Conclusions

1. Developed methodology for experimental research, which served the basis for experimental (pilot) installation.
2. Received dependencies of the temperature that is being created on the surface of bevel from regime factors.
3. This dependency allows developing new regimes of cutting rules bevel that will considerably increase efficiency of beveling process and its quality.

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Високопродуктивна технологія загострення ножів з широкою задньою поверхнею

Розглянуто проблему загострення ножів з широкою задньою поверхнею, яка є на підприємствах, що спеціалізуються з виготовлення струганого та лущеного шпону. Дана оцінка шліфувальних кругів, які застосовуються для загострення ножів. Запропоновано новий спеціальний абразивний інструмент та проведено експериментальні дослідження температури під час шліфування, що дають можливість встановити нові режими загострення ножів з широкою задньою поверхнею, які суттєво підвищать якість та продуктивність процесу.

Ключові слова: абразивний інструмент, ніж, загострення, поверхня.

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THE RELIABILITY OF THE AUTOMATED PRODUCTION SYSTEMS IN WOODWORKING INDUSTRY

The questions of application of modern methods of determination of reliability of equipment are examined for the decision of tasks of increase efficiency of functioning of the automated production systems on the enterprises of industrial forestry complex. Influence of reliability of equipment on the actual productivity of the automated production systems is probed. The results of simulation modeling confirm that average value of duration of intervals of processing is determined in average value of time of an operation and operational readiness coefficient of the equipment. The reduction of reliability of the equipment conducts to useful increase of a dispersion of intervals of processing and to a decrease of parameter of stability of operations. The reliability increase of the automated manufacturing systems is executed with the help of structural reserving, by development of the schemes of arrangement of the equipment, structural-parameter optimization.

Keywords: reliability indexes, factors of origin of refuses, coefficient of readiness of equipment, coefficient of the technical use, the production systems, instability of duration of operations, parameter of stability, imitation design, are automated.

In the process of the protracted exploitation of equipment the set terms of cooperation are violated between mechanisms, details, instruments, purveyances, by facilities managements which are caused cyclic instability of parameters of work of techno-

logical line. Therefore interpretation of the phenomena of reliability of the automated production systems (APS) from positions only a wear and accumulation of damages is insufficient. In technological lines refuses influence on technological reliability through casual character of sizes and certain descriptions of purveyances, parameters of machine-tools and their knots, instruments. Factors which predetermine in one or another measure the origin of refuses in-process technological lines divide into three groups: systematic, cyclic operating and droningly operating factors [1].

Systematic factors are formed in the process of drafting, adjusting and exploitation of equipment. In machine-tools-automats and semi-automatic devices with a programmatic management typical systematic errors there are errors of the management programs. Cyclic operating factors are conditioned instability of external terms, technological and structural parameters: sizes and form of purveyances; physical and chemical properties of the processed materials [4-10]; temperature and humidity of environment; modes of treatment; temperature and properties of workings liquids and gases; initial and eventual positions of mechanisms; coefficient of friction; mutual location of structural elements; recreation of the management programs et cetera. To the group of droningly operating factors belong: wear of instrument, details and knots; break up of mechanisms and built on; rubbing of workings surfaces; senescence of materials, constructions, decline of their firmness; qualification of personnel; organization of service.

For the estimation of reliability of the automated lines such reliability indexes are more frequent all utilized: parameter of intensity of stream of refuses λ; function of reliability of P(t); middle work is on the refuse of t_w; term of service of N; middle technical resource of R; resource; mean time of renewal τ_{in}; intensity of renewal υ; coefficient of readiness of K_r; coefficient of the technical use of K_T. Reliability indexes are closely related to the indexes of the productivity of the automated lines. All of them characterize ability to work of the automated lines together [2]. Thus the indexes of faultlessness and renovation behave to the instantaneous reliability indexes and estimate its level in concrete moments of exploitation. Complex reliability indexes are a coefficient of readiness of K_r and coefficient of the technical use of K_T.

A coefficient of readiness of K_r is a mathematical hope of part of time of the normal functioning of the automated production system. He is determined by duration of trouble-free work and sometimes renewal. The charges of time on renewal in normal work of equipment increase duration of intervals of processing and reduce the actual productivity of machine-tools. In the process of functioning of machine-tools there is a successive duty of two different periods – periods of trouble-free work and periods of renewal in the working state of machines. The period of faultless work of machine-tool is named sometimes time of work of t_w, and period of renewal in its ability to work – sometimes time of renewal in t_r. A between's by these parameters determines the technical level of equipment and efficiency of his use in a production (1).

$$K_r = \frac{\overline{t_w}}{\overline{t_w} + \overline{t_r}}. \quad (1)$$

Actual reliability indexes are determined from data of actual supervisions and measuring with their proper mathematical treatment. Actual supervisions and calculations of actual reliability of mechanisms indexes and built on in the conditions of exploitation it is expedient to combine with analogical researches of the productivity. Stability of functioning of the automated production systems is characterized the parameter of

Erlanger K_i for the interval of processing. His size is calculated by a formula (2). Parameter of Erlanger K_i for the interval of processing depends above all things on the parameter of Erlanger of duration of cycle of K_c and coefficient of readiness of machine of K_r. By a formula (2) it is possible to analyses influence on the parameters of intervals of processing of not only reliability of machine-tools but also all other losses, caused both technical by reasons and external organizationally technical. To such it is possible to take an inopportuneness and disparity of actions of operator, absence of material, energy, shortage in-process but other

$$K_I = \frac{\overline{t_I}^2}{D_I} = \left[\frac{K_r^2}{K_C} + \left(2\frac{\overline{t_W}}{\overline{t_C}} - 1 \right) \left(1 - K_r\right)^2 \right]^{-1}. \qquad (2)$$

With the purpose of acidifying the got analytical decisions and approbation of algorithms of design of duration of intervals of issue of products, we conducted a cybernetic experiment [3]. After the specially made algorithm and proper program on the personal computer the periods of trouble-free work of t_w and renewal in the ability to work machine-tools of t_r and duration of technological operations of t_C were generated with the incident to them laws of distributing. Duration of time off work of t_W and time of renewal in t_r is had character of casual sizes and distributed in swinging majority after the exponential distributing. Correlations of mean values of duration of time off work of t_W and time of renewal in t_r are set the coefficient of readiness of K_r.

But the last in no way determines and does not limit them absolute values. These sizes depend on as technological equipment, his state, organization of service, level of organization of labors of both basic and auxiliary personnel and row of other factors. Therefore for comfort of analysis and generalization of results of experiments we used the relative sizes of time of work $\overline{t_W}/\overline{t_C}$ and to time of renewal $\overline{t_r}/\overline{t_C}$ to middle duration of cycle. The choice of range of varying of entrance factors in a cybernetic experiment is stipulated them sizes are real in a woodworking production. It is changed duration of technological operations in a wide enough range – from a few seconds to a few minutes and anymore. Their parameter of Erlanger changes from 1 to 100 and anymore.

It is got the results of imitation design confirm simply, that the mean value of duration of intervals of issue of products is determined only the average of cycle of machine and coefficient of its readiness. On dispersion of intervals of processing, except for the coefficient of readiness, duration of both period of trouble-free work of technological equipment and time of renewal substantially influences (fig. 1). Diminishing of reliability of equipment results in strong growth of dispersion of D. Intensity of this growth rises with the increase of relative size of time of renewal ($\overline{t_r}/\overline{t_C}$) and relative time of work ($\overline{t_W}/\overline{t_C}$). Some other character of dependences is observed at the permanent size of coefficient of readiness that at stable reliability of machines (fig. 2). Size of dispersion of interval of processing of straight proportional to the relative size of time of work regardless of size of coefficient of readiness. Considerable growth of dispersion of interval of issue with the decline of reliability of machines, in same queue, results in the intensive diminishing of parameter of Erlanger. The parameter of Erlanger especially sharply goes down with diminishing of coefficient of readiness (fig. 3). Such decline is more moderate at the permanent size of coefficient of readiness of machine-tool for the increase of relative duration of time of work, especially for the higher sizes of coefficient of readiness.

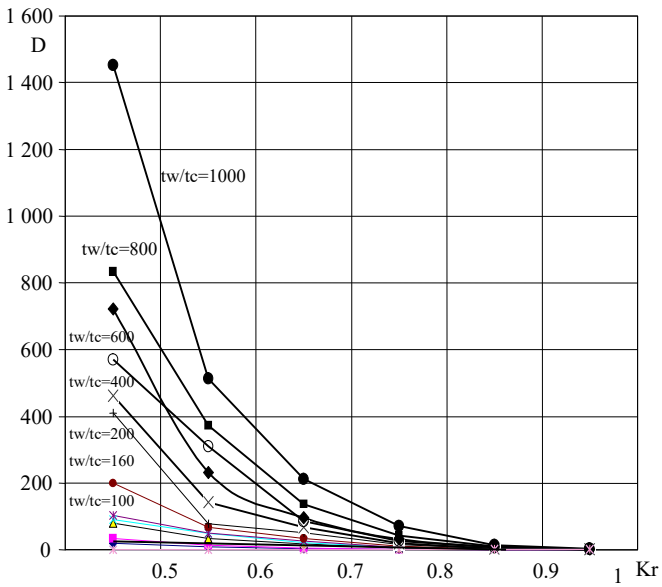

Fig. 1. Dependence of dispersion of interval of processing of D is on reliability of technological equipment

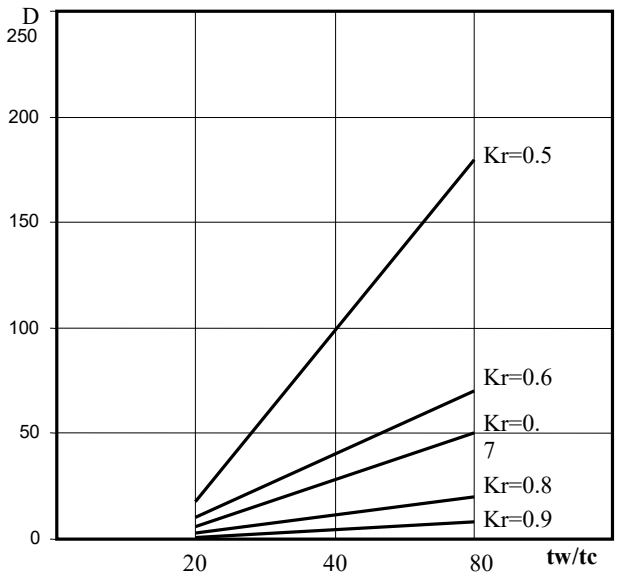

Fig. 2. Influence of time of work on dispersion of interval of processing

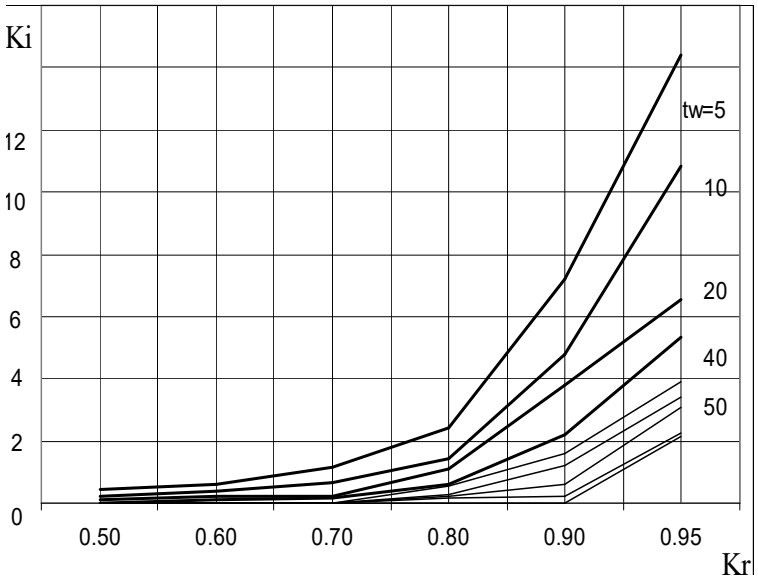

Fig. 3. Dependence of parameter of Erlang of interval of processing from the coefficient of readiness

Thus, an important value has the primary equipping with modern amenities of stability of duration of cycle. More intensive and relative duration of time of work influences in more wide range on possible reliability. Statistical researches and analysis of literary sources are conducted with the use of simulation models, enables to formulate such ***conclusions***:

- reliability of technological equipment creates considerable influence on the actual productivity and efficiency of the automated production systems in woodworking industry. By complex indexes, which estimate reliability of production equipment, technological lines there is a coefficient of readiness and coefficient of the technical use. it is got the results of imitation design confirm simply, that the mean value of duration of intervals of processing of products is determined the size of mean value of time of technological operation and coefficient of readiness a machine-tool. diminishing of reliability of equipment results in considerable growth of dispersion of intervals of issue of products. This growth intensifies with the increase of relative size of time of renewal in the ability to work machine-tool, and also relative time of faultless work of machine-tool.

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Надійність автоматизованих виробничих систем у деревообробній промисловості

Розглянуто питання застосування сучасних методів визначення надійності обладнання для вирішення завдань підвищення ефективності функціонування автоматизованих виробничих систем на підприємствах лісопромислового комплексу. Досліджено вплив надійності обладнання на фактичну продуктивність автоматизованих виробничих систем. Результати моделювання, підтверджують, що середнє значення тривалості інтервалів випуску продукції визначається величиною середнього часу технологічної операційної і коефіцієнтом готовності обладнання. Зменшення надійності обладнання призводить до значного зростання дисперсії інтервалів випуску продукції і до зменшення параметра стабільності операцій. Підвищення надійності автоматизованих виробничих систем доцільно проводити за допомогою структурного резервування, розроблення схем компонування обладнання, структурно-параметричної оптимізації.

Ключові слова: показники надійності, фактори виникнення відмов, коефіцієнт готовності обладнання, коефіцієнт технічного використання, автоматизовані виробничі системи, нестабільність тривалості операцій, параметр стабільності, імітаційне моделювання.

UDK 634.812 ***Prof. Ya.I. Sokolovskyy, assist. O.V. Mokrytska – NFWTU of Ukraine***

MATHEMATICAL SIMULATION OF DEFORMATIONAL AND RELAXATION PROCESS IN CAPILLARY-POROUS MATERIALS

Within the framework of mechanics of heterogeneous environments the mathematical model of the stress-strained state of wood is synthesized as a three-phase system which consists of hard (arboreal matter), liquid and steam-aerial phases. Qualificatory correlations allow to describe resilient, viscous-elastic, residual deformations, and also deformations, predefined by the mechanism of mechanics-sorbtion creep.

Keywords: simulation, creep, viscous-elasticity, capillaries-porous materials, moisture, deformation.