

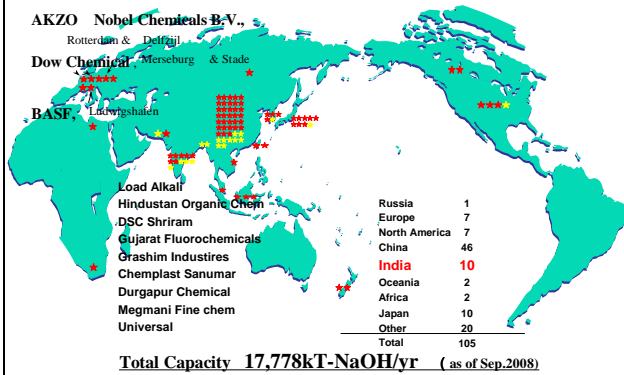
Recent Development of Asahi Kasei Chemicals' IM Technology to reduce Power consumption

Asahi Kasei Chemicals Corporation

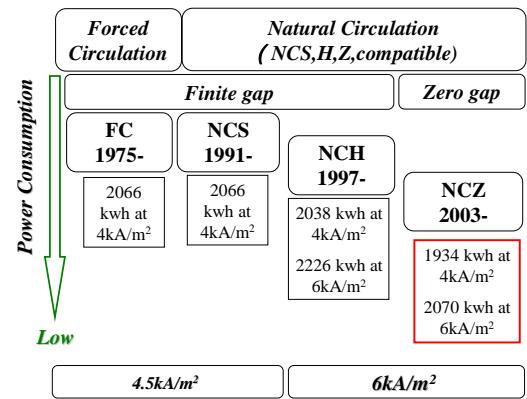
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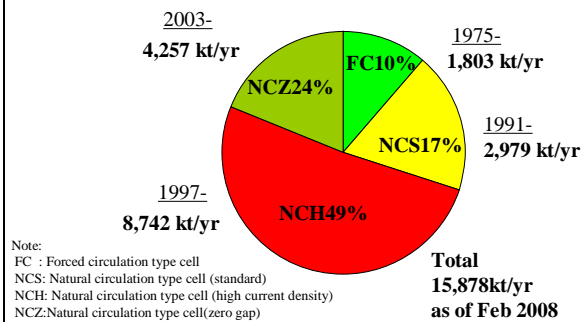
AKCC Users' Plant Location (Total 105)



Overview of Electrolyzer Types



Comparison of Cell Type

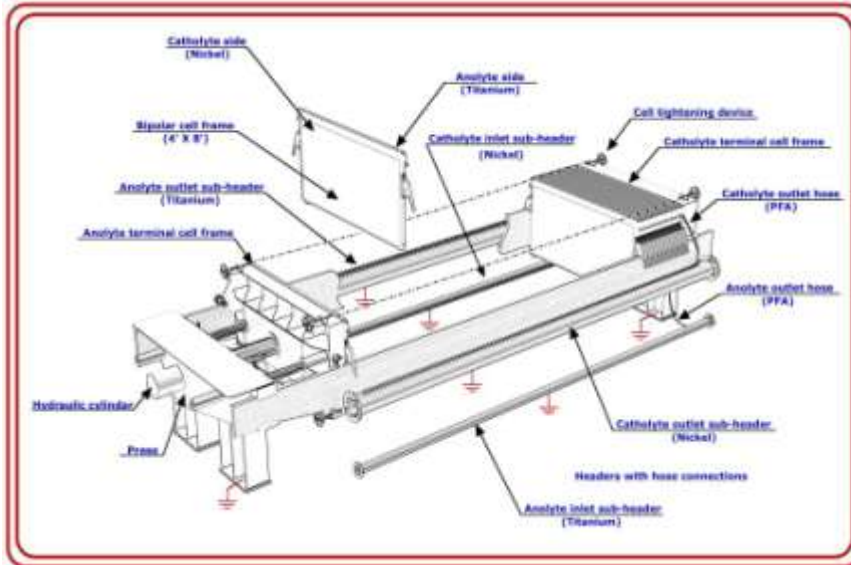


Note:
FC : Forced circulation type cell
NCS: Natural circulation type cell (standard)
NCH: Natural circulation type cell (high current density)
NCZ: Natural circulation type cell (zero gap)

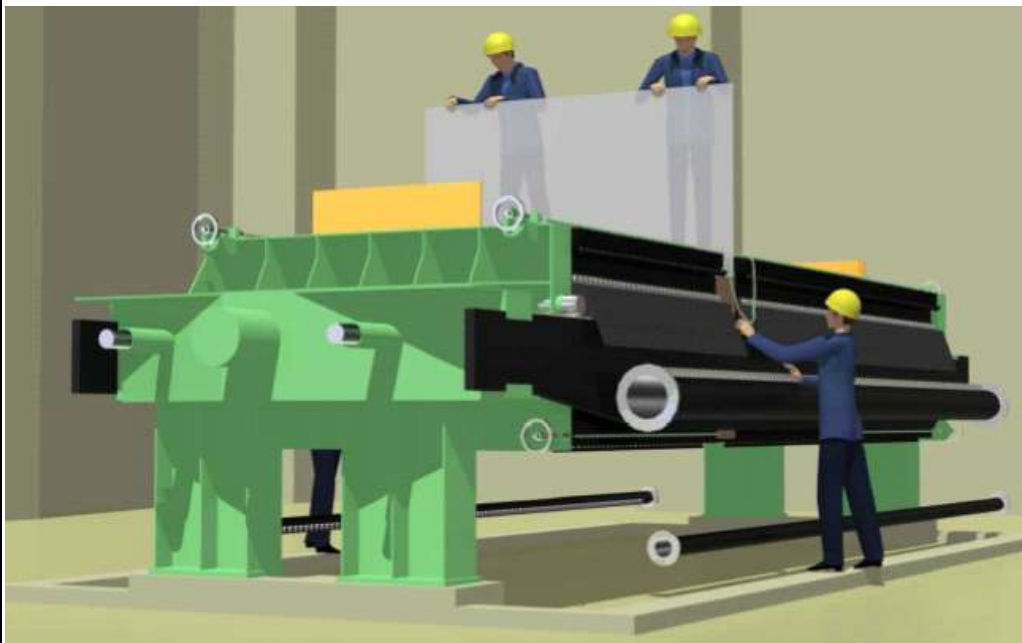
Features of Asahi Kasei Electrolyzers

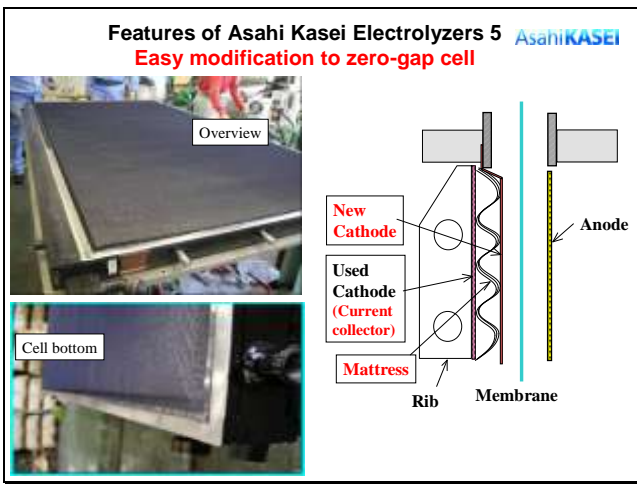
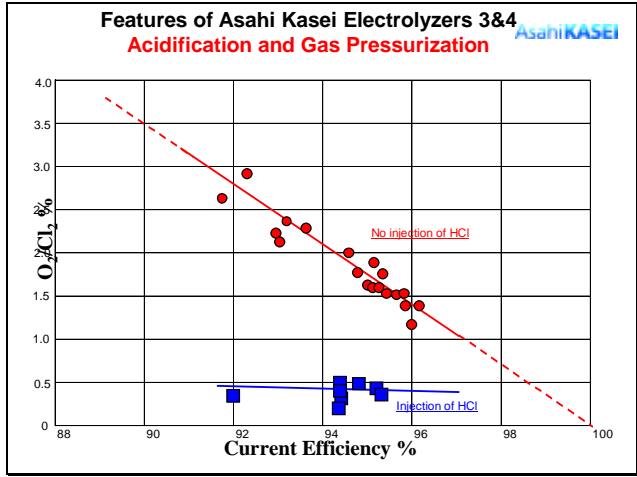
1. Filter press design and rigid structure with metal header
2. Quick, easy maintenance and membrane replacement
3. Brine acidification
4. Gas pressurization
5. Easy update modification of a cell (NCS&NCH → NCZ cell)

Features of Asahi Kasei Electrolyzer **AsahiKASEI** Filter press design and rigid structure with metal header



Features of Asahi Kasei Electrolyzers 2 **AsahiKASEI** Quick, easy maintenance and membrane replacement





Next Generation Cell AsahiKASEI

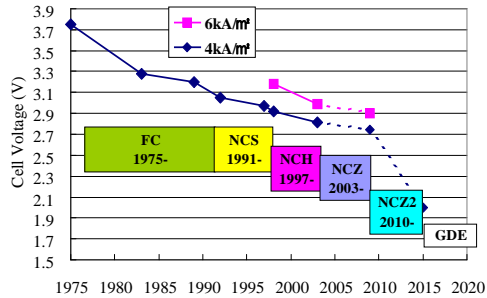
	NCZ	NCZ2
Market Entry	2003	2010 (Expected)
Normal Operation	6kA/m ²	8kA/m ²
Performance at 6kA/m ²	2.99V 2070kwh	2.90V 2004kwh

- NCZ2 Concept Design** AsahiKASEI
- **Lower Cell Voltage & Reliability**
 - 1) Mattress compression optimization
 - 2) New catalyst and configuration of electrodes
 - minimization of gas influence
 - lower overvoltage and longer durability
 - **Higher Current Density Operation**
 - 1) More uniform concentration distribution with inner part design
 - 2) Better separation of gas & liquid

Cell Voltage Components at 6kA/m² AsahiKASEI

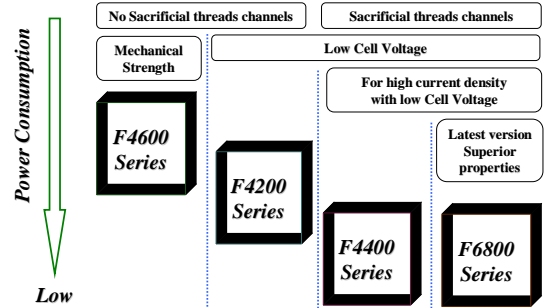
Electrolyzer	NCH	NCZ	NCZ2
Decomposition Voltage	2.21		
Anode Overvoltage	0.07		0.06
Membrane Resistance + Donnan Potential	0.51		
Cell Structure	0.02		
Catholyte Loss	0.23	0.02	0.00
Cathode Overvoltage	0.14	0.09	0.08
Others (Gas influence etc.)	0.07		0.02
Total (expected)	3.25V	2.99V	2.90V

CV Improvement in AKC Technology AsahiKASEI (Cell, Electrode, Membrane)



$670.2 * 1.0V / 0.97 * 18Mt/yr = 1.1 * 10^{13} wh/yr = 6,000kt-CO_2/yr$

Overview of Membrane Types



1) Aciplex™-F membranes has F2200 series for low concentration caustic (20 ~24% NaOH) production.
2) Aciplex™-F membrane can be used for KOH production. Please consult with Asahi personnel.

Point 1: Low Power Consumption

Items	F6801	F4404	F4403D
Cell Voltage (V)	2.92	2.95	2.95
Current Efficiency (%)	97.5	97.5	97.0
Power Consumption (kWh/t-NaOH)	2007	2027	2038

Conditions :
CD=4kA/m², Temp.=90°C COH=32%, CCl=205g/l, 1.5mm gap, AK Lab

➤ **Low PC will contribute to save power costs.**

Summary

AsahiKASEI

- 1) AKCC has developed IM electrolysis technology for more than 34 years.
- 2) AKCC developed 4 types of electrolyzer.
- 3) AKCC will continue to improve Electrolysis Technology such as NCZ2 & GDE (Gas Diffusion Electrode) with lower power consumption and reliability.
- 4) AKCC will continue to improve IM membranes.