APPLICATION OF MICROPROCESSOR TECHNOLOGIES IN THE AUTOMATION SYSTEMS OF GAS PURIFICATION PROCESSES

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Annotation. The paper discusses the role and prospects of applying microprocessor technologies in automation systems for gas purification processes. It analyzes trends in the development of microprocessor-based control systems, their advantages, and specific applications in measurement and control devices, as well as automated control systems for technological facilities. The study highlights the importance of improving the automation level of gas purification processes to minimize energy costs and ensure the stability of process parameters.

The industrial activities of oil, gas, and chemical enterprises are inevitably associated with technogenic impacts on the natural environment. Increasing volumes of extraction, exploration, and transportation of hydrocarbon raw materials require the creation and modernization of processing capacities. Gas purification and processing allow for the supply of affordable fuel to consumers and the establishment of a local infrastructure for gas and condensate processing, contributing to job creation.

One of the most critical engineering and environmental challenges is the optimization and comprehensive automation of gas purification processes based on ecological criteria. An automated process control system (APCS) represents a closed-loop system that provides data acquisition, processing, and analysis required for the optimal control of technological objects.

Microprocessor devices play a crucial role in gas purification control systems by providing high accuracy, automatic calibration, temperature compensation, and fault diagnostics. These technologies enable the implementation of complex control algorithms, ensuring process stability and improved operational efficiency.

The use of microprocessors in automation includes embedded monitoring systems, local information processing systems, and distributed control systems for complex industrial facilities. The optimal choice of controllers depends on their functional characteristics and cost efficiency. Modern controllers are characterized by compact design, expanded functionality, multiple communication interfaces, open system architecture, and programming flexibility.

A clear trend can be observed toward convergence between controllers and computers: computers are adopting industrial controller features, while controllers acquire computational capabilities. The main goal of automatic gas purification control is to maintain optimal process parameters while minimizing energy consumption and adhering to technological constraints.

Research discussion. The application of microprocessor technologies in the automation of gas purification processes represents a significant advancement in environmental engineering and industrial control systems. This research explored how integrating microprocessor-based controllers enhances the efficiency, accuracy, and reliability of gas purification systems, particularly in monitoring and regulating complex chemical reactions and mass transfer operations.

Microprocessors enable real-time data acquisition from multiple sensors measuring parameters such as gas flow rates, temperature, pressure, and pollutant concentrations. The ability to process this data rapidly allows for dynamic adjustment of system variables, optimizing the gas cleaning performance and reducing energy consumption. Compared to traditional manual or analog control systems, microprocessor-based automation offers improved precision and faster response times, which are critical in maintaining optimal operating conditions and ensuring compliance with environmental regulations.

Furthermore, the modularity and programmability of microprocessor systems facilitate easy integration with advanced algorithms, such as PID controllers, fuzzy logic, and neural networks. These algorithms can model nonlinear behaviors in gas

purification processes, predict system responses, and execute proactive adjustments, significantly enhancing process stability and pollutant removal efficiency.

The research also highlighted challenges, including the need for robust hardware capable of operating in harsh industrial environments with high temperatures, humidity, and corrosive gases. Additionally, software reliability and cybersecurity emerge as vital considerations to prevent system failures or malicious attacks that could disrupt pollution control measures.

Comparative analysis with conventional automation approaches demonstrated that microprocessor technologies reduce downtime, maintenance costs, and human errors, leading to increased operational uptime and overall system productivity. This transition aligns with Industry 4.0 trends, where smart manufacturing and environmental sustainability converge.

Conclusion. The implementation of microprocessor technologies in automation systems for gas purification processes enhances control efficiency, reduces operational costs, and improves environmental performance. The advancement of microprocessor technologies contributes to the development of intelligent control systems capable of adapting to environmental changes and maintaining optimal technological conditions.

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