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Development of method for normalizing electricity consumption

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Abstract. The article deals with the calculation of specific indicators of electricity consumption for the production of auxiliary components the technological process. Based on the results of the authors, a method for calculating the normalization of energy in the absence of source materials is proposed. In addition, the method makes it possible to determine the norms of energy consumption given the deviation of the actual values from theoretical.

One of the determining conditions of cost reductions in industrial enterprises and improve economic efficiency of production in general are the rational use of energy resources. However, energy-efficient way of development of the domestic economy is only possible when the formation and implementation of energy efficiency programs in individual enterprises, for which it is necessary to establish an appropriate methodological and methodical base. Delaying the implementation of energy efficiency measures causes significant economic damage to enterprises and negatively affects the overall environmental and socio-economic situation [1].

Energy efficiency is one of the most important indicators of the efficiency of the enterprise as a whole, and for the steel industry, with the characteristic of great energy, and one of the reasons for its survival.

In today's day industries become more popping up new production facilities, equipped with the latest standards. Many companies have built a production process on the basis of compressor equipment. One of the main indicators of the efficiency of the compressor is the specific consumption of energy expended to produce compressed air. To assess the feasibility of using electricity compressor machine requires that its consumption is not coming out of the limits of the rules.

The refore, all companies with compressors, required to establish technically sound consumption rate of electricity to produce compressed air for each compressor machine [2-3].

The specific consumption rate of the electric power on production of compressed air consists of the following elements:

$$E = E_1 + E_2 + E_3 \qquad (1)$$

where E_1 — power consumption on the compressor drive;
E_2 — power consumption on the drive of pumps of the cooling system;
E_3 — power consumption for auxiliary needs of compressor installation (lighting, ventilation, the electro crane, machines, etc.)

The electric power expense can be determined by pumps of the cooling water system:

- With counters of the electric power consumed electrical engines of pumps or by amount of the cooling water, its pressure and to the coefficient of performance of pumps on a formula

$$E = \frac{NQ_w}{3600 \cdot 102\eta_p \eta_e \eta_{trans}} \qquad (2)$$

Where N — a water pressure, including also height of absorption, m of water column;

Q_w — an hour consumption of water;

η_p — Coefficient of performance of the pump;

η_{trans} - coefficient of performance of transfer is accepted on the following.

To data belt 0, 94 — 0, 98, to V-belt 0, 88 — 0, 98, to reducer 0, 88 — 0, 96.

The norm of a specific expense on production of compressed air to be established with a single compressor and the station in general needs for two periods of year, winter and summer [4-6].

For establishment of a consumption rate of the electric power on production of compressed air the materials of tests of compressor machines given to operation, based on the correct indications of instrumentations and theoretical calculations have to serve. The initial value of a specific expense of the electric power is determined by these materials and normal service conditions are established according to which for receiving norm necessary amendments to it are entered [7].

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In case of lack of materials of test and data of operation the initial value of a specific expense of the electric power is determined by a formula

$$S_{ini} = \frac{1000\, L_{is} a_{cor}}{3600 \cdot 102 \eta_{is} \eta_e \eta_{trans}} \quad (3)$$

here L_{is}- isothermal operation of the compressor, m kg,

$$L_{is} = 23000\, \rho_1 V_1 1g \frac{\rho_2}{\rho_1} \quad (4)$$

where P_1 - pressure of absorption, ama;
P_2 — the final pressure of compression, ama;

$1g\frac{\rho_2}{\rho_1}$ — relation logarithm value;

V_1 — the initial soaked-up air volume, equal to 1 m.

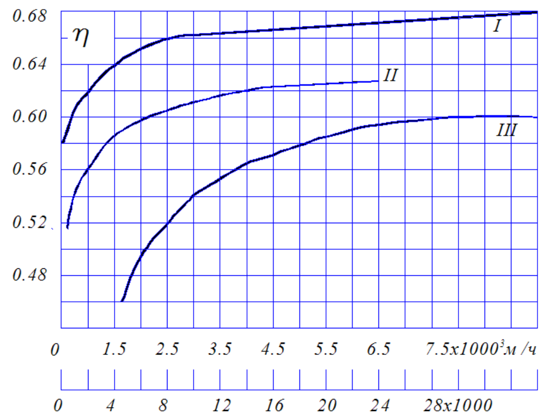

Fig. 1 Average value of isothermal coefficient of performance for various types of compressors depending on productivity at pressure of compression of 8-9 ama of loading

I - piston compressors; II - rotational compressors; III - turbo compressors.

η_{is} — isothermal coefficient of performance of the compressor, we define; with test of the compressor or fig. 1;

η_e — coefficient of performance of the electric motor;

η_{trans} — coefficient of performance of transfers from the electric motor to the compressor;

a_{cor} — the correction coefficient for transfer in normal cubic meters (nm^3), is on a formula;

$$a_{cor} = \frac{1{,}205}{\gamma_v} \quad (5)$$

where γ_v the specific weight of the soaked-up air in the valid conditions,

$$\gamma_v = 0{,}465 \frac{B_{av}}{273 + t} \quad (6)$$

where B_{av} — average barometric pressure, mm of mercury

t - temperature of the soaked-up air for the period of rationing ,°C.

The initial value of a specific expense of the electric power won't be final as the found value belongs to certain conditions: to pressure, loading and to a condition of the compressor. In practical conditions it is necessary to make a number of the amendments considering a deviation of the valid conditions from the theoretical to the found initial value of a specific expense [8].

These amendments have to be considered by the following coefficients:

a) In the coefficient considering wear of the compressor. For new compressors it is equal to unit, and for old machines of piston and rotational types not lower than 0, 90, for turbo compressors not lower than 0, 95. Decline in production below the given norms isn't allowed, and the compressor has to be exposed to capital repairs.

b) In the coefficient considering the final pressure of compression.

c) In correction coefficient, on absorption temperature.

Thus, the economy of the electric power on compressor installations has to be based on the correct organization of rationing and creation of progressive consumption rates of the electric power. Norms have to be under construction on the basis of the technical calculations corresponding to a current state of equipment, features of production in the production technology.

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