UDK 338.512 / 677.025

SYSTEM-TECHNICAL APPROACH TO THE PROJECTING OF THE NEW MACHINERY AND TECHNOLOGIES OF TEXTILE PRODUCTION*

G.I. CHISTOBORODOV, E.N. NIKIFOROVA, V.V. KAPRALOV, M.I. CHISTOBORODOVA

(Ivanovo State Textile Academy)
E-mail: nen@igta.ru

System-technical approach to the projecting of the new machinery and technologies of textile production, based on their dialectical correlation, is developed. Solution of the problem is aimed to the adjustment of the technical development and modernization of textile enterprises.

Keywords: System-technical approach, textile industry, labor productivity, technical – organizational innovations, effectiveness of the production, projecting of technologies and machinery.

System - technical specificity of the production organization is the correlation of the objects, located in the closed space: equipment, its arrangement, technological regimes, raw and material resources, people, their qualification, etc. The development of the system – technical concept used for the projecting of technology, machinery and organization of the production, was based on the systems analysis. The purpose of new system - technical approach was the improvement of the production efficiency, due to the implementation of technical and technological innovations, both while changing all the machines in the technological process and in the case of the local efforts aimed to the partial modernization of the equipment or the technological process. Main stages of the systems analysis are: initial definition of the problem, formulation of the targets and the conditions for the problem's solution, structuring of the problem and systematization of the targets solutions, development of the project for the problem's solution, problem – solving and its implementation. Dependence of the performance measure on the technological, technical and organizational parameters used in the various stages of textile production was chosen as an objective function.

Labor effectiveness in textile production generally depends on the theoretical efficiency of the equipment, rate of the servicing the machines by one person and the factor of the effective time (КПВ) of the machine, defined by the existing method [1]. Structure of the formula for the calculation of this coefficient, does not reveal the reasons for its change along with the differences in the stoppage of the machine.

Otherwise, efficient time factor considers the parameters, directly influencing the performance efficiency: frequency of product breakage (of sliver, roving, yarn or end), time, needed for the elimination of the breakage by the operator, which depends on the working zone and the method of servicing the machine, as well as time, needed for the fulfillment of some additional work. [2]. Increase of the coefficient is achieved by the measures aimed to the technological improvement of the production, its arrangement and use of the new technical means. To avoid the drawbacks of the existing method the new one was suggested for the definition of the effective time coefficient in textile and light industry, which became the base for the system - technical approach used for the projecting of the technology, equipment and organization of textile productions.

* Work is done in the frames of the Russian Federation President's grant for the state support of young Russian scientists – doctors of science (МД-1102.2011.8).

КПВ of the machine is expressed by the particular factors of effective time K_i according to the stoppage types, each of them corresponds to the definite types of the rejections (loss of time). Physical sense of any particular coefficient means that at any chosen period of time the machine could run, that is to say, it is not stopped because of the given reason. Total factor of effective time of the machine depends on the particular Ki:

$$КПВ = \frac{1}{\sum_{i=1}^{m} K_i^{-1} - (m-1)}, \qquad (1)$$

$$K_i = \frac{t_p}{t_p + t_{n_i}}, \qquad (2)$$

where t_p – total operating time needed for the output of the production unit; $t_{п\,i}$ – losses of the i-type, related to the production unit (i =1, 2, ... n); m – number of the types of the stoppages.

Formula (1) defines the dependence between each type of the i-type stoppage and the total КПВ, which is numerically coincided with the same, calculated according to the existing methods used in light industry.

The proposed method for the calculation of КПВ completely clarifies the reserves and the ways of the efficiency improvement of the machine, i.e. realizes the diagnostics of the effectiveness of the existing technology. Diagnosis includes several stages: analysis of the indices of the labor productivity (rates of the output) of the main workers and the efficiency of the technological equipment; calculation of the particular indices of КПВ according to the types and the categories of the stoppages, which are equal to the definite types of the time losses. After КПВ is calculated, the productivity balances are prepared, which reflect the main dependence between the particular stoppages (cycle, technological, organizational – technical) and the loss of КПВ and productivity reduction for the output of the production unit. Growth of КПВ could be done not by the increase of all the particular coefficients, but only by the certain part of it, which is under the level of the fixed optimal meanings. The results of the diagnosis reveal the losses in the output of the machinery unit, caused either by the drawbacks in the construction, low level of the technological safety of the equipment, or by the drawbacks in the labor organization. So, doing in this way, it is possible to define the directions for the primary theoretical researches aimed to the improvement of the technique and technology in textile and light industry.

Technologic efficiency forecasting based on the implementation of the technical and organizational innovations, first, means the diagnosis of the running productions followed by the analysis of the technical, technological or organizational innovations, contributing to the increase of the labor productivity. Using formula (3) it is possible to evaluate the real reserves of the growth of the factor of effective time φ, and, as a consequence, the efficiency of the machine, achieved due to the implementation of the technical –economical measures, and the reduction of the losses of m-type ε times less:

$$\varphi = \frac{КПВ_1}{КПВ_0} = \frac{1}{1\text{-}КПВ_0 t_{n_i} (1-\frac{1}{\varepsilon})}, \qquad (3)$$

where $КПВ_0$, $КПВ_1$ – factors of effective time of the machine accordingly before and after the measures, taken to its growth; ε – coefficient of the losses reduction of the given type.

New method of the factor of effective time calculation assumes the division of all the types of the time losses into three groups: cycle (cl), technological (t) and organizational – technical (ot). This differentiation of the coefficient according to the groups and the types of the stoppages makes possible the conduction of the comparative analysis of the efficiency of the machines of the various types and the selection of the mostly progressive machinery. [3]. Analysis is done by the comparison of the same particular factors of effective time K_i, chosen for the comparable machines, according to the types and the groups of the stoppages: $КПВ_{ЦП}$, $КПВ_{Т}$ и $КПВ_{ОТ}$. Cycle particular factor of effective time ($КПВ_{ЦП}$) describes the constructional sophis-

tication of the machine (presence/absence of the idling, caused by the machine's supply, pick –up of the turned out products and etc.). Technological particular factor of effective time ($КПВ_Т$) means the stoppages due to the technological problems. Organizational – technical particular factor of effective time ($КПВ_{ОТ}$) characterizes the level of the labor organization and the working conditions. The calculation of the total coefficient of effective time is done according to the formula:

$$КПВ = \frac{1}{КПВ_{цп}^{-1} + КПВ_{т}^{-1} + КПВ_{от}^{-1} - 2}. \quad (4)$$

The comparative analysis of the certain production assesses the constructional sophistication of the machinery, their technological safety, level of the labor and production organization.

The effectiveness of the technical systems methodology is evaluated, first of all, by the indices of the growth rates of the labor productivity and also by the reduction of the costs for the output of the products. Formula (5) calculates the effectiveness achieved by the implementation of that or these innovations, aimed to the shortening of the stoppages duration of the machinery and to the increase of the labor productivity (ПТ). As a result of it, we have value of the cost reduction $\Delta C_{ПТ}$ for the production unit:

$$\Delta C_{ПТ} = \left[1 - I_{ЗП}\left(1 - КПВ_0\, t_{n_i}(1 - \frac{1}{\varepsilon})\right)\right] У_{ЗП}\ 100\%, \quad (5)$$

where $I_{ЗП}$ – index of the average salary; $У_{ЗП}$ – part of the salary including the deduction of the unified social tax, in the cost of the product.

As it is given here, formula (5) could be used for the one stage production (for example, for knitting). For the multiple staged textile production, formula (5) describes the value of the costs differentiation for the certain stage. The economic result through the implementation of the innovations is achieved by the value –added products, costs' reduction for the output and the increase of the grade of the turned out products.

The elaborated system - technical approach to the projecting of the technology, machinery and labor organization could be used for the revealing of the labor productivity growth reserves, along with the machinery modernization in spinning, weaving and knitting productions, as well as for the defining of the priorities aimed to the technological improvement of the fibers regeneration from the wastes. As a consequence, the "weak" technological points would be revealed, the tasks for the theoretical researches would be specified and the new technical facilities, providing the raise of the labor productivity and the competitive capacity of the goods would be developed.

CONCLUSIONS

1. The system - technical approach to the projecting of the technology, machinery and the organization of textile productions, including diagnosis, comparative analysis and forecasting of the effectiveness of the running and elaborating machinery and technologies is developed.

2. The comprehensive assessment of the technical – organizational innovations permits to solve the tasks of the successful development of the production in textile and light industry.

BIBLIOGRAPHY

1. *Kutepova K.V., Pobedimsky G.V.* Scientific Organization and Norm-Setting in Textile Industry. – M.: Light and Food Industry, 1981.

2. *Zharova N.G., Chistoborodov G.I., Chistoborodova M.I.* Survey of Reservs and Ways of Increasing Equipment Efficiency in Textile Industry // Vestnik IGTA. – 2001. - № 1. – C. 133 – 137.

3. *Nikiforova E.N., Zharova N.G.* The Problem of Choice of Equipment in Process Innovations // Scientific-Educational Potential of the Nation and Competitiveness of the Country: Collected Articles of the IV-th International Scientific-Practical Conference. –Penza, 2007.- C.115-116.

Recommended by the editorial board. Received 03.06.11.