Introducing FORBLUE™
FLEMION™ F-8080 Series Membranes
Developments of FLEMION

1st Step (2000-2008)

- Much lower water content of S-layer:
  - Higher mechanical strength & stability
- Further increase 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

2nd Step (Enhance the feature of F-8020SP) (2011)

- New generation C-polymer: F-808X

F-8000 Series
- F-8020 SP
- F-8051

Durability against “Dehydration”
Development Steps

Conventional reinforcement with sacrificial fiber
New carboxylic polymer with uniform channel design
Tough reinforcement without sacrificial fiber

F-8020
F-8030
F-8031
F-8021
F-8020SP
F-8051
F-8080 Series
F-8080HD
F-8081HD
F-8080
F-8080A
F-8081
F-8080HD
F-8081HD
F-8080A
### Choice of FLEMION Membranes

<table>
<thead>
<tr>
<th></th>
<th>Cloth with Sacrificial Fibers Tensile Strength 45 N/cm</th>
<th>Cloth without Sacrificial Fibers Tensile Strength 70 N/cm</th>
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<tbody>
<tr>
<td>Higher current density</td>
<td>Flemion F-8080/F-8080A</td>
<td>Flemion F-8081</td>
</tr>
<tr>
<td>Lower voltage</td>
<td>• Lowest voltage</td>
<td>• Robust</td>
</tr>
<tr>
<td>Less impurity influence</td>
<td>• -60 mV</td>
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</tr>
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<td></td>
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<tr>
<td>Lower current density</td>
<td>Flemion F-8080HD</td>
<td>Flemion F-8081HD</td>
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<tr>
<td>Smaller NaCl in NaOH</td>
<td>• Higher durability</td>
<td>• Most durable</td>
</tr>
<tr>
<td>Fewer salt blisters</td>
<td>• -10 mV</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• +30 mV</td>
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<tr>
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<td>• Lower voltage</td>
<td>• Fewer pinching issues</td>
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<td></td>
<td></td>
<td>• Durable for frequent tension</td>
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*Your Dreams, Our Challenge*
**Type of Reinforcement Cloth**

**With Sacrificial Fibers**
- F-8020SP / F-8080 / F-8080A / F-8080HD

**Without Sacrificial Fibers**
- F-8051 / F-8081 / F-8081HD

- **PTFE fiber**
- **Sacrificial fiber**

**Hydrophilic Coating**

**Sulfonate Base Layer**

**Carboxylate Layer**

- Fine mesh
- Many cross point
- Thin fiber
- Without sacrificial fiber
Earlier C-Polymer

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

Cross section

: Ion channel

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

Various size of ion channels

Relatively narrow channel will lose the function in strongly dehydrated state.
Optimized C-polymer with Uniform Channel Size

Uniform channel size avoids losing of function in dehydrated stage.

Dehydrated by:
Stronger brine, caustic, impurities or other operating conditions.
Test for Deterioration by Cl₂ Gas Stagnation

Special Test Conditions for F-8080HD Tests

Cl₂ 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-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.
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

F-8080A: Wider operation range of high temperature
FLEMINON 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.
FLEMIION F-8080A : Higher CE in Hydrated Condition

F-8080A shows higher CE in weak brine.
## Choice of Membranes

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F-8080 shows most stable voltage more than three years operation.
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F-8080 keeps stable current efficiency higher then 95.5% for more than three years operation.
For More Information:

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