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ANALYSIS OF RESEARCH ON THE TREATMENT OF DETAILS ON THE INNER CYLINDRICAL SURFACE LAYER

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ABSTRACT

In this article, the most optimal conditions for the formation of the surface of a cylindrical part processed on automated technological equipment under the influence of aerodynamic motion are determined, the relationship between the physical and mechanical properties of the workpiece and the output characteristics is investigated.

Keywords: *separately-hardening processes, internal surface layers of cylindrical parts, physical and mechanical properties, workpiece.*

АНАЛИЗ ИССЛЕДОВАНИЙ ПО ОБРАБОТКЕ ДЕТАЛЕЙ НА ВНУТРЕННЕМ ЦИЛИНДРИЧЕСКОМ ПОВЕРХНОСТНОМ СЛОЕ

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АННОТАЦИЯ

В данной статье определяются наиболее оптимальные условия процесса формирования поверхности цилиндрической детали, обрабатываемой на автоматизированном технологическом оборудовании под действием аэродинамического движения, исследуется связь между физико-механическими свойствами заготовки и выходными характеристиками.

Ключевые слова*: отдельно-упрочняющие процессы, внутренные поверхностные слои цилиндрических деталей, физико-механические свойства, заготовка.*

INTRODUCTION

Theoretical research in the process of plastic deformation of the surface is carried out on the basis of analysis of the mathematical model of the contact zone, geometric parameters of the contact zone and the state of tension, technical parameters. Compared with the difficulties identified in these studies, the formation of complex cross-linked processes in the processing of parts, zone deformation, hardness and plasticity properties of deformed metal, friction and thermal processes, and so on. In general, the roughness of the processed surface depends on the size and sign of the residual stress in the technological mode of deformation, its strength stage, deformation force and transmission, roughness of the initial product, physical and mechanical properties of the finished material, type of equipment used and its design parameters. It has been found that the rate of deformation at sufficiently wide limits has little effect on the quality of the surface layer. This is considered to lead to increased processing productivity.

DISCUSSION AND RESULTS

The effect of the strength of the deformed elements on the machined surface affects the quality parameters of the detail. Determining the functional relationship between forces is one of the main research tasks in the field of processing the quality of the given equipment and detail parameters. A number of analytical dependencies are recommended by the authors in the calculation of the deformed force. This, in turn, leads to the formation of complex physicochemical processes in the contact area that cannot be accurately evaluated when dealing with deformation balls. As a result, information is now collected based on expanded facts, and rational modes of processing that provide quality and efficiency are selected.

$p = P_H/F_K$; (1.1)

$P_H \approx \pi \cdot (R_\omega \cdot sin\alpha)^2$; (1.2)

$$F_K = \frac{8}{3} \cdot \sqrt{\frac{P_q \cdot R_p \cdot R}{R_q \pm R_p}} \cdot [\sqrt{(h+W) \cdot W} + W + \frac{1}{4} \cdot \sqrt{W \cdot h}], \quad (1.3)$$

here:

α-introduced angle of the deformed element; FK-contact surface area; radius of the R-ball profile; Rq-detail radius; Rsharik radius, W-local reinforcement deformation; h-compression dimension; The size of the R-sphere.

Experiments show that the optimal signs of a are found in the range of 5o to 7o. The complexity of the contact function for the introduction of deformed elements at small angles is that it is possible to measure the plastic sizes and strength of deformations and to decide on the complex application of the rules of plasticity, strength. Therefore, the problem of plastic strength of the deformed metal must be solved.

Plastic deformation is defined by the Hertz equation of a body when a force is applied to the flat surface of a spherically deformed element R between the radii of the contact area by determining the introduction of the exact angle at the contact.

$$r = \left(\frac{3}{4} \cdot P \cdot R \cdot \theta\right)^{\frac{2}{3}}, \quad (1.4)$$

here: $\theta = 1 - v12 - 1 - v22$ -

the Poisson's ratio of the deformed element and the elasticity of the module. Given that the magnitude of the average pressure is q = P / p · r2, the following setting can be made to introduce the phase of deformation into a steel sphere between these parameters. The relationship between the trace of the diameter d of the ball and the load R is introduced in the elastic and plastic fields is described in the Mayer equation:

$P = a \cdot d^n$ (1.6)

here: a end n- elasticity constant

The above formulas are subject to the isotropic state according to Guck's law of the body in contact under deformation conditions without regard to friction. In this case, the contact area is small and the load is perpendicular to the machined surface.

In static compression of a deformed element, the force and the state of movement of the deformation binder along the surface of the part are determined by VM Braslavsky. The work shows that the width and curvature of the intersection generated by the movement of the equipment correspond in practice to the width and curvature of the restored track. Hardening the detail with a ball looks like this:

$$P = 1.475HB^{1.1} \cdot \frac{b}{a}\left(\frac{1}{r} + \frac{1}{R} + \frac{b}{a}\left(\frac{2}{D_p} + \frac{2}{D_d}\right)\right)^{0.3} \cdot \mu^{2.3} \cdot \sin^{2.3}\varphi_a \quad (1.7)$$

where: diameter and radius of the Dp-ball profile; Dd, diameter and radius of curvature formed by R-detail; the angle of the ball introduced in the ph-plane transmission;

b and a are the size of the contact spot. The amount of angle introduced for hardness steel on the Brinelli NV 140 scale is 2o301, while for superhard steel the gradual introduced angle magnification is NV daph = 3o.

Attempts have been made by some authors to improve the dependence of force detection on the basis of a contact task. A.M. Pronin uses the Meyer index in the quality characteristics of the elasticity of the metal, taking into account the specific nature of the deformation in the contact zone associated with the movement of the device. However, studies have shown that the Meyer index varies based on load dependence.

In-depth research has been carried out by V.M.Torbilo and A.S.Donsky in this direction. It uses a complex system of equality methods based on successive approximations.

Therefore, in scientific works, the method of calculating the amount of metal in HV hardness is considered. In this case, when the surface is treated with PPD, the deformation force with quality parameters is realized in two ways. In the first case, the calculated amount of the depth formula is assumed, the relative magnitude determines the elasticity phase and the reduction of the roughness. The second way involves the connection between roughness and strength in surface treatment with PPD.

In some scientific studies, the mode of plastic deformation is considered on the basis of dimensionlessness of pressure

$$q = \frac{P}{F \cdot HV} \quad (1.8)$$

where: F-contact spot area, hardness according to HV-Vikers. In addition, the V parameters of the PPD mode are used in this research

$$B = q \cdot N^m \quad (1.9)$$

In determining the height of micro-roughness, a number of dependencies were obtained by the authors: transmission size, radius of the ball, height of the initial roughness, specific pressure to determine the elastic deformation. For example, the following relationship was proposed by D.D. Papshev to determine the height of micronotextures:

$$Rz = 8s \cdot \underline{0}2R \cdot (1 - k\underline{\quad} - k1) \cdot k\xi \cdot kp \quad (1.20)$$

where: k is the coefficient characterizing the increase in the radius of the material; kx is the coefficient taking into account the plastic properties of the material; coefficient taking into account the pressure in the contact area.

The formula proposed by VI Menshikov takes into account the physicochemical properties of the processed material and the initial height of the irregularities:

$$R_z = R_{z0}\left(1 - K_c \cdot K_m \cdot lg \frac{p}{\beta \cdot F}\right) \quad (1.21)$$

where: RZO- initial height of unevenness; KM - coefficient taking into account the physical and mechanical properties of the processed material; b-coefficient of dependence on the material to be processed; The contact area determined by the following formula:

$$F = 2.7 \cdot \sqrt{\frac{R_d \cdot R_{np} \cdot R}{R_d + R}} \cdot \left(\Delta h + \varepsilon + \sqrt{(\Delta h + \varepsilon) \cdot \varepsilon}\right) \quad (1.22)$$

where: Rd is the radius of the workpiece; Rpr-ball profile profile radius; measurement of e-elastic deformation; Complete deformation in the Dh-contact zone.

In the calculation formula proposed by VM Braslavsky, the magnitude of Rz is related to the magnitude of the transmission and the curvature of the deformed element:

$$R_z = R_{np} - \frac{\sqrt{4 \cdot R_{np}^2 - S_0^2}}{2} \quad (1.23)$$

where: Rz is the height of the irregularities at 10 points; The radius of curvature of rprprofil; So-signal.

A complex connection has been established by Ya.I.Barats:

$$R_z = R_{z0} \cdot (1 - K_c \cdot (104 - \sigma_t)) \cdot lg\, {}^{P}{}_{\lambda} \quad (1.24)$$

where: the initial height of the Rzo- inequalities; Ks-coefficient depending on the processing method, l-coefficient depending on the nature of the stress distribution in the deformation furnace, sT-yield limit, R-load.

There are several calculations to calculate the boundary depth of plastic deformation. The connection between S.G.

$$t = \sqrt{\frac{P}{2 \cdot \sigma_s}} \quad (1.25)$$

where: R-power; sS is the readability limit of the processed material.

The elliptical contact surface in this case is approximated in the form of a circle.

D.D.Papshev showed that the thickness of the reinforcement layer depends on the contact area of the deformed element with the workpiece.

$$\Delta = \frac{1}{\omega} \cdot \sqrt{F_k} \quad (1.26)$$

where: k is the coefficient depending on the material and size of the detail; Fkkontakt area, thickness of D-reinforced layer.

To determine the thickness of the compacted layer, the following correlation was proposed by IV Kudravtsev: ,

$$\omega = 1 + 0.07 \cdot 2 \cdot Rnp \qquad h = \frac{1}{\omega} \cdot \sqrt{\frac{P}{\sigma_s}} \quad (1,27)$$

where: ō-coefficient taking into account the impact on the details and dimensions of the equipment; R-power; sS-readability limit of the processed material; The curves of the radius given at the rpr-contact site. In the research of VM Yaroslavtsev the following formula is given:

$$h_y \geq \frac{23.6 \cdot \sigma_t \cdot R_p}{E}. \quad Rp = \frac{R_1 \cdot R_2}{R1 + R2} \quad (1.28)$$

where: R1, R2- radii of connected cylinders; st-readability limit of the processed material; E-elastic modulus; the thickness of the hypuxed layer.Thus, the analysis of sources showed that the quality indicators of the processed surface, deformation strength and transmission are sufficiently different dependencies, as well as roughness, profile radius, plastic properties of the material, geometric parameters depending on the contact area. The variety of formulas proposed by different authors allows for the understanding and in-depth analysis of PPD processing in the physical process. However, the above dependencies reflect the specific properties of the processes seen and include the experimental coefficients and are determined by the change in the deformation condition. In addition, the deformation force is used as the balloon deformation elements in the methods seen. Theoretical research is examined and the processes in the experimental study of stand equipment and instruments are clarified, key indicators are recorded using profilometers in laboratory and production conditions, as well as applied directly from the geometric dimensions of the contact zone using other modern methods and equipment microscopes. At the same time, experimental research is carried out using their optimal planning methods and the organization of modern statistical methods of processing the results of measurements.

Today, such an experimental method is the main task in optimizing the parameters of the plastic deformation process and the design of equipment.

CONCLUSION

In this work, the methods of finishing and strengthening of plastic deformation of the inner surface layer of cylindrical parts were studied and analyzed. As a result of the analysis, a spherical center escape rocket design was designed.

Based on the research, the following conclusions were drawn:

1. Several processing schemes of the centrifugal raskatnik have been designed.
2. A schematic diagram of the centrifugal raskatnik has been developed.
3. During the processing, the forces acting on the ball were identified.
4. The geometric parameters of the contact zone for the deformed elements were determined.
5. In aerodynamically moving devices, the dependence of the state of voltage on the contact formed at the junction of the sphere with the cylindrical surface is determined.
6. A fundamentally new design of a ball head operating in aerodynamic motion has been developed

7. Theoretical research on the state of stress in the contact zone and the effect of deformation force on geometric parameters.

8. The design method of the tool for finishing and strengthening of details on an inner cylindrical surface layer is developed.

9. The rules of finishing and strengthening of details on the inner cylindrical surface layer are determined

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