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THE POSSIBILITY OF IDENTIFYING THE BENEFITS OF COATING PISTON RINGS

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ABSTRACT

It has been proven through experimentation that in spark ignition reciprocating internal combustion engines the piston group contributes to an overall mechanical losses in the engine of approximately 45%, for diesel engines the share of the piston group is around 50% of the total losses. It is therefore logical that in order to reduce mechanical losses in a reciprocating internal combustion engine one should focus on finding possible measures to reduce friction losses in the piston group. As a result, coating the sealing (friction) surfaces of piston rings and the friction parts of pistons offers a promising solution.

Keywords: tribometer, piston ring, mechanical losses, coating.

INTRODUCTION

Increasing the efficiency of machinery and equipment is associated with reducing the lost energy necessary to offset friction losses arising on the contact sur-faces of mutually moving parts. The size of the friction losses depends on the load of the contact surfaces. At the same time, a significant role is played by the quality of the surface of the contact areas and the presence of lubrication be-tween the “contact” surfaces of moving parts, as well as the relative speed of the moving parts (the dependence of these factors can be shown a in general form using a so-called Stribeck curve) (Priest, 2000). In cases where mutually moving pairs operate in a state of steady movement it is possible to achieve low friction losses using a suitable lubricant (i.e. to achieve an operating state using effective hydrodynamic lubrication) - such cases mostly concern rotational movement. In the design of machines, however, there are many cases where the sliding movement between pairs is at variable speeds and rapidly alternating directions. In these cases, the contact surfaces of the moving parts pass from marginal to hydrodynamic friction. In some cases of reciprocating sliding movement it is not possible to safely ensure that the movement be-tween the pairs is under hydrodynamic friction - dry or semi-dry friction - then the friction loss increases and in these cases the quality of the surface of the contact area (surface roughness and coefficient of dry friction) significantly decreases due to these friction losses. A typical case of reciprocating sliding movement with significant friction losses on the overall mechanical losses of the machine is a piston group (piston with piston rings) in a piston combustion engine or in a piston compressor.

RESULTS AND CONCLUSIONS

The test equipment for measuring friction losses across the piston ring was structurally designed and physically implemented at the Technical University of Liberec. A Parker -

PowerRod Actuator was used to create the linear reciprocating motion with variable speed. Therefore, no crank mechanism was used. The drive is created by connecting the rod with the piston and piston rings through the de-signed reduction. The cutout of the engine block is placed together with a base plate on a linear line with an extremely low friction coefficient. The base plate is connected to the frame of the structure through a force sensor. The whole of the test equipment is placed behind an aluminum profile frame to facilitate making adjustments when changing the test components.

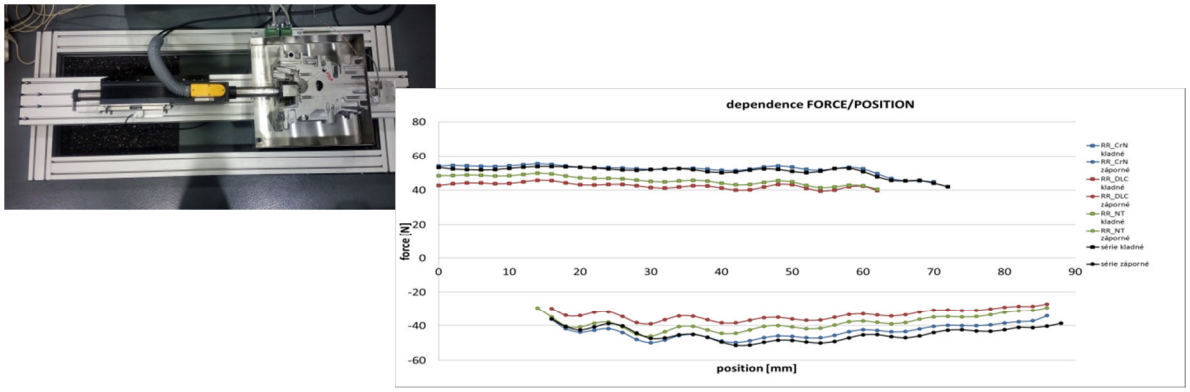

Fig. 1 - The tribometer with linear reciprocating movement, Comparing the benefits coatings piston rings (black - serial version rings, blue color - rings coated with CrN, green - rings coated with NT, purple color - rings coated with DLC)

The measurements performed to-date indicate high repeatability and stability of the linear reciprocating motion on the measured sample. The graphs show the course of the force depending on the position. From the results it is possible to identify the contribution of individual coatings to reduce mechanical losses.

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