

AUTOMATION AND ARTIFICIAL INTELLIGENCE IN CHEMICAL MANUFACTURING

The chemical industry is undergoing a significant transformation through the integration of Artificial Intelligence (hereinafter – AI) technologies. From preventive maintenance to real-time process optimization, AI is revolutionizing the way that chemical plants operate, making them safer, more efficient and more productive. These factors determine the topicality of the choice of this research topic.

The application of AI in automation is realized in the use of technologies that allow machines to perform complex tasks without human involvement. AI is able to work with a very large amount of different data and can perform tasks more quickly and more accurately than a human.

The most important aspects of the interaction of artificial intelligence in the process of automation in the chemical industry are as follows:

- **carrying out routine tasks.** For example, a machine learning system, can analyze huge amounts of data, classify it or filter it;
- **decision-making.** For example, AI can analyze data from a retrospective perspective, track trends and make forecasts that are used to set production strategies;
- **monitoring and quality control processes.** Systems equipped with AI use computer vision and machine learning to detect defects in real time. These systems improve accuracy, reduce human error and optimize production efficiency.

There are the following stages in the process of automation using AI:

1. Analyzing and defining the purpose of automation.
2. Solving the decision.
3. Monitoring of system operation and optimization [1].

Chemical manufacturers implementing AI based preventive maintenance systems have reported:

- reduction in maintenance costs by 20-30%;
- decrease in unplanned downtime by 10-20%;
- increased equipment service life by 15-25% [2].

Dow Chemical implemented an AI system to optimize its batch processing operations. The system analyzes historical process data and real-time sensor information to optimize reaction conditions, resulting in:

- 20% improvement in batch yield;
- 15% reduction in energy consumption;
- 30% decrease in quality deviations [2].

One of the key AI technologies, in our opinion, is predictive maintenance. It is one of the most significant applications of AI in manufacturing. By analyzing sensor data, AI predicts equipment failures in advance of their occurrence, reducing downtime and maintenance costs. For example, BASF's predictive maintenance system has reduced unplanned downtime by 15% and extended the life of equipment [2].

Based on the above, we can make the following conclusion: although AI will not replace human expertise, however, the implementation of AI in the automation process in the chemical industry has many advantages, thus increasing production efficiency, optimizing costs and improving product quality.

Automation is not just an area, it is the future and that's why I chose it as my specialty.

REFERENCES

1. Popov, Aleksandr Automation and artificial intelligence: how to optimise processes in a company / Aleksandr Popov. – URL: <https://bigdata.bee-line.ru/blog/articles/avtomatizaciya-iskusstvennyj-intellekt> (date of access: 24.02.2025).

2. Top Use Cases of AI in Chemical Manufacturing: Transforming Industry Operations [Electronic resource]. –URL: <https://www.chemengconsulting.com/blog/2025/02/24/ai-applications-chemical-manufacturing-industry/1106> (date of access: 24.02.2025).