Experimental Investigation of Lubrication Regimes on Piston Ring -Cylinder Liner Contacts for Large Two-stroke Engines

Friction in the piston ring package (piston, piston rings and cylinder liner) is a one of the largest contributors to the overall mechanical power loss of two stroke marine diesel engines. This can be seen both from service experiments and through simulation studies. From these studies it can be concluded that the friction force in the piston rings has its maximum contribution around the two dead centres - top dead centre (TDC) and bottom dead centre (BDC). It can be shown through simulation and from service experience that the tendency of asperity contact between piston ring and cylinder liner is pronounced around TDC and BDC. From a tribological point of view, it is the tribological mechanisms around TDC and BDC, which are the main area of interest in an experimental investigation. Since this is a difficult investigation to conduct on operating engines a small scale experimental setup was developed. The intent of this work is to study the tribology of the piston rings at a lab scale test rig. A reciprocating test rig was developed in collaboration with The Technical University of Denmark to study the performance of piston rings of two stroke marine diesel engines. The basic principle behind the test rig is similar to an operating engine where a piston ring segment is moving in a reciprocating motion subjected to a certain normal load. Segments of the piston ring and the cylinder liner material for the test rig were taken from the operating engines and were machined for the dimensions of the test rig. Friction force, oil film thickness and temperature distribution of the piston ring is studied as a function of crank shaft position, rotational speed, and loading of the piston ring. Furthermore Electrical Resistance measurements are conducted in order to investigate the transition from full separation (hydrodynamic conditions) to partial separation (boundary lubrication). Finally simulations are carried out on a selected set of experiments in order to compare the measured values with theoretical results.

Authors are:

Mr. Anders Vølund, MAN Diesel SE, Denmark Mr. Christian Felter, MAN Diesel SE, Denmark