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ABSTRACT OF DISSERTATION

INNOVATIVE METHODS OF SURFACE MICROGRINDING USING WHEELS WITH A CONICAL AND HYPERBOLOID ACTIVE SURFACE

The dissertation presents research and analysis on new methods of microgrinding flat of surfaces that enable high accuracy and efficiency of the process of removing the surface layer of low-thickness material.

The main purpose of the dissertation was to develop the basis for the application of new microgrinding methods, characterized by: a large length of the grinding zone, low removal speed of the allowance and automatic reduction of the removal speed of the allowance along with the machining time of the workpiece (along with the movement of the workpiece along the machining zone). To achieve the main purpose of the dissertation, procedures of a comprehensive modeling and simulation system were developed to test the surface forming processes for different kinematic systems, for different geometrical relations between the nominal surface of the object and the surface of the tool and for different paths of object movement.

In order to obtain the goals of the dissertation, which were determined based on the analysis of the state of knowledge (chapter 2), two research hypotheses and problems requiring a solution were formulated (chapter 3):

- Modeling the surface of corners of abrasive grains.
- Modeling of the active surface of abrasive tools, taking into account the correlation of the spatial distribution of their tops.
- Modeling of geometrical features of pile-ups.
- Algorithmization of surface microgrinding process using wheels with conical and hyperboloid active surface.
- Selection of kinematic and geometric features of the process of surface microgrinding using wheels with a conical and hyperboloid active surface.

The range of the analyzed state of knowledge included grinding processes, in particular precise surface grinding, modeling and simulation of these processes as well as topography analyzes of the surface treated.

In chapter 4, complex procedures and models are presented as components of a comprehensive system for simulating the process of surface microgrinding by the circumference of the grinder and the studies regarding their validation in combination with real metering data and experimental data.

The selected problems resulting from the difficulty of removing the thin layer in the precision grinding processes of the grinding wheel circuit are described in chapter 5. Research and conclusions from the analyzes carried out in this chapter were made on the basis of data obtained from the application of a comprehensive system for simulating the process of grinding and microgrinding of planes by grinding wheel circumference.

The concept of an innovative method for microgrinding flat surfaces with various modifications is presented in chapter 6. This chapter describes the analysis of the position and shape of the surface of the grinding zone for various technological systems and the methodology for the selection of geometrical features for the treatment method under study. In the further part of this chapter, the methodology of modeling the process of surface microgrinding using the hyperboloid active surface and the results of analysis are presented: phases of the process of shaping the surface, layout of machining traces, activity of abrasive grains during the movement of the object in the grinding zone, the speed of removal of the allowance and changes in the topography of the machined surface. A proved research hypotheses was demonstrated.

In the experimental studies, the collections of small machined parts were used in the AR7 (grinding machine specialized for automated machining of planes in small ceramic elements) in device test in the implementation phase was processed, for which diamond wheels with resin binder were used. The surface images of ceramic elements before and after the microgrinding process were investigated using the SEM Phenom ProX scanning electron microscope, on the basis of which the features of the morphology of the tested surfaces (high porosity) were described. On the basis of studies of surface topography of ceramic elements after the machining process, favorable changes in the value of the analyzed parameters for the evaluation of stereometric features for shaped surfaces with the use of wheels with a conical active surface were demonstrated.

This dissertation was summarized with conclusions and the directions of further research were determined (chapter 7). The conclusions were divided into two areas, which concerned the modeling of microgrinding processes and the new microgrinding method. The result of this dissertation are conclusions that relate to the application of the new processing method analyzed in the work and concern: processing parameters, stereometric features of treated surfaces, selection of grinding wheels and construction of specialized grinding machines for precision grinding of flat surfaces in small elements.

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