

THE INFLUENCE OF ADDITION ELEMENTS ON SINTERED IRON COMPACTS MICROHARDNESS

Ionici C., Căpățână C.

UNIVERSITY of Tg-Jiu

ABSTRACT

New antifriction Materials based on iron powder, with several addition elements were developed using PM technologies. The samples were obtained by uniaxially cold compaction using pressure forces of 300 MPa and sintering in dry hydrogen atmosphere at three different temperatures. In this study the effect of copper, in and lead addition elements on Vickers hardness and microhardness as a function of process parameters was investigated. Vickers hardness was evaluated at an indentation load of 50 N and Vickers microhardness was evaluated at an indentation load of 0.1 N.

Keywords: powder metallurgy, sintered iron compacts, microhardness, addition elements

INTRODUCTION

Technical and economical advantages of the P/M technology lead to performing a wide type of new materials and products with special characteristic required by modern techniques [1].

In order to meet the requirements of future possible applications, it is important to improve the existing and develop new methods of enhancing the applied properties. This may be achieved by efficient alloying, using efficient combinations of alloying elements.

Many sintered parts reach sufficiently high strength properties, for example, similar to cast iron, already at a porosity of 20-15%. Controlled non-homogeneity of the structure by powder metallurgy processes make it possible to obtain special properties of materials, which cannot be obtained by conventional technologies. It is essential to know the actual loading conditions of the part and modify alloying and the treatment conditions of the material on the basis of these conditions [2].

The metallic powder sintered parts present the remarkable physical, chemical and mechanical characteristics, which are determined by their composition and the phase structure as well as the shape and mass distribution of the grains [3]. The study also attempts to optimize the addition elements and sintering condition (temperature, maintaining time) in order to obtain adequate values of hardness and to investigate the quality of the sintered materials microstructure.

EXPERIMENTAL PROCEDURE

As experimental materials, iron powder by Ductil S.A. Buzău DWP 200 electrolytic copper powder, brass, tin and lead powder were used.

The powder mixtures were cold compacted in a die with single action of the upper punch at a pressure of 300 MPa

obtaining 10 mm cylindrical sample. The compacted samples were placed in a tubular furnace having uniform heating zone and sintered at 600°C, 650°C and 600°C for 20, 25 and 45 minutes.

The sintering atmosphere was dry hydrogen with a flow rate of 11/min. The samples were cooled in furnace by switching off the powder and maintaining the same flow rate of the hydrogen gas. The reference densities for selected composition were calculated by the rule of mixtures.

The sintered samples were metallographic prepared by polishing in order to investigate the porosity and by reactive etching in order to evaluate microhardness of the individual grain and structural constituents. Reference densities for each alloy composition were calculated by the rule of mixtures and the total porosity of the sintered specimens was evaluated from the difference between the reference density and calculated density.

The characteristics of the elemental powders and the composition of the mixtures are presented in Table 1 and the experimental conditions are presented in Table 2.

Table. 1. The influence of addition elements on the sintered iron.

Sample.

POWDER COMPOSITION							
	IRO N %	Si %	Mu %	P %	S %	O ₂ LOS S	O ₂
DW P 200	0,02 0	0,05 0	0,20 0	0,02 0	0,01 5	0,20 0	0,2 20
CHARACTERISTICS OF ELEMENTAL POWDER							
Particle size (μm)	>160		160- 100	100-63		<63	
DWP 200	15%		20- 40%	20-40%		20-45%	

APARENT DENSITY g/cm ³	2,5-2,7
FLOW RATE (S/50 g)	33

From this tipe by iron powder obtained three materials FC-40 (iron-lase, C-0,4%), FC-80 (Iron-base, C-0,80%) and Fe 50 U₃ (iron base, C-0,5%, Cu-3%).

CONCLUSION

Hardness express the resistance of material to deformation of the surface caused by the effect of a geometrically defined body.

The value obtained by these methods ar referred to as macrohardness, the value increasing by addition elements and time by sintering process.

Table 2 Experimental conditions.

Sintering Conditions	Sintering temperature [°C]	600-650 ^o
	Holding time [min]	20,35, 40
	Atmosphere	Dry hydrogen
Sintered density [g/cm ³]		6,95

Tests of hardness of powder materials in determining the hardness of the material of a whole, including pores, were carried out using the Vickers method.

RESULTS AND DISCUSSIONS

Hardness expresses the resistance of the material to the deformation of the surface caused by the effect of a geometrically defined body. Although, the value of the porous materials hardness is always lower then the compact materials hardness, for a general qualitative characterization of the sintered alloys macrohardness Vickers method has been used. This method is based on the Vickers method with a very low load.

The influence of the additional elements contents from the hardness (the selected compositions containing cooper powder and brass powder) is in Figures 1.

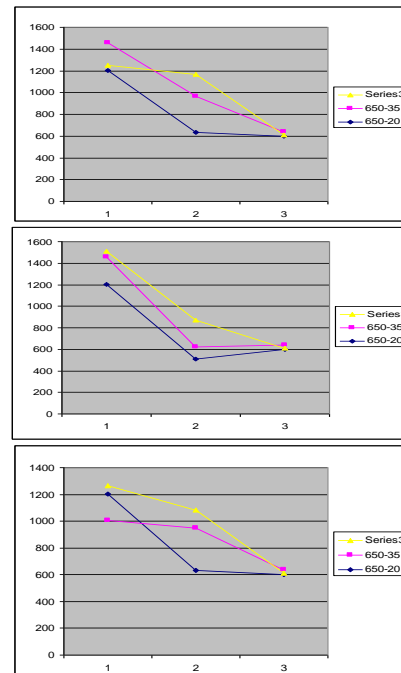


Figure 1. The influence of the additional elements and sintering parameters on the hardness.

The influence of hardness of additional elements from sintering parameters is described in Figures 2.

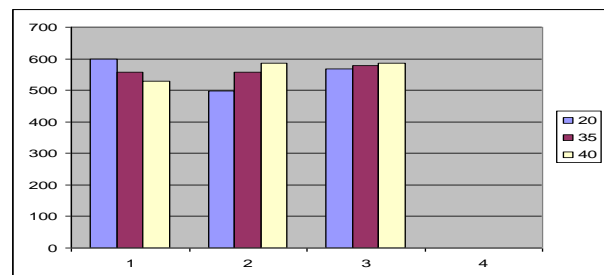


Figure 2. The influence of the additional elements and sintering parameters on the hardness of the alloys containing brass powder.

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