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Usage of Abrasive Grains with Controllable Shapes as Means of Grinding Wheels Operation Stabilization

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Abstract

In general the efficiency of the grinding process depends on the effectiveness of the cutting ability of each individual grain. The better each grain works, the higher the performance of grinding is. The grain geometry which is favorable for a particular case may provide for the most efficient work of the grain. In turn, the geometry of the grain is determined by two main factors: the shape and its position in the tool body (grinding wheel). In Volzhsky Polytechnic Institute (branch) of Volgograd State Technical University in the SEC "Volzhsky Scientific-Research Institution of Abrasive Grinding" the new technology of the production of an abrasive tool was made. It allows both stabilizing its operation and managing its performance at the manufacturing stage by improving of the classification process of grinding grain, not only by its size but also by its the shape.

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Keywords: abrasive; grinding; shape of a grain.

1. Introduction

Currently, grinding places about 20% of all kinds of mechanical processing. In general mechanical engineering about 10 ÷ 12% of machine tools are grinding ones, in the car producing industry - 25%, and in the bearing industry- up to 55 ÷ 60%. Therefore, the issues related to the method of grinding are considered to be highly relevant ones.

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2. Relevance

Frequently any process of grinding is very unstable. It is due to changes in cutting characteristics of tool during its operation [1-23]. Therefore the grinding process becomes more complicated and requires the permanent correction of the tool and its operation modes. In this connection, the issues are related to the creation of a tool which composition would include grains with controlled shapes have the significant relevance. It would let us create the tool with regimented characteristics, the stable indicators of the grinding process and the possibility of its usage for the work with CNC machines.

3. The formulation of the problem

One of the main reasons of the decreasing of the grinding efficiency is that the tool is made of grinding grains of an arbitrary shape. As a result many grains participate poorly or do not participate at all in the overall process of cutting because of unfavorable geometry of their cutting wedges. Some attempts were taken to solve this problem for grinding belts with the help of the orientations of long axis of a grain perpendicular to the basis with the help of electrostatics. In this research we study how the physico-mechanical properties of initial materials influence the production of abrasive grains, in particular - the material of the aluminothermic production of niobium [23].

As we can conclude from practice, the effect of this measure is quite good. However this approach may provide only a partial solution of the problem, as the second factor, forming of the geometry of the cutting grain wedge, i.e. its shape, remains unmanageable. If this factor is taken into consideration and is purposefully varied, it will become possible to achieve a better effect of the usage of each grain.

Traditionally,the form of particles is divided into two classes: isometric and non isometric. The particles, having a ratio of geometric dimensions l/h<2, where l - length, and h - width or height, are considered to be isometric. A medium-grained fraction (from 200 to 800 micrometers) in the white electrocorundum contains 50-65% of isometric particles; fine grained ones (50 to 160 microns) - 25-45%. This correlation is common for other types of abrasive materials as well. All isometric particles, that satisfy the condition l/h<2, have the pretty same form and volumetric figure. Non isometric part of the material is represented by the set of the diverse shapes of particles: tubulars having a significant thickness, thin tubulars, acicular, etc. [1,2,5,6,8,9,12,13,17].

We created the computer program for the analysis of different shapes of grains. With the help of this program we investigated the abrasive materials produced at JSC “Boksitogorsk alumina”. The analysis of the results of the research let us make the following conclusions:

- grain distribution according to the shape depends on the brand, technology of manufacturing and abrasive grit;
- the bulk of the grain has so-called intermediate (2<l/h<3) shape, the rest of grains has isometric (l/h<2) and tabulate (l/h<3) shape.

Such inequality of grain shapes influences on the production of each grain, because the difference in shapes leads to the difference in the geometry of their cutting edges, and, hence, influences on the ability to cut off the shavings.

4. The results of the experimental studies

The research on the cutting ability and strength of individual abrasive grains with different shapes shows the following:

The experiments which were made to determine the cutting ability of individual grains were implemented on the surface grinder 3G71 model where a disc with a grain was fixed on the spindle, the cutting conditions were following ones: the rotational speed of the disc V = 30 m / s; longitudinal feed S = 0,20 m / min; the depth of the cut t = 0,04 mm.

To hold the experiments we selected grains 13A125 (JSC “Boksitogorsk alumina”) with isometric and intermediate tubular shapes (which were alternately and individually fixed on the metal disk, simulating a grinding tool).

The orientation angle (γ) of abrasive grains of the disk was changed according to the cutting direction varied from 15° to + 90°.