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Structure and Properties Sintering Materials from Partly Alloyed Powders on Bases Iron

Annotation. *Considered structure and properties sintering materials from partly alloyed powders on the basis of iron. Work out mixture for get composition contraction materials on bases powders of partly alloyed steel УЕ–6. Established correlation granulometric composition, contents oils with technological parameters cold pressing with following sintering and properties powder goods. It was determined that the increase of sintering temperature more than 11500C didn't lead to the substantial homogenization of alloy, while the increase of the carbon content up to 2.0 and 5.0 weight % promotes to active sintering of the goods.*

Key words: *sintering materials, partly alloyed materials, composition materials, mixture.*

Ref. 7, fig. 6.

Formulation of the problem in general terms

An important role in the creation of new construction materials and products from them is powder metallurgy, which has a number of advantages over traditional methods of producing billets. Powder metallurgy techniques allow to obtain products with predetermined as physico-mechanical and performance [2].

Increasing the strength of powder materials is mainly achieved by establishing such optimum conditions that would ensure high quality matching powder particles during sintering. Analysis of the literature shows that the decline in properties due to the presence of impurities on the surface of the particles, the existence of discontinuities that arise due to the rough powders [1; 3].

Creating powder products for sealed units rotary compressors requires research aimed at the same time ensuring high structural strength, durability and accuracy. Therefore, the development of new methods of doping powders, allowing to provide cold pressing process without lubrication and create a close contact between the particles, opens up great opportunities for products with a high level of physical and mechanical properties and performance.

Analysis of recent research and publications

Our review of scientific information shows that currently the creation of high-strength structural materials is mainly achieved by doping a complex that enhances the physical and mechanical properties. However, the use of complex alloys in powder metallurgy technologically difficult to implement, and not economical due to the high cost of dopants [3; 6].

Therefore, the development of wear-resistant and high-strength materials derived from partially alloyed iron-based powders, for details of the rotary compressor is an urgent task.

The published studies [4; 5; 7] aimed at improving the characteristics of powders by cold pressing, sintered materials have designs that combine parts required for wear resistant properties: good processability, good wear resistance, gas tightness, sufficient mechanical strength, etc.

Thus, the analysis of literary and production data identified the need to create a new composite materials with desired properties and the development of processes for production of products from them.

The wording of the purpose of Article

In view of the above, the purpose of our work is to study the structure and properties of sintered materials for constructional purposes, derived from partially alloyed iron-based powders.

Basic material

On the basis of studies to determine the optimal composition and mode of preparation of the charge, the main characteristics of the raw materials. Selected methods and means of the processing of their experiments and results. The design of the mixer, which allows to achieve a multi-component system by mixing the complex effect of vane and screw mixer (Fig. 1).

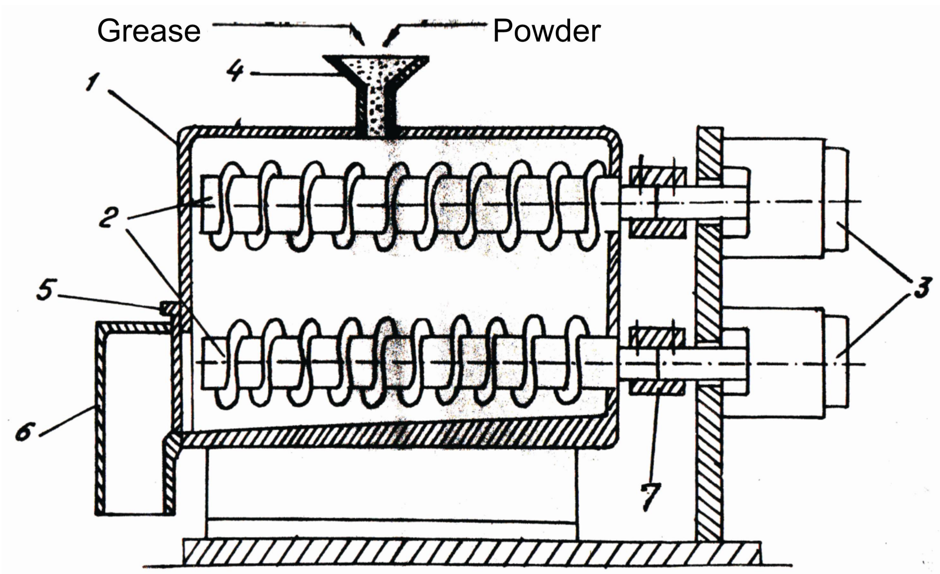

Fig. 1. Screw mixer: 1 – camera; 2 – blade; 3 – motor; 4 – bunker; 5 – a cover; 6 – bunker; 7 – coupling

Research powders were used: partially alloyed iron marks UE-6 ("ultrapak") TU Sulin metallurgical plant and graphite marks GK-3 (GOST 4404-78). Charge for producing a sintered material based on partially alloyed iron powder comprises, in weight.%: Graphite 0.5-5.0, else UE-6.

Mixing of the components was carried out in a V – shaped mixer for 3.6 ks. Cold pressing prismatic samples 10x10x55 mm size were carried out on a hydraulic press HPM – 100S in the industrial press-forms. Testing of the experimental techniques of molding blanks was performed on a hydraulic press P7640 force of 1000 tons with an experimental press – forms. In laboratory conditions, the samples were performed on compression hydraulic press GP-125 using a commercial mold.

Sintering was carried out in an industrial environment in the ovens of conveyor type «Koyo Lindberg» at temperatures of 1100-1200^{0}C at a constant speed of movement of the conveyor belt that delivers long-lasting sintering 3.6 ks. As a protective gas is an endothermic medium used. Composition endogas periodically monitored chromatograph brand LHM – 3MD.

The temperature in the preheating zone of the furnace is 500-600 ^{o} C and constantly monitored chrome-aluminum thermocouple, and in the sintering zone – platinum – platinum-rhodium thermocouple TPP0555.

Sintered samples to determine the density and porosity were vacuum impregnated with oil brand XM – 6 in a laboratory setting. The impregnation was carried out by immersion in heated oil components at 80-100 ^{o} C with soaking for 0.5-2.0 hours followed by cooling in liquid oil.

Studies of the microstructure of powder particles, and sintered samples were microscope PME OLIMPUS, NEOFOT-21, RME-200; chemical composition studied by the scanning electron microscope brands TESLA BS-300.

The hardness of the samples was determined according to GOST 9013-59; tensile strengths and bending according to GOST 1497-73 and GOST 18228-78, respectively, and toughness according to GOST 9654-78. Tribological characteristics of the samples were studied on a standard machine SMC – 2 GOST 26614-85 using a special device.

Justification results. The experimental results showed that the use of partially alloyed powder "ultrapak" marks CU-6 in order to create anti-friction powder materials and construction purposes is a very promising direction.

It is established that the content management processing lubricant in the charge, in particular engine oil, promotes the formation of a material of high mechanical properties ($\sigma_в$ >1300 MPa). Thus alloying powders "ultrapak" occurs due to carbon process and the gas phase lubrication carbonaceous protective atmosphere during sintering.

Studying the influence of lubricants on the technological properties showed that production of high structural products optimum content of zinc stearate in the mixture is 0.5 wt.%, And the lubricating oil – 1.0 wt.%. Under these content reaches the highest value and optimal mechanical properties of the sintered material (Fig. 2, Fig. 3).

Found that the introduction of the batch of graphite fine powder (less than 100 micron) high quality samples are obtained, with a reduction in size increases the mechanical and frictional properties.

Determined that the grain size of the powder "ultrapak" on the properties of the samples to act – differently. When using fines formed low density, which is related to their higher oxidation.

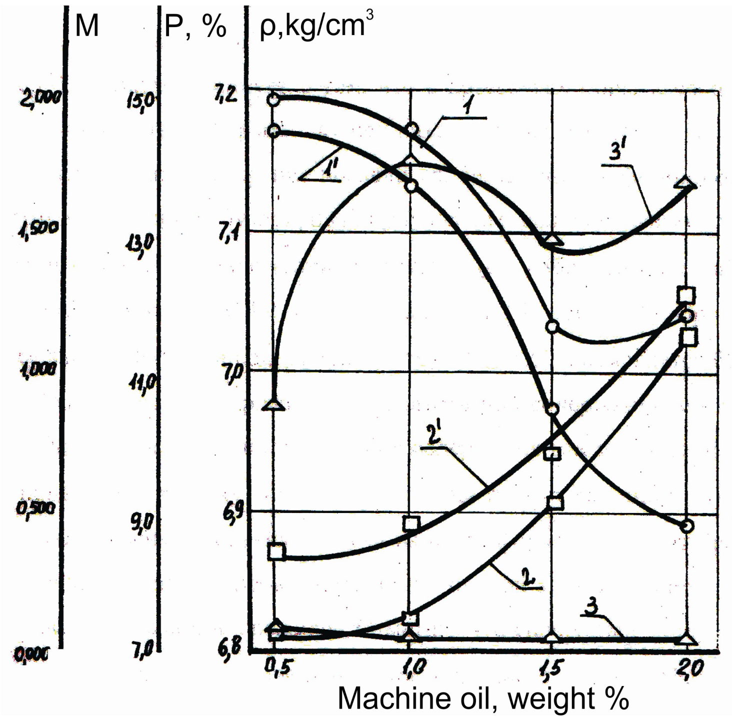

Fig. 2. Dependence of the density (1, 1 '), porosity (2, 2') and oil absorption (3, 3') of the samples of lubricating oil content in the mixture: 1, 2, 3 – raw, 1', 2 ', 3' – sintered samples

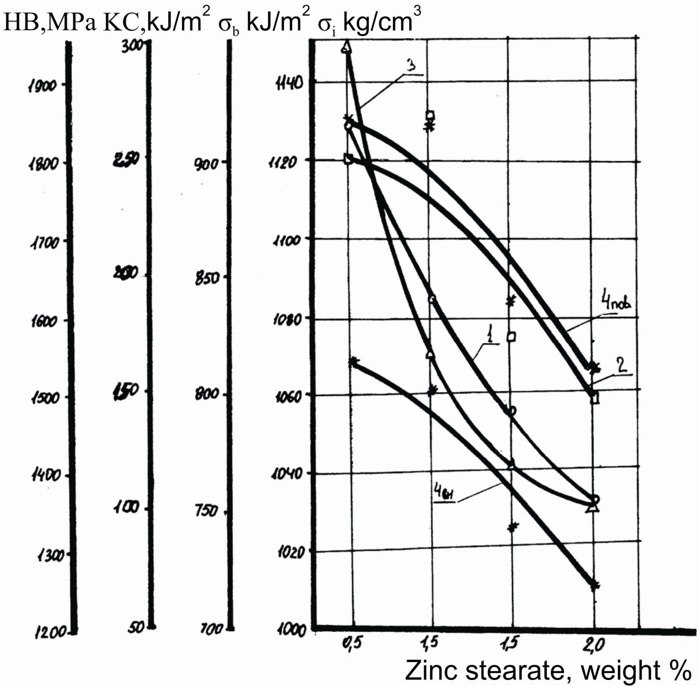

Fig. 3. The dependence of the mechanical properties of the samples by the content of zinc stearate in the mixture 1 – ψ_b; 2 – ψ_i; 3 – the COP; 4 – NV

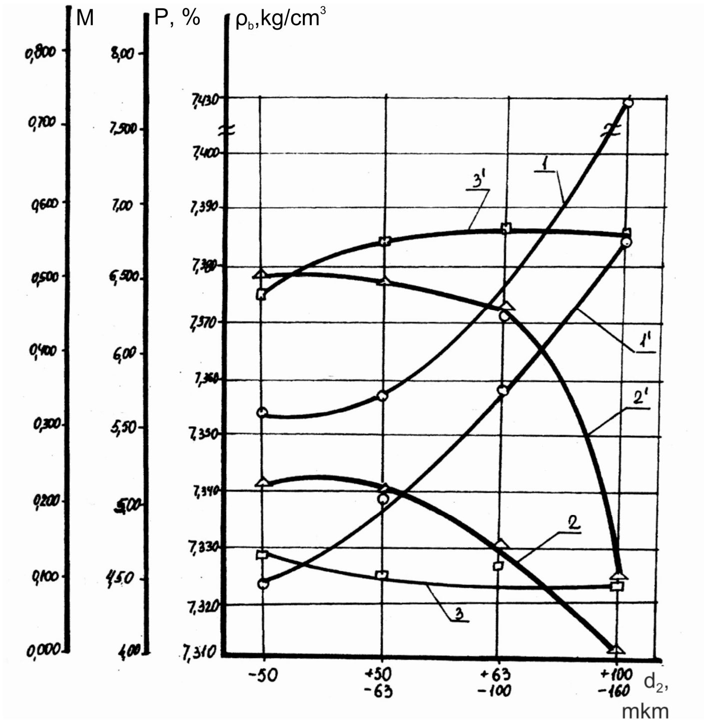

Fig. 4. Dependence of the mechanical properties of the alloy on the dispersion of iron powder: 1 – ψ_b; 2 – ψ_i; 3 – the COP; 4 – CWP; 4 / – RGR

Tensile strength and hardness of the samples with the maximum values are due to obtain a homogeneous structure (Fig. 4).

Analysis of the microstructure showed that the sintering takes place formation of hardening structures that are associated with a complex contribution of alloying elements (Ni, Mo, Cu) on the kinetics of isothermal transformation, carbide formation and dispersion of powders. Found that quenching structure arises mainly when the graphite content in the mixture greater than about 2.0 wt. %.

It was found that a significant effect on the structure and properties of the material from the "ultrapak" provides the sintering temperature. It is determined that the optimum sintering temperature "ultrapak" is 1100 – 1150 ^{0}C. Further increase creates wear due to formation of structures and cementite carbides alloyed (Fig. 5).

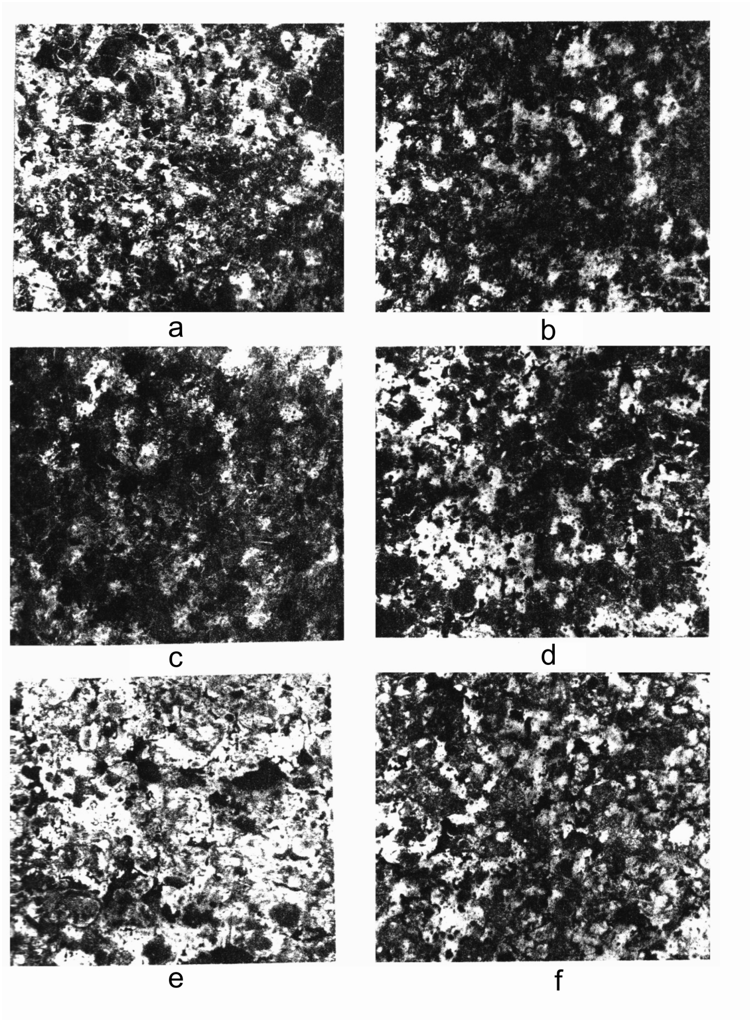

Fig. 5. The microstructure of the sintered (P=1000 MPa, T=1150^{0}C) of the samples from "ultrapak" x200. a) b) c) – the outer surface; d) e) f) – the inner surface

Experimental studies, it was found that the best results for the physical, mechanical and anti-friction properties are achieved when the graphite content in the charge of 0.5-1.0 wt. %. Increasing the graphite content exceeding 2.0 wt. % Is undesirable because – due to its negative influence on all the properties of the sintered body, including and antifriction (Fig. 6).

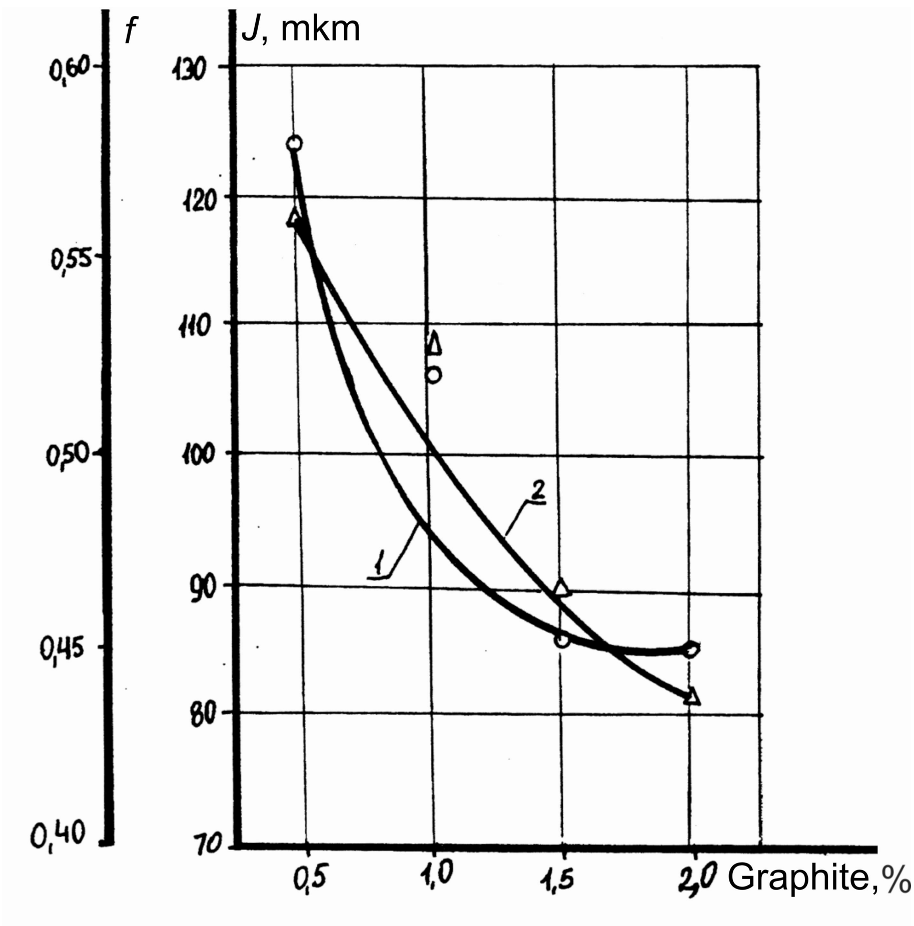

Fig. 6. Coefficient of friction (1) and the wear rate (2) the content of graphite in the batch. Tsp = 1150^{0}C

Conclusions and prospects for further research in this area

Thus, developed charge for structural composites based on partially alloyed steel powders VE-6. The charge includes powders partially alloyed iron and graphite in the following ratio, wt.%; 0.5-2.0 graphite powder and iron powder alloyed partially – the rest, dispersion powders is -160 +50 microns.
The interrelation between the particle size distribution, content of lubricants with the technological parameters of cold pressing followed by sintering and properties of powder products. The mechanism of structure formation of powder materials based on partially explained by the formation of iron-doped hardened

structure during sintering, complex contribution of dopants and dispersion components of the charge.

It was established that the dopant during sintering to form solid solutions of varying composition type Fe-Ni, Fe-Cu, Fe-Ni, Fe-Cu – Ni-Mo et al. It has been determined that increasing the sintering temperature of more than 1150 ^{0} C does not lead to a substantial homogenization alloy while increasing the carbon content, and 5.0 to 2.0 wt.% contribute to the active sintering products.

Proposed in this paper, as technology opens up great opportunities in powder metallurgy, and prospects for further research in order to obtain products with a high performance level.

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