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The Effect of Adsorption of Plasticization in the Journal Bearings Vehicle Diesel Engines

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I. Introduction

Connecting rod bearing a four highly accelerated diesel (see Fig. 1-2) loaded the alternating load on the forces of inertia and pressure forces gases. Due to the low loading of excitation forces in diesel engines with sliding bearings exposed to oscillatory process of the formation of the real fluctuations in the oil layer of the connecting rod bearing is not opened and their physical nature is not explained. Oscillatory phenomena occurring in the oil layer of the connecting rod bearing at the moment of impact the application of dynamic loading is extremely complex and not well understood, so that now they give the correct physical interpretation.

Figure 1: Diesel Generator DGR 500/1500 In-Line Diesel Engine combined 6CHN21/21

In addition to depending on the hydrodynamic oil film bearing the geometric parameters and relative eccentricity proved [1-2], [3] that the oscillatory process in the oil layer thickness promotes cavitation phenomena: in the lubricating layer always contain steam and steam bubbles. Getting in the zone of high hydrodynamic fluctuations of the oil layer, bubbles, destroying much reduced in volume or slam, exposing the surface of the liner impact of high intensity and causing plastic deformation, structural and phase changes in the antifriction layer, which ultimately contributes to fatigue failure of the bearings. The intensity of cavitation in the oil layer has an impact loading of the bearing assembly and diesel as a whole, including its forcing the parameters of the thermodynamic cycle.

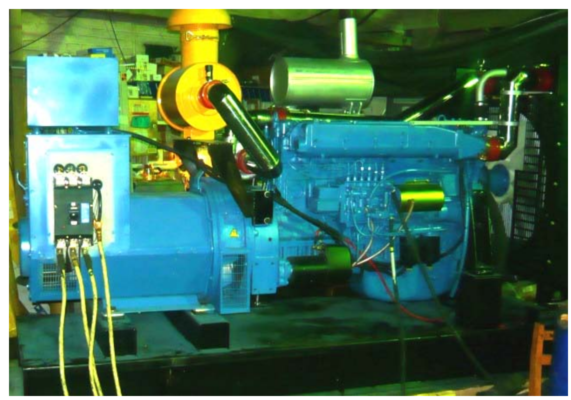

Figure 2: Testbench based 6CHN21 / 21

II. Results and Discussion

To evaluate the interaction and mutual influence of the dynamics of the loading of the crank mechanism (CSV), and hydrodynamic fluctuations in the oil layer of the connecting rod bearing is useful to consider the main factor driving - gas force F (t). When operation of the engine crank as the oscillating system is experiencing shock loads resulting from the emission rates of thermal energy from multifocal autoignition of fuel in the combustion process, the impact of which on the piston is pulsed 1 (Figure 3).

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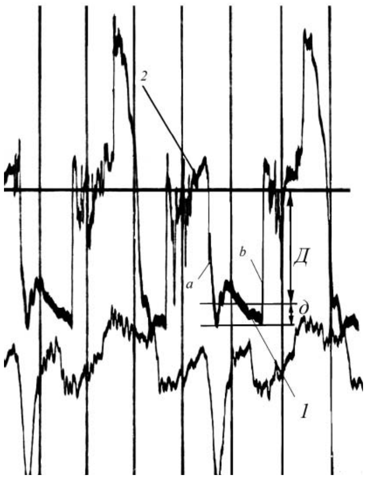

Figure 3: Torsiogramma dynamics loading CSV and hydrodynamic fluctuations in the oil layer of the connecting rod bearing

The latter is a measure of the impact force is characterized by a coefficient determined K_D by the dependence $K_D = 1 + \frac{d}{D}$ of the dynamic and experimental values K_D for the diesel crank 6CHN21/21 according to Figure 3 is 1.2. Value K_D depends on the design parameters crank modes of engine operation, the nature of occurrence of the start phase visible to the maximum pressure of the combustion cycle of the ignition delay duration, the amount of the fuel supplied in the first phase and the nature of the fuel supply period, a sharp pressure increase, etc.

The results show that during the combustion process impact force arising abruptly (see Fig. 3 a, b) is applied to the hot surface of the piston, is directed along the axis of the cylinder and is characteristic of the second controlled period of the combustion process. Impact force determines the dynamics of the combustion process in terms of the value of the existing forces and is not involved in the transposition of the piston.

Specific form of existence of the gas forces are of vibration, reflecting the intensity of the gas forces. Amplitude of vibration depends on the maximum rate of pressure rise K_{MAX}, the dynamics of heat at the time period of uncontrolled combustion of the fuel and the combustion process is accompanied at all stages.

Table I: Values K_{MAX} for diesel engines such CHN21/21, determined from the indicator diagrams workflow (Figure 4) as the slope of the tangent to the x-axis

P_{MAX}, MPa	12,26	10,1	8,34
K_{MAX}, MPa/ α	32,1	16,7	6,46

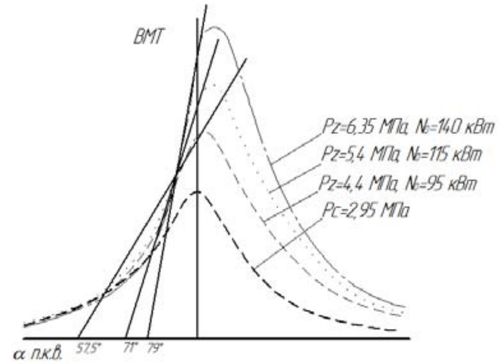

Figure 4: Indicator diagrams of the gas pressure in the cylinder of a diesel engine 6CHN 21/21

Perturbing gas forces $F_{(t)}$ created by the pulsed nature of the shock load of vibration and causes a forced oscillation crank 1 (Figure 3).

Piston system - crank due to its inertia is not able to follow the change in gas pressure in the cylinder of a diesel engine from the combustion of fuel. Therefore, in the initial period of the motion (at a push) from the end of the fuel in the cylinder on the compression stroke before the intense combustion (at the time period of uncontrolled combustion of fuel injected in the ignition delay) in the CSV there own damped oscillations 2 (Figure 3).

Alternating loading CSV forces of gas pressure and inertia forces for the loading cycle crank pins performs dynamic movement on a complex trajectory (Figure 5), characterized by a given load, the relative gap, lubricant viscosity, hydrodynamic characteristics, the main of which is the minimum thickness of the lubricant h_{MIN}. Currently used methods for calculating the hydrodynamic oil film bearings slip is not considered dynamic load application and the law of motion of the center of the crankshaft journal for the cycle. In this case, the dynamic problem is reduced to quasi-static due to the fact that in the classical hydrodynamic lubrication theory degree of dynamic load application is not normally considered [1]. Bearing this in mind, the minimum thickness of the oil layer dynamic bearing sliding evaluate the dependence

$$h_{MIN} = K_D \cdot h_{MINst},$$

where K_D - coefficient of dynamic loads; h_{MINst} - Quasi-static component of the minimum oil film thickness.

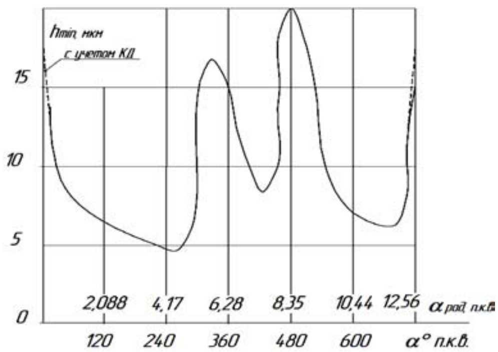

Figure 5: Dynamic movement committed crank pins at alternating loading crank forces the gas pressure and inertia forces for loading cycle

III. Conclusion

As shown by theoretical and experimental studies on the example of the dynamics of loading diesel 6CHN21/21 [3-4], the dynamic factor in the Powertrain with $K_D=1{,}2$ declines $K_D=1{,}18$ in the oil layer to the connecting rod bearing due to dissipation and damping of the vibrational energy of a rod and a layer of oil bearing. However, the main part of the dynamic tension ($K_D=1{,}18$) is passed through the oil layer of the crank journal crankshaft bearings and its bed of the block - housing, causing local deformations, high dynamic stresses and vibrations in the mating parts impacting negatively on the reliability and the fatigue strength of diesel engines and also creating unforeseen emergencies even in the polishing stage. Therefore, it seems appropriate solution twofold task by one: to reduce the dynamic loading K_D by neutralizing the oscillatory process in the oil layer of the plain bearing and apply effective measures to retain lubricant on the friction surfaces. Such methods should include the use of the bearing surface - active agents (surfactants), causing, as is well known, the formation of an anti-friction wear-resistant film. [5] The latter is a self-healing plastically deformed soft and thin layer. Since the direct change in the damping capacity of the oil film thickness is difficult, and the estimate of energy dissipation fluctuations in CSV as parts of complex configuration presents certain difficulties due to the fact that the dissipation of energy is not a linear function of the dynamic tension structure for the assessment of loading in the oil layer in the plain bearing conditions of application of surfactants requires new approaches.

Surfactant molecules cover the entire surface friction sliding bearings and crankshaft with an adsorbing epilam film, which by lowering the surface energy of the material facilitates plastic flow in the grains located in the surface layer. Adsorption softening material is a consequence of the physical interaction with the adsorption of the boundary film. This phenomenon is known as adsorption and plasticize the first condition PA Rebinder discovered by him in 1931. Active epilam molecules penetrate the microscopic cracks, micropores, creating adsorption - a relaxed feature, which is the second manifestation of the PA Rebinder. Adsorption of the surfactant causes a decrease in specific surface energies and intensifies the plastic deformation of the material, thereby reducing its strength characteristics and to establish a positive gradient of the mechanical properties of the friction zone.

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