Researches regarding the die pressing parameters on the press ability of iron powders

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The aim of this paper is to present the effect of the pressing speed on the press ability of the iron powders. For the research iron powder type FERSINT RI 180/3.0 with different particle size was used. The cylindrical samples with 12 mm diameter have been processed by unilateral die pressing at three pressures 200, 300 and 400 MPa. The influence of the particle size, pressure and pressing speed on the compacted samples was studied. It is shown that the pressing speed plays an important role in the pressing process of iron powders.

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Keywords: Iron powders, Die pressing, Pressing speed

1. Introduction

Formation of powdered metal parts by die pressing process is most often used because it has a high productivity and can be adapted easily to the production profile changes. Powder pressing plays an important role in the flow chart of parts made by Powder Metallurgy (PM) technologies. There are a lot of techniques of powder pressing (hot or cold) such as: uniaxial compaction (double or single action), isostatic compaction, high velocity compaction and so on. [1-5]. Factors affecting the formation of parts by pressing the metal powders are: pressing method; pressure, pressing time and temperature; pressing speed; pressing atmosphere; lubricants and other benefits; dies quality. Advantages of die pressing of powders are: elaboration of some semi-finished parts respectively high precision parts; the achievement of high quality manufactured surfaces and with a precision geometry; porosity and compactness can be performed widely, ranging specific pressing force; the process of die pressing is characterized by high productivity could be mechanize and automate. Modern presses allow productivity up to 120 - 200 pieces / min; raw material - metal powder – is used complete in the pressing process.

This study is a part of researches regarding the elaboration of Fe-C alloy by PM process. There are some studies regarding the elaboration of Fe-C which are connected to the die pressing: 1. by mixing the Fe powder and graphite powder [6] and 2. by pressing the Fe powders and after that by carburizing the green parts in methane atmosphere [7-10].

2. Experimental

For the research conventional iron powders from Ductil SA Buzau with different particles size were used. The powders properties are presented in table 1 and 2.

Table 1. Chemical properties of Fe powder.

CHEMICAL ELEMENT	MAX [%]
Carbon, C%	0,02
Sulfur, S%	0,015
Phosphorus, P%	0,02
Silicon, Si%	0,05
Manganese, Mn%	0,20
Oxygen, O%	0,22

Table 2 Physical properties of Fe powder

PROPERTY	MIN	MAX
Hall Apparent Density [g/cm^3]	2,50	2,70
Hall Flow Rate [sec/50g]	31	33
Particle size distribution		
+212 µm (%)	---	0,1
-212/+160 µm (%)	---	15
-160/+100µm (%)	20	40
-100/+63µm (%)	20	40
Pan (%),	25	45
GREEN PROPERTIES		
Compressibility (at 600MPa-43,5tsi, 0,75% Acrawax) [g/cm^3]	6,95	---

The iron cylindrical billets of 12 mm diameter have been processed by unilateral cold compaction in a metallic die (Fig. 1) at 200, 300 and 400 MPa, on LBG electromechanical-computerized 100kN testing machine, equipped with TCSoft2004Plus software Fig. 2.

The schematic example of unilateral die pressing with single action is presented in figure 3.

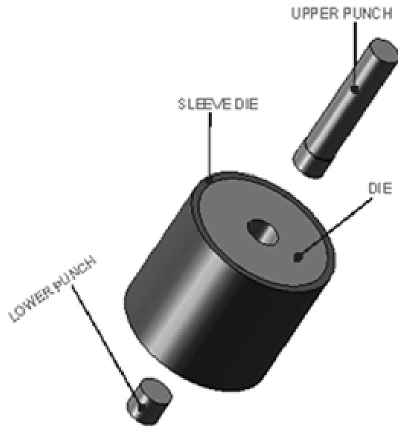

Fig. 1 The cylindrical die used for pressing

Fig. 2 Testing machine.

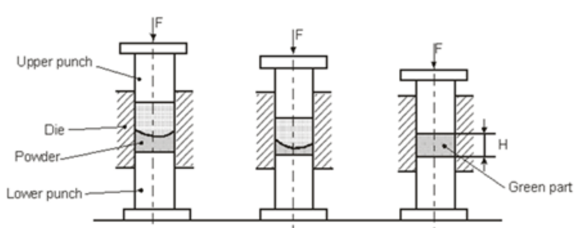

Fig. 3. Unidirectional pressing with single action

3. Results and discussion

The testing machine has the possibility to control the pressing speed and, for the pressing process were used different speeds from 10 to 50 mm/min, being made 45 green parts.

The evolution of green densities and porosities function the particle size, pressing speed and pressure is presented in Figs. 4-6.

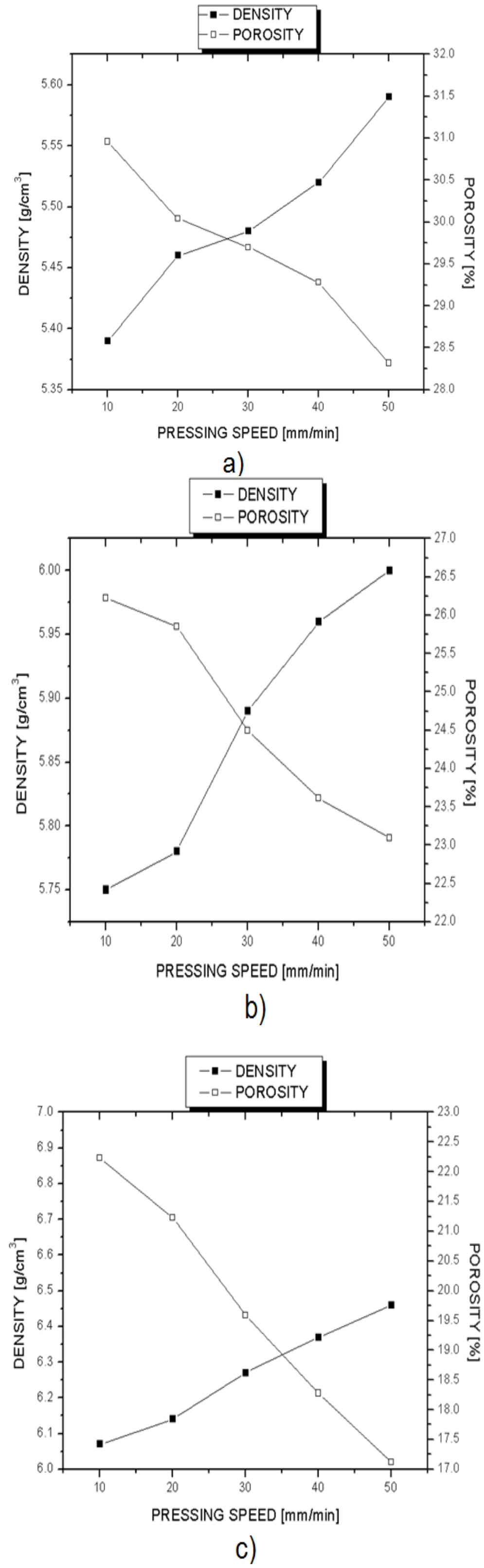

Fig. 4 Evolution of density and porosity function the pressure, pressing speed for the samples obtained by Fe powders with particle size about 56 μm: a) 200 MPa; b) 300 MPa; c) 400 MPa

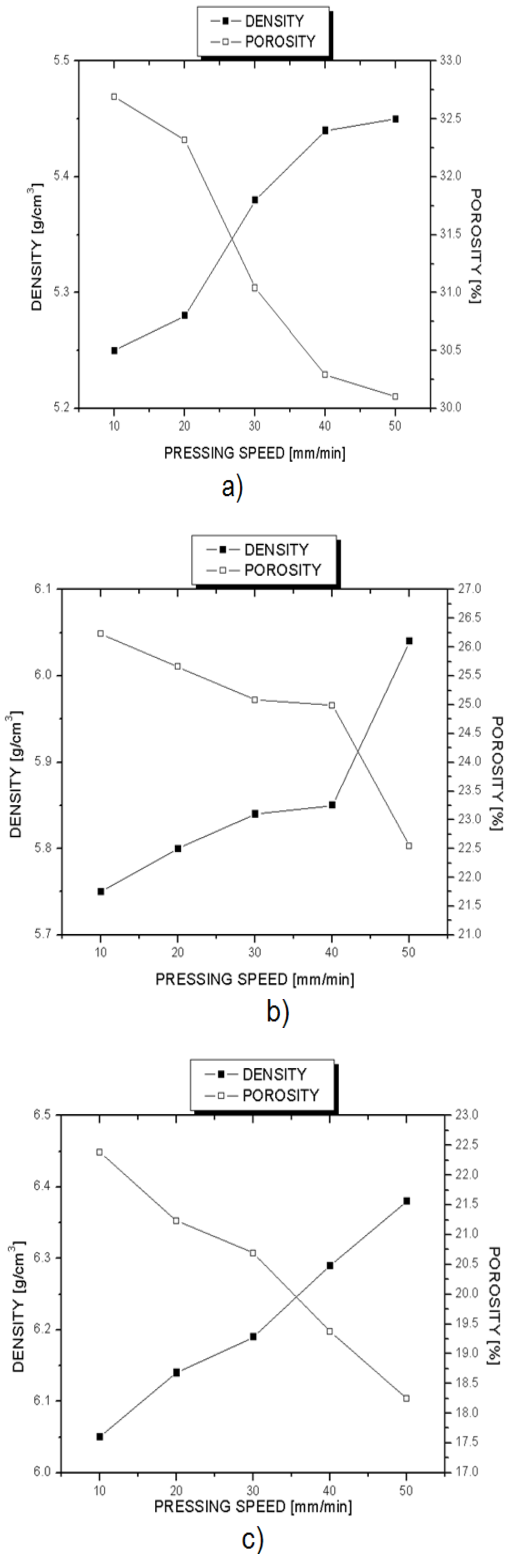

Fig. 5 Evolution of density and porosity function the pressure, pressing speed for the samples obtained by Fe powders with particle size about 100 µm: a) 200 MPa; b) 300 MPa; c) 400 MPa.

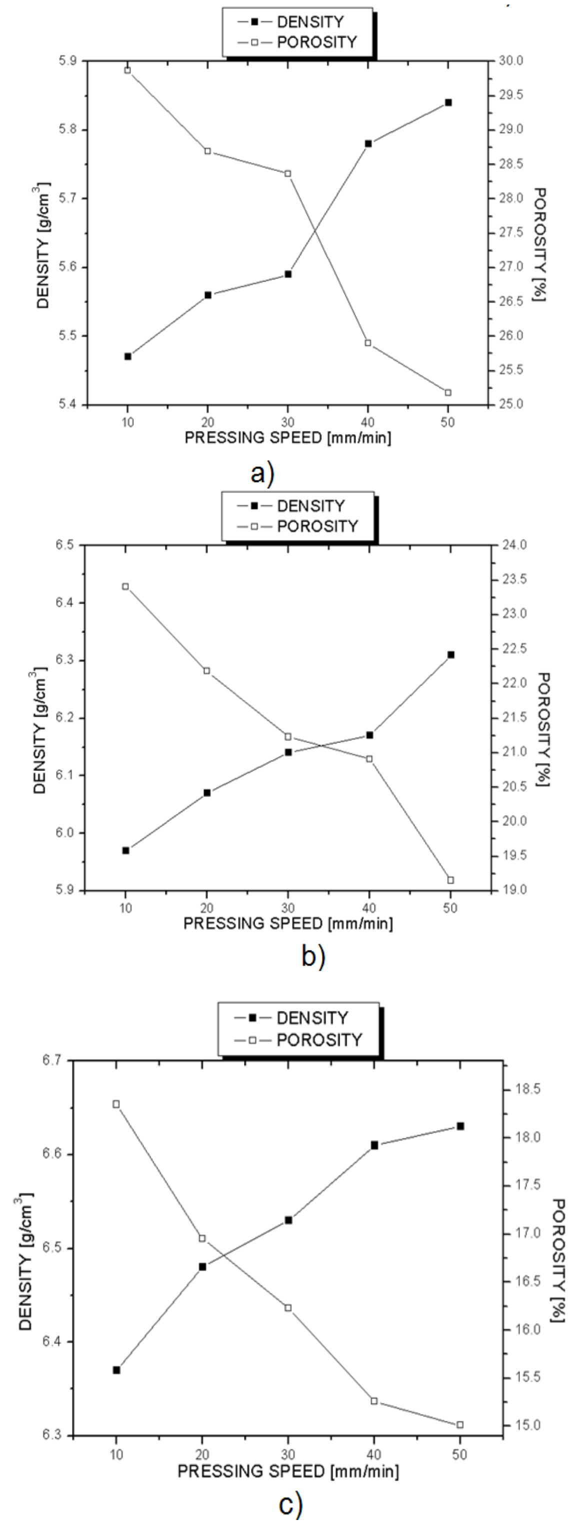

Fig. 6 Evolution of density and porosity function the pressure, pressing speed for the samples obtained by Fe powders with particle size about 200 µm: a) 200 MPa; b) 300 MPa; c) 400 MPa

4. Conclusions

The experimental results lead to the following conclusions:

- as it is shown in fig. 4-6, the density and the porosity are depending to the pressing speed; the density increase with the increasing of the pressing speed;
- regarding the compaction pressure it is normal to achieve higher densities at higher pressures;
- this experiment is very important for the processing of steels by carburizing treatment because the porosity can be controlled which plays an important role in the carbon diffusion.

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