THE FORMATION PROCESSES OF FINE-DISPERSED METALLIC NANO-POWDERS FROM MINING AND METALLURGICAL INDUSTRY TECHNOGENIC WASTES

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Introduction

The prerequisites for the development of the work are the world trends in solving the problems of creating a fundamental theory of condensed state, describing the physical basis of the formation of fine-dispersed metallic nano-powders from technogenic waste. At the present stage, this problem throughout the world occupy one of the most important places among the branches of science and technology [1-3]. This is due to the fact that technogenic wastes of the mining and metallurgical industry technogenic wastes generated in the process of extraction, enrichment and processing are not widely used in industry and, therefore, are stored in dumps, tailing pits and sludge pits. At the present days, the total amount of technogenic waste of the mining and metallurgical industry stored in dumps, tailing pits and sludge pits reaches tens of billions of tons [4-7]. Meanwhile, in terms of its material composition and physico-chemical properties, technogenic wastes of the mining and metallurgical industry are of great interest for their use as the potential raw material for the production of molded engineering products through thermomechanical and physicochemical processing.

The purpose of the scientific work is to obtain new knowledge about the physical and technological foundations of alternative approaches to the formation of fine-dispersed metallic nano-powders from technogenic wastes of the mining and metallurgical industry, to establish the principles and mechanisms underlying in the bases of the communication between their production regimes and properties, and development of the predicting method of the composition and structure of molded products.

Materials and Methods

The composition of technogenic waste contains a significant content of very important components (silicates, aluminates, quartzites, oxides of various metals, etc.). Thus, in the wastes of copper-bearing ores residual amount of non-ferrous metals is contained, in the waste of iron ore raw materials, the share of iron-containing minerals (in terms of metallic iron) can reach 20 or more percent. In connection with the foregoing, the need to create a new concept for the formation of powder materials from technogenic wastes, based on the laws of condensed-state physics, is at the forefront. This approach is interesting and non-trivial. Hence the careful and throughly study of it by many researchers. The review of the literature on this issue points to an abundance of scientific sources. Nevertheless, it has been established that, despite the wide application of methods for obtaining fine-dispersed metallic nano-powders, information about predicting their properties is either very limited or contradictory, or does not exist. This concerns the research of the physical foundations of the technology of formation of powder materials, modeling of methods for forming multifunctional products.

Results and Discussion

Objectives of the work:

❑ - Analysis, classification and generalization of existing theories of processes of powder metallurgy and the justification of new approaches in the aspect of condensed state physics.

❑-Modeling of physical principles of formation of fine-dispersed metal nano-powders from technogenic wastes of the mining and metallurgical industry.

❑-Development of the methods of predicting the composition and structure of molded articles on the basis of the theory and physical regularities of compaction of powder materials.

The practical significance of the new approaches of the interpretation of the physical bases of technological processes of the modern level is determined by a number of criteria, the main of them is the science intensity, the ability to predict the structure and properties of materials, and the hi-tech factor embedded in the model as pledge of further product licensing. The creation of new concept at the interface between the physics of condensed matter and powder metallurgy makes it possible to use the results of fundamental research for both practical calculations of technology and for solving environmental problems: the utilization of man-made waste from the mining and metallurgical industry.

In carrying out previous studies, the authors advanced and subsequently developed a hypothesis about the possibility of creating new concept for the formation of powder materials based on the theory of condensed state. Experimental testing of the hypothesis proved its adequacy: the principles of flexible management of the composition, structure, dispersion of nano-powders from technogenic raw materials were established, which made it possible to obtain from them multi-purpose molded products.

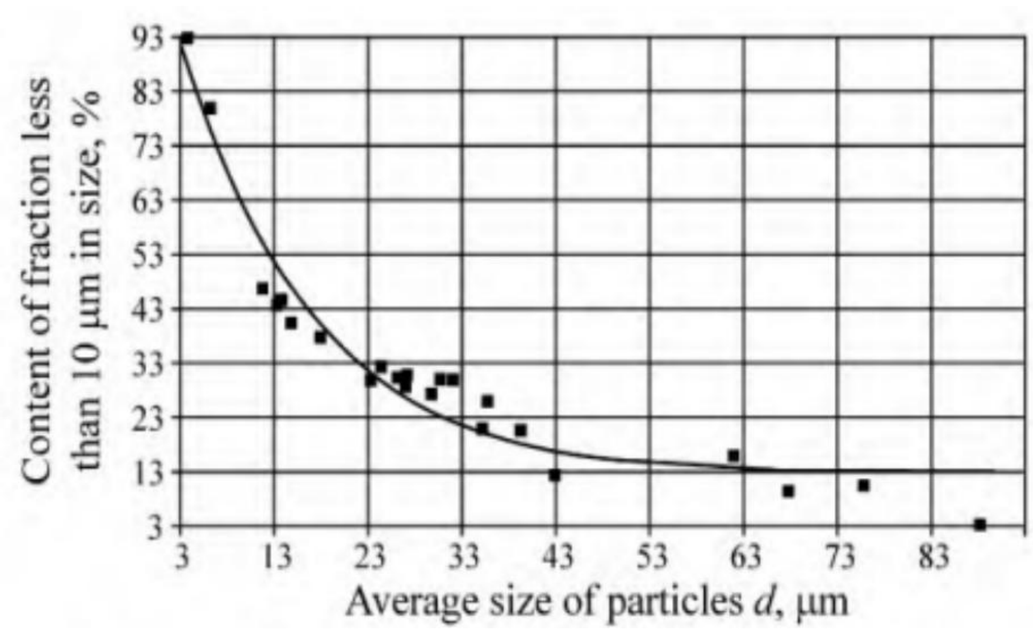

Figure 1. The relationship between the content of fraction with the size of powder particles

The approximation reliability is R2= 0,988; 0,970; 0,943; 0,934; 0,940; 0,957 for fractions of less than 0,5; 1; 3; 5; 10; 43 μm.

Figure 2. Powder of metallurgical industry technogenic waste after grinding o the planetary mill and further centrigugation

Conclusions

❑The presence of metallurgical industry technogenic waste becoms a key factor for providing the invironmental safety of the country.

❑The up-to-date main technology solutions for elliminating the negative effect of technogenic wastes requier the consideration of their dispensability.

❑The estimated economic effect of using the results of the proposed approach at one enterprise is 250-300 thousand US dollars per year in comparison with traditional, widely used nowadays in abroad.

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