RESEARCHES REGARDING SOME SINTERED SAMPLES MADE UP OF DIFFERENT POWDERS

Ion DINESCU

Air Force Academy „Henri Coandă" of Brasov

***Abstract**: In this paper there are presented the results of a study about some physico-mechanical characteristics (time of sinterisation, density, hardness, stretching resistance, contraction) of sintered samples made of different powders. There were used: powders resulting from ball-bearings machining (RUL) and powders made by famous international companies (Mannesmann, Höganäs). All the results of the study are presented comparatively for the different samples.*

***Keywords**: powder, sintering, bearings, properties, samples.*

1. INTRODUCTION

With the grinding of components of ball-bearings, it is resulting an important quantity of sludge. With a rather easy technology, we can separate the powder from ball-bearings steel [1, 5].

By pressing and sintering, we can obtain parts what's characteristics and properties are presented as following.

2. CHEMICAL COMPOSITION OF SINTERED SAMPLES

The chemical composition of sintered samples, usually, different a little from the powder's chemical composition.

During sintering samples with iron base, the carbon level may be not in the normal limits, if the protecting atmosphere within the sintering furnace has not the prescribed composition.

In the case of sintered samples made of powder resulted from ball-bearings, chemical composition (%) is presented in Table 1.

Table 1 Chemical composition of sintered samples

C	**Mn**	**Cr**	**Ni**	**Cu**	**Al**	**Si**
0.2	0.31	1.74	0.2	0.4	1.61	1.4
Mo	**V**	**W**	**Ti**	**Mg**	**Zn**	**Fe**
0.2	0.007	0.1	0.1	0.01	0.03	<92

Chemical composition was determined with a spectrograph. As it can be observed from this table, the carbon's percentage is decreasing, reaching the value of 0.2%, and the other elements maintain there primary values [2,3].

Researches regarding chemical composition of sintered samples resulted from ball-bearings processing, show, that, these samples can be thermochemically treated as example - carburization or carbonitruration.

3. TIME OF SINTERISATION, DENSITY AND HARDNESS

The sintering time is an important parameter for the sintering of the pressed objects made of powders.

The research studies carried out have shown that the sintering time for the resulted powder in the case of bearings processing is of 90 minutes. If this value is higher, the variation of the mechanical properties is not significant.

In Figure 1, the hardness variation according to the sintering time is presented. The objects have been pressed with a pressure of 700 MPa and sintered at a temperature of 1150 °C.

Density and hardness are important parameters for the physico-mechanical

characteristics of any kind of material, and also for sintered samples. Sintered samples density is influenced in the first place by compressure pression (strength of pressure) of the powder. An important influence over density has the sintering temperature, but also the sintering time of the pressed material [2,4]. The hardness of sintered materials depends, in the first place, on density, and the nature of the powder.

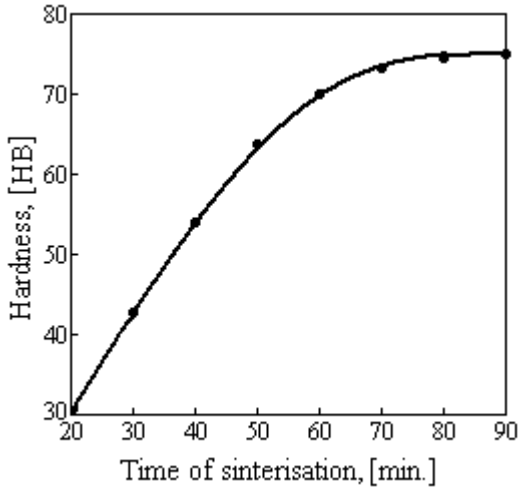


Fig. 1 Hardness Variation according to the Sintering Time

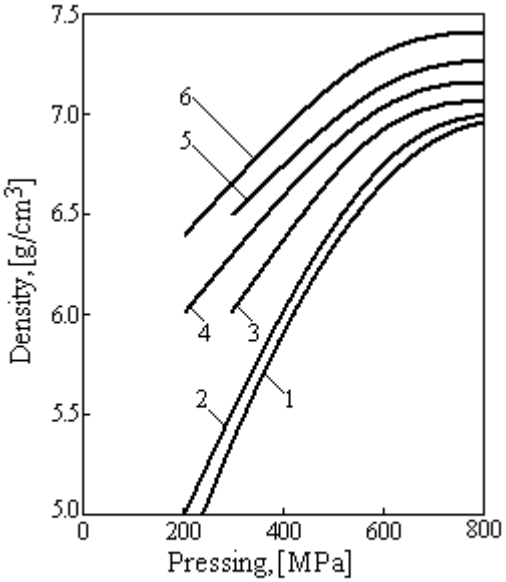


Fig. 2 Variation of density during sintering different powders

The study of these parameters, for the sintered samples made from ball-bearings processing, was made by compeering different sintered materials from different kinds of powders.

The results can be observed in Fig. 2.

Comparing the obtained values with the characteristics of some pieces made of powders produced especially for sintering, we can observe similarities.

At a pressure of 500-700 MPa, the density of pieces of RUL powder is approaching the hardness of pieces of high pressability, like Atomet 4601, Sumiron 4100 S.

As in the case of density, variation of hardness for the same types of powders is presented in Fig. 3.

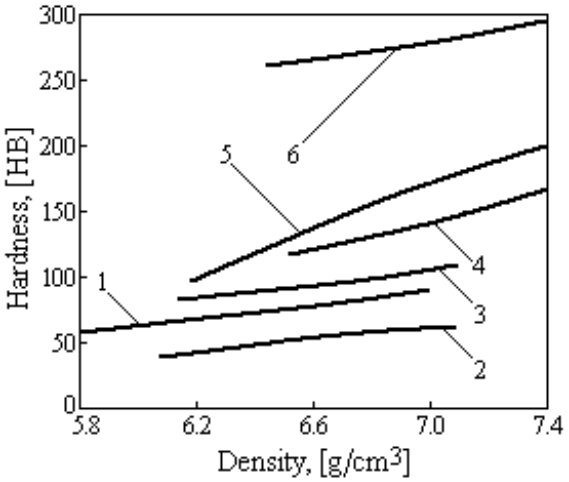


Fig. 3 Variation of sinterisation hardness for different powders

As it was expected, in the case of hardness, in a certain way there are maintained the relations as in variation of density. But, in some cases, sintered samples of powder resulted from ball-bearings processing, have a better hardness as other pieces (example: RZ 400).

4. STRETCHING RESISTANCE

There have been carried out several tests in order to determine the stretching resistance.

The results of these tests are presented in Table 2.

Table 2 Stretching Tests Results

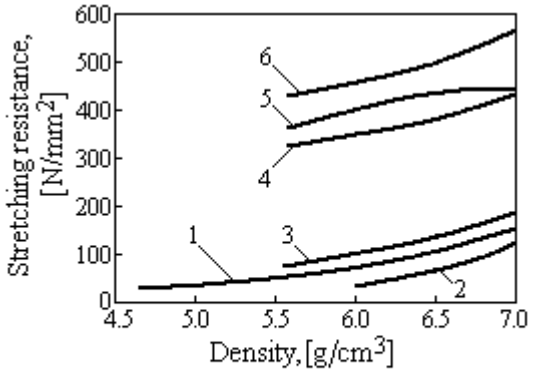
No.	Density, [g/cm^3]	Stretching resistance, [N/mm^2]
1	4.8	28
2	5.6	42
3	6.2	76
4	6.6	105
5	6.9	141

The samples for the stretching test have been pressed with pressures in between 300 and 700 MPa and sintered for 60 minutes at the temperature of 1150°C.

Stretching resistance is the main characteristic for determination of mechanical resistance of materials, and mainly of sintered samples too. Stretching resistance of sintered materials depends on factors like:

- physico - chemical characteristics of the powder;
- pressing parameters (strength, pressure), sintering parameters (time, temperature, atmosphere);
- porosity;
- the type of heat-treating after sintering.

Comparatively to the studied powders, stretching resistance of RUL powder is presented in Fig. 4



1-RUL, 2-Sumiron 4100S, 3-RZ 400,
4-Atomet 4601, 5-Ultrapac, 6-NC 100-24

Fig. 4 Stretching resistance

We can observe that stretching resistance of sintered pieces made of powders from ball-bearings processing, is approaching the stretching resistance of sintered pieces made from Höganäs powder (NC 100-24) and Mannesmann (RZ 400).

5. DIMENSIONAL VARIATIONS

Sintered materials can be successfully used rather then those obtained in a classical way, if dimensions and its variations are maintained beside the best tolerance.

Dimensionality is a very important parameter for the fabrication of sintered samples made from powders.

The exact determination of the variation of dimension and the right designing of pressing matrix, are permitting to make sintered samples without a later calibration.

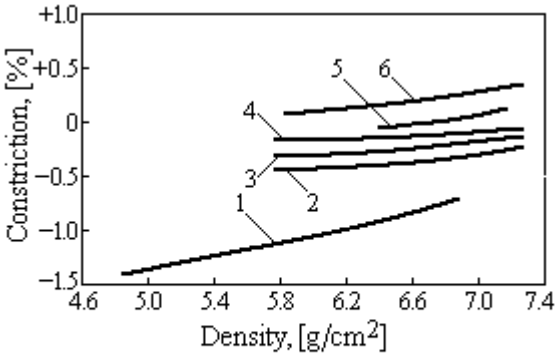
Variation of dimensions of sintered samples is influenced by:

- the type of the powder;
- the size of grain;
- density (table 3);
- compaction pressure;
- sintering parameters (temperature, time, atmosphere).

Table 3 Constriction Variation According to the Density

No.	Density, [g/cm^3]	Constriction, [%]
1	4.8	- 1.5
2	5.6	- 1.3
3	6.2	- 1.0
4	6.9	- 0.5

The values of constriction of sintered samples, made of the powders studied in this paper, are presented in Fig. 5.



1-RUL, 2-RZ 400, 3-Sumiron 4100S,
4-NC 100-24, 5-Atomet 4601, 6-Ultrapac

Fig. 5 Constriction of sintered samples

Sintered samples of RUL powder are containing a lot of iron, what is generating

constriction. Theoretically, because of the copper it should appear a growth of volume (copper is diffusing in iron at the sintering temperature; this will lead to acceleration of sinterisation, and the Fe particles have no time to get together), but because of the low percentage (0.40% Cu) contraction will take place [3,4].

6. CONCLUSIONS

The values of some physico - mechanical parameters for sintered samples made of powders obtained from ball-bearings processing (RUL) are in a lot of cases close to the values of sintered pieces made from other powders, especially produced.

It can be said that, from RUL powder it can be obtained parts with high density and hardness, and also with a good stretching resistance.

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