

THE CONCEPT OF MODULAR TECHNOLOGICAL MACHINES IN INDUSTRY AND THEIR ADVANTAGES

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Abstract:

This scientific article provides an in-depth analysis of the importance of the concept of modular technological machines in industrial processes, their practical application and strategic advantages. Today's industrial competitiveness, production flexibility and ease of service are creating the need to switch to modular systems. The operational efficiency, cost-effectiveness and maintenance advantages of modular machines are also scientifically highlighted. Continuity in production, the possibility of configuration and integrated control technologies make modular machines a key component of the industry of the future. This essay, along with the theoretical foundations of the concept, also analyzes the positive transformational effects that will result from its practical implementation.

Keywords: Modularity, industrial technologies, modular machines, production efficiency, configuration, operation, flexibility, industrial transformation, maintenance, innovative approach.

The rapid development of modern industry, the increasing complexity of production systems and the expansion of the range of products require solutions that can meet new requirements for production facilities, in particular, technological machines. In particular, factors such as rapidly changing market needs, flexibility of product configuration, increased production efficiency, technological reliability and ease of maintenance are currently promoting the concept of modular technological machines in industry. This concept allows for a fundamental shift in the processes of mechanical engineering, automation, technological flexibility and modernization in industry.

The principle of modularity is at the heart of modern engineering thinking and allows for the simplification of complex systems, their effective design and management. In this case, technological machines are considered not as a whole, but as a set of independent and mutually compatible functional blocks. This approach allows the development of parts, technological blocks or functional components of machines as separate modules. Each module performs a specific function, operates independently and can be replaced or updated at any time. This radically increases flexibility and efficiency in the production process.

Modular technological machines are recognized as the most important innovative approach in advanced industries. With their help, production lines can be adapted to various products in a short time, outdated components can be replaced with modern ones, and even new technologies can be introduced. With the help of technological machines built on the basis of

modularity, enterprises reduce production costs, optimize logistics costs, increase operational efficiency, and simplify repair work. This allows them to increase competitiveness and quickly respond to market needs.

Modular technological machines are based on several basic principles, among which functional separation, interface uniformity, configuration flexibility, technological continuity, and ease of maintenance take a special place. Their constructive solution is developed in such a way that each module is connected to the general system through a clear interface and allows it to work in various configurations. Therefore, modular machines form the universal basis of technological lines and serve as a basis for the production of customized products.

In industry, the modular approach shows its strongest positive aspects, especially in the production of small and medium-sized batches. For example, when there is a need to produce products of special configurations for different customers, modular systems allow you to quickly adapt to new requirements. At the same time, it becomes possible to use one modular machine for many technological purposes. This is extremely relevant in conditions where it is necessary to produce several types of products at the same time. Another important advantage is the openness of modular machines to modernization. With the pace of technical progress increasing from year to year, enterprises are forced to frequently update their equipment. In machines with traditional designs, this process requires a lot of time and resources. In modular machines, this process is much simpler: a module reflecting the new technology is developed and integrated into the existing system. For this, it is not necessary to replace the entire machine, only the necessary module is replaced or updated. This ensures production continuity and dramatically reduces overall costs.

In addition, modular technological machines allow for increased reliability during operation. Each module can be diagnosed separately, preventive maintenance can be carried out in accordance with the maintenance schedule. Also, if malfunctions in the system are detected in only one module, the problem can be eliminated by replacing this module without stopping the entire system. This is very important for enterprises in terms of saving time and maintaining efficiency.

Modularity is a solution that is compatible with the concepts of digital transformation, artificial intelligence, IoT and Industry 4.0 in industry. Especially in smart production systems, modular machines open up the possibility of real-time monitoring, automatic parameter changes, and remote control. Based on such capabilities, modular machines are becoming the most modern link in the enterprise's production.

Another aspect is environmental and energy efficiency. Modular machines usually consume only the necessary reserves and power through modules with specific functions. This serves to optimize energy consumption, reduce heat loss and reduce the negative impact on the environment. At a time when environmental standards are becoming more stringent, this factor is of particular importance for global industry.

In recent years, large industrial companies, including leading brands such as Siemens, Bosch Rexroth, Mitsubishi, ABB, Fanuc, have been actively implementing the concept of modular machines into their production systems. The modular platforms developed by them have been tested in various industry segments and have yielded high results. This confirms the superiority of this approach not only in theory, but also in practice.

At the same time, modular machine design and production engineers require a new level of thinking, a systematic approach and deep technological knowledge. From the initial design stage, the structural architecture of the entire system must be defined, the interfaces between modules must be standardized, and functional compatibility must be ensured. Otherwise, the effect of modularity may not be fully manifested.

In conclusion, the concept of modular technological machines in industry is an advanced approach that can fully meet the needs of modern production, ensuring efficiency, reliability and flexibility. It plays an important role in ensuring not only technological superiority, but also economic efficiency, environmental safety and competitiveness. Today, the introduction of technological machines operating on the principle of modularity in any area of industry is a requirement of the future, one of the important steps towards the digital transformation of industry.

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