OF OPERATIONAL COUNTING WIN PARAMETERS FOR A FAMILY OF TRIPS

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ANNOTATION

A simplified structure with a constant material and technical base and a changing mode of the technological process is proposed for the development (calculation) of generalized tables of a variant of work.

АННОТАЦИЯ

Предложена упрощённая структура с постоянной материально - технической базой и изменяющимся режимом технологического процесса для разработки (расчёта) обобщённых таблиц варианта работы.

Keywords – payoff parameter, work option, generalized table, optimal trajectory, mode characteristics, choice.

Ключевые слова – параметр выигрыша, вариант работы, обобщённая таблица, оптимальная траектория, характеристика режима, выбор.

The rationale for choosing the gain parameter in the problems of optimizing the transportation process for diesel and electric locomotives in operation is indicated in the study [1], which did not study the issues of an integrated approach to organizing the operational calculation of the optimal gain for a family of trips.

In production conditions, it is often necessary to make mass calculations of the magnitude of one or another possible optimal gain for a wide variety of cases of the process.

Such calculations are necessary to identify the normalized value of the payoff parameter B, which makes it possible to evaluate the results of the work of individual locomotive crews and performers, to spend money correctly, and to finance production. As a result, production efficiency will increase.

Thus, the identification of ways convenient for determining the results of work on the accepted payoff, taking into account the possibilities for the best conduct of the process, or, more precisely, normalized results, is of great practical importance.

In production conditions, where the number of different processes is large, it is not always possible to make the appropriate calculations of the gain parameter B for each case of the process with the choice of the optimal solution, even using a computer, due to the complexity and the need for large expenditures of time and money.

At present, for example, in locomotive depots, it is necessary to identify the normalized value of energy consumed for 300–400 or more routes, which will require a lot of time to prepare the initial information and computer calculations [2,3].

Apparently, it is expedient to carry out in advance the corresponding calculations on a computer to identify additional dependencies, using which it will be possible to compile the corresponding tables for calculating the gain parameter B for trips with sufficient accuracy for practice.

The foregoing raises the question of creating simplified methods for calculating the values of the payoff parameter B for a particular family of processes. All the number of processes of a particular production can be divided into work options (VR), for which the elements of the material technical base of the MB remain unchanged in the process of work, and only the elements of the organization of the work of the OP change and, accordingly, the technology or mode of conducting the process itself. If for each variant of VR operation we find the average values of the coordinates of the organization of work Op (for example, for each variant of the VR operation of the transportation work of depot locomotives - the average weight of the train Qp, the average number of axles in the composition mp, the average travel time on the section tp, the average number of stops on intermediate stations zp, etc., and then perform detailed traction and economic calculations for Computer with the optimization of the locomotive transportation process for average conditions, as well as additionally for three to four trips, covering the entire range of possible changes in the coordinates of the operation option Op, it is possible to obtain data that allow expressing the patterns of changes in the optimal trajectory (optimal control) P_т^* for the family work variant processes depending on the change in the coordinates of the work variant Op. The resulting optimal trajectory P_т^* of each case of the work option must be expressed through some of its characteristics, which we propose for trips: transformation of the term Vk into the mechanical tangential work Ak; α is an indicator of the perfection of the speed trajectory from the path along the main resistance and β is an indicator of the cost of the tangential mechanical work of the locomotive Ak for the work of the brake forces of the train.

In view of what has been said, for a family of trips at t = post, the value of the term of the payoff parameter Bk can be expressed by a complex dependence on several variables, namely:

$$B_{к}=f\{O_p,\ \eta_p\,(O_p),\ \alpha(O_p),\ \beta(O_p)\} \qquad (1)$$

where - Op is the object's operation organization vector.

The total differential VK will be

$$dB_\kappa = \sum_{i=1}^{\kappa} \frac{\partial B_\kappa}{\partial O_i} do_p^i + \sum_{i=1}^{\kappa} \frac{\partial B_\kappa}{\partial \eta_в} \frac{\partial \eta_в}{\partial o_p^i} do_p^i + \sum_{i=1}^{\kappa} \frac{\partial B_\kappa}{\partial \alpha} \frac{\partial \alpha}{\partial o_p^i} do_p^i + \sum_{i=1}^{\kappa} \frac{\partial B_\kappa}{\partial \beta} \frac{\partial \beta}{\partial o_p^i} do_p^i$$

(2)

where i is the number of coordinates of the work organization vector Op of the object, while i = 1, 2,...,k.

The solution of system (2) gives integral dependences of the form

$$B_\kappa = \sum_{i=1}^{\kappa} B_{o_p^i} = B^1_{o_p^1} + B^2_{o_p^2} + \ldots + B^\kappa_{o_p^\kappa} \quad (3)$$

However, the tables compiled according to these dependencies will be very complex and of little use for practical use.

In order to simplify the calculations of VK, the following simplification methods can be recommended:

1. Take in (1) the values of the characteristics P_m^* depending on only one coordinate of the operation variant Op, the most important for the given gain parameter of the Bk term, which are revealed when analyzing the structure of Bk in order to divide it into a number of terms.

Having identified the characteristics $\eta_{o_p^i}$, $d_{o_p^i}$, $\beta_{o_p^i}$, you can write the partial derivative in terms of its terms

$$\frac{\partial в_\kappa}{\partial O_p^i} = \frac{\partial \left(B_\kappa^1 + B_\kappa^2 + \ldots + B_\kappa^h \right)}{\partial O_p^i} \quad (4)$$

Here, based on the nature of the process, it may turn out that some of the components fall out, when ($\frac{\partial B_\kappa^i}{\partial O_p^i} = 0,$, that is, the partial derivative of this term of the payoff parameter Bk with respect to the coordinate of the work option Op is equal to zero).

Having carried out such an analysis, instead of (1) we can obtain

$$B_\kappa \approx f_1 \left\{ O_p^1, \eta_{O_p^1}\left(O_p^1\right), \alpha_{O_p^1}\left(O_p^1\right), \beta_{O_p^1}\left(O_p^1\right) \right\} + \ldots + f_\kappa \left\{ O_p^\kappa, \eta_{O_p^\kappa}\left(O_p^\kappa\right), \alpha_{O_p^\kappa}\left(O_p^\kappa\right), \beta_{O_p^\kappa}\left(O_p^\kappa\right) \right\}$$

(5)

integral dependencies, which will be of the form

$$B_к \approx B^1_{O^1_p} + B^2_{O^2_p} + \ldots + B^к_{O^к_p} \quad (6)$$

Terms $B^1_{O^1_p}$, $B^2_{O^2_p}$, … depend on only one coordinate and the tables will be quite simple and convenient, and also for all options for conducting a given type of process (for all processes of a given production) are the same, which is of great convenience.

Such tables will be called generalized tables (OT).

The deviations of the results obtained from the OT data will depend only on the difference in changes in the characteristics of the control mode for the adopted order, in comparison with its exact dependence on all coordinates of the operation variant Op. In many cases, the proposed simplifications make it possible to obtain results that are quite acceptable for practical use, allowing you to find the necessary data with minimal time.

2. If we take in expression (1) the characteristics of the optimal control

$P^*_т$ (we denote them by η_n, α_n и β_n), depending on two coordinates at once (for example, from O^1_p и O^2_p) provided that they are independent of the other remaining coordinates of the Op option - in this case, instead of expression (1), taking into account the possibility of splitting the total differential (2), we have

$$B_к \approx f_n\{O^1_p, O^2_p \eta_n(O^1_p, O^2_p), \alpha_n(O^1_p, O^2_p), \beta_n(O^1_p, O^2_p)\} + \Delta B_1 + \Delta B_2 + \ldots + \Delta B_n \quad (7)$$

This leads to a certain increase in the volume and number of tables for calculating the gain parameter B in all variants of the production process, with a corresponding refinement of the results of calculating Bk according to such tables and maintaining the simplicity of calculations.

Such tables are called work variant tables (TVR). With the accepted simplification, the integral dependences will be of the following form

$$B_к \approx B^n_к + \Delta B_{O^3_p} + \Delta B_{O^4_p} + \ldots + \Delta B_{O^n_p} \quad (8)$$

Unlike expression (3), here the term $B^n_к$ combines two values at once $B^1_{O^1_p}$ и $B^2_{O^2_p}$ и is expressed by the following dependence

$$B_{\kappa}^{n} = f_{n}\left\{O_{p}^{1}, O_{p}^{2}, \eta_{n}\left(O_{p}^{1}, O_{p}^{2}\right), \alpha_{n}\left(O_{p}^{1}, O_{p}^{2}\right) + \beta_{n}\left(O_{p}^{1}, O_{p}^{2}\right)\right\} \quad (9)$$

with identified dependencies η_n, α_n, и β_n, based on the production (execution) of traction - economic calculations (TER).

Terms $\Delta B_{O_p^3}, \Delta B_{O_p^4} \ldots$ in expression (8) are some correction values that refine the values $B_к$ when deviating O_p^3, O_p^4 .... from their average (calculated) values for a given work option.

The resulting structure of expression (9) is very simple and convenient for compiling an algorithm for calculating work option tables, and will be used in subsequent studies related to the forecasting and normalization of energy consumption for train traction by diesel and electric traction locomotives, along with the development of an algorithm for calculating data for generalized job tables.

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