New Generation of Solar thermal Cooling with Yazaki

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Yazaki Energy System Corporation
Beijing Office
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1. Company Introduction

2. Yazaki’s Absorption Chiller in SHC

3. Yazaki-SHC Development Consideration

4. SHC in a passive house of China

5. New Absorption Chiller Concept
1. Company Introduction: Corporate snapshot

- Founded in 1929 by Mr. Sadami Yazaki
- Established as YAZAKI Corporation in 1941
- Today the company operates globally
- Privately owned

Chairman: Mr. Yasuhiko Yazaki
President: Mr. Shinji Yazaki

Locations

World Headquarters
Y-City, 1500 Mishuku, Susono-City, Shizuoka 410-1194, Japan

Tokyo Headquarters
17th floor, Mita-Kokusai Bdg., 1-4-28 Mita, Minato-Ku, Tokyo 108-8333, Japan
# Company Introduction: business scope

## ENERGY SYSTEMS

- Absorption & Solar Thermal Technology
- Electrical Wires
- Gas Equipment
- General Transportation Systems

## AUTOMOTIVE

- Electrical Distribution Systems
- Components
- Electronics & Instrumentation
- High Voltage

## NEW BUSINESS

- Recycling
- Nursing Care
1. Company Introduction: Group global footprint

**YAZAKI WORKS IN 45 COUNTRIES AND 476 LOCATIONS TODAY**

As of 06.2015

**TOTAL**
45 Countries - 170 Affiliates - 476 Locations - 279,800 Employees
2. Yazaki’s Absorption Chiller in SHC

- **EU**: 132 Projects, 56 Spain
- **ASIA**: 230 Projects
- **USA&CND**: 25 Projects

**Projects by Region**:
- **Vatican**: 2009
- **Abu Dhabi**: 2008
- **Beijing**: 2013
- **Canada**: 2012

**First SHC House**: 1974

**Total Projects**: 387
3. Yazaki-SHC Development Consideration

**SHC 1.0**
- **Focus:** supply
- **(2016-17)**

**SHC 2.0**
- **Focus:** supply + demand
- **(2018)**

**Yazaki Thermal Concepts**
- **Focus:** supply + demand + grid

**Energy Efficiency** + **Renewables** + **Passive Architecture 1.0**

**Energy Efficiency** + **Renewables** + **Passive Architecture 2.0**
low energy consumption building and green building in Shandong Province, 2015

① Energy consumption for air-conditioning (<30kWh/m²y)
② Proportion of renewable energy (>12%)
### Comparison between general buildings and passive buildings

<table>
<thead>
<tr>
<th></th>
<th>General buildings (hypothesis)</th>
<th>Passive buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building construction</strong></td>
<td>Facade</td>
<td>Roof</td>
</tr>
<tr>
<td><strong>Heat transmission coefficient (HTC)</strong></td>
<td>HTC (W/m²・K) : 1.06</td>
<td>HTC (W/m²・K) : 0.15</td>
</tr>
<tr>
<td></td>
<td>Roof</td>
<td>HTC (W/m²・K) : 1.09</td>
</tr>
<tr>
<td></td>
<td>Window</td>
<td>HTC (W/m²・K) : 2.40</td>
</tr>
</tbody>
</table>

Based on passive house,
- HTC of facades and roof achieves an 85% reduction.
- HTC of the window is decreased about 60%.
Annual thermal load, including internal heat generation is decreased about 70%.

Heating load: 23,879kWh $\Rightarrow$ 263kWh (nearly zero)
Cooling load: 39,800kWh $\Rightarrow$ 21,317kWh (half)
Annual thermal load: 63,679kWh $\Rightarrow$ 21,580kWh
4. SHC in a passive house of China:

Example: passive buildings in Shandong, China

System concept:

① Primary energy reduction due to solar thermal
   - The water fired chilled (WFC) for cooling is applied
   - Prior control for cooling and heating from solar thermal

② Application of radiation cooling and heating
   - Power reduction of indoor unit
   - System efficiency improvement from cold water with higher temperature and hot water with lower temperature

③ Application of variable flow cold water system by load-side two-way valve
   - Power reduction by the inverter control for load-side cold water pump
4. SHC in a passive house of China

Energy saving assessment [supply-side only] (kWh/m²)

| Energy consumption ratio of supply side and load side is 50:50 |
| Renewable energy ratio (※2) (%) |

| Energy consumption for air-conditioning (<30kWh/m²y) |
| Proportion of renewable energy (>12%) |

Renewable energy ratio = output of SHC/(output of SHC + output of EHP)

More energy could be saved and the renewable energy ratio is higher than expected.

<table>
<thead>
<tr>
<th>Cooling</th>
<th>Heating</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.15</td>
<td>4.28</td>
<td>9.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Requirements

- Low energy consumption building and green building in Shandong Province, 2015
- Energy consumption for air-conditioning (<30kWh/m²y)
- Proportion of renewable energy (>12%)
## 4. SHC in a passive house of China: PE reduction

<table>
<thead>
<tr>
<th>Buildings</th>
<th>Supply side air-conditioning device</th>
<th>Aperture area [m²]</th>
<th>Primary energy Usage [GJ]</th>
<th>Primary energy Reduction [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A General</td>
<td>Air source Heat pump (ASHP)</td>
<td>-</td>
<td>235</td>
<td>-</td>
</tr>
<tr>
<td>B High thermal insulation</td>
<td>ASHP</td>
<td>-</td>
<td>128</td>
<td>45.5</td>
</tr>
<tr>
<td>C High thermal insulation</td>
<td>ASHP + SHC</td>
<td>100</td>
<td>113</td>
<td>51.9</td>
</tr>
<tr>
<td>D High thermal insulation</td>
<td>High efficiency ASHP + SHC upgrade + Integration with buildings</td>
<td>356</td>
<td>67</td>
<td>71.6</td>
</tr>
</tbody>
</table>

※ASHP (cooling COP 2.84, heating COP 3.87)
High efficiency ASHP (cooling COP 4.80, heating COP 4.80)

### SHC upgrade tech:
- High efficiency collector
- Thermal stratified tank
- Power reduction of pump
- Low temperature driven chiller
- System optimal control

### Example:
- Unique design, More thermal collection

### Graph:
- Primary energy usage [GJ]
- Primary energy reduction rate [%]
5. New Absorption Chiller Concept

technology & initiatives for low temperature driven of YAZAKI WFC

- Small size & compact
- High durability & long life
- Simple design & installation
- Low maintenance

Available rage for solar energy
(WFC with low temperature heat medium)

Available rage for solar energy
(conventional WFC)

Working condition for the new chiller

Working condition for conventional chiller

Turbo chiller

Conventional chiller

WFC technical development
① low temperature heat medium
② low power for pump

Low temperature heat medium + Low power

System COP vs Heat medium temperature

COP 25 20 15 10 8 5 4 0
Heat medium temperature 60 62 64 66 68 70 72 73 74 75 76 78 80 82 84 86 88 90 92 94

Only One tech
5. New Absorption Chiller Concept

Yazaki’s new package SHC system (Plug-in system)

- Heat Storage Tank
- Cooling Tower (Closed Type)
- WFC-SC5
Thank you for your attention!

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