Power Indicators of Bar Abrasive Processing

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Abstract: Energy approach in modelling of the process of superfinishing allows you to create a more universal model of the process that allows the search of new directions of perfection of technology of final precision processing of a wide range of parts. Factor to energy of single cut abrasive grain at bar to abrasive processing - as generalized factor of cut, since takes into account and power of cutting, depth, length, and volume of single cut is considered in the article. Each of these factors characterizes the cut on the one hand, but factor to energy of single cut characterizes the nature of cut by abrasive grain as a whole.
[Tyurin A.N. **Power Indicators of Bar Abrasive Processing**. *Life Sci J* 2013;10(11s):104-107] (ISSN:1097-8135). http://www.lifesciencesite.com. 19

Keywords: bar abrasive processing, superfinishing, energy of cutting, cutting moshchnost.

1. Introduction

At the present time there are a number of different theoretical approaches to the modeling of the process of precisely defined. However, all of them are mainly of a private nature, reflecting the specific conditions of the process of superfinishing, which limits their practical application in improving the technology superfinishing processing. In our opinion, using the energy approach in modelling of the process of superfinishing will allow to summarize earlier studies in this area and create a more universal model, which allows to carry out search of new directions of perfection of the technology of the final precision processing of a wide range of parts [1, 2,3,4,5,6,7,8,9].

The essence of all processes of machining of workpieces, including the process of precisely defined, is in the process of transformation of energy from one kind into another. In the process of superfinishing processing energy drive equipment is transformed into the energy of cutting individual abrasive grains and energy of friction chips and cuttings to the surface. The energy of the cutting and energy of friction is converted partly in the internal energy of the workpiece and ligaments of the tool, and partly in thermal energy. Heat energy released during processing, accompanied by a branch of the микростружки, and the increment of internal energy is accompanied by a hardening of the surface layer of the workpiece. Increment of internal energy of the ligament that holds the grain on the surface of the instrument, accompanied by its destruction, which contributes to, on the one hand, самозатачиванию tool and the increase of its cutting power, and on the other hand, a decrease in the depth of single slice, which is accompanied by a decrease in speed of removal of the allowance and the reduction of the roughness of the processed surface.

Thus, the process of superfinishing is, first of all, the energy of the process, and, therefore, without serious analysis of the energy parameters of this process it is impossible to make a fairly complete picture of the nature of the course of this process [10,11,12,13,14].

All the energy performance of superfinishing processing are divided into single and generalized. Single indicators reflect the impact on the surface of single abrasive grains.

The most common single indicator is a lump of energy of a single slice. Under the lump-sum of the energy of a single slice understand the energy spent on continuous cutting of the material blanks of a single abrasive grain.

This cut can be complete and incomplete. A complete snapshot of the work, if a single abrasive grain comes out of contact with the treated surface without damage. Such cases usually cut is unlikely, as are the use of very small depth of cutting abrasive grains, firmly held a bundle. But it is known that in the process of superfinishing allowance is actively removed under condition of active самозатачивания of the abrasive tool. And for this it is necessary to ensure such conditions of treatment, in which a single abrasive grain under the action of the treated surface actively fall out of the bunch tool. If abrasive grain in continuous contact with the treated surface falls out of the bunch and ceases to be cut, it turns out part-time slice. When it decreases, and the depth and length of the cut, which leads to reduction of a lump of energy of a single slice.

Thus, the one-time energy of a single cutting depends on a lump-sum cutting depth and from a single length of the cut. And although the parameters of the cutting part of abrasive grains depends on their material, but for each of the material of the medium-probable parameters of the cutting part of the grains depend on the cutting depth, so that the ratio between the depth of cuts and width of the sections remain constant. Therefore, we adopted instead of two single power parameters of the process of superfinishing - lump-sum depth of cut and one-time square slice, one parameter - a lump-sum depth of a single slice.

Under the lump-sum depth of the cut will understand the medium-probable depth of cut a single abrasive grain. Under the lump-sum chop length will understand the medium-probable length of continuous cutting a single abrasive grain. The word «one» emphasizes that in this case is considered a single slice, made a single abrasive grain during his one continuous contact with the treated surface.

As the energy cutoff depends not only on the parameters of the sections, the number of single energy parameter applies and the internal energy of the material being processed workpiece. Under the internal energy of the material being processed workpiece will understand the energy required to remove from the treated surface single abrasive grain of a unit volume of the material. The product of the volume of a single slice on the internal energy of the material being processed should be equal to the lump of energy of a single slice.

Since, as was noted above, the single abrasive grain at superfinishing make in their most incomplete sections, one of the most important unit of energy indicators is the internal energy of the material ligaments. Under the internal energy of material ligaments will understand the medium-likely value of the energy of deformation of bridges ligaments, in which the grains fall out of the bunch tool. Because the strength of the retention of grains of a bunch of tools and probability of the appearance of the peaks of the grains above the level of the ligaments depends on the distance of the vertices of the grains to the level of the ligaments, the internal energy of material ligaments will depend on the distance of the level of bundles to the surface being processed in the course of processing. Thus, the power indicator depends on the conditions of processing, mainly on the characteristics of the instrument and to the specific force of clamping tool for logging.

The generalized energy-power parameters of the process of superfinishing applies the power of cutting and specific power of friction. To the cutting power will consider the part of the power spent on the implementation of the process of superfinishing, which is used in the unit of time for the formation of single slice, formed by the abrasive grains that are simultaneous in contact on a unit area of the surface treated. This value is also a medium-likely because depends on the medium-likely values of a lump of energy of single slice of medium-likely the number of active abrasive grains per unit of treated surface. If the unit power of cutting multiplied by the square of contact of the tool and the workpiece, you get a power cut.

Specific power of friction is the medium-probable portion of the power spent on the process of superfinishing, which is spent for friction chips and cuttings, located in the pores of the abrasive tool, with the unit of the processed surface of the workpiece. In our opinion, this is one of the most important energy parameters of the process of precisely defined. On the one hand, the higher the power rating of friction, the lower the coefficient of efficiency of process of the technological system and below the speed of removal of the allowance. But on the other hand, the higher the power rating of friction, the shallower the depth of implementation of abrasive grains on the surface of the workpiece and the less roughness of the processed surface. It is known that without the active clogging of the working surface of the abrasive tool in the final part of the operation, you cannot get the lowest values of a roughness of the machined surface, even a very fine-grained tool. Therefore, it is very important to maintain an effective balance between the specific power of cutting and a specific power of friction at the initial and final stages of the process of precisely defined.

The quality of the surface layer of the processed surface depends on the internal energy, which receives the processed surfaces in the process of plastic deformation. The value of the increment of this energy is determined by the normal force of cutting a single grain and depth of deformation, which corresponds to a lump-sum depth of the cut.

2. Conclusion.

The basis for constructing the energy model of the process of superfinishing put the following conditions:

1. The number of used energy parameters of the process of superfinishing should be enough to need the performance of the treatment process, such as performance, quality of processing, size of the allowance, etc. The most universal of such criteria are the one-time energy cut and specific power of superfinishing. The one-time energy cutoff, on the one hand, is determined by the area of single slice, and, consequently, the depth of the residual scratches on the surface of the workpiece and the roughness of the obtained surface. On the other hand, this criterion depends on the length of single slice, and, consequently, in conjunction with the depth of the

cuts he characterizes the intensity of the removal of the allowance. Usually increases with the speed of removal of the allowance surface roughness increases. But this is not always the case, as well as increasing the speed of cutting leads to an increase in lump-energy cutoff at a constant depth of the cut, and, therefore, you can find the conditions of increase of productivity of processing without the need to improve the roughness of the processed surface.

In contrast to the one-time energy cutoff power required for the handling, characterizes the net effect on the treated surface with all of abrasive grains, which are on the surface of the contact with the workpiece. On the one hand, it depends on a lump of energy of the stubble and, therefore, reflects and the roughness of the obtained surface of the workpiece and the removal rate of the allowance. But this option gives a very important additional information about the dynamics of the process, namely reflects the influence of the number of participating in the contact of abrasive grains and the actual contact area.

Thus, the analysis of only these two energy parameters allows to obtain sufficient information about the mechanism of the process of precisely defined, and therefore allows you to determine the rational conditions of the process and improve the process.

2. Energy criteria for the process of superfinishing should be universal and must ensure the possibility of comparison between the different methods and the conditions of its implementation. This provides an opportunity to not only rational build a particular process, by means of the optimization of the conditions of its implementation. But it gives the opportunity to effectively search for the most efficient directions of improvement of the process and allows you to create new ways of processing and design new technologies superfinishing processing. Such universal criteria again is a lump of energy of the stubble and consumed power. Whatever the scheme was not implemented process, always the one-time energy cutoff is determined by the one-time depth of cut and cutting speeds, and spent capacity depends on a lump of energy of the stubble and the number of active, involved in cutting in a unit of time.

3. The energy parameters of the process of superfinishing must be mathematically related to the main indicators of the process. Especially important to ensure the connection of these parameters with such important indicators as renting of metal in the process of processing and roughness of the processed surface.

Abrasive processing is characterized by the presence of many random factors that determine the process. These include a random shape and size of abrasive grains, the random nature of their location on the working surface of the tool, both at depth and along the working surface, the random character of an arrangement of bridges ligaments in the tool, random values of the parameters, characterizing the strength of the retention of grains in tandem, the random distribution of the volume of pores on the surface of the tool, random depth of cuts, a random number of grains, at the same time involved in cutting, etc. Therefore, deterministic models of the processes of abrasive processing, which offers most of the researchers, poorly reflect the real process in connection with that today, the necessity arose to develop a coherent theory of abrasive processing that takes into account the stochastic nature of this complex multifactor process.

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10/4/2013