Numerical and Experimental Investigations of Oil Jet Cooling of Pistons

By

Mani Bijoy Varghese

Thermal loading of diesel engine pistons has increased dramatically in recent years due to applications of various technologies to meet low emission and high power requirements. Control of piston temperatures by cooling of these pistons has become one of the determining factors in a successful engine design. The pistons are cooled by oil jets fired at the underside from the crankcase. Any undesirable piston temperature rise may lead to engine seizure because of piston warping. However, if the temperature at the underside of the piston, where the oil jet strikes the piston, is above the boiling point of the oil being used, it may contribute to the mist generation. This mist significantly contributes to the non-tail pipe emissions in the form of unburnt hydrocarbons (UBHC's) which has unfortunately not been looked into so seriously, as the current stress of all the automobile manufacturers is on meeting the tail-pipe emission legislative limits.

In this investigation, a numerical model has been developed using finite elements method for studying the oil jet cooling of pistons. Using the numerical modeling, heat transfer coefficient (h) at the underside of the piston is predicted. This predicted value of heat transfer coefficient significantly helps in selecting right oil type, oil jet velocity, oil jet diameter and distance of the nozzle from the underside of the piston. It also helps to predict, whether the selected grade of oil will contribute to mist generation. Experimental validations of the numerical modeling were carried out on a flat plate. Problem of mist generation was also studied on a flat plate using a web camera having a frame speed of 15 fps.