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Optimization of electricity generation mode, energy-intensive units, operating and various regimes production

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Abstract. The article provides an analysis of the optimization of the modes of electrical loads of energy-intensive units operating in various production modes, in particular, the mode of continuous operation of the unit, the mode of continuous operation, the mode of continuous operation of the unit with a constant hourly output, the mode of continuous operation of the unit with varying productivity, the operation of the unit in variable mode. And also measures are proposed to reduce power consumption, taking into account the technological process.

1 Introduction

An analysis of the work of enterprises in the cotton and silk industries shows that they have significant reserves of energy savings that require the most complete identification and rational use. Their implementation largely depends on the correct organization and feasibility of rationing electricity consumption. The scientifically based rate of specific electricity consumption per unit of output creates the basis for calculating the electricity needs of production sites, workshops and the enterprise as a whole [1-5, 16, 17].

2 The current state of the investigated problem

The work of industrial enterprises is carried out on the basis of progressive rationing, the purpose of which is to determine the consumption of electricity per unit of output for specific production conditions, ensure the rational and economical use of electricity in the production process, and establish the initial value for determining the need for production in electricity.

One of the most important issues to be solved in the development of energy saving technology for power-consuming industrial facilities is to ensure the minimum level of power consumption. At the same time, it should be borne in mind that the nature of the power consumed is strictly subject to the technological regulations of the unit operating in both constant and variable load modes. The complexity of solving the problem is also in the fact that under operating conditions there is a significant deviation of electrical loads due to the influence of various random factors [6-12, 18, 19].

The technical literature discusses methods for constructing "typical graphs" of electrical loads based on identification classification methods that allow the use of mathematical models to solve optimization problems.

However, the use of a set of "typical graphs" of electrical loads and their probabilistic characteristics does not provide the desired accuracy in the calculation of electrical loads and their optimization in the conditions of operation of energy-intensive equipment, since the gap between the calculated and actual loads of industrial enterprises is estimated at 200% [13-15, 20-24, 2].

Studies carried out from the standpoint of a systematic approach make it possible to develop methods for optimizing electrical loads in determining clear dependencies between the operation of an electrical wire and their energy performance.

Below we consider the solution of the problem for the most typical operating conditions of the units.

3 The mode of continuous operation of the unit.

The continuous operation mode of the unit has two characteristic features [25-27, 8, 14]:

a) continuous operation with constant hourly output;

b) continuous operation mode with varying performance.

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$$P = P_{id} + P_{aux.mech} + P_u \quad (1)$$

When the units are operating in the and modes, the power consumption can be expressed by the following formula: where is the P_{id} -idle power; $P_{aux.mech}$ - power of auxiliary mechanisms; P_u - useful power of the unit. In those cases when, under the influence of random factors, there is a fluctuation in the value of P, the average value is taken as the calculated load. Power, as a rule, can be taken as a constant value. An exception can be made for units, idling power, which may undergo a certain change during the billing period. An example of this is cement tube ball mills, whose grinding media lose their weight over time, as a result of which the idle power consumption is significantly reduced [28-33, 21, 9].

The mode of continuous operation of the unit with a constant hourly output. In this mode, the power consumption is practically unchanged, provided:

$$P_{id} = const; P_{aux.mech} = const; P_l = const; A = const$$

Under the condition, $P_{id} = \text{var}; P_{aux.mech} = const$ the resulting power for the billing period varies within certain limits.

The mode of continuous operation of the unit with varying performance. Under operating conditions, there may be various disturbances in the rhythm of the supply of processed products, which is associated with a change in productivity and, accordingly, power consumption. In this case, $P = f(A)$ the nature of the change in power consumption can be expressed.

4 Operation of the unit in variable mode.

The operation of a number of units can be characterized by the following modes:

1) The mode of alternation of the maximum load with a complete shutdown of the unit.

2) The mode of alternating the maximum load with the idling of the unit.

3) Mode of alternating maximum and reduced load.

In all these modes, the average power is taken into account, which is determined depending on the performance in accordance with formula (1).

A special place in the calculation of the power consumption in the unit when operating in these modes is occupied by the starting costs of the units, which in some cases have a significant share in the total power consumption. The value of starting costs (start and stop mode) has a significant impact on the energy performance of the unit and for each of them it has its own characteristics. The value of these costs in most cases is determined experimentally and should be taken into account in the process of optimizing power consumption modes.

Measures to reduce power consumption. The choice of the most advantageous mode of operation of the unit, providing a reduction in power consumption, can be ensured by the following measures:

- reduction of the idle speed of the unit due to its correct operation, adjustment of the unit,
- timely and high-quality lubrication, modernization and replacement of individual components;
- reduction of idle time when operating in variable mode;
- reducing the load power of the unit by regulating its speed, monitoring the quality of processed products;
- control of the current and voltage regime during the operation of electrothermal units, as well as optimization of their values, taking into account the specific features of the technological process.

The choice of the most advantageous mode of operation of the unit under conditions a and b can be carried out in accordance with the nomogram constructed according to the expression $P = f(A)$. In particular, $0 \rightarrow P_{\max}$ with performance A, the mode will be preferable if, according to the conditions of the technology, the specified mode can be allowed. In this case, the average power $P_{id} \rightarrow P_{\max}$ for the regime will be reduced by the value $P_A = P_B$.

5 Conclusion

The energy services of textile and cotton enterprises still allow inaccuracies in the rationing, evaluation and distribution of energy resources, since they do not fully take into account the specifics of the production process, the power consumption modes of technological equipment, the features of its operation, therefore, it is necessary to improve methods for analyzing and predicting the power consumption of the plant (industrial Association), which is a self-supporting unit with an independent balance sheet and reporting.

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