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SPECIFIC FEATURES OF THE PRESSURE ROLLER ROLLING ON THE DEFORMABLE SURFACE OF THE SEWED TISSUE WITH EMULSION.

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Annotation: *In article it is considered deformations rubber a roller, at various modes of sewing together of fabrics which puts additional with emulsion for seam strengthening. Also to be cited the settlement data of process taking into account friction factor, and properties of sewed materials.*

Key words: *clamping a roller, deformation, swings a roller, a conducted wheel, rigidity of rubber, loading on a roller.*

When the pressure roller is rolling, deformation occurs simultaneously in three mutually perpendicular directions normal to the surface, across and longitudinally in relation to the plane of rotation of the pressure roller.

The first of these deformations characterizes tissue compaction, the second is the bulging of the tissue to the sides and the third is the displacement of the tissue in the direction of movement, which simultaneously accompanies the emulsion.

When the tissue is displaced in the direction of movement, both tissue compaction and squeezing out of the composite material, as well as its displacement, take place. The ratio of these types of deformations depends on the state of the fabric and the amount of emulsion between the layers of the fabric, the kinematics of the pressure roll, the width of the roll and the speed of the fabric. If it is impossible to seal, the emulsion of the tissue is squeezed up and to the sides.

When a highly deformable roller is rolling, the deformation of the fabric, in addition to its own characteristic, is greatly influenced by the rigidity of the roller rubber. So, with a sufficiently high rigidity of the rubber of the roller, its high normal rigidity, the cross-section of the track has the shape shown in Fig. 1.

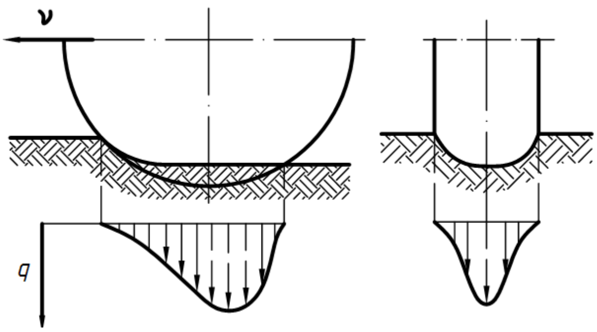

Fig. 1. Distribution of pressures in contact of the roller with the sewn fabric

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The rolling resistance of a roller on a deformable fabric consists of the rolling resistance of the roller and the rolling resistance of the fabric.

Due to the complexity of determining the rolling resistance of the fabric of a deformable rubber roller, the rolling process of a rigid roller can be considered, which has a diameter larger than the deformable roller, but has an equivalent effect on the fabric [1].

The condition of equivalence is the coincidence of the curvature of the longitudinal section of the deformable and rigid roller in the contact plane. Then (Fig. 2, a) for these rollers the length of the half-chord is

$$AB = \sqrt{r_c^2 - \left[r_c - \left(h_r + h_{шг}\right)\right]^2} = \sqrt{r_{жс} - \left(r_{жс} - h\right)^2}$$

Where h_{shg} = G_k / C_n — normal deformation of the rubber on the surface of the pressure roller;

G_k- normal load on the pressure roller.

C_n- hardness of rubber on the surface of the pressure roller.

r_c, $r_ж$ — correspondingly, the free radius of the deformable and rigid roller.

Transforming the obtained expression and neglecting the quantities of the second order of smallness, we obtain

$$r_{жс} = r_c\left(1 + \frac{h_{шг}}{h_r}\right) \quad (1)$$

Let us turn to the rolling pattern of a rigid driven wheel (Fig. 2, b), which is equivalent in the mentioned sense to a deformable one.

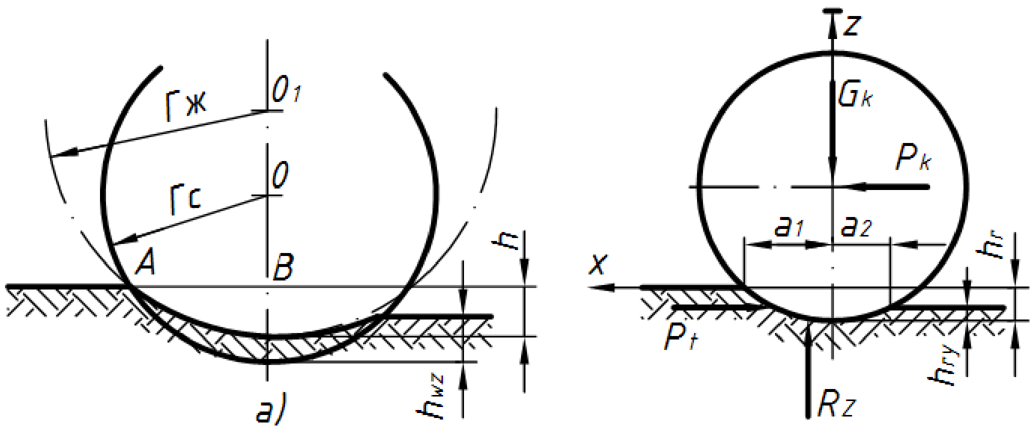

Fig. 2. Rolling wheel on deformable soil

Suppose that the wheel is moving at a low speed, so that on each elementary segment of the path, soil deformations, corresponding to the prolonged action of the load, have time to occur. When moving along the tissue, as in an elastically plastic medium, the roller in the front part at the loading area forms a track with a depth of h_g, and in the rear part, at the unloading area, a partial restoration of tissue deformation by the value of h_{hy} occurs.

The normal load of the G_K roller is balanced by the resistance of the fabric

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$$G_k = \int_{a_1}^{a_2} pbdx ,$$

where b — roller width .

Applying dependence (1), we obtain

$$G_k = c_r b \int_{a_1}^{a_2} h^{\mu} dx. \quad (2).$$

Integrating expression (2) and assuming that $c_г$ and μ at the loading and unloading sections are the same, we obtain

$$G_k = c_r b \sqrt{2r_{ж}} \left(1 - \frac{\mu}{3}\right)\left(h^{\mu+\frac{1}{2}} + h_{ry}^{\mu+\frac{1}{2}}\right) \quad (3)$$

$c_г$ - material parameters, material settlement coefficient.

μ - coefficient for some fabrics.

For plastic fabrics 0.5, for elastic fabrics 0, and for thickening fabrics 1.

For the overwhelming majority of tissues, elastic deformations are significantly less than plastic ones. The resistance of the fabric to the rolling of the roller can be determined if the work spent on the formation of the track is known. As it was shown, when the roller rolls, complex deformations of the fabric occur.

Considering deformations only in the plane of a rectilinearly rolling roller, it can be assumed that the sum of all deformations of the fabric consists of deformations caused by the displacement of the points of the roller when the roller moves. Then the work expended by the roller on the formation of a rut (the work of rutting) is proportional to the displacement of point 1 of the roller rim in the fabric (Fig. 3), which in pure rolling occurs along the cycloid, and the force tangential to this trajectory.

Let there be an elementary platform in the vicinity of point 1 of the roller rim, which moves along the trajectory of this point and at some time is at a depth from $(h_r - h)$ the entrance to the ground. Then the elementary force tangent to the trajectory of point 1 on the roller;

$$dP = pbdl$$

where b— the width of the platform, equal to the width of the roller;

(dl — the projection of the length of the platform onto the plane perpendicular to the tangential force dP.

Rutting work per wheel revolution

$$A_{fоб} = b \int_0^{2\pi r} dl \int_0^s pds \quad (4).$$

To find the second integral in expression (4), it is necessary to have an analytical dependence for the length of the cycloid, which is not available.

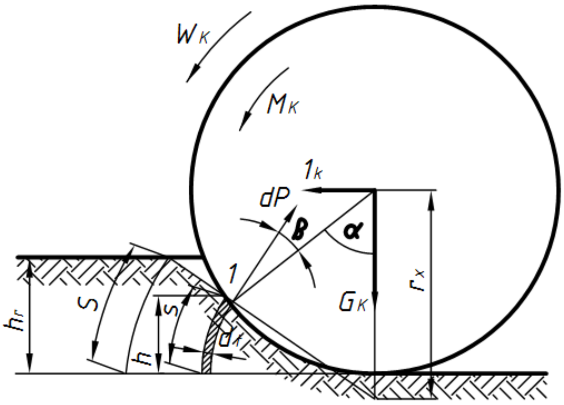

Fig. 3. Towards the definition of work on tissue deformation.

Calculations show that the solution of expression (3) using empirical formulas that determine the length of the cycloid in the studied area is not significantly more accurate than its solution under the assumption that the work of rutting is spent only on deformation of the tissue in normal to its surface direction. Therefore, with an accuracy sufficient for practice, the second integral can be $\int_0^{h_r} pdh$ replace with, and then use one of the expressions

(1) - (3) and determine the work of A_{fob}.

Using, for example, the simplest expression (1), we obtain

$$A_{фоб} = c_1 b 2\pi r_{ж} \int_0^{h_{rr}} h^{\mu} dh = c_1 b 2\pi r_{ж} \frac{h_r^{\mu+1}}{\mu+1}$$

Hence, the resistance force of the fabric, rolling of the free roller is determined rolling resistance power

$$N_{fr}^c = P_{fr}^c v_м = c_r b \omega_k r_k h_r^{\mu+1} / (\mu+1)$$

and the coefficient of rolling resistance of the fabric

$$f_r = \frac{c_r b}{G_k} \frac{h_r^{\mu+1}}{\mu+1} \qquad (5)$$

The value of the roller track hr required to determine the rolling resistance can be found from equation (3) with the substitution of the value r_j from expression (1) into it and the solution with respect to $h = h_r$. It is impossible to express the value of h in general form, since equation (3) contains this value in two terms, in one of which it is included in different (depending on μ) degrees. So, for example, at $\mu = 0{,}5$ (plastic fabric adras or silk) the value

$$h_r = 0.5\left(\sqrt{\frac{2.88 G_k}{c_r^2 b^2} + h_{шz}^2} - h_{шz}\right)$$

The interaction of a deformable roller with a deformable material - fabric, which is not yet described by absolutely accurate analytical characteristics, is a complex process. At the same time, it should be borne in mind that when the roller rolls on a deformable fabric, some characteristics of

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the roller change, for example, its radial stiffness and the rolling coefficient of the roller on the fabric [2,3].

Since the tissue is an elastically plastic medium, the term "tissue stiffness" can be applied to it, albeit conditionally, which rather corresponds to the density of the tissue. With an increase in the "stiffness", or the compaction of the fabric, the rigidity of the roller interacting with it decreases, which leads to a decrease in the contact patch of the roller, as a result of which the roller support area decreases. If the roller is supported by both the treadmill and the sidewalls on the uncompressed fabric, then it rests on the rigid flat surface only by the treadmill, which leads to a decrease in the integral rigidity of the roller. With a change in the rigidity of the roller, its deformation changes, and in this regard, as shown above, irreversible losses and rolling resistance change.

When the roller moves over the fabric with the emulsion, the tackiness of the emulsion has a definite effect on the rolling resistance. The stickiness of the thick liquid emulsion is relatively high. There is absolutely no stickiness in dry fabric material.

The experimental results show that the adhesion of the wheel when it rolls on a solid support surface and on a deformable fabric is different. It is even a function of the mechanical properties of the fabric and the roller coating of the toist, rubber. If, when driving on hard supporting surfaces, adhesion is determined almost exclusively by the frictional properties of the roller and the rolling surface, then when moving on a deformable fabric, the resistance of the emulsion has a greater effect. This is because in many cases the frictional force between the roller surface and the fabric is less than the frictional force with dry material.

A change in rolling resistance will lead to a change in the load on the roller, when the fabric is moved with the help of two rollers pressed against each other with a certain load G_k- B this case, the resistance depends on the thickness of the fabric and its mechanical characteristics.

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