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Sintered materials testing in law temperature

Cristina Ionici[1], Nicoleta Mihuț[1] and Adina Tătar[1]

[1]Faculty of Engineering, "Constantin Brâncusi" University of Târgu Jiu, Gorj County, Romania

E-mail: feliciaionici@gmail.com

Abstract. Alloying elements have an important affect upon the mechanical properties of the Sintered Materials. Latest research in the field of powder metallurgy show concern over attempts fatigue. Have been made to predict the endurance limit to fatigue for predicting the effect of residual porosity and the tensile strength. It was found that the surface finish of the samples has a great influence on the fatigue strength. The sample containing pores - those caused by transient liquid phase by the Mo particle - the adverse effect of such flaws on the fatigue strength, which was also found by testing the fatigue. strength. The test of compression at low temperatures is made between (100-120) K and are respected the conditions foreseen by the technical norms of execution of the performed trials at low temperatures. The test at compression at low temperatures consists, as in the case of the environment, in applying the compression charge until the apparition of the first fissure.
Keywords: *sintered materials, mechanical testing, law temperature, strength.*

Introduction

In recent years many attempts have been made to assess the strength limit parallel models for predicting the effect of residual porosity on tensile strength [1,2,3,4,5]. There exist two types of porosity influence the mechanical properties of PM materials . The “primary” porosity is already existent in the green compact , more or less eventually distributed , and can be seen as an integral value . The “secondary” porosity is formed during liquid phase sintering and is equal to singular defects . The metallic materials sintered are the materials obtained through the new technologies and exactly the metallurgy of dusts. The metallurgy development was determined by the scientific and technical progress that needs products with special properties that cannot be elaborated through other procedures. The metallurgy of dusts may enter successfully among the classical technologies by the varieties of pieces obtained through this procedure.
In the last years the major of countries strongly industrialized MP concur successfully the conventional technologies. As it may be observed, through a classical method of deformation, the sintered material does not behave at a mechanic request as the compact material. In the structure of a MS the presence of pores influences the behavior at the mechanic request, after it ahs been concluded also in the case of the mechanic trial of compression. The trial to compression is a static request and consists in the appliance of some axial charges of compression of a cylindrical test piece until breakage or to the apparition of a fissure.

These testing are made with low speed of deformation, applying the charge progressively and without shocks that is why deformation is realized slowly. The material characteristics submitted to testing are mentioned in table 1.

Table 1. Characteristics of material testing

Material	**Composition**				**Density g/cm^3 min.**	**Elongation % min.**	**Tensile strength daN/mm^2**	**No heat treatment HB**
	C %	**Fe %**	**Cu %**	**Altele %**				
FC 40	*0,426*	*rest*	-	*Max.2*	*6,87*	*3*	*18*	*50*
FC 80	*0,805*	*rest*	-	*Max.2*	*6,95*	*2*		
F50U2	*0,503*	*rest*	*2*	*Max.2*	*6,89*	*2*	*35*	*105*
F80U3	*0,809*	*rest*	*3*	*Max.2*	*6,96*	*0,5*	*35*	*105*

Contents

The test of compression at low temperatures is made between 130-150 K and are respected the conditions foreseen by the technical norms of execution of the performed trials at low temperatures.

The test at compression at low temperatures consists, as in the case of the environment, in applying the compression charge until the apparition of the first fissure. During the compression trial it is followed the shortage and crowning of the test piece. The first operation before performing the test of compression is the visual control of the cylindrical test pieces that follow to be submitted to the trial, after which the test piece is introduced in the cooling environment, liquid azotes.

Choosing the liquid azotes as a cooling agent is due to the critical point inferior to the trial temperature, the trial temperature minimum corresponds to the value of 77K. The cooling installation is a shaft with liquid azotes due to the small dimensions of the compression tests.The test pieces were introduced in the shaft with liquid azotes and after five minutes from the violent boiling of the azotes, at the temperature of 77K, are taken out the test pieces with the help of pliers and are positioned in the trial machine.a thermometer, the temperature directly on the test to have correct data upon the measurements

There are visible the material deformations through the test pieces tightness and flattening, figure 1.

Figure 1. Cylindrical specimens tested materials

The test pieces structures submitted to the compression trials at low temperatures are pointed out through the micrographics 3.a, b, c, and result from the tests processed and their submission to a metallographic attack with Nital.

The structural analyze of the material FC 40 submitted to compression at low temperatures. After requesting the compression of the test pieces from FC 40 at low temperatures it is observed the same ferito-perlitical structure with a large dimensional heterogeneity. So, it is also accentuated a large amount of freckles. The structural constituents loose their aspect of deformation observed in the structure of the requested test at the environment temperature.

The requested tests at compressions at low temperatures from the material with 0, 8% carbon, FC 80, presents the same constituents, protected and pearled with a non-homogenate repartition in the field. The constituents granulation is getting smaller and looses its aspect of practical deformation. The structure is much more homogeneousness as a result of the request in the cryogenically environment, and the freckles are better accentuated.

The compression test at low temperatures presents a homogeneousness structure towards other tests submitted to the cryogenic environment and also towards the tests submitted to the request in the environment. The constituent's granulation is more delicate, the deformation aspect is less favorable and the freckles network is more evident.

If there is made a comparison of the compression results at low temperatures with the achieved results from the environment, we can say that the resulted values at low temperatures are superior, I illustrate this comparison through the representation of the compression force with the materials of cylindrical test pieces in figure 2.

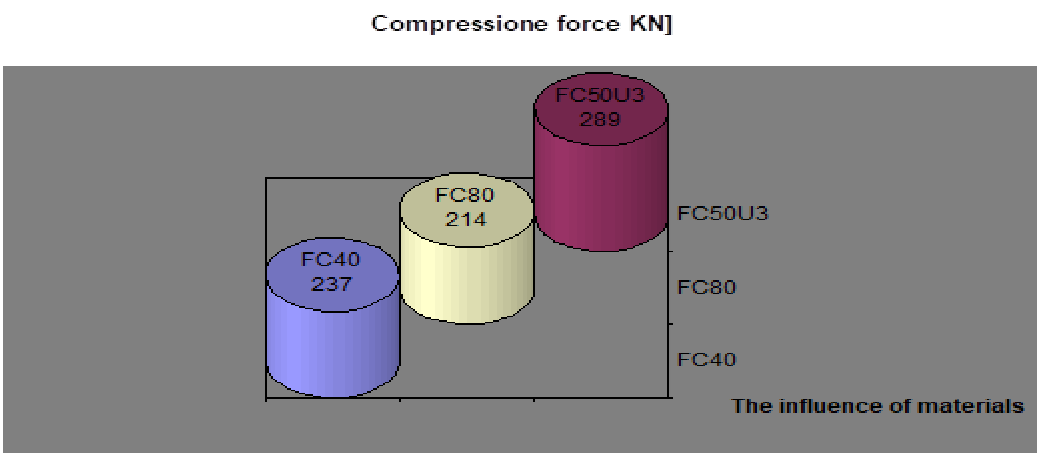

Figure 2. The influence of materials upon the compression force

Shows that the best behavior but also the weakest, respectively the material with 0,5% carbon and 3% copper, FC 50U3 and the material with 0,8% carbon. The material with 0, 4 % carbon keeps the proportion had in the case of the environment.

All the three materials accept superior charges to the environment due to the crumbling of materials at low temperatures.

Another important parameter of the composition influence of the material in the answer to the mechanic request of compression is the visualization between the two averages in figure 3.

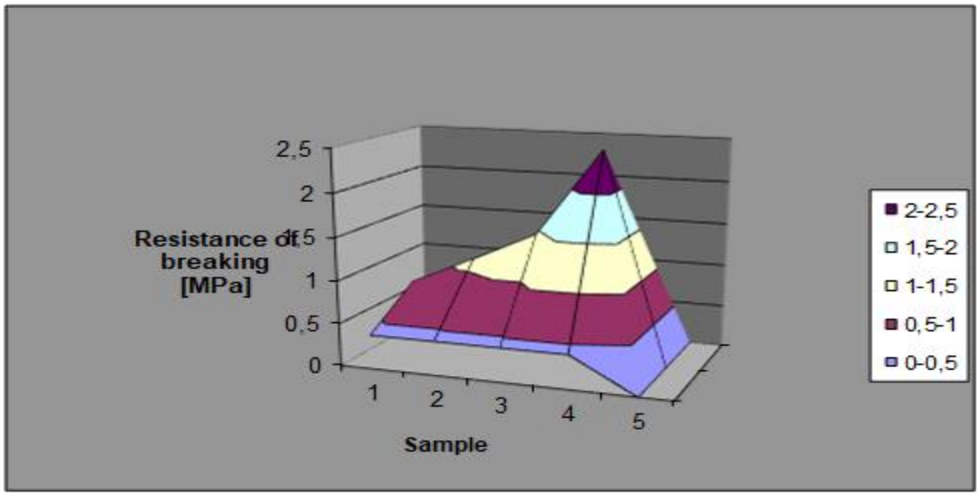

Figure 3. Mechanics request of compression

Analyzes show that an intensification of the material densification in the case of low temperatures that leads to an increased resistance in the case of mechanic requests, large deformation tensions being accepted, figure 4.

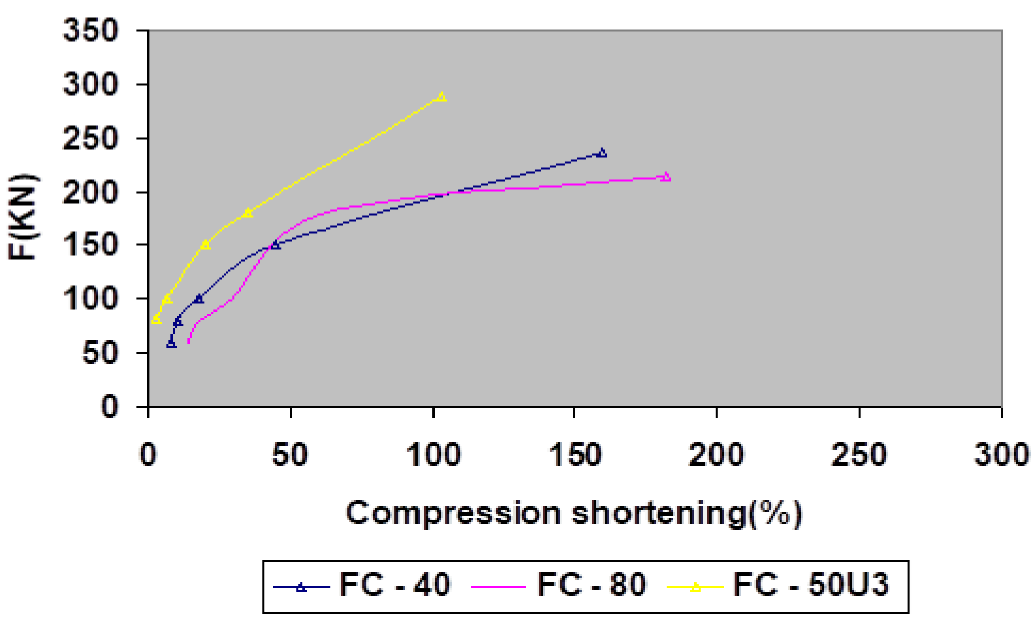

Figure 4. Mechanics request of compression, shorting.

For the materials sintered by the chosen composition for the type of test pieces submitted to the trial at environmental temperature, the corresponding breakage the obtained porosity may be a ductile breakage.

Conclusions

Among the experimental data corresponding to compression from the calculated data we have considered the following observations upon the behavior of materials at request:

- Rrom the analysis of the variations, we can say that the evolution of the applied forces is slow, especially in the case of the FC 50U3 material, and the high value of the crushing resistance is attributed to the copper and a higher densification of the material due to the working environment. All three materials accept loads higher than the environment due to the embrittlement of the materials at low temperatures.
- The compression of the sintered materials is different from the compact materials ones because plasticity is not based on the law of constant volume.
- From the analysis of the results we can say that the best response with the shortening of the specimens is presented by the material FC 50U3, with a content of 0.5% carbon and 3% copper, and the weakest response with the shortening of the specimens is presented by the material with 0.4 % carbon, FC 80. We also observed this result during the experiments because the cylindrical specimen from the FC 40 material deformed the fastest for the same value of the applied force.
- Due to this embrittlement, we have a strengthening of the bonds between the particles and the materials subjected to low temperatures have superior crushing resistance values as follows: for FC40, 0.4% carbon, a maximum strength is 2469 MPa.
- For FC80, 0.8% carbon, a maximum strength is 2352 MPa versus 2352.
- And for FC50U3, 0.5% carbon and 3% copper, the maximum strength is 3856 MPa.

References

[1]. A.P.M.I. Int, *Powder Metallurgy 1977 Facts*, www.epma.com.;
[2] Ianăşi Cătălina, Study of the parameters of some reinforced elements. Fiabilitate si Durabilitate . 2019, Issue 1, p73-76. 4p.
[3]. P.Beiss, *Steam treatment of sintered parts*, PM 1990, World Conf.London, England, 1990,p.488-491;
[4]. M.Mangra, Technologies and applications in powder metallurgy, Ed.Universitaria, of Craiova, 2002;
[5]. Pasăre Minodora, Dependence between the hardness of a composite material and the mode of the force application. Annals of 'Constantin Brancusi' University of Targu-Jiu. Engineering Series . 2019, Issue 2, p115-118. 4p.
[6]. ISO 5740, Resistance tests, Sintered metal materials Standards Collection;
[7]. SR, ISO 5755/2, Tests at low temperature.