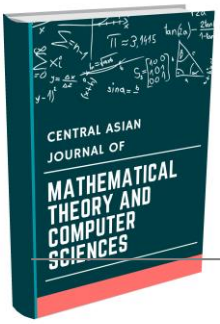

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DETERMINATION OF CRITICAL PRESSURE OF COMPRESSION SHAFTS OF MECHANICAL PROCESSING SHAFT TECHNOLOGICAL MACHINE FOR TRANSVERSE SEMI-PRODUCT

Artikova Baktigul Mirzarakhimovna, Ibrahimov Shehroz Abdurakhmonovich, Temirov Javokhir Tokhirjan o'g'li

Tashkent State transport University

shexrozibrahimov@gmail.com

Abstract

Roller machines are widely used in many industries. The main working bodies of roller machines are working shaft pairs. Val pairs and the material being processed together form a two-Val module [1-5].

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In dual-valve modules, technological processes are carried out as a result of the interaction of shafts with the material being processed. The interaction processes in the contact area of technological machines in two-shaft modules are very complex and researchers have been working for a long time [6-9].

The variety of tasks of machines, the difference in the requirements for their parameters, the difference in the properties of recycled materials leads to the emergence of many works related to the analysis of valli machines. However, the studies performed up to this time have not become a fundamental theory that covers experiments and allows for prior knowledge of the interactions of valli machines in the contact area [7-14].

We find the deformation value of the point M in the Free State located in the contact area of the working shaft and the material being processed (Figure 1).

$$h_M = PM = DB - BE, \quad DB = h_r = R(1-\cos\varphi_0)$$

Then

$$BE = R(1-\cos\alpha), \quad h_M = R(\cos\alpha - \cos\varphi_0)$$

One-valued compression deformation is represented by the following equation

$$\varepsilon = \frac{2R}{h_M}(\cos\alpha - \cos\varphi_0) \quad (1)$$

The stress in compression can be recorded using Guk's law:

$$\sigma = E\varepsilon \quad (2)$$

E – modulus of elasticity of the material being processed.

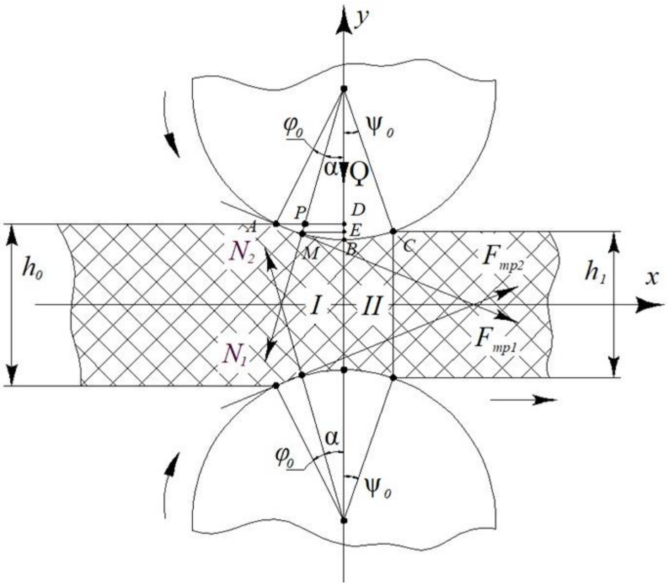

Figure 1. Scheme of transverse semi-product position between working shafts

The thickness of the transverse semi-finished products and the nature of the material is characterized by a normal elasticity module. In semi-finished tanning products, the boundary conditions of the modulus of elasticity can be written with the formula:

$$E_y = \frac{h_0 \sigma_{\max}}{2R_B(1-\cos\varphi_0)} \qquad (3)$$

There $\sigma_{\max}$ – maximum value of voltage in compression, kN/m2; h_0 – transverse semi-product starting thickness, m; R_B – working shafts radius, m; φ_0 – coverage angle, grad. When the pressure is small enough in the shafts used in tanning, the voltage can be written as follows using Guk's law:

$$d\sigma = E_y d\varepsilon = -\frac{2RE_y \sin\alpha}{h_0} d\alpha$$

As a result, we write the voltage in compression as:

$$\sigma = -\int \frac{2RE_y \sin\alpha}{h_0} d\alpha = \frac{2RE_y \cos\alpha}{h_0} + C \quad . \qquad (4)$$

If the forces acting on the transverse semi-finished products are clear, an arbitrary compressive stress can be determined:

$$P = \frac{\delta R \cos\varphi_0 d\alpha}{R\cos\alpha d\alpha} = \sigma = \frac{2RE_y}{h_0}\left(\cos\alpha - \cos\varphi_0\right) \quad . \qquad (5)$$

Elastic – plastic deformation occurs when the pressure force in the shafts is too large, and it is observed that the bond between the deformation and the tension in the material being processed is no proportional.

$$\sigma = E_y \varepsilon^n \qquad (6)$$

n=0,4 – 1,5

By substituting Equation (1) into equation (6) of the formula ε, we obtain equation (7):

$$\sigma = E_y\left(\frac{2R}{h_0}(\cos\alpha - \cos\varphi_0)\right)^n \qquad (7)$$

In private, at point A and outgoing Point C, which enter the contact socket $\alpha = \varphi_0$ да $\sigma = 0$ since, we find the differential constant:

$$C = -\frac{2RE_y}{h_0}\cos\alpha$$

$$P = \frac{\sigma}{\cos\alpha} \qquad (8)$$

$$P_{\max} = \sigma_{\max} = \frac{2RE_y}{h_0}(1 - \cos\varphi_0) \qquad (9)$$

The resulting equation (9) determines the maximum stress value in the case of elastic deformation in the contact area of the working shafts and the transverse semi-product.

The graph of the defined equation (9) is E = 105 Pa, h = 10 мм, radii of working shafts R = 120 mm, R = 180 mm ва R = 240 mm we build for the values that are (Figure 2).

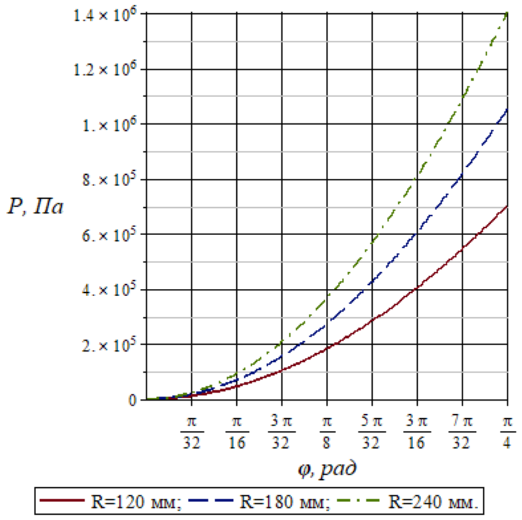

Figure 2. Graph solution of the transverse semi-product depending on the angle of coverage of the critical voltage in the area of deformation

From the resulting graphical solution, it follows that as the coverage angle increases at large values of the working shafts radius, the critical voltage value also increases in the area of deformation.

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