EFFECTIVE ENERGETICS FOR RURAL LOCALITY (TERRITORIES)

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Abstract. Power capacity reduction of production under competition becomes a problem with increasing actuality. The production of agro-industrial complex together with centralized power supply received optional methods of power equipment and its service, worked out for industrial enterprises. However, agricultural production has special features, which influence (through the parameters of effective power utilization) the methods of power resources appreciation and methods of rational equipment operation. Let us take three main methods:

1. The availability of land plots of different functions;
2. The availability of biological objects in production structure;
3. Closer connection of production effectiveness with the environment conditions. The first peculiarity defines the power resource of renewed sources, including the secondary bio energy one.

The second peculiarity transforms the technological production regime from technical into bio technical one. Besides, with the help of biological object we can define the energetic structure of enterprise that is more different, e.g., for animal husbandry and hot house farms. The third peculiarity suggests the search for acceptable correlation of positive and negative environment influence, usage indicators of power, which can be obtained from natural fuel. The method of final relations (MFR), which was worked out at our University (St-Petersburg State Agrarian University) gave the opportunity to regard the power structure of the consumer as a system with an integrative property and it gives us the possibility to take into consideration these given peculiarities of agricultural production. The development of effective energetics will need more qualified specialists and elaboration (working out) of new forms of power system usage of production consumers. These two tasks (educational and scientific) must be solved at sectoral agricultural educational institutions.

Key words: power saving, optimization, engineering.

Specific features of power usage in AIC

The importance of power as a steady development factor of rural territories is obvious and does not require special confirmations. Moreover, the specific features of agricultural enterprises bind them to consider their power usage, taking into account the structure of fixed capital, kinds of manufacture, industrial waste, ecological requirements, local marketing and other aspects. In particular, these territories not only define the potential of solar, wind and hydraulic energy, but also can contain an essential resource of reproduced bioenergy. Compiling the power balance of agricultural enterprises (manufacture) it is impossible to be limited only to technical scheme of the manufacture. Besides, the essential specific feature is the presence of biological objects in the industrial structure. For example, the cultivation of plants in artificial conditions is based on leading to them electromagnetic energy in significant amounts during the maturing (period) cycle, considerably exceeding the duration time of production output. While breeding animals and birds, on the contrary, the direct leading is not present, but there is a certain dependence of their efficiency from the breeding conditions, created by power expenditure. An essential specific feature, which was aggravated in Russia during the recent years is the transition to market production conditions, exposed methodical imperfection of clear technical approach to the consumer power system, based on the choice of the maximal power equipment. The methodical imperfection has resulted in noncompetitiveness of the product in the market because of its high power consumption and cost price.

In [1] more perfect power scheme of the consumer, involving power technological processes is given and the method of final relations (MFR) is stated [2] as a basis of power expenditure optimization . This method has allowed to formulate a number of scientific rules, solving the efficient power consuming problem.

The basic scientific rules of MFR

1. The preservation energy law is based on a method, involving measuring parameters at the ends of technical elements (initial Q_{in} and final Q_f), determining losses ΔQ:

$$Q_{in} - Q_f = \Delta Q \,. \tag{1}$$

2. The transition to relative parameters of the preservation law (relative power consumption process $Q_e = \dfrac{Q_{in}}{Q_f}$ and relative losses $\Delta Q^* = \dfrac{\Delta Q}{Q_f}$), that have identical derivative in time and characterize the effectiveness of the process, that consume energy and, on the other hand, in losses:

$$\frac{Q_{in}}{Q_f} - 1 = \frac{\Delta Q}{Q_f}. \tag{2}$$

The introduction of industrial ETP to this scheme allows to proceed directly to power consumption of production $Q_{in}=Q_f\,P^{-1}$, if the minimal (theoretical) meaning of specific energy on a unit of production Q^{sp} is known:

$$\frac{Q_{in}}{Q^{sp}\cdot P} - 1 = \frac{\Delta Q}{Q^{sp}\cdot P} \text{ or } \frac{Q_p}{Q^{sp}} - 1 = \frac{\Delta Q^{sp}}{Q^{sp}}. \tag{3}$$

From here we receive the relation between the relative and actual power capacity in the form of equality $Q_p=Q_e.Q^{sp}$.

3. The independence of registered measured increments (Q_{in} and Q_f) from the function allows to proceed to the processes linearization and to build the effective analysis on multiplicate synchronism of the final parameter change. The measurements on separate elements give additional information about the effectiveness of the scheme.

4. The relative power consumption differentiation allows to define partial derivative, that reflects the influential degree, of every final parameter in order to measure the relative power consumption:

$$Q'_e = \left(\frac{Q_{in}}{Q_f}\right) = \frac{Q'_{in}}{Q_f} - \frac{Q_{in}}{Q_f}\cdot\frac{Q'_{in}}{Q_f}. \tag{4}$$

From here we get the condition of stability $Q_э$:

$$\frac{Q'_{in}}{Q'_f} = \frac{Q_{in}}{Q_f}. \tag{5}$$

This is a mathematical expression of changing synchronism of final parameters.

5. The graphic representation (production) of the private derivative Q_e is shown in Fig. 1. If final parameters measurements will be added by their relative increments, appears one more opportunity for MFR – temporary attachment of the loss change, that is dependent upon the working regime and energetic characteristics. The specified opportunities of MFR allow to carry out flexible management of power processes in a consumer system with the aim of decreasing the production consumption.

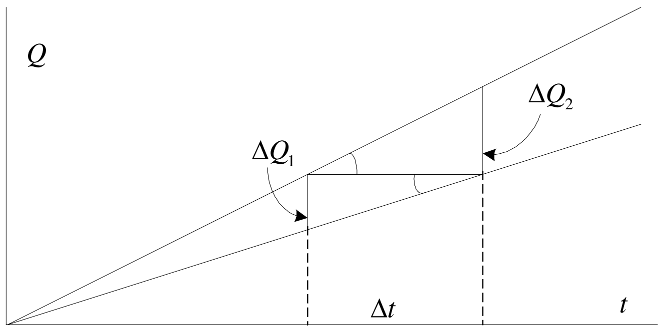

Fig. 1. **The graphical representation (production) of the private derivative Q_e**

Engineering of consumer system quality

The main feature of relative losses in expression (2) is that for the element they are increased together with the coordinate (length), they are increased with consecutive connection of elements in line, i.e., they are integrative parameters, and that forms recognition of the power structure by the system [3]. The energetic line is the basic kind of connection of system elements, at which the power consumption grows with the increase of elements number in accordance with the expression

$$Q_{elin} = \prod^{n} Q_{ei} \, . \tag{6}$$

Therefore, one can confirm, that the least meaning of this equation $\frac{\Delta Q}{Q_f}$, for the line will correspond only to the nominal element regime. To transit to the management of power processes effectiveness the method of the analysis is offered and it is based on the increments theorems. In particular, when a meter records power, new consequences of Langrange theorem can be proved about final increments. It is shown in Fig. 2, that we can conclude that

$$Q_2 - Q_1 = Q'(T)(t_2 - t_1) \tag{7}$$

there exists such time interval, during which power increment in a linear process model, will become equal to the actual increment according to the moment T. Obviously, the meaning Δt is a parameter, which characterizes the difference between the actual process and linear model. SQ the known measurements meaning, of the ΔQ divergence allows measurements meaning $\Delta t = \frac{\Delta Q}{Q'_{mid}}$ to be considered for sure. Then measurement Q_f at the moment (T +Δt) will allow to judge quantitatively about the change of derivative $Q'_f\,(t)$, i.e., about the dynamics of divergence of the curve and model. The bottom part of Fig. 2 illustrates the expediency of transition to the third model of the process determined by the average derivative $Q'_f\,(t)$ at each moment.

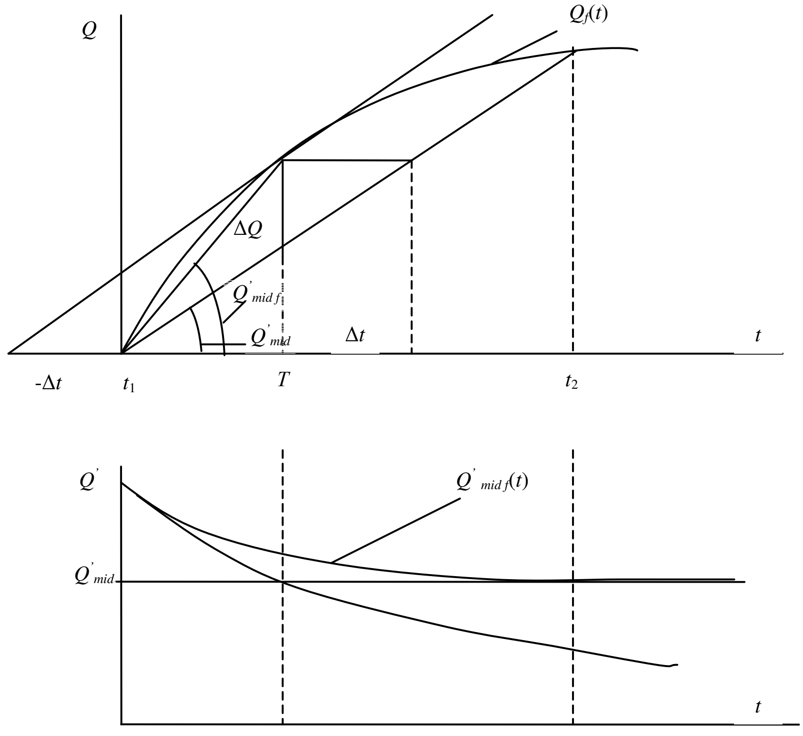

Fig. 2. **The graphical representation of change of derivative $Q'_f\,(t)$**

In a combination with MFR we receive the following expression, reflecting

$$\Delta Q'_f = Q'_{mid} \; (1 + \frac{\Delta t}{T}) \tag{8}$$

the dynamics of the process, necessary for estimation of growth distinction integral meaning Q_f and Q_{mid}.

The considered features give the bases to speak not only about expediency of transition from the concept “power structure” to the concept “power system“, but also to put a problem of management of the system. As for the purpose of management it is necessary to consider the decrease of the production consumption, that corresponds both to the reduction of the relative power consumption of separate elements and processes and reduction of the integrative parameter meaning $\frac{\Delta Q}{Q_f}$ or $\frac{\Delta Q^{sp}}{Q^{sp}}$ for ETP. Quite clear, that such purpose management of this system is possible under the influence on the element condition (state) and process effectiveness, i.e., under the aim of quality management of the whole system functioning. The introduction of the quality concept of functioning is not a simple transition to the new term. As it was already specified, the first stage of power structure creation is the choice of the equipment, that is carried out at maximal loading and determining only one parameter of the element (as a rule, nominal), that corresponds to the state, providing the power consumption reliability under extreme mode high efficiency . The real system exploitation will inevitably require (in addition to reliability) another quality – minimal losses, i.e., the state of element, which has not been stipulated by its internal power characteristic. By present time the essential positive experience of quality management organization, is generalized according to the international standard ISO 9000 and there are positive results while using this experience in complex technical structures [4].

Maintenance of engineering

It can be explained especially, that two perspective circumstances, essentially adding expediency of transition from the power consumer structure (the main aim of it - the choice of the equipment with maximal loading) to power integral system, where power processes may be characterized by qualitative parameters, operating with which it is possible to ensure the maximal quality of all consumer system.

On the one hand, the monitoring service project system automatic control development, its installation and adjustment should appear as external firm, this will mean transition to the outsourcing service, providing maximal quality of the whole power consumer system.

On the other hand, rendering similar services there must be organized the aim of preparation of specialists and their knowledge should be higher than the knowledge of the engineers trained now, capable to carry out only a competent choice of equipment. First of all, we can speak about more deeper, more purposefully for the fundamental preparation (higher mathematics, theory of power processes in the equipment and technological processes, information technologies of reception, processing, transfer and usage of the data in energetic, energy management, economy of high-quality energy (power) systems etc.). The specificity of power systems gives us the possibility to put a question about the introduction of an applied cycle for power engineers “Mathematical power”.

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