MODERN PREPARATION OF THE POWER-ENGINEERS FOR THE DEVELOPMENT OF RURAL TERRITORIES

Valeriy Karpov, Natalya Ivannikova
The St.-Petersburg State Agrarian University, Power-engineering Faculty (SPbSAU)
karpov39@mail.ru

Abstract. The new contents of special disciplines for preparation of the engineers is developed in SPbSAU. It provides power support study of the agricultural manufacture as reliable and opportune supply of the minimal energy to all power technological processes (PTP). This is deeper education in comparison with the level, accepted in Russia, of equipment choice. The basic points of the contents are those. The agricultural area occupies significant territories determining an opportunity of the use of resources of renewing sources of energy (the sun, wind, water, bioenergy). The traditional plan of equipment accommodation, determining now the preparation level of specialist, should be advanced up to the power chart, including power technological processes. Three types of (PTP) power technological processes, covering all variants of power use are offered. The concept of private profitable power is introduced and its growth of power saving is proved. Specialist, possessing such knowledge, becomes one of the managers of the enterprise. Such specific feature of agricultural manufacture, as a bioobject presence, determining all its technological format, obliges to conduct preparation of specialists in agrarian high schools only. The most probable form of power management in this branch is to render services to the enterprises by the specialized firm (outsourcing). The work of such firms will ensure the balanced development of rural infrastructure territories.

Key words: power saving, method of final relations, optimization, technical power audit, power profitability, power engineering management.

Introduction

The transition of agricultural manufacture in Russia to the market conditions has seriously aggravated a problem of production power consumption decrease and has presented new requirements to the specialists of enterprises power services. To formulate these requirements, it is necessary to understand the disadvantages of traditional engineering preparation. The main attention is paid to the choice of equipment, energy supply, protection and regulated service at exploitation. Thus, rated power of engineering equipment should correspond to the maximal calculated load. Following this principle provides high inherent reliability of the equipment life.

The disadvantage, found in market conditions, is that equipment works, as a rule, not in a nominal calculated mode, but in varied partial modes, at which the parameters of power efficiency become usually worse. To estimate the influence of such deterioration on power consumption of production at our university, it is offered to model power system of production not by separate units of equipment, but by the set of power processes, occurring while accompanying the movement of energy from input up to direct use.

Parameters of power processes

As the concept of energy saving is based on specific power parameters (main - power consumption of production) it is offered to add power technological processes to the equipment arrangement model, to save the compelled account, and market conditions of manufacture must be divided into causing expenses and proceeds (see Fig. 1).

The distinctive feature of such model is the presence of elements obviously meaning not the equipment, but power processes. Power technological processes (PTP) define the purpose of consumption of all kinds of power, because each of them provides getting any of private result, without which the realization of the whole production cycle is impossible.

The concrete purpose of PTP allows to classify them into three kinds [1]: basic industrial (PTP1), whose result is the product sold in the market: Auxiliary (PTP 2), which supply the basic (PTP1), for example, with preparation of raw material - threshing, splitting, drying, moisturing, mixing, forming etc.; creating necessary conditions for (PTP3), for ability to live, for growing plants, for looking, after animals (temperature, lighting, ventilation etc.).

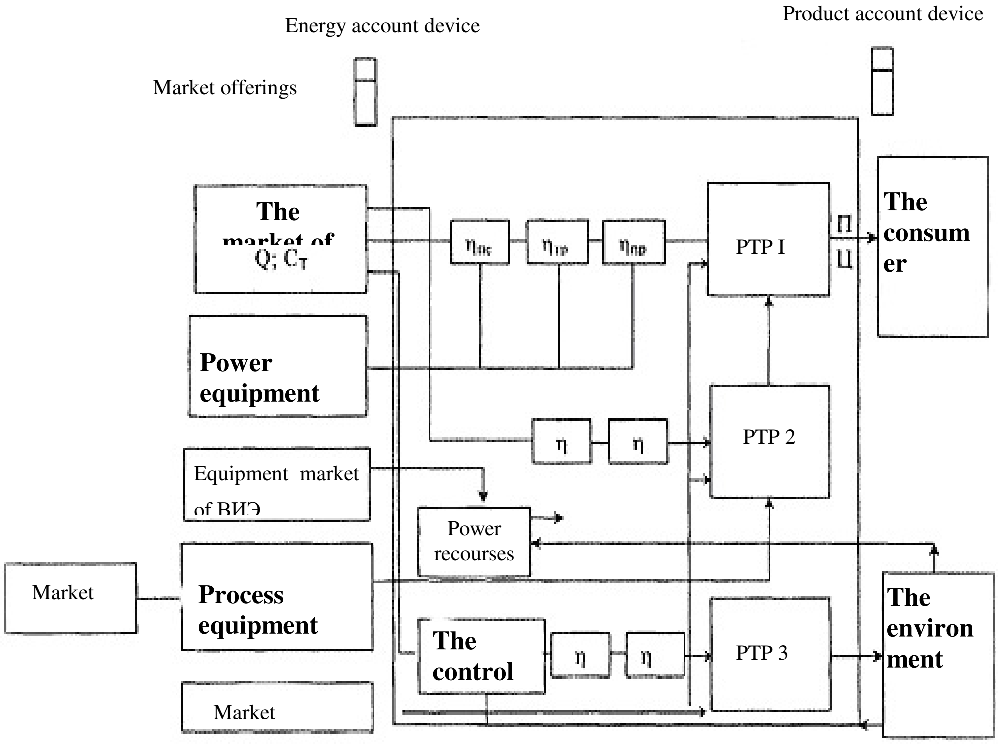

Fig. 1. **The power circuit of manufacture**

The introduction into the PTP plan inserts an important addition in the study of the equipment. Let's consider it as the example of PTP 1, ensuring the volume receiving П for the definite period of time at the energy consumption *Q*. As a rule, the preliminary study of the technological process backgrounds (physical, chemical, biological etc.) enables to determine theoretical meaning of energy $Q^{уд}$, necessary for the reception of expected quality of raw material. During the process realization together with measuring energy supply *Q*, we have two its meanings $Q > Q^{уд}$ *П*. The relationship between these two meanings gives us new parameter (see Equation 1).

$$Q_э=Q / Q^{уд} < П \tag{1}$$

This parameter has received the name of relative power consumption process [2], and its contents is opened by the derivative expression (see Equation 2).

$$Q_э=Q_n / Q^{уд} \tag{2}$$

Where Q_n – is an actual power consumption of production, parameter of criterion function of energy saving. Thus, the transition from the equipment study to the process study (corresponds to one of the main principles of the international standard of quality of management ISQ):

- establishes the relationship between the contents of education and basic target (not technical) parameter of manufacture;
- introduces relative parameter $Q_э$, applicable for power engineering processes in any element of consumption system;
- indicates the method of monitoring the efficiency of power processes in any element, in the basis of which we can find the relationship between the initial meaning of energy $Q_н$ and final one Q_k, that is $Q_э=Q_н/Q_k$ and it has received the name - method of final relations (MFR) (1)

Research method

The task of power saving, formed according power chart used in method of final relations MFR, is described in [3]. The solving of it assumes creation of special information-measuring system (IMS), which allows realizing MFR by registration final engineering parameters (for example, $Q_н$ and Q_k). The system must have the software for primary information processing, means of visualization and archives, interfaces to deliver information with the purpose of more detailed processing as well. For more distinct representation about the opportunities we must note, that the IMS relationship between relative parameter $Q_э$ and power consumption and the law of saving is very important.

Strictly speaking, while dividing the expression $Q_н$-$Q_к$=ΔQ upon $Q_к$ we can get it in relative parameters (see Equation 3).

$$Q_э-1=\Delta Q/Q_к \tag{3}$$

This expression opens the contents of efficiency process in dynamics, i.e. derivative $Q_э$ in time is equal to the derivative of relative losses. Besides, equating the derivative to zero allows to conclude that constancy $Q_э$ is the relation constancy of derivatives of $Q_н$ and $Q_к$, i.e. their synchronous change, that gives concrete sense to the management consumption energy system.

The use of the law of saving shows that a means of power consumption decrease is the relative losses decrease in any element, including PTP. The law of saving only establishes optimization limits of power engineering processes. According to expression (3) lover limit (minimum $Q_э$, is 1.0) is achieved by the decrease ΔQ up to zero, therefore $Q_э \rightarrow 1.0$ and $Q_n \rightarrow Q^{уд}$). The upper limit is $Q_э=2$, that corresponds the equality $\Delta Q=Q_к$, and as for the delivering element it means that at more increase ΔQ it begins to disperse energy. The specified limit for the whole system will means, that the energy disperses so much that is needed theoretically for manufacture. It is important to note, that if the meaning of non- economic growth (it happens when the production is increased at the expense of more expensive resources) is included into the manufacturing process, the optimal economic limit comes at equal limit use and limit costs [4]. The same analogue is more eloquent.

If to take into account, that at power consumption of separate elements $Q_{эi}$, the power consumption of their serious connection will be equal to their power consumption product $Q_{эл} = \prod^{n} Q_{эi}$ and $Q_э$ is directly connected to the power consumption meaning of production, then when power chart is available, there appears the possibility of address element control, i.e. the possibility of transition to the computer technological data analysis and process management.

It is necessary to emphasize, that IMS application means the control not only manufactures as such, but also the condition of all mechanisms and equipment, conformity of buildings and structures to the normative requirements (for example, in heat isolation, transparency and size of window apertures, infiltration etc.), efficiency of use of buildings in manufacture and so on. All these essentially expand and deepen the functions of power services of AIC enterprises, raise their rank and responsibility for an economic situation of manufacture and demand the form changes of power service. One of the directions of reforming is the transition to the outsourcing service by the firms, specially created for it. Such service will allow expanding management efficiency by power from separate enterprise to scales of industrial associations and regions.

The model of IMS was created at SPbSAU on the basis of 16 channel industrial sample registration ("Vibrator" plant) with the display, primary signal processing and computer interface. The tests have confirmed its efficiency to define, power consumption production and power consumption enterprise measures. The received experience has resulted into the belief, that power saving is necessary to consider as a complex of measures including technical power audit of consumer system with the help of IMS, project draft of power saving, measures and reconstruction consumption system with the account of terms and economic substantiations, step by step project realization.

Theoretical positions

At registration of meters indications in IMS, the basic information may be represented as a primary formed function and this makes the mathematical analysis very original. The primary formed function definition is the aim of mathematical accounts. It becomes possible to linearize the process in registration meter line in accordance with theorem about increments. It is important to note, that the transition to average derivative saves the meaning of complete increment, i.e. it does not insert any distortions to be main parameter account – the power meaning, bringing together the initial Q_H (t) and final linear primary formed functions into the Decart (cartesian) common coordinate system (Q; t) according to the method of final relations (MFR) allows to get the function of energy losses which cannot be received with the help of the device. The characteristics, represented in fig. 2, testify with complete evidence that the meanings of $Q_к$ repeat the meaning of $Q_н$ with certain periodicity. Mathematically it means, that the power engineering process can be considered as consisting of two reciprocal derivatives $Q_н$ and Q_k, determined by their meanings.

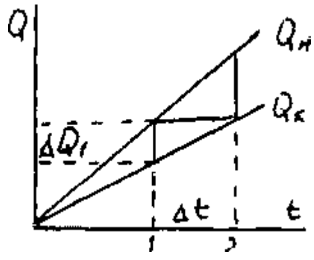

Fig. 2. **Initial and final energetic process diagram**

It is possible to show, that relative increase of losses is repeated with the same periodicity in $Q_э$ times, and this, on the first hand, confirms once again universality of this parameter, and on the second hand, makes possible for not continuous, but periodic control of process in order to define the growth of the decrease of relative consumption, that creates an opportunity for more accurate control of power consumption. The presence of these and deeper features gives the ground to tell that special mathematical direction can be developed which is nearly the same as mathematical physics.

As it was already specified, the introduction of (PTPI) into the power chart of enterprise enables to compare expenses for energy QC_T (C_T – is a tariff) with the income from the production realization *ЦП* (Ц – is a price of production) (see Equations 4 and 5).

$$K_эЦП=\alpha QC_T\,, \tag{4}$$

where $K_э$ – share of power in the cost price of production, a – income factor.

Having transformed this expression, we receive

$$Ц=\alpha/K_эQ_nC_T\,, \tag{5}$$

where Q_n – power consumption of production.

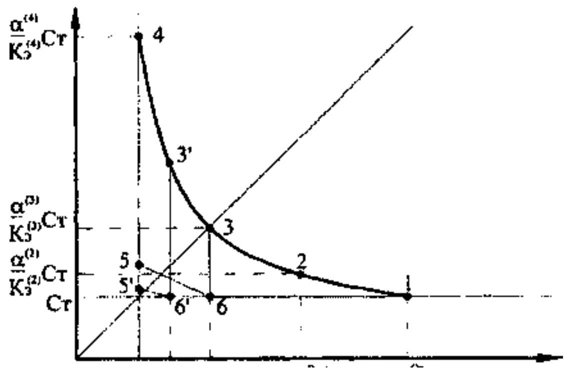

Fig. 3. **Growth of individual profit – making capacity of energy at the decrease of $Q_э$**

Let's note, that the factor $\alpha/K_э$ (α>1.0; K<1.0) is necessarily grows only at realization of measures on power saving (or reduction Q_n). Name this factor $\alpha_э=\alpha/K_э$ as individual profit-making capacity of energy and ascertain that individual profit-making capacity of energy appears and becomes growing in hyperbolic dependence from the decrease of Q_n (see Fig. 3). The limit of growth $\alpha_э$ is defined by equality $Q_n=Q^{уд}$.

Conclusions

Formulating the new requirements for preparation of power engineers it is necessary to take into account the main requirement – his or (her) readiness for productive-technological activity (this is an educational standard requirement). The power chart and process approach to the efficient analysis gives ground to consider, that the main productive function of power engineer is optimal power supply of all power technological processes and effective utilization of all power engineering resources. More profound theoretical preparation should be supplied at the expanse of addition of the basic contents of investigated disciplines with modeling and decision optimization. The significant role of information-measuring systems assumes serious study of modern information of manufacture maintenance. It is expedient to provide introduction of the applied mathematics course, the content of which should depend on a method and theory of power saving. The specificity of agricultural manufacture (ground availability, biological production opportunity of an effective utilization of renewing sources of energy and secondary power resources), relation with an environment, problem of development and steady developments of territories makes the preparation of specialists (power-engineers) a prerogative of agricultural high schools.

References

1. Karpov V.N Power saving. Method of final relations. – SPb.: SPbSAU, 2005. – 137 pages.
2. Karpov V.N. Introduction into the enterprises power saving of AIC.(agro-industral complex) – SPb.: SPbSAU, 1999. – 72 pages.
3. Karpov V.N. The power saving task // Mechanization and electrification of agriculture. – № 12, 2007. – C 3-5.
4. G. Daily. The narrow world // In scientific world (Scientific American). – № 12, 2005. – C 61-63.