1TH INTERNATIONAL WORKSHOP "ADVANCED METHODS AND TRENDS IN PRODUCTION ENGINEERING"

FACTORS OF INFLUENCE CONCERNING THE WEAR OF THE SHEATING

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1. THE STATE OF THE SHEATING AFTER ONE CYCLE

The duration of the internal combstion engine's work is limited by the wear of the cylinder-piston ensemble.

The intense wear of the internal combustion engines cylinders is determined by:

- the high temperature near the heating chamber where the gas reaches temperatures of 2500 K ;
- the maximum pressure of the gas which care reach 35-60 kgf/cm^2;
- the variable speed of the piston reaching periodically zero;
- the insufficient lubrification;
- the maximum concentration of abrasion particles from the atmosphere and the excessive quantity of gas.

In conclusion, the engines cylinder is subdued to a near process, to adherence, over which comes with variable intensity the abrasion.

The main agent in the cylinder's wear is temperature and movement with variable speed of the piston, in the reduction of the cylinder's wear the most important thing is the lubricant.

In figure 1.1. there is shown the variation of the wear of engine IAZ-204 's shealthing after 60 h of function in practice from table 1

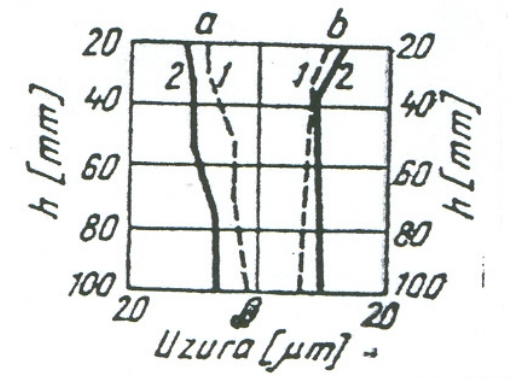

Fig.1.1. The variation of the cylinder 's wear on the h height of the sheating :
1-.at condition I; 2-at condition II; a-in the parallel plane on the bent axle;b-in the erect plane on the bent axle.

Table 1.1. The wear of engine;s IAZ –204 ‘s shealthing

The name of experiment	n (rot/min)	P_C (kgf/cm^2)	n (rot/min)	P_C (kgf/cm^2)	Time (h)
The wear of the engine	1600	4	1600	4	12
The raise of the wear curve	1600	3	1600	4	24
Lasting at wear	1600	3	1600	4	100
The raise of the wear curve	1600	3	1600	4	24

In the work process, the cylinder-piston-segment groups is wearing out in the presence of the corrosive medium which takes place at the burning of the engine fuel mixture when gases are formed (carbon dioxide, carbon oxide, oxygene, sulphurous combinations, other chemical combinations and water vapour).

When the temperature of the cylinder’s walls are approaching the dew-point temperature of the burning products, the water vapours are inspissating on the walls forming in the presence of the gases, acids that emphosize the wear.

At low temperatures of the walls the role of the electrochemical processes which destroy the structure of the superficial strate of the cylinder’s is emphasized.

The intnsaty of the wear is unequal on the length of the cylinder’s walls, the maximum wear taking place in the friction area of the first segment of astriction .

The cylinder’s wear in the inner dead center is in general more emphasized than in the outer dead center, where the oil strip is always there, missing also the suplimentary pressure of the gasses on the segments.

The epure of the wear of the cylinder’s I-IV are presented in the figure 1.2., for the raise of the wear’s epure were made 40 grooves on the generators at 5 distances from the superior plane of the cylinder’s block type.

When it comes to the structure and physical-mechanical features of the materials that were used in the making of the pieces from the cylinder-piston-segment groups, the experience shows that the resistance of cast iron wear grows at the sametime with the raise of it’s hardness , alloyed cast iron is more resistant to wear than pure cast iron and less resistant than the modified cast iron .

The modified cast iron, with magnesium, having module additives presents a higher resistance to wear than the modified cast iron with graying additives, having graphite module of small dimension .

In the outer dead center area there is a more pronounced emphasized wear because of:

- high temperature and pressure during the burning and relaxation;
- local dilution of the oil strip by the fuel mixture which enters with high speed during the period of process;
- the diminution of the oil’s clinginess;
- the reduction of the piston till zero;
- the change of the movement which decreases, the thickness of the oil strip changing the feature character of the friction.

The resistance to wear of the superficially flame hardened cast iron is higher than of the flame -hardened cast iron and the resistance at erosion and corrosion is emphasized by the nitration and chromium plating of the surfaces.

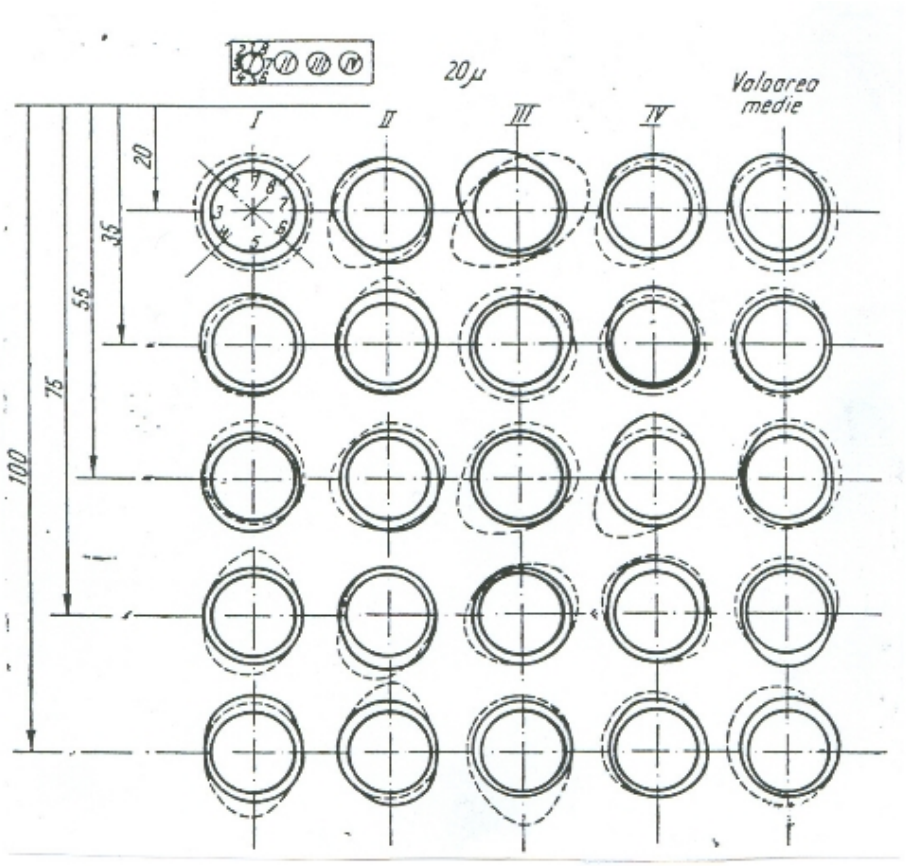

Fig.1.2. The epure of the cylinder's wear straight line at I condition ; interrupted line at II condition .

For knowing the causes of the wear in order to decrease it, one must have in mind the premises of the cylinder's wear mechanism which reduce to the prescriptions of project and technology of execution should be followed:

- when they put together the three elements they should avoid asymmetrical solicitation which under the influence of the force of inertia could be emphasized;
- the access of the oil when it is near the inner dead center, not to be stopped during function and most of all the beginning is presented by an adequante form of the segments and a right clengyness of the oil ;
- the asperity of the surfaces could be favourable or not depending on the absolute value of the asperity and the hardness of the surfaces, on a favourable value of the asperity, or when there is good hydrodynamics, the real contact surface has mixte liquid material abrasion particles entering between the asperities, their action being stopped;
- the hardness of the straight surfaces has a small effect and in the case of the hard surfaces, it can be positive or negative ;
- at normal intensities of other agents the abrasion leads to wear more emphasized than the corrosion.

In the case of the cylinder-piston-segment groups, the segments have the heading role of mobile pieces towards the cylinder, because each of it's point remains in permanent contact with the cylinder's surface, while its different points come in contact successively:

- the contact wear and the tiredness does not constitute emphasized forms of wear;
- the fuel and the lubricant when they are not of the quality indicated by the buildind firm;
- the action of the enviroment could emphasize the usage by the presence of the abrasive particles and of the chemical gases in the aspired air.

When during the building, the position of the cylinder presents deviation from the direction of the piston's movements, some generators of the cylinder will suffer excessive solicitations like in the figure 1.3.

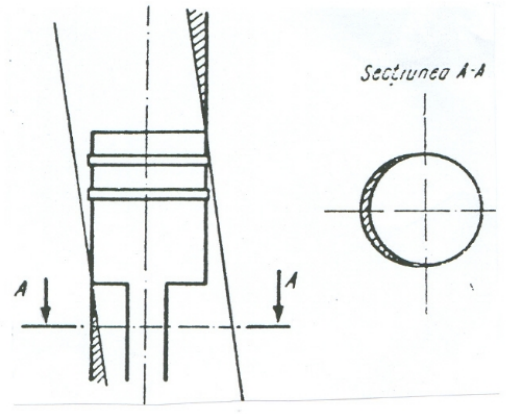

Fig. 1.3. The wear of the cylinder.

In comparison with the medium hight of the asperities which are 0,001mm, the deviations are 0,1mm, in conclusion the hardness of the surfaces constitutes a remedy of aproximatively 100 times less important than the remedy of the building deviation.

So the usage of the cylinder and segments is due always to the errors of building .

2. THE INFLUENCE OF THE FUEL, OIL AND ADDITIVES ON THE WEAR OF CYLINDER

The corrosion is one of the main agent which determine the rhythm and character of the internal-combustion engine's wear.

The mechanism and the speed of corrosian are determined by the fuel and oil, the time and building of the engine and also the practice.

The corrosion of the engine's pieces is due to organical ssubstances which are in the fuel and oil and those that are forming during the burning .

In the fuel and oil can exist active compounds of sulph, water, acids, etc. which can had to wear by corrosion.

3. THE INFLUENCE OF THE FUEL ON THE WEAR OF CYLINDER

The presence of sulphur in fuel and of the sulphurous compounds constitutes the main source for corrosion, so the sulphurethed hydrogen H_2S acts upon iron, plumbum forming sulphide .

The compounds that are present in fuel had to the corrosion of the pieces as in table 2

Table2.The influence of the organics acids from fuel against the wear of pieces

Index	The acidity of the fuel (mgKOH/100ml) 4	The acidity of fuel (mgKOH/100ml) 50
The medium wear of the piston after 500h (mm)	0,0015	0,0023
The wear of the first segment of compresion	0,03	0,07
The deposit on the head of the cylinder's block (mm)	0,05-0,08	0,12-0,15

The fuels for Diesel engines that contain vanadium even though in very small qualities (0,005%) intensify the process of corrosive wear of bottom of the piston , the head of evacuated valve disk, etc.

The observation and the experiments have shown that there are no alloy which can resist the corrosive action of vanadium.

4.THE INFLUENCE OF THE LUBRIFICAT ON THE WEAR OF CYLINDER

The quality of the lubricant is a main agent in the wear of the internal-combustion engine's pieces .

The lubricant contribute to a better function to the duration of function to the decrease of the fuel and also to the decrease of the expense.

The oil used with the internal combustion engine, in initial state generally do not contain compounds that could produce sensible corrosion.

The speed of the corrosion action could be written down by the following ecuation:

$$\mathbf{dC/dt=K.A.C} \qquad (1)$$

where C-the concentration of the acids after a t period of time;

A-the metallic surface;

K-the speed of reaction.

By the ecuation 1's integration the speed of reaction can be determinated :

$$\mathbf{K=2,3/A.t\ (lg.C_O/C)} \qquad (2)$$

In which C_O – the concentration of the acid at t=0

The reaction speed is presented in figure 4.1. by a straight line which gives through the origin and the tangent of the angle of tilt indicates the speed of reaction K, as one can see from the inclination of lines that doesn't contain acid with a small number of molecules.

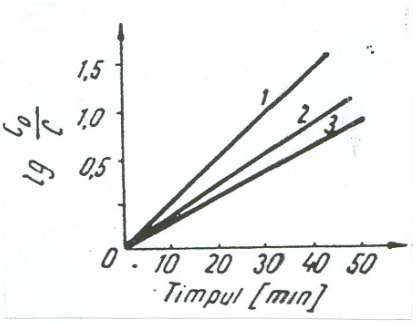

Fig.4.1. The variation of the corrosion speed w s :1-caprylic acid,2-stearic acid, 3-oleic acid .

The corrosion due to oil takes place in cylinders, pistons, segments.

Thus, after the burning of fuel SO_2 and SO_3 is formed which inspissate together with the water vapourson the cold surface of the sheating,, creating sulphuric acid.

These entering the oil which covers the surface of sheating of the piston and segments produce an intensity of the wear by electrocorrosion .

In this case this leads to the formation of calamine which also intensifics the wear.

The engine's technical state has influence on the intensity of wearing of the oil and could be measured by the usage of the pieces that enter the cylinder –piston groups.

Together with the wear the quantity og gas that enter into the carcass groups because of the piston's high temperature and accelerates the technical wear of the oil.

The quantity of gas that enter into carcass grows in the sametime with the wear of the piston's segments.

The termical solicitation is determined by the ecuation:

$$\mathbf{Q=C/F\ .i\ .k} \qquad (3)$$

where C-the medium fuel consumption;

i-the number of cylinders;

F- the total work surface of the piston and cylinder ;

k-dimensional factor k=1 kcal/kg.

So in conclusion, knowing the influence of different agents on the reliability of the machinery, a more detailed study about the improvement of the fuel's characteristics /feature and additives used could constitute an increase of the duration of the engins function.

The intervention in the fuel's composition, in the structure of the metals would decrease /diminish the action during a long period of time on the machinery..

Finding the best operating conditions of the cylinders and the agents of in fluence, could lead to avoidance of wear and intervention.

Thus by through, the improuvement of reability and maintainability would be able to obtain a superior quality.

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