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Influence of Abrasive Grain Geometrical Characteristics on the Grinding Quality

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Abstract

In the engineering industry grinding is mostly the final operation of the production process, therefore it should provide for the necessary surface quality, dimensional accuracy, and the required geometric shape of a product. This paper reveals how raw material grit, abrasive grains shape, ordering of grains influence the efficiency of the grinding wheels. The implemented research let us conclude that the shape of the grain has a significant influence on performance characteristics of abrasive tools. The choice of a certain shape and orientation of grains depends on the particular task and the desirable result of the process.

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Keywords: abrasive; grinding; shape of grain; grinding tool.

1. Introduction

Currently In mechanical engineering industry in most of the cases grinding is a final operation. Final operations should provide the necessary surface quality, dimensional accuracy and the proper geometric shape, that has a great influence on the durability of the assembly and the entire machine. Therefore, the issues of the achievement of the desired surface quality and precision of processing products attract great practical and theoretical interest.

Relevance It is known [1-23] that for the production of abrasive tool with the specific properties, that will be used for abrasive treatment of some parts and materials the special abrasives with specified size and shape of the abrasive grains are required . It would allow to create a tool with egimented characteristics, stable indicators of the grinding process and the possibility of using it to work with CNC machines.

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2. Formulation of the problem

Analysing the effectiveness of the application of grinding wheels we came to a conclusion, that although they are commonly used, its potential is engaged only partially. [1,4-8,12,13]. One of the main reason of such a situation is disordered shape of abrasive grains in the body of grinding wheels (Fig. 1). Arbitrary shape of the grains generates arbitrary and unfavorable geometry of the cutting microclines. As a result part of the grains is not involved in the overall process of microcutting altogether or their participation is very low. Disordered grain shape also creates defects in the structure of grinding wheels and as a result, deteriorates their physical, mechanical and cutting properties.

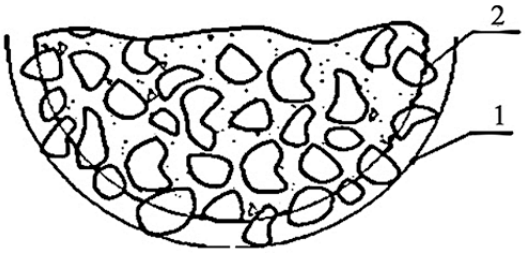

Fig. 1. The scheme of the working layer of the grinding wheel: 1-outside surface, 2 – binder surface.

In general the effectiveness of the grinding process depends on the effectiveness of cutting of each single grain: the better each single grain works, the higher the integral indicator - performance instrument as a whole is. However, to make ach grain work with full capacity, It is necessary that this grain has favorable, for this case cutting geometry. In its turn, the geometry of the grain is determined by two main factors - the shape and location in the tool body. Meanwhile, the analysis shows that in the practice of the manufacture of grinding wheels these factors typically remain untapped and uncontrolled. The solution of the problem of the ordering grains shape gives the prospect of a better use of their potential and, on this basis, let increase the performance indicators of instruments and efficiency of the grinding process in general.

The shape of a grain influences on the strength of its adhesion to the binder its abrasive ability and mechanical strength. It is possible to enhance the cutting abilities and reduce the wheel wear due to the classification of grain shape, applying the particular shape for different tasks.

According to the requirements of GOST 3647-80, GOST 28818-90 after sieving grains become divided according to the size of the cells of sieve. In the process of sieving in accordance with standards there is a large variation (25 to 28%) of grain size. The shape of particles, generated during the grinding of abrasive material depends not only on the properties of the material, but only on the type of the grinding device and grinding technology. Investigations of various methods of grinding of abrasive particles have shown that a change in the nature of the impact on the ground material (impact, abrasion, chipping, etc.) significantly affect the form of particles [1].

For example in white electrocorundum the medium-grained fractions (200 to 800 micrometers) contain 50÷65% of isometric particles and in the fine-grained (50 to 160 micrometrs) 25÷45%.

The same situation is common for other kinds of abrasive materials as well. It is necessary to note that the mechanical strength of particles of various shapes and its cutting ability in the tool are significantly different.

Commercially manufactured standard grinding wheel includes abrasive grains of isometric, intermediate, lamellar shape randomly placed in his binder.

3. Theoretical part

Quantitative estimation of grain shape, provided by GOST 9206 70 and used by many authors is made by means of the determination a generally accepted parameter- "shape factor" of grain. The most objective ways of its determination are as follows: G.M. Gavrilov and A.N. Reznikov [3] considering the grain like an ellipsoid of revolution, understand the "shape factor" of grain as the ratio of its smaller and larger axles; A.N. Korotkov [2]