



Euro Chlor 10th International Chlorine
Technology Conference & Exhibition

New Flemion Membranes for Zero Gap Configuration

AGC Chemicals
ASAHI GLASS CO., LTD.

16th May 2017



Contents



- Influence of Zero Gap on the membrane
- F-8080A : New Type of F-8080 series
for Zero Gap
- Next Generation Membrane

Configuration of Finite Gap and Zero Gap AGC

Finite Gap

Labels: Anode, Membrane, Cathode Expand Metal

Zero Gap

Labels: Anode, Membrane, Current Collector, Elastic Cushion, Fine Mesh Cathode Woven Mesh

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Less Catholyte Flow at Membrane Surface AGC

Finite Gap

Labels: Anode, Membrane, Cathode Expand Metal

Catholyte Flow

Zero Gap

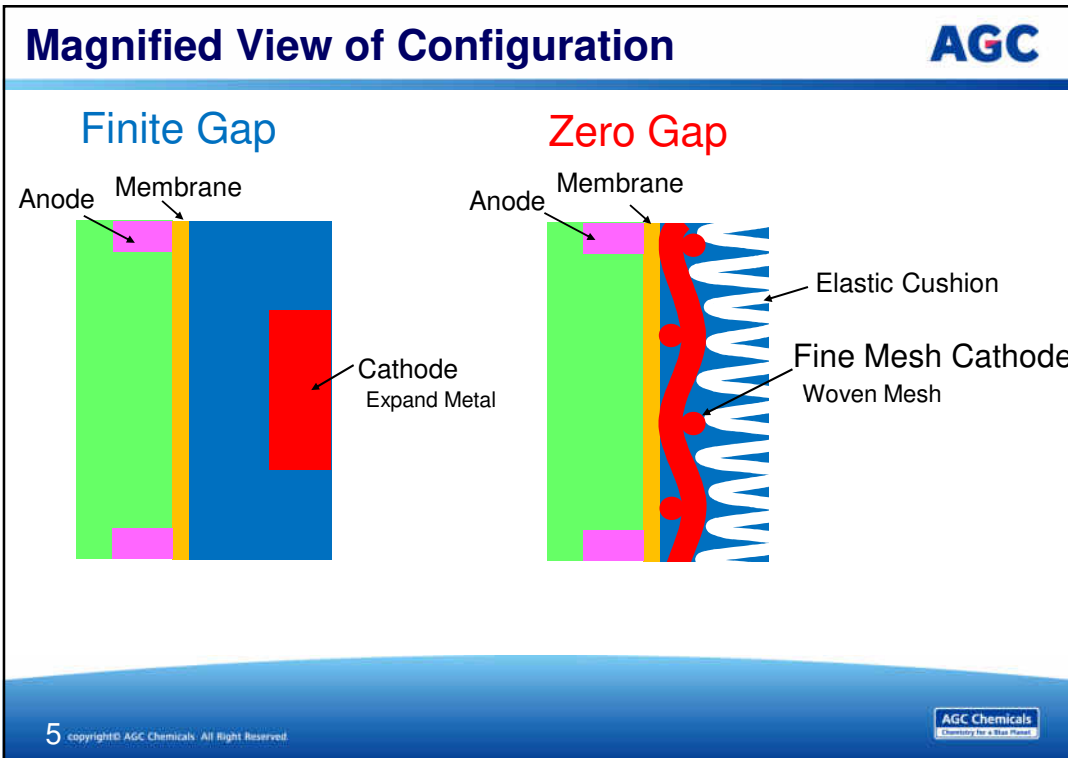
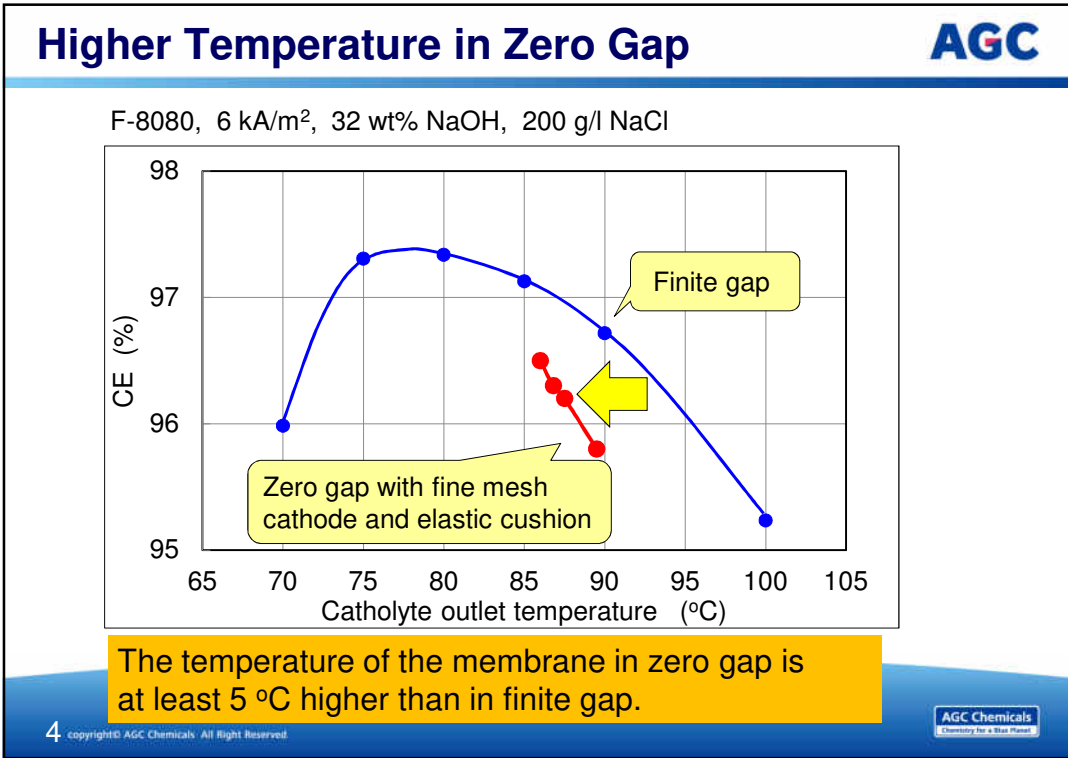
Labels: Anode, Membrane, Current Collector, Elastic Cushion, Fine Mesh Cathode Woven Mesh

Catholyte Flow

Less Flow caused by the structure

Less flow of catholyte at membrane surface removes less heat of membrane, which makes membrane higher temperature than catholyte outlet.

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Less H₂ Gas Flow in Zero Gap Structure AGC

Finite Gap

Zero Gap

Less flow makes more H₂ gas bubbles touch the membrane, caused by zero gap structure.

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Higher H₂ in Cl₂ at Lower CD AGC

H₂/Cl₂ on anode side at low CD in commercial size electrolyzer

Catholyte outlet temperature (°C)	H ₂ /Cl ₂ on anode side (vol%) - Finite Gap (0.8kA/m ²)	H ₂ /Cl ₂ on anode side (vol%) - Zero Gap (0.7kA/m ²)
73	0.15	-
74	0.15	-
75	0.15	-
76	-	0.45
76	-	0.60
76	-	0.90
77	-	0.45
77	-	0.65
77	-	0.75
78	-	0.60
78	-	0.65
78	-	0.95
79	-	0.50
79	-	0.60
79	-	1.15
80	-	0.70
80	-	1.00
81	-	0.75
81	-	1.05
82	-	0.70
83	-	0.75

Zero gap shows higher H₂ in Cl₂ than finite gap in same electrolyzer, which indicates more H₂ gas touches to cathode side surface of the membrane.

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- Influence of Zero Gap on the membrane
- **F-8080A ; New Type of F-8080 series for Zero Gap**
- Next Generation Membrane

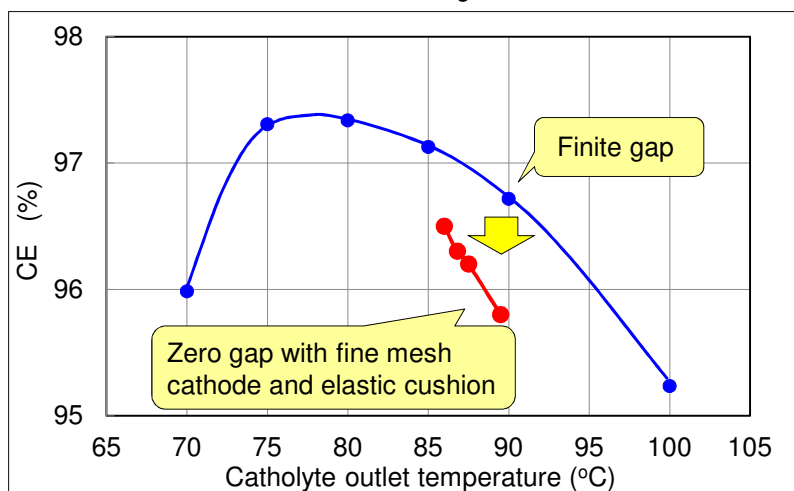
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F-8080 : CE Decrease in Zero Gap

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F-8080, 6 kA/m², 32 wt% NaOH, 200 g/l NaCl



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

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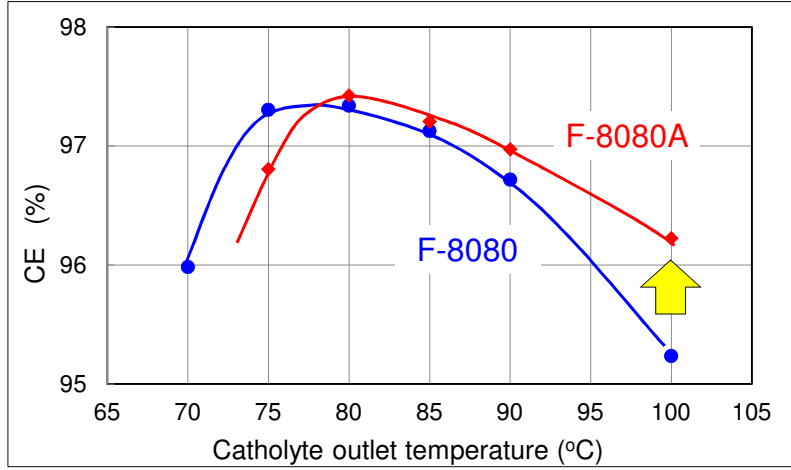
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F-8080A : Higher CE at High Temperature



Finite gap (Lab cell)

6 kA/m², 32 wt% NaOH, 200 g/l NaCl



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

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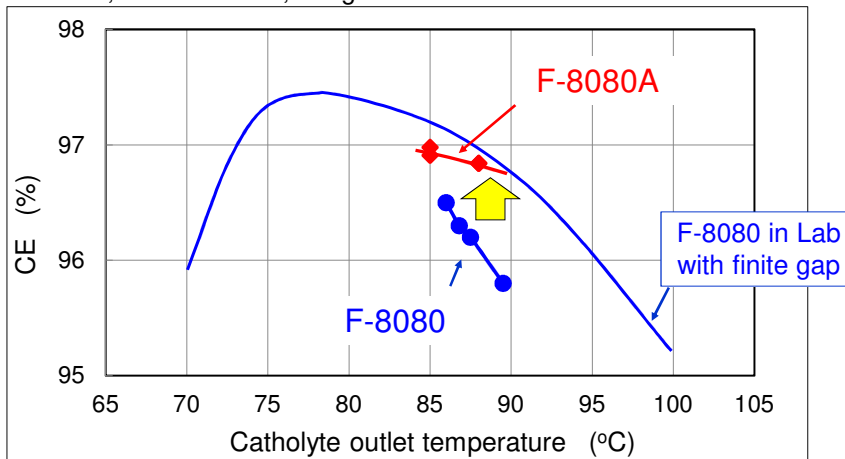


F-8080A : Higher CE in nx-BiTAC



Zero gap (nx-BiTAC)

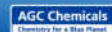
6kA/m², 32wt% NaOH, 200g/l NaCl



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

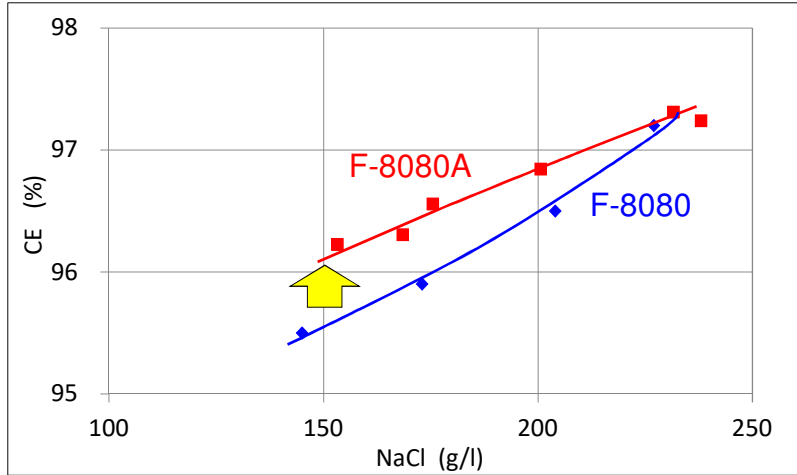
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F-8080A : Higher CE in Hydrated Condition AGC

Lab cell, 6 kA/m², 90 °C, 32 wt% NaOH



F-8080A shows higher CE in weak brine.

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Features of F-8080A AGC

- 1. Higher stability for zero gap**
 - Especially, higher CE at high temperature
- 2. Higher CE against hydrated state**
 - higher CE in weak brine
- 3. Same voltage and durability as F-8080**
 - Low voltage and high durability
 - Fine adjustment of F-8080 which has proven reliability

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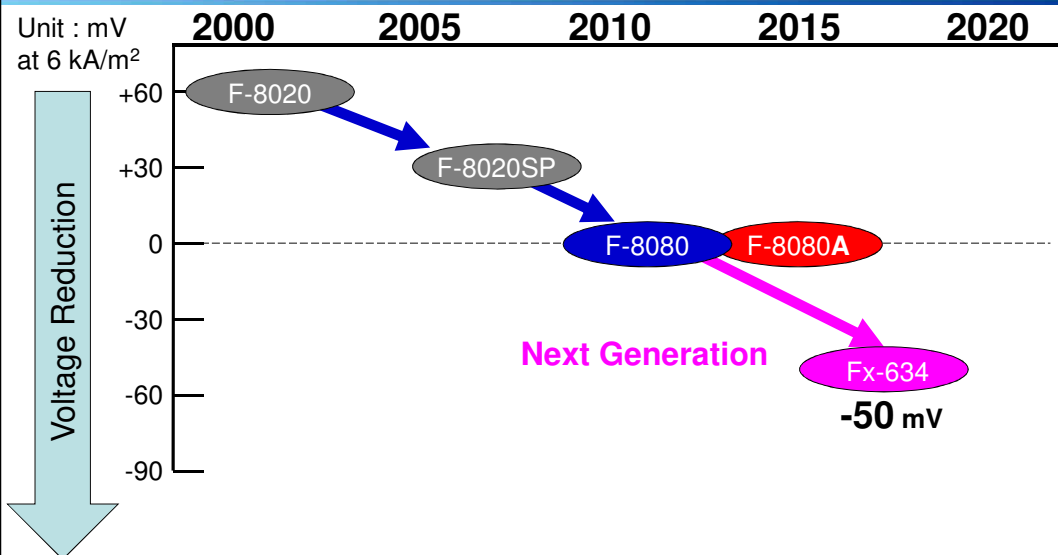
- Influence of Zero Gap on the membrane
- F-8080A : New Type of F-8080 series for Zero Gap
- **Next Generation Membrane**
 - Lowest Voltage
 - Higher CE in Wider Range
 - Higher Durability against Impurities

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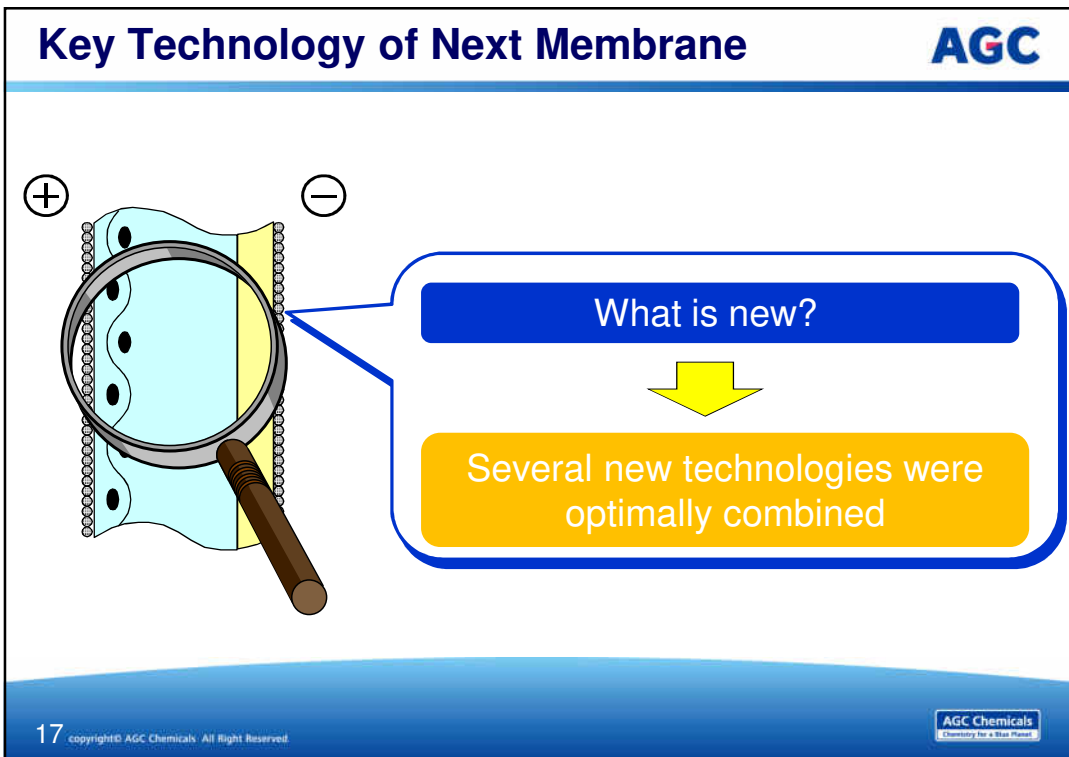
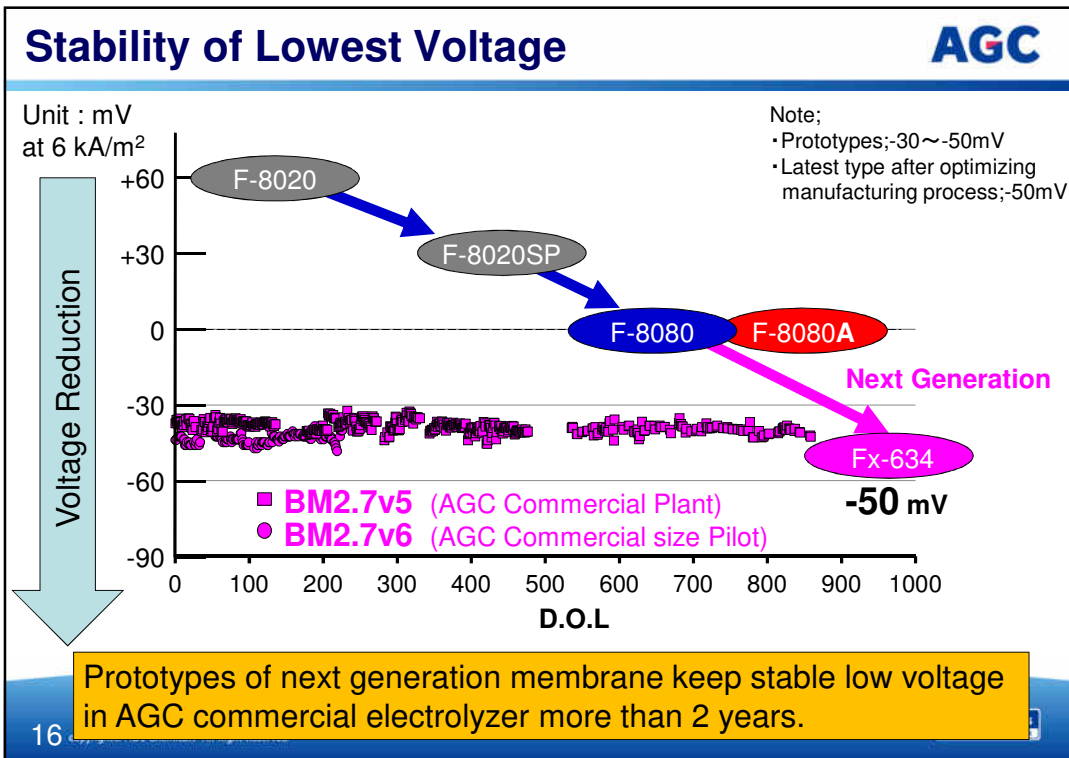
Lowest Voltage

AGC




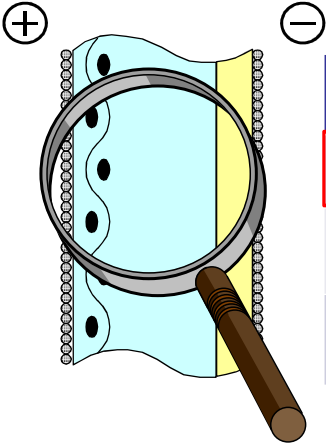
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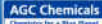


Key Technology of Next Membrane




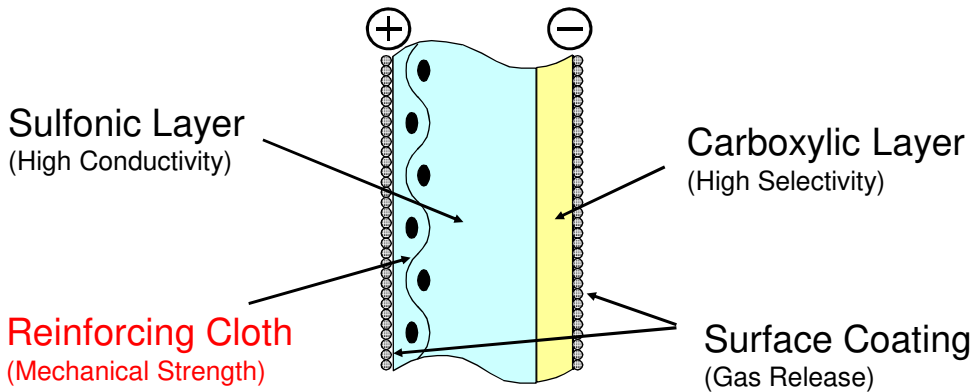


Advantages	Key Technologies
Voltage Reduction	Optimized Reinforcing cloth
Higher CE in Wider Range	Fine Ion Channel
Higher Durability against Impurities	Uniform Ion Channel

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Basic Structure of Flemion



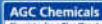


Sulfonic Layer
(High Conductivity)


Carboxylic Layer
(High Selectivity)

Reinforcing Cloth
(Mechanical Strength)

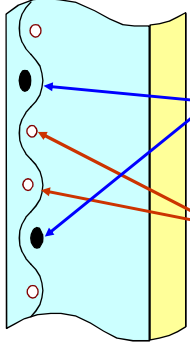
Surface Coating
(Gas Release)

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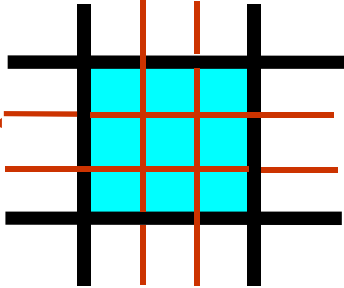
Standard Reinforcing Cloth



Cross section



Plane Figure




Permanent Fiber (PTFE fiber)

Sacrificial Fiber (PET fiber)


Note;

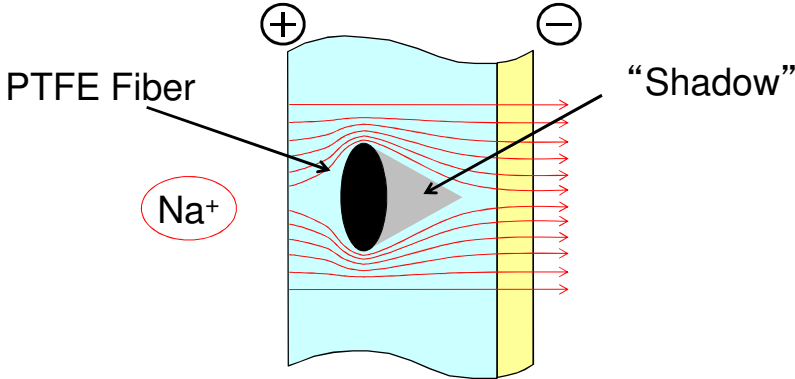
- F-8080 and F-8080A have standard reinforcing cloth
- PET fiber dissolves under the electrolysis

Standard cloth is plain-woven fabric which is composed of PTFE fiber and PET fiber.

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Influence of Cloth on cell voltage






PTFE Fiber

Na⁺

“Shadow”

PTFE fiber interferes the Na⁺ migration which causes the increase of the cell voltage.

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How to reduce the shadow area (1)

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Conventional cloth

Flat type

Optimized cloth

Circle type

Note; There is no difference of fiber fineness between flat type and circle type

The shape of PTFE fiber changes into circle type, which reduces shadow area.

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How to reduce the shadow area (2)

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Sacrificial Fiber Hole
(filled with solution)

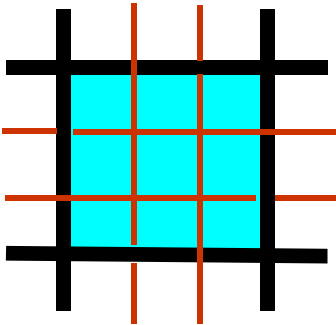
PET fiber dissolves under the electrolysis and makes sacrificial fiber holes, which reduce the shadow area.

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How to reduce the shadow area (2)

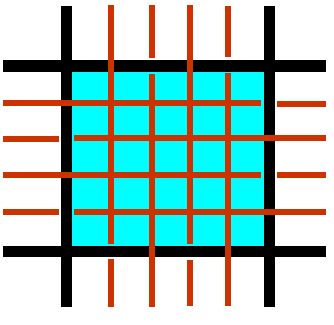
Conventional cloth

F-8080/F-8080A




Optimized cloth

Fx-634



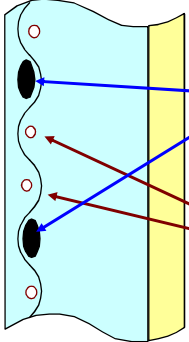
The optimized cloth has 4 PET fibers between PTFE fibers, which reduce the shadow area more.

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Optimized Reinforcing cloth

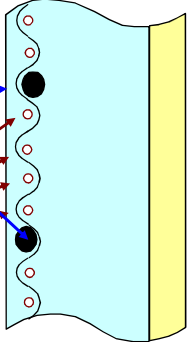
Conventional Cloth

F-8080/F-8080A



Optimized Cloth

Fx-634




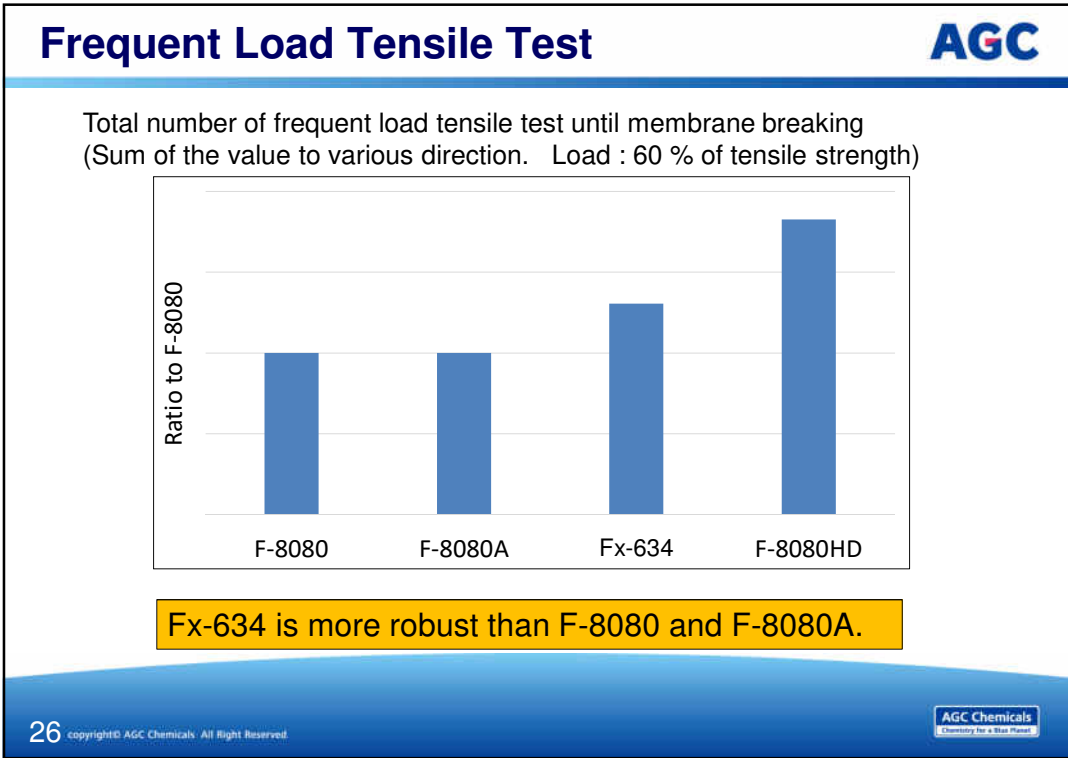
PTFE Fiber

PET Fiber

Optimized reinforcing cloth reduces the shadow area more and makes Fx-634 show lower voltage.

Note; Optimized cloth is a part of voltage reduction technologies.

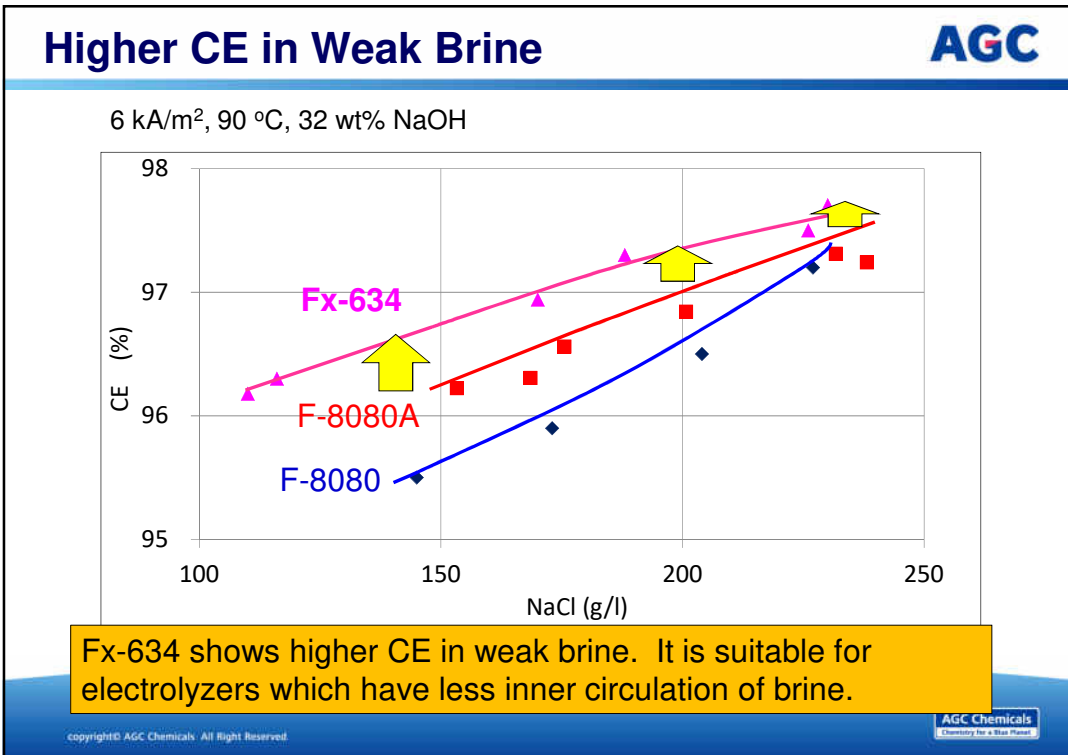
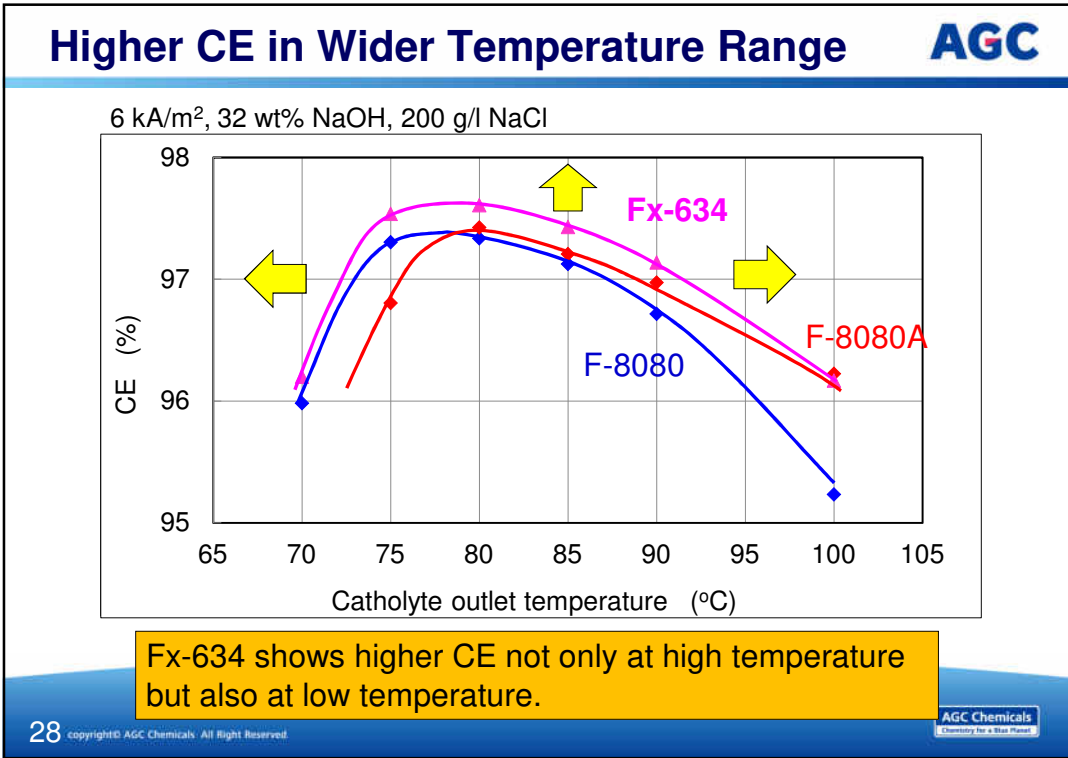
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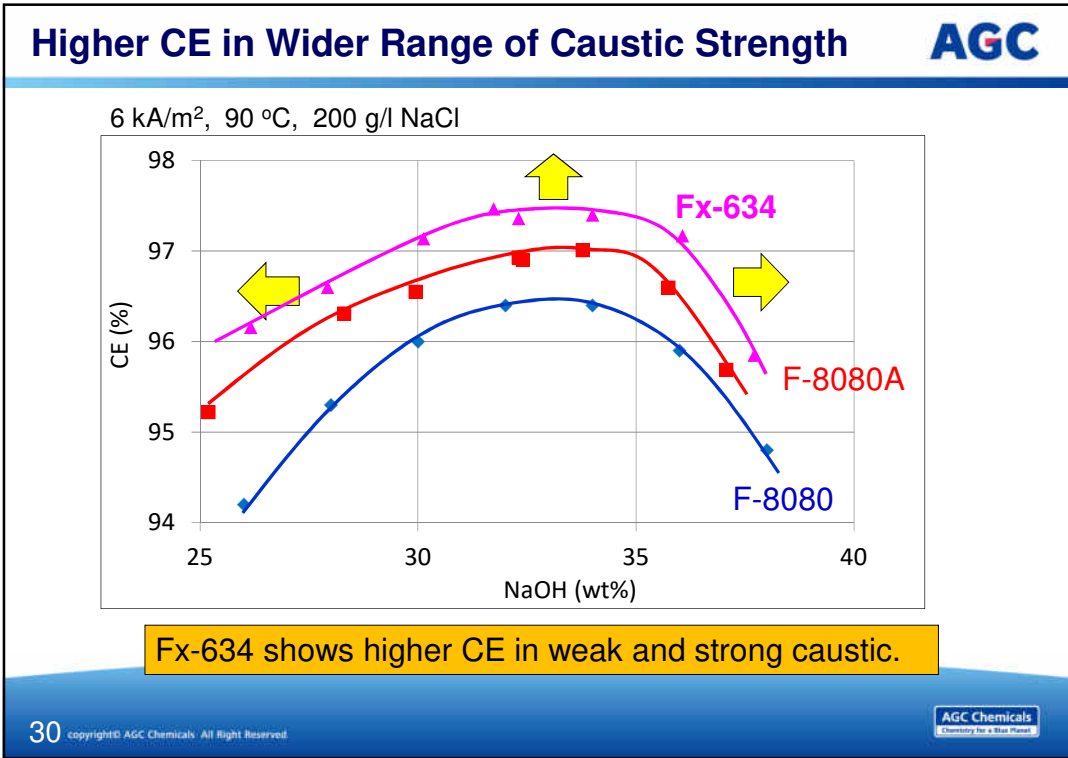


Key Technology of Next Membrane AGC

Advantages	Key Technologies
Voltage Reduction	Optimized Reinforcing cloth
Higher CE in Wider Range	Fine Ion Channel
Higher Durability against Impurities	Uniform Ion Channel

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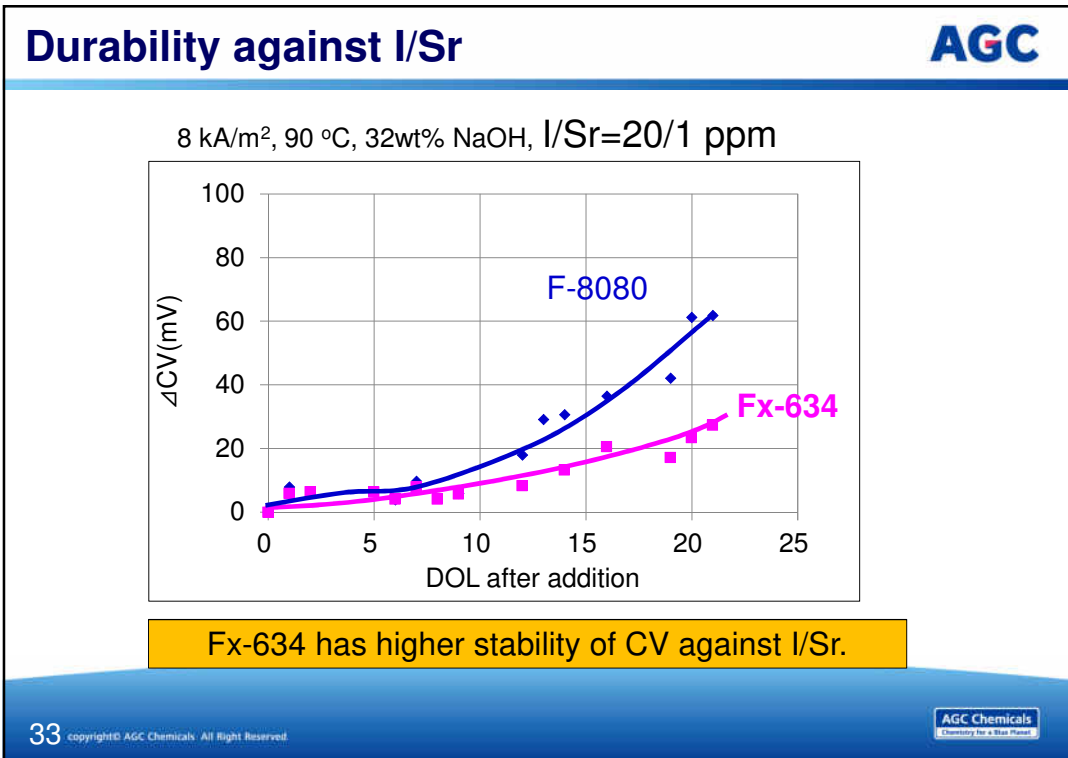
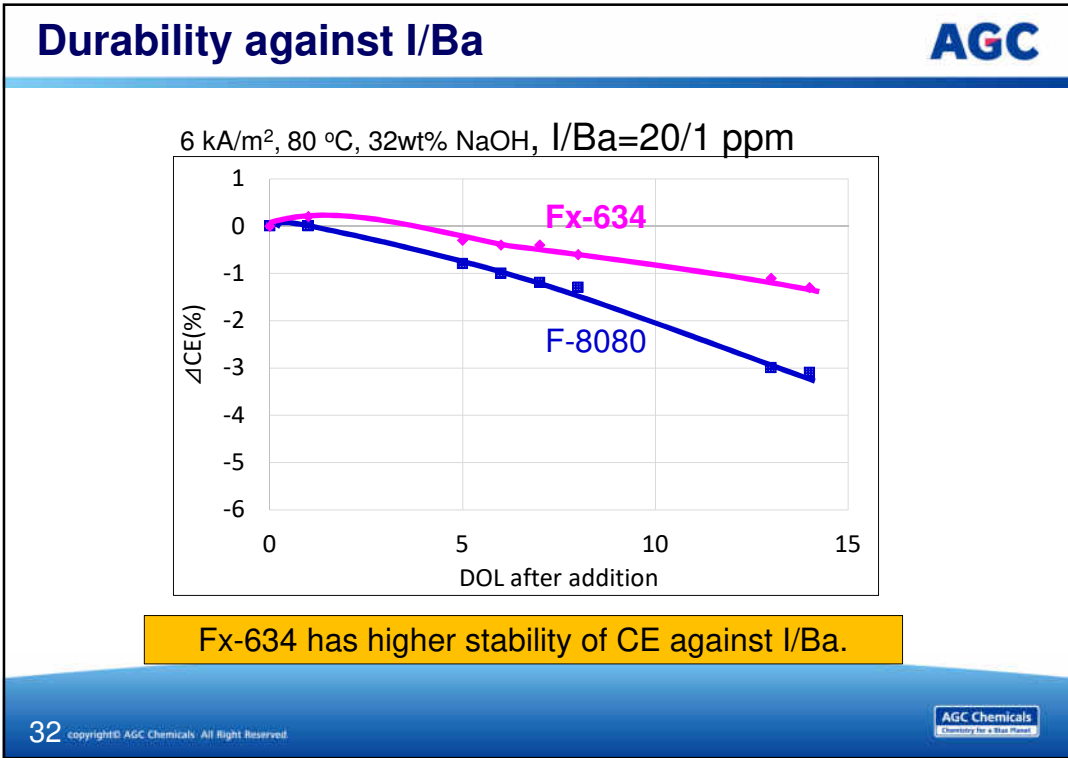




Key Technology of Next Membrane AGC

Advantages	Key Technologies
Voltage Reduction	Optimized Reinforcing cloth
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Higher Durability against Impurities	Uniform Ion Channel

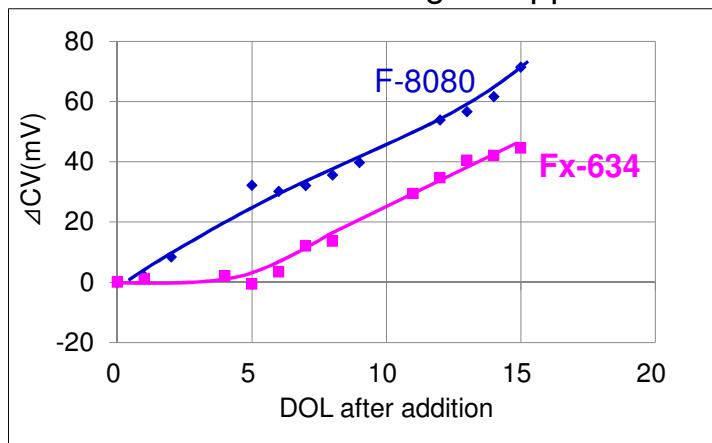
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Durability against Mg

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8 kA/m², 90 °C, 32wt% NaOH, Mg=0.1 ppm



Fx-634 has higher stability of CV against Mg.

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Chemistry that's a Step Ahead

Next Generation Membrane : Fx-634

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1. Lowest voltage

- 50 mV lower voltage than F-8080 and F-8080A
- Optimized reinforcing cloth

2. Higher CE in both hydrated and dehydrated state

- Suitable for zero gap and finite gap
- Suitable for electrolyzer which has less inner circulation of brine

3. Higher durability against Impurities

4. Better robustness

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Chemistry that's a Step Ahead

Summary



- **Influence of Zero Gap on the membrane**
 - **Higher temperature** due to less heat removal
- **F-8080A : New Type of F-8080 series for Zero Gap**
 - Advanced F-8080 for higher temperature and weak brine, **for hydrated state.**
 - Fine adjustment of F-8080 which has **proven reliability.**
- **Next Generation Membrane : Fx-634**
 - **50 mV lower voltage** than F-8080/F-8080A
 - **Higher CE in both more hydrated and more dehydrated state**
 - **Durability against impurities and better robustness**



Thank you for your attention



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for a Blue Planet**
AGC Chemicals

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Create a safe, secure, comfortable and environmentally friendly world with chemical technology.
通过我们的化学技术,来创造一个安全、安心、舒适且环保的世界!