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Editorial

Special Issue "Design, Control and Optimization of Desalination Processes"

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Water scarcity due to the ever-increasing worldwide demand and climate change is one of the greatest hurdles of our time. In this light, desalination technologies are pivotal to tackle water shortage generated by population, industrial and urban growth and improve water availability in climate-stressed regions. Desalination can be divided into three main categories: thermal (multi-effect distillation, multi-stage flash distillation, mechanical, and thermal vapor compression), chemical (ion exchange), and membrane-based (reverse osmosis, membrane distillation, forward osmosis, nanofiltration and electrodialysis) processes. Despite the technological advances of desalination over recent decades, several issues such as the rather low water recovery factor and excessive energy consumption, together with their elevated costs, constitute major obstacles for its widespread practical implementation. Furthermore, the enormous amount of brine disposal and the high dependence on fossil fuels also raise important environmental concerns. The application of design, modelling, simulation and optimization techniques, allied to the development of more efficient controlling strategies and innovative desalination systems, is therefore paramount to overcome previous barriers and provide ameliorated solutions to process energy, economic and environmental performances.

This Special Issue on "Design, Control and Optimization of Desalination Processes" aims to gather the foremost developments in design, modelling and optimization methodologies, along with improved control and simulation strategies to address the most challenging problems faced by the desalination industry today. In this way, this Special Issue comprises three review papers on the scope and limitations of modelling, simulation, and optimization of spiral wound reverse osmosis desalination [1]; the drivers, challenges, and future prospects of a forward osmosis technique for seawater desalination [2]; the energy, exergy, and thermo-economic analysis of renewable energy-driven integrated desalination and polygeneration systems [3].

This Special Issue also encompasses eleven research articles covering the optimal sizing of hybrid solar photovoltaic, fuel cells, hydrogen storage, and reverse osmosis seawater desalination system [4]; design of unconfined dense plunging jets used for brine disposal from desalination plants [5]; mode-based analysis and optimal operation of a multi-stage flash desalination system [6]; simulation analysis and optimization of a coupled reverse osmosis and membrane capacitive deionization plant for seawater desalination [7]; optimal operating parameters of a capacitive deionization desalination system via radial movement optimization [8]; design and thermodynamic analysis of a scraped surface crystallizer plant for freeze desalination [9]; design of a fault detection and isolation control system for industrial seawater reverse osmosis desalination plants based on structural analysis [10]; simulation and economic feasibility evaluation of an ocean thermal energy conversion system for electricity and freshwater production [11]; design and performance investigation of a closed-cycle humidification–dehumidification desalination system [12]; two-dimensional modelling approach and performance assessment of ion-exchange membrane in membrane capacitive deionization [13]; and, advanced exergy, exergoeconomic, and exergoenvironmental analyses of a combined cycle power plant integrated with multi-effect distillation and reverse osmosis desalination units [14].

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