EXPERIMENTAL RESEARCH REGARDING THE PHYSICO-CHEMICAL FEATURES OF THE METALLIC MATERIALS USED FOR THE MAKING OF THE BUSHINGS WITHIN THE MILITARY TECHNIQUE

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Abstract: *The materials used within the production of the bushings must have a series of physico-chemical features. These features influence the behavior of the bushing during its functioning process. The present paper illustrates the results of the research made by the authors upon the physico-chemical features of two types of materials used in the making of the bushings within the military technique.*

Key words: *bushings, the physico-chemical analysis, the fluidity of the powder, the apparent density.*

1. INTRODUCTION

The physico-chemical analysis made for the metallic materials used in the making of the bushings are:

- the determination of the chemical composition: Sn, Pb;
- the determination of the oxides, the quality of the protective atmosphere in the installation that makes the powder;
- the granulometrical analysis for the powders that are used in the making of the antifriction composites based on Cu-Pb;
- the determination of the time requires by the flow and of the apparent density of the powders used in the making of several types of bushings;
- the analysis of the microstructure of the metallic materials that appear in the composition of the making of the bushings in several stages of the making process: Cu-Pb, Al-Sn;
- spectrometric analysis of the composition of the antifriction materials based on Al-Sn;
- the determination of the Sn in the Al-Sn alloy;
- the determination of the Cu in the Al-Sn alloy;
- the determination of the Ni antifriction alloy Al-Sn;
- the analyses have respected the legal standard norms.

2. CHEMICAL METHODS REGARDING THE ANALYSIS OF THE METALLIC POWDERS USED IN THE MAKING OF THE BUSHINGS USED IN THE MILITARY TECHNIQUE

The tin is determined volumetrically by the titration with iodine of the 0.1 N solution – after a previous chemical fixation of the other Cu-Pb elements as follows: 1g of powder is being weighed, with a 0.0002g precision at the analytical scales; we pour it in an Erlenmeyer glass with the volume of 500 cm^3 over which we add 20 cm^3 of HCl 3:5 parts in order to obtain a violent reaction; after approximately 10 min, the sample is being boiled at a low fired adding 80 cm^3 HCl 3:5 volumetrically parts of 10 cm^3 of a mercuric chlorine, sol. 30 g/l, 10 cm^3 of an hypochlorous acid with a concentration of 30%; the boiling continues for approximately 5 min until the sample becomes clear; we cool it in a water bath under a dioxide carbon current; after it is cooled we add 10 cm^3 of a sodium sulphocyanide,

potassium or ammonium, solution of 50 cm^3 potassium iodide, solution of 5 cm^3 of starch 1%, and we titrate it with a solution of 0.1 N.

The quantity of tin (g) is being determined with the help of formula nr. 1:

$$g\% = \frac{(V \cdot f \cdot 0.00593 \cdot 100)}{a} \quad (1)$$

where: V = the volume of the iodine solution, consumed within the titration (cm^3); f = the factor of the iodine solution 0.1 N; 0,00593 = the quantity of Sn^{4+}, (g), that corresponds to 1 cm^3 of iodine solution 0,1 N; a = the mass of the sample.

The lead is being determined electrolytic by using a platinum electrode (the sieve) as an anode. The weighed sample is being dissolved in a solution of azotes acid 25 cm^3 1:1, and a violent reaction takes place with precipitate deposits.

The clear solution obtained by filtration is submitted to electrolysis in certain conditions. After the lead dioxide is being deposited on the anode, it has to be weighed and we calculate the lead quantity that exists in the sample.

The depositing mechanism can be explained in the following way: on the anode we witness an oxidation of the Pb^{2+} and Pb^{4+} ions.

This is how we obtain the tetra leaded nitrogenous and as a consequence of the hydrolysis, the lead dioxide is being formed, according to the reaction nr 2:

$$Pb^{2+} + H_2O \rightarrow 4H^+ + PbO_2, \quad (2)$$

insoluble that is disposed on the anode.

The determination of the lead is being made in the following way: we weigh on an analytical scales (with a precision of 0,0002 g) the quantity of 0,25 g of powder in a Berzelius glass over which we add 25 cm^3 of HNO_3 1:1 (the acid is added carefully, the reaction being violent) we cover it with a watch glass and it is slowly warmed until the liquid's volume is being reduced up to its half, with the formation of a white rough-grained precipitate; we dilute it with hot water up to a volume of 125 cm^3 and then we boil it; we live it in a warm environment for an hour, and then we filter it still hot through a double filter with a blue stripe, we wash it with hot water until the blue marks disappear from the filter paper, the clear solution obtained after the filtration is submitted to an electrolysis; beforehand the electrodes have been weighed on the analytical scales (with a precision of 0,2 mg) and after them being introduced in the electrolyte (the sample) we can make the necessary connexions and the agitator is being turned on, the depositing duration being of 45 minutes at the tension of 2,5-3,5 V with the intensity of 2,8 amperes; in order to see the end of the pepositing process we will complete the electrolyte with distilled water and the depositing will continue for another 10 min; if nothing else gets deposited, the lead oxide that is already deposited on the electrolyte is being washed without turning off the electrical current, replacing the electrolysis glass with another one that contains distilled water; the washing is being repeated 2 or 3 times, after which the current and the agitator are being turned off; the anode is being let loose from its holder and is quickly introduced in a glass full of alcohol after which it is being dried in a drying stove at 100°C for 5min; we cool it then in the dryer and then it is being weighed on the analytical scales.

Knowing the initial weight of the anode (g_1) and the final one (g_2) as well as the weight of the analyzed powder (powder that here has 0,25 g) and the percentage content of lead we can obtain results with the help of formula (3):

$$G\% = \frac{[(g_2 - g_1)0.8662 \cdot 100]}{0.25} = (g_2 - g_1) \cdot 346.5 \quad (3)$$

where: 0.8662 = the transformation factor of the leaded dioxide in lead.

In the end the leaded dioxide gets away from the platinum through the process of decomposition into hydrochloric acid (with a dilution concentration of 1:1) and the copper deposited on the cathode will be dissolved with nitrogenous acid (dilution 1:1). The electrodes are being washed with distilled

water, then dried in the drying stove and kept in the dryer.

3. PHYSICAL METHODS REGARDING THE ANALYSIS OF METALLIC POWDERS USED IN THE MAKING OF THE BUSHINGS USED IN THE MILITARY TECHNIQUE

In order to determine the fluidity of the powder we use a flowing funnel that has a calibrated orifice, a device that holds the funnel (without any vibration) and a timer [1,2].

The fluidity of the powder is determined as follows: 50 g of samples are being weighed on the technical scales (precision of 0,1 g), the sample is being poured into the funnel so that it is completely filled; we measure the time during which the powder flows – time that represents the fluidity and it is expressed in seconds.

The apparent density is being determined as following: we weigh with the technical scales (with a precision of 0,1 g) a quantity of 80 g of powder in a bucket shaped pot that has a volume of 14 cm³; the powder is leveled at the surface with the help of a spatula, avoiding the trepidation of the pot, that might influence the volume; after the leveling the extra powder is being removed in order to avoid the weighing losses; we weigh it again full of the subsided powder.

The calculus of the apparent density (g/cm^3), is made with the help of formula (4):

$$\rho = \frac{a}{v} \qquad (4)$$

where: a = the quantity of powder (gram) weighed after the flowing; v = the volume of the bucket shaped pot where we collected the sample.

This method determines the proportions of different sizes of granules from the granulled mixture Cu-Pb with a set of standard sieves with a mechanical stirring [3, 4].

In table 1 we have presented the equivalences between the number of the sieve and the powders used in the making of the bushings.

Table 1 The COMPULSORY characteristics of the powders

No. of the sieve	Tyler-Nesb equivalent	The size of the sieves expressed in microns
80	80	177
100	100	149
110	150	105
200	200	74
270	-	-
325	325	44
tray	remainings	-

The granulometrical analysis is being made as follows: we weigh at the technical scales 100g of sample and we put it in the sieve no.80; we cover it with a tin made of steel, we make sure that the sieves do not move; we start the steering, we stop the sifting after 15 min.

On a cut paper we successively empty every sieve and we weigh all together all the powder in all the sieves, in the end the quantity representing precisely 100 g.

4. CONCLUSIONS

Since the antifriction material based on sintered Cu-Pb powders has a metallic structure, the connections are being established during the process of sintering between the granules of the powder and they can be explained by the interatomical forces that appear in the crystalic network that metals have.

When sintering throughout warm up, the atoms of the powder are being rearranged within the network so that the structure of the crystalic network can be formed.

Due to the heat, in the sintering oven, the powder put on the steel pot is subdued to the diffusion phenomenon (in a solid stage) at the surface and upon the volume as well. It is explainable through the fact that the atoms situated on the tops of the granules of the powders are moving on the surfaces, gathering themselves on the non-uniform parts of the surface.

At higher temperatures we can witness diffusion at the level of the granules of the

powder and the ones of the steel as well.

After the research made we ended up to the conclusion that the apparent density is influenced by the way in which the powdered is being obtained, by the drying temperature as well as by the granulometrical class. The softer powder has a higher apparent density than the rough one.

It can also be seen that if the apparent density of the alloy is higher, the powder is much more compact, and the spaces within the granules are smaller.

The powder density is lower than the one of the alloy, thing that underlines a higher porosity of the sintered material.

The size of the granules and their granulometrical distribution are physical properties that have a tremendous importance that may influence the technological properties of the powders and of the sinterised finite products.

BIBLIOGRAPHY

1. Dinescu, I., Moldovan, G., Cozma, R., *Study Regarding the Friction Inside the Bushings***,** Review of the Air Force Academy, The scientific informative review No. 2/2006, December, 2006, The Air Force Academy "Henri Coandă" Printed House, p. 15-18;
2. Bardocz, G., Dinescu, I., *Research Regarding the Variation of the Friction Coefficient within the Bushings*, Bulletin of the "Transilvania" University of Brasov, Supliment BRAMAT 2007, Published by "Transilvania" University Press, p. 509-514;
3. Dinescu, I., Bardocz, G., *Materiale metalice utilizate la fabricarea lagărelor cu alunecare*, Sesiunea de comunicări ştiinţifice cu participare internaţională „Educaţie şi cercetare ştiinţifică la standarde europene", The Air Force Academy Printed House, 2007;
4. Dinescu, I., Bardocz, G., *Materials of a bimetal type made for Bushings*, The 12th International Conference „The Knowledge Based Organization", Land Forces Academy "Nicolae Bălcescu" Publishing House, Sibiu, June 2oo7, p.179-183.