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New aspects of the effect of pre configuration of surfaces made by antifriction materials by the FINPLAST process

Dumitru Dascălu

Naval Academy „Mircea cel Bătrân”, Constanța, Romania
dumitru_dascalu2005@yahoo.com

Abstract. The technological process described in this paper is a solution to extend the processes for improve the performance of materials by heat, chemical and thermochemical treatments, cold hardening, etc., in the case of anti-friction materials. The name of process is Finplast. For obtain this surface of sliding bearings material it’s using the cold plastic deformation proceeding.

1. Generalities

The paper presents a new concept for improving the performance of sliding bearings called structural preconfiguration [2]. The process described is a proposal to extend the processes to improve the surface characteristics of anti-friction materials by thermal, chemical and thermochemical treatments, by cold hardening, etc. These materials have as main characteristics specific plasticity and deformability. These qualities allow the adaptation of the optimal geometric shape of the bearing surfaces from the contacting anti-friction materials.

This reduce manufacturing and mounting errors on the contact between surfaces. Studying these features, the author developed, developed and studied a new process and technology for finishing surfaces made of anti-friction materials called FINPLAST [3]. It is an original process proposed by the author, intended for the finishing by cold plastic deformation of the surfaces made of antifriction materials of sliding bearings.

For the analysis and evaluation of the process, several samples were made taking into account the following technological parameters:

-alloy type: AlSn10, obtained by hot plating and CuPb5 obtained by warm sintering;

- the value of the finishing force F [daN];
- number of passes of the press roller n;
- lubrication or non-lubrication during finishing of the contact between the bearing surface and the press roller;

By modifying these parameters or obtained sample surfaces. These sample areas are identified by a two-digit code (a.b). For the AlSn10 samples a is 1, and for CuPb5, a is 2. The second digit b differentiates the samples according to the technological parameters of the process specified under each detail.

2. Description and analysis of experimental results

In fig. 1.1. the scanner image at 1:1 scale of the AlSn10 alloy surface is shown, and in fig. 1.2. of the surface of the CuPb5 alloy. The images were taken by scanning, a common scanner that allows you to view the influence of finishing parameters.

The two-digit sample codes and the values of the technological parameters used for each sample area are specified below each enlarged detail. The details were made by cropping from the original image and enlarging it accordingly. The detail code is identical to that of the sample from which it was detached. By z.n.f are specified the areas resulting from the cutting, which were not finished by the finpalst process. This way you can see the effect of the finish.[4] Analyzing the images as a whole, a more intense brightness of the z.n.f. surfaces by comparison with areas subject to finishing by deformed plastic.

This bright ness is explained by the surfaces resulting from cutting following contact between the surface of the anti-friction material and the cutting tool. The roughness of the surfaces resulting from the finishing turning prior to the plastic deformation can be clearly distinguished. The opacity of the surfaces subjected to finishing by the finplast process is caused by the destruction by pressing of the chipped surfaces. After pressing, the surface undergoes changes in the surface layer. This explains the opacity of the finished surfaces.

It is also noted that regardless of the parameters used, all surfaces finished by the finplast process show a significant change compared to z.n.f.

Analyzing as a whole the details from fig.1.1. and fig. 1.2 there are differences between them which show that the technological parameters used influence the quality of the resulting surface. By comparison, the much darker color of the finished surfaces in the presence of lubricant can be noticed. The presence of lubricant at the time of finishing reduces the friction between the roller and the antifriction layer as well as the relative friction between the crystals in the surface layer.

The darker areas specific to the finished surfaces in the presence of lubricant are similar to the surfaces resulting from the appearance of the piting phenomenon. The alveolar shape of the surfaces causes the reflected waves to extinguish each other by their composition. From a tribological point of view, the alveolar and homogeneous shape is more important than their dimensions. So the presence of lubricant in the contact area between the roller and the finished surface is an advantage.

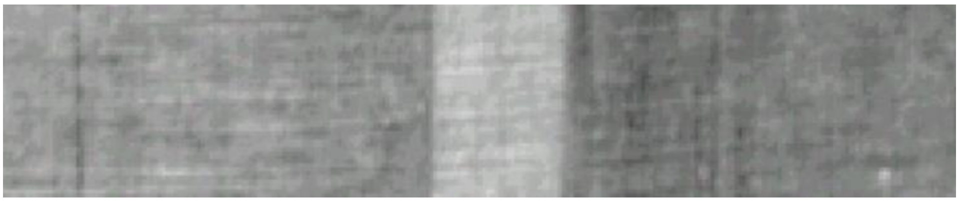
In the case of AlSn10 alloy, regardless of the finishing parameters used, it results in a surface with homogeneous roughness, in which, for the most part, the roughness after turning has disappeared. The process also significantly changes the characteristics of rough surfaces, obtained by turning.

Fig. 1.1. Scanned image of AlSn10 study samples (1: 1 scale)

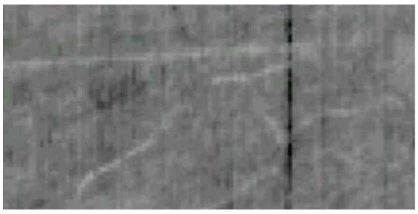
Detail. 1.1. (F = 248.2 daN; n = 1; no lubrication)

Detail 1.2. 248.2 daN; n = 1 ^ z.n.f. ^ ; Detail 1.3. (F = 248.2 daN; n = 2 lubricated, no (lubrication)

Detail 1.4. (F = 248.2 daN; n = 2; lubricated) Detail 1.5. (F = 248.2 daN n = 3; lubricated);



Detail 1.6. (F = 328.5 daN n = 1; lubrication) ^ z.n.f ^ Detail 1.7. (F = 328.5 daN; n = 2, without lubricated)



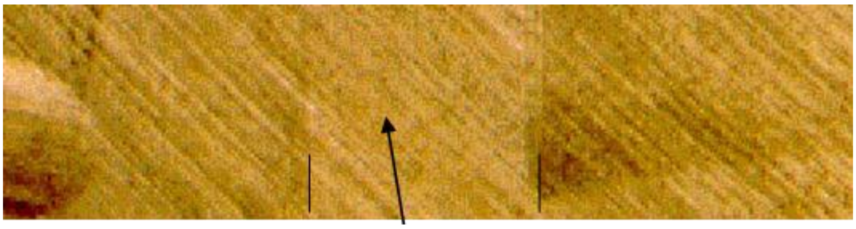
Detail 1.8.
(F=456.2 daN; n=1; lubricated)

Detail 1.9.
(F=143 daN; n=5; without lubrication)

z.n.f ^ Detail 1.10.
(F=143 daN; n=5; lubricated)

Detail 1.11 ^z.n.f
(F=77.5 daN; n=1; lubricated)

Fig. 1.2 Scanned image of CuPb5 samples and details



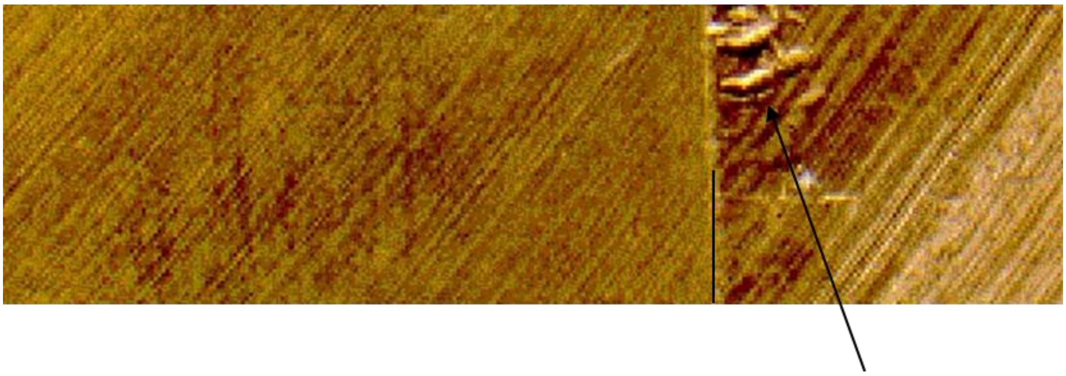
Detail 2.1 (F=77.5 daN; n=1; lubricated) Detail 2.2 (F=248.2 daN; n=1; without lubrication)

Detail 2.3. ^ z.n.f. ^. Detail 2.4.

(F= 248,.2; daN; n=1;without lubrication) (F=248.2 daN; n=2; without lubrication)

Ball footprint from microhardness determination

z.n.f .. ^ Detail 2.5 (F = 328.5 daN; n = 1; with lubrication)



Detail 2.6. (F = 328; 5 daN; n = 1; with lubrication) ^ z.n.f. corrected cutting defect

The peculiarities of the finplast deformation finishing effect for the sintered CuPb5 alloy are made based on the details accompanying figure 1.2. All the details indicate that the surface of the sintered alloy changes differently compared to the plated AlSn10 alloy.

All surfaces finished by FINPLAST, in the case of CuPb5 alloy, show certain differences compared to the first alloy. In all cases, the structure made by sintering in the case of the alloy based on hardened spherical crystals, the rough character resulting from the chipping is maintained. This essential technological feature of sintered materials made by pressing spherical particles from Cu hardened on the outside followed by pressing the material into molds generates a material with a relatively stable equilibrium structure, mass hardened of these alloys. [5]

In addition, the different qualities of the materials of the two alloys are added. Thus, spherical Cu particles are much harder than Al crystals. At the same time, the superficial state of the resulting surfaces has an unbalanced structure, relatively tense, due to the influence of the turning layer (SIA).

In the case of sintered alloy, the spherical powders in the structure have a harder and tighter surface on the outside. After hot or cold sintering, these particles form an equilibrium structure, which in turn is stressed due to the structural peculiarities of the pressing process itself. After turning, when part of the sintered layer is removed, due to the new equilibrium states, the surface layer hardens, forming a hardened layer. By pressing with a roller, this harder surface suffers a "sinking" in the mass of the base material, more porous and more relaxed. The micro geometry of the layer changes less.[6] From the details presented, it results that the roughness decreases in different heights, depending on the technological parameters used. This is all the more obvious when we compare the areas deformed by finplast, with the standard ones, z.n.f., located in the vicinity, regardless of the technological finishing regime used.

3. Partial conclusions:

- Regardless of the materials used and the values of the technological parameters of the finishing process used, the effect of finishing by the Finplast process on the tribological surfaces is significant;
- the very low roughness of the press roller produces a homogenization of the surface roughness finished by the FINPLAST process;
- AlSn10 alloy, obtained by hot plating, due to its plasticity undergoes a transformation of microgeometry much more significant in value than CuPb5 alloy, obtained by sintering;

-The surfaces obtained in the case of AlSn10 alloy are much closer to the ideal ones, for certain technological parameters of FINPLAST;

- In the case of sintered materials, the surface layer is much more hardened by hardening, and the FINPLAST effect is significantly smaller.

4. Structural reconfiguration

The above conclusions show that the anti-friction materials suffer from mechanical processing, regardless of the process, changes in the previous structure.

The new structures obtained by various processes and technologies are maintained until a new higher intensity load changes the previous equilibrium structure, creating a new structure superficially or en masse.

In the case of sliding bearings, the layer of anti-friction material is permanently modified starting from the running-in loads, until the next request with values of the operating parameters of the respective bearing.

Due to the plasticity of the anti-friction materials, this new equilibrium structure resulting in response to the last value of the bearing stress will be maintained even if the stress in the bearing will be reduced as in the case of elastic materials. Cyclically, the structural changes will take place until the moment when the load on the respective bearing reaches the maximum projected value;

The concept of structural pre configuration proposes that from the factory the bearing be required by the FINPLAST process to the maximum load given by the designer, eliminating the steps of step adaptation described above.

The process is similar to treatments and technologies to achieve mechanical properties and not only by changing its internal structure (heat treatment, hardening, surface hardening, normalization, carbonitriding, tempering, hardening, etc.).

The controlled pressing of the surface of the anti-friction material restores the connections between the layer of the base material and the particles detached from the structure by cutting processes (BEILBY LAYER).

By fixing by wan der vaals or covalent chemical bonds, the loss of substance is reduced by accentuating the phenomenon of wear. The realization of these connections of the crystals partially detached from the basic material, in the initial phase, gives those bearings a superior reliability.

Due to these connections, some of the crystals with unstable positions can be placed in much more stable areas, generating stable local equilibria.

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