ADVANCED RO ELEMENT OBTAINED BY NEW MEMBRANE AND CHANNEL MATERIAL

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Introduction

Reverse osmosis (RO) membranes are regarded as the most powerful tools to solve global water problems, since they make it possible to supply high-grade water with low cost and low energy consumption. RO membrane technologies have made great progress in last 50 years. However, still more improvement of membrane performance is required to achieve lower energy consumption and higher water quality in seawater, brackish water, and tap water desalination field.

Toray has made efforts to elucidate dynamics of water molecules during water permeation process using neutron scattering and molecular dynamics simulation. Utilizing these results, new RO membranes with high water permeability was developed based on advanced molecular design of cross-linked polyamide pore structure. In addition, Toray created a new permeate channel material of element with low water flow resistance that enhanced water flux of the new RO membrane element.

Material and Method

<RO membranes>

Polyamide RO membranes were fabricated by interfacial polymerization of aromatic amines and carboxylic acid chlorides. Protuberance and pore structures of the polyamide RO membranes were analyzed by Transmission Electron Microscope (TEM) and molecular dynamics (MD) simulation. (*Figure 1*)

<RO elements>

The membrane was folded, and cut, and a net was arranged as the feed-channel material. In addition, these were spirally wound around a water-collecting tube while the end of a new permeate channel material of element with low water flow resistance was wound around it, thereby obtaining a wound body to produce an 2-inch element.

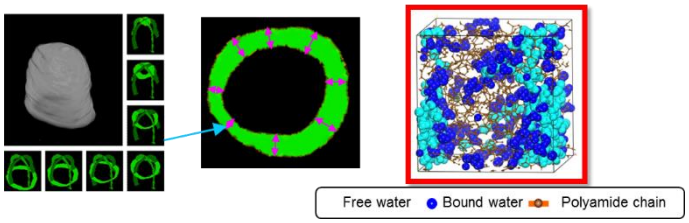

Figure 1 – Protuberance structure image and pore analysis (left : 3D TEM , right : MD simulation)

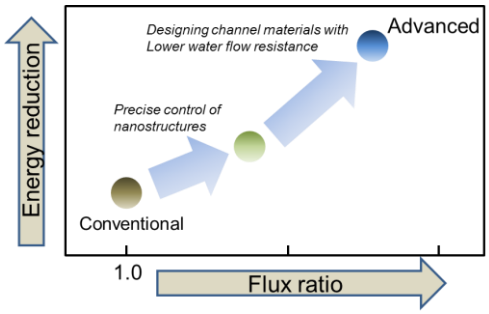

Figure 2– Relevance of water flux of RO elements and energy consumption reduction

Results and Conclusions

We succeeded in quantitative analysis of protuberance and pore structures of polyamide RO membranes. Based on fundamental analysis, precise structure control of protuberance and pore structure of RO membranes was carried out to improve membrane performance dramatically.

Also we succeeded in the development of a new permeate channel material of element with low water flow resistance in filtration. Low water flow resistance of permeate channel contribute to water permeability of the membranes. This excellent performance was verified through filtration tests of RO elements in laboratory. The obtained RO element is expected to reduce energy consumption in applications such as brackish water desalination, wastewater treatment and so on. (*Figure 2*)

We have been developing innovative RO element with further excellent performance based on membrane with precisely controlled nanostructures and channel materials with lower water flow resistance. New results will be presented in the conference.