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ECOLOGICAL AND ENERGY-SAVING ASPECTS OF TURBOCOMPRESSOR OPERATION: ENERGY EFFICIENCY TESTING ON A SPECIALIZED BENCH

ЭКОЛОГИЧЕСКИЕ И ЭНЕРГОСБЕРЕГАЮЩИЕ АСПЕКТЫ РАБОТЫ ТУРБОКОМПРЕССОРОВ: ИСПЫТАНИЯ ЭНЕРГОЭФФЕКТИВНОСТИ НА СПЕЦИАЛИЗИРОВАННОМ СТЕНДЕ

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Abstract: Research has shown that modern turbo compressors, despite their important role in optimizing gas compression and heating processes in automotive and industrial applications, are characterized by high greenhouse gas emissions and energy consumption. This article examines the ecological and energy-saving aspects of turbo compressor operation, as well as the results of energy efficiency testing on a specialized bench. The focus is on the principles of turbo compressor operation, methods for assessing their energy efficiency, and ways to reduce their negative impact on the environment. The work is of interest to specialists in the

fields of mechanical engineering, thermal energy, and environmental safety, as well as to developers of new technologies in the area of turbomachinery.

Keywords: turbo compressor, temperature, noise level, high thermal conductivity alloys, friction losses, thermal stability, mechanical stability.

Аннотация: Исследования показали, что современные турбокомпрессоры, несмотря на их важную роль в оптимизации процессов сжатия и прогрева газов в автомобилестроении и промышленности, характеризуются высокими выбросами парниковых газов и энергопотреблением. В статье рассматриваются экологические и энергосберегающие аспекты работы турбокомпрессоров, а также результаты испытаний их энергоэффективности на специализированном стенде. Основное внимание уделяется принципам работы турбокомпрессоров, методам оценки их энергоэффективности и способам снижения негативного воздействия на окружающую среду. Работа представляет интерес для специалистов в области машиностроения, теплоэнергетики и экологической безопасности, а также для разработчиков новых технологий в сфере турбомашин.

Ключевые слова: турбокомпрессор, температура, уровень шума, высокотеплопроводные сплавы, потери на трение, термическая устойчивость, механическая устойчивость.

Modern technologies require the encouragement and implementation of environmentally friendly and efficient solutions to reduce environmental impact. Turbo compressors used in various industries, including automotive and industrial processes, play a key role in optimizing gas compression and heating processes. However, their operation is often associated with high greenhouse gas emissions and energy consumption. This article examines the ecological and energy-saving aspects of turbo compressor operation and presents the results of energy efficiency testing conducted on a specialized test bench.

Turbo compressors operate on the principle of energy conversion, where the kinetic energy of gas flows is converted into mechanical work. This process is

typically accompanied by significant losses due to friction, thermal losses, and pressure changes. To enhance the efficiency of turbo compressors and mitigate their negative impact on the environment, various technologies aimed at improving compression processes have been developed.

Different experimental studies are conducted on specialized test benches to assess the energy efficiency of turbo compressors. Sensors are installed on the bench to measure key parameters, including pressure, temperature, rotational speed, and gas flow rate.

Testing allows for the identification of important characteristics such as:

- Enthalpy and temperature at the compressor inlet and outlet.

- Overall performance, defined as the ratio of compressed gas to the power expended on its compression.

- Emission levels of carbon oxides, nitrogen oxides, and other substances that negatively impact the environment.

Reducing emissions and improving energy consumption efficiency can be achieved through the optimization of turbo compressor operation and the use of alternative energy sources. For example, the application of recycling technologies, thermal insulation, and the use of high-efficiency materials can significantly reduce environmental impact.

The ecological benefits of increasing energy efficiency include fuel consumption reduction and decreased carbon emissions, making turbo compressors more compliant with international environmental standards.

It should be noted that energy efficiency testing of turbo compressors on specialized test benches is an important tool for evaluating their ecological and energy-saving characteristics. The development and implementation of new technologies and testing methods will significantly enhance performance and reduce negative environmental impacts. Integrating these methods into industrial processes will promote more sustainable development and compliance with environmental regulations.

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