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Monitoring Operating Parameters of Abrasive Materials

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Abstract

The authors review the methodology for monitoring of operational indicators of abrasive materials. They describe existing methods of evaluating brittle and strength properties of abrasive grain as a construction made of this material, and equipment for assessing the crushability of abrasive grains, their cutting and polishing ability, wear resistance.
The possibility of applying the method and apparatus for determining the brittle strength of the abrasive grains of black silicon carbide is illustrated theoretically. It justifies the application of the original device to determine the cutting ability of grinding materials. In the device we implemented the conditions that ensure constant cutting force at the hardware level which allows us to estimate the effect physical, mechanical, and geometrical parameters of abrasive grains have on the intensity of abrasive dispersion of a metal. Specific dispersion energy is introduced as a new indicator for the operation of abrasive grain. The cutting ability of SiC and Al_2O_3 abrasive grains in the range of different grit and cutting speeds is experimentally studied.
The possibility of monitoring operational indicators of abrasive grains of different materials using the RSZ-2 is experimentally confirmed.

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Keywords: monitoring; specific dispersion energy; abrasive grains; fragility; crushing strength; crushing load.

1. Introduction

Improving the efficiency of abrasive processing of machine parts provides for the improvement of the characteristics of the instrument, which involves developing the system and means of monitoring their performance: cutting ability and durability between fittings of the grinding wheel, the roughness of the processed surface. When

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creating abrasive instruments, characteristics of materials that the grinding wheel is made of play important part. In this regard, presence of criteria for evaluating the quality of abrasive materials and tools allows for a well-grounded choice of rational characteristics of grinding wheels, while projecting technological processes of final processing.

The main criteria for evaluating the quality of abrasive materials are: durability, performance, roughness of the processed surface of the billet. According to the research [1-5] under other equal conditions, considering the last two of the above criteria, assessing the cutting ability of abrasive grains and their resistance to the forces generated by grinding, greatly depend on their crushability and fragility [6].

Currently people have developed methods for evaluation of brittle strength and structural properties of the abrasive grain as construction of the material and mechanical properties of the material substances of abrasive grains [7-13], as well as equipment to determine the degradability of the strength of abrasive grains, their cutting and polishing ability and wear resistance.

2. Theoretical part

Test method on collapsibility (fragility) of the aggregate grains of grinding material in a ball mill is included in the national standards of USA, Germany, Italy, France. We implemented this method on the test device of Russian production PHZ. As a criterion of abrasive grain collapsibility we took the percentage of grinding residue of individual fractions G, which is the percentage of intact grains. To compare the different chemical composition of the grinding grains by this method they need to have the same grit. Studied abrasive grains of normal electrocorundum (Al_2O_3) and black silicon carbide (SiO) with grit 250 and 1250 μm.

Fig. 1 shows the data on fragility of grinding materials.

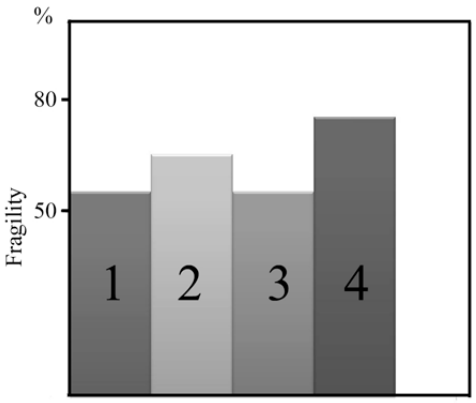

Fig. 1. Collapsibility (fragility) of grinding materials: 1, 2 – normal electrocorundum with grit 250 and 1250 μm; 3, 4 –black silicon carbide with grit 2 50 и 1250 μm.

Fig. 1 data analysis shows that the fragility of black silicon carbide grain increases with an increase in grit. The fragility of normal electrocorundum remains almost constant with grit 250 μm – 1250 μm.

An important characteristic of grinding material mechanical properties is a static crush strength of individual grains. To implement this test method we used a well-known automated device, allowing to test the process of crushing of abrasive grains with a velocity of about 20 grains per second [6].

As a result, studies of the grains of Al_2O_3 and SiC showed the crushing strength of 25 N and 30 N, with microhardness of 22 GPA and 31 GPA, microfragilityof 5,3 and 5,0, and microstrength of 1,95 MPa and 275 GPA.

Evaluation of physico-mechanical characteristics of abrasive materials in the framework of the described techniques allows to implement control at the stage of their production with the aim of regulating technological regimes at all stages: smelting, milling, sizing.

Along with this, while manufacturing abrasive materials it is important to take into account such indicators as their cutting ability. Methodological difficulties in determining the cutting ability of abrasive grains is that the most accurate software method – microcutting with a single grain fixed in the periphery of the rotating disk, is time-