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Sustainable and Intelligent Approaches to Modern Chemical Process Design

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Editor-in-Chief Lecture

It is our pleasure to present this new issue of Chemical Process Design. This issue continues the journal's mission to publish high-quality research that advances the design, modeling, optimization, and sustainable development of chemical and energy-related processes. The contributions reflect the evolving landscape of modern chemical engineering, where sustainability, advanced materials, artificial intelligence, process simulation, resource recovery, and safety increasingly shape both research and industrial practice.

Several contributions in this issue focus on sustainable materials and environmental applications. Studies on the green synthesis of copper oxide nanoparticles, surfactant-modified zeolites for copper removal, and Mg-modified biomass for cobalt biosorption highlight the potential of environmentally benign and low-cost materials for pollution control and resource recovery.

Energy efficiency and sustainable process integration form another important theme. Research on the vacuum drying of magnesium hydroxide using recovered industrial waste heat and solar-assisted multi-effect distillation demonstrates how waste heat and renewable energy can be integrated into chemical and desalination processes to improve resource and energy efficiency.

The growing role of artificial intelligence and data-driven modeling is also highlighted. Contributions employ neural networks for hydrodynamic prediction, response surface methodology for viscosity modeling, and machine-learning algorithms for near-real-time COD prediction in wastewater treatment. These studies demonstrate the increasing integration of experimental data, statistical methods, and AI into process monitoring, prediction, and optimization.

The issue further addresses uncertainty-aware reactor design, process adaptation, safety, and dynamic separation. Uncertainty quantification is incorporated into photocatalytic reactor design, while process simulation is used to evaluate refinery feed adaptation. Dynamic modeling of fire-induced domino effects and transient krypton isotope separation further emphasizes the importance of safety, reliability, and dynamic behavior in modern process design.

Together, these contributions illustrate the broad and evolving scope of chemical process design—from sustainable materials and energy integration to artificial intelligence, uncertainty analysis, industrial simulation, safety, and advanced separation. They emphasize that future progress will increasingly depend on integrating mechanistic understanding, experimental data, computational intelligence, sustainability, and industrial knowledge to develop more efficient, reliable, flexible, and environmentally responsible processes.

We hope that the findings presented in this issue will provide valuable insights for researchers, engineers, and practitioners working toward the development of next-generation chemical and energy processes.

We sincerely thank the authors for submitting their valuable work to Chemical Process Design. We also extend our appreciation to the reviewers for their careful evaluations and constructive feedback, and to the members of the editorial board for their continued dedication to maintaining the scientific quality of the journal. We hope that this issue will stimulate further research and collaboration in the field of chemical process design.

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