FORBLUE™

S-SERIES membranes for PEMWE

Improvements in gas crossover and membrane structure

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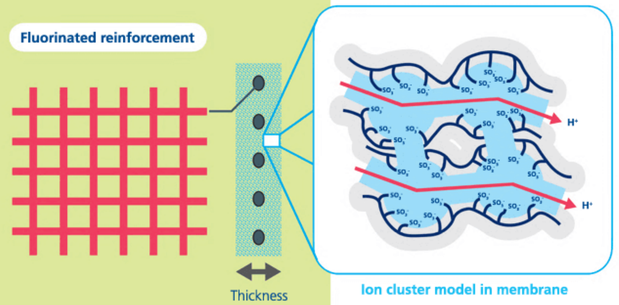
Abstract

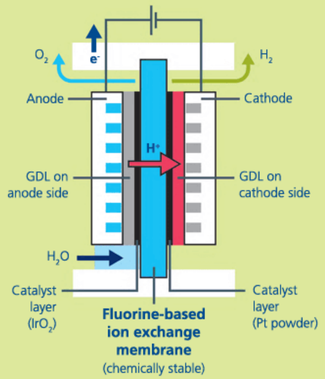
S-SERIES, a FORBLUE™ member, is a perfluorinated ion exchange membrane used for polymer electrolyte membrane water electrolysis and various other electrolysis and electrodialysis applications.

Recently, AGC has developed a new generation of S-SERIES membranes with smaller thicknesses, improved reinforcement, and higher ion-exchange capacity (IEC).

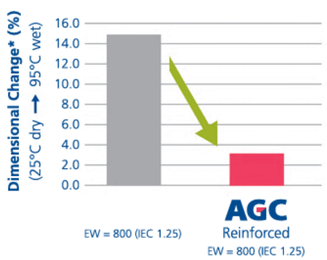
The membrane showed lower electric resistance, more stable dimensional change, and lower gas crossover compared to standard and competitive membranes.

AGC Membrane Design

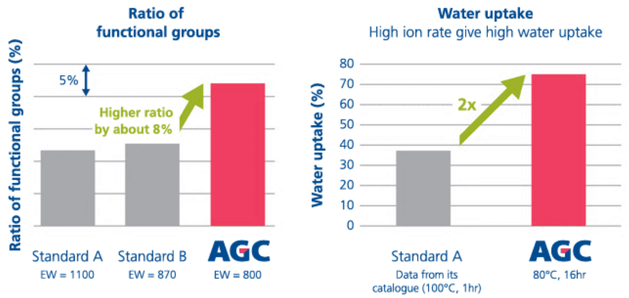




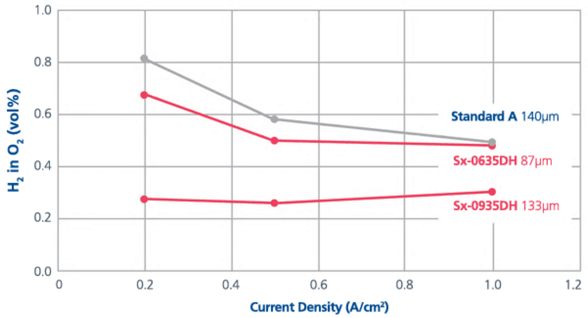
Effect of Reinforcement



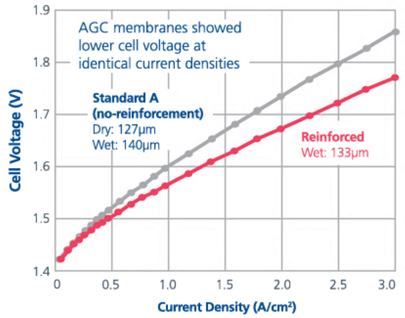
Comparison with Conventional Membrane



Gas Crossover Comparison



i-V Curve



Conclusion

- Higher IEC makes larger ion channels, referred to as water uptake, lowering cell voltage.
- Additionally, new reinforcement improved dimensional stability even with higher water uptake.
- Gas crossover can be minimized even with a thinner membrane.
- Newly developed membranes optimize IEC, thickness, and reinforcement.

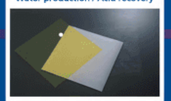
History of AGC's FORBLUE Business

1933 Start of caustic soda production (chemical process)

1950 Begins R&D on the **SELEMION** membrane, an ion exchange membrane for electrolysis and electrodialysis

1962 Starts research into fluoropolymers and launches **SELEMION** as a commercial product, which, depending on the application, can generate a small amount of hydrogen gas

FORBLUE™ SELEMION
Salt production / Desalting / Water production / Acid recovery



Hydrocarbon ion exchange membrane

1964 Begins fluorochemicals business (fluorocarbons)

1975 Launches **FLEMION**, an ion exchange membrane for the chlor-alkali industry, generating hydrogen gas a a biproduct

FORBLUE™ FLEMION
Caustic soda production / Caustic potash manufacturing

Perfluoro ion exchange membrane

1978 Starts ion exchange membrane (IEM) plant operation (AZEC electrolyzer)

1990 **sunsep** product line is launched for dehumidification of gas passing through the tube

FORBLUE™ sunsep
Dehumidification / Humidification of gas

Perfluoro sulfonic acid tube

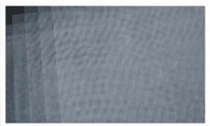
2001 Discontinued electrolyzer business and focus on IEM business

2017 Introduces the FORBLUE family of separation and ion exchange functional products: **FLEMION**, **SELEMION**, **S-SERIES**, **i-SERIES**, and **sunsep**

FORBLUE™ i-SERIES
Fuel cells

Perfluoro sulfonic acid polymer dispersion

FORBLUE™ S-SERIES
Various electrolysis and electrodialysis applications



Perfluoro sulfonic acid exchange membrane

AGC Chemicals Company Position in the Hydrogen Economy

With 60 years of experience in ion exchange membranes (IEM), AGC has supported various industries and embraces the opportunity to support the growing hydrogen economy.