DENSITY BEFORE SINTERING WATER DISPERSED IRON POWDERS

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Abstract

In the present study,is invesigated the influence of the pressing force on the density of powder metallurgical samples of water - dispersed iron powders before their sintering. Tabular and graphical data presents dependenceis on the influence of pressing force, type of iron powder and plasticizer on the density of iron samples before their sintering and pressing. Three iron powders obtained by dispersion with water - ABC 100.30, AHC 100.29 and ASC 100.29 were used. Three types of plasticizers have been added to them and they have been pressed with efforts of 300 ÷ 800 MPa. Density of tested samples was determined by there weight.

Keywords: powder metallurgy, iron powders type ABC 100.30, AHC 100.29 and ASC 100.29. water dispersion, density, plasticizer, pressing force

INTRODUCTION

Dispersion of melts is the cheapest method for obtaining iron and alloy powders. In principle, its basis is that the melt is subjected to the action of a stream of heated gas or a jet of liquid, as well as to centrifugal forces and rotating solid surfaces. As a result, it turns into drops. Which latter solidify after rapid cooling in a chamber, sometimes using cooling media. The method has a number of advantages over other industrial methods for obtaining powders, expressed in:[2,6]

- high productivity;
- high manufacturability;
- possibility for automation;
- small energy losses;
- high quality powders.

The different technological options for dispersing the melt can be divided into two main groups:

- centrifugal dispersion;
- nozzle spraying.

In addition to these two groups of methods, they have found less application in practice:[3]

- ultrasonic spraying;
- electropulse spraying;
- detonation spraying;
- electromagnetic field spraying;
- electronic evaporation with ion or laser beam, etc.

On an industrial scale, hot air and water spraying has found the greatest application. A schematic diagram of the technological process is presented in Fig.1.[3,4]

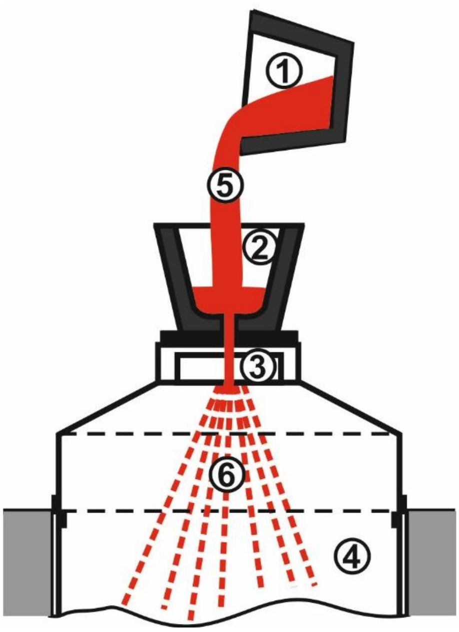

Fig. 1. Schematic diagram of installation for dusting metal powders
1 - crucible; 2 - metal receiver; 3 - nozzle; 4 – bunker.

The most responsible unit in the atomizer is the nozzle. It can be pneumatic (for gas spraying) or hydraulic (for liquid spraying). Pneumatic nozzles, can be used in subsonic and supersonic, with preferences tending to the last one. There is a process of intensification and stabilization of the technological regime. These nozzles can be used with hot or cold gas. Hot gas nozzles are used for spraying easily fusible materials (tin, zinc, aluminum, lead, etc.). Cold gas nozzles are used to spray iron alloys and copper.

In the present publication we study the density before sintering of iron powders obtained by dispersion with water according to the scheme presented in Fig.1.

EXPOSURE

Three brands of iron powders were tested - ABC 100.30, AHC 100.29 and ASC 100.29. They are obtained by aqueous dispersion of a melt of iron scrub heated to temperatures of 1640 ÷ 1700ºC. Nozzles with a diameter of 14 ÷ 16mm were used for spraying.

After spraying, the main technological properties of the powders are determined, which are presented in Table №1.

Table 1. *Experimental results for technological properties of dispersed iron powders*

Powder mark	AHC 100.29	ASC 100.29	ABC 100.30
Max. particle size, µm	170	170	170
Apparent density, $.10^3 kg/m^3$	2,98	2,98	3,00
Flowability, s	25	25	25
Compaction at 420MPa, $.10^3 kg/m^3$	6,75	6,82	6,91
Max. O_2, %	0,10÷0,20	0,10÷0,15	0,10÷0,15
Max. C, %	0,01÷0,02	0,01÷0,02	0,01÷0,02

The experiments were performed at a compressive force of 300 ÷ 800 MPa.

To facilitate the pressing process, lubricants have been added to the starting iron powders - 0.8% zinc stearate, 0.6% Kenolube and Lubricated PS.

After pressing, the density of the briquettes was determined by the weighting method [5].

The experimental results in Tables №2, 3 and 4 are the arithmetic, which mean values of five measurements of briquettes with the same charge composition.

The graphical interpretation of the results for the three types of lubricants used is presented in Fig.2÷4. From the obtained graphic dependences it can be seen that with increasing press force the density of the samples changes exponentially. Initially, when pressing with a force of up to 500 MPa, the increase in density is more intense, then with increasing pressing force, the values for the density of the samples change more smoothly. This increase is different for the three brands of iron powder tested and the three types of plasticizers used in the pressing process.

Table 2*. Experimental results with 0.8% zinc stearate*

Brand powder	Pressing force, MPa					
	300	400	500	600	700	800
	ρ, g/cm^3					
AHC 100.29	6,45	6,74	6,89	7,14	7,20	7,31
ASC 100.29	6,57	6,82	6,93	7,19	7,24	7,33
ABC 100.30	6,69	6,91	7,06	7,27	7,30	7,36

Table 3*. Experimental results with 0.6% Kenolube*

Brand powder	Pressing force, MPa					
	300	400	500	600	700	800
	ρ, g/cm^3					
AHC 100.29	6,51	6,73	6,94	7,15	7,23	7,29
ASC 100.29	6,66	6,81	6,98	7,23	7,28	7,35
ABC 100.30	6,72	6,89	7,10	7,27	7,35	7,41

Table 4*. Experimental results with Lubricated PS*

Brand powder	Pressing force, MPa					
	300	400	500	600	700	800
	ρ, g/cm^3					
AHC 100.29	6,57	6,69	6,96	7,12	7,28	7,33
ASC 100.29	6,62	6,76	7,16	7,23	7,38	7,45
ABC 100.30	6,73	6,88	7,31	7,45	7,49	7,57

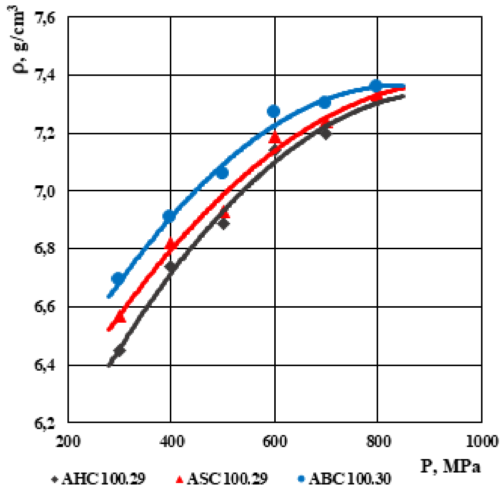

Fig.2. *Change of density depending on the compressive force of samples containing 0.8% zinc stearate*

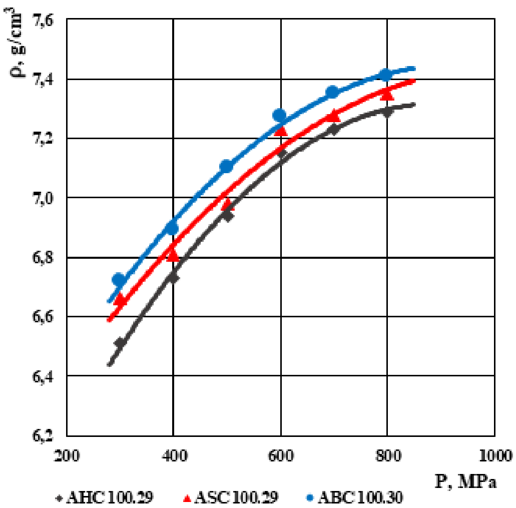

Fig.3. *Change in density depending on the compressive force of beavers containing 0.6% "Kenolube"*

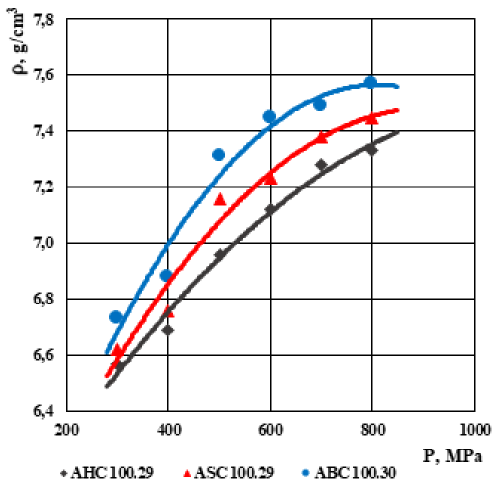

Fig. 4. *Change of density depending on the compressive force of samples containing lubricated "PS".*

The most significant is the increase in density in iron powders type ABC 100.30 - 6.69÷7.57g/cm^3. For powders type AHC 100.29 and ASC 100.29 it is 6.45÷7.33 and 6.57÷7.45g/cm^3, respectively. This is explained by the lower compressibility values of these powders. Table 1 shows that the experimental values for the compressibility of iron powders ANC 100.29 and ACC 100.29 is 6.75 and 6.82g/cm^3, respectively, and of ABC 100.30 is 6.91g/cm^3.

Comparing the influence of the plasticizer on the density of the samples after pressing, it was found that the highest values are achieved when using the plasticizer Lubricated PS. The samples pressed with this plasticizer reach densities in the range of 6.57÷7.57g/cm^3. For samples compressed with 0.8% zinc stearate and 0.6% Kenolube, the density varies in the range of 6.45 ÷ 7.36 and 6.51 ÷ 7.41 g / cm^3, respectively. From the results obtained for the influence of the plasticizer on the density of the pressed samples, it may be recommended to use Lubricated PS plasticizer for iron powders obtained by the spraying method.

Comparing the experimental results obtained with those obtained in similar studies of iron powders obtained by reduction [1], it can be concluded that the powders obtained by aqueous dispersion after pressing with equal force have better compaction than those obtained by reduction. During the first stage of compaction with a force of up to 500MPa, the density of the water-dispersed powders exceeds that of the powders obtained by reduction by 0.42÷0.48g/cm^3. With an increase in the pressing force above 500MPa, this difference decreases and varies in the range of 0.22÷ 0.27g/cm^3. Differences in compaction can be explained by the different shape of the iron particles. The reduction technology produces particles with a spongy and dendritic structure, which at the initial moment of pressing are more difficult to compact than the particles with a spheroidal shape, which are obtained by water dispersion of melts.

CONCLUSION

From the conducted experiments and the results obtained in them, the following more important conclusions can be formulated:

The influence of the pressing force, the type of iron powder obtained by water dispersion and the type of plasticizer used on the density of powder metallurgical samples after pressing with a force of 300 ÷ 800 MPa was traced.

It has been confirmed that during pressing the density of the samples changes exponentially with two zones clearly expressed in the graphs. Zone of intensive growth to a pressing force of 500 MPa and a smoother increase to pressing forces above 500 MPa.

The most significant increase in the density values depending on the plasticizer used is observed in samples of ABC iron powder - 6.69÷7.57g/cm^3. For powders type AHC 100.29 and ASC 100.29 it is less - respectively 6, 45÷7.33 and 6.57÷7.45g/cm^3. This is a result of their lower compressibility.

When pressing samples of iron powders obtained by the method of water dispersion, the use of a plasticizer Lubricated PS is recommended. Because other things being equal, the density of the samples is the highest - 6.57÷7.57g/cm^3.

All other things being equal, the achieved density of water-dispersed iron powders exceeds that of powders obtained by reduction by 0.42÷0.48g/cm^3, by pressing with a force of up to 500MPa and by 0.22÷0.27g/cm^3, by pressing with a force of 500÷800MPa.

The higher compaction of water-dispersed iron powders compared to those obtained by reduction is mainly due to their regular spherical shape.

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