proposed simulation model, which takes into account the actual dimensional and qualitative characteristic of raw materials and specification of lumber, received voluminous output purely radial sawn timber from logs provided by segment and cleaving-segment cutting patterns.

Radial sawn timber, sawlog, sector log sawingschemes, live-and-segment log sawing schemes,edged sawn timber, general-purpose sawn timber, the volume of logs, taperingness of logs.

UDC 674.047

ALGORITHM OF SAW TIMBER DRYING QUALITY

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Is given the analysis of the existing methods of the automatic regulation of the process of the drying of timber, the need of regulating drying process taking into account the variable characteristics of wood and drying agent is substantiated, is developed algorithm of the regulator of kiln drier.

Timber, drying, the regulation of process, the quality of drying, the algorithm of drying regulator

Taking into account the significant changeability of the properties of wood, the influence of the climatic parameters on massive wood articles form changing, ever greater popularity became glued articles. Thus, glued beam, panel make it possible to use as the low quality raw materials not only to preserve the decorative qualities, like massive wood, but also to reach the form and sizes stabilities. In this case we could not forget about necessary level of saw timbers drying quality.

The convective drying of lumber today is most popular, and one of the methods of the achievement of its high quality and working cost reduction - is the automation of process. The automatic regulation of kiln drying process must ensure peak productivities, efficiency with the retention of dried material quality. This tasks can be solved with the help of the system of automation, which makes it possible to optimize process not only by the average values of the controlled parameters, but also taking into account their changeability through the kiln.

The saw timber drying quality, accordingly standard, [1] evaluate by moisture indices, namely: achievement to the assigned final moisture content of material, to the deviation of the average final moisture content of party from the assigned final moisture content of material, to the deviation of the final moisture content of separate lumber in the party from the assigned final moisture content, and also with respect the state of material, which is characterized by the index of residual stresses.

There is a number method, which make it possible to control the state of wood for the drying elongation. The determination moment of decrease and sign change of total internal stresses is one of them. To govern regime is possible by determining the change in the shrinkage of width of board, which indicate the appearance of dangerous internal stresses for the integrity of material. However, this method did not find a practical use because shrinkage during process varies monotonically and it is not possible to establish the moments of achieving of maximum, drop and sign change of stresses. This method of control is based on the fixation of hairline cracks, i.e., moreover reduction of drying quality.

Are known such methods of the checking of internal stresses as the method of differential shrinkage, which take on account the different moisture content over the cross section of material, method of the efforts of wrapping resistances and others, which did not find thus wide application.

The systems of distance control and automatic regulation of drying agent parameters and checking of wood moisture content are most common. Meanwhile regulation of process even in the most solid firm kilns is gone according to averaged data despite that one of the indices of quality level of drying is the root-mean-square deviation of final moisture content.

The aim of research – developing of algorithm of the regulator of kiln drier. розробка алгоритму роботи регулятора лісосушарки.

Material and method. To account for the probability characteristics of the dried material, kiln thermal and aerodynamic characteristics it was used the algorithm of the calculation of the dispersion of final moisture content, obtained professor by M. Feller [2] with the description of drying process by partial differential equation taking into account variable initial and boundary conditions.

The diffusion coefficient was accepted determined, since to determine its value directly before lumber drying in the storage is not possible because it needs complexity and durations experiments. In the literature there are no data about its scattering for each species, especially because the value of the diffusion depends from wood density, which grows in the specific locality.

For calculating the deviations of the final moisture content of separate saw timber in the party from the assigned final moisture content, namely the root-mean-square deviation, is used the following algorithm:

$$S^{(n)}{}_W = \pm\sqrt{\left(\frac{W_{st}^{(n)} - W_{eq.m.c.}^{(n)}}{W_{st}^{(n-1)} - W_{eq.m.c.}^{(n)}}\right)^2 d_W^{(n-1)} + d_{W_{eq.m.c.}}^{n}}, \qquad (1)$$

Where n – the index of the regime stage;

$W_{st}^{(n)}$ - moisture content on the n regime stage;

$W_{st}^{(n-1)}$ - moisture content on the $n-1$ regime stage, for the initial conditions $W_{st}^{(n-1)} = W_0$,

W_0 – initial moisture content;

$W_{eq.m.c}^{(n)}$ – equlibrium moisture content on the n regime stage;

$d^{n}_{W_{eq.m.c.}}$ - dispersion of the equlibrium moisture content on the n regime stage;

$d^{(n-1)}_{W}$ - dispersion of the initial moisture content on the $(n-1)$ regime stage.

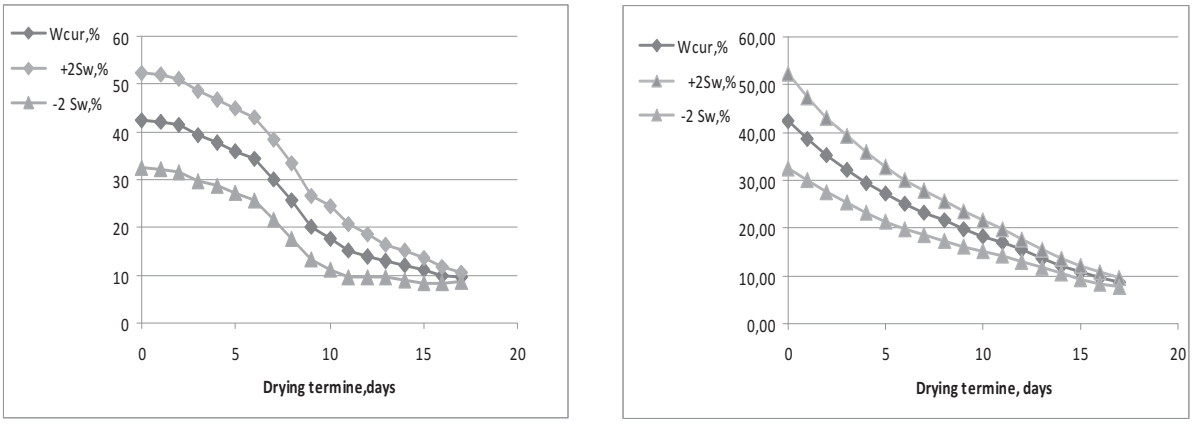
The calculations of scattering current and final moisture content in the dried lumber storage were done in accordance with equation (1) and is determined drying quality according to standart 4921:2008 [1]. For the calculations we used the results of the experiments, carried out in the convective drying chambers with the vertical- transverse circulation ring of the drying agent of the following firms «Nardi», «Copcal», «Termolegno» Italian kilns.

In these chambers were dried the pine lumber with 30,40 and 50 mm thickness. According to planning of experiment with the index of accuracy 5% and the index of authenticity t= 2,0 for the probability of the result p=0,954 accepted a quantity of dryings - 17.

Preliminarily in the parties of the pine saw timbers, which enter the drying chamber were produced the measurements of initial moisture content with the help of the conductivity moisture meter BPK- 12 M (Russia), which makes it possible to determine the moisture content of boards with accuracy ±1,0% in the range 6-30%.

After material were loading in chamber and the fans started was measured the average speed of the drying agent at the output from the storage in accordance with the procedure, presented in the monograph [3]. Measurements were conducted with the help of the speed meter with extension sensing element UC-1 (Ukraine), that make it possible to determine the speed of circulation in the range 0.1 - 20 m/s with the accuracy ± 0.1 m/s.

Results. Our investigations of scattering the moisture content of saw timber storage according to the results of measurement on the sensors of moisture showed that between experimental and calculation data is observed the difference (Figure 1). This is connected with the fact that there was small quantity of moisture sensors in chambers – only 6, which does not ensure the necessary authenticity of the values of the average current moisture of the storage.



a b

Figure 1. Results of the investigations of the current average moisture content of pine saw timbers with 50 mm thickness and scattering of the current moisture (W_{cur}) of separate boards in the storage (±2Sw): a – experimental data; b –calculation data

For the achievement necessary accuracy of regulation it is necessary not only to use the specialized multichannel regulators with the small dead zone, which work in the logical regimes, but also to increase quantity moisture sensors. A moisture sensors quantity depends on the capacity of chamber and must correspond to quantity of species, which must be selected for evaluating the drying quality according standards [1, 4]. Thus, for the investigated chambers for pine saw timbers the permissible error in the psychometric difference must be ±0,8°C [5], and moisture sensors quantity for the chamber "Termolegno" must be increased to 21.

Contemporary chambers are, as a rule, completed by one or two pairs air state sensors, which are established in both sides of storage. During reversing of drying agent the worker that pair, which allows information about the temperature and the relative humidity of air at the entrance into the storage. These sensors given only averaged data, with out calculate scattering heat stream thought the material. Meanwhile it is known [4] that during the drying process observed the tendency of reduction the nonuniformity of temperature field, which is connected with the drying agent density changes and changes of the storage geometry as a result of the shrinkage of lumber.

Moreover for the chambers with the average speed of drying agent circulation in the storage in the limits $1{,}1\frac{m}{c} < v_{av} < 3{,}0\frac{m}{c}$ is observed reduction in scattering thermal field 1,2-1,4 times for the elongation of a change in the average value of temperature in the range $30^{\circ}C < t_{av} < 80^{\circ}C$. In the chambers with the range of speed fluctuations of the circulation in the limits $0{,}3\frac{m}{c} < v_{av} \le 1{,}0\frac{m}{c}$ the uniformity of thermal field increases 2,7-3,3 for the same temperature parameters. Using the obtained dependence between the coefficients of variation in the aerodynamic and thermal fields in the saw timber storage, which is described by the equation:

$$V_t = 0{,}25V_v - 2{,}85, \qquad (2)$$

we could determinate the changeability of equilibrium moisture content during the drying process.

Having a information about the actual scattering of the saw timber current moisture and of thermal field in the chamber it is possible at the arbitrary moment of time to calculate the root-mean-square deviation of the current moisture in the storage, to compare it with the actual and, if takes place noncoincidence more than 30%, to correct drying regime.

This principle is realized in the system of the automation, developed by us. The algorithm of the work of regulator is given on Figure 2. The realization of the automatic control system of the process of the saw timber drying with the use of the algorithm proposed makes it possible to interfere in time into the regime and to reach the necessary level of drying quality.

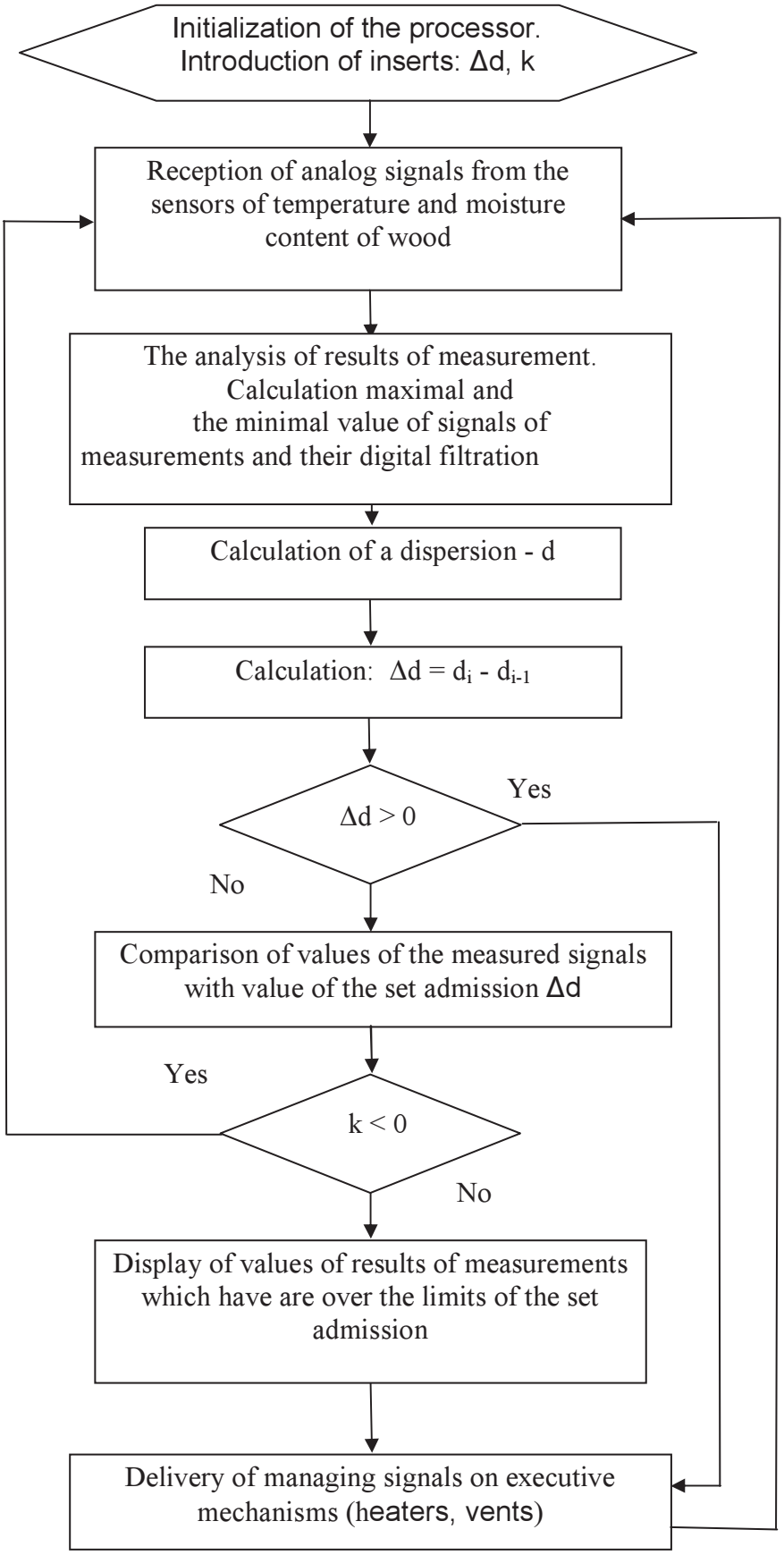


Figure 2. The algorithm of the work of chamber regulator

Conclusion

1.It is established that most common for regulating the drying process are the automatic control systems on the saw timbers average moisture content They help to control the average moisture content of the dried material and to change the parameters of regime in the case of nonconformity the estimated time of reaching final moisture content, which placed into the regulator.

2.Taking into account standard requirements for the drying quality, the changeability of the properties of wood and drying agent is substantiated the need of regulating the process not only according to averaged data, but also taking into account scattering moisture content on the saw timber storage.

3.Is developed the algorithm of the regulator of the system of automation, in which is realized the prognosis of the saw timber drying quality according to the moisture indices..

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Проаналізовано існуючі способи автоматичного регулювання процесу сушіння пилопродукції. Обґрунтовано необхідність регулювання процесу з врахуванням ймовірнісних характеристик деревини та сушильного агента. Розроблено алгоритм роботи регулятора сушарки.

Пилопродукція, сушіння, регулювання процесу, якість сушіння, алгоритм роботи регулятора.

Проанализированы существующие способы автоматического регулирования процесса сушки пилопродукции. Обоснована необходимость регулирования процесса с учетом изменчивых характеристик древесины и сушильного агента. Разработан алгоритм роботы регулятора сушилки.

Пилопродукция, сушка, регулирование процесса, качество сушки, алгоритм работы регулятора