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IMPROVEMENT OF PHYSICAL, MECHANICAL, AND PHYSICO-CHEMICAL PROPERTIES OF DIAMOND GRINDING POWDER THROUGH INNOVATIVE METHODS OF STRENGTH-BASED SEPARATION

Introduction. *In the machine-building industry, the performance of highly productive diamond abrasive tools critically depends on the quality of the diamond grinding powders used. Optimal tool efficiency requires powders that exhibit high uniformity in both particle size and strength.*

Problem Statement. *In both the production and operational use of grinding tools, diamond grinding powders with heterogeneous particle size and mechanical strength characteristics are commonly employed. This variability negatively affects tool performance and wear resistance.*

Purpose. *This study aims to enhance the selectivity of separation processes for diamond grinding powders synthesized under different growth conditions. The focus is on the implementation of combined gravitational separation schemes that integrate magnetic and electrostatic separation techniques.*

Materials and Methods. *To improve powder uniformity by increasing property contrast, fine copper and iron particles have been deposited onto diamond powder grains (grades AC20–AC32) via adsorption from aqueous solutions at various pH levels. This surface modification has significantly enhanced the magnetic and electrical responses of the grains, enabling their effective separation in external magnetic and electric fields based on these induced differences.*

Results. *An adhesive-magnetic sorting method has been developed, enabling the separation of diamond grinding powders into fractions with greater uniformity in shape and particle size, as well as improved thermal resistance. The powders obtained via this method demonstrate superior strength and .uniformity and can be classified as elite-grade materials.*

Conclusions. *The application of gravitational methods, in combination with surface modification and magnetic/electric field-assisted separation, has proven effective for classifying diamond grinding powders according to defectiveness and strength. The resulting powders, characterized by high thermal stability and consistent particle dimensions and strength properties, significantly enhance the performance and durability of diamond-based abrasive tools.*

Keywords: diamond grinding powders, surface defects, separation by surface defect, fine copper and iron particles, solution pH, magnetic separation, .uniformity and strength of powders.

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The performance of diamond abrasive tools has been significantly influenced by the physico-mechanical and physico-chemical properties of diamond grinding powders and the mechanisms of their interaction with the surface of the workpiece [1, 2]. These properties, in turn, are determined by the technologies of powder synthesis, extraction, processing, and classification [3—5]. One of the promising approaches to improving the wear resistance of diamond abrasive tools has involved the use of diamond powders with high uniformity in terms of strength and particle size, surface defectiveness, and consistent content of intracrystalline inclusions and impurities.

Real diamond crystals deviate from ideal structures due to the presence of defects, ranging from point to volumetric ones [6, 7]. The research conducted at the Bakul Institute for Superhard Materials (ISM) of the National Academy of Sciences of Ukraine — by O. O. Shulzhenko, A. L. Maistrenko, H. P. Bohatyrieva, and H. F. Nevstruiev — has convincingly demonstrated that the strength characteristics of diamond grinding powders are critically affected by the grain shape, the presence of metal-solvent inclusions, and other bulk and surface defects, all of which have been shown to influence tool performance. This has necessitated the separation of diamond grains into powders of differing strength grades.

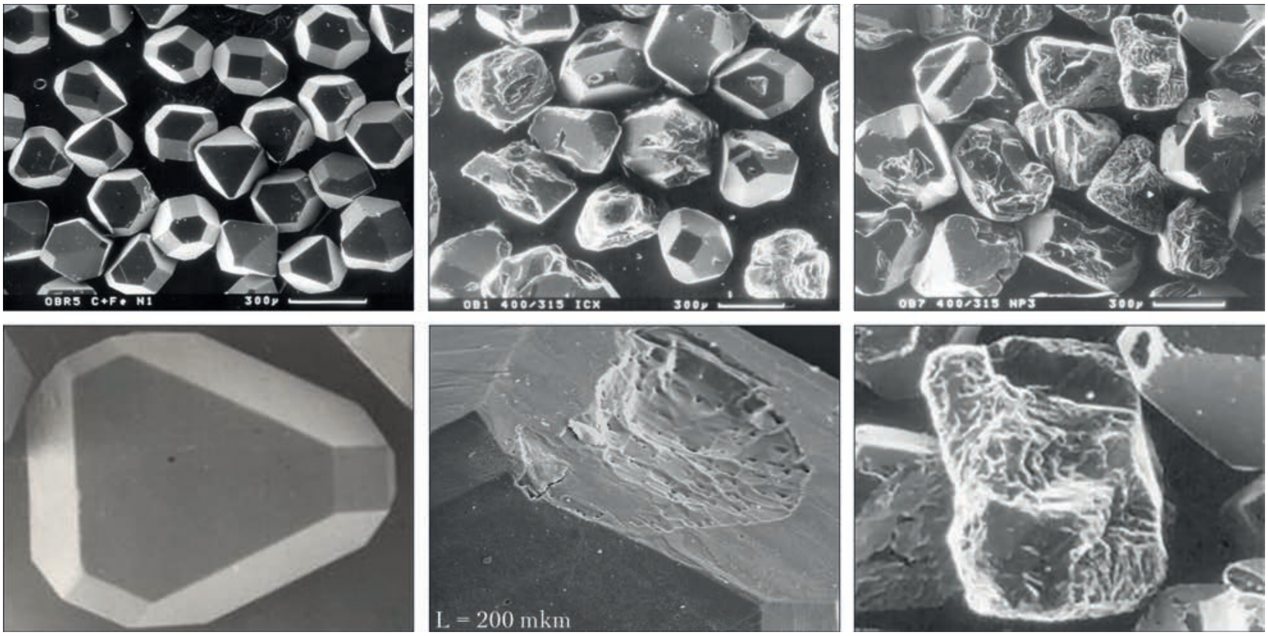
To achieve powder material uniformity, gravitational separation methods have been widely applied. These methods are based on differences in particle motion velocities in aqueous or gaseous media under the influence of gravitational or centrifugal forces. Under these conditions, particles are subjected to forces of gravity, hydrodynamic drag, and friction [8—10]. Separation in a gravitational field occurs due to differences in particle density, size, and shape.

Gravitational processes have been employed both independently and in combination with other separation methods — such as flotation, washing, sedimentation, magnetic, or electrostatic separation — for the extraction and classification of powder materials. In such cases, powders are separated into fractions with different properties according to more complex technological schemes. At the ISM, gravitational methods have been extensively utilized both as standalone processes for classifying powders by particle size and morphology [11, 12], and as part of combined schemes incorporating magnetic and electrostatic separation techniques [13, 14].

The gravitational separation of mineral grains and diamond grinding powders on a vibrating surface has proven to be both efficient and technologically simple [11, 12]. The application of sorting diamond powders based on grain shape has enabled the production of grinding powders across a wide range of grades, from AC15 to AC100. However, shape-based separation does not account for the dependence of grain strength on bulk defects (such as inclusions and impurities), and especially surface defects. As a result, powders obtained using this method, while exhibiting high uniformity in shape factor, have shown low consistency in the strength characteristics.

A practical approach to obtaining diamond grinding powders with different strength levels has involved sorting diamond grains based on the types and severity of their defects. For optimizing sorting methods and quantitatively assessing the defectiveness of diamond grains, it has been proposed to classify all defect types into three principal categories: shape defects, bulk defects (based on the number of intracrystalline inclusions), and surface defects of the diamond crystals [6, 7, 13, 14].

To enable the separation of diamonds according to the number of intracrystalline inclusions — which directly influence the magnetic properties of diamonds (i.e., their magnetic susceptibility) — a technological scheme has been developed that combines gravitational processes with magnetic separation. The use of such methods has facilitated the production of powders with enhanced thermal stability, suitable for drilling and electroplated tools. However, no consistent improvement in mechanical strength has been observed as a result of separating diamonds by their magnetic susceptibility. At the same time, it has been clearly



a *b* *c*

Fig. 1. General appearance of diamond grinding powders and individual diamond crystals with smooth (*a*), partially defective (*b*), and defective surfaces (*c*) [20]

established that a decrease in magnetic susceptibility correlates with increased thermal resistance of the diamond grains, greater tool performance, and reduced specific diamond consumption in tool production [15, 16].

The next stage in the development of diamond sorting methods has focused on separating grains according to surface defectiveness that manifests itself as surface roughness and microdefects. Research into the surface properties of diamonds by various investigators — particularly the targeted studies conducted by H. P. Bohatyrieva [17, 18] — has contributed to a general understanding of surface defectiveness as a basis for strength-based separation processes. It is well known that the surface of a diamond crystal exhibits increased excess surface energy, which leads to a range of surface phenomena. Among these, adhesion, cohesion, wettability, and friction have been identified as the most critical for the practical separation of crystals [19].

Flotation-Based Separation of Diamond Crystals is founded on differences in the degree of surface defectiveness across individual crystal faces, which results in varying wettability by liquids. This variation in wettability enables diamond grains to attach to the surface of gas bubbles. At the Bakul Institute for Superhard Materials (ISM), a foam flotation method for diamond sorting has been developed [19]. In this technique, air bubbles are passed through the powder. Particles with hydrophobic surfaces — that is, surfaces that are poorly wetted or not wetted by water-adhere to the air bubbles and are carried to the surface, forming the froth product of separation. Conversely, particles that are well wetted by water do not adhere to the bubbles and remain suspended in the liquid, forming the underflow product.

This method has achieved positive results in sorting diamond grinding powders by strength, particularly for powders containing crystals with grit sizes not exceeding 200 μm [20].

Fig. 1 presents electron microscopic images of the surface morphology of diamond grinding powders and individual diamond crystals of 250/200 grit size, including (*a*) smooth surface, (*b*) partially defective surface, and (*c*) defective surface.

Visual inspection clearly reveals distinct differences in the surface condition of the powders, which can be regarded as the extreme manifestations of diamond crystal surface defectiveness. In reality, there exists a continuous spectrum of surface conditions ranging from smooth to highly defective. Furthermore, there is no sharp boundary between crystals with smooth surfaces and those with only defective surfaces. It is common to observe that within a single crystal, smooth surface regions coexist with areas exhibiting surface damage. For instance, in Fig. 1, *b*, a smooth surface region is shown adjacent to an area where part of the crystal has been fractured.

Therefore, any characterization of surface defectiveness shall consider the condition of the entire surface of the diamond grain.

The principle of utilizing surface defects for the targeted modification of crystal properties lies in selecting the type and intensity of energy exposure during the pre-separation processing of crystals such that no significant structural changes occur, while achieving sufficient alteration in properties to enable effective separation. To enhance the contrast in the properties of diamond powder grains, the application of surface forces has been proposed to immobilize finely dispersed metallic particles with pronounced magnetic or electrical characteristics on the diamond surface. The mass of particles adhered to the surface is proportional to the degree of surface defectiveness of the crystal, thus providing additional enhancement of its magnetic or electrical properties. These amplified property differences have served as the basis for the separation of diamond grains in magnetic or electric fields [21, 22].

The objective of this study has been to employ various gravitational separation methods to improve the physico-mechanical and physico-chemical properties of diamond grinding powders synthesized in different growth systems, by increasing the efficiency of separation based on surface defectiveness.

The investigation has been conducted on diamond powders of grade AC32 with a grit size of 250/200, synthesized in an Fe—Co—C system, and on powders of grade AC20 with a grit size of 125/100, synthesized in a Ni—Mn—C system.

The investigated diamond grinding powders have initially been separated into magnetic and non-magnetic fractions in order to eliminate diamond grains containing metallic intracrystalline inclusions and impurities characterized by high magnetic susceptibility. In each obtained fraction, magnetic susceptibility, compressive strength, and thermal resistance — expressed as the thermal stability coefficient — have been measured. Subsequently, the non-magnetic diamond powders have been further separated based on surface defectiveness.

Prior to this separation, the powders of the non-magnetic fractions have undergone chemical treatment to remove surface contaminants. This treatment has been conducted in a 15 ± 2% sodium hydroxide solution with the addition of 4 ± 1% hydrogen peroxide for 25 ± 2 minutes at the boiling point of the solution.

The application of finely dispersed metallic particles of copper or iron (less than 1000 nm in size, at a concentration of 2.5 ± 0.1%) has been performed in a mildly alkaline (pH 8—9) and neutral (pH 7) aqueous medium under constant agitation at a temperature of 40 ± 3 °C for 25 ± 2 minutes. After deposition, the water containing unbound particles has been decanted, and the diamond powders with adhered particles have been dried.

To obtain four diamond powder fractions with varying levels of surface defectiveness, the copper-coated powders have been separated in an electric field using an EC-2 electroseparator at field strengths ranging from 5 kV to 25 kV. The iron-coated powders have been separated in a magnetic field using a 138T electromagnetic separator at field intensities ranging from 5 to 20 A/m.

To increase the yield of the main fraction and improve the .uniformity coefficient with respect to the linear dimensions of diamond grains, gravitational methods have been applied. Specifically, final classification by grit size using R-20 standard sieves has been performed to isolate narrow size classes, along with additional shape-based classification on a vibrating table.

After the separation of diamond grinding powders into individual fractions, the following parameters have been determined for each: yield (expressed as a percentage), surface defectiveness — quantified using the surface activity coefficient (K_a) [23], compressive strength (P) [12], and thermal stability (K_{TS}) [24]. Additionally, the .uniformity of the diamond grains in terms of strength ($K_{h\ trength}$) [25] and linear dimensions ($K_{h\ size}$) [26] has been assessed. Magnetic susceptibility (χ) has also been measured [7, 27].

The external morphology of the diamond grinding powders has been examined using an Axioscope 5 optical microscope (ZEISS, Germany).

The condition of the surface of the original diamond powders has been characterized by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX), combined with digital image processing, using a ZEISS EVO 50XVP scanning electron microscope (Carl Zeiss, Germany).

The results of the separation in a magnetic field of the AC32 diamond powders with a grit size of 250/200, synthesized in the Fe—Co—C system and exhibiting pronounced magnetic properties (the magnetic susceptibility of the original powder is approximately 170×10^{-8} m^3/kg), are presented in Table 1. As shown in Table 1, after magnetic separation, the magnetic susceptibility of the magnetic fractions exceeds that of the non-magnetic fraction by factors of approximately 2.0, 1.5, and 1.3, respectively. This leads to a reduction in thermal stability by 30, 17, and 10%, respectively, due to the higher content of intracrystalline inclusions [13, 15].

However, such separation only enables the classification of diamond powders according to the quantity of inclusions and impurities; all resulting diamond fractions remain within the same grade in terms of compressive strength.

To produce diamond grinding powders with varying strength characteristics, non-magnetic fractions are subjected to adhesion-magnetic separation [20, 21]. However, powders synthesized in ferrous alloy growth media exhibit pronounced magnetic properties, which significantly reduce the selectivity of their separation when using adhesion-magnetic methods with iron particles.

In general, due to the presence of metallic inclusions, diamond powders exhibit inherent magnetic susceptibility (χ_0). When ferromagnetic microparticles are deposited onto the surface of diamond grains, a total magnetic susceptibility (χ_t) is formed. Since this parameter applies to all tested diamond powders, the acquired magnetic susceptibility (χ_a) is determined as the difference: $\chi_a = \chi_t - \chi_0$. In practice, χ_a may be equal to or even an order of magnitude lower than χ_0, which sharply reduces the effectiveness of diamond powder separation by both surface defectiveness and mechanical strength [22].

Therefore, in the sorting of diamond powders synthesized using ferrous alloys, other types of metallic particles should be used to enhance the selectivity of separation. These particles shall increase

Table 1. **Physical and Mechanical Properties of the Original AC32 Diamond Grinding Powders Before and After Their Separation in a Magnetic Field**

Separation product	Yield, %	χ, $\times 10^{-8}$ m^3/kg	P, H	K_{TS}, %	Grade
Magn. 1	18.3	232	57	45	AC32
Magn. 2	33.4	180	58	58	AC32
Magn. 3	21.2	160	53	65	AC32
Magn. 4, Non-magnetic	27.1	119	55	75	AC32
Output	100,0	169	56	61	AC32

the contrast in powder grain properties while preserving their structure and inherent characteristics. This allows separation in an appropriate external field into a series of distinct fractions differing in both surface defectiveness and strength. In this study, electrically conductive copper particles are deposited onto the surface of diamond grains in a weakly alkaline medium.

It is well established that dispersed systems containing a stabilizer can exist for extended periods, thereby enabling more effective interaction between metallic particles and the surface of diamond grains [28]. To increase the sedimentation stability of metal particle suspensions in aqueous solution, a stabilizer in the form of sodium hydroxide is added, resulting in a weakly alkaline solution with a pH of 8—9. In this environment, metal particles interact with the alkali, forming hydrated iron or copper oxides. This interaction increases the density and viscosity of the dispersion medium, thereby improving the suspension stability of the particles and promoting their adsorption and attachment to the surface of diamond grains.

The selective deposition of metal particles onto the diamond surface is primarily facilitated by defective surface regions, which accumulate dislocation clusters and adsorption centers. After drying, the metallic particles anchored on the surface of diamond grains enhance their electrical conductivity, enabling more efficient separation in an electric field into fractions of diamond grains with varying surface defectiveness — and, consequently, different physico-mechanical properties.

The physico-mechanical and physico-chemical properties of the original AC32 diamond grinding powders before and after their separation in a weakly alkaline medium via adhesion-electrical sorting are presented in Table 2.

As a result of the separation of the original diamond grains by the defectiveness of their surface, powders corresponding to fractions 1 and 4 have been obtained. These differed approximately 2.5 times in terms of surface activity coefficient and 3.8 times in compressive strength. The diamond grinding powders obtained from all four fractions exhibited improved .uniformity in compressive strength compared to the original powders, ranging from 2.0 to 1.4 times, and improved uniformity in terms of linear dimensions by factors ranging from 1.7 to 1.2. This enables the production of AC80 diamond grinding powders from the original AC32 diamonds, with uniformity in strength and linear dimensions approximately twice as high as in the original powders.

To assess the influence of the pH of the aqueous medium on the selectivity of the separation process based on surface defectiveness of AC32 diamond grains, additional experiments have been conducted using a neutral pH aqueous solution with an appropriate pH indicator. In this case, the powders corresponding to fractions 1 and 4 differ approximately 3.9 times in surface activity coefficient, enabling the isolation of diamond grinding powders with reduced strength corresponding to AC65 from the original AC32 diamonds.

Table 2. **The Physico-Mechanical and Physico-Chemical Properties of the Original AC32 Diamond Grinding Powders Before and After Their Separation in a Weakly Alkaline Medium**

Separation fraction	Yield, %	K_a, %	P, H	$K_{h\ strength}$, %	$K_{h\ size}$, %	Grade by DSTU 3292
1	3.5	0.59	100.0	68	78	AC80
2	45.0	0.77	64.0	64	72	AC50
3	40.0	0.91	50.0	59	65	AC32
4	11.5	1.46	26.0	49	55	AC20
Output	100		55.0	34	47	AC32

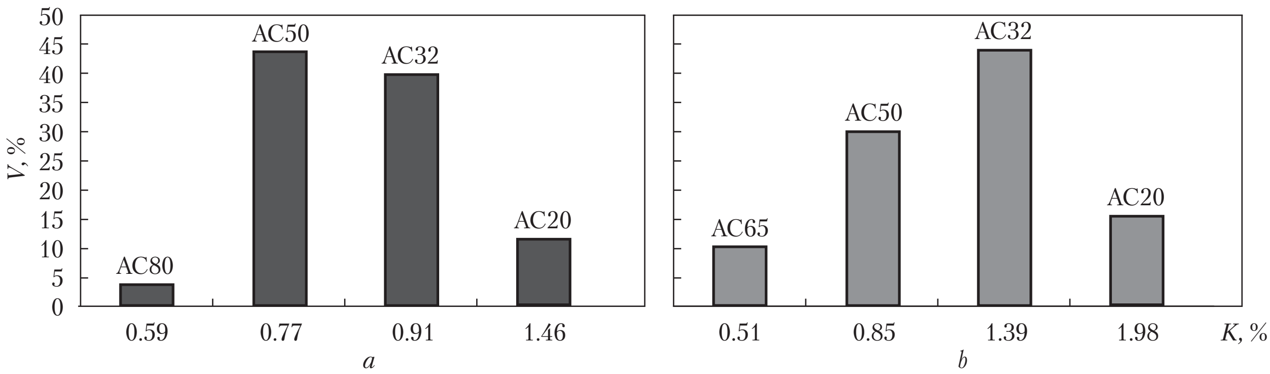


Fig. 2. Histograms of the surface distribution of diamond crystals in an aqueous medium by surface defectiveness in mildly alkaline (*a*) and neutral (*b*) media

Figure 2 presents histograms of the distribution of diamond crystals according to their surface activity coefficients after separation in weakly alkaline and neutral media. As shown in Fig. 2, the weakly alkaline medium provides higher selectivity in particle attachment to the surface, allowing for more efficient separation of diamond powders in an electric field with varying intensity.

The dependence of the strength of AC32 diamond grinding powders on their surface defectiveness during separation in weakly alkaline and neutral media is shown in Fig. 3. Changes in strength .uniformity across different fractions of AC32 diamond powders are presented in Fig. 4. The data in Figs. 3 and 4 clearly demonstrate that separation selectivity is higher in a weakly alkaline medium. Therefore, subsequent separation processes are carried out under weakly alkaline conditions.

Similar experiments have been conducted for the sorting of AC20 diamond powder with a grit size of 125/100, synthesized in the Ni—Mn—C system using ferromagnetic fine-dispersed iron particles. To remove diamond grains containing metallic intracrystalline inclusions and impurities — which exhibit higher magnetic susceptibility — the diamond crystals are initially separated into three fractions in a magnetic field: two magnetic fractions and one non-magnetic fraction. The results are presented in Table 3.

As shown in Table 3, after separation in the magnetic field, the magnetic susceptibility of the diamond powders in the magnetic fractions is approximately 3.5 times higher than that of the non-magnetic fraction. This difference leads to a reduction in thermal stability of around 30% due to the increased content of intracrystalline inclusions [13, 15]. Thus, such separation allows for the production of diamond grinding powders with varying amounts of inclusions and impurities; however, all resulting diamond fractions still fall within the same grade in terms of strength.

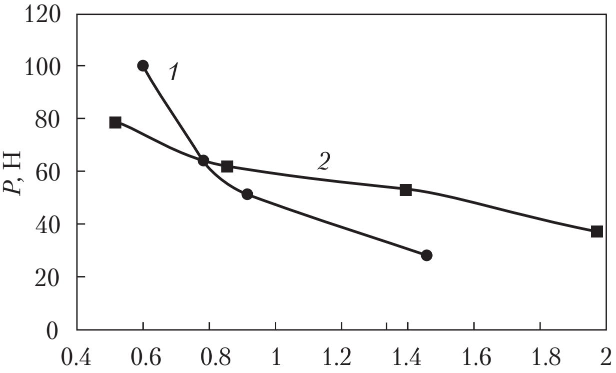


Fig. 3. Dependence of diamond grinding powder strength on surface defectiveness during separation in mildly alkaline (*1*) and neutral (*2*) media

Further, the non-magnetic diamond grain fraction is separated by surface defectiveness using adhesion-magnetic separation in a slightly alkaline medium, with fine-dispersed iron particles. After

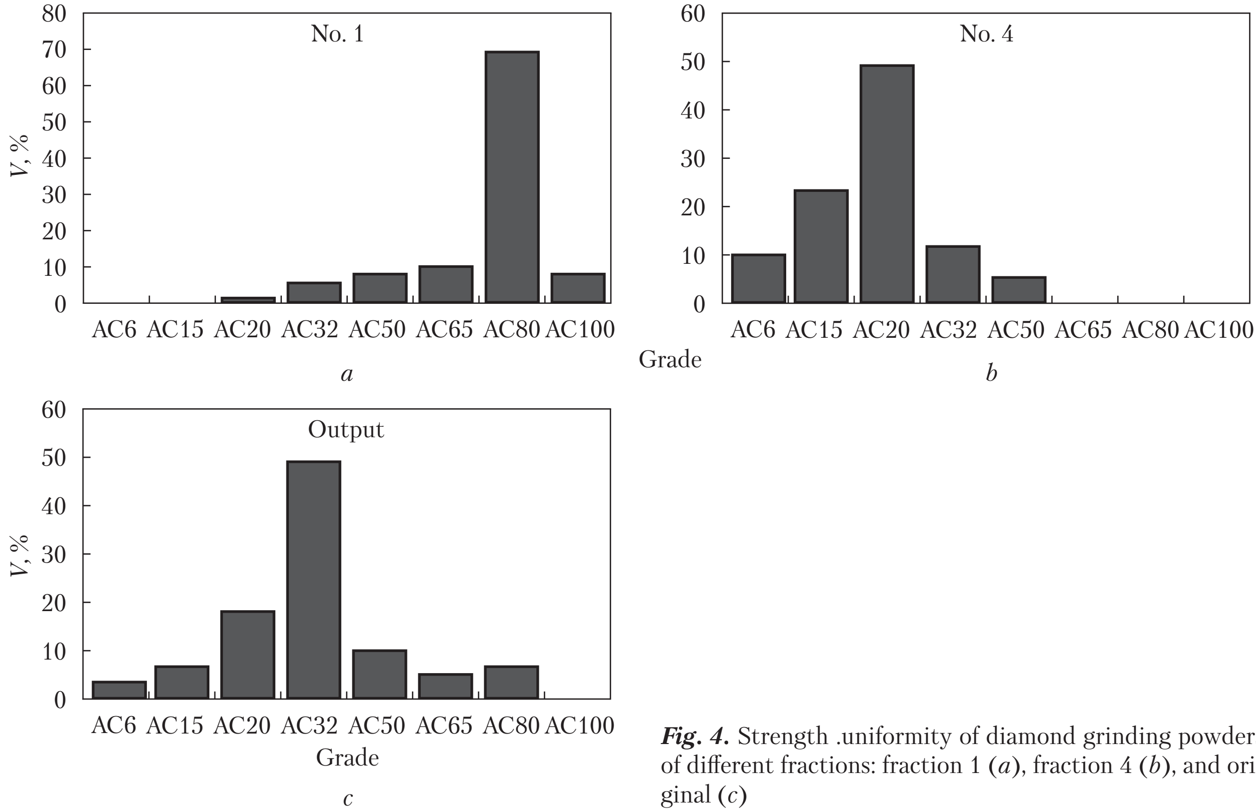


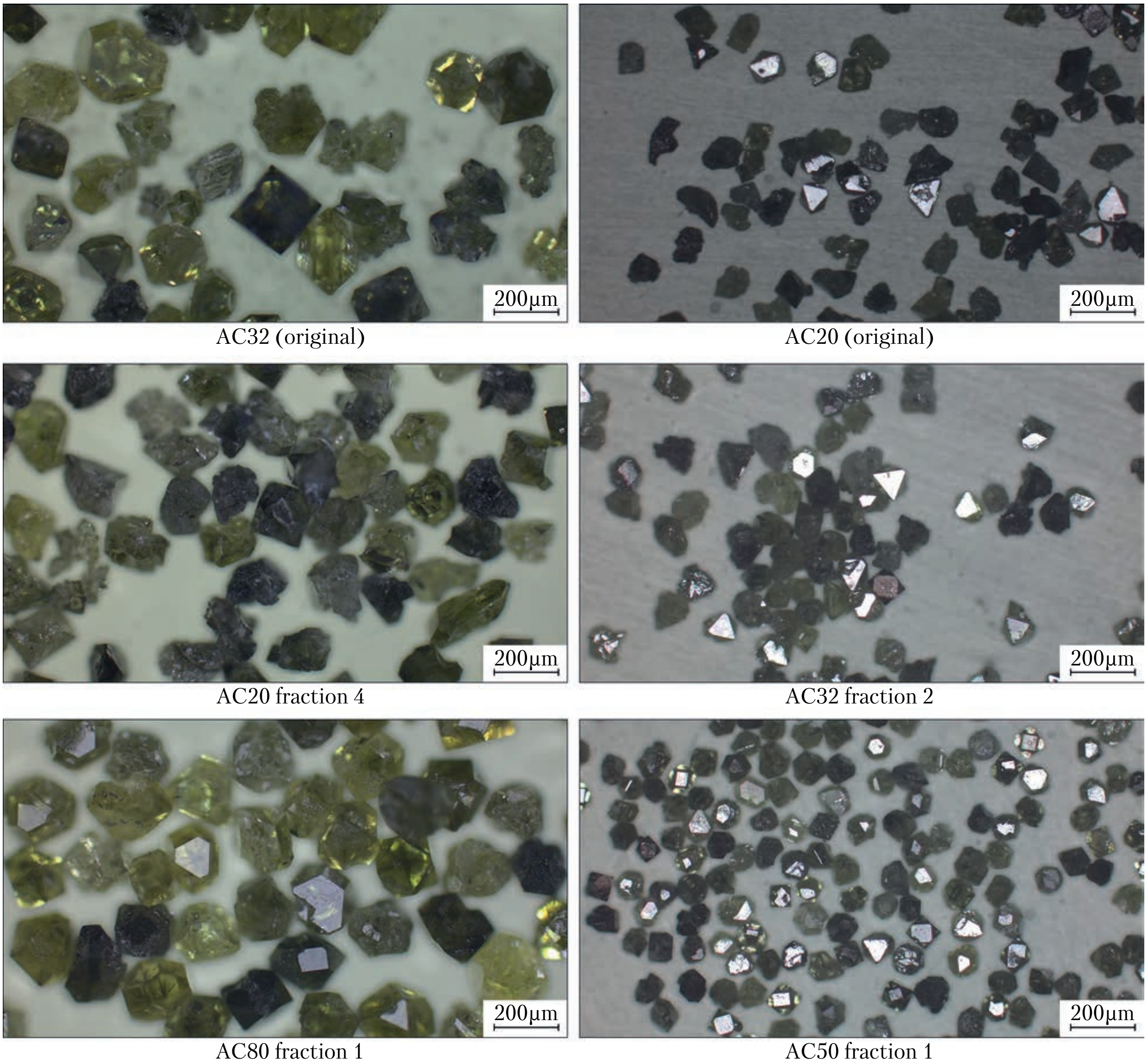
Fig. 4. Strength .uniformity of diamond grinding powders of different fractions: fraction 1 (*a*), fraction 4 (*b*), and original (*c*)

Table 3. **Physico-Mechanical Properties of the Original AC20 Diamond Grinding Powders Before and After Their Separation in a Magnetic Field**

Separation product	Yeild, %	χ, $\times 10^{-8}$ m^3/kg	P, H	K_{TS}, %	Grade
Magn. 1	9.5	29.4	25.1	59	AC20
Magn. 2	10.5	27.2	26.4	68	AC20
Magn. 3, Non-magnetic	80.0	7.5	24.6	85	AC20
Original	100.0	10.7	24.8	78	AC20

Table 4. **Physico-Mechanical and Physico-Chemical Properties of the Original Diamond Grinding Powders of AC20 Grade with Grit Size 125/100 Before and After Adhesion-Magnetic Sorting**

Separation fraction	Yield, %	K_a, %	P, H	K_{TS}, %	$K_{h\,strength}$, %	$K_{h\,size}$, %	Grade by DSTU 3292
1	11.5	0.57	40.8	93	75	58	AC50
2	34.0	0.71	28.3	90	72	56	AC32
3	43.7	0.89	20.6	75	65	52	AC20
4	10.8	1.15	11.7	65	57	50	AC15
Original	100		24.6	85	46	38	AC20



AC32 (original) AC20 (original)

AC20 fraction 4 AC32 fraction 2

AC80 fraction 1 AC50 fraction 1

Fig. 5. Appearance of diamond crystals from different fractions of diamond grinding powders: grade AC32 with grit size 250/200 obtained in the Fe—Co—C system, and grade AC20 with grit size 125/100 obtained in the Ni—Mn—C system

separation, each individual fraction is analyzed for yield (as a percentage), surface defectiveness (expressed as the surface activity coefficient), and compressive strength. Additionally, thermal stability, strength and grain size uniformity have been evaluated. The measured physical, mechanical, and physicochemical properties of the obtained diamond fractions are presented in Table 4.

Based on the test results, it has been established that the separation of the non-magnetic diamond grains with a grit size of 125/100 by surface defectiveness produced distribution fractions 1 and 4. These fractions differ in surface activity coefficient by approximately a factor of 2, allowing for the extraction of AC50 and AC32 diamond grades in a total amount of 45.5%, including 11.5% of AC50.

The appearance of diamond crystals from various fractions obtained by separating AC32 and AC20 diamond powders is shown in Fig. 5. As seen from there, the crystals differ in shape, uniformity, and surface defectiveness. Since all images are taken at the same magnification, it is evident that diamond crystals grown in different synthesis environments differ significantly in all these parameters. Crystals synthesized in the Ni—Mn—C system exhibit significantly smaller sizes, reduced transparency, darker color, and lower uniformity in linear dimensions.

It should also be noted that different diamond grades vary considerably in terms of uniformity and linear dimensions. Crystals of grades AC50 and AC80 demonstrate greater uniformity, which substantially enhances their mechanical strength. For example, following adhesion-electrical separation of the original AC32 diamond powder (grit size 250/200) synthesized in the Fe—Co—C system, the highest shape and size uniformity has been observed in grade AC80, fraction 1 (Table 2). The compressive strength of this fraction is approximately twice that of the original powder. In contrast, the lowest shape and size uniformity has been observed in grade AC20, fraction 4. These crystals differ from the original fraction in surface activity coefficient by approximately a factor of 2.5, in strength uniformity by a factor of 2.0, and by a factor of 1.7 in grain size uniformity coefficient.

After adhesion-magnetic sorting of the original AC20 diamond powders with a grit size of 125/100, synthesized in the Ni—Mn—C growth system, the greatest shape and size uniformity has been observed in the AC50 crystals of fraction 1 (Table 3). Crystals from the separated AC32 fraction 2 are less uniform in shape and linear dimensions, but the thermal stability of both fractions is approximately 20% higher than that of diamonds in fractions 3 and 4 (see Table 4). Based on their uniformity and strength characteristics, the diamond powders from the first two fractions obtained through adhesion-magnetic separation of AC20 diamonds (grit size 125/100, Ni—Mn—C system) can be classified as elite grades according to the technical specifications TU U 23.9-05417377-367:2020 “Elite synthetic diamond powders for diamond tool applications.” This conclusion is supported by the comparative analysis of the shape and linear dimensions of the AC32 and AC50 fractions relative to the original AC20 powders (see Fig. 5).

Thus, by enhancing the effectiveness of gravitational methods in surface defect-based separation of diamond powders synthesized in different growth systems, and by improving their physical-mechanical and physical-chemical properties, diamond powders with high thermal stability and uniformity in strength and linear dimensions have been obtained.

CONCLUSIONS

1. Various methods for separating diamond powders of different strengths using gravity-based techniques have been reviewed. These methods rely on differences in particle motion velocities in water or air media under gravitational or centrifugal forces. To improve the physical-mechanical and physicochemical properties of diamond powders synthesized in various growth systems, an enhanced technological scheme combining gravitational processes with magnetic separation has been applied to increase the efficiency of surface defect-based separation.

2. To improve the uniformity of powder materials by increasing the contrast of their surface properties, fine copper and iron particles are adsorbed onto diamond grains from aqueous solutions at different pH levels. These deposited particles significantly enhance the electrical and magnetic properties of the diamond particles, enabling their separation in magnetic and electric fields based on these differences.

3. In the case of surface-defect-based separation of AC32 diamond powders, when metallic particles are deposited in a neutral aqueous medium, fractions 1 and 4 have been obtained. They differ in surface activity coefficients approxima-

tely 3.9 times due to the enhanced deposition of fine conductive copper particles. This has enabled the extraction of diamond powders with higher strength corresponding to grade AC65.

4. The separation of AC32 diamonds with grit size 250/200, synthesized in the Fe—Co—C system, in a weakly alkaline aqueous medium, yields fractions 1 and 4 with a surface activity coefficient difference of approximately 2.5 times and a strength uniformity ranging from 68% to 49%. This has allowed the isolation of AC80 diamond powders with strength uniformity nearly twice that of the original powders. It has been thus established that weakly alkaline conditions using copper particles result in higher separation selectivity.

5. According to the experimental results, the separation of AC20 diamond powders with a grit size of 125/100 produces fractions 1 and 4, which differ in surface activity coefficients approximately 2 times. This has enabled the recovery of AC50 and AC32 diamond grades in a total yield of 45.5%, including 11.5% of AC50. The thermal stability of powders from fractions 1 and 2 is approximately 25% higher than that of fractions 3 and 4. Their uniformity in strength and linear dimensions is also about 20% higher. Therefore, based on the specifications of TU U 23.9-05417377-367:2020 *Elite synthetic diamond powders for diamond tool applications*, the powders from the first two fractions can be classified as elite grades.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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ПОКРАЩЕННЯ ФІЗИКО-МЕХАНІЧНИХ ТА ФІЗИКО-ХІМІЧНИХ ВЛАСТИВОСТЕЙ ШЛІФПОРОШКІВ АЛМАЗУ ЧЕРЕЗ ЗАСТОСУВАННЯ ІННОВАЦІЙНИХ МЕТОДІВ ЇХНЬОГО РОЗДІЛЕННЯ ЗА МІЦНІСТЮ

Вступ. Для підприємств машинобудівної галузі важливим є високопродуктивний алмазно-абразивний інструмент, для ефективної роботи якого характерним є застосування алмазних шліфувальних порошків, що мають високу однорідність за лінійними розмірами та міцністю.

Проблематика. При виготовленні шліфувального інструменту, а також при його застосуванні, використовуються шліфпорошки алмазу, частинки якого мають різні розмірні та міцнісні характеристики, що, у свою чергу, суттєво впливає на його роботу та зносостійкість.

Мета. Підвищення селективності сепарації для розділення алмазних шліфпорошків, отриманих у різних ростових середовищах, гравітаційними методами розділення у вигляді комбінованих схем, що включають магнітну та електричну сепарації.

Матеріали й методи. Для досягнення однорідності порошкових матеріалів шляхом підвищення контрастності властивостей на зерна алмазного порошку марок АС20-АС32 адсорбцією з водних розчинів при різних pH наносили тонкодисперсні частинки міді та заліза. Останні суттєво посилювали електричні й магнітні властивості, на основі відмінностей яких проводили поділ зерен алмазу в магнітному або електричному полях.

Результати. Розроблено метод адгезійно-магнітного сортування вихідних шліфпорошків алмазу, що дозволяє отримувати алмази зі збільшеною однорідністю за формою та розміром, а також із вищою термостійкістю. За показниками однорідності та міцності отримані шляхом адгезійно-магнітного сортування шліфпорошки алмазу можуть бути віднесені до елітних марок.

Висновки. Застосування гравітаційних методів для розподілу за дефектністю поверхні шліфпорошків алмазу, одержаних в різних ростових системах, та покращення їхніх фізико-механічних та фізико-хімічних властивостей є дієвим методом, оскільки сепаровані шліфпорошки алмазу з високою термостійкістю та однорідні за характеристиками міцності й лінійними розмірами можуть мати суттєвий позитивний вплив на роботу алмазного інструменту.

Ключові слова: шліфпорошки алмазу, дефекти поверхні, розділення за дефектністю поверхні, тонкодисперсні частинки міді та заліза, pH розчину, магнітна сепарація, однорідність та міцність порошків.