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THE MICROGEOMETRY SURFACE EVOLUTION DURING THE CAVITATION PROCESS

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Abstract: *The first part of the paper analyses the vibration parameters on a tribosystem constituted by the cylinder liner and the cylinder block of a Diesel engine. Further on is there are presented the experimental researches on a tribomodel that corresponds to the geometrical characteristics of the engine.The construction of the tribomodel permits the combination of the study of the vibration type of cavitation with a hydrodynamics cavitation. A cylinder liner with 6 mm in thickness on the tribomodel was tested and the roughness on the external surface was measured.in a single paragraph, without "tab"-s. The abstract will have 7...10 lines.*

Key words: *cylinder line, cylinder block, engine, cavitation*

1. Introduction

The damage processes by cavitation (cavitation wear) are met in many technical domains (the chemical industry, the nuclear technology, the geology, the hydro and thermoenergy).

In the case of internal combustion engines, this type of wear appears on the external surface of the cylinder liner in contact with cooling water.

In some case, the wear of the external surface of a cylinder liner is 3 –5 greater than that of the internal surface that is in contact with the piston rings. It was considered that this wear was due to the chemical and electrochemical corrosion processes; at present at the basis are the cylinder liner vibrations that lead to a specifically type of wear – cavitation wear.

2. Working Methodology

In the specialty literature there is no unanimously accepted methodology concerning the behavior study of different materials, generally, and of the cylinder liner and of the cylinder block of the internal combustion engines in particular, at the vibration cavitation damage.

Generally, the tests are achieved:

a) on the triboelements of the real triboelements structure, which require a long experimental period, with implications in the research of the damaged zones and in the quantitative estimation of damage ;
b) on the models of the real tribomodels, in the cavitation tunnel, on the testing stands of the engines and which required, also, a long period ;
c) on the cavitation tribomodels, where the wear processes are intensified, the testing time is relatively diminished and with the possibilities concerning the modification and the control of the working parameters.

The experimental researches presented in this paper have been effected starting from

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the tribomodel concept that it was developed in some preceding papers ([1], [2], [8]).

There will be used the format A4 (210 mm x 297 mm), the limits of the printing zone being set using „Page setup": margins: upwards - 5 cm, downwards, left, right - 3.5 cm; heading - 4 cm; foot margin - 0 cm; „Different" first page; „Different" pages even and uneven.

The paper will be drawn up in two columns, of the width 67.5 mm, separated through a space of 5 mm. Exceptions are the title of the paper, the authors and their affiliation, the abstract and the key words, which will be drawn along the page.

For this the following stages have been traversed:

I. The study of the vibration parameters (frequency, acceleration) and the working parameters of a Diesel engine.
II. The study of the superficial layer parameters ″$\mathbf{S_s}$″ (the microgeometry, the hardness, the tensions state, the structure, the chemical composition, the purity) and of the tribosystem ″$\mathbf{C_r}$″ (the looseness value of triboelements, the thickness or the the quantity of removed material, the contact spot) for different values of the commanding parameters ″**U**″ (the water temperature, the diameter, the thickness and the material of cylinder liner, working time), on the projected and achieved tribomodel.

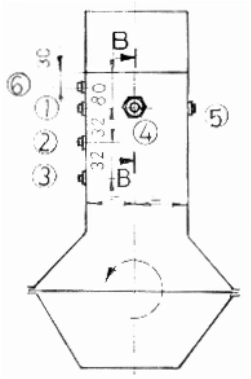

Fig. 1 *The disposal scheme of the measurement points* [3]

The determinations have been effected on the first cylinder of the engine for the rotations (1320, 1500, 1620, 1755, 1830) rot/min, on the hydraulic brake characteristic.

At the last working regime the measurements were effected with the suspended fuel oil injection of the first cylinder.

According to the BUREAU VERITAS classification register [7], the hard harmonics for the stroke engine are N/2, N, 3N/2 and 2N, where N represents the number of the engine's cylinders. Thus, the hard harmonics are: II, IV, VI and VIII.

The experimental study concerning the microgeometry of the vibration triboelement has been effected on the cylinder liner with 6 mm in thickness. The determinations of the roughness values have been effected on the generatrix I (the points 1, 2 and 3), II (the points 4, 5 and 6) and III (the points 7, 8 and 9) (fig. 2).

The mean depth in ten points of the roughness R_z, respectively the difference between the arithmetic mean of the high prominence ordinates and of the low cavity ordinates of the effective profile measured in the base length limits, from a parallel line with the mean line and which do not intersect the profile [6].

3. Experimental results

The variation of the cylinder liner acceleration with the rotation, for the three hard harmonics, is presented in the figures 3, 4 and 5.

In the figure 6 is presented the variation curves of the mean roughness R_z on the external surface of the cylinder liner in time.

It was established that, because of the great vibrations and of the cavitation bubble breaking, on the generatrix I and III, at the superior part a cutback of the microgeometry prominence from cylinder liner surface has occurred, and after wards a notch of them has manifested.

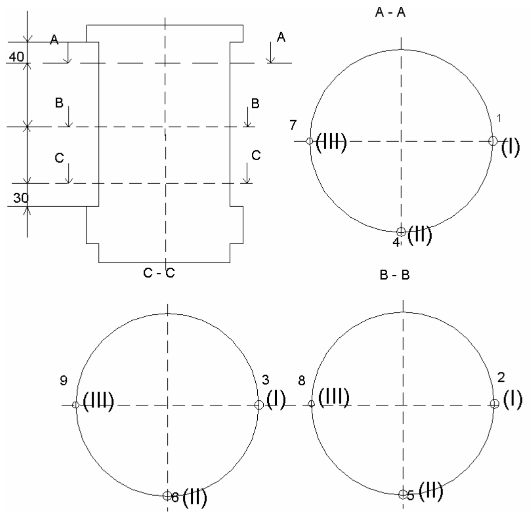

Fig. 2. *The measurement points disposal on the external surface of the cylinder liner* [5]

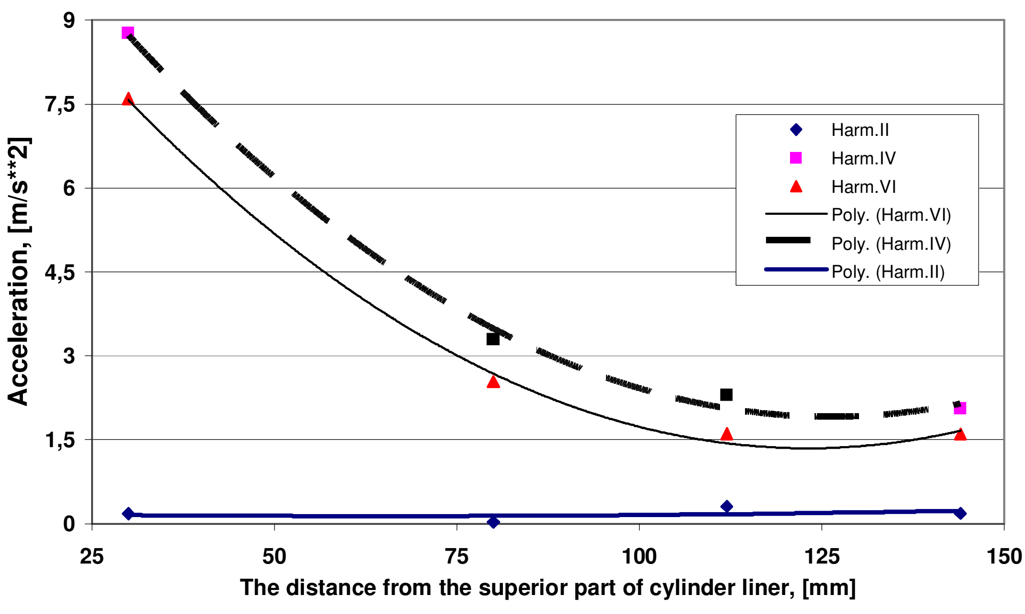

Fig. 3. *The variation of the cylinder liner acceleration in the poins 6, 1, 2 and 3, at the rotation n=1500 rot/min.*

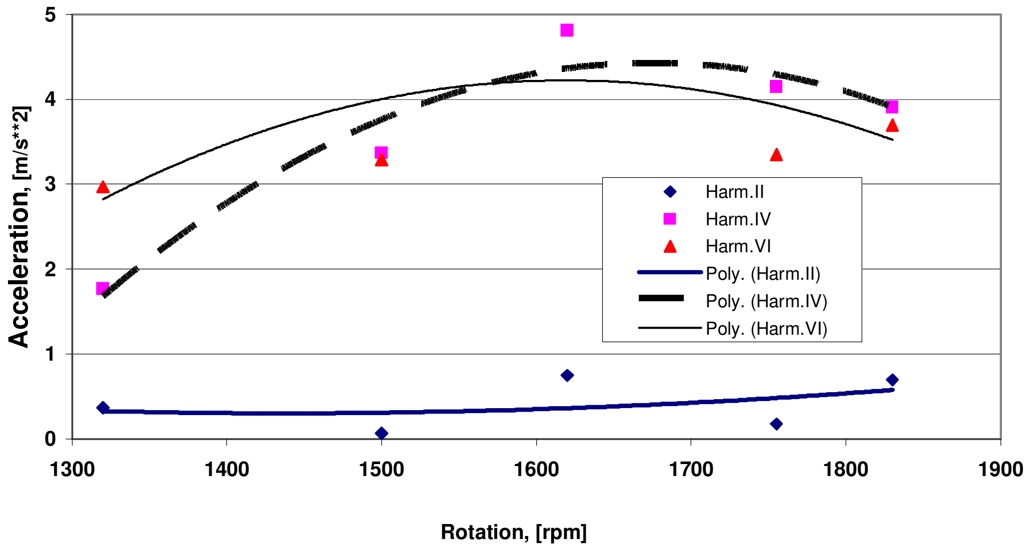

Fig. 4. *The acceleration variation of the cylinder liner - Point 4 -*

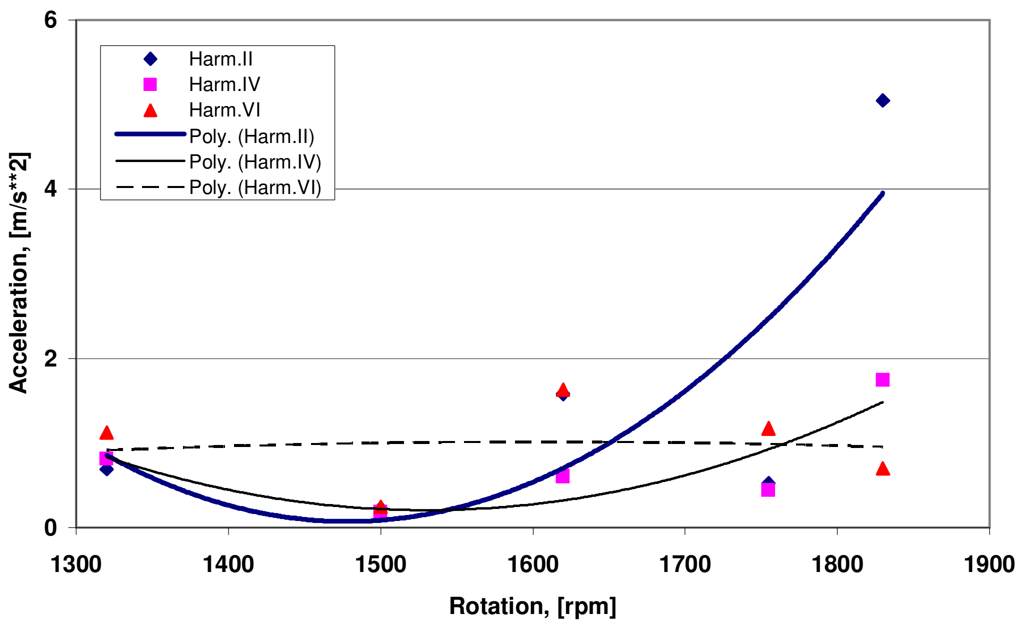

Fig. 5. *The acceleration variation with the rotation - Point 5 -*

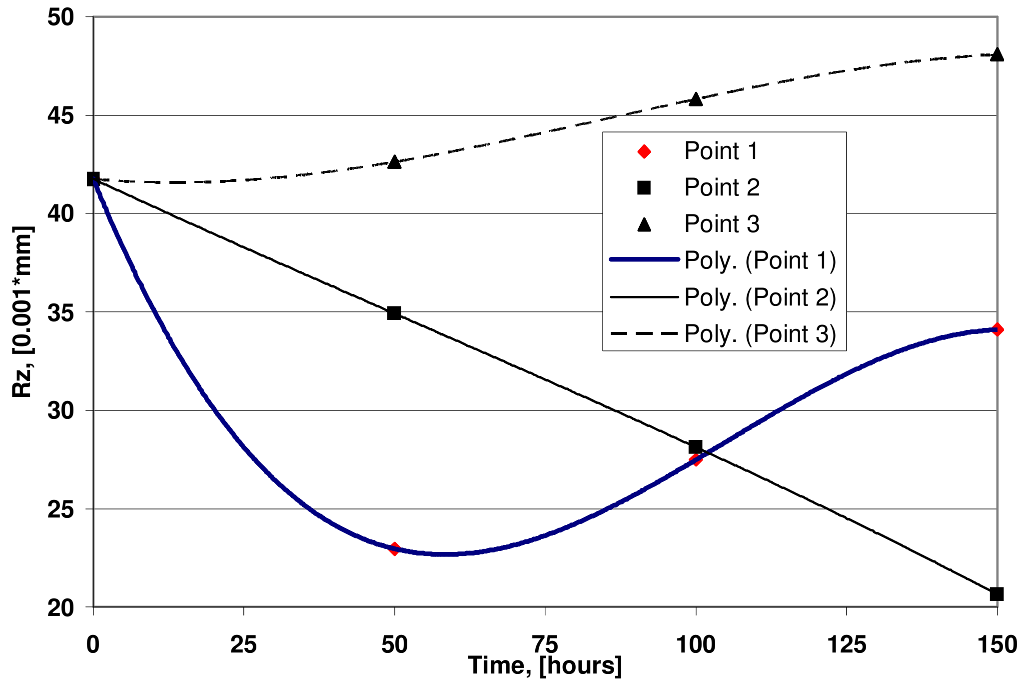

Fig. 6. *The roughness Rz variation with the working time in the points 1-3.*

4.Conlcusions

The measurements effected on the D-103 Diesel engine have permitted to establish the zone and the working regime where the vibrations are maximum. The great values of the vibration acceleration of the cylinder liner have been reported near the interior dead point and in the movement plan of the connecting rod.

From the analysis of the vibration cceleration distribution we can derive the following conclusions:

1. At the superior part (the points 1, 4 and 7), where the vibrations are maximum, there has been a reduction of the roughness R_z continued with an increase of this.
2. At the middle of the cylinder liner (the points 2, 5 and 8) the roughness R_z regresses continuously, and at the inferior part (the points 3, 6 and 9) R_z increases, more pronounced in the point 6, that can be associated with the influence of the hydrodynamics cavitation in the water' flow section..
3. For the inferior part, where the level of the vibrations is reduced, at the entrance zone of the water, we noticed the hydrodynamics cavitation's intensive influence, as a consequence of the modification of direction and of the water's flow section in the space between the cylinder block and the cylinder liner. So, we ascertain a low increase and approximately linear of the roughness, in comparison with the variation in jumps from the superior part of the cylinder liner.

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