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Dimensional Characteristics of Electroerovine Chrome-Containing Powders

[1]E.V. Ageev, [2]A.Yu. Altukhov, [3]A.V. Shcherbakov and [4]A.N. Novikov
[1]Department of Technical Sciences, South-West State University,
Street, 94, 50 Years of October St., Kursk, Russia
[2]South-West State University, Kursk, Russia
[3]Academic Institute of Transport, South-West State University, Kursk, Russia
[4]Department of Technical Sciences, Orel State University named after I.S. Turgenev,
Street 77 Moscowskaya, Orel, Russia

Abstract: To develop a technology for producing powdered chromium-containing materials by electroerosive dispersion and to evaluate the effectiveness of their use, complex theoretical and experimental studies are required. The purpose of this work was to study the dimensional characteristics of powders, obtained by electroerosive dispersion of chromium-containing waste. Determination of the particle size distribution of the powders was carried out on a laser particle size analyzer "Analysette 22 NanoTec" by the dispersion method. When dispersed, the measurement was carried out in a dispersion module for dry samples without ultrasound. In this module, agglomerates of dry samples are processed by mechanical and pneumatic forces. During the measurement, the sample comes from an elongated funnel to the vibro-feeder tray of a dry dispersing device. The dosed supply of the sample is carried out with the help of an original, vibrating tray feeder with adjustable amplitude. Dispersing is carried out in a two-phase nozzle with an annular gap by means of thin metal plates with aerodynamic formation of the waves at the nozzle exit and a high flow rate in the nozzle channel. Dosed portions of the sample are sent by compressed air into the dispersing nozzle (Two-stage nozzle) of the measuring device where the sample is dispersed with an additional adjustable air flow (air nozzle) once more and at an increased speed falls under the laser beam. It has been experimentally established that the powders, obtained by electroerosive dispersion of chromium-containing wastes, have the following dimensional characteristics: the average particle size is 23.86 μm; the arithmetic value is 74.859 μm; specific surface area-1552.99 cm^2/cm^3; the coefficient of elongation of particles with a size of 61.156 μm is 2.49.

Key words: Chrome-containing waste, electroerosive dispersion, powder, dimensional characteristics, size, complex

INTRODUCTION

The search and introduction of new methods for processing metal waste including chromium-containing ones is one of the perspective directions. In recent decades as a result of studies of electroerosion in the interelectrode gap filled with freely contacting metal granules and dielectric working fluid it has become possible to create a productive technology for the preparation of dispersed powders of metals and their compounds. The high productivity of powder formation and product dispersion, the ecological purity of the main technological process and the possibility of obtaining finely divided powders from practically all conductive materials (including super-hard, heat-resistant and plastic) and their compounds with working fluid elements (carbides, oxides, hydroxides) determine the perspective and relevance of this research direction (Ageeva *et al*., 2015; Ageev and Latypov 2014; Ageev *et al*., 2014. For development a technology of the powdered chromium containing materials production by electroerosive dispersion and to evaluate the effectiveness of their use, complex theoretical and experimental studies is required (Maltsev, 2003; Chandler *et al*., 20014; Wang and Qiu, 2006; Wang *et al*., 2009; Kazi *et al*., 2006).

Carrying out the planned measures will solve the problem of obtaining chrome-containing powders, including nanopowders and their further use and thereby, reduce the cost of production of the final product.

Purpose of research: The purpose of this researcher was to study the dimensional characteristics of powders, obtained by electroerosive dispersion of chromium containing waste.

Corresponding Author: E.V. Ageev, Department of Technical Sciences, South-West State University,
Years of October, Street, 50, 94, Kursk, Russia

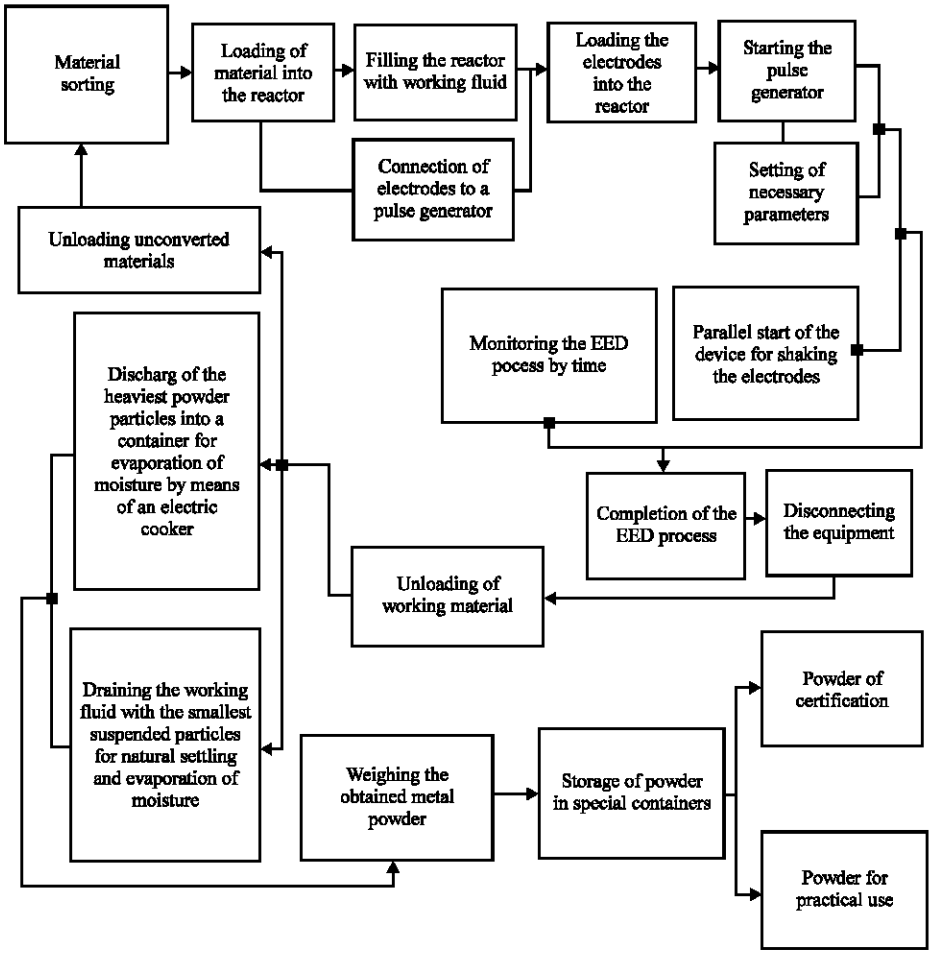

Fig. 1: Scheme of the electroerosive dispersion process

MATERIALAS AND METHODS

Object and methods of research: The process of electroerosive dispersion of chromium-containing waste was carried out according to the scheme shown in Fig. 1.

A determination of the microparticles size distribution of the Nichrome water sample was made (application 1 contains the standard report).

Dispersing was in a liquid with ultrasound. Research methodology (FR 1.27.2009.06762 "Method for measuring particle size in suspensions, emulsions and aerosols in the nanometer and colloid ranges using the dynamic light scattering effect").

Sample preparation: Dispersion of the sample in a liquid. The measurement of the background was carried out 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 effect on the current result is eliminated. Measurement of the particle size distribution: the test sample with a volume of about 1-5 g was placed in a module for liquid dispersion (500 mL volume). The measurement started automatically as soon as the absorption value reached the specified value.

Measurement parameters: Type of measurement fraunhofer method; the measurement range is 0.1 μm]1021.87 [μm]; resolution-102 channels (20/383 mm); absorption-11,00%; the duration of the measurement is 90 (scans); regularization is an average model.

RESULTS AND DISCUSSION

The results of particle size measurement are shown in Table 1 and Fig. 2. Integral curve and histogram: integral curve in coordinates Q3 (x) = f (μm) (left scale) each point on the curve shows how much percentage of the sample has a particle size less than or equal to a given one. Histogram in the coordinates q3 (x) = f (μm) (right scale)

Table 1: Microparticles size distribution

Size characteristics (μm)	Size (μ)
D10 (10% of particles)	39.463
D20 (20% of particles)	45.641
D30 (30% of particles)	50.929
D40 (40% of particles)	55.862
D50 (50% of particles)	61. 156
D60 (60% of particles)	67.051
D70 (70% of particles)	74.524
D80 (80% of particles)	86.635
D90 (90% of particles)	149.852
D95 (95% of particles)	188.215
d[4, 3] volumetric mean diameter	74.860
d[3, 2] average diameter in relation to surface area	38.640
d[3, 0] average diameter in relation to the volume	3.250
d[2, 0] average diameter in relation to the area	0.940
d[1, 0] average diameter in relation to length	0.480

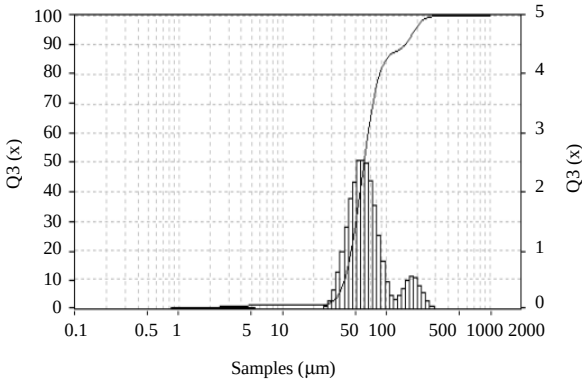

Fig. 2: Size distribution of microparticles of the sample Nichrome (water

is the amount of a sample with a given particle size. It has been experimentally established that the average particle size is 23.86 μm, the arithmetic value is 74.859 μm, the specific surface area is 1552.99 cm^2/cm^3, the elongation coefficient (elongation) of particles of 61.156 μm is 2.49. Table 1 shows the results of a study of the microparticles size distribution. D50 (50% of particles) 61.156 μm, i.e., particles which smaller than or equal to 61.156 μm in the powder are contained 50.0% of the total volume.

CONCLUSION

Thus, it has been experimentally established that powders, obtained by electroerosive dispersion of chromium-containing waste have the following dimensional characteristics: average particle size 23.86 μm; the arithmetic value is 74.859 μm; specific surface area-1552.99 cm^2/cm^3; the coefficient of elongation (elongation) of particles with a size of 61.156 μm is 2.49.

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