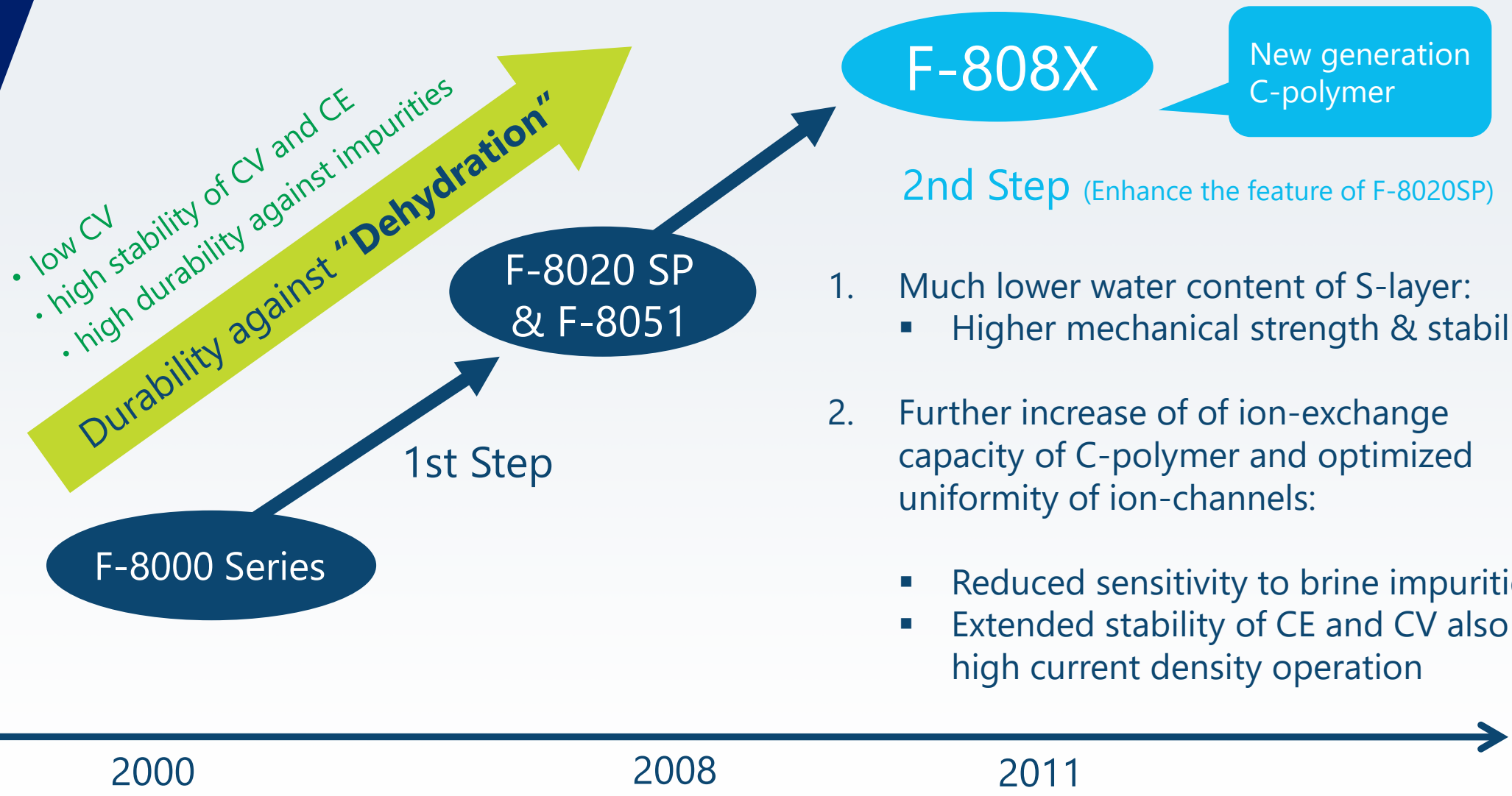
Introducing FORBLUE™ FLEMION™ F-8080 Series Membranes

AGC

FORBLUE™

Developments of FLEMION

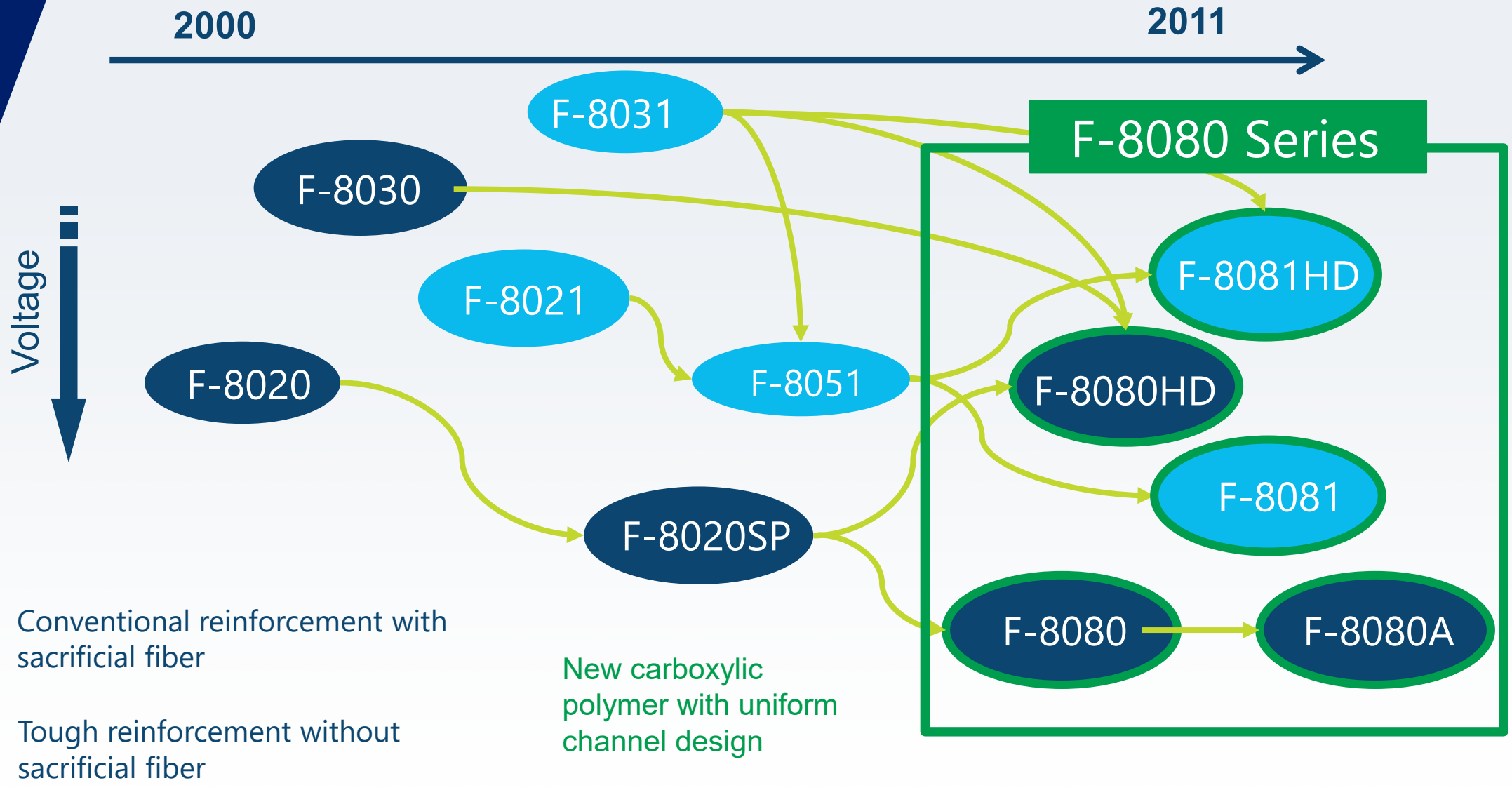


1. Much lower water content of S-layer:
   - Higher mechanical strength & stability

2. Further increase of of ion-exchange capacity of C-polymer and optimized uniformity of ion-channels:

   - Reduced sensitivity to brine impurities
   - Extended stability of CE and CV also at high current density operation

Development Steps



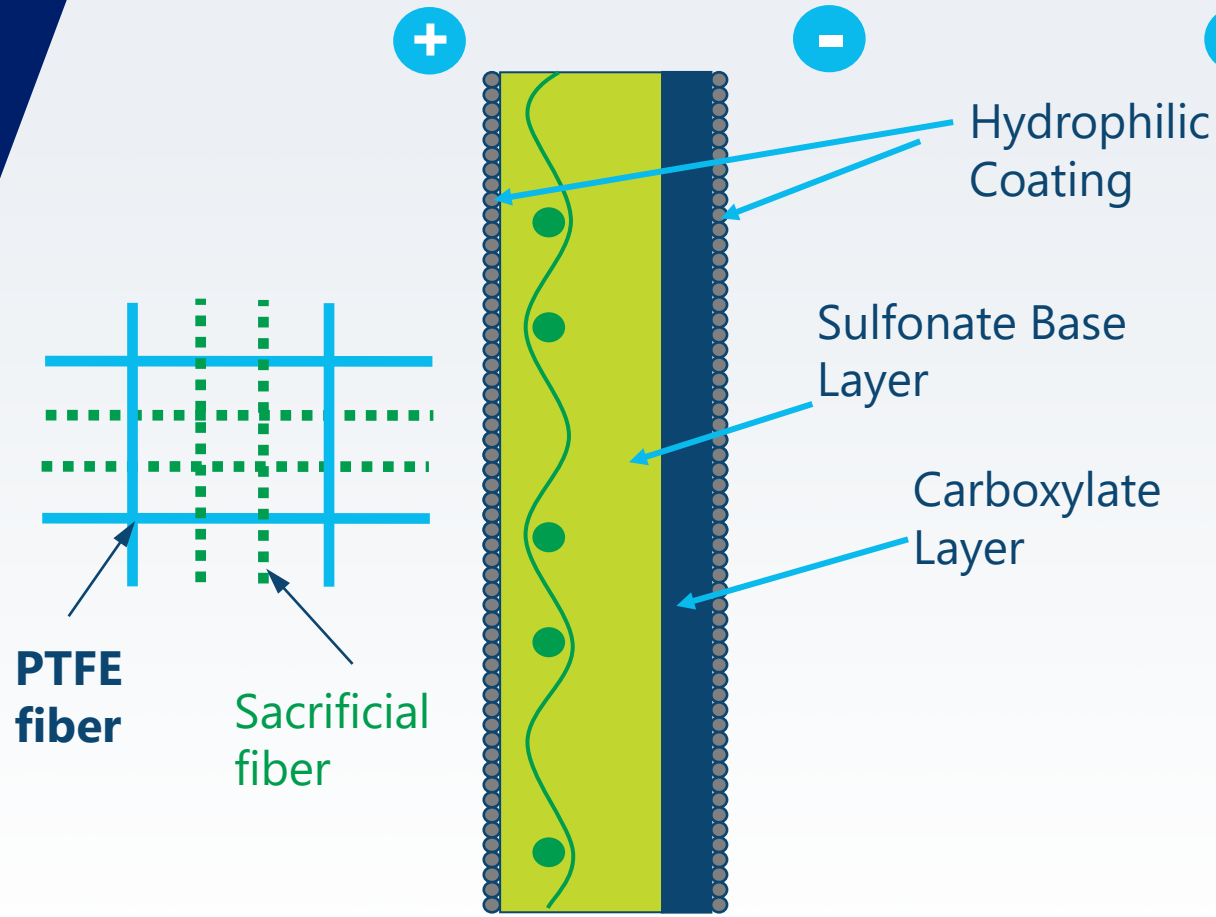
Choice of FLEMION Membranes

	Cloth **with** Sacrificial Fibers Tensile Strength 45 N/cm	Cloth **without** Sacrificial Fibers Tensile Strength 70 N/cm
Higher current density Lower voltage Less impurity influence	Flemion F-8080/F-8080A • Lowest voltage • -60 mV	Flemion F-8081 • Robust • Lower voltage • -20 mV
Lower current density Smaller NaCl in NaOH Fewer salt blisters	Flemion F-8080HD • Higher durability • -10 mV	Flemion F-8081HD • Most durable • Most robust • +30 mV
	• Lower voltage	• Fewer pinching issues • Durable for frequent tension

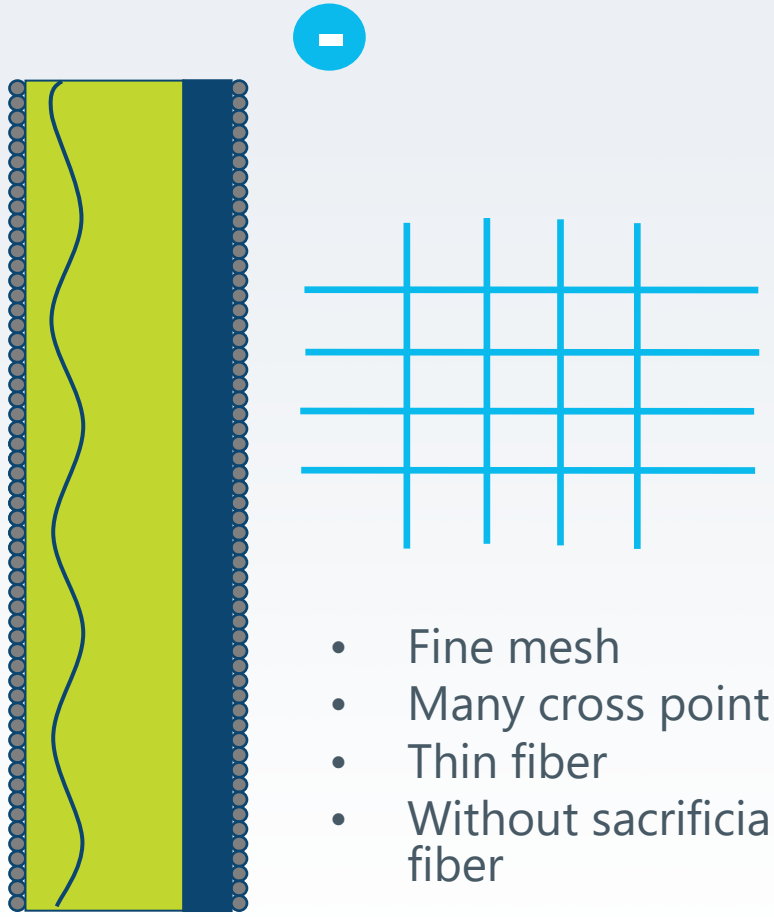
Your Dreams, Our Challenge

Type of Reinforcement Cloth

With Sacrifical Fibers
F-8020SP / F-8080 / F-8080A / F-8080HD

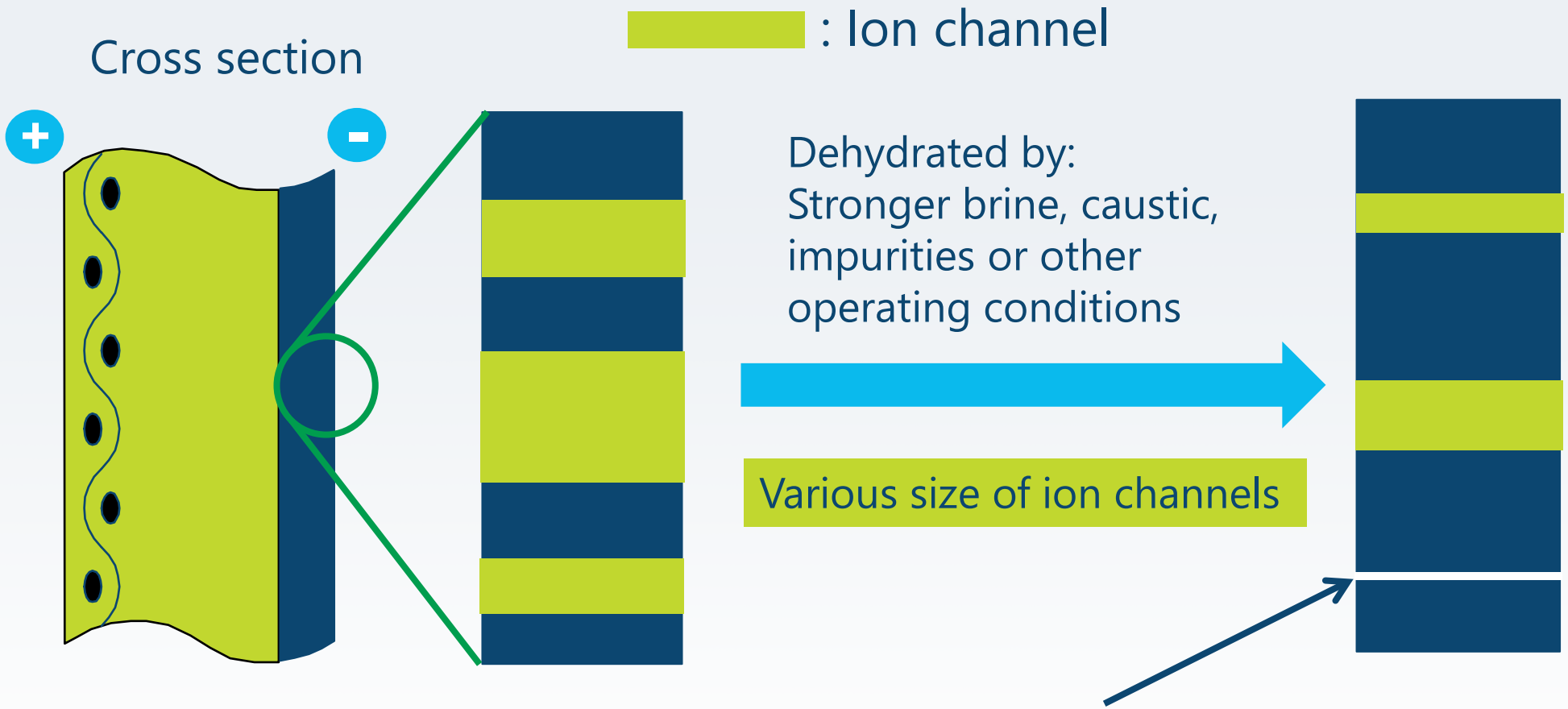


Without Sacrifical Fibers
F-8051 / F-8081 / F-8081HD



- Fine mesh
- Many cross point
- Thin fiber
- Without sacrificial fiber

Earlier C-Polymer

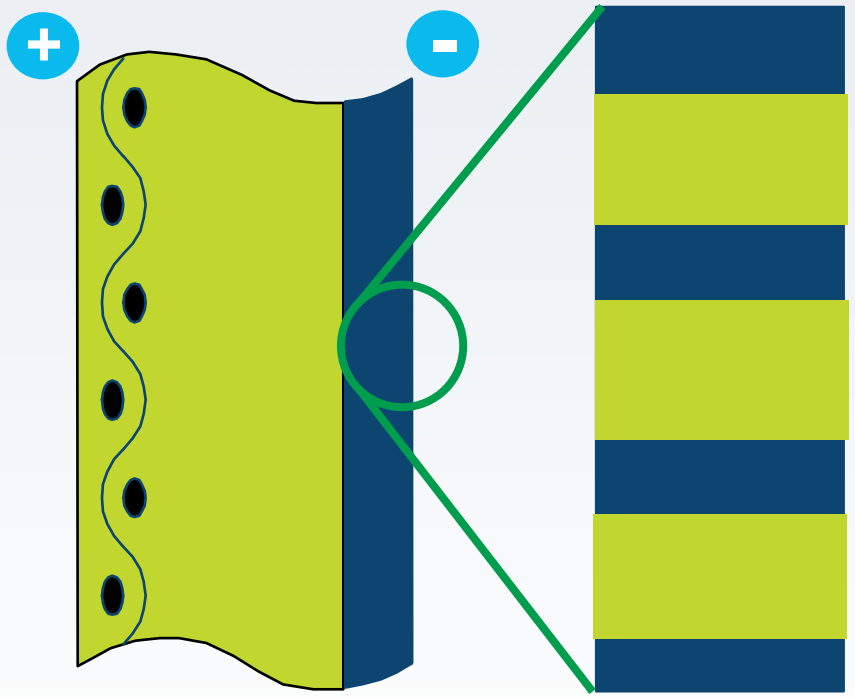


Relatively narrow channel will lose the function in strongly dehydrated state.

Optimized C-polymer with Uniform Channel Size

F-808x
Cross section

: Ion Channel



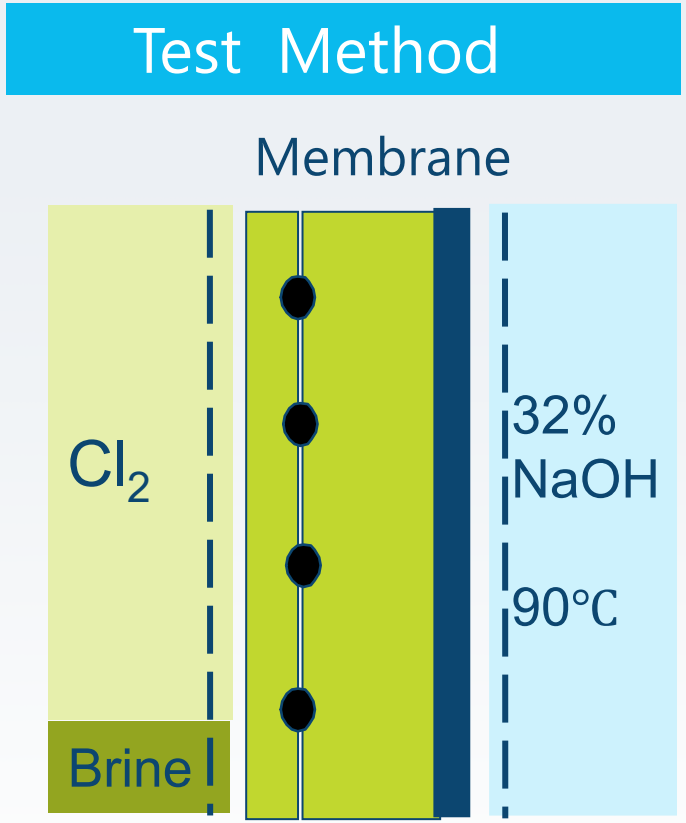
Dehydrated by:
Stronger brine, caustic, impurities or other operating conditions

Uniform channel size avoids losing of function in dehydrated stage.

Test for Deterioration by Cl2 Gas Stagnation

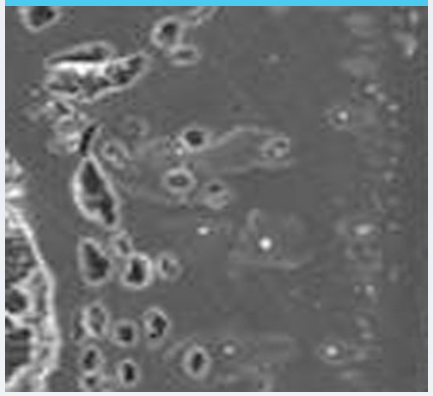
Special Test Conditions for F-8080HD Tests

Cl_2 gas stagnation on anode side and high caustic strength on cathode side. Under these conditions salt crystals may be formed in membrane



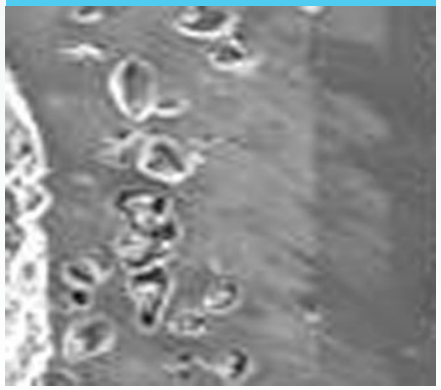
Test for Deterioration by Cl2 Gas Stagnation

F-8020SP

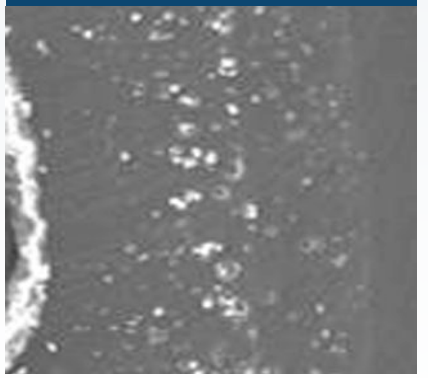


- F-8080 has same durability for Cl2 gas stagnation with very low voltage.
- **F-8080HD** has much higher durability for Cl2 gas stagnation with lower voltage than F-8020.

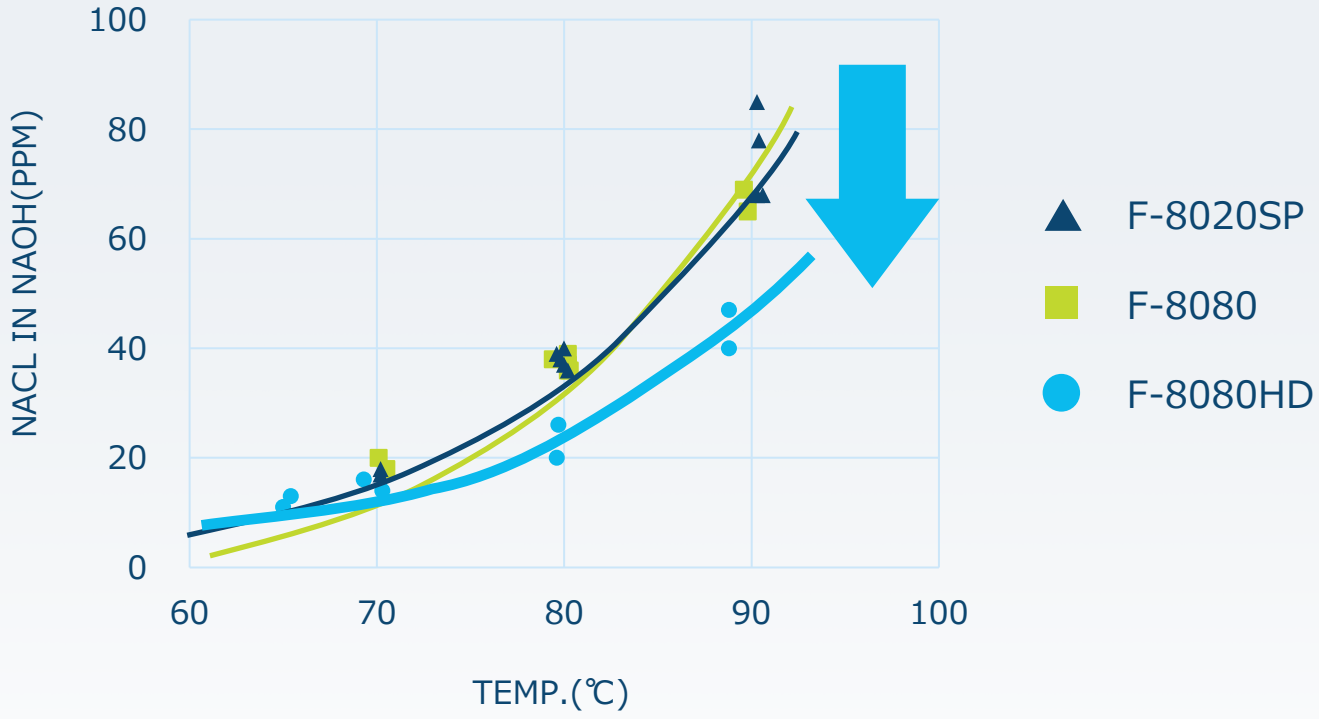
F-8080



F-8080HD



Low NaCl in NaOH at Low C.D. and High Temp

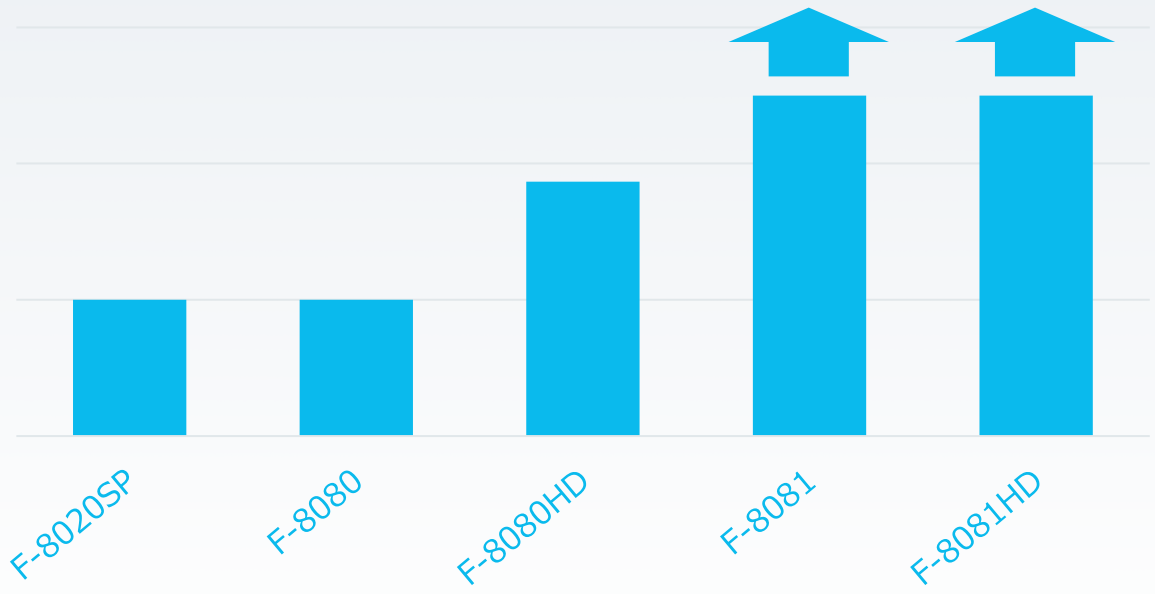


F-8080HD shows lower NaCl concentration in NaOH.

Frequent Load Tensile Test

Comparison of F-8020SP, F-8080, F-8080HD, F-8081 and F-8081HD

Repetition of Test until Membrane Rupture (Sum of the Value to Various Direction)



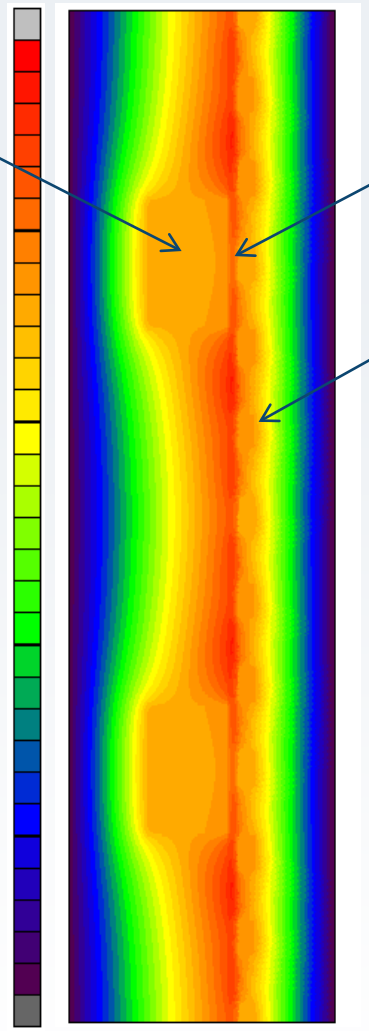
- F-8080HD is nearly twice as robust for frequent load as F-8080.
- F-8081 and F-8081HD could not be ruptured within certain period.

Features of FLEMION F-8080A

1. **CE stability in high temperature for latest zero gap electrolyzer**
2. Resistance for Ni
3. Higher CE in weak brine (by less circulation)

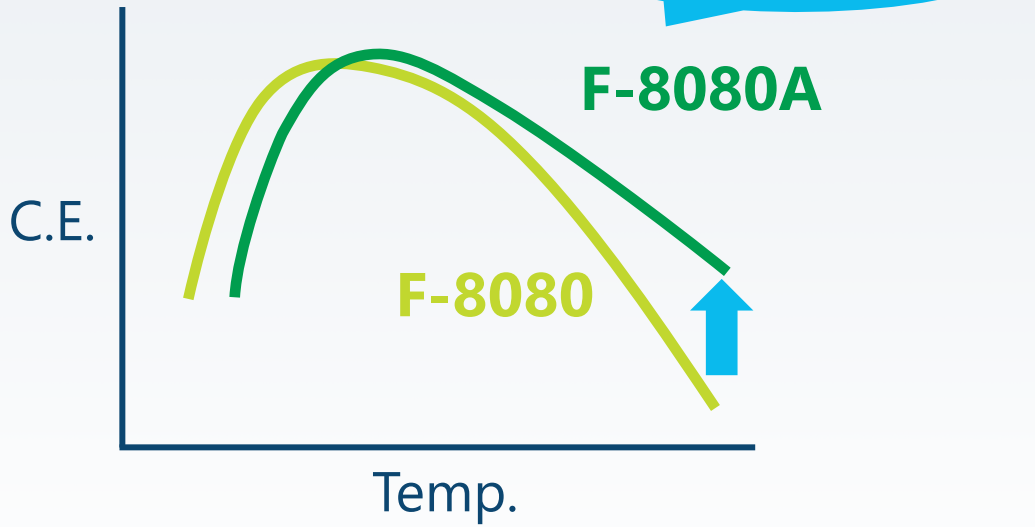
Controlled C-polymer for Zero Gap Design

Stable C.E. for Zero Gap: F-8080A



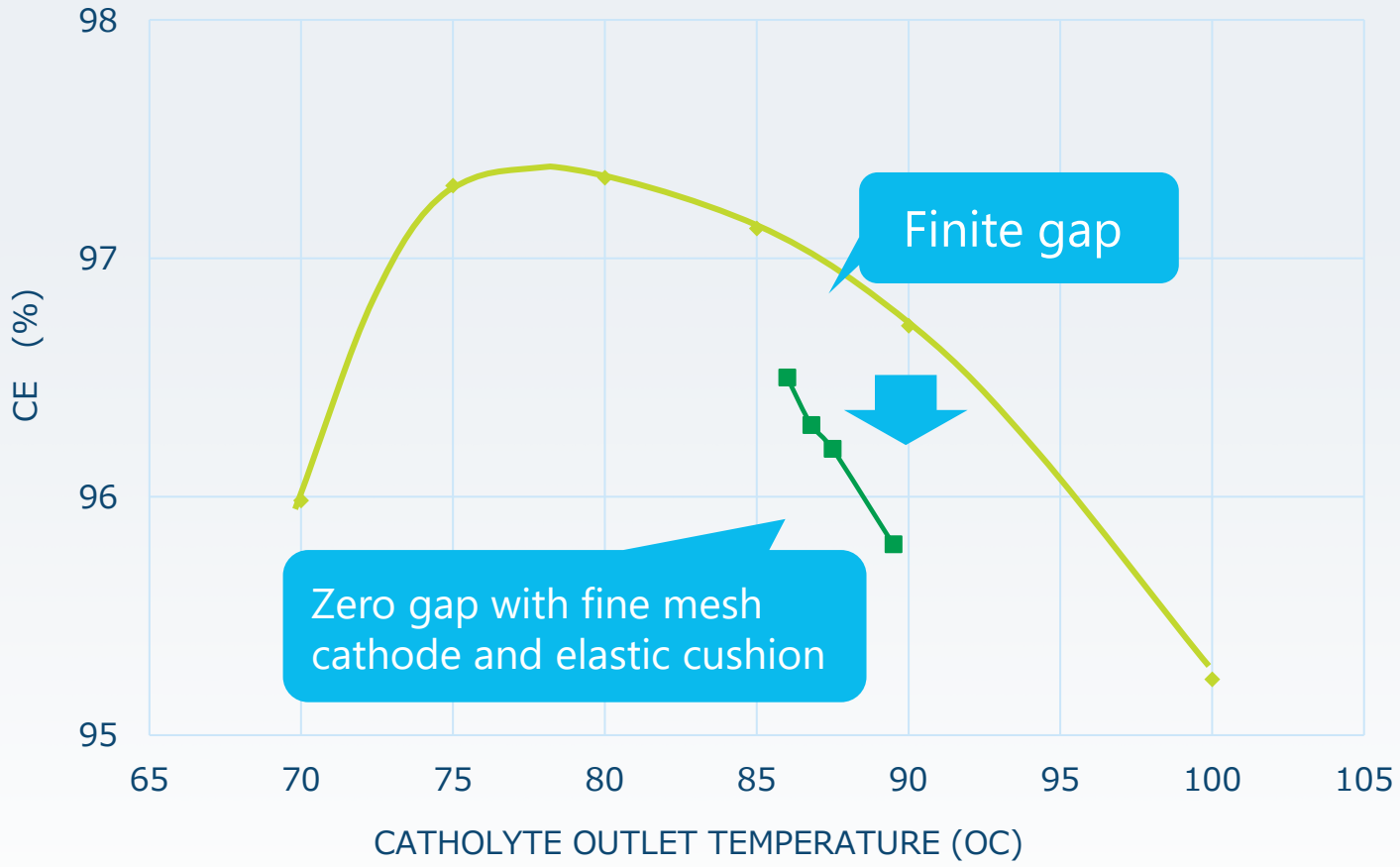
Higher Temp

for Zero Gap



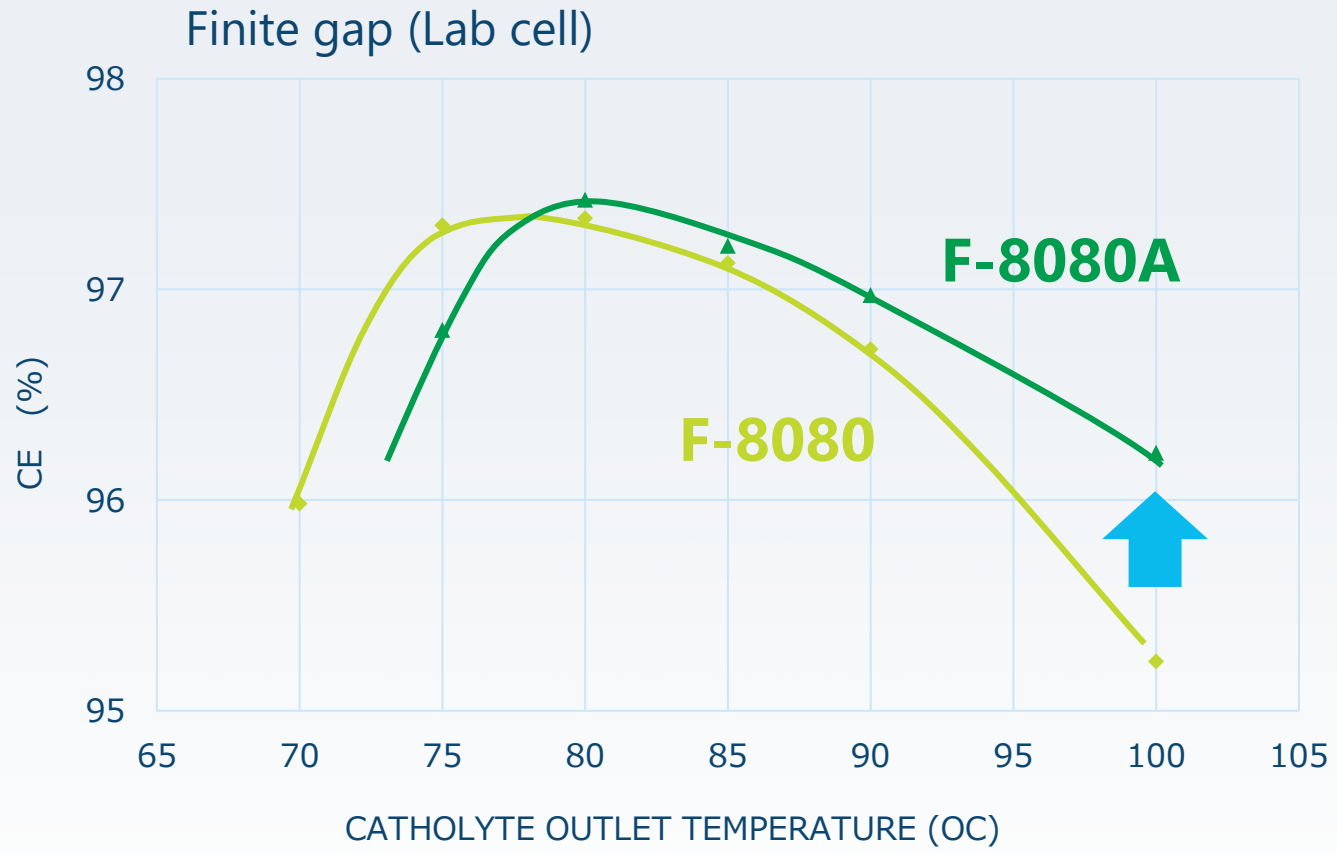
F-8080A: Wider operation range of high temperature

FLEMION F-8080 : CE Decrease in Zero Gap



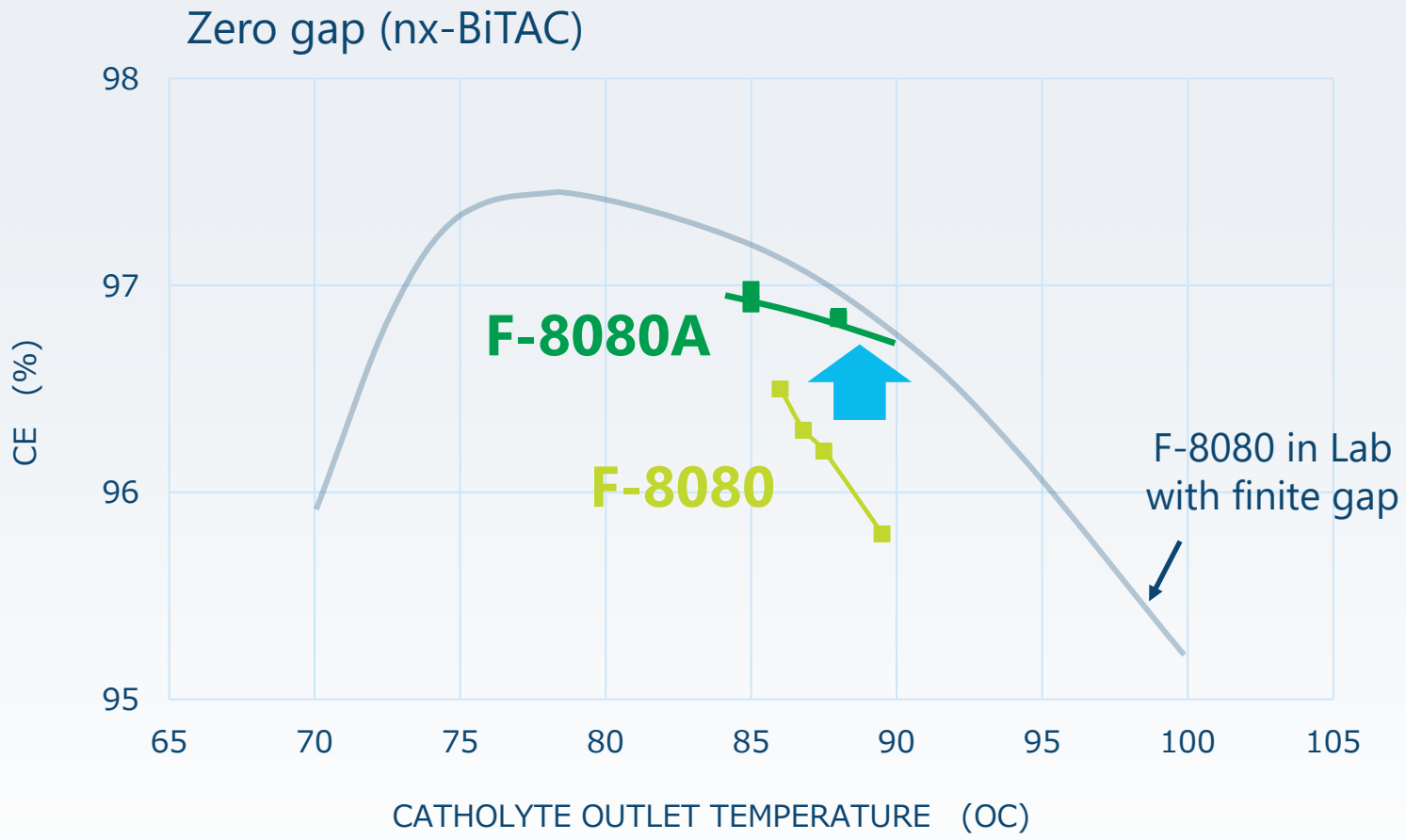
F-8080 in zero gap shows 0.5-1% lower CE than in finite gap at high temperature.

FLEMION F-8080A : Higher CE at High Temperature



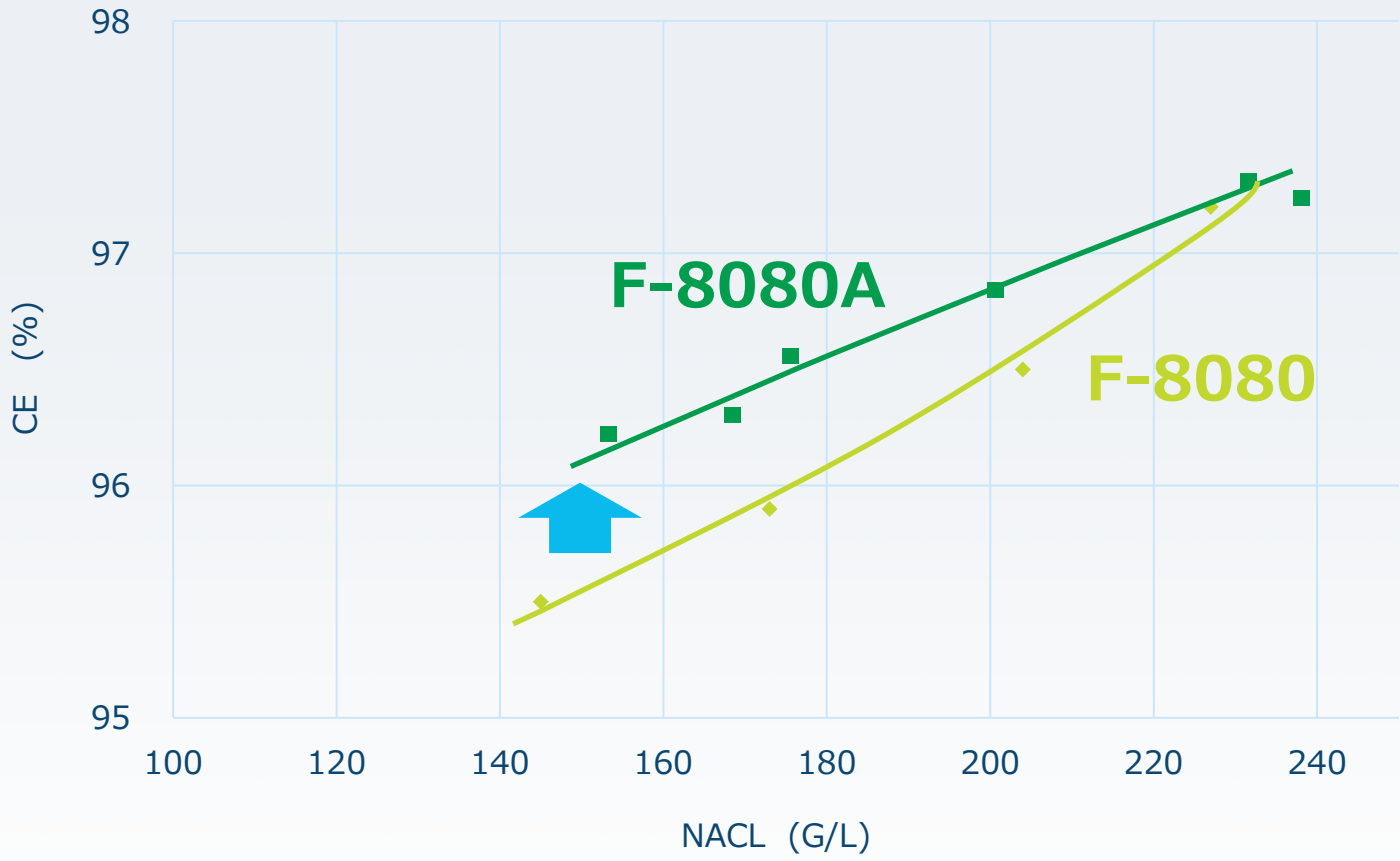
F-8080A shows more than 96% CE even at 100 °C.

FLEMION F-8080A : Higher CE in nx-BiTAC



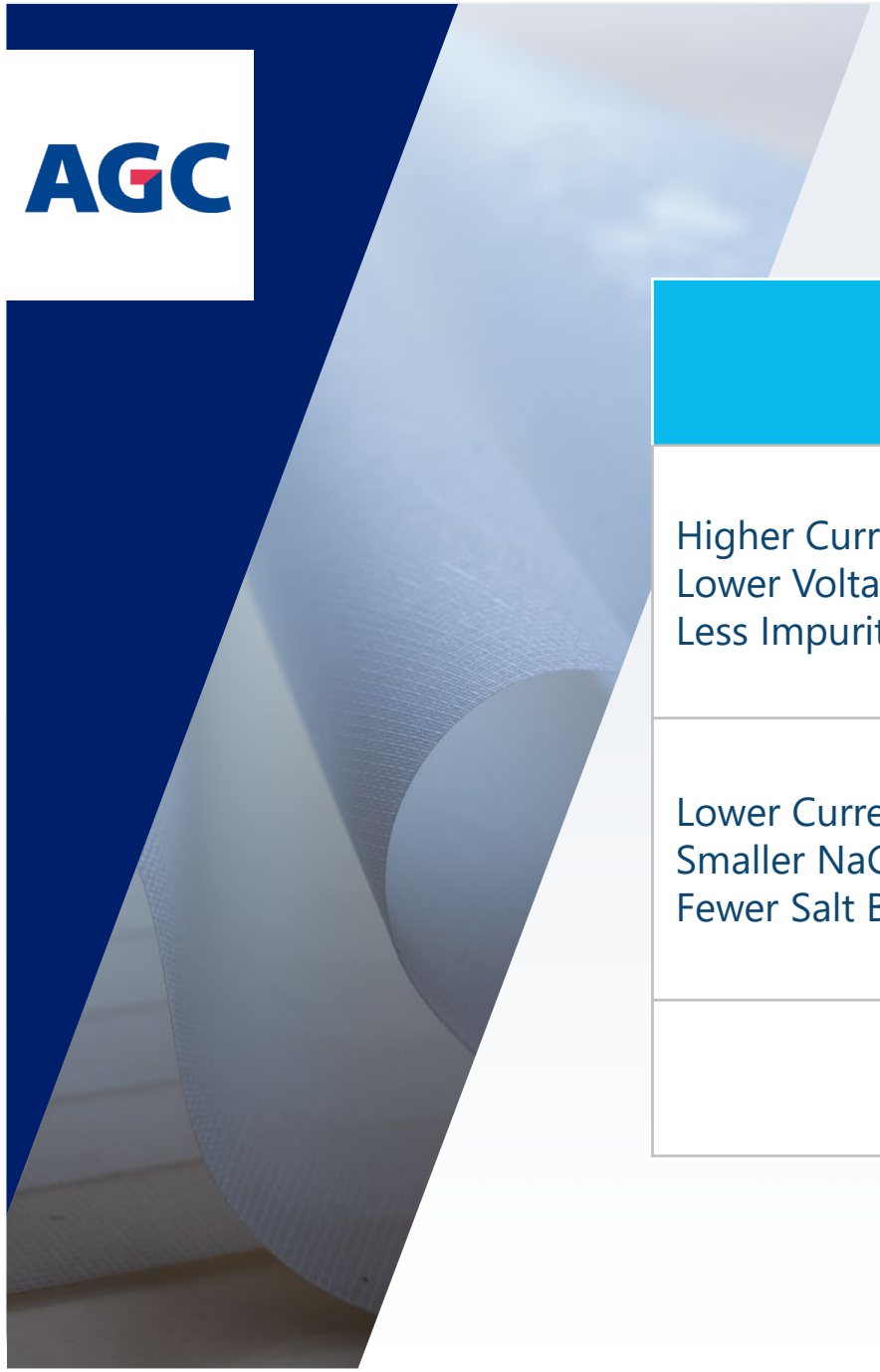
F-8080A in nx-BiTAC shows high enough CE at high temperature.

FLEMION F-8080A : Higher CE in Hydrated Condition



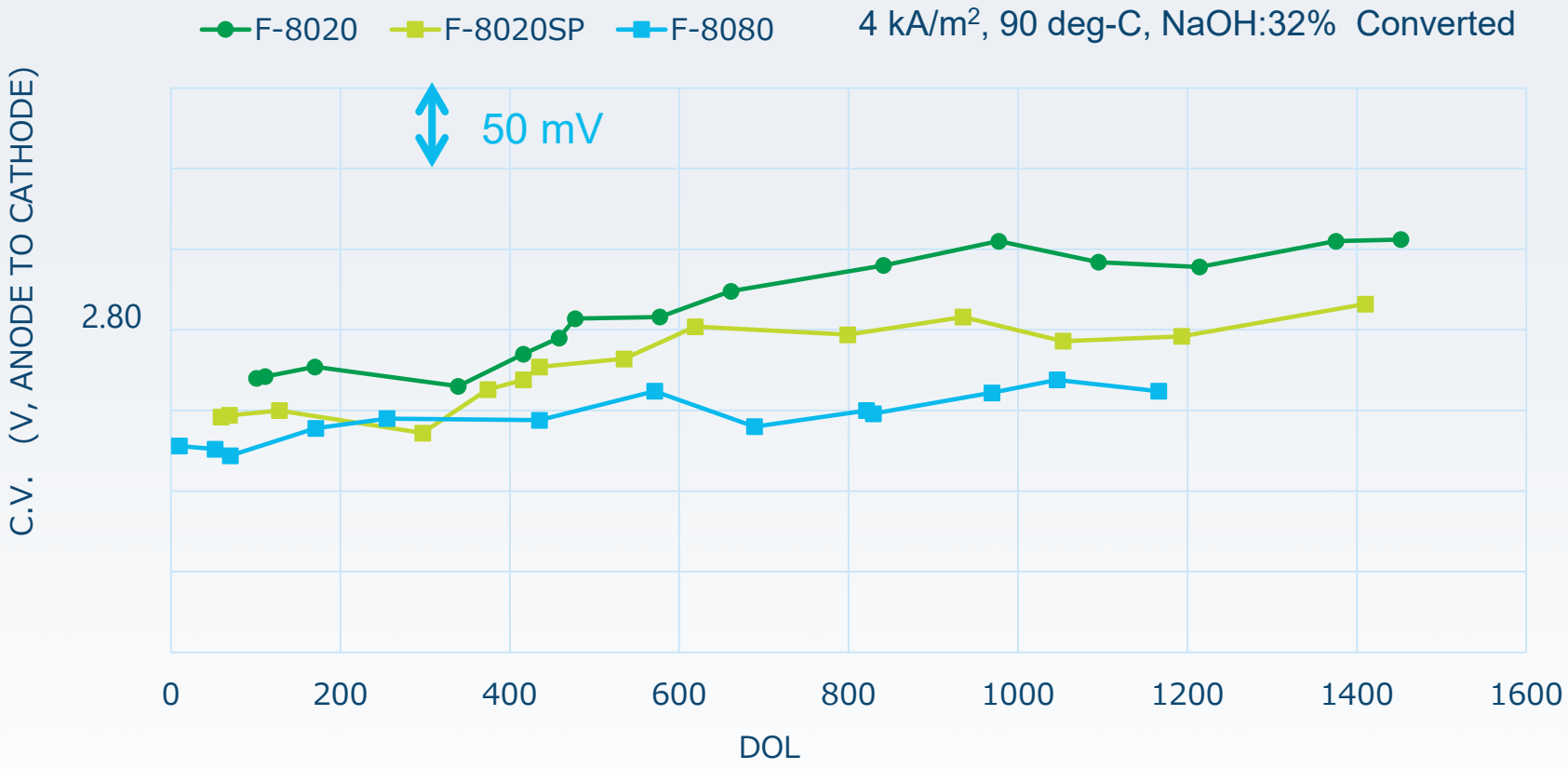
F-8080A shows higher CE in weak brine.

Choice of Membranes



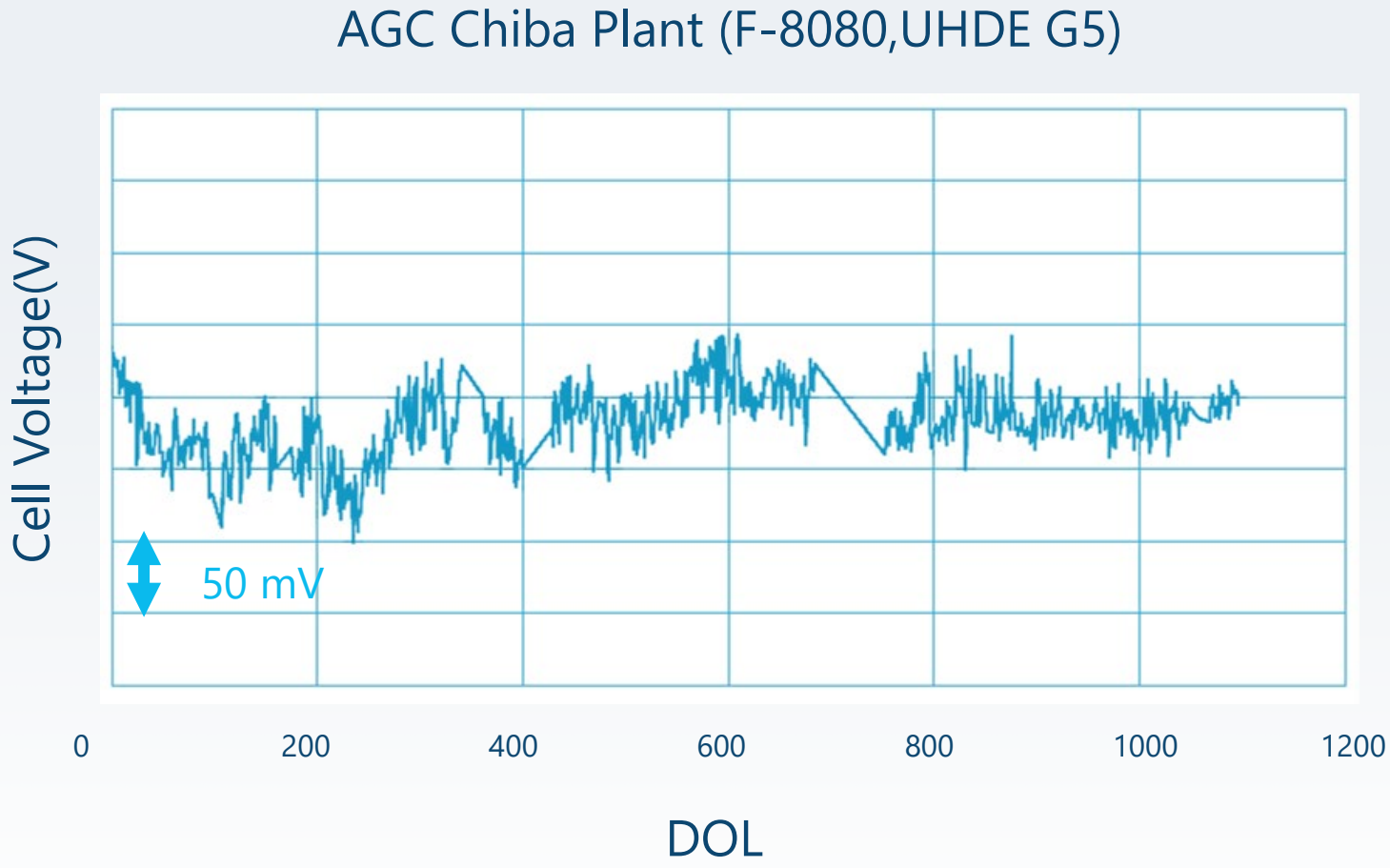
	Cloth **With** Sacrificial Fibers Tensile Strength 45 N/cm	Cloth **Without** Sacrificial Fibers Tensile Strength 70 N/cm
Higher Current Density Lower Voltage Less Impurity Influence	• F-8080 / F-8080A • Lowest Voltage • -60 mV	• F-8081 • Robust • Lower Voltage • -20 mV
Lower Current Density Smaller NaCl in NaOH Fewer Salt Blisters	• F-8080HD • Higher Durability • -10 mV	• F-8081HD • Most Durable • Most Robust • +30 mV
	• Lower Voltage	• Less Pinching Issues • Durable for Frequent Tension

Voltage Stability in AGC Plant



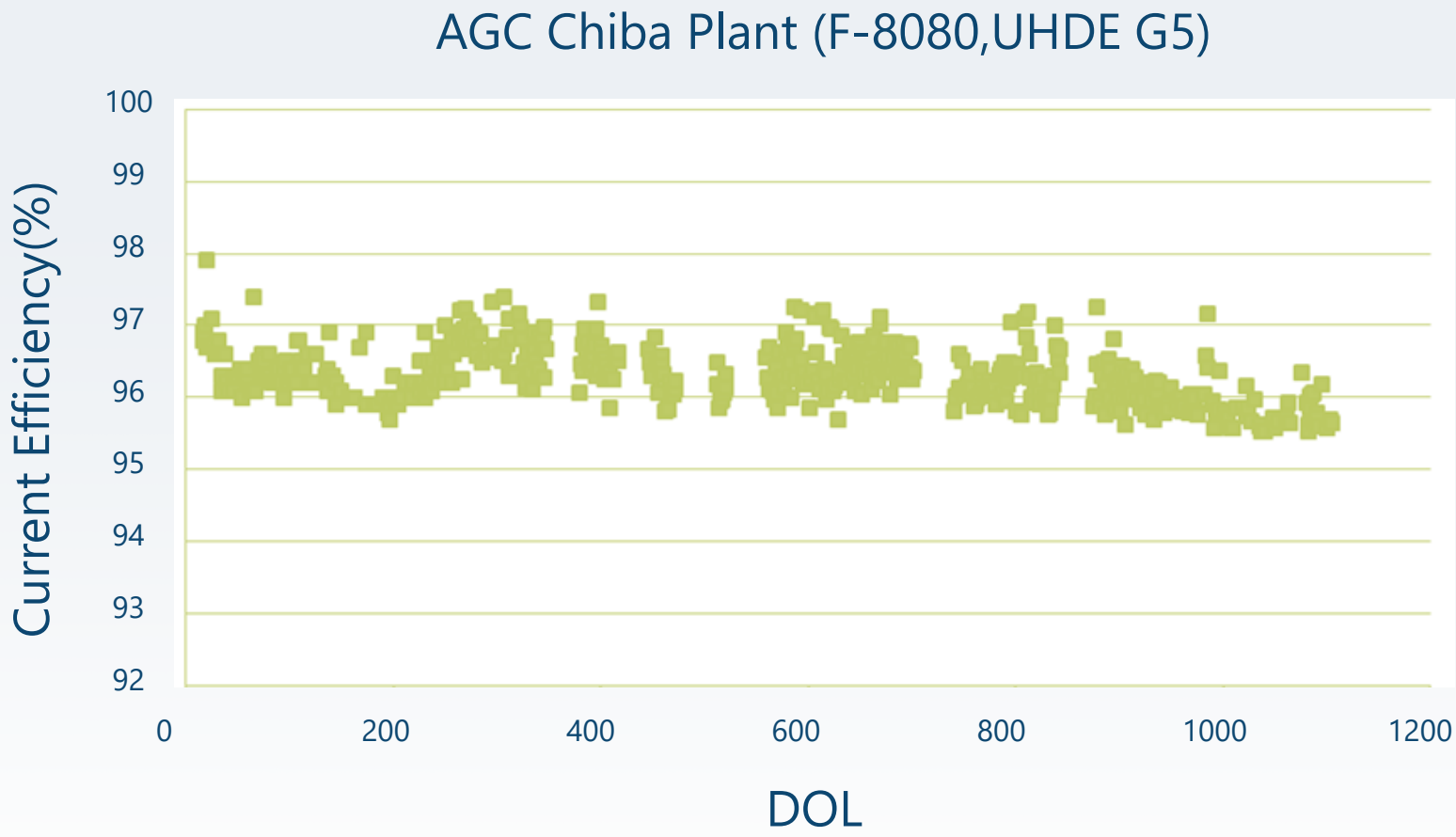
F-8080 shows most stable voltage more than three years operation.

Voltage in AGC Plant



F-8080 shows most stable voltage more than three years operation.

Stable CE in AGC Plant



F-8080 keeps stable current efficiency higher then 95.5% for more than three years operation.

For More Information:

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