MATERIALS FOR THE BUSHINGS

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Abstract: *The bearings materials must comply with certain difficult, and sometimes contradictory, requirements, the high level of the mechanical and heat density, specific to the present machine building, constituting the first element that has to be taken into consideration. The development of the machine building, apparatus, equipment and installations lead to a very great number of friction bearings: fluid bearings, very thin fluid bearings, mixed-lubricated bearings, non-lubricated friction bearings.*

Keywords: *bushings, the friction, the friction coupling, the friction coefficient.*

1. INTRODUCTION

The remarkable progress and the rapid development of industry at the global level arise very important issues concerning the superior exploitation of some categories of cheap and widely spread raw materials as well as the continuous improvement, through accumulations, of the operating processes of the future technology all over the world.

2. FRICTION BEARINGS

The development of the machine building, apparatus, equipment and installations lead to a very great number of friction bearings:

- fluid bearings;
- very thin fluid bearings;
- mixed-lubricated bearings;
- non-lubricated friction bearings.

Because of performances and durability, the fluid bearings are the most frequently used, the other types previously mentioned being used only in special cases, characterized by small specific loadings and reduced speeds (the bearings of certain knuckles, bearings that have no great importance for the functioning of the assembly and have small speeds and displacements etc.) [1].

According to the load type as to the volume of revolution, there can be identified:

- radial bearings,which take over the radial force, limitting the motion in the perpendicular plane on the rotation axis (the active surface of the bearing is parallel to the rotation axis);
- axial bearings, which take over loadings in the direction of the rotation axis (the active surface of the bearing is approximately in the perpendicular plane on the rotation axis);
- the radial-axial bearings, which can take over both the radial loadings and the axial ones (the active surface is conic or spherical).

According to the main mechanism of pressure production in the lubricant film, there can be identified the following bearings: self-supported bearings, interior pressure bearings which can be hydrostatic or aerostatic ones.

3. BEARINGS MATERIALS

The bearings materials must comply with certain difficult, and sometimes contradictory, requirements, the high level of the mechanical and heat density, specific to the present machine building, constituting the first element that has to be taken into consideration [3].

The dynamically loaded bearings are subject to a certain accentuated fatigue stress, which is a great disadvantage. Besides the size and direction of the load, which stresses the phenomenon of fatigue, it is worth to mention that the medium value of the specific loads on these bearings can reach 400-800 daN/cm², at important peripheral speeds, a direct result of the rotatative speed of 5000-8000 rot/min or even higher frequently reached ones at present.

The complexity of the issue, consisting in the choice of a right material for the bearing, is more obvious if the vibrations are mentioned as well as the chemical attacks and the influence of radiations at which are exposed the bearings of some machines or specific equipment.

At present, the main categories of metallic materials used at the production of friction bearings (radial, axial and hydrostatic) are: Pb-Sn system alloys, Copper based molten or sintered alloys, Al based alloys, other Cd, Zn, Ag based alloys etc.

The AS20 alloy is used for semibushings with or without lapping coat and antirust protection of Sn of 1...2 µm and Sn coatless bushings, for petrol and Diesel medium sollicited engines, with full-pressure lubrication. The spindles are treated at min. 200 HB.

The antifriction layer is plated on steel support, thus having a good loading capacity and abrasive resistance. From the chemically subsided Sn film results a very good embedment capacity.

The AS6 alloy is used for semibushings with the IIIrd working layer galvanically subsided from PbSnCu 22±2 µm, the PbSn protection coat of 1-2 µm being here included. The AS6 alloy semibushings are used for petrol and Diesel sollicited engines, with full-pressure lubrication.

The spindles are treated at min. 200 HB. The antifriction layer is plated on steel support, thus having a good endurance strength and an excellent corrosion resistance.

The CP25S2 alloy is used for semibushings with the IIIrd working layer galvanically subsided from PbSnCu 22±2 µm, the PbSn protection coat of 1-2 µm being here included. This alloy type is also used for the base bearings and the connecting-rod bushings with high loading, for great load and speed. The antifriction layer is plated on steel support, the IIIrd layer being galvanically subsided, improving thus the embedment capacity, having a better fatigue resistance and a higher hardness. The spindles are treated at min. 200 HB.

The CP10S10 alloy is used for semibushings with the IIIrd working layer galvanically subsided from PbSnCu 22±2 µm, the PbSn protection coat of 1-2 µm being here included, especially for the piston-boss bushings. The antifriction layer has a good conformability and abrasive resistance admitting great loadings with oscillating or rotary motion. The spindles must be treated at min. 200 HB.

The CP22S4 alloy is used for semibushings with the IIIrd working layer galvanically subsided from PbSnCu 22±2 µm, the PbSn protection coat of 1-2 µm being here included, as well as for petrol and Diesel engine or turbine bushings, which are medium solicited at high speed. The lubrication is done at full pressure.

The spindles must be treated at min. 200 HB. The antifriction layer has a good embedment capacity admitting medium loadings with oscillating or rotary motion at high speed.

The samples from the metallic materials used at the production of friction bearings (Fig. 1) for which there have been carried out the experimental research studies concerning the structure (chemical composition, microstructure), resistance properties (hardness, stretching resistance, critical shear stress, flexural strength, aherence of the antifriction layer), determination of the static quotients of friction which appear in the case of the friction bearings are the following ones:

1. Al-Sn based antifriction materials plated on the steel support

2. Copper-Plumbum sintered powder based antifriction materials plated on the steel support.

4. MATERIALS STRESS FOR BEARINGS

The various stress types and influences at which the antifriction materials are subject are the following ones [1, 2]:

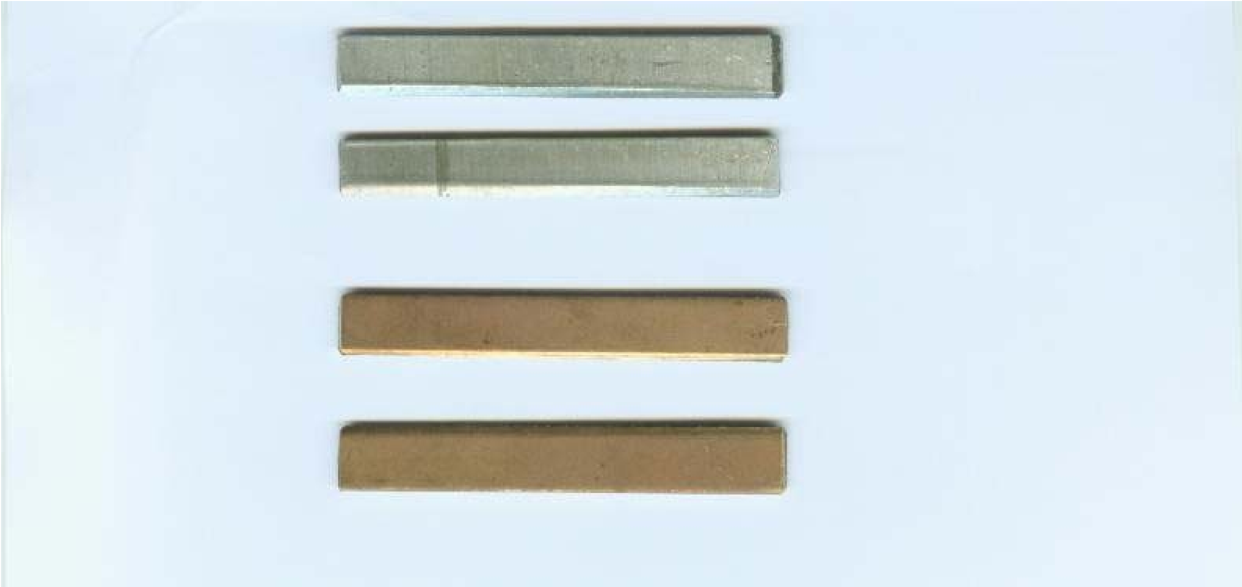

Fig. 1 Metallic Materials Used for Friction Bearings

- mechanical ones – contact pressures, fatigue stress, in the case of variable forces bearings, exaggerated loadings at the edges when the bearing alignment is not right, vibrations, shocks, etc;
- heat ones, derived from the friction in the bearing;
- chemical attacks, which can derive either from the interior of the bearing, as a result of the use of an inappropriate lubricant, or from the exterior, as a consequence of the functional characteristics specific to that particular machine or equipment;
- wear effects – the relative motion of the bearing surfaces producing different types of mechanical wear;
- the effects of the foreign micro particles and of the contaminated substances – these can produce the abrasive or chemical wear;
- cavitations – appears in the lubricant film and can lead to the damage of the bearing;
- the electrostatic loadings – have been determined as another source of stress and damage of the bearing material;
- exposure to radiations.

5. RESISTANCE PROPERTIES

Because the bearing is a mechanical system through which forces and moments are transmitted, first of all, the mechanical properties of those particular materials must be taken into consideration being indispensable for the fulfillment of the fundamental role of the bearing [1].

The contact pressure resistance and hardness, conditions the capacity of bearing mechanical stress. Together with this property appears the first and the most important compromise concerning the properties of antifriction materials, the hardness being as high as possible for the take over of some important contact pressures and as low as possible for the embedment of the foreign micro particles brought in the bearing by the oil flow and for the fulfillment of the conformability conditions.

The hardness is determined all through the operating process of metallic bushings whose antifriction alloy is finally plated on the support steel strip. From a functional point of view, the hardness value of the alloy coat taken off on the finished bushing has the greatest importance as that particular determination is made after ending the lamination, heat treatment and mechanical workings, that is in the physical state in which the bushing will function.

6. FATIGUE BEHAVIOUR

The fatigue stress of the bearing material appears in the case of variable loadings, depending on the number of cycles. In the internal combustion engines, for instance – through the nature of their functioning, the bearings (connecting-rod bolt bushing, connecting-rod and cranked shaft bearings) are subject to certain loads whose vectors are variable in time as amplitude and position, the immediate consequence being the fatigue phenomenon of the antifriction material [2].

The importance of the micro structural imperfections, inherent in the case of technical materials (different heterogeneity forms, gaps, dislocations, foreign materials inclusions etc.), for the identification of the specific resistance properties is manifested by the fact that the last ones vary in inverse ratio to the surface or volume linear dimensions.

Thus, it results that the probability of fracture nucleus knocking off through fatigue grows according to the length, surface or volume of the piece involved as the possibility of the existence of some favorable conditions increases, of some micro fissures of critical dimensions respectively.

7. CONCLUSIONS

From the fact presented above there can be drawn a series of conclusions.

The friction force depends upon a complex of factors: the normal charge, the sliding velocity, the type of contact, the quality and the rugosity of the surface, the type of materials in contact, the rigid or the elastic character of the surfaces, the superficial temperature and also the presence of some particles on the friction surface (lubricant, impurities etc.).

The friction coefficient, just like the friction force, is influenced by several factors, one of the most important being the state of the surfaces (the micro geometry and the physic-chemical properties of the superficial layers) [2, 3].

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