IONOMR INNOVATIONS

AEMION+® 3rd Generation ELECTROLYSIS OFFERINGS

Generation Anion Exchange Membranes & Polymers

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PRODUCT INFORMATION

Ionomr designs and manufactures breakthrough advanced ion-exchange materials to enable rapid growth of the hydrogen economy. Ionomr's Aemion+® anion exchange membranes are significantly more durable than our competitors' leading to thinner membranes, longer service life and reduced overall system costs.

Our membranes have low ionic resistance, high electrical resistance, and strong chemical stability in solutions of both high and low pH, including concentrated alkaline solutions (KOH preferred) **from 0.1 M to 2 M at 90°C.**

Ionomr's advanced anion exchange membranes and polymers are a breakthrough in material science with a unique hydrocarbon structure and the strongest alkaline stability available. Aemion+® provides specialized solutions for OEMs with unique application challenges.

Aemion+® represents a fundamental shift in anion-exchange technology. Through Aemion+®, we provide a platform to enable simultaneous performance and lifetime improvements in clean technologies while further reducing their environmental impact.

For use in electrolysis applications including AEM water electrolysis & CO_2 Electrolysis, hydrocarbon based Aemion+® membranes and polymers can be utilized in the required conditions and paired with its high performance, unlocks many end use applications that were previously constrained by the membrane's instability.

Aemion+® enables electrochemical systems without the need for precious metals (commonly platinum and iridium), providing a pathway for the production of energy-efficient and low-cost green hydrogen as well as profitible carbon capture and utilization technologies.

AEMION+® REINFORCED MEMBRANES PRELIMINARY

Thickness and Reinforcement Properties

Membrane Type	Typical Thickness (µm)	IEC[1] (meq/g)	Reinforcement
AF3-HWK9-75-X	75	1.9-2.7	Woven PEEK

Physical Properties[2]	MD	TD	Test Method
Tensile Strength, MPa	54-60	53-58	ASTM 638
Young's Modulus, MPa	600-670	600-650	ASTM 638
Elongation to break, %	24 - 30	20 - 28	ASTM 638
Hydrolytic Properties[3]			
Water Uptake			
to water soaked, 80 °C	< 15%		ASTM D570
Linear Expansion			
to water soaked, 80 °C	< 3%		ASTM D570
Z-Expansion			
to water soaked, 80 °C	< 8%		ASTM D570
Electrochemical Properties			
Area Resistance, $m\Omega \cdot cm^2$	< 190		Internal[4]
Hydrogen permeability, $N\mu L.cm^{-2}\ min^{-2}.\ bara^{-2}$	< 3.5		Note[5]
Chemical Stability			
Recommended Condition	0.1 - 2 M KOH, ≤90 °C		Internal[6]
Other Properties			
Maximum Processing Temperature	150 °C		
Polymer Tg	> 300 °C		
Counter-ions as produced	I^-/Cl^-		

Notes

1. Polymer IEC in the hydroxide (OH-) counter-ion form.
2. Measured at 22 °C fully hydrated
3. Measured from dried to equilibrated in DI water at 22 °C
4. Measured in water electrolysis conditions at 60 °C, 1 M KOH, OCV, BOL expectations 220 +/−50, determined by effectiveness of exchange into hydroxide form and zero-gap configuration.
5. Not a standard test. Hydrogen permeability is measured in internal testing condition for reference only and is not necessarily representative of customer conditions. It is recommended to verify permeability in individual systems once received.
6. Measured ex-situ by determining steady-state mechanical strength, conductivity, & IEC at specified temperature and regularly exchanged KOH electrolyte.

AEMION+® IONOMERS: DRY RESIN

Ionomer Type	IEC[1] (meq/g)	Conductivity Cl^- (mS/cm)	Water Uptake[2] OH^- (%)	Water Uptake[2] Cl^- (%)
AP3-HNN9-00-X	1.9-2.7	4 - 9	20 - 50	10 - 15

Notes

1. IEC in the hydroxide (OH^-) counter-ion form, calculated by NMR. Recommend silver nitrate for measurement by titration.
2. Approximate swelling properties when cast into membrane form at 25 - 50 µm, at 80°C.

These are prototype materials only intended to be used for early development activities and not intended for production items. Product information is to be used as a guide only, subject to change at any time.

Document ID	Title
FM-6063-B	Properties of Next-Gen Aemion⁺™ Water Electrolysis Membranes

Revision	Prepared By	Approved By	Effective Date
B	Tong Li	Andrew Belletti	Jan 11, 2023

This document is reviewed to ensure its continuing relevance to the systems and process that it describes.

REVISION HISTORY:

Revision	Date	Description of Changes	Approved By
A	Sept. 9, 2022	Initial Draft	Scott McDermid
B	Jan. 11, 2023	Updated data	Andrew Belletti

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