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Editorial

Advances in Energy System Synthesis and the Energy–Water Nexus in Industry

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Energy and water are key resources for human life and industry production. Since more and more countries are successively proposing carbon reduction goals, as a main route for carbon reduction, new energy saving technologies have become a very hot research topic. Meanwhile, with the increasing scarcity of freshwater resources, revolutionary water-saving technologies are urgently needed in human society. In industries and normal human activities, energy and water are highly interactive, forming an energy–water nexus. Optimization of the energy–water nexus will help to expand the technological path of wastewater and heat recovery. This Special Issue, "Recent Advances in Energy System Synthesis and the Energy–Water Nexus in Industry", aims to present new research on how to save both water and energy resources through energy–water nexus optimization and new equipment technologies. This Special Issue is available online at: https://www.mdpi.com/journal/processes/special_issues/energy_system_synthesis, accessed on 13 July 2023.

This Special Issue contains the latest research in the industry energy system and water–energy nexus, with a total of seven original articles. Three articles focus on the recent advances in new unit operation technologies with high efficiency and low energy consumption, including plate heat exchangers, wellhead multistage bundle gas–liquid separators and circulating fluidized beds. Two articles feature recent developments in heat recovery system optimization considering multi-scale decision making and the selection of different energy saving technologies. One article investigates the new water network synthesis methodology based on mathematical programming. The other article presents a study on the energy performance of different CO_2 capture technologies in the coal to ethylene glycol process. A summary of the contributions is presented next.

Beck et al. [1] propose an energy system synthesis methodology based on an optimal design and operate a supply and heat recovery system and production scheduling simultaneously. In this work, different decarbonization measures are combined and eight potential future scenarios are proposed to guide the design and operation of the system under different decarbonization rates. Xu et al. [2] present a new automated heat exchanger network retrofit methodology to further recover heat. In this work, multiple heat exchanger types are considered to fit heat transfer characteristics in different positions in the heat exchanger network. The pinch approach is used to solve the problem, and to consider multiple heat exchangers, multiple minimum heat transfer temperature differences are also considered. When the optimal structure of the heat exchanger network is found and the type of heat exchanger is decided, the next step is to establish the optimal design of a heat exchanger. Xu et al. [3] propose a computer-aided optimization method to guide the design of plate heat exchangers. An MINLP mathematical model is developed to select the best combination of the flow pass configuration and available commercial plate

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geometries within practical design constraints. By using the newly proposed method, the heat transfer area can be reduced. Zhuge et al. [4] propose a wellhead multistage bundle gas–liquid separator combining a gas–liquid cylindrical cyclone with multi-tube bundle components. This new separator is expected to improve the gas–liquid separation performance. A numerical simulation method is used to evaluate the performance of the separator. Yang et al. [5] present a study investigating the flow characteristics of desulphurization ash particles in a riser with an inner diameter of 70 mm and a height of 12.6 m, at a gas velocity of 4–7 m/s and a solids circulation rate of 15–45 $kg/m^2 \cdot s$. It is found that the particle-based Archimedes number has a linear relationship with the solid holdup at all operating conditions. Ma et al. [6] compare different CO_2 capture technologies for the coal to ethylene glycol process. These include Rectisol, mono-ethanol amine (MEA), chilled ammonia process (CAP) and dimethyl carbonate (DMC) technologies. In this study, it is found that energy consumption of the Rectisol process is the lowest. In a water network, Zhou et al. [7] consider multiple water source problems in water network design and operation optimization. In this work, the influence of multi-period demand variation on technology and the capacity selection of desalination water stations is examined and a multi-period model is used to describe such a problem. This work can guide the design and operation of industrial and urban water supply networks.

Lastly, the Guest Editors would like to express their gratitude to all the authors for their high-quality manuscripts. It is our sincere hope that this Special Issue will help to promote energy and water saving technologies in the field of process engineering.

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