FEATURES OF THE PHYSICAL AND MECHANICAL CHARACTERISTICS OF DIAMOND POWDER, AC20 GRADE, GRAIN 100/80, AND THE PRODUCTS OF ITS FLOTATION SEPARATION

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The physico-mechanical characteristics of AC20 diamond powder with a grain size of 100/80 and the products of its flotation separation were studied. Separation was carried out in one stage. The work uses well-known methods of researching synthetic diamond powders. Static strength was investigated using the DA-2 device, morphometric characteristics were investigated using the DialInspect. OSM device. It was established that the use of flotation separation of AC20 diamond powder with a grain size of 100/80 allows to obtain diamond powder with an increased strength index under static compression by 23.8%, increased uniformity in strength by 25.0%, a significantly reduced proportion of impurities and inclusions, and morphometric characteristics close to the original powder.

Key words: synthetic diamond grinding powder, flotation, strength, morphometric characteristics

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The purpose of the work is to study the physical and mechanical characteristics of the products of flotation separation of diamond powder, which is intended for use in abrasive tools.

**Research methodology**

The diamond powder synthesized in the Ni-Mn-C system was studied. Powder grade - AC20, grain size 100/80

The products (foam and chamber) obtained as a result of flotation separation of the original powder were studied.

The process is carried out in one stage. Separation products are chemically purified from flotation reagents. In the paper, the strength indicators were determined during static compression according to the DSTU 3292-9 method using the DA-2 device [7].

Well-known methods, which were developed at the V.M. Bakul Institute of Information Technology, determined the size distribution of powder particles, the specific magnetic susceptibility of the powder (χ, 10-8, m3/kg) and the mass fraction of impurities in the form of non-combustible residue (% by mass).

Morphometric characteristics were determined using the DialInspect.OSM device [8].

The minimum (Fmin, μm) and maximum (Fmax, μm) Feret diameters, grain height (H), grain projection roughness (Rg), external specific surface index (Fpt., m2/kg) were determined.

The conceptual meaning of these characteristics is presented in the methodological materials of the manufacturer of the DialInspect.OSM device [8] and in the publications of the authors of this article, for example, in [3, 9].

**Results of the work and their discussion.**

The results of the study of the distribution of particles of the original powder and flotation products by size are presented in Fig. 1.

![Fig. 1. Integral distribution of particles of the initial powder and flotation products (1 - chamber product, 2 - foam product, 3 - initial powder) by size.](image)

It follows from the results (Fig. 1) that the size distribution of the particles of the original powder and flotation products is almost completely different.

The interval of distribution of diamond particles by size is 30-160 microns. The largest number of particles of the original powder (99.32%), foam product (99.01%), chamber product (98.96%) is in the range of 80-125 microns.

Physico-mechanical and morphometric characteristics of the original powder and the products of its flotation separation are given in table. 1.

The results show that the number of particles in the foam product is much smaller than in the chamber product. The mass of foam and chamber products differs by 6.5 times.

Compared to the chamber product, the foam product is characterized by a reduced specific surface area, a low content of impurities and inclusions, increased strength under static compression and uniformity in strength.

The morphometric characteristics of the products of flotation distribution are close in value to the characteristics of the original powder.
Distribution by grain strength during static compression of particles of the original powder and flotation products is presented in Fig. 2.

It follows from the results that the distribution of particles of the original powder and products of flotation distribution are close.

Table 1.

Characteristics of the initial powder of the AC20 grade with a grain size of 100/80 and the products of its flotation separation

<table>
<thead>
<tr>
<th>Indexes</th>
<th>AC20 diamond powder, grain size 100/80</th>
<th>Powder separation products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass fraction of the powder sample, %</td>
<td>100</td>
<td>13.41</td>
</tr>
<tr>
<td>Specific magnetic susceptibility, (average value), $\chi \cdot 10^{-8}$ m$^3$/kg</td>
<td>0.810</td>
<td>0.002</td>
</tr>
<tr>
<td>Mass fraction of impurities - non-combustible residue, % by mass</td>
<td>1.48</td>
<td>0.20</td>
</tr>
<tr>
<td>Strength index under static compression, N</td>
<td>13.0 [6]</td>
<td>16.5</td>
</tr>
<tr>
<td>Uniformity in strength, %</td>
<td>16.0</td>
<td>20.0</td>
</tr>
<tr>
<td>$F_{\text{max}}$, $\mu$m (average value / uniformity of the indicator)</td>
<td>133.71 / 0.692</td>
<td>137.74 / 0.7197</td>
</tr>
<tr>
<td>$F_{\text{min}}$, $\mu$m (average value / uniformity of the indicator)</td>
<td>102.83/0.7017</td>
<td>104.63 / 0.7258</td>
</tr>
<tr>
<td>$R_g$, (average value / of the indicator)</td>
<td>1.0569 / 0.7588</td>
<td>1.0615 / 0.7450</td>
</tr>
<tr>
<td>$F_{pt}$, m$^2$/kg (average value)</td>
<td>20.70</td>
<td>21.90</td>
</tr>
</tbody>
</table>

Fig. 2. Integral distribution of particles of the original powder and flotation products (1 - chamber product, 2 - foam product, 3 - original powder) according to the strength of grains during static compression

The mathematical linear approximation of the distribution curves shows that the tangent of the slope angle of the curves differs. The tangent of the angle of inclination of the distribution of the foam product is 1.86, the chamber product is 1.60, and the initial powder is 1.68. Therefore, the distribution of the powder particles of the foam product according to the strength of the grains during static compression is the most uniform.

Conclusions

The application of flotation separation of AC20 diamond powder with a grain size of 100/80 allows to obtain a diamond powder characterized by an increased strength index under static compression by
23.8%, an increased homogeneity in strength by 25.0%, a significantly reduced number of inclusions compared to the initial values powder.

Compared to the chamber product, the foam product is characterized by a reduced specific surface area, a low content of impurities and inclusions, increased strength under static compression and uniformity in strength.

The morphometric characteristics of the products of flotation distribution are close in value to the characteristics of the original powder. The distribution of particles of the powder of the foam product according to the strength of the grains during static compression is the most uniform.

References


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