Study of the particle size distribution of electroerosive materials obtained from waste alloys based on W-Ni-Fe in lighting kerosene

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Abstract. This article presents a study of the particle size distribution of electroerosive materials based on W-Ni-Fe alloy, obtained in lighting kerosene. It was found that the volumetric average particle diameter of the resulting electroerosion materials is 47,733 microns.

1. Introduction
The W-Ni-Fe alloy is a proportional alloy of tungsten, nickel and iron. It is a heavy alloy with increased stability. Due to its unique strength properties, it finds its application in the manufacture of components for the military industry. But due to its high radiation protection, the alloy based on W-Ni-Fe is found in the nuclear industry by its main field of application [1-5].

The widespread use of an alloy based on W-Ni-Fe in various industries leads to a large accumulation of its waste requiring processing. Currently, there are many ways to recycle metal waste in order to reuse it. However, the disadvantages of the known methods are increased energy consumption, multi-operation process [1-7].

The most promising method for processing metal waste is the method of electroerosive dispersion (EED), which is distinguished by the environmental cleanliness of the process and relatively low energy costs.

Carrying out the planned measures will allow to solve the problem of waste disposal and their further use and thereby reduce the cost of production of the final product.

The aim of the work was to conduct a study of the particle size distribution of electroerosive materials based on W-Ni-Fe alloy, obtained in lighting kerosene.

2. Materials and Methods
To obtain powder from waste alloys based on W-Ni-Fe, an EED device developed by the authors was used [7]. Waste was loaded into a reactor filled with a working liquid - lighting kerosene, the process was carried out with the following electrical parameters: capacitance of discharge capacitors 65.5 μF, voltage 150 V, pulse repetition rate 100 Hz.

The particle size distribution of the obtained electroerosion materials was studied on an Analysette 22 NanoTec laser particle size analyzer (Figure 1).
Analysette 22 NanoTec can determine the size distribution in suspensions, emulsions and aerosols by laser diffraction [8-15].

In order to reduce the influence of the measuring fluid, a background measurement is carried out before each measurement. Any contamination from previous measurements is measured and its effect on the current result is eliminated. Measurement of particle size distribution: a sample of the test volume of about 1-5 g was placed in a module for dispersion in a liquid (volume of 500 ml). Measurement began automatically as soon as the absorption value reached the specified value. Measurement parameters: type of measurement - according to the Fraunhofer method; measuring range 0.1 [\mu m] - 1021.87 [\mu m]; Resolution 102 channels (20/383 mm); measurement duration 100 (scans); regularization is the middle model [16–20].

3. Results
The results of measuring the particle size of the resulting EED materials are shown in Figure 2 and Table 1.

![Figure 2. Microparticles size distribution of sample: 1 - integral curve; 2 - histogram](image)

Figure 2. Microparticles size distribution of sample: 1 - integral curve; 2 - histogram
Table 1. The results of the microparticles size distribution study

| Parameter         | Value  |
|-------------------|--------|
| D10 (10% of particles), μm | 14,482 |
| D20 (20% of particles), μm | 29,37  |
| D30 (30% of particles), μm | 34,993 |
| D40 (40% of particles), μm | 41,326 |
| D50 (50% of particles), μm | 47,733 |
| D60 (60% of particles), μm | 54,229 |
| D70 (70% of particles), μm | 61,01  |
| D80 (80% of particles), μm | 69,006 |
| D90 (90% of particles), μm | 79,913 |
| D95 (95% of particles), μm | 85,508 |
| d[4,3] Volumetric average diameter, μm | 48.14 |
| d[3,2] The average diameter of the surface area, μm | 10.26 |
| d[3,0] Average diameter in relation to volume, μm | 1.79  |
| d[2,0] The average diameter in relation to the area, μm | 0.75  |
| d[1,0] Average diameter in relation to length, μm | 0.59  |

Note. D50 (50% of particles) - 47,733 microns, i.e. 50% of the total particle volume is less than or equal to 47,733 microns.

As a result of studying the particle size distribution of electroerosive materials based on W-Ni-Fe alloy, obtained in lighting kerosene, it was found that the volumetric average particle diameter of the sample is 47.733 μm.

4. Conclusions

Based on the study of the particle size distribution of electroerosive materials based on W-Ni-Fe alloy, obtained in lighting kerosene, it was found that the volumetric average particle diameter of the resulting electroerosion materials is 47.733 μm.

The study will determine the most relevant application area of the obtained samples and improve the quality of scientific and technological developments.

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