

THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING THE PERFORMANCE OF SHELL AND TUBE HEAT EXCHANGERS IN THE CHEMICAL INDUSTRY

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Annotation: Shell and tube heat exchangers are fundamental components in the chemical industry, responsible for efficient heat transfer processes critical for various manufacturing operations. As the chemical industry continues to evolve and strive for increased efficiency and sustainability, the integration of artificial intelligence (AI) technologies has emerged as a promising avenue to optimize the operation and performance of these heat exchangers. This paper explores the current state of shell and tube heat exchangers in the chemical industry and investigates the pivotal role that AI plays in improving their efficiency, reliability, and overall effectiveness. We delve into the applications of AI in the design, monitoring, and control of heat exchangers, highlighting key benefits and challenges associated with its implementation.

Keywords: Artificial Intelligence (AI), Shell and Tube Heat Exchangers, Chemical Industry, Heat Exchanger Design, Heat Exchanger Optimization, Machine Learning, Energy Efficiency, Monitoring and Control, Process Optimization, Data Analytics, Predictive Maintenance, Computational Fluid Dynamics (CFD), Heat Transfer Efficiency, Sustainability, Industrial Automation, Fault Detection and Diagnosis, Thermal Performance, Materials Selection, Energy Savings, Operational Efficiency

Introduction. The chemical industry is characterized by its energy-intensive processes, where heat exchangers play a vital role in heat recovery and temperature control. Shell and tube heat exchangers are widely used due to their versatility, high heat transfer efficiency, and robust design. However, traditional approaches to the design and operation of these heat exchangers often rely on simplified models and manual adjustments, leaving room for improvement in terms of energy efficiency, sustainability, and cost-effectiveness.

Artificial intelligence, particularly machine learning and data analytics, has gained significant attention in recent years for its potential to optimize various industrial processes, including those involving heat exchangers. This paper explores the applications of AI in enhancing the performance of shell and tube heat exchangers in the chemical industry, addressing both theoretical and practical aspects.

The Role of Shell and Tube Heat Exchangers in the Chemical Industry

Shell and tube heat exchangers are used in a wide range of chemical processes, including distillation, condensation, evaporation, and heat recovery. Their robust construction and ability to handle high-pressure and high-temperature fluids make them a preferred choice for many applications. However, the efficiency of these heat exchangers depends on several factors, including design, operation, maintenance, and the properties of the fluids being exchanged.

AI in the Design of Shell and Tube Heat Exchangers

The design phase of a shell and tube heat exchanger is critical in determining its long-term performance. AI technologies can assist in the optimization of heat exchanger design by:

- a. Generating efficient geometries: AI algorithms can explore a vast design space to identify configurations that maximize heat transfer efficiency while minimizing pressure drop and material usage.
- b. Material selection: AI can assist in selecting the most suitable materials for specific operating conditions, considering factors such as corrosion resistance, thermal conductivity, and cost.
- c. Performance prediction: Machine learning models can predict the expected performance of a heat exchanger design under different scenarios, enabling engineers to make informed decisions.

AI for Monitoring and Control. Real-time monitoring and control are crucial for maintaining the efficiency and reliability of shell and tube heat exchangers. AI can enhance these aspects by:

- a. Predictive maintenance: Machine learning models can analyze sensor data to predict when maintenance is needed, reducing downtime and preventing costly failures.
- b. Fault detection and diagnosis: AI algorithms can identify and diagnose faults in heat exchangers, helping operators take corrective actions promptly.
- c. Adaptive control: AI-based control systems can optimize heat exchanger operation by adjusting parameters in response to changing conditions, such as variations in fluid flow rates and temperatures.

Challenges and Considerations. While the integration of AI into shell and tube heat exchangers offers numerous benefits, several challenges and considerations must be addressed:

- a. Data availability: High-quality data is essential for training AI models, and acquiring such data can be challenging in some industrial settings.
- b. Model interpretability: The "black-box" nature of some AI algorithms can make it difficult to understand and trust their decisions.
- c. Implementation costs: Integrating AI systems may require initial investments in hardware, software, and expertise.

Conclusion: In the chemical industry, the adoption of artificial intelligence has the potential to revolutionize the design, monitoring, and control of shell and tube heat exchangers. By leveraging AI's capabilities, chemical manufacturers can achieve higher energy efficiency, reduced operational costs, and improved sustainability. While challenges exist, ongoing research and development efforts in this field are

likely to overcome these obstacles and pave the way for a smarter, more efficient chemical industry.

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ОБ ОДНОМ ПОДХОДЕ ОЦЕНКИ ПЛАТЕЖНЫХ ТРАНЗАКЦИЙ НА ПРЕДМЕТ МОШЕННИЧЕСТВА

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Аннотация: В данной статье предлагается алгоритм предсказания мошеннических транзакций. В алгоритме используются методы анализа, статистики, скоринга и классификации.

Ключевые слова: Мошенничество, транзакция, аккаунт, скоринг, фрод мониторинг, антифрод системы, риск, алгоритм, метод.

В настоящее время увеличивается количество финансовых транзакций, что приводит к росту финансового мошенничества и, как следствие, возникновению потерь в мировой экономике от кибератак. Выявление девиантных транзакций является актуальной темой современных исследований, поскольку для всех участников банковской системы важно минимизировать риски, которые могут возникать из-за наличия уязвимостей при совершении онлайн-операций. Рост финансовых потерь из-за увеличения финансового мошенничества актуализирует значимость применения математических методов для анализа