A Method of Calculating the Depth of Cut in A Lathe After Rolling on A Rough Part.

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ABSTRACT

In this work, considering the treatment of the cutting tool as another manifestation of the process of decay in hard polymeric materials, a new solution to the problem of improving the quality of the machined surface by the method of initial rolling of the rough part on the basis of the thermofluctuation theory of decay is shown. the polymer sketch detail to be machined is first processed by the initial rolling method

Keywords: Cutter, scraper, tumor, bench, press, deformation, casting, deformation, polymer, fluoroplastic, composite, rhythm.

Due to the external deformation, such a change occurs in the structure of the material: part of the chemical bonds is broken, part is strengthened. This leads to a decrease in the activation energy of the polymer bonds, and the interaction of the material surface layer with the cutting tool leads to a decrease in shear strength, as the deformation process of the cut layer is facilitated by the formation of a decay zone before. The size of the microcracks and the plastic deformation zone decreases at the cutting edge of the material in front of the cutting plate, the main (main) crack has a stable direction of development along the cutting line, which is a condition for increasing surface quality. the probability of formation is reduced.

The quality of the machined surface is affected by the machining modes: the average pressure at the joint ρ; contact area F_k; the magnitude of the force acting on the workpiece by the tool P_H; the dimensions of the deforming tool, the longitudinal thrust S and the rolling speed V. The rolling modes are determined according to the detail requirements. However, technological maps should show such work that can be easily controlled during processing.

Rolling rhythms are determined according to the requirements for detail. In this case, the technological maps should show the control of the processing process. These include, above all, the dimensions of the normative force, the transmission and the deformation device.

The forces acting on a rough detail by rolling and grinding.

External forces acting on deformation are divided into active, antifaal and friction forces [6,9,10]. The friction force can be active in some cases (e.g. rolling), in other cases it can be a repulsive force (e.g. in sinking). In machining for straightening, the active forces are generated by the rotation of the parts (machining on a lathe) by the movement of the part along the table or by the rotation of the rolling head. Thus, the active forces in alignment are the effort forces. In such cases, the pressure field remains unchanged during the deformation process. The reactive forces will be directed perpendicular to the working surface of the instrument.

The processes occurring in the deformation furnace are determined by the nature of the distribution and magnitude of the normative and tensile forces. Because the rolling smoothing process is carried out at friction and vibration rhythms, the normative stresses have a basic amount. The magnitude of the force that provides the required voltage at the deformation furnace depends on its magnitude and the size of the connection area. In longitudinal transmission wheel machining, the equal effect of all forces is divided into three influences (on the three spatial coordinate axes): normative, tensile, and transmission forces.

The main force that creates the required pressure at the joint of the deformable tool and the part is the normative force P_H. The main movement is the power consumption and the strength of some parts of the machine is calculated from the magnitude of the experimental force P_T. The force required for transmission and the endurance of the transmission mechanism is determined by the bullet force P_0.

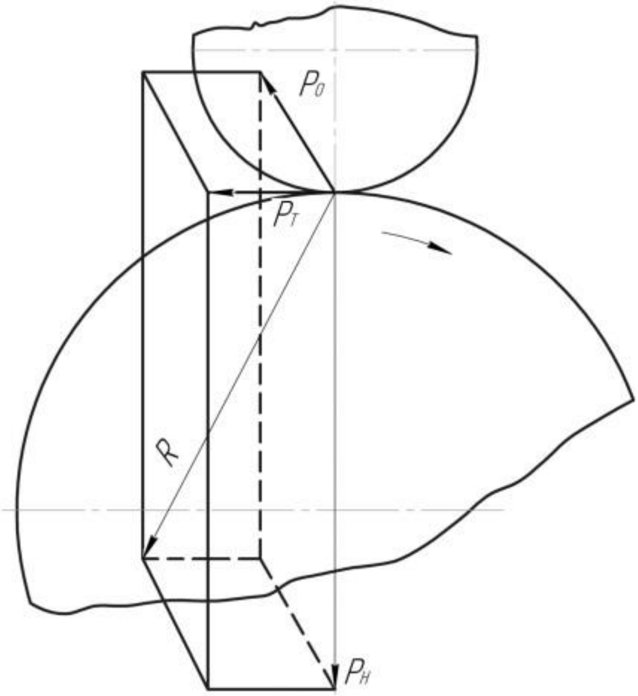

Figure 1. Scheme of forces acting on rolling.

Equally effective force

$$P=\sqrt{P_H^2+P_T^2+P_0^2} \quad (1).$$

An average of ten times smaller than the normative force was found in practical experiments. The change in transmission is weakly reflected in the ratio of these forces.

Based on applied research [6], the following ratios of forces acting in the processing of semi-finished products are obtained:

$\frac{P_T}{P_n}$=0,07÷0,12; $\frac{P_0}{P_H}$=0,05÷0,1; (2)

We express the equal acting force by P_H, then

$P=\sqrt{P_n^2+[(0{,}07\div0{,}12)P_H]^2+[(0{,}05\div0{,}1)P_n]^2}$=(1,004÷1,012) P_n (3)

It can be seen that the magnitude of the equal impact force differs by only 1.2% from the magnitude of the normative force.

Methods of calculating the normative force.

Let us consider an approximate method of taking into account the normative force that determines the magnitude of the defined stress in the deformation furnace. On the surface where the part is connected to the sphere, we separate the element area dF (Figure 2), the area is located at an angle P_H directed to φ. The normal voltage σ applies to this platform.

Thus, $P_H=\int_F^{\sigma} cos\phi dF$. (4)

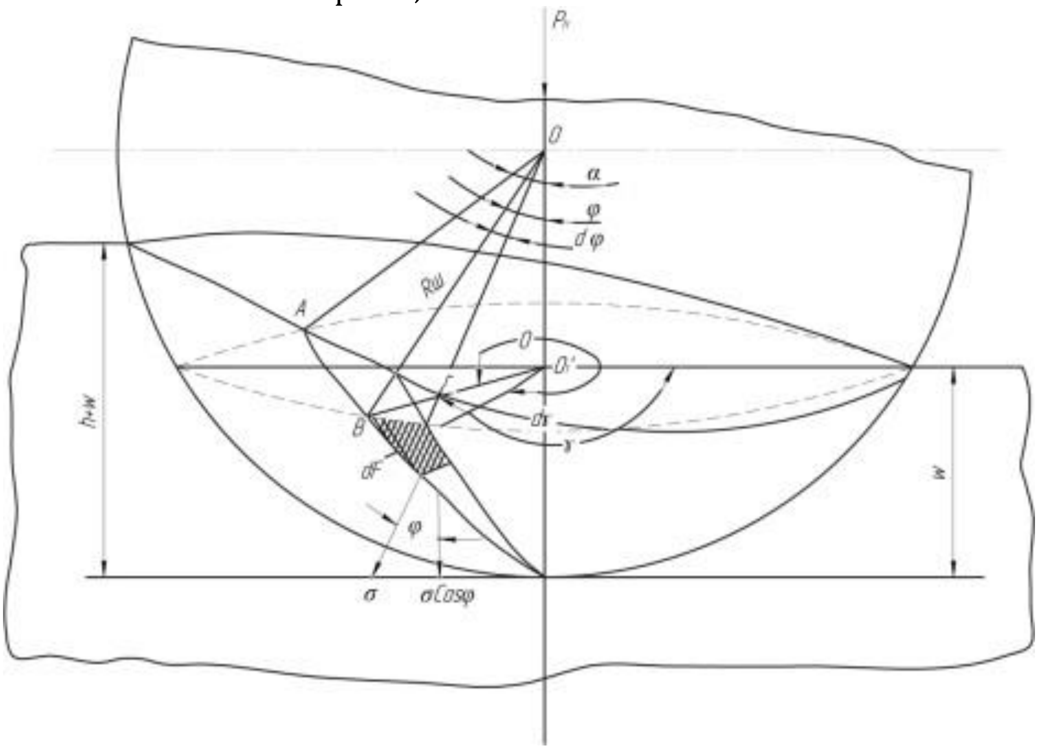

Figure 2. Determination of normative force magnitude: h -residual deformation; ω -elastic, tensile deformation.

We can obtain this expression in accordance with Figure 2

$dF=R_{sh}d\varphi rd\gamma$,

where r is the elementary field distance from the axis of the sphere.

So (given the formulas) and finally we can write

$P_H=R_{sh}^2\int_0^{sh=2\pi}\int_0^{\alpha}\sigma sin\varphi cos\varphi d\varphi d\gamma$. (5)

A complex volume-stress state occurs at the deformation furnace. In this case, the law of voltage distribution on the contact surface is unknown. The magnitude of the pressing angle α varies with the magnification of the angle γ, as the exit point from the contact of the tool with the detail assumes a different position. For example, only the elastic deformation occurs outside the center line of the sphere, and the angle a is the smallest. The specified instruments exclude the possibility of calculating integrals (2.6).

However, if, instead of the actual stresses, we take the average amount $\sigma_{o'r}$ on the surface of their connection and calculate a as the average amount of the pressure angle α, then expression (6) takes the following form:

$P_H \cong \sigma_{o'r}R_{sh}^2\int_0^{2\pi}\int_0^{\alpha}\sigma sin\varphi cos\varphi d\varphi d\gamma$ (6)

According to the internal integral formula (6):

$$\int_0^{\alpha} sin\varphi cos\varphi d\varphi = \frac{1}{4}\int_0^{\alpha} sin2\varphi d(2\varphi) = \frac{1}{4}(1-cos2\alpha)$$

Substituting the internal integral quantity (value) into expression (6),

$$P_H \cong \frac{1}{4}\sigma_{o'r}R_{sh}^2(1-cos2\alpha)\int_0^{2\pi} d\gamma = \frac{1}{2}\pi R_{sh}^2\sigma_{o'r}(1-cos2\alpha)$$

Substituting $(1-cos2\alpha)$ for $2sin^2\alpha$ and substituting $\sigma_{o'r}$ for the mean pressure P at the junction, we write

$P_H \cong \pi p(R_{sh}sin\alpha)^2$ (7)

Expression (7) allows to determine the magnitude of (P), depending on the size of the deforming bubble at the recommended mean pressure P_H. To do this, it is necessary to determine the average value of the angle α by prior experiment. The latter depends on the mechanical properties of the material and the dimensions of the raw material being processed. Based on the assumptions assumed, it should be borne in mind that expression (7) is approximate. However, when angle α is chosen correctly, expression (7) can provide satisfactory results for technical calculations.

For example, it has been determined in practical experiments that the magnitude of the angle α is in the range of 5 ° -7 ° when leveling the outer cylindrical surfaces of metal sketch parts with optimal modes to strengthen the finish. These data were obtained by rolling 10 mm balls.

It should be borne in mind that the angle α is determined by taking into account the elastic deformation of the material of the part. In this case, the compression angle is only 3 ° -5 ° from the elastic deformation. The value included in formula (7) depends on the contact area of the P detail material and the magnitude of the force acting on the wheel.

Calculation of the cutting depth taking into account the elastic end effect.

Based on the implementation of the above instructions, the depth of distribution of deformation and the phenomenon of elastic restoration of the outer surface of the material to ensure the high quality of lathe processing of the sketch detail of polymer materials after the rolling process.

Cutting depth

$t_p \geq h_g$ (8)

Assume that h_g-is the depth of propagation of the deformation.

Taking into account the elastic end effect, the parameter t_p has to be calculated in a complex form

$t_p \geq h_g - \delta$ (9)

where δ is the magnitude of the elastic regeneration of the deformed layer.

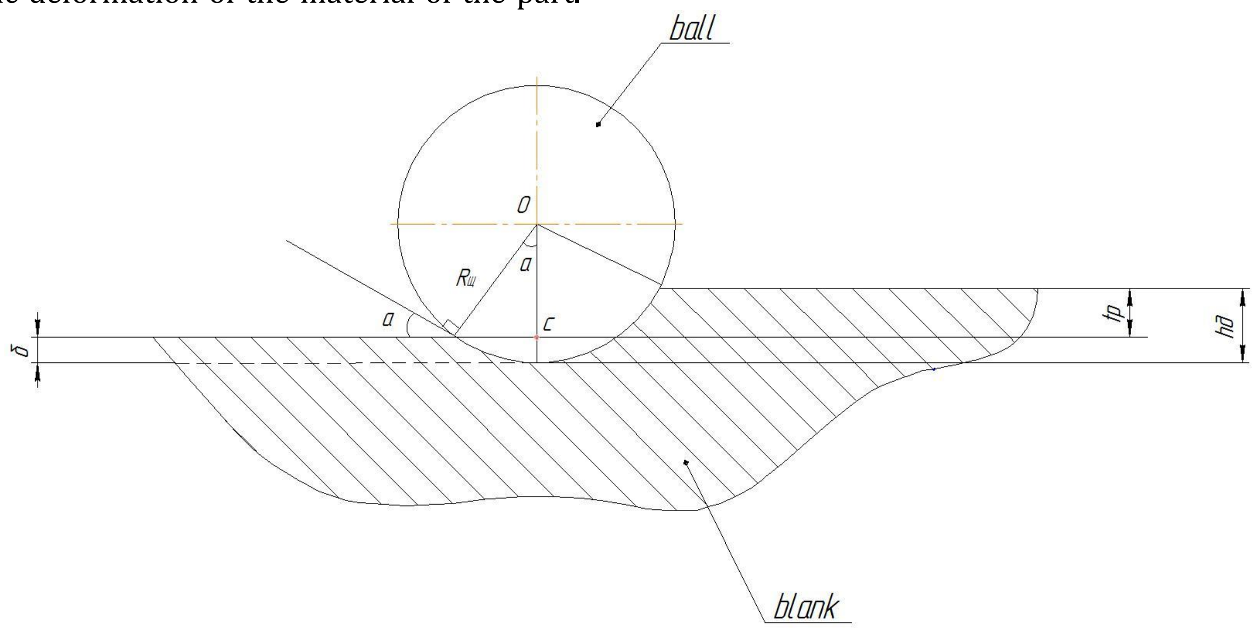

Figure 3. Determining the magnitude of the elastic recovery of the deformed layer: h_g-depth of the deformed distribution; elastic regeneration of the δ -deformed layer.

The magnitude of the elastic recovery δ can be found using the calculation scheme, Figure 3

δ=R_{sh}→OC, OC=R_{sh}·sin(90-α) and we can decisively:

δ=R_{sh}·(sin (90- α)) (10)

We determine the depth of deformation by the following formula:

$h_d=2h_{st}\cdot\sqrt{1+f^2}$ (11)

$h_{st}=\sqrt{\frac{P_n}{2\cdot\sigma}}$ (12)

Then (9) will look like this:

$t_p \geq 2\cdot\sqrt{\frac{P_n}{2\cdot\sigma}}\cdot\sqrt{1+f^2}-R_{sh}\cdot(1-$ син$(90-\alpha))$ (13)

We use expression (7) to calculate the normative force that determines the magnitude of a given stress in a deformation furnace.

For P_n, put from the expression (7) to (13) and cut

$t_p \geq R_{sh}\cdot\left(\sqrt{\frac{2\cdot\pi\cdot sin^2\alpha\cdot(1+f^2)}{\sigma}}+\right.$ син$\left.(90-\alpha)-1\right)$ (14) we get.

Thus, the expression (14) is formed, according to which, taking into account the deformation stress of the surface layer of the sketch detail and the magnitude of the elastic recovery of the sketch material, an important indicator of the cut is the depth of cut.

Conclusions.

1. Based on the analysis of the mechanism of thermofluction decomposition of materials, it is proved and practically approved that it is expedient to apply the initial rolling treatment of polymeric materials to reduce the surface strength in the subsequent turning of rough parts. It has been proven and practically proven to improve the quality of the next lathe operation by reducing the energy of activation of the process of breaking the bonds in the material and on this basis.
2. On the basis of theoretical and practical studies, taking into account the fact of elastic recovery after cessation of the loading effect of polymeric materials, a correlation was established between the cutting depth of the sketch detail and the processing stress.

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