

Editorial

Special Issue on “Process Design, Integration, and Intensification”

Dominic C. Y. Foo ^{1,*}  and Mahmoud El-Halwagi ^{2,*} 

¹ Department of Chemical and Environmental Engineering, University of Nottingham, 43500 Semenyih, Selangor, Malaysia

² Chemical Engineering Department, Texas A&M University, College Station, TX 77843, USA

* Correspondence: Dominic.Foo@nottingham.edu.my (D.C.Y.F.); el-halwagi@tamu.edu (M.E.-H.)

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With the growing emphasis on enhancing the sustainability and efficiency of industrial plants, process integration and intensification are gaining additional interest throughout the chemical engineering community. Some of the hallmarks of process integration and intensification include a holistic perspective in design, and the enhancement of material and energy intensity. The techniques can apply to individual unit operations, multiple units, a whole industrial facility, or even a cluster of industrial plants.

This Special Issue on “[Process Design, Integration, and Intensification](#)” aims to cover recent advances in the development and application of process integration and intensification. Two works related to process design and integration were reported for simultaneous optimisation of water and energy usage in hydraulic fracturing [1], as well as the design of a palm oil milling process [2]. Besides, two works reported process intensification involving desalination unit [3] and reactive distillation [4].

Brief Synopsis of Papers in the Special Issue

In the work of Oke et al. [1], a mathematical model was proposed for simultaneous optimisation of water and energy usage in hydraulic fracturing. The recycling/reuse of fracturing water is achieved through the purification of flowback wastewater using thermally driven membrane distillation (MD). The study also examines the feasibility of utilising the co-produced gas as a potential source of energy for MD. The proposed framework aids in understanding the potential impact of using scheduling and optimisation techniques to address flowback wastewater management.

Foong et al. [2] on the other hand, proposed a hybrid approach to solve a palm oil milling process. The hybrid approach consists of mathematical programming and graphical techniques. The former is used to optimise a palm oil milling process to achieve maximum economic performance. On the other hand, a graphical approach known as feasible operating range analysis (FORA) is used to study the utilisation and flexibility of the developed design.

In the work reported by Alghamdi et al. [3], an integrated study of modeling, optimization, and experimental work was undertaken for a solar-driven humidification and dehumidification desalination system in Saudi Arabia. Design, construction, and operation are performed, and the system is analyzed at different circulating oil and air flow rates to obtain the optimum operating conditions.

The work of Yamaki et al. [4] reported process intensification involving a reactive distillation column. The authors clarified the factors that are responsible for reaction conversion improvement for reactive distillation column used in the synthesis of tert-amyl methyl ether (TAME). The study also analysed the effect of the intermediate reboiler duty on the reaction performance. The results revealed that the liquid and vapor flow rates influenced the reaction and separation performances, respectively.

Another work that investigated the improvement on the chemical reaction was reported by Yang et al. [5], who proposed an optimisation methodology using Computational Fluid Dynamics (CFD) based compartmental modelling to improve mixing and reaction selectivity. Results demonstrate

that reaction selectivity can be improved by controlling rates and feed locations of the reactor. The proposed approach was demonstrated with Bourne competitive reaction network.

The adsorptive properties of poly(1-methylpyrrol-2-ylsquaraine) (PMPS) particles were investigated by Ifealebuegu et al. [6]. The PMPS particles were synthesised by condensing squaric acid with 1-methylpyrrole in butanol, and serves as an alternative adsorbent for treating endocrine-disrupting chemicals in water. The results demonstrated that PMPS particles are effective in the removal of endocrine disrupting chemicals (EDCs) in water, though the removal process was complex and involves multiple rate-limiting steps and physicochemical interactions between the EDCs and the particles.

Abdullah et al. [7] proposed some techniques for improving the reliability of predictive functional control (PFC), when the latter is applied to systems with challenging dynamics. Instead of eliminating or cancelling the undesirable poles, this paper proposes to shape the undesirable poles in order to further enhance the tuning, feasibility, and stability properties of the PFC. The proposed modification is analysed and evaluated on several numerical examples and also a hardware application.

In the perspective paper by Uhlenbrock et al. [8], business models and the regulatory framework regarding the extraction of traditional herbal medicines as complex extracts are outlined. Accordingly, modern approaches to innovative process design methods are necessary. Besides, the benefit of standardised laboratory equipment combined with physico-chemical predictive process modeling, and innovative modular, flexible manufacturing technologies—which are fully automated by advanced process control methods, are described.

Prof. Dr. Mahmoud El-Halwagi
Prof. Dr. Dominic C. Y. Foo
Guest Editors

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