International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 4 Issue 10, October - 2020, Pages: 107-108

Basic Ways to Improve Efficiency Operations of Asynchronous Electric Drives

Olimov Orif

Faculty of Power engineering and Radio electronics
Jizzakh polytechnic institute
Jizzakh city, Uzbekistan
Uchqun8822@gmail.com

Abstract — *Ways to save energy in asynchronous electric drives and improve the efficiency of working modes of electric drives are analyzed in this paper*

Keywords — electric drive; thyristor voltage Converter – asynchronous motor; phase rotor; technological process; DC and AC;

Currently, the main type of regulated electric drive is a frequency-controlled asynchronous electric drive - the system "semiconductor frequency Converter-asynchronous motor". However, along with this electric drive, in some cases for solving individual production tasks and energy saving, the system "thyristor voltage Converter – asynchronous motor" is used, which provides voltage regulation of the first harmonic of the voltage supplied to the stator.

In operation are also electric drives based on asynchronous motors with a phase rotor, regulated by changing the additional resistances in the rotor circuits, the so – called rheostat control systems – "rheostat control device – asynchronous motor with a phase rotor". Especially many of these electric drives are part of lifting and transport mechanisms.

Taking into account the above methods and control systems for asynchronous electric drives, it is possible to outline the following directions for reducing AD energy consumption.

The first direction is associated with the reduction of losses in the electric drive when it performs specified technological operations according to specified tachograms and with a certain loading mode. These are electric drives that operate in start-and-stop modes (cranes, elevators, main drives of slabs and blanks, auxiliary positional mechanisms of rolling mills, etc.) or long-term modes with a slowly changing load (pumps, fans, compressors, conveyors, etc.). In such electric drives, due to the reduction of electric drive losses in steady-state and transient modes, significant energy savings can be achieved. In cinematically connected electric drives (roller rails, multi-motor bogie drives, etc.), a uniform division of loads between the motors also minimizes losses in them.

The second direction is related to changing the technological process based on the transition to more advanced methods of regulating the electric drive and the parameters of this technological process. This reduces the energy consumption of the electric drive. As an example, electric drives of turbo mechanisms (pumps, fans, turbochargers), reciprocating pumps and compressors, conveyors, fuel — air ratio control systems, etc. can be used. In this case, as a rule, the effect is not limited to saving electricity in the electric drive, in many cases it is possible to save resources (water, solid and liquid fuels, etc.).

Both of these directions are characterized by the fact that they reduce energy consumption in the electric drive: in the first case, due to reducing energy losses, in the second, due to the use of less energy-consuming process control on the part of the electric drive.

We can also mention the third direction, which ensures the implementation of energy-saving technologies. It is known that there are a number of technological processes where an electric drive of relatively small power controls the flow of energy, the power of which is tens or hundreds of times greater than the power of the electric drive. Such objects include DC and AC arc steelmaking furnaces, vacuum arc furnaces, ore recovery furnaces, induction heating plants, etc. On them, electric drives with a capacity of several kilowatts can control a process that consumes tens or even hundreds of megawatts. It is obvious that the efficient use of such significant amounts of energy largely depends on the perfection of the electric drive, its speed and accuracy, the degree of automation of the process. This direction is not associated with a decrease in the energy flow through the electric drive, more often than not, the energy consumption of the electric drive even increases. Nevertheless, since this direction is associated with significant energy savings, let's consider it on the example of an arc steelmaking furnace.

Let's formulate the ways of energy saving in an asynchronous electric drive.

In the first direction, the following ways can be used to reduce energy losses in an asynchronous electric drive.

1. Reasonable choice of the installed motor power corresponding to the real needs of the controlled mechanism. This task is related to the fact that the load factor of many engines is 50% or less, which indicates either a low qualification of developers, or the imperfection of the used method for calculating the power of the electric drive. It is obvious that an engine of low power quickly fails due to overheating, and an engine with a large power reserve converts energy inefficiently, i.e. with high specific losses in the engine itself due to low efficiency and in the supply network due to a low power factor. Therefore, the first way is to improve the methods of selecting engine power and checking it for heating, as well as to improve the skills of developers, designers and maintenance personnel. In practice, there are cases when a failed motor is replaced by a suitable shaft height or

diameter, and not by power. The existing methods of selecting engine power and testing it by heating can only be considered as a first approximation. It is necessary to develop more advanced methods based on accurate accounting of the operating modes of the electric drive, changes in its energy indicators, thermal processes in the engine, insulation conditions, etc. Of course, this implies extensive use of computer technology and special software.

2. Transition to more economical engines, in which the rated values of efficiency and power factor are increased due to the increase in the mass of active materials (iron and copper), the use of more advanced materials and technologies. This path, despite the high cost of such engines, becomes obvious when we consider that according to Western European experts, the cost of electricity consumed annually by an average engine is 5 times higher than its cost. During the service life of the engine, which is tens of years, energy savings will significantly exceed the capital costs of such an upgrade. As noted earlier, this path has not yet been properly recognized in domestic practice.

3. Transition to a more energy-efficient electric drive system. Energy losses in transient modes change markedly when using rheostat control, TPN – AD and PPC – AD systems with minimal losses when using frequency-controlled electric drives. Therefore, within each of these systems, there are more or less successful options in terms of energy and technology. The task of the designer is a competent and fully justified choice of a specific technical solution.

4. Use of special technical means that ensure the minimization of energy losses in the electric drive. Since a significant part of asynchronous electric drives operate under conditions of slowly changing loads (electric drives of turbo-mechanisms , conveyors, etc.), the deviation of the load of the electric drive from the nominal one worsens the energy performance of the electric drive. Currently, such means can include devices for regulating the voltage on the engine in accordance with the level of its load. As a rule, these are either special voltage regulators based on TPN that are switched on between the mains and the motor stator, or frequency converters that provide a so-called power-saving mode. In the first case, the TPN performs, in addition to the function of energy saving, no less important functions of controlling the start and brake modes, sometimes regulates the speed or torque, provides protection, diagnostics, i.e. increases the technical level of the drive as a whole. In the second case, the power saving mode is considered as an additional option of the frequency Converter and is available only in some manufactured types of converters. Given the versatility of their application, such devices are economically feasible for variable-load drives, even at a relatively high cost.

5. Improvement of electric drive control algorithms in the TPN – AD and PPC – AD systems based on energy criteria for evaluating its quality, i.e. improvement of known solutions, development of effective technical solutions for their implementation and search for new solutions that are optimal in the energy sense.

In the second direction of reducing energy consumption, it is crucial to switch from an unregulated electric drive to an regulated one and increase the level of automation by including a number of technological parameters (pressure, flow, temperature, etc.) in the control loop.

The third direction of reducing energy consumption is characterized by the improvement of the electric drive system in combination with automation of the technological process and the correct choice of the appropriate quality control of the electric drive from the existing ones or the development of new, better systems.

References

[1] Mirzaev, Uchkun, Mathematical Description of Asynchronous Motors (April 15, 2020). International Journal of Academic and Applied Research (IJAAR), 2020, Available at SSRN: https://ssrn.com/abstract=3593185 or http://dx.doi.org/10.2139/ssrn.3593185

[2] Mirzaev, Uchkun, Choice For Electric Power Unit Smoke Exhausts №1 Tolimarjon Thermal Electric Power Plant (April 30, 2020). International Journal of Engineering and Information Systems (IJEAIS), 2020, Available at SSRN: https://ssrn.com/abstract=3593125

[3] Mirzayev Uchqun, Tulakov Jahongir. The Research of the V-I Characteristics of Solar Panel Using a Computerized Measuring Bench “EPH 2 Advanced Photovoltaics Trainer”. Automation, Control and Intelligent Systems. 2019; 7(3): 79-83. doi: 10.11648/j.acis.20190703.11 ISSN: 2328-5583 (Print); ISSN: 2328-5591

[4] Mirzaev, Uchkun, Experiment of Open-circuit Voltage in 'EPH 2 Advanced Photovoltaics Trainer' Laboratory and Types of PV Cell (April 30, 2020). International Journal of Engineering and Information Systems (IJEAIS) Vol. 4, Issue 4, April – 2020, Pages: 41-46; ISSN: 2643-640X, Available at SSRN: https://ssrn.com/abstract=3623014

[5] Mirzaev, Uchkun, Study of the Electrical Characteristics of a Solar Panel for Multi-Residential Apartments Using a Computerized Measuring Stand ‘Eph 2 Advanced Photovoltaic Trainer’ (2020). International Journal of Academic Engineering Research (IJAER) ISSN: 2643-9085 Vol. 4, Issue 4, April – 2020, Pages: 59-61 , Available at SSRN: https://ssrn.com/abstract=3622045

[6] Acarnley PP. Stepping Motors: A Guide to Modern Theory and Practice. 4th ed. London, IET; 2002. Pages: 85-86

[7] Hendershot JR, Miller TJE. Design of Brushless Permanent-Magnet Motors. LLC. Motor Design Books;