Journal of Membrane Science and Research 5 (2019) 1-2

Journal of Membrane Science & Research

journal homepage: www.msrjournal.com

Editorial Note

Membrane Science and Research in Asia and the Middle East: State of the Art and Perspectives

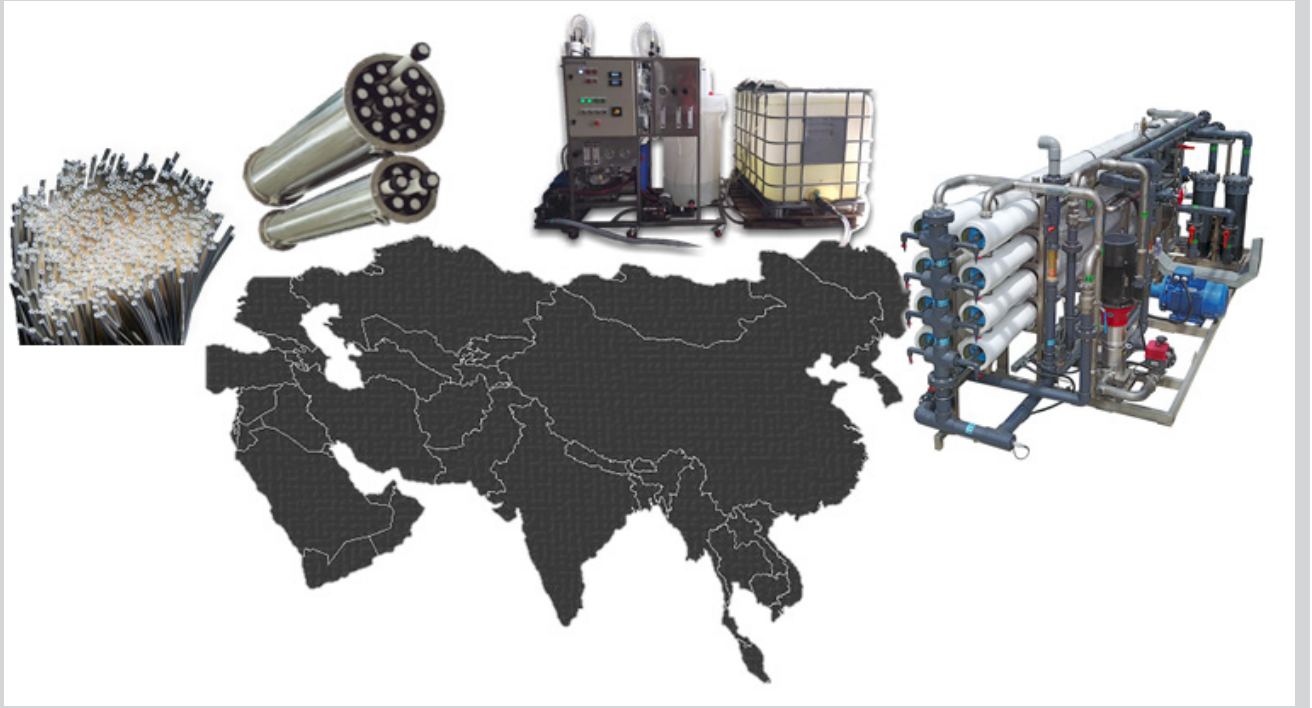
Ahmad Fauzi Ismail, Pei Sean Goh

Guest Editors

Advanced Membrane Technology Research Centre (AMTEC), School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Johor, Malaysia

Email: afauzi@utm.my (A.F. Ismail); peisean@petroleum.utm.my (P.S. Goh)

Graphical abstract



Asia and the Middle East represent one of the most dynamic regions in the world which has experienced fast economic and technological growth. Access to clean and affordable water is essential for building resilience and maintaining human's well-being and livelihood development in this region. Likewise, various energy resources are fundamental to support stable economic and social progress for better life quality. In the coming decades, water and energy demand is projected to hike exponentially in Asia and the Middle East region. While sustaining the pace to prosper in their growth and development, this region is facing a multitude of water-energy-environment nexus challenges. Over the last decade, massive economic development, population growth, urbanization and industrialization have come at the expense of the water and energy sustainability. Natural disasters and climate changes have further amplified the vulnerability of water and energy supply. The pressing needs have called for innovative ways to address issues related to water and energy in economically and environmentally sustainable manner.

DOI: 10.22079/JMSR.2018.96997.1226

Wastewater treatment and desalination are viable options to provide safe drinking water in the water-stress regions as well as to reduce the environmental impacts resulted from human activities. In this aspect, membrane-based separation has been long implemented as a clean technology to enhance water and energy reliability. Pressure driven membrane processes such as reverse osmosis and ultrafiltration as well as osmotically driven membrane processes such as forward osmosis have been employed to produce clean water and resolve water pollution issues. Additionally, membrane technology is a very well-established tool in tackling greenhouse gases produced from the burning of fossil fuels. In fact, membrane technology has also been widely used on oil and gas industries for natural gas sweetening. Membrane technology holds great potential in harvesting renewables into energy and energy storage systems for long-term or remote usage. Proton exchange membrane fuel cell technology is one of the attractive approaches to attain energy sustainability. This renewable resource is expected to play a substantial role in creating new energy industries while significant contributing to the reduction in environmental impact and enhancement in energy security.

Membrane-based technologies can be further improved in terms of efficiency and performance, cost and affordability as well as energy consumption to make them more commercially attractive. Membrane modification is currently one of the most implemented strategies to achieve these purposes. Various approaches have been established to render desired characteristics to the membranes in order to overcome the shortcoming of the conventionally used membranes. New functionalities have feasibly been introduced through the incorporation of nanomaterials, blending of various polymers at the microscopic level as well as chemical grafting or physical coating of functional groups. The innovative designs of membrane have paved ways to new classes of membrane with unique structural and morphological properties as well as tailored surface chemistry which can eventually lead to better performance and applications. The modifications have also allowed the formation of robust and mechanically strong membranes to deal with harsh conditions without sacrificing the stability and life span of the membranes.

This special issue features the recent progresses and future perspectives on membranes and membrane process development in Asia and the Middle East. It covers both original research articles and comprehensive reviews on the recent advances in membrane development particularly in the sectors of energy, water and environment. The advances, novelties and innovations made in membrane science and technology for the applications in desalination, wastewater treatment and energy production have been discussed. The state of the art progresses in this direction have been highlighted in this special issue.

Membrane technologies play a remarkable role in maintaining the sustainability of water, energy and environment. Many of these membrane-based technologies or products, such as reverse osmosis, carbon capture, proton exchange membrane fuel cells have been commercialized in industrial scale. Despite these successes and positive outlook, there are still clear weaknesses and limitations in membrane long term sustainability. Membrane modifications and system optimization are expected to lead the future trend to minimize the production cost, rationalize energy usage and minimize waste or secondary pollutant production while heightening the efficiency in various applications. On the other hand, the establishment of well-structured membrane-related research centres and facilities is expected to boost multidisciplinary and interdisciplinary research and collaboration across Asia and the Middle East regions and the world. It is expected to see more research and development to make significant impacts on promoting the growth of membrane science and technologies to address major sustainable development challenges. In the coming decades, membrane technology markets will continue to demonstrate positive growth trends in Asia and the Middle East owing to the wide focus in clean water and energy production. More Asia and the Middle East developing countries will standout with their emerging membrane technology to compete with the European and U.S. markets.

Lastly, the editors would like to express their gratitude to the contributors of this special issue. It is hoped that this special issue, with the collection of ideas from the researchers actively working in membrane science and research, will provide directions and guideline to the entire membrane community regarding the future outlook and roadmap of this technology for bench-scale and commercialization applications in Asia and the Middle East regions.