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APPLICATION OF VIBROACOUSTIC SIGNALS IN PROCESSING COMPLEX SURFACES OF TITANIUM ALLOYS

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Annotation

This article provides information on the study of finger milling methods for hard-working titanium alloys.

Keywords: titanium, nickel, chemical, hydrogen, carbon, sulfur, allotropic, alloy, Lubrication-cooling, milling, cutting.

Annotasiya

Ushbu maqolada qiyin ishlov beriladigan titan qotishmalariga barmoq frezada ishlov berish usullarini o‘rganishni haqida ma’lumotlar keltirilgan.

Tayanch iboralar: titan, nikel, kimyoviy, vodorod, uglerod, oltingugurt, allotropik, qotishma, Moylash-sovitish, frezalash, kesish.

Аннотасия

В данной статье представлена информация по изучению методов пальчикового фрезерования труднообрабатываемых титановых сплавов.

Ключевой слова: титановые, никелевые, химические, водородные, углеродные, серные, аллотропные, сплавные, смазочно-охлаждающие, фрезерные, режущие.

Introduction

Mechanical engineering technology development functional being released of the product quality and reliability increase big requirements puts. Researchers research that shows that the car details eng important exploitation characteristics - this resolution accuracy, residue durability, edible durability, contact virginity, transplantation stability and a series indicator - details known level surface layers’ quality with determined.

High robustness has which was materials alloys physico-mechanical properties and structure to himself specific properties a lot cases other constructive materials designed processing give standards in use difficulties t he seeks. Fingerprinted titanium alloys in milling surface layer quality technological factors effect about information oz as , other kind of processing in giving obtained from the data difference does and often to them zid is coming.

High robustness has which was materials alloys tay yo rlangan this kind of details nomenclature (body, bracket, monorels, spangouts and b) broad to be despite milling _ on the bench edge milling cutters using processing given detail curves linear surfaces tarang condition research not done. Aviation and in instrumentation milling benches exploit ink in doing detail weight relief for milling often closing operation become calculated his all surfaces (only execution yo ki basic , but not free surfaces) _ processing give to the goal appropriate. Therefore for detail construction and function according to milled surfaces quality his functional remove and exploitation to do while u yo ki this requirements put possible.

Take it visited research result that kursatadiki high robustness has which was materials finger freza using processing in giving acceptable cutting rhythms in the selection high robustness has which was materials processing give jara yo nida his technological route changes if entered , ie cutting rhythms modern , efficient methods using processing give more improvement [1].

The positive combination of titanium-based alloys, one of the most difficult-to-process materials, has ensured their widespread use in aerospace, shipbuilding and instrumentation, chemical engineering, and a number of industries. Alloys of difficult-to-work materials are superior to alloys of aluminum, nickel and iron in terms of relative strength. The plastic properties of titanium alloys are lower than those of iron and nickel-based alloys. Compared to these materials, titanium alloys have a much lower modulus of elasticity, which is prone to elastic deformation during cutting. Titanium alloys have a heat resistance of 500-600 ° C and corrosion resistance to many harmful environments. [2]

Figure 1: Finger milling on hard-to-handle materials milling using.

Titanium and its alloys are not resistant to friction and abrasion, one of the specific functional properties of which occurs during the cutting process is the tendency to contact adhesion (cold welding). A characteristic feature of the physical properties of titanium is that it has 4 times less electrical and thermal conductivity than nickel, 5 times less than iron and 24 times less than aluminum. In turn, titanium alloys have an average thermal conductivity of 2 times lower than technical titanium. Titanium is located between aluminum and iron in terms of specific heat capacity. [3]

The most important influence on the properties and condition of titanium alloys is carried out by the compounds and alloying elements. The chemical composition of titanium-based alloys can be expressed as follows: secondary Ti-Al (VT5), tertiary Ti-Al-Cr (VT3), Ti-Al-Mo (VT8), Ti-Al-V (VT6), quaternary Ti- Al-Cr-Mo (VTZ-1, VT15) and other complex systems.

Another unique property of titanium is its high chemical activity. At high temperatures, titanium alloys are strongly bound to hydrogen (300 ° C), oxygen (500 ° C), nitrogen (600 ° C), as well as halides, carbon, sulfur, and other elements present in the air and in the process environment. As a result, the mechanical properties of titanium deteriorate: hardness increases significantly, plasticity decreases, resulting in increased brittleness of the metal; elongation stress is formed in the surface layer. As a result, the strength and fatigue properties of titanium alloys are reduced. [2]

Nitrogen and oxygen mixed with the surface layers of titanium alloys cause a phase-structural change consisting of the formation of the α-structure. The alpha surface layer is characterized by high hardness and abrasive properties. Its presence in semi-finished products such as rods, forks, stamps makes it much more difficult to work with cutting tools.

Sweating and brittleness are also observed in the surface layers when cutting titanium alloys by the cutting method.

Titanium has polymorphic properties and has two different allotropic appearances. The low-temperature appearance (a - titanium) is formed at temperatures below 882.5 ° C and is characterized by a dense hexagonal crystal lattice. The high-temperature appearance (b - titanium) is stable at temperatures above 882.5 ° C and has a cubic-shaped, volume-centered crystal lattice structure. Titanium alloys have a structure corresponding to the allotropic appearance of titanium. [4]

The following structural groups of titanium alloys can be obtained by alloying:

1. a -alloys;
2. beta-alloys;
3. a + b -alloys;
4. b -alloys.

titanium alloys often depend on the phase state rather than the chemical state. Therefore, the structure of titanium alloys has a significant impact on their cutting and processing.

An important operational characteristic of titanium alloys is the fatigue of its low strength. Their tolerance limit averages 0.58 of the strength limit, which is half that of s $_{v\ \text{in steels.}}$ However, the durability of titanium alloys depends significantly on the quality of the metal surface layer. In many literatures it is shown that the fatigue limit of titanium alloys depends on the value and depth of distribution of the technological residual stress, the sign. It has also been suggested that the fatigue strength of the residual stress is comparable to the micro-geometry of the surface after treatment. [2]

When cutting titanium alloys, it is characterized by the formation of flakes in the form of novs (Fig. 3).

Figure 3: Detail separation process during machining.

However, the microphotographic analysis of the base of the scrap of titanium alloys a and a + b shows that the scrap has a simple structure and consists of slightly undeformed elements consisting of thin and hard deformed surface layers [3]. When cutting B alloys, the layer being cut consists of grains that have undergone rigid deformation and do not have a rigid structure. Sharp type - novsimon.

VAS activity should take into account the continuous nature of most mechanical processing operations VAS of materials. Therefore, special attention should be paid to the correct selection of the signal attenuation limit "because it can change several times even with a small change in the amplitude of the small value of VAS activity" explained by the specificity of ziga. In practice, the discrimination limit should only allow the recording of individual changes in the signal, i.e., close to the amplitude of the maximum signal.

In this case, the individual signal diagrams, which are approximately proportional to these cutting speed conditions responsible for increasing the VAS activity compared to the signal amplitude, are explained by the following frequency increase and are one of the strongest VAS sources in the cut-off zone. (Figure 4).

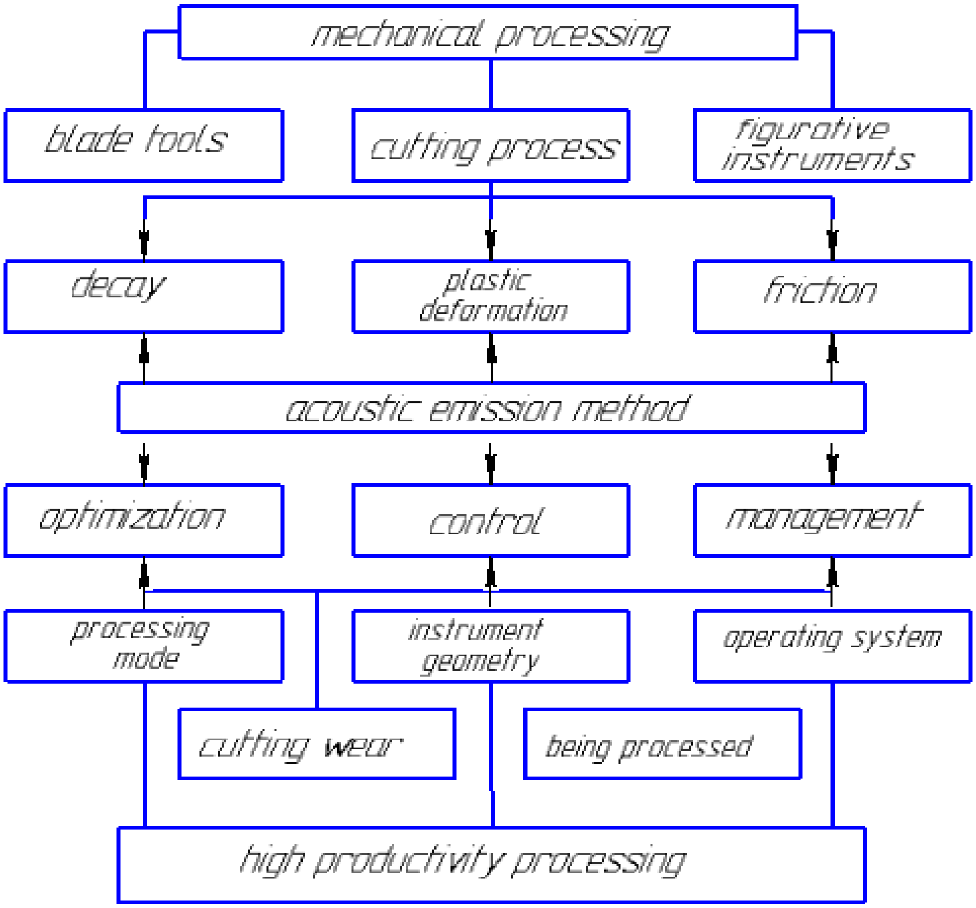

Figure 4. As shown in the diagram , mechanical processing using acoustic emission (VAS).

From the VAS method structural diagram of use in the processing of changes in cutting conditions. Because VAS is produced by basic physical processing processes, experiments have shown that any change in their energy capacity leads to a change in acoustic radiation parameters.

The main treatment factors diagnosed with this method are: chip formation and collapse. The onset of chip crushing is usually accompanied by a characteristic increase in signal

VAS, which can be used to control vibration sharpening, drilling, especially the recording process; sharpening geometry and brand of tool materials, as well as the effect of wear-resistant coating; rigidity of process system elements; the effect of physical and mechanical properties of materials on processing; the type of technological environment used, its concentration; surface quality and the presence of a recyclable structure material; knife and abrasive tool wear; surface depth and pre-processing methods. Thus, the VAS method allows the identification of all important processing properties and, especially valuable ones, to determine their interactions. This predetermines the possibility of using VAS signals to control the intersection. A block diagram of the application of the VAS method in machining operations is shown.

In the technological system, the workpiece during machining of the machine tool generates high-frequency elastic waves, and at the same time their parameters and appearance are manifested in the stresses that occur when the dynamic local processing. Their main source is the cutting zone, where plastic deformation and destruction of recycled material occur and cracking of friction bonds on the contact surfaces of the tool. These processes inevitably result in the discharge of a rigid body, such as a cutter, with varying degrees of permanent and temporary localization, and the technological waves of forces propagating in an elastic medium (i.e. across the elements of the technological system carries certain information).

Note that if low-frequency oscillations are caused by the unevenness of the machining process and are caused by many external factors, primarily due to the stiffness and inertial properties of the technological system elements, then VAS waves during cutting is formed as a result of dominant physical processes (friction, plastic is deformed). This is their parameter by analyzing the dependence of the apparatus on the processing conditions for technological cutting diagnostics namayon will be .

For example, the modification, processing, and recording of received power waves is called the vibro acoustic method. VAS sources can be conditionally divided into external and internal components. The first includes sources located on the surface of an object, such as friction, collisions, or voltage waves generated by the turbulent flow of a liquid or gas. creates certain advantages. These dynamic processes are related to the redistribution of mechanical stress fields in the main part of the material to the internal sources of the VAS (e.g., plastic deformation, micro and macrofractionation, phase transformations). From these positions, it can be concluded that there are a number of VAS sources in the sound output zone, and in the case of voltage waves of different power and spectral density.

It should be noted that the degree of correlation between different VAS parameters and the cut characteristics studied can vary within very wide limits. However, these sound output conditions, if any, are recorded very reliably because the parameters are usually interrelated. Therefore, when conducting experiments, it is advisable to record several parameters of the VAS, such as amplitude (energy characteristic) and activity (spectral characteristic).

Experiments have shown that the construction of the dependence of VAS parameters on the cutting conditions includes not only VAS parameters, but also their combination, for example, the technological characteristics of the signal output:

$$W_m = A^2 N_S / (P_z v_{rez}),$$

Here: $A^2 N_S$ acoustic signal propagation; A-signal amplitude VAS ; N_S -thermodynamic signal VAS, $P_z v_{rez}$ - shear force. Good results are obtained by acoustic signals during processing.

$$W_I = AN_S / v_{rez.}$$

Physically, when we look at it, it is the pulse of elastic waves that are simultaneously generated in the exit zone of the sound during processing. Most acoustic measurements are comparative in nature, so the graphical parameters of the VAS or technological criteria expressed by formulas (1) "(2) are usually expressed in relative or conditional units, such as the millimeter of the tip of a pen. Sometimes the VAS parameters lead to the input of the sensor; for this, the electrical signal received from the recording equipment is divided by the total gain factor of the measuring instruments.

Cutting Mode Settings

The cutting speed determines the formation of the metal surface layer by influencing the intensity and strength of the plastic deformation of the metal, the duration of contact between the cutting tool and the part, the amount of load and friction coefficient on the tool body surface (Figure 4). [5]

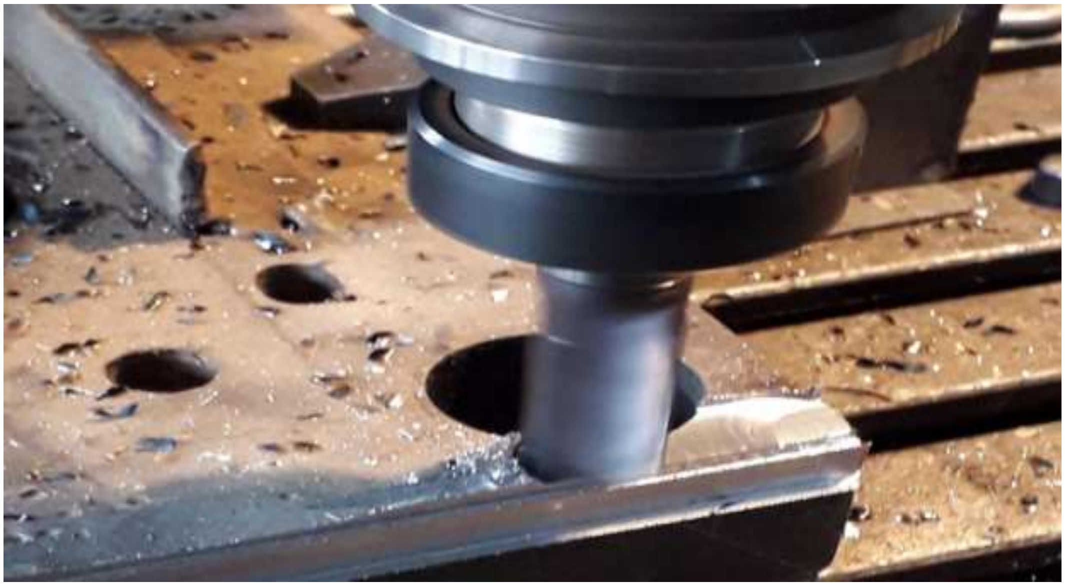

Figure 4. The process of processing with the help of finger milling

There is not much information about the effect of cutting speed on the quality of the surface layer when milling hard-working materials, moreover, they are mutually exclusive.

According to the source, the cutting speed in the range of 15 to 47 m / min does not affect the surface roughness when sharpening hard-working materials.

The same conclusion can be drawn from the data obtained in the end milling of materials that are difficult to work with lubricants. At the same time, it is said that an increase in the cutting speed of structural steels in finger milling leads to an increase in the roughness, as well as a decrease in roughness. [6]

When milling hard-working materials 14x17N2, 12x18N9, 12x18N10T, 08x18N10T, an increase in the density of the surface layer was observed with increasing cutting speed.

14 x17N2 alloy, it is shown that the density of the surface layer has a variable dependence on the cutting speed.

Conclusion

1. This can increase the productivity and reduce the cost of cutting hard-working alloys.
2. Given the problems in cutting hard-to-work alloys, the following research is considered necessary.
3. Theoretical study of complex stress states in high-speed machining of difficult-to-work alloys.
4. The effect of the angle of deflection of the cutting edge on the residual stresses is related to the components of the shear forces acting on the shear and the surface layers of the metal.

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