Study of the fractional composition of electroerosive powder materials of the tungsten nickel iron alloy obtained in lighting kerosene

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Abstract. The article presents the results of experimental research aimed at studying the fractional composition of electroerosive powder materials of the tungsten nickel iron alloy obtained in lighting kerosene. It has been found that more than half of the total number of particles is particles with a size of less than 47.7 microns. It was also noted that particles with a size less than or equal to 29.37 microns in the powder include 20.0% of the total volume. The conducted research makes it possible to determine the most relevant field of application of the obtained powder materials and will improve the quality of scientific and technical developments in the field of application of electroerosive powder materials.

1 Introduction

Heavy alloys based on tungsten are widely used in many areas, including defense industry [1-9]. Today, one of the main problems in the use of these alloys is their waste processing and reuse [10-15]. The existing industrial technologies for grinding such alloys are characterized by large-capacity, high energy consumption and environmental problems. Search for new environmentally friendly technologies for processing waste of heavy tungsten alloys, including the tungsten nickel iron alloy is relevant and necessary.

One of the promising and industrially unapplicable methods of grinding any electrically conductive material is the electroerosive method [16-21]. At the present time, there are no scientific and technical developments on the use of particles of the W-Ni-Fe alloy dispersed by electric erosion as a charge for the production of heavy tungsten pseudo alloys and products from them. For these purposes, comprehensive theoretical and experimental research is required. Carrying out the planned measures allow us to solve the problem of processing waste of heavy tungsten alloys, save expensive tungsten and reuse it.

The aim of the research was to study the fractional composition of electroerosive powder materials of the W-Ni-Fe alloy obtained in lighting kerosene.

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2 Materials and Methods

To realize the planned studies, powders were obtained on a patented installation for electroerosive dispersion (Figure 1). Lighting kerosene was used as a working fluid. As shown by the results of earlier studies, the powder obtained by electrodispersing the waste of the W-Ni-Fe alloy in kerosene consists of particles of regular spherical shape and elliptical shape.

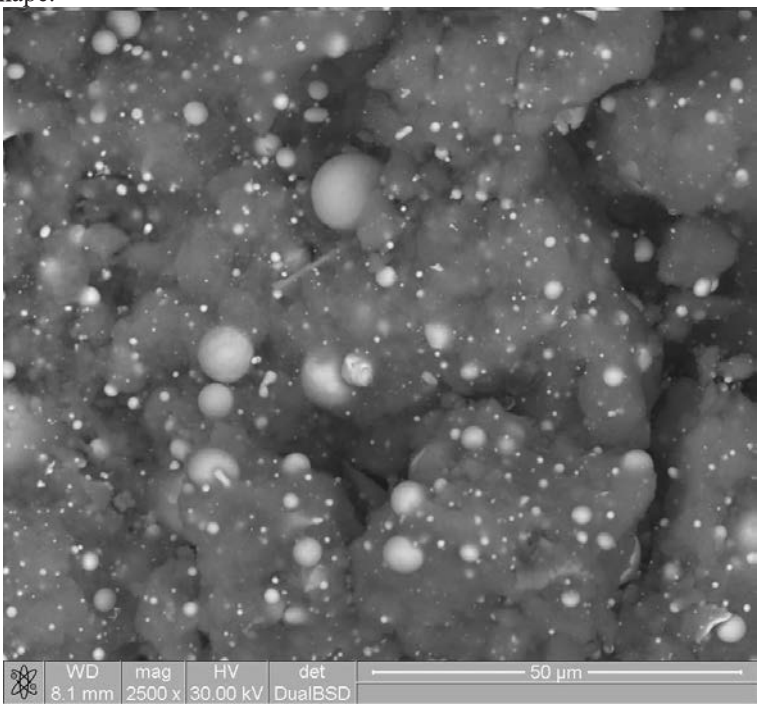

Fig. 1. Electron microscopic image of powder particles obtained in kerosene

The fractional composition of W-Ni-Fe powders was studied using a laser analyzer «Analysette 22 NanoTec» (Figure 2).

Fig. 2. Laser particle size analyzer «Analysette 22 NanoTec»

The «Analysette 22 NanoTec» has a measuring range from 0.01 to 2000 microns. Analyzers that determine particle size distribution by means of laser diffraction use the physical principle of electromagnetic wave scattering. The design consists of a laser directed to a detector through a measuring cell. By means of a dispersing device, the particles are fed into the measuring cell and pass through the laser beam. The light scattered in proportion to the particle size is focused onto the detector through a lens. From the distribution of the scattered light, using complex mathematics, the particle size distribution is calculated. The result is volume fractions corresponding to equivalent diameters in laser diffraction. Sample preparation: dispersion of a sample in a liquid. Background measurement - In order to reduce the influence of the measuring liquid, a background measurement is carried out before each measurement. Any contamination from previous measurements is measured and its influence on the current result is eliminated. Measurement of particle size distribution: a sample of the test with a volume of about 1-5 g was placed in a module for dispersion in liquid (volume of 500 ml). The measurement started automatically as soon as the absorbance reached the specified value.

Measurement parameters: Measurement type - Fraunhofer method; measurement range - 0.1 [microns] - 265.42 [microns]; resolution - 102 channels (20/383 mm); measurement duration - 100 (scans); regularization is the middle model.

3 Results

The results of fractional analysis are shown in the table 1.

Table 1. Fractional composition of W-Ni-Fe powders

Parameter	Value
D10 (10% of particles), microns	14.482
D20 (20% of particles), microns	29.37
D30 (30% of particles), microns	34.993
D40 (40% of particles), microns	41.326
D50 (50% of particles), microns	47.733
D60 (60% of particles), microns	54.229
D70 (70% of particles), microns	61.01
D80 (80% of particles), microns	69.006
D90 (90% of particles), microns	79.913
D95 (95% of particles), microns	85.508
d[4.3] Volumetric average diameter, microns	48.14
d[3.2] Average diameter over surface area, microns	10.26
d[3.0] Average diameter in relation to volume, microns	1.79
d[2.0] Average diameter in relation to area, microns	0.75
d[1.0] Average diameter in relation to length, microns	0.59

As a result of the exploration of the fractional composition of electroerosive powders obtained from the waste of the W-Ni-Fe alloy in kerosene, it was found that D50 (50% of particles) - 47.733 microns, that is, particles with a size less than or equal to 47.733 microns in the powder contains 50.0% of the total volume.

4 Conclusion

Based on the experimental studies carried out to study the fractional composition of electroerosive powder materials of the tungsten nickel iron alloy obtained in lighting kerosene, we can conclude that more than half of the total number of particles is particles with a size of less than 47.7 microns. It was also noted that particles with a size less than or equal to 29.37 microns in the powder contain 20.0% of the total volume. The conducted research makes it possible to determine the most relevant field of application of the obtained powder materials and will improve the quality of scientific and technical developments in the field of application of electroerosive powder materials.

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