

SOLUTIONS TO PROVIDE ENERGY SAVING IN TECHNOLOGICAL MACHINES

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Abstract: This scientific article analyzes modern approaches to ensuring energy efficiency in technological machines. It covers technological, management and design solutions related to reducing energy consumption, increasing production efficiency, rational use of resources and ensuring environmental safety. The possibilities of increasing energy efficiency through frequency control systems, energy-efficient electric motors, heat recovery methods, digitalization and optimization mechanisms based on artificial intelligence are widely disclosed. The impact of the maintenance system and material selection on energy is also analyzed in detail. The ideas put forward in this essay serve to ensure the sustainable development of industrial enterprises and their operation in accordance with international standards.

Keywords: energy efficiency, technological machines, frequency control, energy efficiency, automation, digitalization, artificial intelligence, maintenance, environmental sustainability.

The rational use of energy resources in industrial production processes is one of the main criteria for introducing modern technologies. Against the background of limited energy resources in the world and rising prices, the issue of increasing energy efficiency in industrial sectors is gaining urgent importance. In particular, technological machines are the main equipment that accounts for a large part of energy consumption, and their operation in an energy-efficient mode plays an important role in ensuring the competitiveness of enterprises. Therefore, solutions to ensure energy efficiency in technological machines should be implemented at all stages of production.

Improving the energy efficiency of technological machines is carried out in several important areas. These solutions are aimed at reducing losses in the processes of energy generation, transmission, storage and processing, and increasing the efficiency of the work. First of all, the use of highly efficient electromechanical systems is required. For example, modern energy-efficient electric motors (IE3 and IE4 classes) consume 10-15% less energy than traditional engines. Such motors reduce waste during operation and have a significant impact on production costs.

In addition, the use of frequency converters is one of the most important means of increasing energy efficiency. With the help of frequency regulators, the speed of rotation of the machine is adjusted based on the real load, which prevents the engine from overworking. As a result, energy consumption is reduced and the service life of the equipment is extended. In many industrial sectors (ventilation, pumping systems, compressors), energy savings of up to 30-50% can be achieved through frequency control.

The reuse of thermal energy is also an important factor in increasing energy efficiency. Many technological machines generate a large amount of heat during operation, and by reusing this heat, energy waste can be reduced. For example, excess heat generated in boilers or furnaces can be used for water heating or other technological needs. Such systems are called "heat recuperators" and are widely used as a secondary heat source in production processes.

Optimized control of technological processes also plays a special role in ensuring energy efficiency. With the help of automated control systems, technological machines are started only when necessary, unnecessary work cycles are reduced, and resources are distributed rationally. For example, excessive energy consumption is reduced by automatically regulating the operation of the machine by determining the load level using sensors. Monitoring and control systems developed based on digital technologies provide real-time control over each movement of the machine, ensuring accuracy.

Another important aspect is the maintenance system of technological machines. The effective operation of equipment depends on their technical condition, and interruptions or delays in maintenance lead to increased energy consumption. For example, a malfunction of the lubrication system causes an increase in friction force, which leads to increased energy consumption. Therefore, constant monitoring of the condition of machines through planned maintenance (TPM) is an important factor in reducing energy consumption.

Changes at the level of materials and design solutions also contribute to energy efficiency. Modern light alloys, composite materials and polished surfaces reduce friction in machine parts, lighten the weight of moving parts, and as a result, high productivity is achieved with less energy. This is especially important for high-speed mechanisms.

The digitalization of production and the introduction of artificial intelligence within the framework of the Industry 4.0 concept have launched a new stage in increasing energy efficiency in technological machines. Continuous analysis of machine operation algorithms through Big Data, prevention of anomalies and real-

time optimization can minimize energy consumption. In addition, AI can be used to predict the load level of the machine, determine where and when energy should be spent. This approach brings the energy use strategy to a higher level.

Ecological factors are also directly related to energy efficiency. By increasing energy efficiency, carbon dioxide emissions are reduced, and the level of atmospheric pollution is reduced. This not only increases production efficiency, but also strengthens the environmental sustainability of the enterprise. Today, energy management is considered a key criterion in international certification systems (ISO 50001).

Conclusion Ensuring energy efficiency in technological machines is a means not only of reducing production costs, but also of rational use of resources, ensuring environmental safety, and increasing the competitiveness of the enterprise. This process requires solutions that are scientifically based, digitalized, automated, and adapted to environmental criteria in all respects. Implementing each measure to increase energy efficiency on the basis of an integrated approach plays an important role in ensuring the sustainability of industrial development. By optimizing technological machines and implementing modern energy-saving technologies, each industrial enterprise can increase its productivity, reduce energy consumption, and minimize environmental risks.

References:

1. Nazarov B.J., Murodov Sh.K. Texnologik mashinalar va jihozlar. – Toshkent: Iqtisodiyot va ta’lim, 2022. – 284 b.
2. Qosimov U.K., Hamidov A.Sh. Avtomatlashtirilgan texnologik tizimlar va energiya samaradorlik. – Toshkent: TATU nashriyoti, 2021. – 216 b.
3. Yunusov Sh.T. Energiya tejovchi texnologiyalarni sanoat ishlab chiqarishiga joriy etish yo‘llari // Texnika va texnologiyalar muammolari. – 2023. – №1. – B. 60–67.
4. Abdullayev A.X. Texnologik mashinalarning energetik samaradorligi va ekspluatatsiyasi. – Toshkent: Fan, 2020. – 312 b.
5. Brovko P.M., Zlotin B.N. Energoeffektiv texnologiyalar mashinasozlikda. – Moskva: Mashinasozlik, 2019. – 256 b.
6. Filippov I.A. Texnologik mashinalarga xizmat ko‘rsatish va energiya isrofini kamaytirish mexanizmlari. – Sankt-Peterburg: Politeknika, 2020. – 318 b.
7. Azizov I.R., Xayrullaev S.B. Sanoatda energiya menejmenti va monitoring tizimlari // Ilmiy-amaliy texnika jurnali. – 2023. – №2. – B. 45–52.
8. World Economic Forum. Industry 4.0: Shaping the Future of Advanced Manufacturing. – Geneva, 2022. [Elektron resurs] <https://www.weforum.org/reports>