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Electric drive efficiency criterion for specific energy consumption

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The article considers the choice of a generalized criterion for the efficiency of an electric drive according to the spent energy of a railway rolling stock. The quality indicators of the automated electric drive of railway rolling stock are analyzed and a conclusion is made on the use of a generalized efficiency criterion for the operation of railway transport in an optimal mode.

Energy efficiency is the basis for the performance of technical systems. Energy efficiency has always been closely related to the energy crisis in the world. In the past it was a temporary event, but these days it has become a permanent and global problem due to pollution. The name has ranged from energy conservation in the early 80's, through energy efficiency in the 90's, to energy efficiency today. Electric drives account for about 65 % of electricity. Therefore, electric drives have great potential for energy savings, technically and economically. Electric drive efficiency depends on many factors including: motor efficiency, motor speed control, proper calibration, power quality, distribution losses, mechanical transmission, maintenance practices, mechanical end-use efficiency (pump, compressor, fan, etc.) [1].

Generalized criterion of traction electric drive efficiency, should provide all quality indicators. Since extreme values of indicators are not realized simultaneously, it is necessary to find such solution, which would satisfy average values of efficiency criterion. This condition can be realized using not only the electric drive, but also the control system with vector optimization. At present, there is no detailed analysis of quality indicators of the automated electric drive, and there is no methodology for selecting the optimality criterion [2].

While the unregulated electric drive was and still is dominated by the asynchronous motor, the regulated drive has, until recently, almost exclusively used the direct current motor. In recent years, with the advent of reliable and affordable frequency converters, the situation has changed dramatically. In Europe by 2000, only 15 % of adjustable frequency drives are equipped with DC motors. Therefore, it is relevant to consider the problem of energy saving mainly in relation to asynchronous electric drive, including frequency – controlled drive.

In the world practice there are several main directions of solution of the mentioned problem [3].

Power efficient motors (PM) are asynchronous motors with squirrel-cage rotor in which it is possible to increase the rated efficiency by 1–2 % (powerful motors) or by 4–5 % (small motors) at some increase of motor price by increasing the active materials mass, their quality as well as by means of special methods.

This approach can be beneficial if the load varies little, speed control is not required, and the motor is properly selected.

Correct selection of a motor in terms of power for a particular process. It is known, that the average load of the electric motor (relation of power consumed by the working body of the machine to the rated power of the electric motor) in the domestic industry makes 0,3–0,4 (in the European practice this value is 0,6). This means that the motor operates with an efficiency much lower than the nominal. Excessive «just in case» capacity of the motor often leads to imperceptible at first sight, but very significant negative consequences in the technological sphere serviced by the electric drive, for example, to the excessive head in hydraulic networks, associated with the growth of losses, reduction of reliability [4].

Application of filter-compensating devices in electric drive power supply circuit in order to increase power factor and filter higher current harmonics. In an unregulated electric drive with an induction motor running idle for a part of a cycle – voltage reduction with load reduction. The above-mentioned directions concern energy saving in the drive itself and have the purpose to reduce losses for transformation of electric energy into mechanical one and to increase energy parameters of electric drive. Automated electric drive gives wider opportunities for energy saving up to creation of new energy saving technologies.

Therefore, the main way of energy saving by means of electric drive is to supply at each moment of time to the final consumer the required power exactly at that moment. This can be achieved by controlling the coordinates (i. e., speed and torque) of the drive in a regulated electric drive. This process has become central to the development of electric drives in recent years, and the transition from unregulated to regulated drives in technologies where it is required is expected to reduce up to 30 % of the electrical energy.

Specific power consumption, designated ωd and measured in kilowatt-hours per unit of production, the value ωd is an integral indicator of power consumption per unit of production, for example, kWh per 1 ton of soil (kWh/t); this value usually includes power consumption for all auxiliary needs, such as electric lighting of the face. This value plays a major role in calculations related to determining electrical loads and power consumption, and is equal to:

$$W_{Sp} = \frac{W}{M},$$

where W – energy consumption, kWh; M – production in kind, for example, T.

Reducing losses in supply networks. The problem of power losses arises due to the low, especially at low loads, power factor, due to which the current flowing in the supply lines, transformers, is higher than the current associated with active power, hence, the losses in the lines are higher.

The problem of reactive power compensation traditionally enjoys great attention in domestic practice. Various technical solutions have been found and applied (switched capacitor banks, synchronous compensators, filter-compensating devices, etc.).

However, most of these techniques are oriented on unregulated and sometimes strongly unloaded electric drive with squirrel cage induction motors. The achieved effect can be incommensurably less than the losses from the use of unregulated electric drive.

Other ways to save energy in the unregulated electric drive include: reducing the no-load time; switching the windings by Δ-Y schemes for no-load or low-load times; changing the type of braking in electric drives with frequent starts and brakes [5]. Specific power consumption $F_7 = \frac{|W(S)|}{\varphi}$ (J/Rad).

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Английская архитектурная терминология в описании стиля барокко кампусов Оксфордского университета

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В статье описаны основные характеристики терминологических единиц, используемых при описании кампусов Оксфордского университета, выполненных в стиле барокко. Даны основные характеристики используемых терминологических единиц, таких как этимология, компонентность и количество их значений в научно-популярных текстах по данной тематике.

Целью данной работы является изучение архитектурной терминологии при описании стиля барокко кампусов Оксфордского университета на основе анализа структурных и понятийных единиц, используемых в текстах научно-популярного стиля, www.british-history.com.

Кампусы оксфордского университета представлены различными архитектурными стилями. К данному архитектурному стилю принадлежат три