for long time temperature gets increased. Efforts are made to increase the heat transfer rate from casing, for this various material are being used and tested. To minimize this heating problem, high temperature regions are to be coated with HTC material. This HTC material have high Thermal conductivity which leads in increase of heat transfer rates from those areas. This technique will help us to run the engine at higher rpm in specified temperature range. But HTC material only transfers the heat from one point to another. Hence external cooling is also be given to dissipate the heat to surrounding. All this study will be done by thermal analysis of engine using FEM software and validate the result by comparing the results of engine without HTC coated components and with HTC material coated components.*

***Key Words*: HTC material, Operating temperature, Higher rpm.**

1. INTRODUCTION

The energy released in combustion chamber of IC engine gets dissipated by 3 different ways. About 35% of fuel energy is converted into useful crank shaft work and about 30% energy is expelled out from exhaust. These leaves about 1/3rd of total energy to be transmitted from enclosed cylinder through the cylinder walls and cylinder heads to the surrounding atmosphere. The temperature in the combustion chamber goes upto 2700k. Due to this high temperature, thermal stresses will be developed distorting cylinder head and piston. Generally exhaust valve, inlet valve cylinder wall, piston face piston ring, piston skirts are subjected to high temperature and also called as high temperature zones. Therefore cooling must be provided for cylinder head, cylinder wall and piston. High heat fluxes is generated due to which wear tear is caused of engine part. This leads to ceasing of engine at elevated temperatures and decrease the efficiency of engine. So there is need of cooling of these parts and to keep them at proper working temperatures. The objective is to reduce the temperature by removing the heat by introduction of HTC (Highly Thermal Conducting) material and TIM (thermal Interfacing Material) and to provide integral cooling system to remove excess heat.

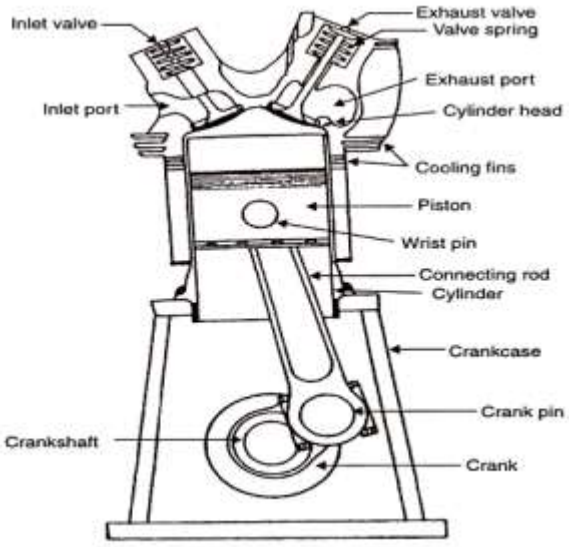

Fig-1 Cross-sectional area of IC engine

2. OBJECTIVE

Enhancing the heat transfer through high temperature zones. By the application of HTC (highly thermal conducting) material like sintered cooper coating. Coating with sintered cooper material will help us to increase the heat transfer rate in that regions which ultimately will decrease the temperature at those region. In addition to this apparatus we will provide the cooling system outside the engine which will help us to dissipate the heat to surrounding.

The components that are to be coated by sintered copper are as follows :_

1. Valve
2. Cylinder head
3. Valve seats

3. DISCUSSION

Exhaust valve and inlet valves, piston ring, piston face, piston skirt, cylinder wall are subjected to very high temperatures and this reduces the design life of the engine components due to thermal stresses induced in it. It also leads to inefficient operation of engine.

4. LITERATURE RESERCH

4.1. THERMAL ANALYSIS OF AN EXHAUST VALVE OF AN IC ENGINE USING DIFFERENT MATERIALS.

One of the crucial part in the IC engine is exhaust valve. Both the inlet and exhaust valve are subjected to very high temperature. Most of the automotive exhaust valve operate between 650C to 875C. But during the power stroke inlet and exhaust valve gets subjected to 1900C to 2200c. so to withstand this high temperatures it is necessary to select the best materials and hence more preference is given to selection of materials of this valves.

4.2. VALVE COOLING.

Various methods are used to cool the exhaust valve as it becomes very hot due to the passage of hot exhaust gases. This temperature increase can reduce the valve life. Additional water circulation is usually provided near the exhaust valve seating in the engine head. Sodium cooled valves are used in the heavy-duty engine and aircraft engines. These valves have a hollow head and stem, which is partly filled with sodium or a mixture of salts. During operation of the valve the up and down movement of sodium transfers the heat near the head portion at a faster rate.

4.3. STUDY OF COOLING SYSTEM IN I.C. ENGINE IMPROVING PERFORMANCE WITH REDUCTION OF COST.

Existing cooling system works on thermo-siphon principle. It has a sensing plug which is immersed in the coolant water presents in the engine block water jackets. It senses the temperature of coolant water and indicates through temperature gauge. Whenever engine gets experienced temperature in serious condition due to the sudden failure of water pump and leakage through hoses it gives danger sound for precaution to engine failure due to overheating.

5. METHODOLOGY

5.1. Thermal Analysis of the Valve :-

Applying Boundary Conditions:-

The valve subjected to two boundary conditions, first is the flat face that is affected by temperature in the cylinder and second is inside the exhaust port. The heat is transferred from the gases to the valve through convection. The inner face is subjected to max temperature of 1200^{o}and the side on the exhaust port is 650^{o} C.

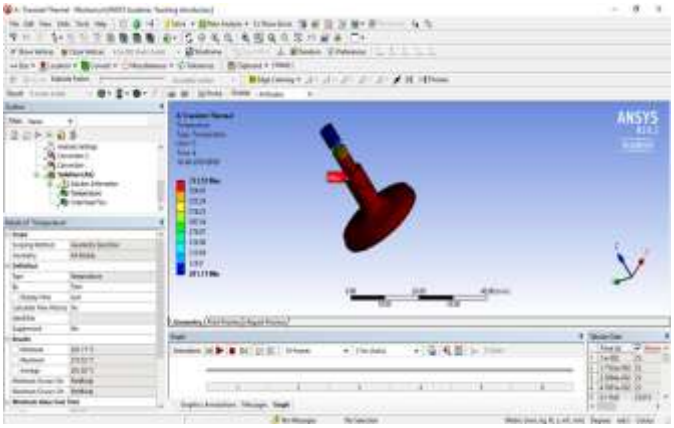

Fig-2 Temperature distribution on valve after coating.

Temperature distribution after applying coat:-Maximum temperature of the valve is 373.52^{o}C.

5.2. Analysis of Valve Seat :-

Applying Boundary Conditions:-

The valve seat is subject to heat from the valve and the cylinder head. The valve is in constant contact with the valve at the upper face apart from the time the valve is raised for exhaust gases to pass. Therefore the type of heat transfer is conduction.

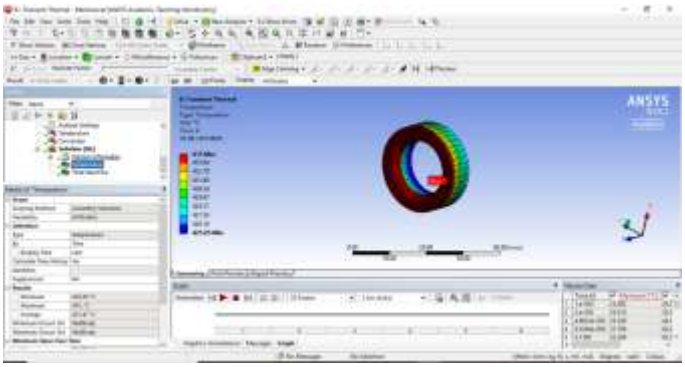

Fig-3 Temperature distribution of the valve seat after coating.

Temperature Distribution after applying the coat:- The maximum Temperature is 435^{o}C.

6. CONCLUSION

From the analysis it can be seen that regions of high temperature can be coated with copper and this will result in the reduction in the maximum temperature. The temperature of the valve was 451.79^{o}C after the coating was applied the reduced temperature was 373.56^{o}C. Also the

heat flux reduced from 2.895 W/mm^2 to 2.5437 W/mm^2. This will not only help reduce the risk of running engines at higher temperatures but also reduce pollution as components of NO_x that are harmful are produced at higher temperatures.

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