EXPERIMENTAL RESEARCH REGARDING THE ANTI FRICTION MATERIALS

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Abstract: *The most important requirements are those concerning the assurance of high mechanical characteristics under special regimes (extreme temperatures, high pressures, corrosive agents, etc.), whereas the weight of the finished product must be minimized by diminishing the density of the materials.*

Another issue in view is that of material saving, of the wise use of materials by means of rationally conceived projects and scientifically elaborated consumptions.

The paper presents a few characteristics of certain alloys necessary in the production of friction bearings used in the military technique.

Keywords: *technologies, bimetal, materials, friction bearing.*

1. INTRODUCTION

At present, the main categories of metallic materials used in the production of friction (radial, axial and hydrostatic) are the following ones [3] : alloys from the Pb-Sn system, cast or sintered Cu-based alloys, Al-based alloys, other Cd, Zn, Ag-based alloys etc.

The tin based alloys – babbit – with the following composition 88% Sn, 8% Sb and 4% Cu. This alloy has rapidly become the most frequently used in the production of bearings all over the world. The white metals presented the attributes of the soft metals, with low melting point, toleration of the untreated cracks, high capacity of incorporating the foreign particles, which conferred them certain clear advantages in comparison with other anti-friction materials.

Lead based alloys – Pb based white metals – especially the alloys with As content, are still used both in the United States and Europe because of the advantages offered by the Pb which replaced Sn, the Pb which is not short. The Pb-based alloys contain, in general, Sb, Sn and Cu as alloying elements. Concerning the hardness and resistance, they are similar to the Sn-based alloys, but they are inferior from the point of view of the fatigue strength.

Bronze alloy with Pb, on steel support – is applied by casting or sintering. The Cu-Pb alloys sintered on steel support are more modern than those directly cast on steel strip or support. As related to the lead or tin –based white metals, the copper based alloys have a charging capacity and a strength resistance which are 3-5 bigger, but the high hardness of the copper-based alloys requires higher pin hardness.

The Al-based alloys – massive bearings have been cast, starting from the idea of obtaining an alloy having a structure similar to that of the babbit, that is a hard stage alloy in a soft basal mass. It has been proved that such an alloy is more resistant at greater stress than the babbit or bronze.

An important disadvantage in extending the Al-Si alloys is the fact that, having constituents with high melting points, they do not present the advantages of those with low hardness, having a more reduced conformability. Recently, in order to replace the lack of conformability, certain companies use the method of working surface galvanic coating of the Al-Si layer or the AlSn6 with an extra Pb-Sn layer thick of about 0,25 mm.

2. THE MATERIALS USED

The materials used in the production of the friction bearings for which there have been used samples and have been carried out studies and experimental research are the following ones: base on Al-Sn plated on the steel support, based on Cu-Pb sintered powders on steel support. [3]

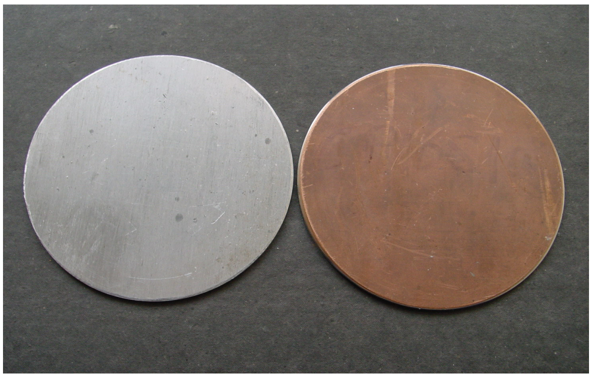
AS20 (Steel Support Plated with: 20% Sn, 1% Cu, the rest - Al).

CP10S10 (Steel Support with: 23% Pb, 10% Sn, the rest - Cu).

Concerning these materials, there have been studied the following aspects: chemical composition, micro-structure, certain resistance properties (hardness, stretching resistance, shearing, bending, adherence of the anti-friction layer), values of friction static quotients as well as the technologies of obtaining the anti-friction material and the bearing.

Fig.1. The mobile semi coupling made out of steel OLC 45

Experimental research studies have been made on a number of six couplings made out of different materials used when making the bushings [e.g. an antifriction material based on Al-Sn (AS20) + steel OLC 45, anti-friction material based on synthesized powders Cu-Pb (CP10S10) + steel OLC 45], presented in the figures 1 and 2.



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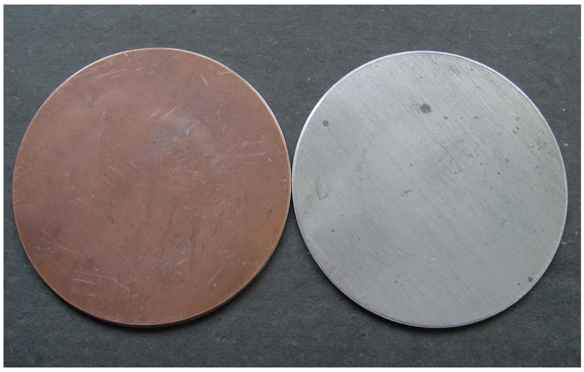

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Fig.2. Fixed semi couplings made out of anti-friction materials

In figure 2 are presented the four fixed semi couplings made out of antifriction.

3. PRODUCTION TECHNOLOGY OF THE AS20

The elaboration and casting of the AS20 alloy (Al – Sn 20%) is made in the following stages: the preparation of the charging made of the pre-alloys of Al-Ni, Al-Cu and raw material; the melting of the charging; the transfer of the alloy, degasification, de-oxidation and maintenance at the casting temperature; the casting.

The properties of the anti-friction alloy are greatly determined by its chemical composition. It decides the good behavior of the ingots at the following lamination operations in which the alloy suffers many structural transformations. [1, 2]

The alloy temperature must reach 750-760°C. The temperature plays an important role as the alloy must be transferred into the soaking furnace, period of time in which the temperature decreases. The casting of the anti-friction alloy represents a very important operation which greatly determines the quality of the cast ingots.

The appreciation of the quality of the cast ingots is made according to the English standards. There are rejected the ingots presenting gaseous inclusions, faults as "metallic beads", cold welding or other casting faults.

The elaboration technology of the Al-Sn alloy requires the use of the pre-alloy made up of Al-Ni and Al-Cu. Because of the huge differences between the melting temperatures of the alloying elements, the nickel and copper will not be introduced directly, but under the form of the pre-alloy Al-Cu and Al-Ni, respectively, which have low melting points.

The pre-alloy casting temperature is of 850-860°C. The main operations for obtaining the double strips of Al-Sn based anti-friction material are the following ones: pre-lamination of the AS20 ingots; annealing of the pre-laminated ingots; plating the alloy ingots with Al foil; lamination of the plated ingots; plating the steel strips with alloy strip; annealing the double strips.

The annealing of the pre-laminated ingots is made at the best temperature of 355-360°C, and the best annealing time duration is of 150 minutes.

4. PRODUCTION TECHNOLOGY OF THE CP10S10

The stages in the production of the thin-walled bushings made of sintered Cu-Pb anti-friction material are the following ones: production of alloy powder; sintering of the powder on the steel support (obtaining the double strip based on sintered Cu-Pb).

The technological process of obtaining the alloy powder consists of the following operations: the preparation of the cold charging, melting, casting and production of powder. [1, 2]

The melting is made in two gas-furnaces, capable of being swung open, consisting of a swinging melting tank and a collecting crucible.

This is maintained during casting in both crucibles. Throughout casting, the mode of action of the atomizers, which will form the powder from the melted alloy, is permanently monitored.

In order to obtain the powder, there should be highlighted certain parameters, such as: the pressure of the filtered water, the water softening degree, the regeneration of the de-ionized water, the pressure of the de-ionized water at the atomizers, the moisture of the powder at the entrance of the drier, the temperature at the exit of the drier, neutral air supply in the drier, powder sieving manner, the sieve quality and in the end it can be noticed if the powder corresponds to the requirements. [1]

The technological process of obtaining the double strip based on sintered Cu-Pb consists of the following stages: the preparation of the strips (coils) for sintering; depositing the powder on the steel strip having in view the sintering; the sintering of the powder on the steel strip; lamination of the double strip.

The preparation of the steel coils on which the Cu-Pb powder is sintered consists in executing certain operations aiming at assuring a continuous technological process (butt welding of the strips, straightening in order to remove the curvatures and unevenness resulted after welding, washing at the temperature of 77-88°C with water mixed with a degreasing and washing, drying at the temperature of 95°C through infrared rays heating).

The process of depositing the powder for sintering on the steel strip is made by means of a complex plant consisting of: the plant for the strip speed control and adjustment, the depositing plant proper and the suction hood.

The depositing plant proper has a tank dosing the powder quantity according to the calculated alloy thickness and the width of the steel strip.

In order to avoid the oxidation of both the powder and the steel, a neutral atmosphere is needed in the sintering furnace and the sintering speed will be established according to the heating curve of the sintering furnace.

The sintering process on the steel strip ends with the strip cooling.

The lamination of the sintered strip aims at obtaining the necessary density of the deposited powder.

According to the hardness of the alloy layer as well as to the tolerance of the double strip thickness, it is recommended to deal with: a final sintering and lamination; two sintering and two laminations.

In both cases, the lamination reduction will be made so that not to appear the melting of the lead from the alloy.

5. CONCLUSIONS

As the anti-friction material based on Cu-Pb sintered powders has a metallic structure, the relations established during the sintering process between the powder granules can be explained by the inter-atomic forces from the crystalline network of the metals. Theoretically, there is a metallic contact between the powder granules, but practically, this contact is seldom realized due to an oxide coating at the surface of the granules. The concentration of these oxides can be controlled and must not exceed the imposed value of 0.55%.

Because of the heat from the sintering furnace, the powder deposited on the steel support suffers the phenomenon of surface and volume diffusion (in solid phase). This can be explained by the fact that the atoms situated on the prominences and tips of the powder granules move on the surface of the granules, concentrating themselves in the surface unevenness. At higher temperatures, the diffusion between the powder granules and those of the steel support takes place.

The factors which influence the Cu-Pb powder sintering on the steel support are: the sintering temperature, the heating speed and the cooling speed, the sintering atmosphere, the size of the powder granules, the powder type, diffusion (at the limit in between the granules, surface limit, volume limit), chemical composition of the powder.

The mixture of alumina and tin oxide is accepted only if the surface occupied by them does not exceed 80% of the interface length.

The structures with sulphide inclusions, with foreign bodies inclusions and small cracks are accepted according to the adherence tests (chiseling, peeling).

The super-sintering is not admitted in the structure of the sintered alloy.

The double strips must not present a series of faults, such as: overlaps because of lamination, surface slag imprints, oxide traces after pickling, foreign bodies inclusions, cracks.

BIBLIOGRAPHY

1. Dinescu, I., Bardocz, G. *Materials for the Bushings*, REVIEW of the Air Force Academy, No. 1/2007, ISSN 1842-9238, pg. 19-22.
2. Dinescu, I., Bardocz, G. *Remarks Regarding the Friction within the Bushings*, Bulletin of the “Transilvania” University of Brasov, Supliment BRAMAT 2007, Published by “Transilvania” University Press, ISSN 1223-9631, pg. 503-508.
3. Dinescu, I., Dinescu, I.M. *Experimental Research Regarding the Phisyco – Chemical Features of the Metallic Materials Used for the Making of the Bushings within the Military Technique*, REVIEW of the Air Force Academy, No. 2/2007, ISSN 1842-9238, pg. 11-14.