Engineering and Technology Journal e-ISSN: 2456-3358

Volume 09 Issue 05 May-2024, Page No.- 3985-3987

DOI: 10.47191/etj/v9i05.15, I.F. – 8.227

Technologıcal Methods of Increasıng Bearıng Performance

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ABSTRACT: The tribological characteristics of bearing shells manufactured using various technologies have been studied. The results obtained allow us to determine the most technologically advanced method. One of the main requirements for load-bearing shells is the absence of macrostresses in the surface layers of the load-bearing shells, leading to their destruction. The studies were carried out only in near-surface areas. The results obtained show that there are no macrostresses in antifriction coatings obtained by ion-plasma and galvanic methods.

An important feature is the high adhesion strength of the antifriction layers to the base.

Adhesion tests were carried out on samples cut from liners obtained by the acoustic method. The greatest adhesion strength is observed with ion plasma coating, it is 22 MPa.

KEYWORDS: liner, crankshaft, galvanic method, wear, torque friction.

INTRODUCTİON

Crankshaft bearings are one of the most critical parts that determine the reliability of internal combustion engines. They operate under difficult conditions of variable loads, high sliding speeds and other unfavorable factors, which determines a complex set of requirements for their manufacturing technology and the properties of the bearing materials being tested.Currently, one of the most per- babbitt is a promising material as an antifriction coating for crankshaft bearing shells [1]. There are various methods for applying an anti-friction layer. Comparison of the tribo-technical characteristics of liners with coatings applied by different methods allows us to determine the most effective one.

GOAL AND PROBLEM STATEMENT

In the practice of machine-building plants, an antifriction layer is applied to bearing shells using the following methods:

1 – centrifugal casting;

2 – chemical-thermal treatment; 3 – galvanic;

4 – ion-plasma sputtering.

The purpose of the work is to determine the most

the most effective existing method for increasing the performance of bearings.

METHODOLOGY AND RESEARCH RESULTS

Application of antifriction layers on the inserts breathing was carried out during condensation in a vacuum of high-speed flows of metal plasma on the workpieces. The process consists of alternately applying layers of different compositions with given physical and mechanical properties and a certain thickness; in this case, the adhesion between the layers should have values that ensure high performance characteristics of the liner. To obtain the required adhesion values between layers, it is necessary to deposit them in a single vacuum cycle, which eliminates the depressurization of the installation before applying any of the subsequent layers.

The choice of deposition modes for coating layers was determined by a number of factors: the layer thickness must be uniform; the applied layers must be as plastic as possible, ensuring good running-in of the parts in the friction unit.

The challenge of achieving uniform thickness

layer was solved by installing the liners on a rotating table, while the distance from the cathodes to the middle of the ring, described by the working surface of the liner during rotation, was chosen equal to 0.2 m.

The hardness and ductility of the layer depends on the arc current, the sputtered material and the magnitude of the bias voltage on the substrate. When using a vacuum-arc cathode, the layer partially contains a droplet phase formed during erosion of the cathode in the arc spot. The concentration of the droplet phase is the main factor determining its roughness. Studies of surface morphology have shown that in arc current ranges of 10-30 A, the surface roughness does not exceed Ra 4, which meets the requirements for the surface roughness of bearing shells Ra 6.3.

The value of the arc current for each of the deposited materials must be large enough to ensure stable arc combustion and high productivity of the process. On the other hand, it should be minimal to reduce the concentration of the droplet phase in the flow of the deposited material.

The values of negative bias voltage for each of the deposited materials have their own certain limitations, the main one of which is the low temperature of the substrate.

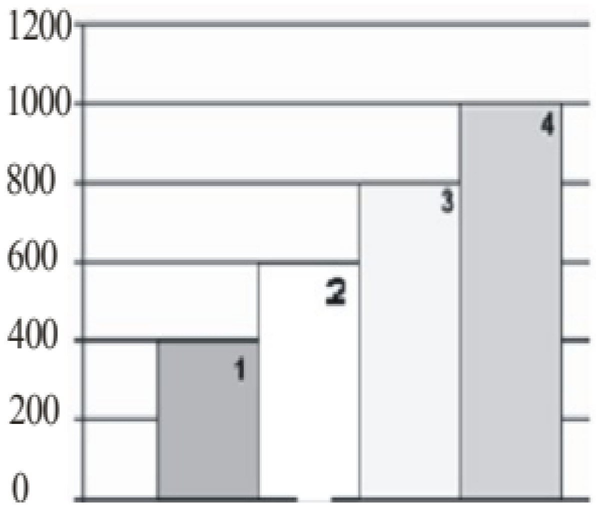
Increasing adhesion between layers during continuous application can be achieved by forming transition zones of mixed composition between layers. High adhesion to the base, acceptable values of microhardness and surface roughness, and the best tribotechnical parameters are characteristic of coatings obtained at a negative bias voltage on the substrate of 40 V. The magnitude of the adhesive interaction between the first layer and the base, and between subsequent ones layers exceeds 60 MPa.

Study assessing the influence of surface-

of the third layer for tribological characteristics was carried out on a friction machine SMTs-2, M-22M. Test modes were determined based on the operating conditions of the crank group parts of the 5D49 diesel engine. To determine wear resistance, a sliding speed of 2 m/s was studied under a load of 6 MPa for 7 hours. The bearing capacity and friction coefficient were determined at speeds of 1–3 m/s and loads from 2 to 20 MPa. The criterion for wear resistance is the weight loss of the test samples, which was determined by weighing on an analytical balance with an accuracy of 10-4 g. The friction coefficient was calculated and the loading at which the friction moment changed was recorded.

Studies have been carried out on liners under

dowels made by centrifugal casting, chemical-thermal, galvanic and ion-plasma methods.

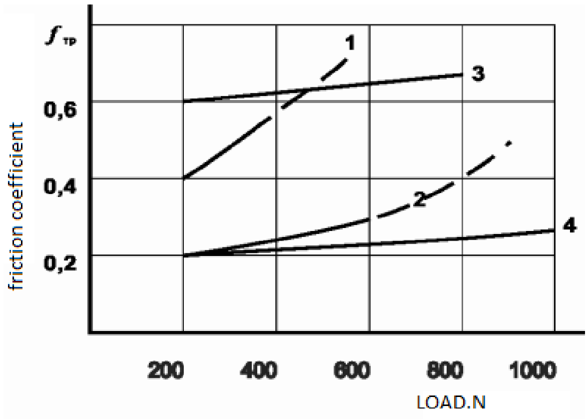


Coating Methods

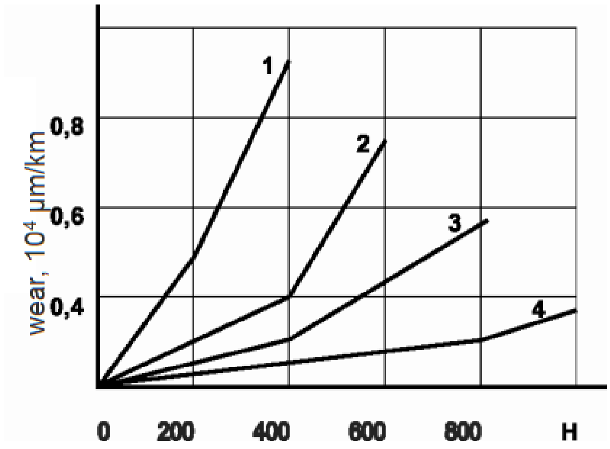
Rice. 1. Coating methods: 1 – centrifugal casting method; 2 – chemical-thermal method; 3 – galvanic method; 4 – ion-plasma sputtering method

The research results showed that in terms of the degree of increase in the anti-scuff properties of the multilayer coating of the liner, the ion-plasma method gives the greatest effect (Fig. 1).

The effect of increasing scuffing resistance, which is achieved by ion-plasma application of an antifriction layer, is accompanied by a decrease in friction forces, as evidenced by a change in the friction coefficient (Fig. 2).



Rice. 2. Influence of the type of coating on the change in the friction coefficient: 1 – centrifugal casting; 2 – chemical-thermal treatment; 3 – galvanic; 4 – ion-plasma sputtering



Rice. 3. Influence of the coating application method on the linear wear of samples: 1 – centrifugal casting; 2 – chemical-thermal method; 3 – galvanic method; 4 – ion-plasma sputtering

Conducted wear resistance studies showed that the ion-plasma coating method increases the wear resistance of bearing materials by 1.6 - 1.7 times compared to the galvanic method.

One of the main requirements for bearing shells is the absence of macro-stresses in the surface layers of the bearing shells, which leads to their destruction. Research was carried out only in areas close to the surface.

The results obtained indicate that in antifriction coatings, obtained by ion-plasma and galvanic methods, there are no macrovoltages.

An important characteristic is adhesion high strength of antifriction layers with the base.

Adhesion tests were carried out on ob- samples cut from inserts obtained in four ways, using the acoustic method. The highest adhesive strength is observed in the ion plasma coating, it is 22 MPa.

CONCLUSION

The studies have shown that the ion-plasma method used to apply an antifriction surface layer to bearing liners improves run-in and increases service life by almost 2 times compared to liners made by galvanic method.

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