CloroSur Technical Seminar 2018

AGC FORBLUE™ FLEMION™, your reliable membrane Technology partner

Nov. 16, 2018

AGC Chemicals
Membrane R&D Group

CREATION THROUGH SEPARATION FORBLUE™

Contents

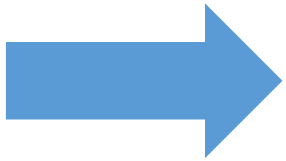
Contents

From Asahi Glass Company to AGC

From July 1st 2018

AGC

ASAHI GLASS CO., LTD.



AGC

Your Dreams, Our Challenge

AGC Inc.

FORBLUE™

Company Outline

Foundation :	September 1907
Business Segment :	Glass, Chemicals, Electronics and Ceramics/Others
Employees :	53,000+
Group Companies :	210 companies （Overseas 172 companies）
FY 2017 Net Sales :	1,464 billion yen（approx. 13.3 billion US＄）
FY 2017 Operating Profit :	120 billion yen（approx. 1.1 billion US＄）

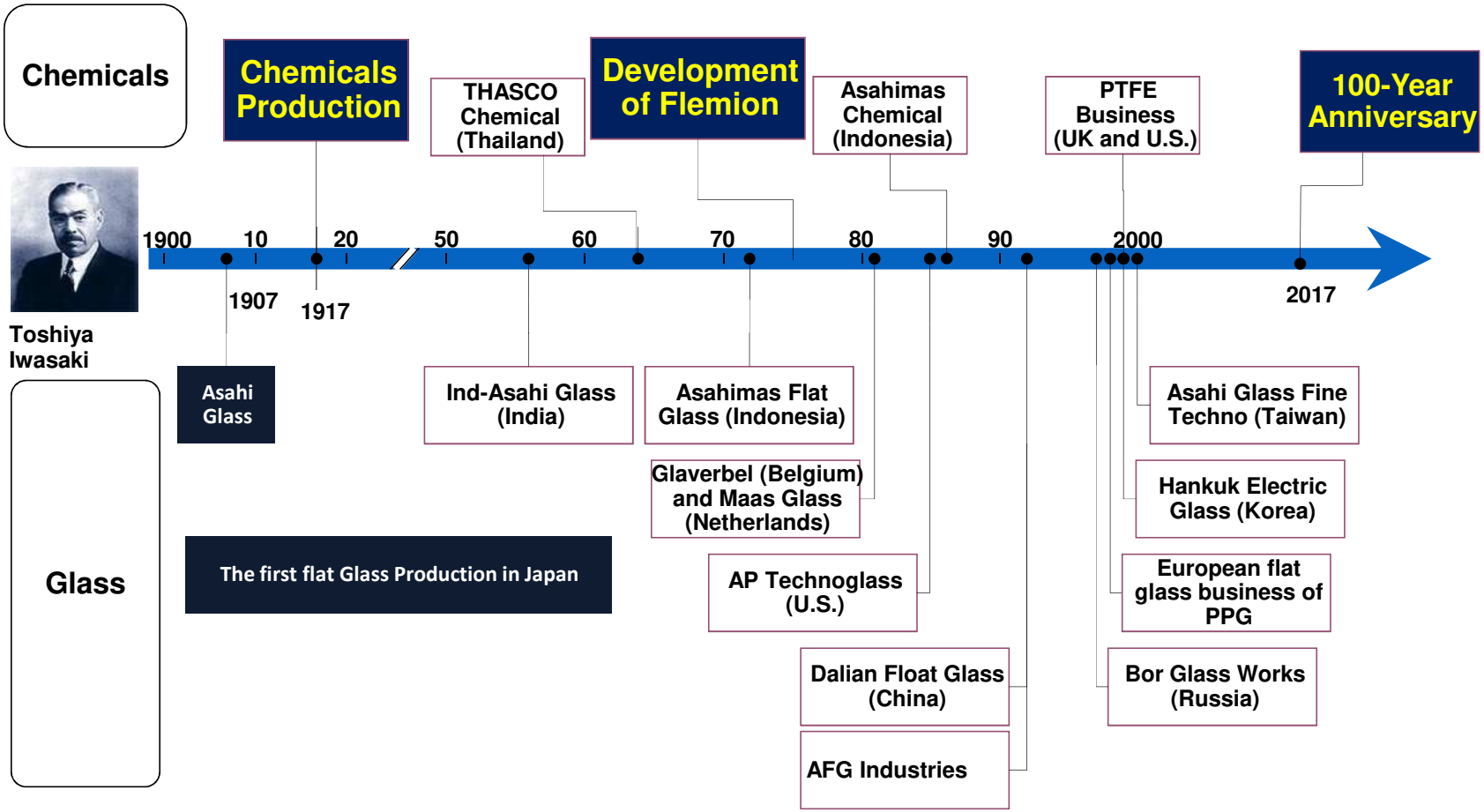
Long History

4 Segments

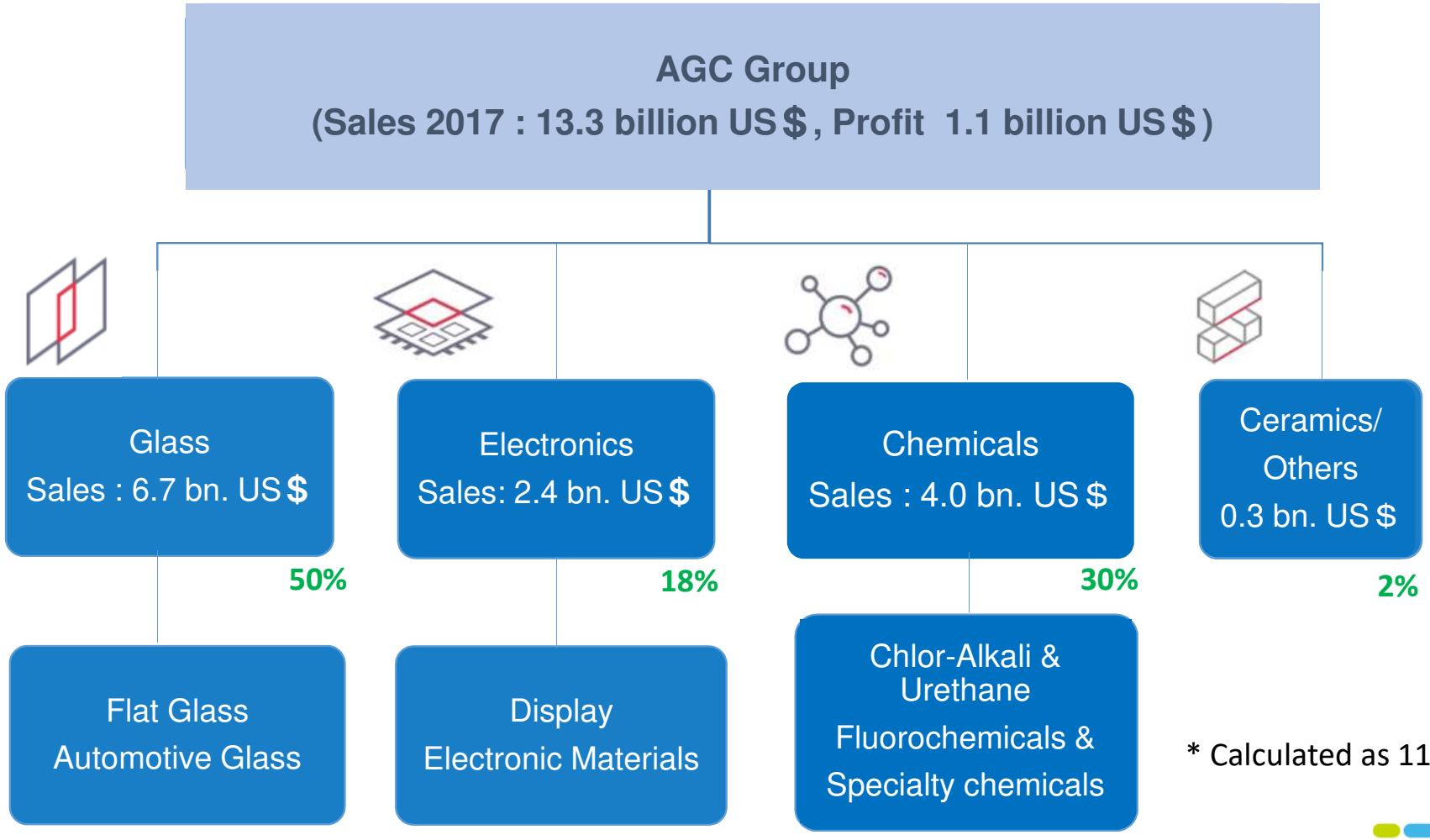
World wide

* Calculated as 110 yen/USD

AGC History

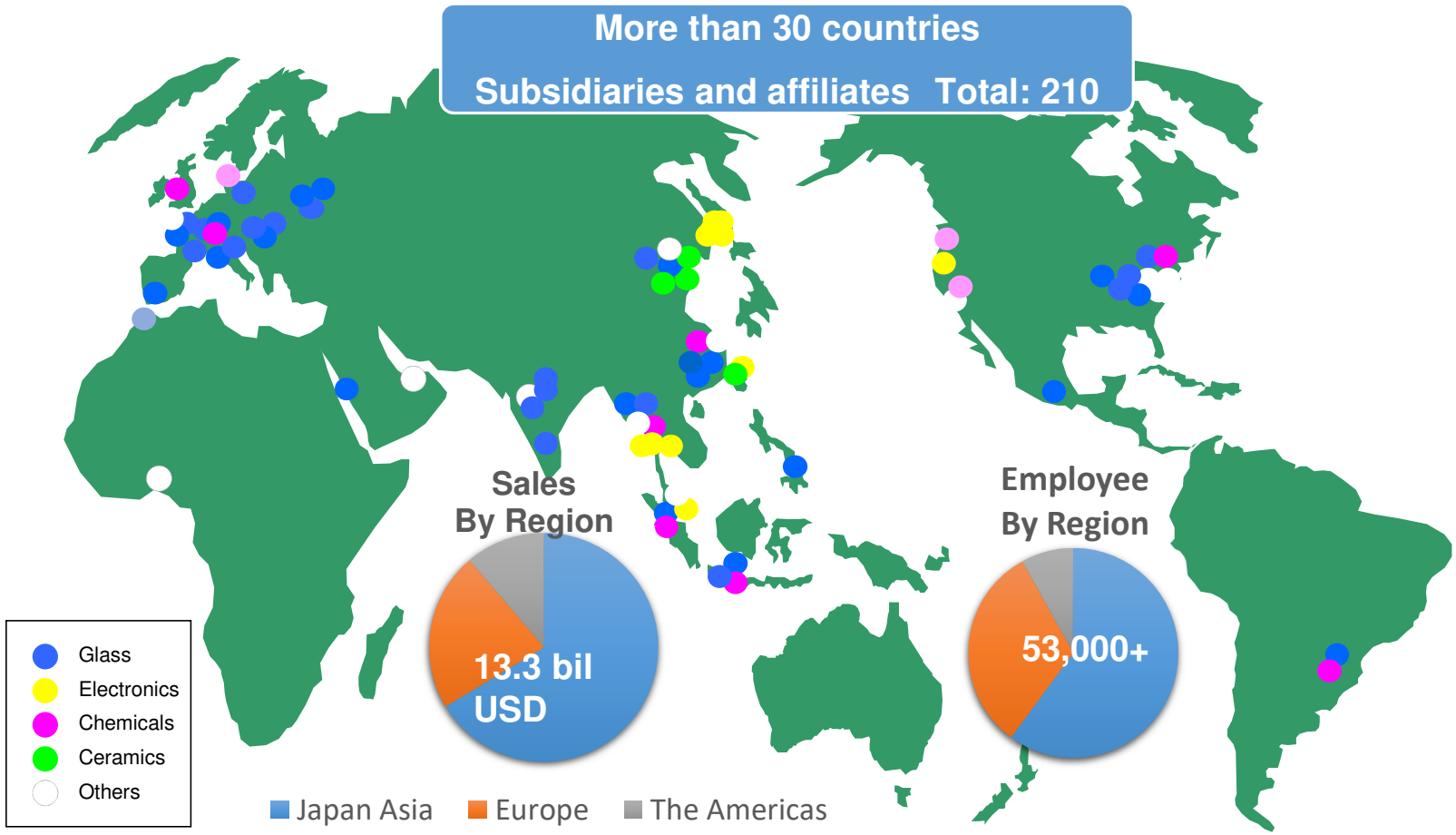


Business Segments



* Calculated as 110 yen/USD

AGC Group's Global Network



*As of December 31, 2017

8

FORBLUE™

Global Business Position

※FY2015 company estimates

Architectural Glass

No.1

Automotive window

No.1

Fluoropolymer ETFE

No.1

LCD Glass substrate

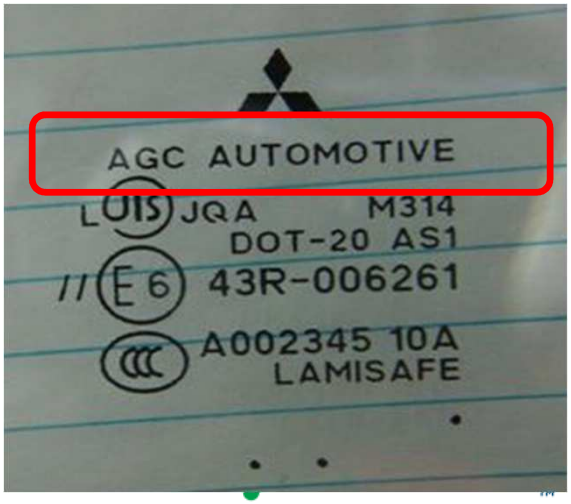
No.2

Quartz glass

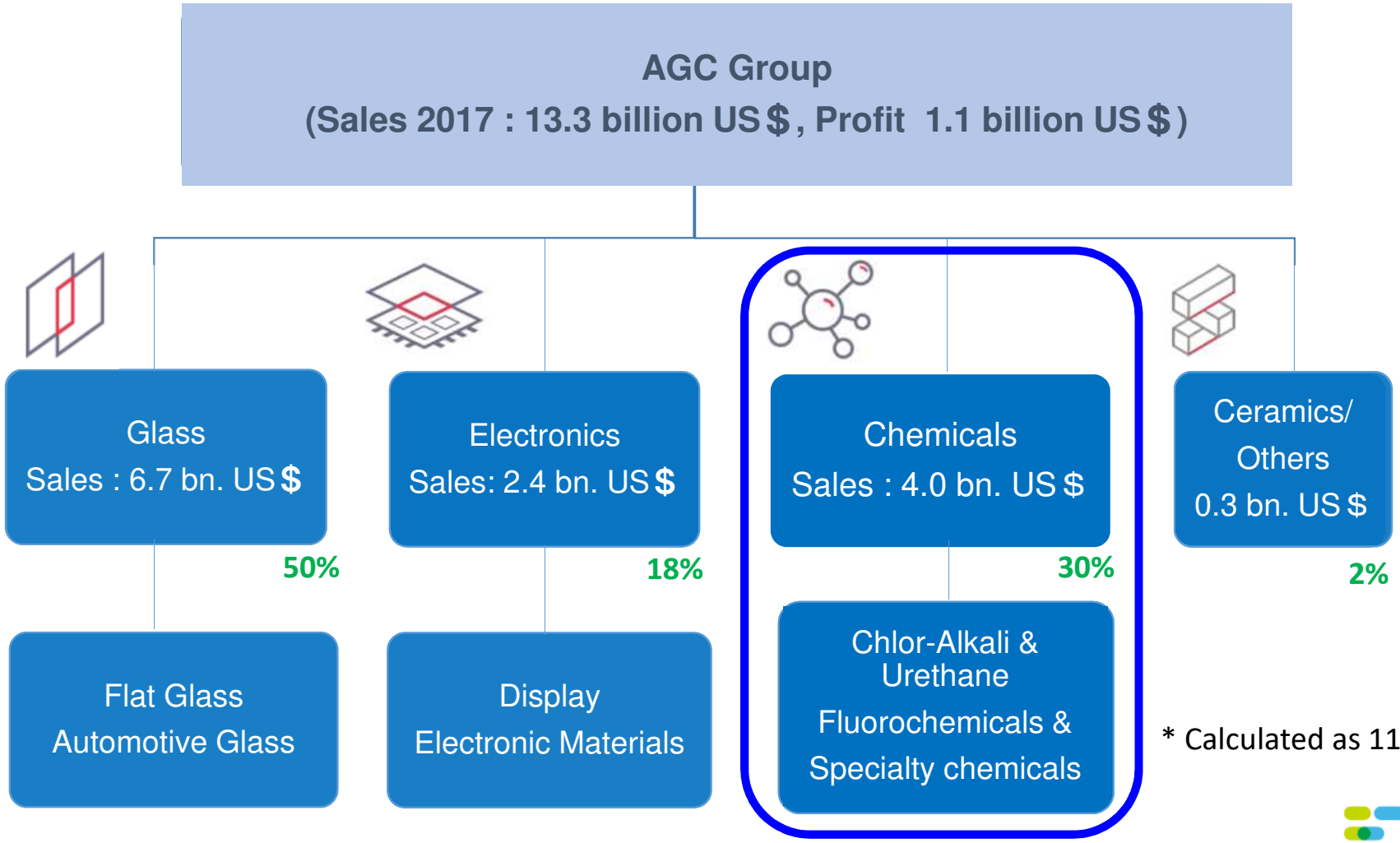
No.1

Aluminum silica glass for Smart Phone

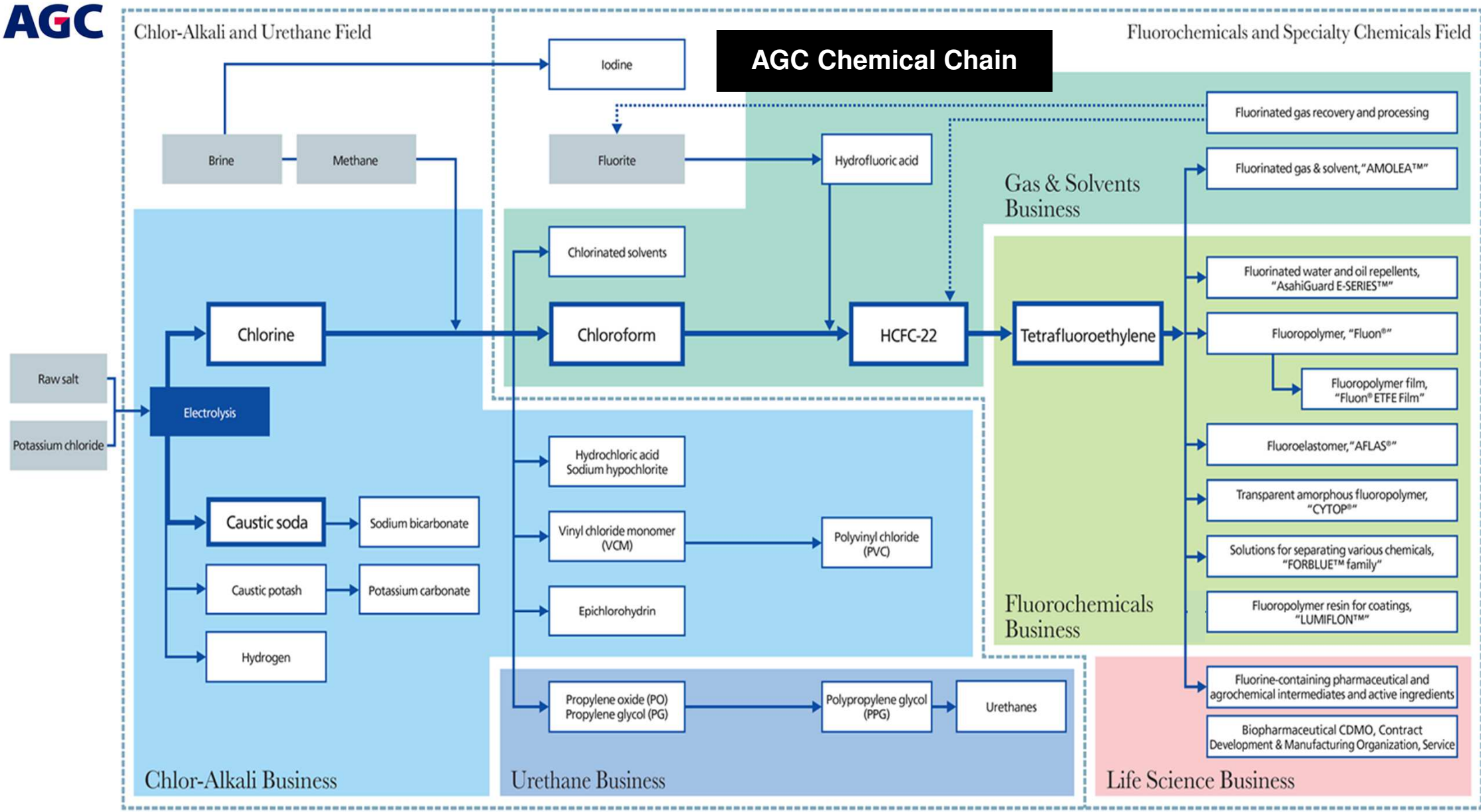
No.2



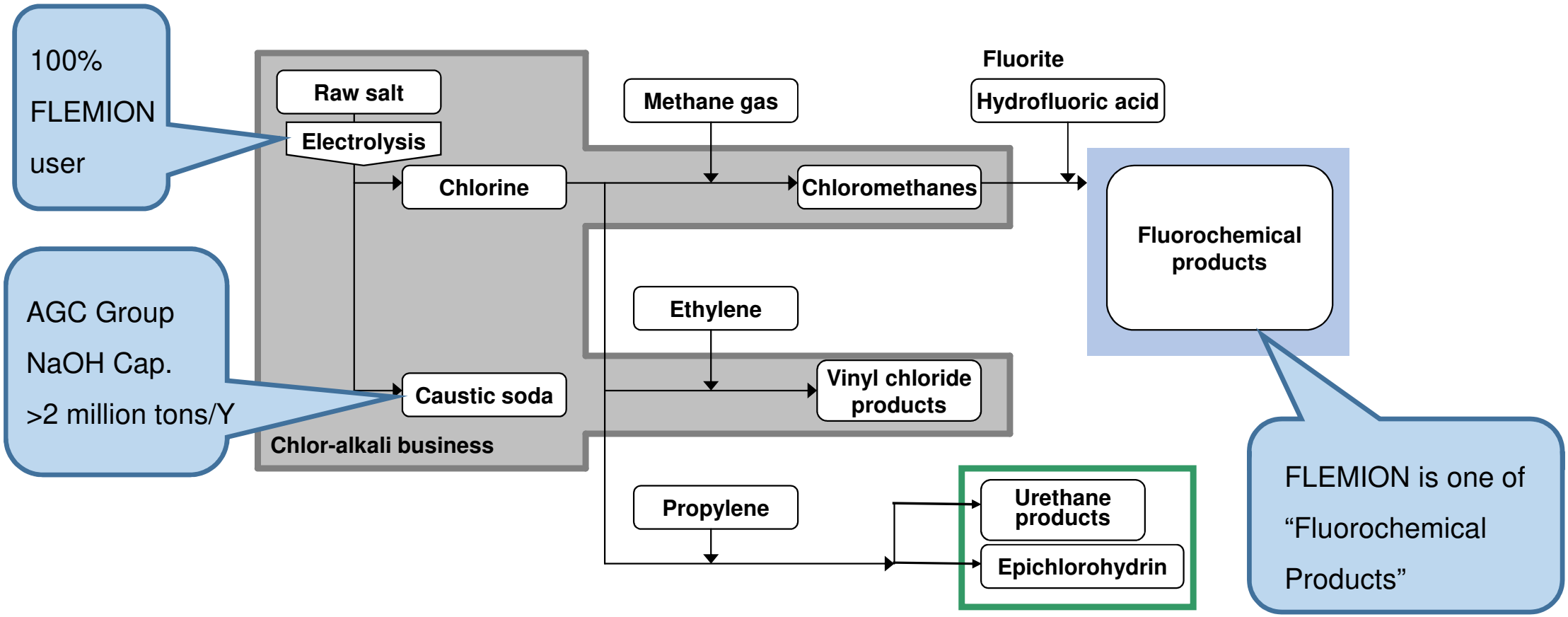
Business Segments



* Calculated as 110 yen/USD


AGC
AGC Chemical Chain
Chlor-Alkali and Urethane Field
Fluorochemicals and Specialty Chemicals Field
Iodine
Brine
Methane
Fluorite
Hydrofluoric acid
Fluorinated gas recovery and processing
Fluorinated gas & solvent, "AMOLEA™"
Gas & Solvents Business
Chlorinated solvents
Chlorine
Chloroform
HCFC-22
Tetrafluoroethylene
Fluorinated water and oil repellents, "AsahiGuard E-SERIES™"
Fluoropolymer, "Fluon®"
Fluoropolymer film, "Fluon® ETFE Film"
Raw salt
Potassium chloride
Electrolysis
Hydrochloric acid
Sodium hypochlorite
Fluoroelastomer, "AFLAS®"
Caustic soda
Sodium bicarbonate
Vinyl chloride monomer (VCM)
Polyvinyl chloride (PVC)
Transparent amorphous fluoropolymer, "CYTOP®"
Caustic potash
Potassium carbonate
Epichlorohydrin
Solutions for separating various chemicals, "FORBLUE™ family"
Fluoropolymer resin for coatings, "LUMIFLON™"
Hydrogen
Fluorochemicals Business
Propylene oxide (PO)
Propylene glycol (PG)
Polypropylene glycol (PPG)
Urethanes
Fluorine-containing pharmaceutical and agrochemical intermediates and active ingredients
Biopharmaceutical CDMO, Contract Development & Manufacturing Organization, Service
Chlor-Alkali Business
Urethane Business
Life Science Business

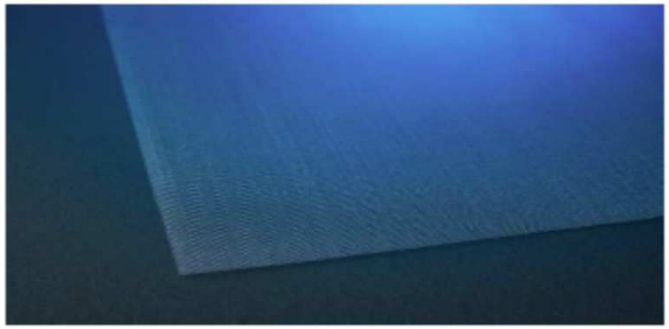
AGC Chemical Chain



FORBLUE Family started November 2017

FORBLUE™

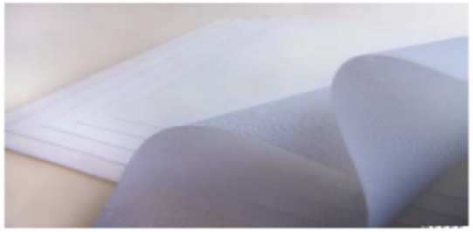
CREATION THROUGH SEPARATION



FORBLUE™ S-SERIES

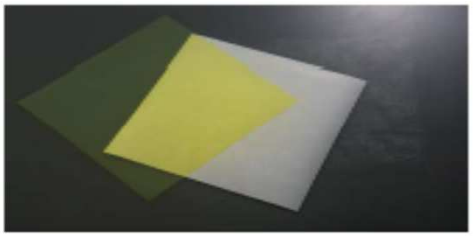
- PFSA
- S layer only
- Testing membrane for various use

FORBLUE™ FLEMION™



- PFSA
- S & C layer
- For NaOH / KOH production

FORBLUE™ SELEMION®



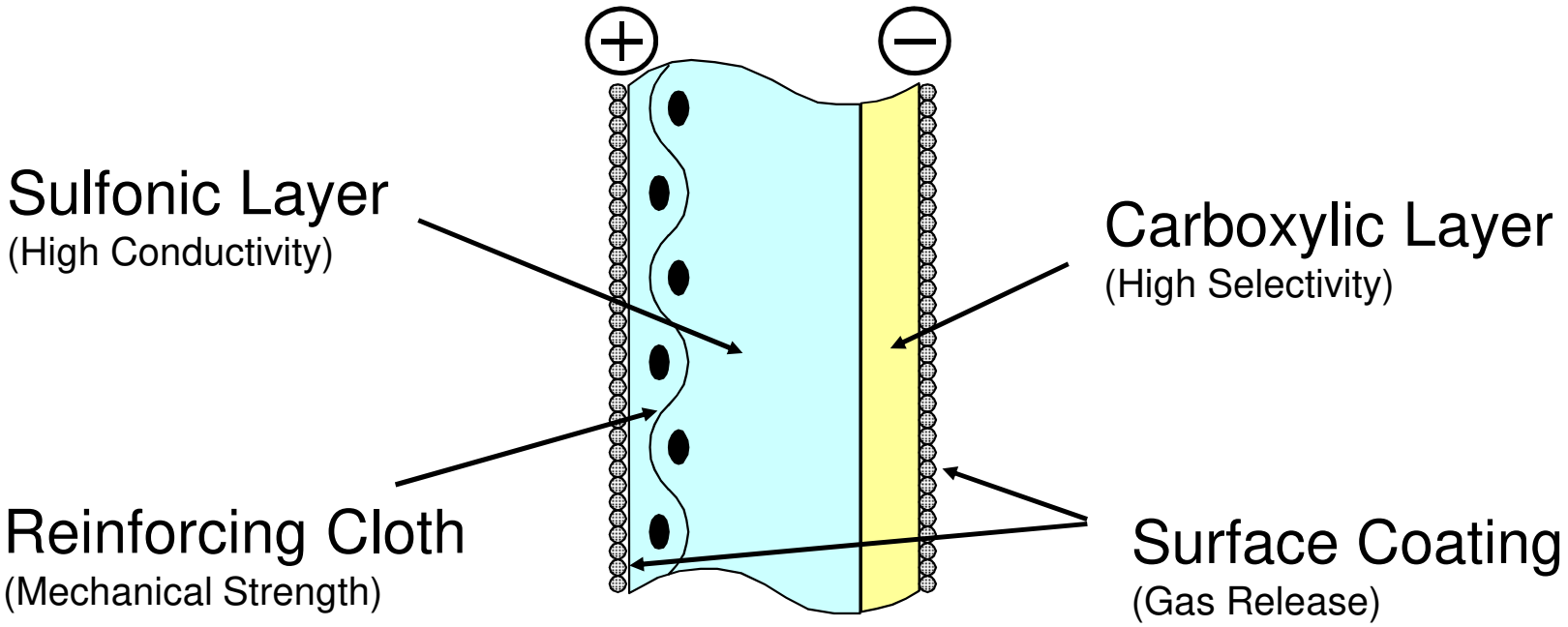
- Hydro carbon base
- For salt production or waste water reclamation and so on

FORBLUE™ SUNSEP®

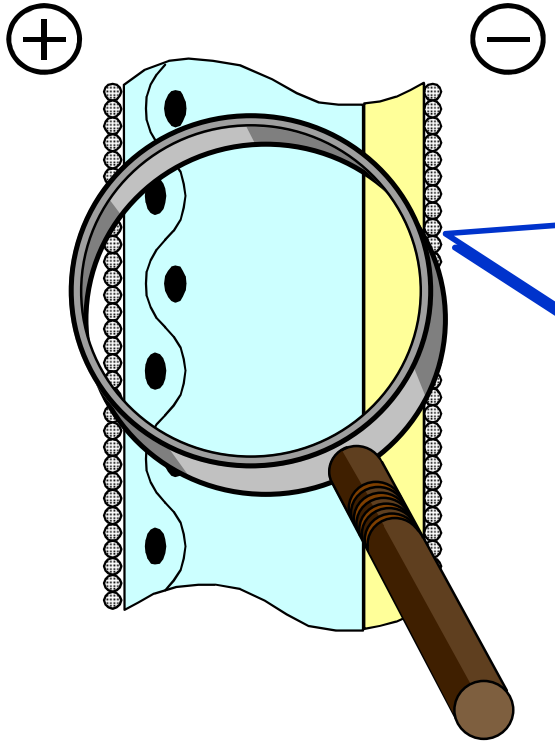
- Hollow ion exchange resin
- gas dryer / humidifier

Contents

Basic Structure of FLEMION™



Key Technologies of New Generation Membrane Fx-9010



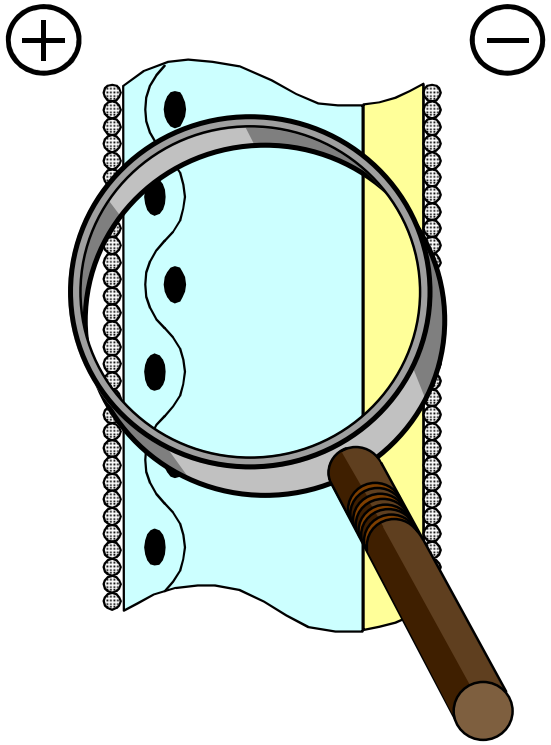
What is new?

Several new technologies were optimally combined.

FORBLUE™

Key Technologies of New Generation Membrane Fx-9010

Main 3 improvement to realize 5 concepts



Concepts

- 1. Low Voltage
- 2. Wider Operational Range
- 3. Higher Robustness
- 4. Higher Durability against Brine Impurities
- 5. Suitability for Zero-Gap

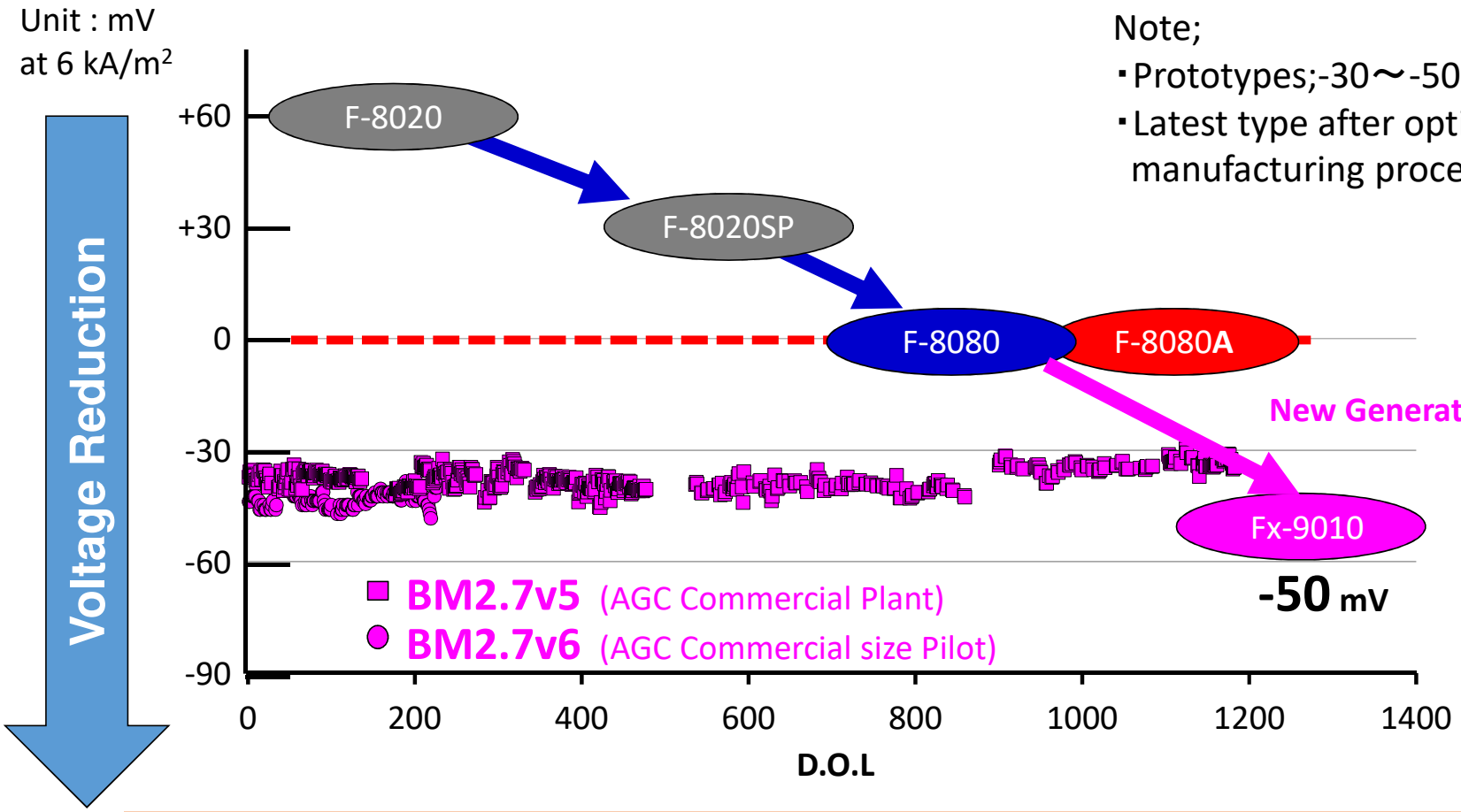
Key Technologies

- 1. New Cloth Design
- 2. New Sulfonic Polymer Layer
- 3. Improved Ion Channel
- Other minor improvements

FORBLUE™

Contents

Voltage of Fx-9010 in Commercial Electrolyzer (AGC)

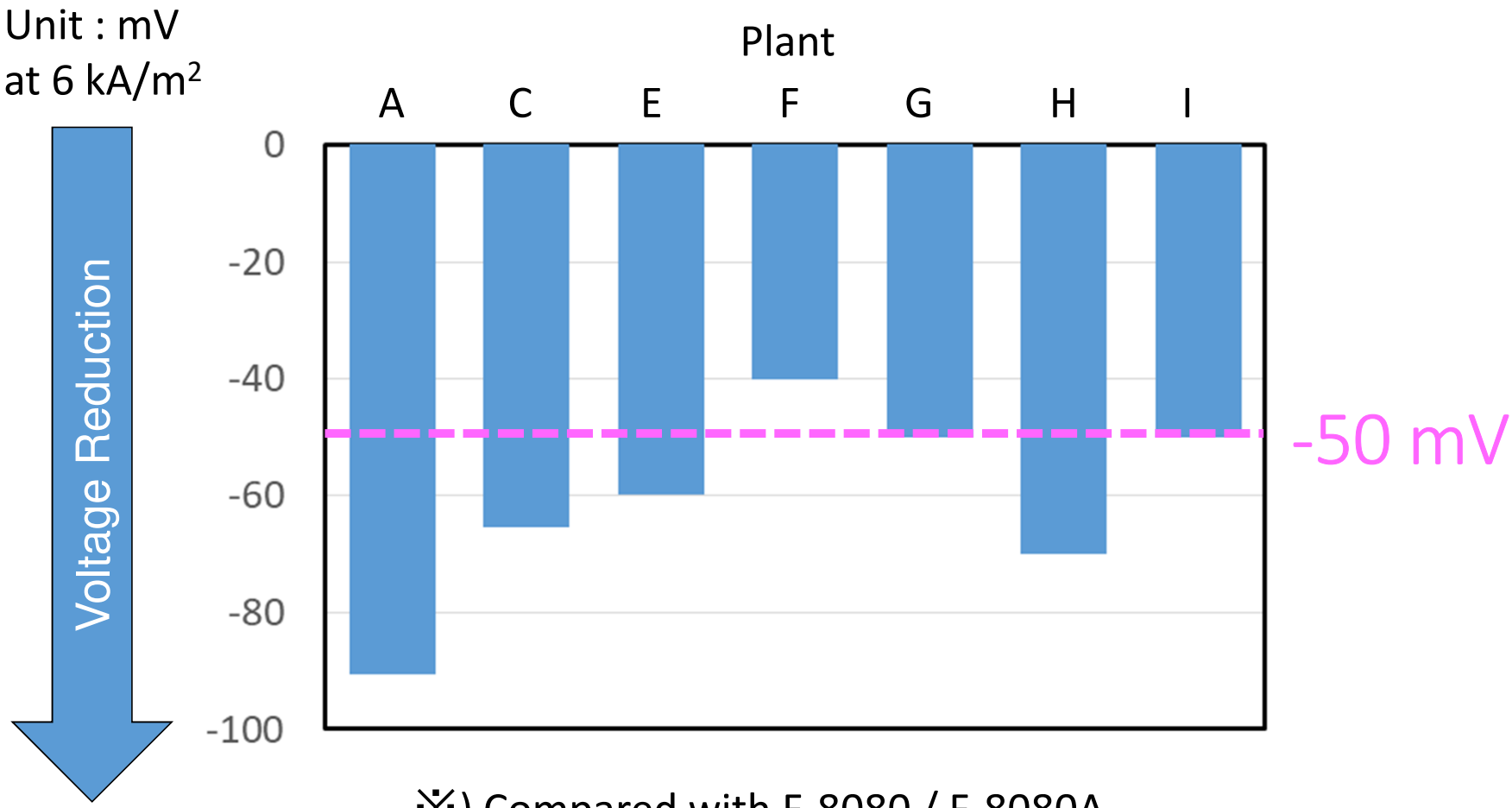


Note;
- Prototypes;-30～-50 mV
- Latest type after optimizing manufacturing process ; -50 mV

Showed low voltage of about -50mV compared to our current main membranes, F-8080 and F-8080A more than 3 years.

FORBLUE™

Summary : Voltage of Fx-9010



※) Compared with F-8080 / F-8080A
Normalized at 6 kA/m²

Cost impact of -50mV

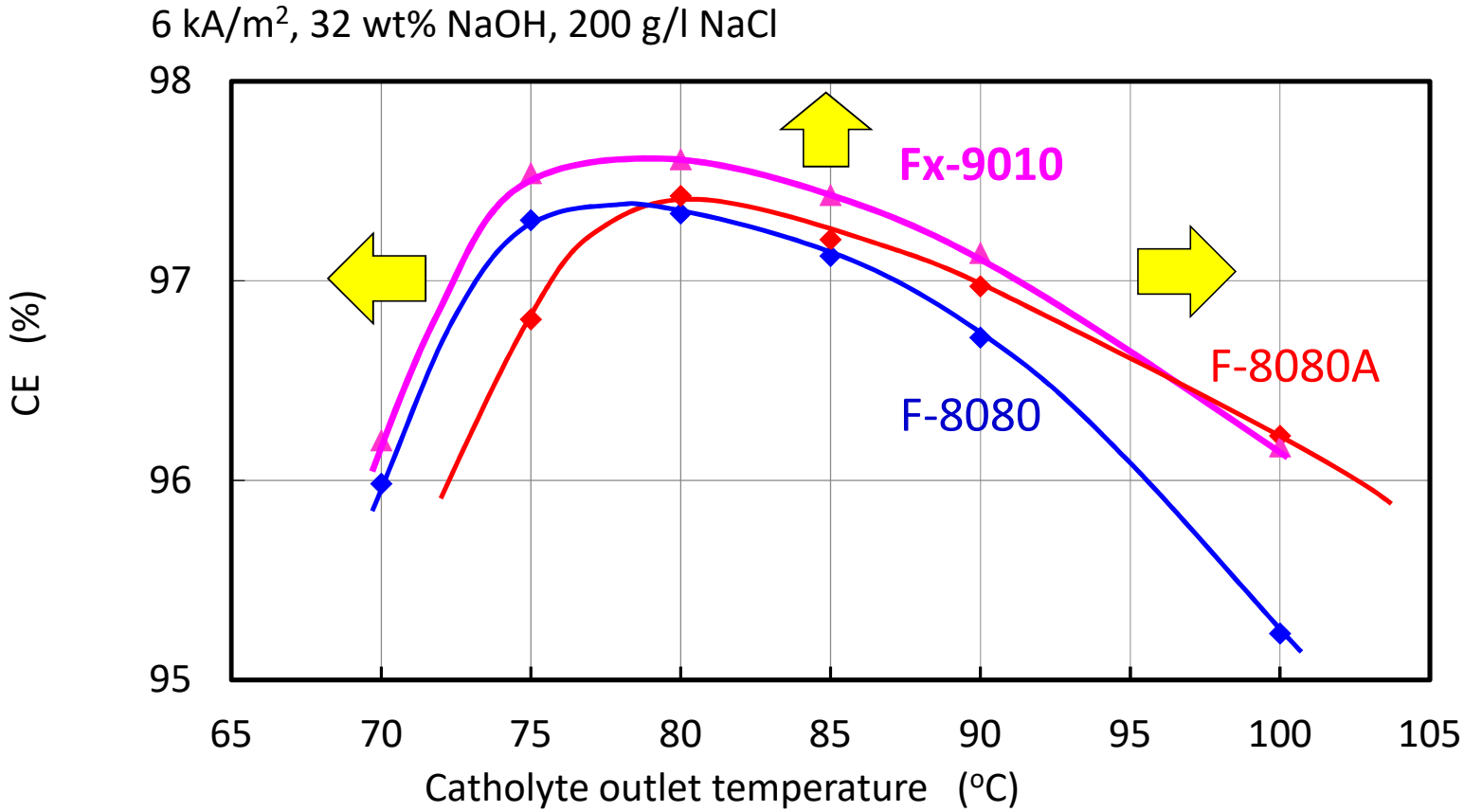
“-50mV” has a tremendous impact for your cost reduction

～Hypothetical examples～

	Current density (KA/m2)	Number of total element of electrolyzer	Current efficiency (%)	NaOH production (thousand ton per year)	Saving Cost for electrical energy (thousand US$/y)	Cost savings per Flemion m2 (US$m2) ※Assumed membrane life is 4 years
Case1	5	930	96	144	500	715
Case2	6	558	96	100	360	858
Case3	4	372	96	46	160	572

Contents

Higher CE in Wider Temperature Range

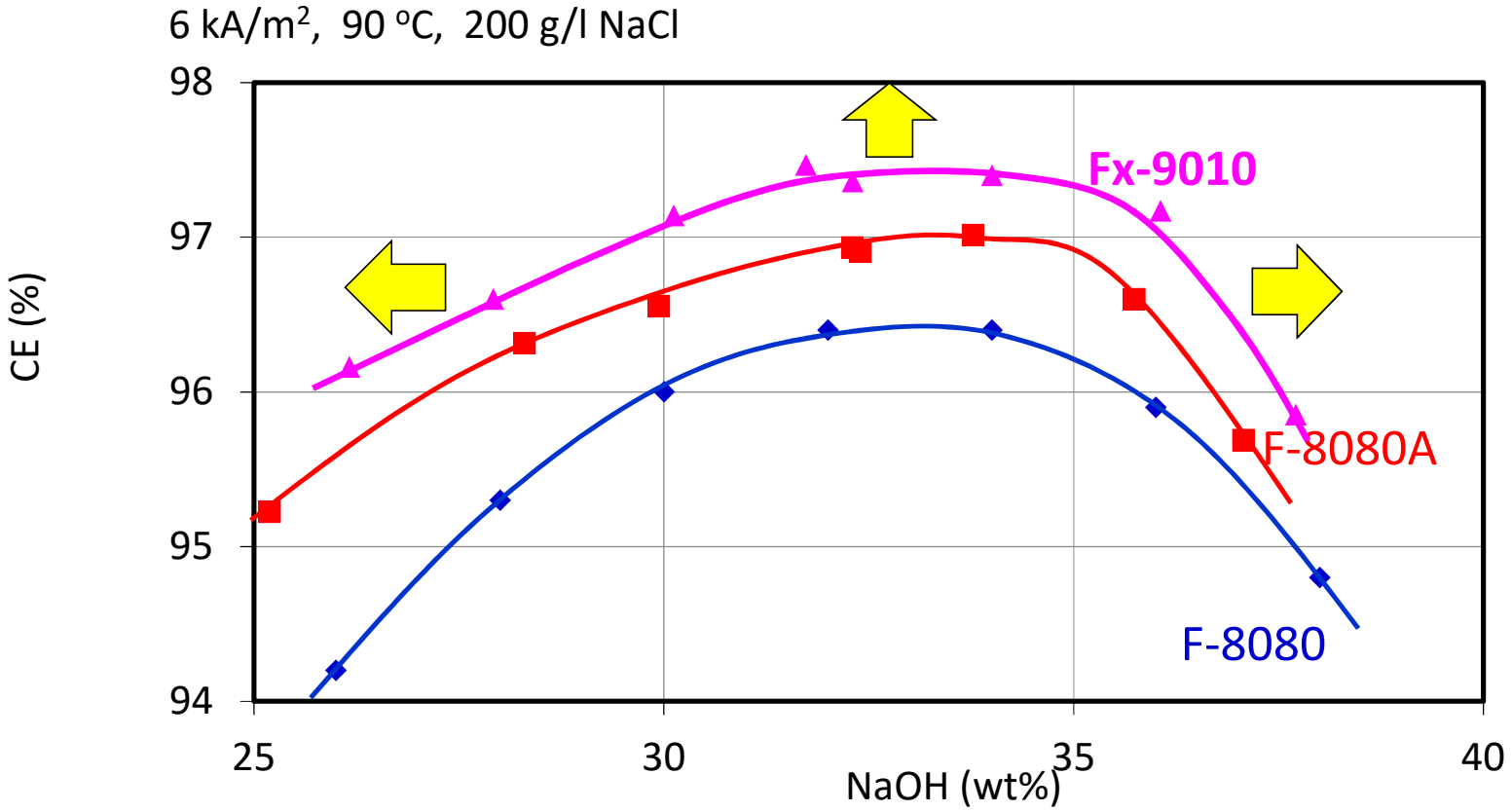


Fx-9010 shows higher CE

not only at high temperature but also at low temperature.

23

Higher CE in Wider Range of Caustic Strength



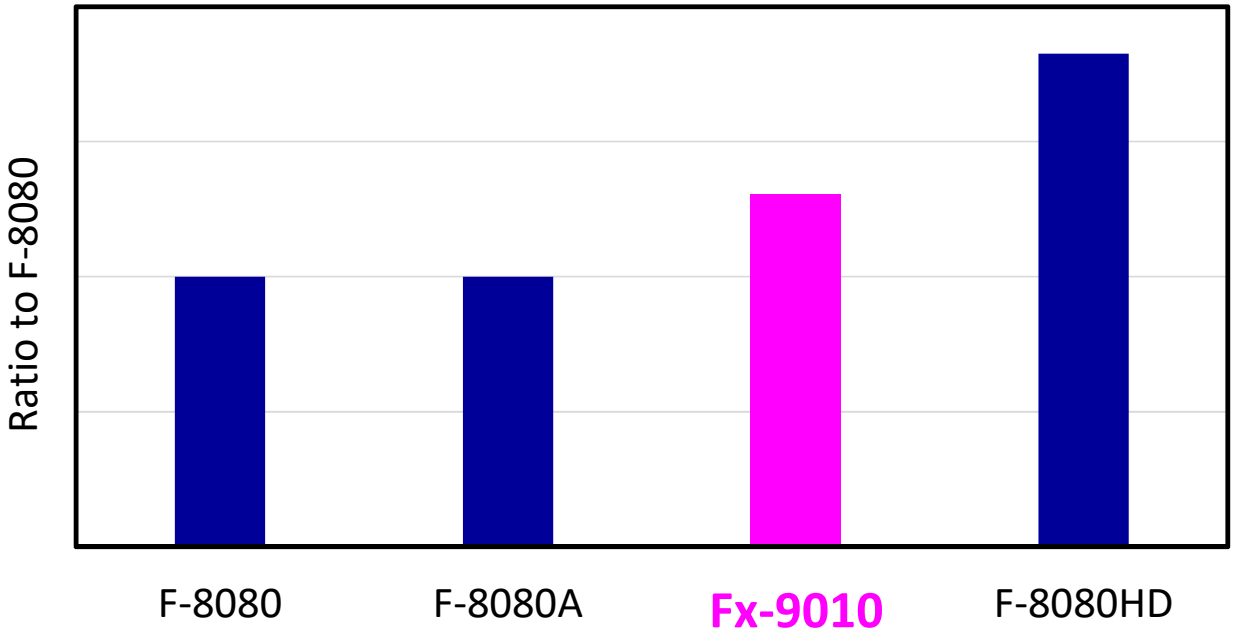
Fx-9010 shows higher CE in weak and strong caustic.

24

Contents

Frequent Load Tensile Test

Total number of frequent load tensile test until membrane breaking
(Sum of the value to various direction. Load : 60 % of tensile strength)

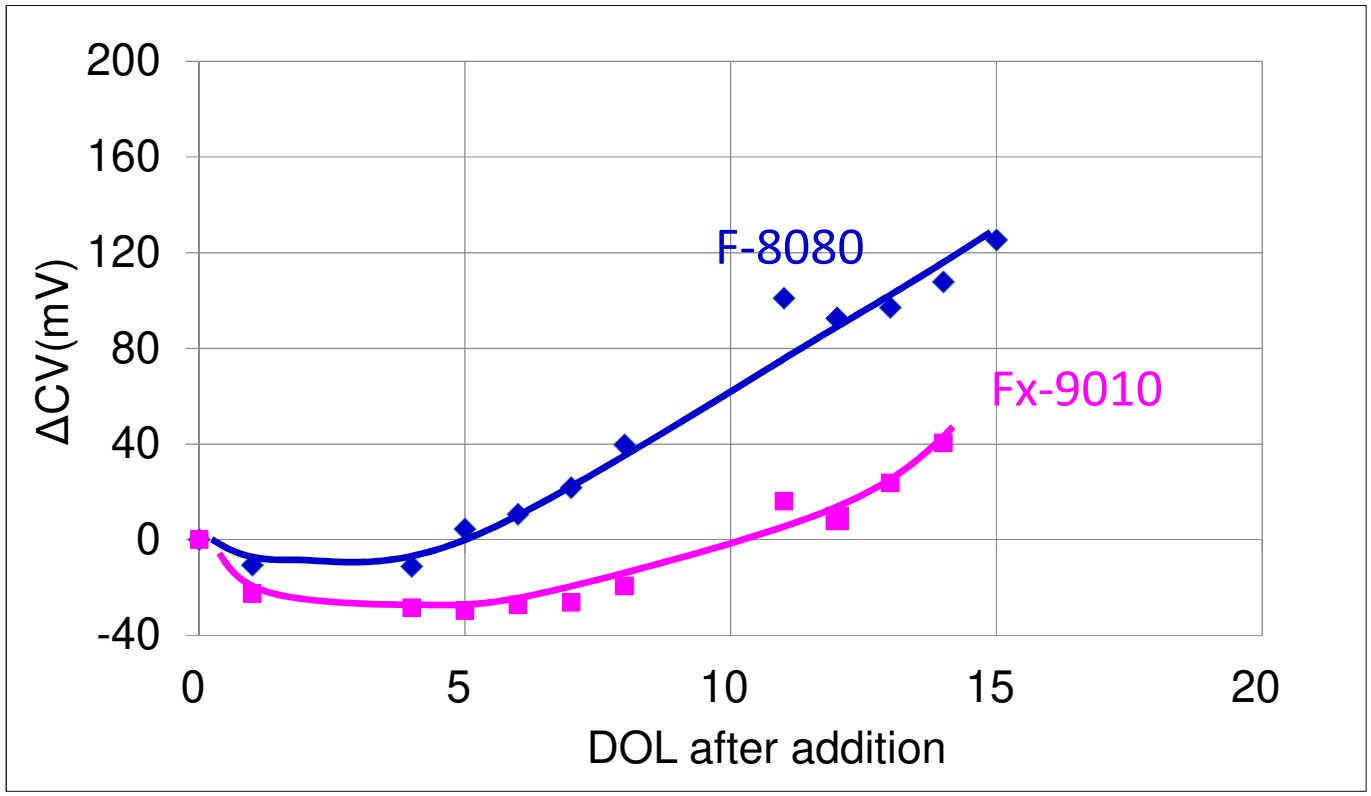


Fx-9010 is more robust than F-8080 and F-8080A.

Contents

Durability against Fe

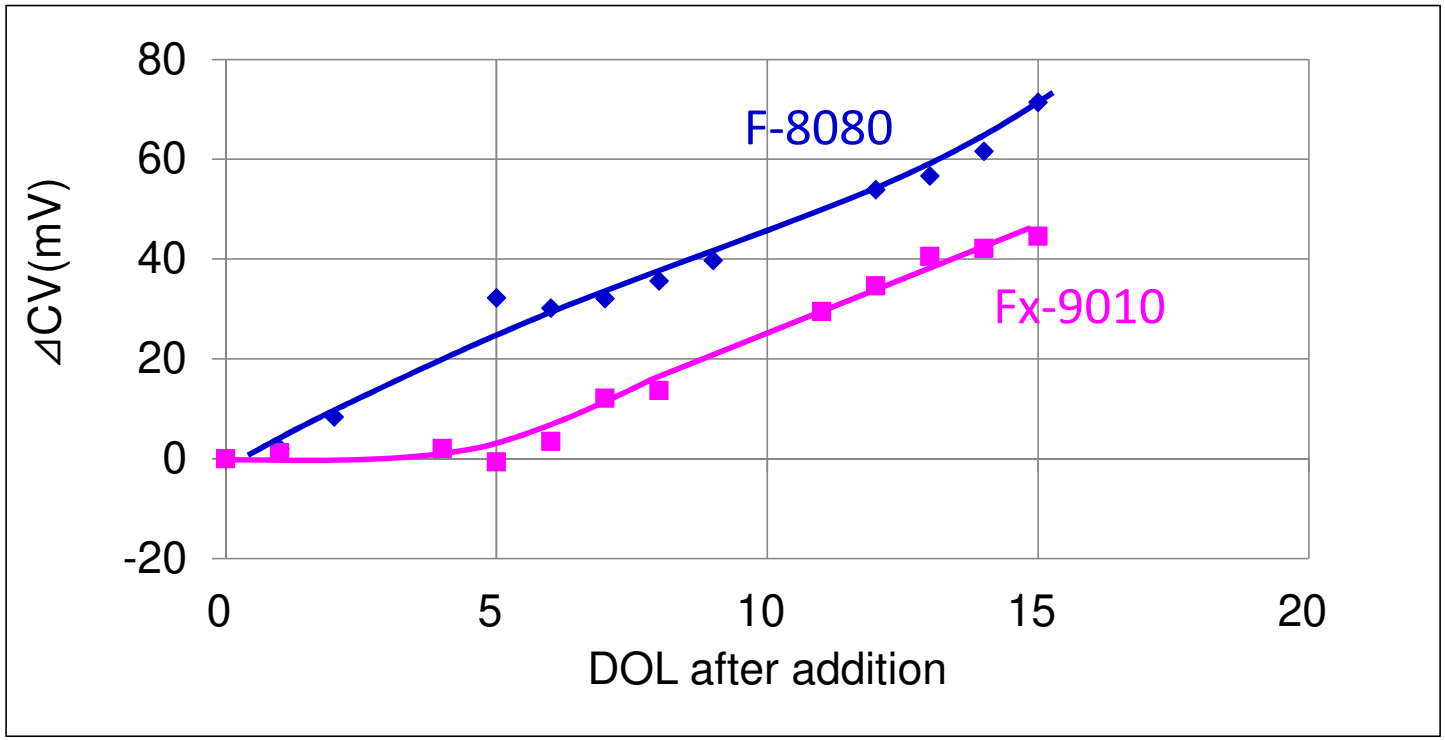
8 kA/m^2, 90 ^{o}C, 32 wt% NaOH, Fe=5 ppm



Fx-9010 has higher stability of CV against Fe.

Durability against Mg

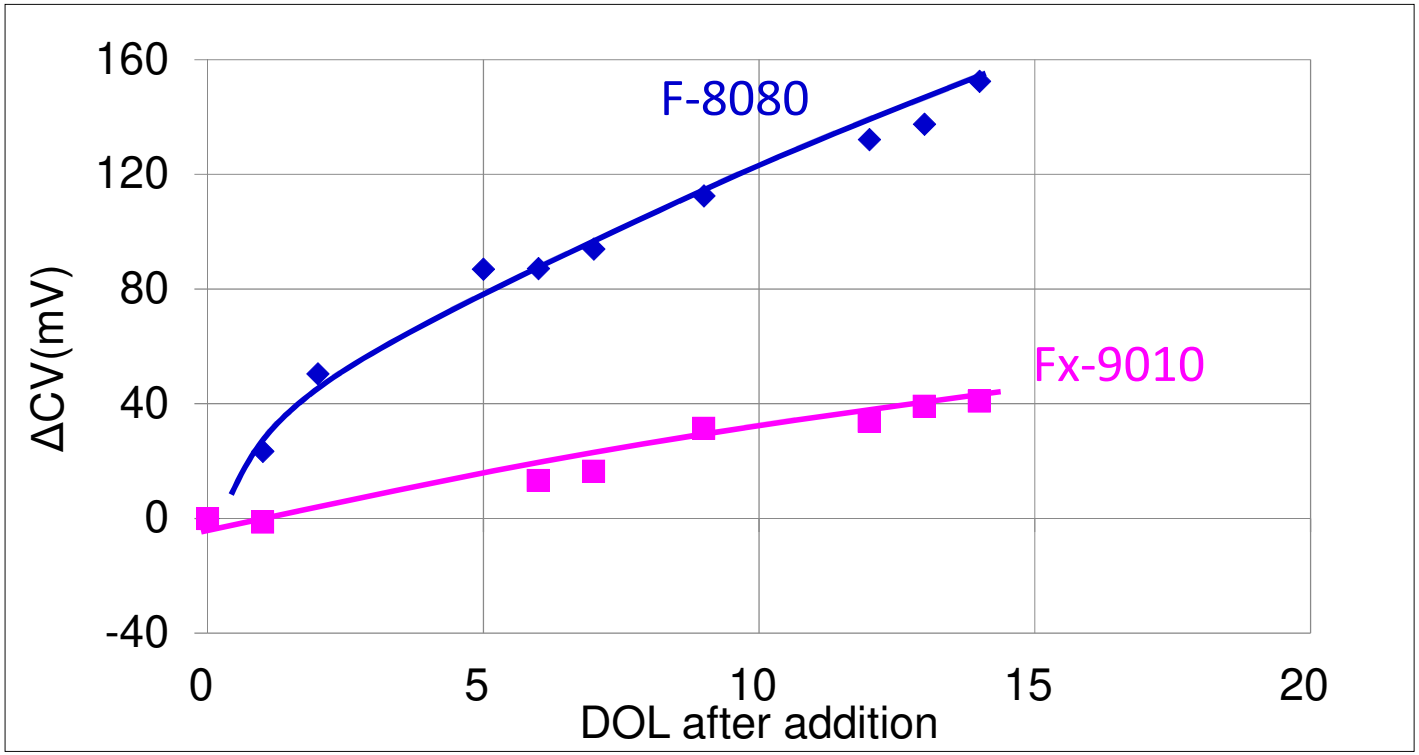
8 kA/m^2, 90 ^{o}C, 32 wt% NaOH, Mg=0.1 ppm



Fx-9010 has higher stability of CV against Mg.

Durability against Ni

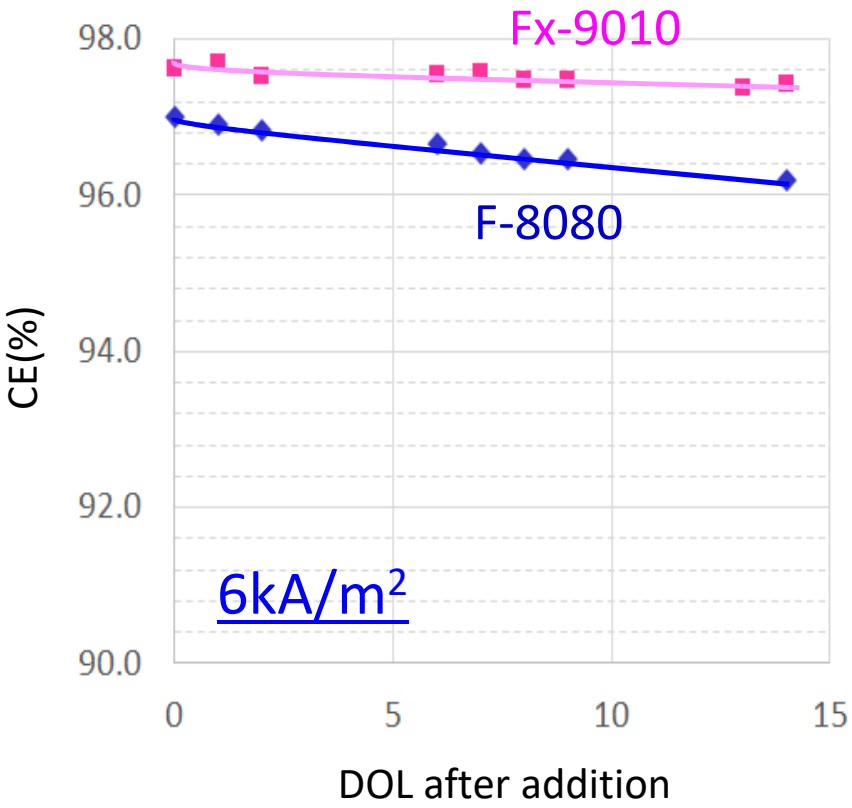
8 kA/m^2, 90 ^{o}C, 32 wt% NaOH, Ni=0.1 ppm

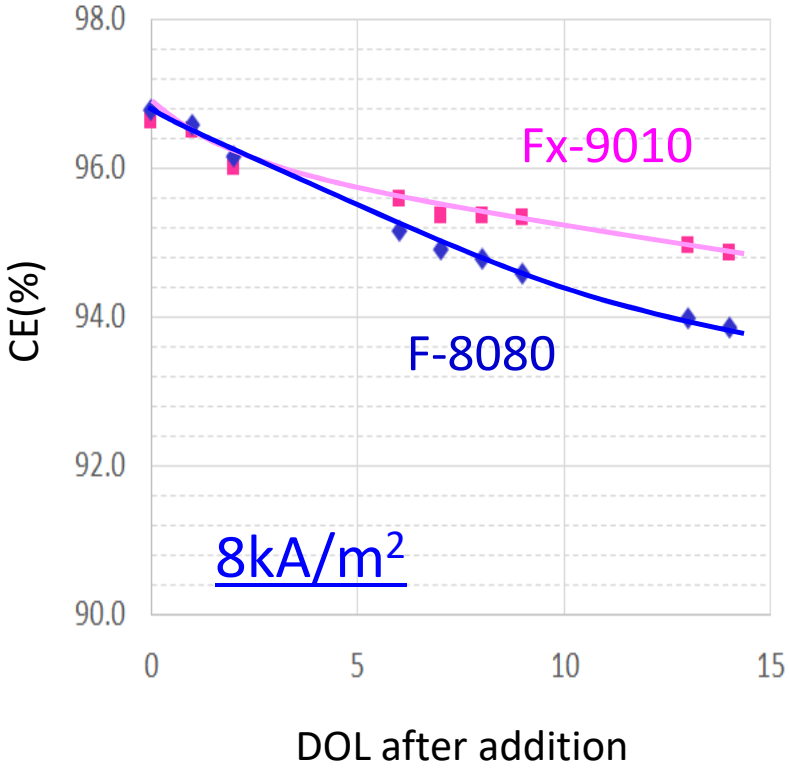


Fx-9010 has higher stability of CV against Ni.

Durability against Al/SiO_2

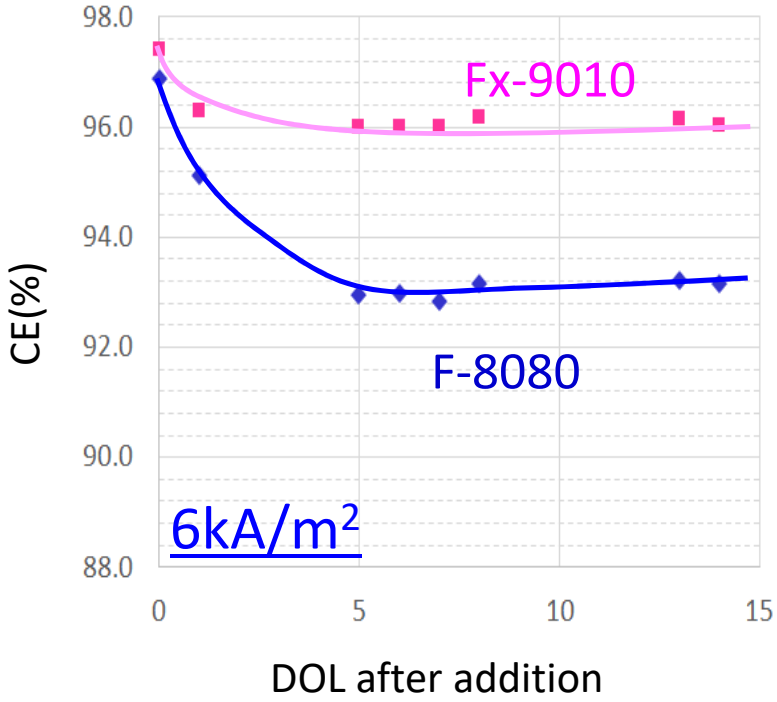
85 °C, 32wt% NaOH, Al/SiO_2=1/30ppm

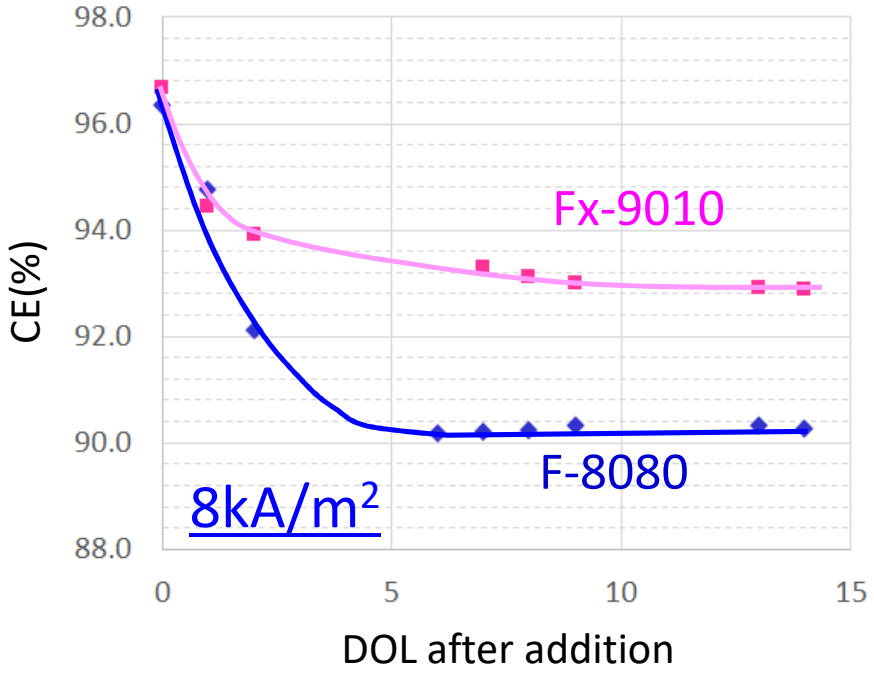




Durability against Ca/SiO_2

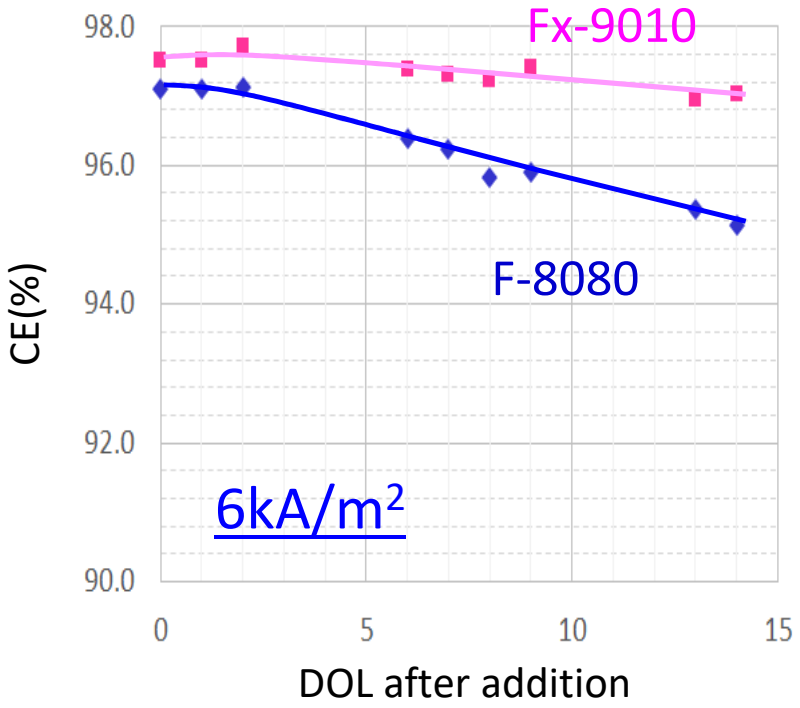
85 °C, 32wt% NaOH, Ca/SiO_2＝0.05/15ppm

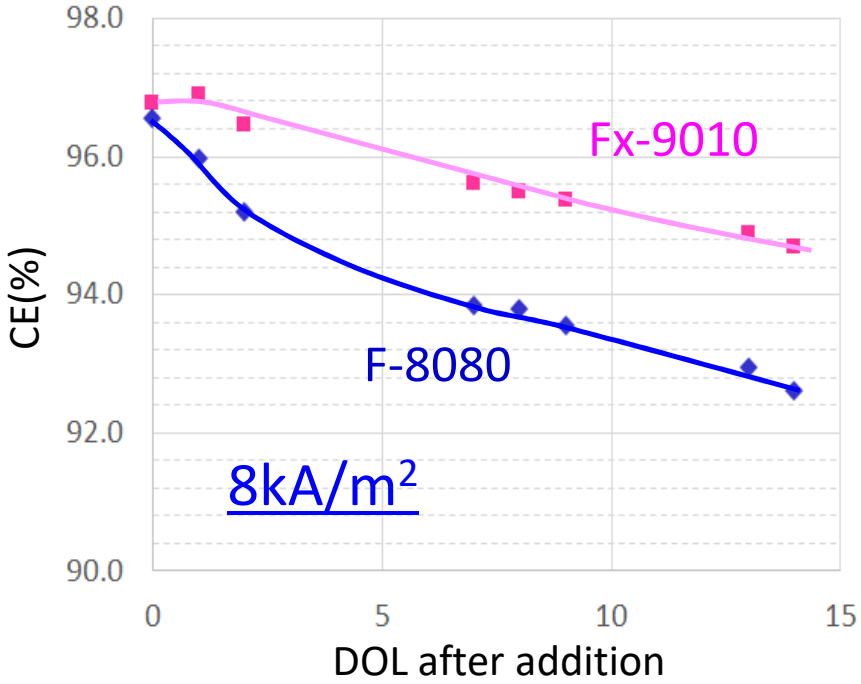




Durability against I/Ba

85 °C, 32wt% NaOH, I/Ba=20/1ppm





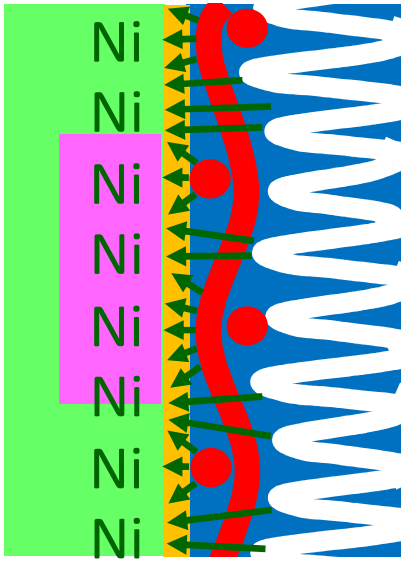
Contents

“Zero gap” has Three Key Points

1

Contacting

Cathode parts

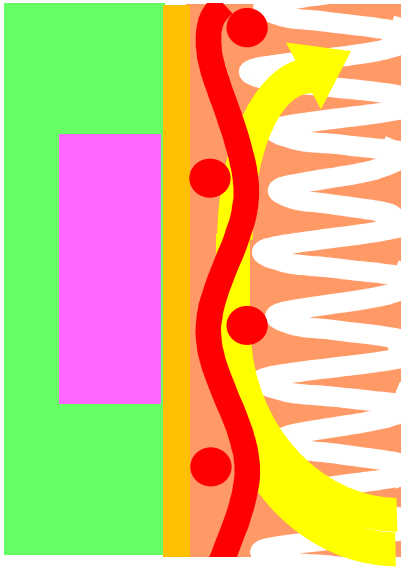


1 Ni stain

2

Less

Catholyte Flow

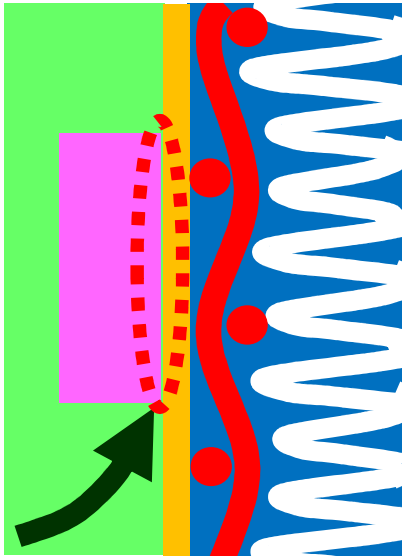


2 High Temperature

3

Less

Brine Supply

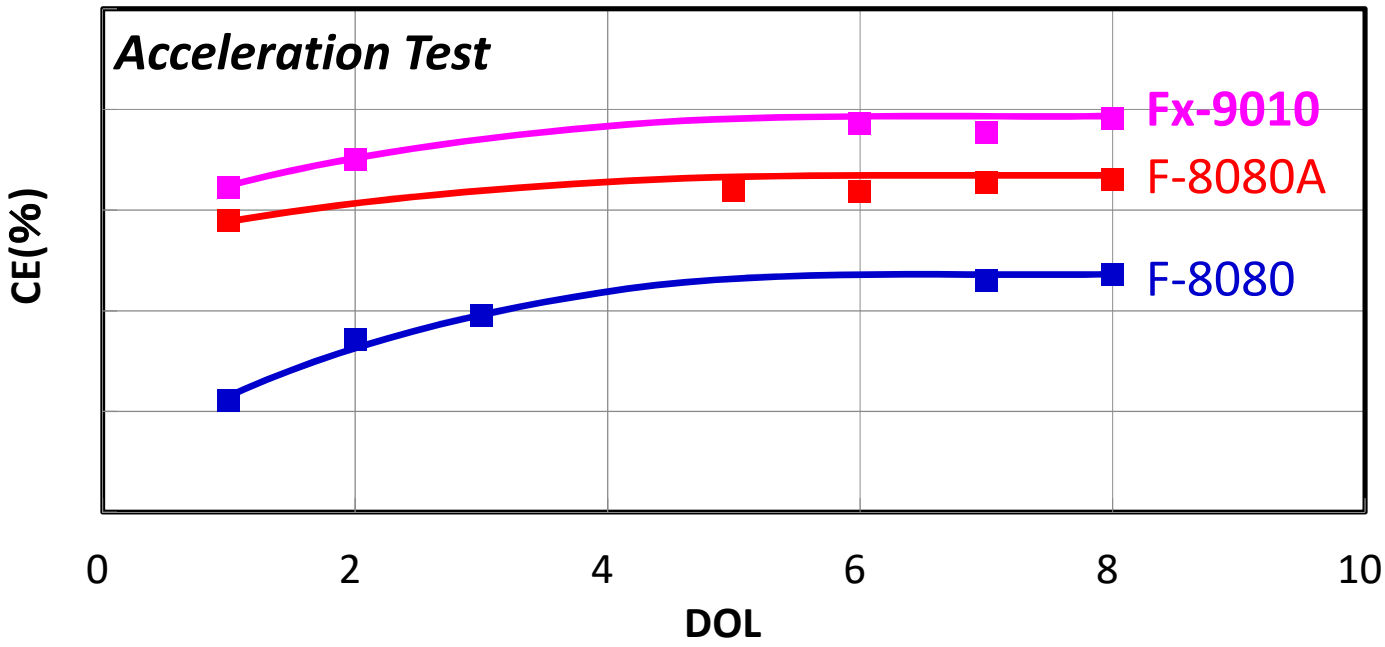


3 Weak brine

Durability against Ni Stain (for Zero Gap)

Note)
Test conditions are confidential

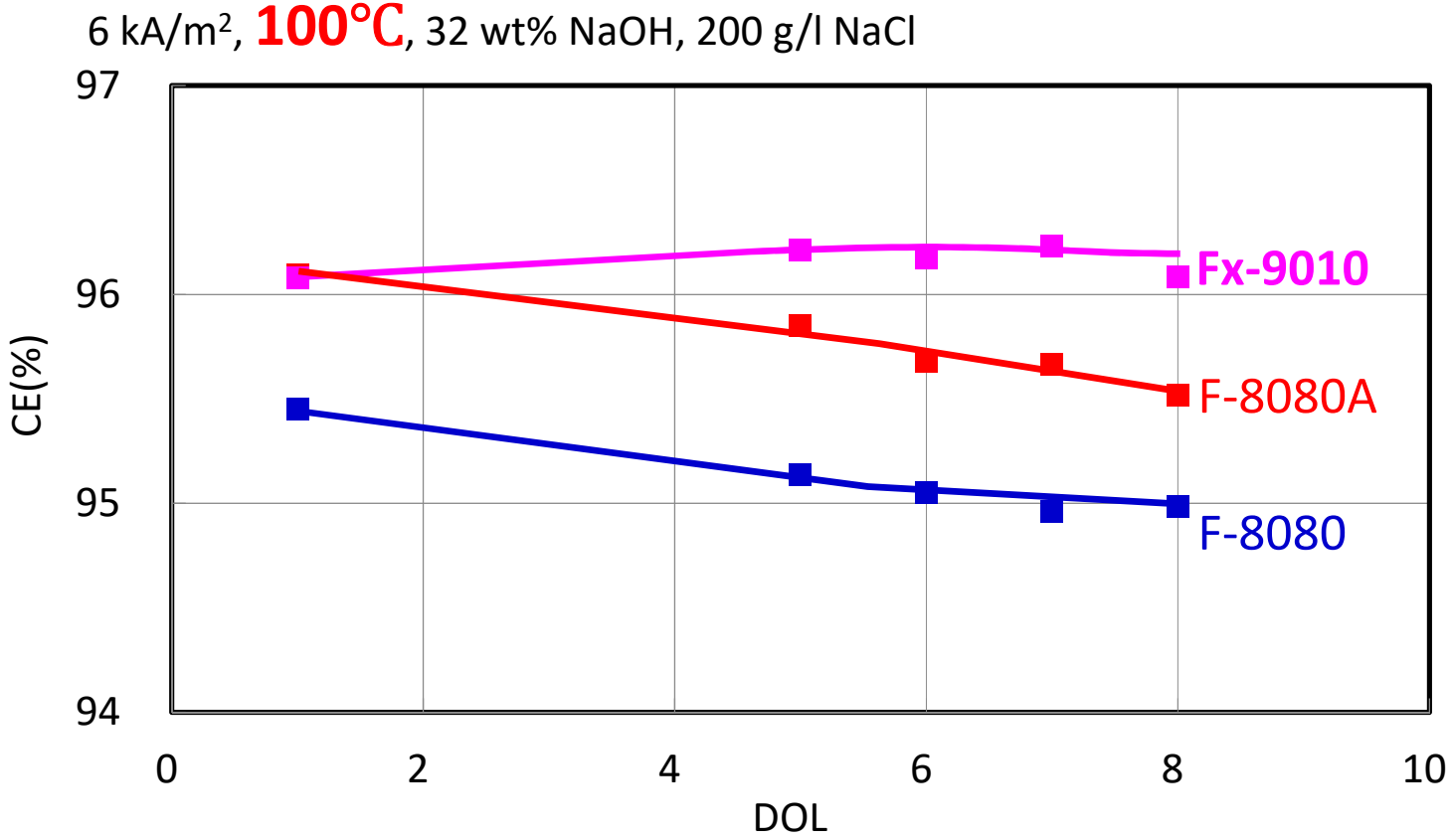
6 kA/m^2, 90 ^{o}C, 32 wt% NaOH,



Fx-9010 has higher stability of CE against Ni stain.

“improved Channel” is applied!

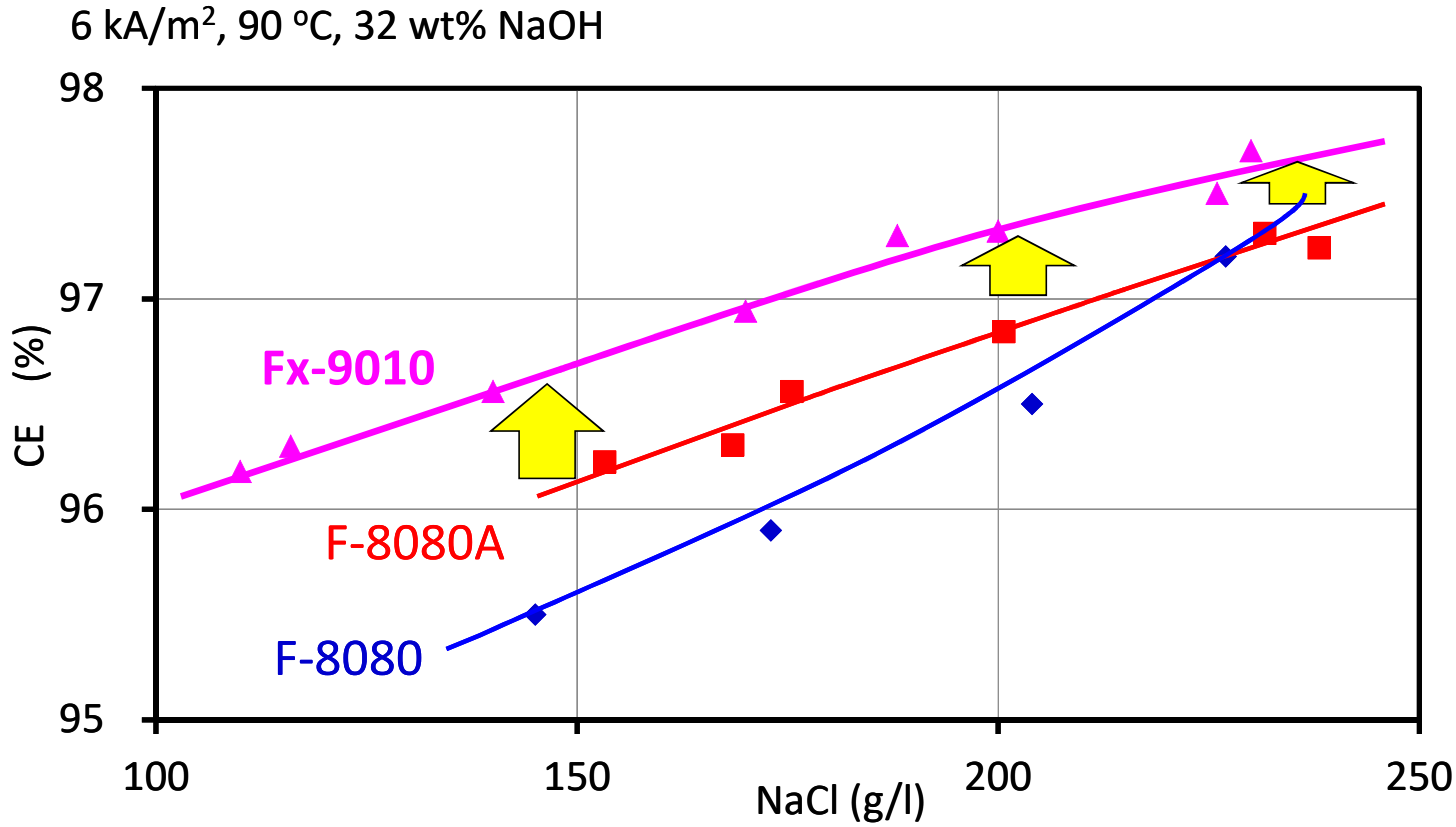
High Durability against High Temperature



Fx-9010 shows higher and stable CE

“Improved Channel” is applied!

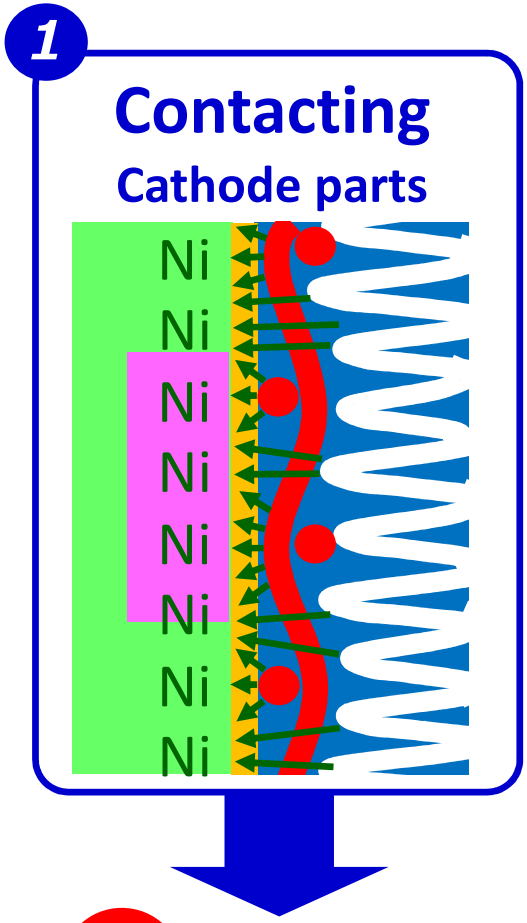
Higher CE in Weak Brine

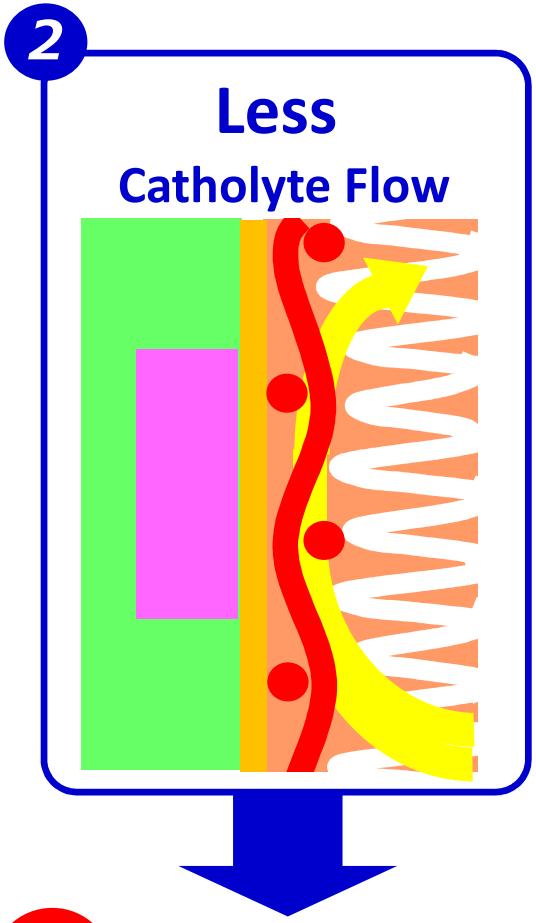


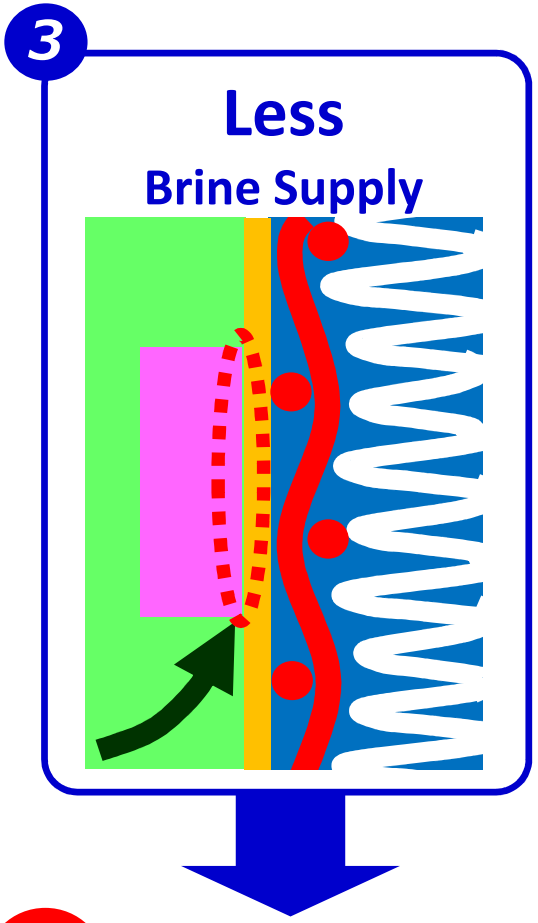
Fx-9010 shows higher CE in weak brine.

It is suitable for electrolyzers which have less inner circulation of brine.

“Zero gap” has Three Key Points







1 Ni stain

2 High Temperature

3 Weak brine

New Generation Membrane : Fx-9010

1. Low Voltage

- 50 mV lower voltage than F-8080 and F-8080A

2. Wider Operational Range

- Higher CE in both Hydrated and Dehydrated State

3. Higher Robustness

- Higher Robustness than F-8080 and F-8080A

4. Higher Durability against Impurities

- Higher Durability against Impurities at High Current Density

5. Suitability for Zero-Gap

- Stable CE at High Temperature and Week Brine
- Excellent Durability against Ni Stain

FORBLUE™

Contents

~How to use our technical service~

- **Just send your brine or salt sample** by using provided sample Kit and shipping label

→We will analyze your sample and repot back to you!

- Please use our service to:
  - -Analyze solid salt, raw brine, filtered brine, purified brine, or other brine sample
  - -Obtain results from AGCCA to compare your own analysis
  - -Utilize the results to track historical performance

and so on.

→Available for any purpose!

Our technical service

- What is the Cost? **Nothing!**

- Why does AGC offer this service? **Just for you!**

  In order to be responsive to your needs and to recommend process improvements.

- How long will the analyses take?

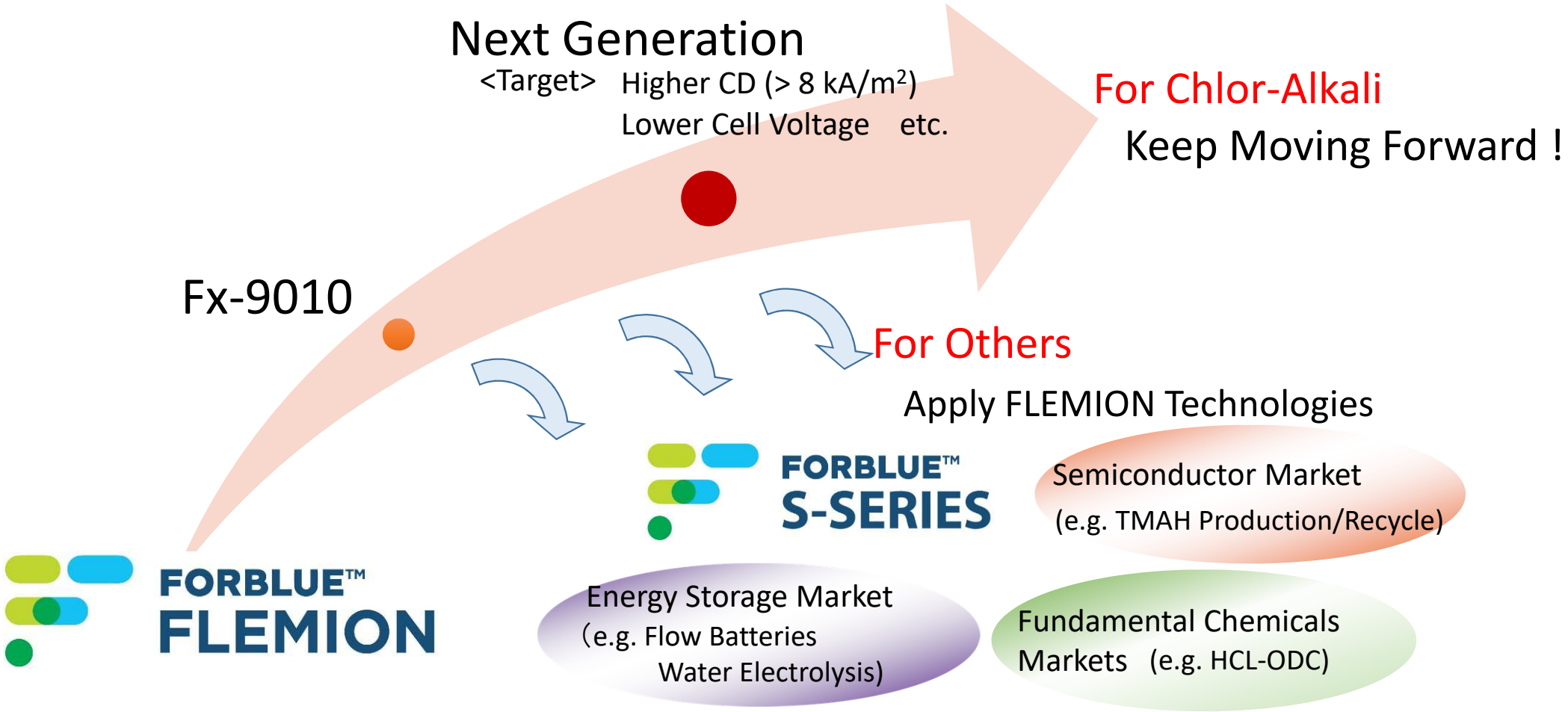
  Approx. two weeks to turn around

  Depending on the situation, it may take a little more

Our technical service

Provided Brine sample Label and sampling kit

R&D of Future FLEMION™



Thank you for your attention!!

AGC FORBLUE™ FLEMION™, your reliable membrane Technology partner