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Journal of
Membrane Science & Technology

Editorial

Membrane Operations and Metrics for Process Intensification

Alessandra Criscuoli*

Institute on Membrane Technology (CNR-ITM), Italy

EDITORIAL NOTE

Membrane operations are efficient separation systems which can be applied in different fields, like water and wastewater treatment, gas separation, chemical reactions, extraction and recovery of high-value compounds, concentration of food streams, biomedical sector. Their performance is usually evaluated in terms of selectivity (indication of the quality of the permeate produced) and of permeability (indication of the quantity of the permeate achieved). Both are important, because reflect the separation efficiency and the productivity of the system, respectively. In addition to the above parameters, others should also be considered, in order to establish the impact of membrane operations on the strategy of Process Intensification of industrial productions. A basic principle of the Process Intensification strategy is to foresee industrial plants which have higher production capacity, as well as lower size than existing ones [1]. Therefore, to measure the intensification reachable by membrane operations, specific metrics must be defined. In this logic, four new metrics were identified and proposed [2], the productivity/size ratio, the productivity/weight ratio, the flexibility and the modularity. The productivity/size ratio and the productivity/weight ratio compare membrane systems to conventional operations in terms of size and weight, respectively, needed for a certain production. Two types of flexibility were considered for further comparison between membrane and traditional operations: one based on the number of variations in the operating conditions that can be managed without modifying the existing units; the other based on the possibility of using the same unit for different applications. Finally, the modularity makes the comparison in terms of change of the plant size needed when a change of the plant productivity occurs. The new metrics were also applied to different case studies, such as the use of membrane contactors in the sparkling water production [2], the use of membrane contactors for the control of the boron content in desalination [3] and the use of direct contact membrane distillation for the purification of aqueous streams containing urea [4]. The use of the new metrics in combination with the existing indicators for sustainability, like the environmental, economic and society ones will help in assessing the role of membrane operations in re-designing industrial productions.

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Correspondence to: Alessandra Criscuoli, Institute on Membrane Technology (CNR-ITM), Italy, Email: a.criscuoli@itm.cnr.it

Received: July 8, 2021; **Accepted:** July 13, 2021; **Published:** July 22, 2021

Citation: Criscuoli A (2021) Membrane Operations and Metrics for Process Intensification. J Membra Sci Technol. 11:238