Fatigue Life Assessment of Ceramic Coated SI Engine Piston through Thermo - Mechanical Loads

Student's Name	**V. V. S. Dinesh**	**AE (FT-2011)**
Academic Supervisor(s)	Vinod K. Banthia and S. Srikari	
Industrial Supervisor(s)		

V. V. S. Dinesh
vvsdinesh@gmail.com
Ph. No: 0 80956 88759

Keywords: Ceramic Coated Piston, Fatigue Life of Coated Piston, TBCs, Temperature Distribution, Thermo-Mechanical Loads

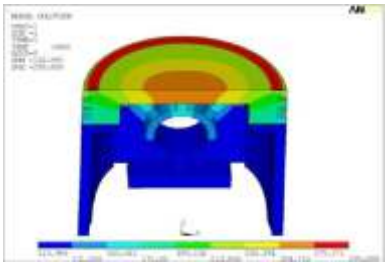
Abstract:

In Internal Combustion (IC) engine, for effective utilisation of heat without much heat transfer, the combustion chamber should be insulated. Because of insulation, temperatures reach very high values. Conventional materials cannot withstand such high temperatures in IC engine. Hence, the solution is to use ceramic coatings on the piston, which help to reduce heat transfer and withstand higher temperatures. The life of components is affected due to the presence of high temperatures. The objective of the present work is to focus on the fatigue life of ceramic coated piston, working under thermal and mechanical loads.

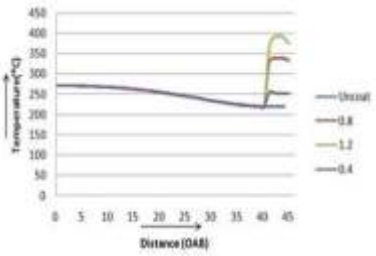
Thermal analysis was carried out on uncoated and ceramic coated piston to verify the temperature changes at the ceramic coated regions using ANSYS. The study of thermal stresses generated due to temperature differences at different materials junctions used in coating were analysed. The loadings on the piston were determined by performing dynamic analysis using ADAMS/view. The stresses due to the thermo-mechanical loads were studied to finally determine the fatigue life of the partially ceramic coated piston.

The temperatures of the piston at the coating thickness increases with the increase in temperature due to low thermal conductivity of ceramics. With the use of the ceramic coatings the overall temperatures of the piston increases and this effect was seen in the fatigue life of the pistons. The fatigue life of the ceramic coated pistons decreases with the increase in the coating thickness of the ceramics due to the presence of higher temperatures.

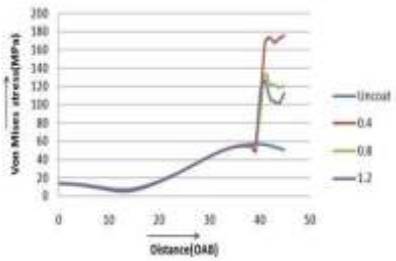
3D mesh



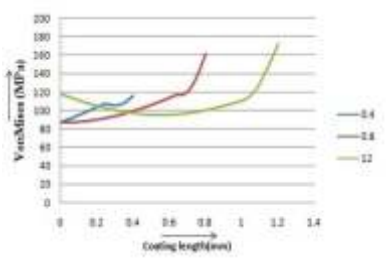
Temperature distribution



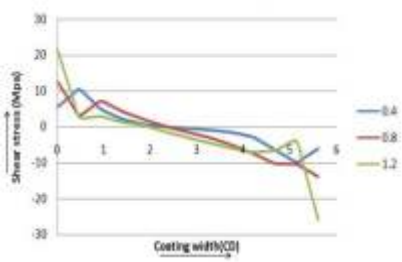
Temperature variation



Von-Mises stress distribution in radial direction



Von-Mises stress distribution in axial direction



Shear stress at the coating interface