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ANALYSIS OF ELECTRICITY CONSUMPTION RATIONING AT ENTERPRISES FERROUS METALLURGY

F.A. Khoshimov, I.U. Rakhmonov (TSTU)

Annotation. Electricity consumption regulation is the primary technical basis for energy consumption planning. Electricity consumption is regulated in the form of specific electricity consumption per unit of production or per unit of work performed. Specific energy consumption rate is understood as the consumption of electricity necessary and sufficient to produce a unit of production or to perform a unit of work in the planned conditions of production and operation. Electricity saving takes place if its actual specific consumption is comparable with progressive norms developed on the basis of introduction of new equipment and technology into production, rational operation of technological equipment and electrical installations. One of the main directions of improvement of rationing is the choice of rationing structure taking into account the objective assessment of actual energy resources saving. The article shows the rationing of electricity consumption in the production of finished products at the enterprises of ferrous metallurgy, in particular, at the electric steelmaking industry. The results of the analysis of the state of electricity consumption rationing in the ferrous metallurgy industry are given. The developed multilevel structure of electricity consumption rationing based on the results of the study, which gives the prospects of determining the possibility of energy saving at the object under consideration, is described.

Key words: power consumption, rationing, specific consumption, power consumption planning, technological process, structure.

The formation of electric power indicators of industrial production, consumption levels and the nature of changes in electrical loads are based on the operating modes of the main equipment of the unit. The study and the correct assessment of the power consumption indicators of this equipment, taking into account its technical condition and the features of the technological process, make it possible to correctly analyze the dynamics of the electric load of the enterprise, identify reserves for saving electric energy, improve the accuracy of planning and forecasting power consumption [1-4].

Given that the power consumption of equipment determines the level of energy performance of production, the authors investigated the change in the main energy parameters of power consumption of this equipment. The optimal mode of operation of technological equipment and electrical consumers is determined by the lowest energy losses.

In addition, the specified mode of operation is determined by the consumption of electric energy at the time of release of the unit of production that meets the prospective standards, taking into account the use of modern machinery and equipment in the production process. Since the values of electric energy consumption on the final product are taken as norms, the planning and forecasting of electricity consumption is based on standardization [5-7].

Often there is a need to develop internal production standards, differentiated by articles of energy consumption and sources of loss. The basic principle for compiling such norms is to divide them into production processes. This makes it possible to control the consumption of electricity in all areas of production, especially those that have the greatest impact on the use of electricity and make it possible to identify production areas where energy is wasted. It consists of the costs of the process, the costs of auxiliary needs, as well as the loss of electricity in networks and transformers.

In addition, the norms of specific electricity consumption are essential for planning energy consumption for the current period and future. The methodically correct determination of the rate of specific electricity consumption per unit of output creates the basis for calculating the electricity demand of the sites and production as a whole [8-12].

Existing standards obtained by experimental statistical methods at ferrous metallurgy enterprises do not stimulate rationalization of power consumption. The development of sound standards can only be carried out if the entire set of data necessary for this has been identified. In addition to the proper organization of electricity metering, a detailed analysis of electrical loads and energy consumption by units, workshops and the enterprise as a whole, factors affecting the specific energy consumption should be identified, energy characteristics built, mathematical data from the experiment, etc. [13-15].

On the basis of the above, the authors developed methodological material "Methods of rationing the consumption of fuel and energy resources in the production of rolled metal of JSC "Uzmetkombinat" according to the state of energy supply and water supply systems, as well as measuring the load of units and the results of accounting for long-term (2012-2017) energy consumption for enterprise.

The methodological material was developed taking into account the "Rules for the use of electric and thermal energy" (Tashkent, 2009. P. 214), approved by the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 245 of 08/22/2009.

The teaching material makes it possible to determine the standardization of consumption of electricity, natural gas and thermal energy. Technological, workshop and general production standards have been developed. Calculation of specific energy consumption rates is carried out in energy and auxiliary workshops, in boiler plants, in compressor and ventilation plants.

The energy services of metallurgical enterprises often make inaccuracies in the rationing, assessment and distribution of energy resources, since they do not fully take into account the specifics of the production process, the modes of power consumption of technological equipment, and the features of its operation when using the above methods. This makes it necessary to improve the methods of analysis and standardization of power consumption of the plant, which is a self-supporting unit with an independent balance and reporting.

At the iron and steel enterprises, an important direction in the work on the efficient use of energy consumption is the reduction of energy costs in the production of finished products.

These costs, although they are decisive in energy consumption at all the numerous technological levels of production, nevertheless, at present they are not taken into account in electric power resources [16-18].

It should be noted that power consumption depends on the quality of the metal, on the technical perfection of technological equipment and the production process. Sometimes, to obtain 1 ton of finished products, it is necessary to process several tons of metal. And if the organization of production is not perfect, then there may be excess losses and, accordingly, energy overruns. Therefore, today the improvement of work on the regulation of electricity is relevant.

The choice of the rationing structure taking into account an objective assessment of the actual energy saving is one of the main areas of improvement of rationing. Electricity consumption standards are established with their mandatory control in the following processes and industries: energy-intensive technological processes and units; shop floor electricity consumption standards; electricity consumption standards for lighting, intra-shop electric transport, municipal and household needs; electricity loss standards in networks and converters; general factory electricity consumption standards [19].

By results of research in the field of standardization of parameters of electric power consumption by authors are improved existing methods of standardization of electric power consumption of ferrous metallurgy and the multilevel structure of standardization of electric power consumption at the enterprises of ferrous metallurgy is developed, different from the existing ones

that definition of value of norms and standardization of parameters of electric power consumption is made on the method and the program developed by authors which consider power and technological factors. As a result of what there is a possibility to raise accuracy of calculations. At each level of the hierarchy the systems of rationing on the basis of specific and general norms of electricity consumption at the general production, general workshop and technological levels, which are compared with the system of accounting and reporting on electricity consumption adopted at the enterprise (Fig. 1), have been developed.

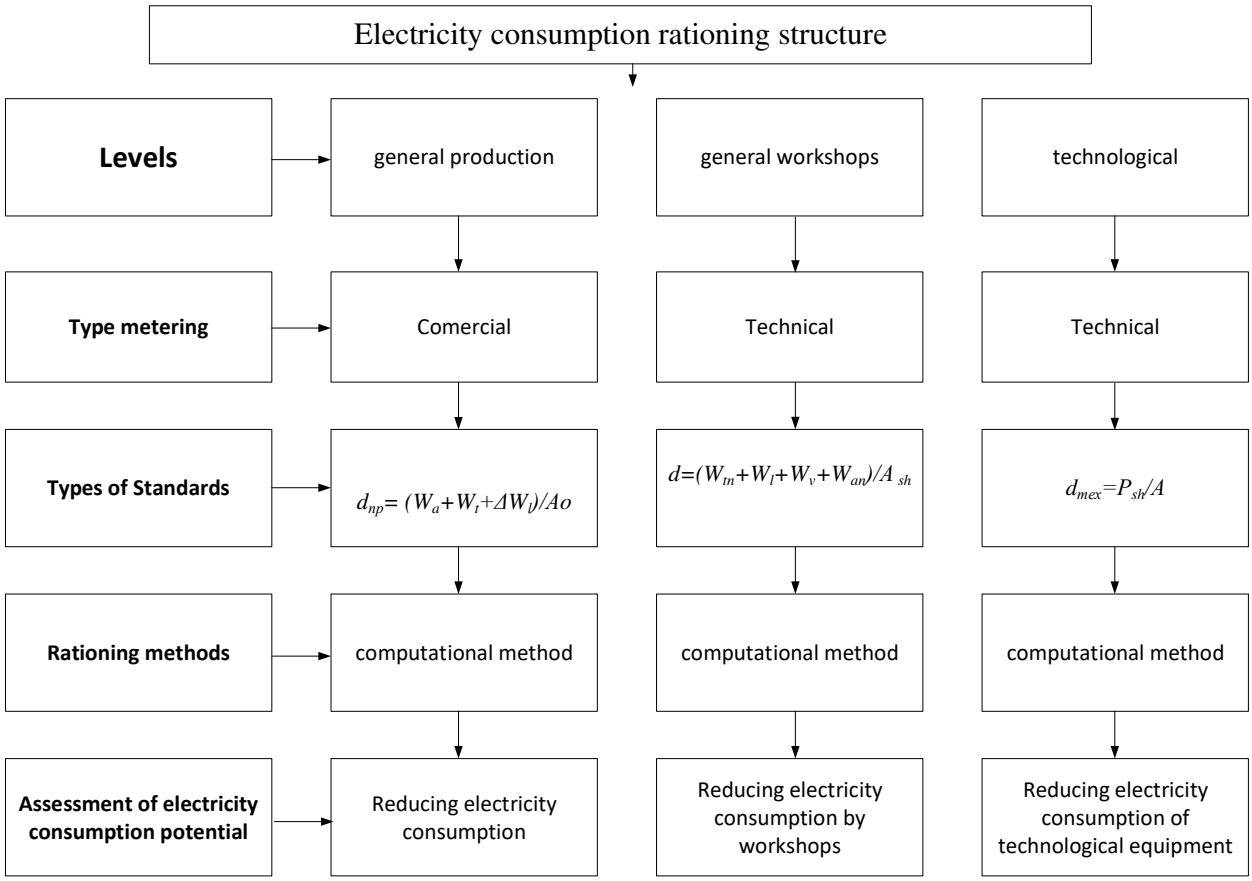

Fig. 1. Structure of enterprise energy consumption rationing

The structure of electricity consumption rationing consists of three levels.

The first level of the structure reflects the general factory level. This level takes into account the energy consumption of the main, auxiliary, shop floor and auxiliary needs of the production of final products. In order to control the change in the value of the specific consumption of electricity produced by the company as a whole and to determine the needs of the company in electricity, general production standards are calculated. When finding the indicators of specific electricity consumption of the enterprise also use general production standards, which are determined by the formula [20]:

$$d_{ot}= (W_a+W_t+\Delta W_l)/A_0 , \quad (1)$$

where W_a is the total electricity consumption in the main and auxiliary workshops;

W_{t-} total electricity consumption for heating, lighting, ventilation and hot water supply;

ΔW_l- losses of electricity in networks and converters;

A_O- production output.

At the industrial enterprises the consumption of electric energy is not stable as it depends on many factors (multi nomenclature of final production, quality of raw materials, etc.).

At the above levels, electricity consumption is rationed according to the proposed method using the Program for Calculation of Specific Electricity Consumption for Smelting of Electric Steel" (Certificate of Official Registration DGU No. 03544 of 17.02.2016), which determines the specific electricity consumption of the main stages (melting, oxidation and recovery) of the technological process. On the basis of the resulting value, the specific power consumption of the unit is determined, which takes into account specific values of furnace capacity, heat and energy losses. Taking into account such factors makes it possible to increase the degree of accuracy in determining the energy consumption. As a technically justified norm of specific energy consumption for steelmaking in electric furnaces should be taken a value that is achievable with the proper organization of the production process and operation of electric furnace equipment. Norms should be calculated on the basis of carefully developed instructions for the implementation of technological and electrical modes, which should be supplied to all electric furnaces.

The efficiency of the electric furnace can be judged by the specific energy consumption for the entire meltdown. However, in order to establish a more reasonable norm and to analyze the reasons that cause deviation of the actual consumption from the norm, it is necessary to consider the process of melting in separate periods [21-22]:

(a) The melting period of the solid fill;

b) the oxidation period;

c) recovery period.

In each of the above periods, the energy consumption is composed of the following: a) the period of melting of solid fillings; b) the oxidation period; c) the recovery period:

a) useful energy consumption;

b) covering heat losses;

c) covering electric losses.

At the second level, the issues of energy consumption rationing are considered in the workshops of the enterprises, where the norms of energy resources consumption for the production of the planned volume of products or works are met, in accordance with the standards adopted by JSC Uzmetkombinat. As an indicator of electricity consumption rationing, a specific rate of energy consumption of the shop is developed, which is determined as follows:

$$d_{wsh}=(W_{tn}+W_l+W_v+W_{an})/A_{wsh}\ , \qquad (2)$$

where W_{tn} - electricity consumption for technological needs, kWh;

W_l- electricity consumption for shop lighting, kWh;

W_v - electricity consumption for ventilation units of the shop, kWh;

W_{an} - power consumption for auxiliary needs, kWh;

A_{wsh} - output volume of the shop, t.

Normative expenses of energy resources consist of:

- Consumption on auxiliary processes;
- expenses for maintenance of technological lines;
- Electricity losses in equipment;
- consumption of energy resources for the technological process.

At the same time, the rate of consumption of energy resources for the technological process (lines) represents the third level of the structure of rationing. The rate of specific energy consumption by technological lines is determined as follows:

$$d_{wsh}=P_{dl}/A, \qquad (3)$$

where P_{dl} is the design load of the unit, kW;

A - unit capacity, t.

At the level described above, electricity consumption is rationed according to the proposed method using the Program for Calculation of Specific Electricity Consumption on Process Lines of Industrial Enterprises (Certificate of Official Registration DGU No. 03543 of 17.02.2016), which defines the norms of total and specific electricity consumption of process equipment. The proposed

method and program make it possible to determine the specific electricity consumption along the technological line depending on the electricity consumption and volume of output and the total electricity consumption of technological and own needs of industrial enterprises.

Thus, as a result of the conducted research on the basis of compliance with the melting process and a rational approach to the use of electrical energy consumption of DSP-100 UMK, a reduction in the specific consumption of electrical energy during the intensification of technological processes at the stages of melting due to the influence of electrical parameters of the energy mode of the equipment by 6-8 kWh/t was provided.

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