Asahi-Kasei’s Large Water Electrolysis system for Power to Gas

2018.10.24
Asahi Kasei Corp.
Clean Energy Project,
Taketoshi Usui
Agenda

- Introduction of Asahi Kasei
- Current Development Status of Alkaline Water Electrolysis System in Asahi Kasei
- Future Plan
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- Current Development Status of Alkaline Water Electrolysis System in Asahi Kasei

- Future Plan
Brief introduction of Asahi Kasei

- A diversified chemical company with three business sectors
- 35,000 employees over 15 countries, headed in Tokyo, Japan
- Around ¥2,000 billion (€16B) net sales (2017)

<table>
<thead>
<tr>
<th>Trade name</th>
<th>President</th>
<th>Fiscal 2017 results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asahi Kasei Corp.</td>
<td>Hideki Kobori</td>
<td>Net sales ¥2,042 billion (€15.7B)</td>
</tr>
<tr>
<td>Head Office</td>
<td></td>
<td>Operating income ¥198.5 billion (€1.53B)</td>
</tr>
<tr>
<td>Chiyoda, Tokyo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Founding</td>
<td>Employees*</td>
<td></td>
</tr>
<tr>
<td>1922</td>
<td>34,670</td>
<td>* As of March 31, 2018</td>
</tr>
</tbody>
</table>

Asahi Kasei Corp. [holding company function]

Material
- Asahi Kasei Corp. [operating function]
- Asahi Kasei Microdevices Corp.

Homes
- Asahi Kasei Homes Corp.
- Asahi Kasei Construction Materials Corp.

Health Care
- Asahi Kasei Pharma Corp.
- Asahi Kasei Medical Co., Ltd.
- ZOLL Medical Corporation
History of Asahi’s electrolyzing technology

We started Hydrogen production by Water Electrolyzing in 1923. We used it for Ammonia production.

Asahi Kasei is the first Japanese company that industrialized Ammonia Production just 10 years after BASF (by conventional Haber-Bosch process) did.

Shitagau Noguchi, who founded Asahi Kasei, invited Italian Chemical Engineer Dr. Casale, and constructed Ammonia production Plant in 1923, in Nobeoka city Miyazaki Prefecture Japan. At that time he introduced Fauser’s Water electrolyzing system for Hydrogen production. This is the origin of Asahi’s electrolyzing technology.
Since 1975, Asahi Kasei has supplied Chlor-Alkali Electrolyzer system all over the world and still continue to polish our system.

+ Total production capacity installed by Asahi Kasei’s System
  over 7.5 billion Nm$^3$-H$_2$ / year
  over 26 countries, 126 production sites

+ Our customers in Europe,
  Dow Chemical in Hamburg
  BASF In Manheim
  Akzo-Nobel in the Netherland etc.
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➤ Future Plan
Process flow of Alkaline water electrolyzer

- **Anolyte Tank**
- **Catholyte Tank**
- **Gas-Liquid Separator**
- **Pure Water Supply**
- **Electrolysis**
- **Liquid Circulation**
- **Electrolyzer**

(Reaction Formula)

\[ H_2O \rightarrow H_2 + 1/2O_2 \]

【Configuration of Electrolysis Cell】

- **KOH, H_2O**
- **O_2**
- **H_2**
- **OH^-**
- **H_2O**
In preparation for the launch of FCV in 2015, the discussion and the interest of the hydrogen energy has been increasing. In this situation, NEDO has been conducting R&D project for the introduction of the hydrogen energy, and furthermore, NEDO will conduct the pioneering R&D regarding the technology of the production, transportation and storage of hydrogen energy for the hydrogen-society after 2030. This project will work on the development of the technology to produce hydrogen from the renewable energy with high efficiency and low cost, and the technology to transport the energy, and finally achieve the comparable price of the new energy carrier such as hydrogen compared with the cost of the energy from fossil fuel.

**Project :** Lead Study Project for Hydrogen Utilization etc. Research and Development

**Purpose of R&D**

In preparation for the launch of FCV in 2015, the discussion and the interest of the hydrogen energy has been increasing. In this situation, NEDO has been conducting R&D project for the introduction of the hydrogen energy, and furthermore, NEDO will conduct the pioneering R&D regarding the technology of the production, transportation and storage of hydrogen energy for the hydrogen-society after 2030. This project will work on the development of the technology to produce hydrogen from the renewable energy with high efficiency and low cost, and the technology to transport the energy, and finally achieve the comparable price of the new energy carrier such as hydrogen compared with the cost of the energy from fossil fuel.

**Size of Project**

- Total budget of the project : $10M (tentative)
- Total budget of NEDO : $40M (tentative) *¥120/$
- Term of the project : 2014 ~ 2017 (four years)

**Contents of R&D**

1. **R&D of the low-cost hydrogen production system**
   To conduct R&D of the hydrogen production system that enables to use effectively the renewable energy output power fluctuates

2. **Research of the high-efficiency hydrogen production technology**
   To conduct R&D of the next generation water electrolysis technology that improve the electrolysis efficiency dramatically
   To conduct the technology demonstration of the high-temperature steam electrolysis which has high electrolysis efficiency

3. **R&D of the peripheral technology (e.g. hydrogen liquefied storage system)**
   To develop the base technology of hydrogen liquefied storage system which can respond to the change of the production amount of hydrogen

4. **Research and study of the energy carrying system**
   To conduct the analytical evaluation research of the new process of the energy carrying system which can storage and transfer hydrogen efficiently

5. **Research and study of the scenario to introduce the total system**
   To consider the scenario that hydrogen and the energy carrying technology will be introduced to the society

Asahi receives “1. R&D of the low-cost hydrogen production system”.
Our current demonstration Systems

Medium size; since Jul. 2015
① Cell Voltage : **1.92 V** (1.0 A/cm²)
② Active Area : **0.25m² /cell**
③ Current Density : max. 1.0 A/cm²
④ Hydrogen Production : ~21Nm³/h
⑤ Temperature ; < 90°C
⑥ Pressure; Normal Pressure

Large size; since Nov. 2015
① Cell Voltage : **1.78 V** (0.6 A/cm²)
② Active Area : 2~3m² /cell
③ Current Density : max. 0.6 A/cm²  
  (limited by power supply)
④ Hydrogen Production : ~25Nm³/h
⑤ Temperature ; < 90°C
⑥ Pressure; Normal Pressure
Electrolyzer response to simulated wind power

- No delay in electrolyzer voltage response to input current

@Mid-size Demonstration Machine

Input current data: 2MW Wind power generator (Stand-alone)
(Current density range: 0kA/m² <-> 10kA/m²)
# Demonstration Project

<table>
<thead>
<tr>
<th>In Japan</th>
<th>In Europe</th>
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<tbody>
<tr>
<td><strong>SomaPJ</strong> <em>(150kw:Large size)</em></td>
<td><strong>FukushimaPJ</strong> <em>(Max. 10MW: Large size)</em></td>
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<tr>
<td><img src="image1" alt="SomaPJ" /></td>
<td><img src="image2" alt="FukushimaPJ" /></td>
</tr>
<tr>
<td>- extend the NEDO Project and relocate it to Soma</td>
<td>- We’ve received the order from Toshiba</td>
</tr>
<tr>
<td>- Corroborate with IHI’s smart community Project</td>
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<table>
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<tr>
<th><strong>H2herten PJ</strong> <em>(140kw:Middle size)</em></th>
<th><strong>Align CCUS</strong></th>
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<tbody>
<tr>
<td><img src="image3" alt="H2herten PJ" /></td>
<td><img src="image4" alt="Align CCUS" /></td>
</tr>
<tr>
<td>- At Herten in NRW, Germany</td>
<td>- At Niederraussem, NRW, Germany</td>
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</table>
ACT ALIGN CCUS Project

- Demonstration on recovery, reuse and storage of CO2 with six working packages
- Three years project until 2020 has received funding from EU and each member country
- Partnership among totally 31 companies and national institutes in Europe
Acknowledgements

ACT ALIGN CCUS Project No 271501

This project has received funding from RVO (NL), FZJ/PtJ(DE), Gassnova (NO), UEFISCDI (RO), BEIS (UK) and is cofunded by the European Commission under the Horizon 2020 programme ACT, Grant Agreement No. 691712.

www.alignccus.eu
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Asahi Kasei’s Business Plan

Middle size System

- 1MW
- 200Nm³/h
- in containers (20ft/40ft)

Large size system

- 10MW~
- 2,000Nm³/h~
- in a building

<table>
<thead>
<tr>
<th>Japan</th>
<th>Demonstration (middle scale)</th>
<th>Demonstration (large scale)</th>
<th>Operation at site (large scale)</th>
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<tbody>
<tr>
<td>Germany</td>
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<tr>
<td></td>
<td>h2-herten in NRW in Germany</td>
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Acknowledgement

Part of this report was done in trust from “Technology, Development for storage and transport of the renewable energy" given by Ministry of Economy, Trade and Industry (METI) and “Hydrogen utilization technology development” given by New Energy and Industrial Technology Development Organization (NEDO).

Including METI and NEDO, I would like to express my deep appreciation to all people concerned with our research and development.
Thank you for your attention!!
The commitment of the Asahi Kasei Group:
To do all that we can in every era to help the people of the world make the most of life and attain fulfillment in living.
Since our founding, we have always been deeply committed to contributing to the development of society, boldly anticipating the emergence of new needs.
This is what we mean by “Creating for Tomorrow.”