Ranking of Cylinder Liner Materials in Two Stroke Marine Diesel Engines

Michael Torben Pedersen* (mpte@mek.dtu.dk)
Peder Klit* (klit@mek.dtu.dk),
Tajammal Imran* (tajim@mek.dtu.dk),
Christian L. Felter**(christianl.felter@man.eu),
Anders Vølund** (anders.voelund@man.eu)

*Department of Mechanical Engineering, D.T.U., Kgs. Lyngby, Denmark

**R&D, MAN Diesel SE, Denmark

ABSTRACT

One of the major prerequisites for an improved combination of cylinder liner material and piston ring material is a good description of the materials tribological performance. Piston rings operate in three different lubrication regimes and the materials should be characterised for all of them before a final selection is made.

A new approach to study the cylinder liner and piston rings (primary drive line in the combustion chamber) is used to characterise five different cylinder liner materials. The utilised test apparatus is working after the block-on-ring principle where the cylinder liner is made into a ring and the piston ring into a block. A short introduction of the test apparatus and its abilities is presented and discussed.

Results from comparison and characterisation of five different cylinder liner materials run with a fixed piston ring material will be presented. A preliminary ranking of the materials will be given based on the materials tribological performance. The materials are evaluated on basis of friction force, oil film thickness variation, temperature variation and rotational speed.

1. INTRODUCTION

Friction between piston ring and cylinder liner is a major source of power consumption in the primary driveline of two stroke marine diesel engines. Also is the service intervals influenced by the friction due to wear of the components. Reduction of the frictional loss requires a solid knowledge of piston ring and cylinder liner tribology. This knowledge can be obtained by experiments where only the interaction between the piston ring material and cylinder liner material is investigated. By making this isolated investigation it is possible to rank different cylinder liner materials and in a simple way test new materials. A test apparatus made after the block-on-ring principle is used for the investigations and the performance of the cylinder liner materials is studied by measuring friction force, oil film thickness, temperature in the contact line and rotational speed of the wheel.

2. SHORT INTRODUCTION TO THE TEST APPARATUS

A special designed test apparatus (presented in [1]) is used to investigate friction between different cylinder liner materials and a fixed piston ring material and wear of the two. The test apparatus is based on the block-on-ring principle. The piston ring is the block and the cylinder liner material is shaped into a ring. The piston ring and cylinder liner materials are delivered by MAN Diesel and they originate from the present engines designed by MAN Diesel SE.

The test apparatus is inspired of the ISO 8251 standard which describes a procedure to test the wear resistance of anodized aluminium and aluminium alloys by mean of an abrasive wheel wear test apparatus. The test apparatus described in this paper is not fully compatible with the ISO 8251 standard but with time it is intended that the developed procedures should be closer to what is described in ISO 8251.

The illustration is taken from the CAD files composed during the development process. Fig. 1 shows a cross section of the test apparatus.