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Editorial Note

Membranes for Development

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Membrane science and technology has been dominated for a long time by advanced countries in Asia (Japan was first, but Korea, Singapore, Malaysia, China/Taiwan have followed), in Europe, Australia, and in North America. Many pioneers in membrane development came from these countries or regions. They should be acknowledged, because their overall contribution in shaping the world as we know it today has been enormous. Think of water desalination, environmental remediation, process intensification in the industry by membranes, leading to reduced energy needs and cleaner processes, solutions for carbon capture not only by post-combustion technologies but also in-process, biomedical applications, and so much more – it is difficult to imagine a world without membranes in the 21st century.

In spite of this there still seems to be a gap with developing countries in which not only (membrane) technologies are less evident, but also academic interest and expertise is lower. Why? It may be a complex interplay between various factors. The first one is a belief that many have, that membranes are too advanced or too expensive for developing countries. This is an absurd belief, and counterproductive because membranes can be an effective catalyst in development. Countries are in fact more than willing to invest; one example is the construction of the Renaissance Dam in Ethiopia, a fabulous investment – not related to membranes – which should not weigh on the development of the country, but contribute to a stronger economy and a better life for the Ethiopians. Membrane technology should be more visible as a tool for development. Unfortunately, academics active in membranes in developing countries are less visible, and therefore have less impact. Research funding and industrial funding in their countries is often not considering membranes, because they are thought not viable. Suppliers and industrial players have reduced activities in countries where membranes are not common, which hampers the logistics if an application is to be implemented. This may be a commercial strategy, but it ignores the immense economical potential once these countries would start implementing membranes as tools for the same areas of development mentioned above, which are accepted commodities in other parts of the world (in Asia, Europe, North America, Australia).

However, the situation may change rapidly if we understand the opportunities in global development. The world today is different from two decades ago. Membranologists are at the forefront of global collaboration. In 2017, the World Association of Membrane Societies (WA-MS) was launched, to enhance the collaboration in the field of membrane science and technology between all parts of the world. The founding members were the Asianean Membrane Society (AMS), the European Membrane Society (EMS), and the North American Membrane Society (NAMS), not by chance those regions where membrane science and technology has a long tradition. They naturally take the lead in this integrative process, while setting up strong links with less traditional societies such as AMSIC, the African Membrane Society. The objectives of the World Association of Membrane Societies are "…in meeting global societal needs related to water, energy, resources, food, chemical and pharmaceutical production and environment and health service through enhancing membrane use, in helping membrane industries to create diverse business opportunities, and in enhancing international collaboration among membrane researchers, educators and entrepreneurs." It is clear that this represents an approach in which all countries and regions work together on topics of global concern, to everyone's benefit. This is not charity, it is working shoulder by shoulder to achieve results that are in everyone's interest. It makes in fact abstraction of any difference between 'developed' and 'developing'. The bottom line is that membranes should play their role everywhere.

The most obvious example of 'membrane development' is China. Once classified as a developing country, it is now among the leading countries in developing innovative membrane technologies. The ICOM conference in Suzhou, China, in 2014, was an immense success and a showcase for innovation. The market share of Chinese researchers in publications in top ranked journals is impressive. China's industrial market for membranes keeps booming. There is no doubt that standards in membrane research and applications in China are exactly the same as in countries with an older membrane tradition.

Iran may be a second example, even though it is more an outlier than a country with a history of development like China. There is much expertise, activity and application of membranes in Iran (Journal of Membrane Science

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and Research is the flagship for this!) but it remains unconnected in terms of organization.

A fine example of a vibrant country in development is Vietnam. Membrane technology is typically considered not viable in Vietnam because it is too expensive. However, the Vietnamese society is organized somewhat differently, and gives many opportunities in setting up commercial applications of membranes: Vietnam is very business-oriented, and membranes are a highly interesting product. There is clearly an economical potential as well, certainly in the 'low cost, high performance' concept where membranes can fit in. This can lead to applications on any scale (an example is described in this issue); the only limitation is the availability of experts with global recognition, and of suppliers of all necessary parts including the membranes themselves. This is a fast changing country, probably the fastest in Asia today, and let us not forget: an undiscovered market for membrane applications. Some African countries are similar, even though the African situation may be somewhat variable: Northern Africa and South Africa are present on the membrane map, but the target of AMSIC is in also engaging the remaining parts of the African continent. This is also clear from the contents of this issue, and is definitely still a work in progress.

This issue is not an end point, it is rather a beginning. Membranes in development requires convincing people, educating people, supporting them – and include them in the global network of membranologists, which is the first requirement for a global society using membranes in all aspects of life.