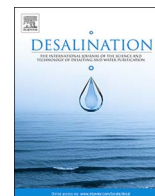




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Editorial note



This special issue includes critical reviews on R & D work in important areas of desalination technology. Several papers report on novel membranes and membrane surface characterization techniques. The development of some innovative membrane-based processes is surveyed. Papers are also included on approaches to deal with the ever present membrane-fouling problem and with the environmental impact due to intake and brine-disposal facilities of desalination plants. A brief outline follows of the papers comprising this issue.

Ismail and Matsuura present a perspective on the contribution of data from advanced membrane characterization techniques toward resolving key issues on transport mechanisms prevailing in Reverse Osmosis (RO) processes. Such data have revealed the heterogeneous structure of the top surface of thin film composite (TFC) polyamide membranes, suggesting the existence of “pores” and of “pore size distribution”. *Johnson et al.* provide a comprehensive review of various membrane surface characterization techniques and improvements thereof. Emphasis is placed on the complementarity of several techniques and the need to use them in tandem for adequate membrane-surface characterization. *Yang et al.* review the field of novel materials (aquaporins, carbon nanotubes, graphene) that are currently used for the development of high permeability membranes. An informative summary is provided of progress and challenges in developing such novel membrane types as well as of their currently achieved performance and future perspectives. *Goh and Ismail* review the recently intensified R&D work on inorganic membranes for many desalination and wastewater treatment applications. Physico-chemical properties, fabrication methods and performance assessment for various classes of inorganic membranes are surveyed. Challenges faced in practical applications and future perspectives are summarized.

Wang et al. survey recent advances in the vigorously pursued development of membranes and processes for desalination based on Forward Osmosis (FO). Various FO membrane designs are reviewed as well as strategies to optimize their properties. The roles and potential of FO in hybrid systems for desalination are evaluated, including future perspectives; the significance of developing appropriate draw solutions is stressed. *Johnson et al.* provide an overview of the theoretical underpinnings of the draw solution performance, for FO implementation, and a critical literature assessment regarding the different types of solutes and draw solutions; the attributes and drawbacks of various tested solutes are summarized. It is suggested that both draw solution and membrane properties will play a critical role in future developments. *Campione et al.* outline the fundamentals of Electro-dialysis (ED) process and recent related developments. They critically review theoretical modeling and experimental studies of the complicated phenomena occurring within ED modules as well as the proposed strategies for enhancement of ED process performance. Recent applications of ED-based processes in the water and energy industry are also presented, highlighting potential and limitations. *Ali et al.* analyze the performance of a novel integrated system, comprising microfiltration (MF) and direct contact membrane distillation (DCMD)/membrane crystallization (MCR), for freshwater and minerals recovery from produced water. Comparison is made with a conventional multi-stage flash process.

Sim et al. provide a comprehensive review of various techniques to determine the fouling potential of feed-water to RO desalination plants and the fouling condition of such membranes; methods proposed for all types of membrane deposits are considered. The suitability of such methods is also assessed for either RO desalination plant monitoring or small scale fluid-characterization and membrane-fouling tests. *Bucs et al.* present a critical review of biofouling control approaches, focusing on feed water pre-treatment, membrane-surface modification, and optimization of spiral wound membrane module design and operation including optimal feed-spacer geometry. The key issues of delaying biofilm development and of biofilm-cleaning strategies are considered; related R&D priorities are suggested. *Missimer and Maliva* review the environmental issues associated with the construction and operation of intake systems and the disposal of concentrate from seawater desalination plants. Methods and practices to minimize such impacts are dealt with. Emphasis is placed on the complete environmental impact analysis, prior to siting and design of intake and concentrate disposal facilities.

In recent years, there is intensified R&D activity in all the afore-mentioned topics, which is evident in the papers of this special issue; this trend is attributed mainly to environmental and social pressures that necessitate development of efficient and sustainable water treatment processes. In parallel, the community of water-treatment professionals tends to grow world-wide. The Guest Editors hope that the authoritative reviews in this special issue will be of help to researchers and various practitioners in the field of desalination, and in particular to those entering this field.

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