Automated System of Prognosis of Resources Expenditure on Production of Metal Output

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Abstract[1]

The process of sheet rolled metal products production can be viewed as a sum of alternating operations of heating, deformation and cooling. To analyze actual expenditure on production, profitability of producing certain types of output and to examine technology on the purpose of reduction of its prices it is necessary to estimate expenditure on technology of producing each and every standard size, to create a matrix of expenditures. The important task consists in definition of expenses on the basic resources and materials for any standard size and any steel grade. Besides, it is necessary to predict costs changes when of changing of conditions or resources value.

1. Introduction

The process of sheet rolled metal products production can be viewed as a sum of alternating operations of heating, deformation and cooling.

The established methodology of estimating expenditure on production of rolled metal products has been leaning on normative basis. Enlarged characteristics of resources expenditure form such the basis. These characteristics have been defined on account of actual expenses, and their blending was implemented not only by assortment and the shops of one enterprise, but sometimes by groups of enterprises. Such methodology does not permit to find out real resources expenditure on output of different types and quality, to divide objectively these expenditure on certain technological operations [1].

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2. Publishing

The technology of calculating and prognostication of costs is based on usage of originally interpreted models of physical processes, which are the basis of certain technological operations (melting, milling, annealing, etc.). Thus, it permits to predict resources costs according to technical regimes of processing, which, in turn, depend on steel grades, standard size and quality requirements.

The technology of calculating is based on the following principles:

1. Main attention in the scheme of calculating is paid to distinct standard sizes and steel grades.
2. Calculations are discharged taking into account all the characteristics of technological operating conditions.
3. Resources costs are defined by separate units and technological operations taking into account the assortment being processed.
4. Differentiation of expenditures for all kinds of resources, including relatively constant costs.
5. Adaptation of methods of calculating resources expenditures to the actual data. In this case the level of adaptation depends on the possibility of specification of units, time intervals and volume of output.

Such approach permits to take differentiated stock of resources expenditures on all types of output, taking into account all its key characteristics with any definite level of specification. Calculations of expenditures can be made in form in kind on certain types of resources and in value form on one or several alterations.

Traditional methods of calculating expenditures, based on account of value of statistically average type of production and dividing all the expenditures with the help of coefficient of difficulty by groups of steel grades does not permit to reveal the real costs of production of distinct type of output. Actually we deal here with elimination of costs. This system of calculating has become widely spread due to its simplicity and intention to simplify the methods, acquainted with manual operations.

Now, having worked out such a method of calculating costs, appears the opportunity to define the costs of principle resources and materials for any standard size and any steel grade. Besides, it is possible to predict costs changes when of changing of conditions or resources value.

Realization of this approach is accomplished by the following scheme.

Suppose, there is a set of standard sizes per a certain period of time, for example per month. Each standard size is characterized by primordial and ultimate thickness, width, tonnage, operating conditions of processing. All the production costs in the frame of each alteration are made up of main articles and are defined for a studied calendar period of time.

According to the established technology of original models calculation of technological characteristics of a distinct process or operation is made. Later among the technological characteristics the normalizing technological dimensions, connected with costs of resources of different types, are essential.

For each of the articles a natural normalizing technological dimension is taken (time of processing, deformation work, heating temperature, etc.). Value of the normalizing dimension shows the dependence of costs on standard size, steel grade and peculiarities of technology.

Researcher has the main role in choosing normalizing dimensions. It depends on his experience and knowledge in the concrete sphere of production.

Technological factors can be defined for each steel grade and each standard size. To compare these values to each other it is necessary to match the coefficient of proportionality, or scaling coefficient [2]. The most convenient choice of coefficients is the choice according to standard sizes, as it has the minimal value of expenditure of element of costs or the maximal volume of production.

$$E = R_{\sum} \cdot K, \tag{1}$$

where $R_{\sum}$ – total value of the technological factor; K – the coefficient of proportionality; E – element of costs.

Thus,

$$E = R_{\sum} \cdot K = K \cdot \sum_{i=1}^{n} R_i \cdot M_i, \tag{2}$$

where R_i — "expenditure " of a technological factor per 1 ton of rolling of i – standard size (rolling work, length of 1 ton of rolling, time of processing, etc.); M_i — mass of i – standard size , processed within a studied period; $R_{\min}$ – minimal value of the factor among all the studied assortment (the scaling value) per 1 ton of rolled products, thus

$$E = K \cdot \sum_{i=1}^{n} R_i \cdot M_i = K \cdot \sum_{i=1}^{n} R_{\min} \cdot k_i \cdot M_i = \\ = K \cdot R_{\min} \sum_{i=1}^{n} k_i \cdot M_i \tag{3}$$

where k_i – coefficient of proportionality.

The coefficient of proportionality permits to judge how much costs of any standard size production prevails the minimal value.

$$R_{\min} = \frac{E}{K \cdot \sum_{i=1}^{n} k_i \cdot M_i} \tag{4}$$

Knowing $R_{\min}$ and K it is possible to define the value or costs in absolute units for any element of costs on producing 1 ton of scaling standard size.

$$Z_j = R_{\min} \cdot K_j = \frac{E_j}{\sum_{i=1}^{n} k_{ij} \cdot M_i} \tag{5}$$

Z_j – expenditure of costs of j – type on producing 1 ton of rolled products; k_{ij} – factor of labour input i – that standard size on j – to a that element of expenses; K_j – coefficient of proportionality j–element of costs; E_j – total expenditure of j–element of costs.

Total costs on production of 1 ton of rolled products of j–standard size can be defined as:

$$S_i = \sum_{j=1}^{m} k_{ij} \cdot R_{\min j} \tag{6}$$

$R_{\min j}$ – minimal value of the scaling factor for j-element of costs.

It is convenient to make a table of labor-consuming coefficients as a whole (matrix), where lines are for certain types of output and columns are for types of costs.

To analyze the dependence of costs on thickness and width you can make a matrix for distinct elements of costs; total costs – a matrix for alteration or aggregate. Such matrix should be made for each steel grade separately.

Such viewing of labor-consuming coefficients gives an easy way to analyze them, to group standard sizes and steel grades having close values of labor-consuming coefficients for distinct articles of costs or for total costs. This permits to minimize the matrix volume and to make it more visual.

Hereinafter the main functions of the elaborated system are put:

- input and editing of the initiate data, interstitial results and stand-by tables;
- receiving and primary processing of shops computers data;

- examining input data for propriety and consistency;
- calculating coefficients of resources costs per ton of rolled products;
- defining paragraph-by-paragraph costs for distinct standard sizes;
- comparison of different standard sizes costs, defining comparative coefficients of rising in price compared to the basic output;
- calculating the matrix of costs for all types of production in absolute and relative form;
- statistical analysis of production data by different criterions;
- analysis of dependence of different characteristics on standard sizes with definite level of specification;
- registration of factual production by alteration per a studied period of time
- registration of actual resources costs on rolling production;
- calculating of energy resources expenditure, raw materials and other resources on production of rolled products of different types;
- estimation of production value per 1 ton of rolled products;
- calculating coefficients of production efficiency for different types of rolled products;
- estimation of energy resources expenditure, raw and other materials for a definite production plan;
- estimation of economical efficiency of different production plans;
- representing results in form of reports and graphics;
- predicting certain types of costs when changing production volume;
- predicting costs when changing value of energy resources and other materials;
- predicting costs when changing assortment or proportion of volume of production of rolled products of different types.

While uniting standard sizes in groups sill values are taken to put grades and standard sizes to certain groups. Spacing is chosen according to the wanted number of groups [3].

Such information can be used for predicting costs and their changes according to different technical conditions. Researcher can use several methods of making prognoses:

1. Method "per January". The value of costs coefficient per January is taken as a predicting costs coefficient and the prognosis is made for other months. By analogy prognoses "per February", "per Mach" are made.
2. Method "by average". The value of costs coefficient for all the months is taken as a predicting costs coefficient. This coefficient can be used to make prognoses for other months.
3. Method of exponential smoothing. Sum of consumption coefficients for the previous months with the balance diminishing as the exponential curve due to the distance to the certain month is taken as a predicting value of a consumption coefficient for the certain month.
4. Method of predicting according to the matrix of costs. It is a complicated method of making prognoses based on specification of actual production.

The elaborated prognosis system permits to estimate costs changes (total and paragraph-by-paragraph) for any unit when of changing of production volume of certain steel grades or standard sizes.

3. Results

Possible ways of using the results of the system:

1. Constant accurate and fast re-calculation of labor-consuming coefficients and coefficients of rising in price due to the new data.
2. Reducing of material and monetary expenditures according to the choice of the most economical standard sizes for the made orders.
3. Calculating of material and monetary expenditures for different production plans in order to choose the most appropriate set of orders to be accomplished.
4. Choice of the most appropriate technologies for a set of units (according to the variability of characteristics of interstitial products).
5. Differentiation of the production prices according to its characteristics, based on the calculated expenditures. Using such differentiation it is possible to keep the average price at a certain level and at the same time to stabilize the profits of the enterprise.
6. Knowing the assortment production plan of a plant it is possible to accurately calculate the necessary resources costs. This permits to reveal the costs deviation comparing with the planned ones, define and locate unnecessary over expenditures.
7. Predicting resources costs when changing the production conditions.

4. Conclusion

The elaborated automated system permits to receive more detailed information on expenditures and help in setting prices for different types of products, reducing time of reaction to changes of economical and technical situations.

The specific feature of the proposed system is the possibility of dynamic calculation of costs for all types of products per a definite period of time, based on the actual data, regulated level of specification of the results and visual form of their presentation.

References

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