WOODWORKING INDUSTRY

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DETERMINATION OF THE MAIN PARAMETERS OF APPARATUS FOR DENSIFICATION OF VENEER

Considered the principal device for sealing veneer with two drive rollers, each with a diameter of 150 mm. Defined the required compression force and feed force veneer veneer with his seal. The simplified scheme of heating of sheet of an interline interval is offered during its consolidation by two steams of rollers. The numerical estimations which have shown possibility of achievement of temperature of plastic deformation of an interline interval approximately on 57% of its thickness from outer sides of sheet are executed.

Introduction. The investigations for the application of densified sliced veneer for lamination of pieces of interior door frames have been conducted at the BSTU. Oak timber veneer with a thickness of 0.6 mm and moisture content of 8% was densified in a press using a flat pressing technique. At the degree of density of 25% the veneer surface requiring no grinding is obtained and the lacquer consumption decreases two-fold.

Main part. Veneer compression will be driving two pairs of rollers, each with a diameter of 150 mm. The force generated by each pair of rolls should provide specific pressure on the veneer, the size is somewhat greater than tensile strength of oak wood with veneer across fibers. Each pair of rolls should provide a veneer compression force of 7,400 n. Power feed veneer N, kW is equal to:

$$N = \frac{F_f \cdot U \cdot K_s}{60 \cdot 1000}, \quad (1)$$

where F_f is feeding force, n; U – feed speed, m/min; K_s – safety coefficient, accepted, K_s = 1.3.

To carry out payment rate adopted equal 12 m/min. Feed force define formula:

$$F_n = 2F_b \cdot \mu_c, \quad (2)$$

where F_b is the rolling friction of the upper drum (same is lower); SC-adhesion coefficient drum with wood, Oak STS = 0.345. Substituting (2) into (1):

$$N = \frac{2F_b \cdot \mu_c \cdot K_s \cdot U}{60 \cdot 1000} = 1{,}33.$$

we get: . At U = 20 m/min, N = 2.2 kW.

Pressing should be kept at a temperature of approximately 80 veneer within –100°C.

When heating the hot rollers veneer veneer while between them at speed 12 m/min is only 0.03 c. Take temperature roller 200°C. In conditions of contact heating duration of heating in the middle of the thickness of the veneer to a temperature of 100°C is defined by the formula:

$$\tau = \frac{F_0 R^2}{a}, \quad (3)$$

Where F_0 is the criterion of the Fourier transform; R – half the thickness of the veneer, R = 0.3 mm, a is the coefficient of thermal diffusivity, м^2/s.

Coefficient:

$$a = \frac{\lambda}{\rho C}, \quad (4)$$

where λ is the coefficient of thermal conductivity, w/m °; ρ oak density 700 kg/m^3; C is the specific heat of wood, kJ/kg · grad. At a temperature of 100° c and wood moisture 8% specific heat C = 0.327 kcal/kg, and the thermal oak is 0.25 Watt/(m·°C). Then м^2/s.

$$a = \frac{0{,}25}{0{,}327 \cdot 700 \cdot 1000} = 1{,}1 \cdot 10^{-6} \text{ m}^2\text{/s}.$$

The Fourier criterion of the transform we find according to the nomogram of [1] on the basis of the values of the dimensionless and X/R, where X is the distance from the surface to the point of heating. Dimensionless temperature is

$$\Theta = \frac{t_r - t_{vn}}{t_r - t_0} = \frac{200 - 100}{200 - 20} = 0{,}56,$$

where t_r, t_{vn}, t_0 is the temperature of roller, veneer and the environment.

In Θ = 0.56 and X/R = 1 from the graph we can find F_o = 0.2. From equation (3) count = 0.018 s.

When the $t_в$ = 200°C veneer thickness 0.6 mm will have time to warm up in the middle of a slightly higher temperature 100°C. The average temperature across the section is about veneer 150°C. More than enough to surface temperature was 100°C or more, and in the mid 60–80°C. The roller temperature is enough to accept equal 140°C.

At the exit of the surface temperature of an Interline interval is equal to 140°C, in the mid–60°C and the average temperature across the section 80°C. At a speed of 20 m/min, temperature will be equal to 140 veneer, 50 and 73°C. In view of its low traffic sheet of veneer is a little different from the above estimates. The figure shows the distribution of temperature on thickness an Interline interval under the rollers (1) and (2) obtained from the solution of heat transfer by convection equation of stationary boundary conditions of the first kind in the zones of contact roller with veneer and third kind outside these zones. Convective heat transfer coefficient calculation carried out by reference to [2], according to the local Nusselt number:

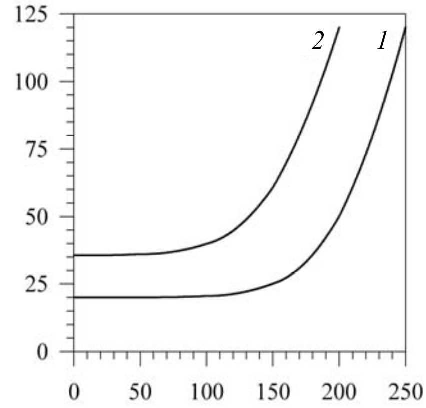
$$\mathrm{Nu} = 0.332\,\mathrm{Re}^{0.5}\,\mathrm{Pr}^{0.33}\left(\frac{\mathrm{Pr}}{\mathrm{Pr}_{vn}}\right)^{0.25}, \qquad (5)$$

where the Prandla number of local surface temperature veneer and veneer ambient air is equal to 0.71. Local Nusselt numbers and values are calculated based on the distance the Reynolds x from the edge of the plot surface veneer that has a heat transfer on Newton, t. e.:

$$\mathrm{Re} = \frac{Ux}{\nu}, \ (6)$$

$$\mathrm{Nu} = \frac{\alpha x}{\lambda}. \ (7)$$

The air inside the special device for sealing a veneer is warmed up to a certain temperature. In simulation warm-up veneer we asked the air temperature in this device is 100°C, 120°C rollers – veneer, at the entrance to the device – 20°C. Length of the veneer to the ground with the first couple rolls stood at 200 mm, the distance between the centers of the rollers with one hand veneer – 242.74 mm. Thought that after passing through each pair of rollers depth permanent deformation of veneer is 100 microns. Given the symmetry of the problem on the median plane of the sheet of veneer, considered the heat from one side of the pair of rollers. On the symmetry axis set condition zero heat flow.



Veneer thickness temperature distribution at the exit after the first (*1*) and second (*2*) roller speed veneer 20 sm/s

As you can see from the picture, after the passage of the first pair of rollers on the temperature rose on the symmetry axis 4°C and there is a strong is other mality the thickness of the veneer. Temperature of 80°C is achieved at a distance of approximately 225 microns from the middle of the sheet of veneer thickness. Now the temperature 80°C is reached at a depth of 170 μm on the plane of symmetry. At a distance of 150 to 200 μm average temperature of about 90°C, allowing you to rely on the absence of deformation recovery after compression.

Conclusion. The calculations are estimates and show the possibility of heating the veneer with his seal without significant deformation recovery.

References

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