Industrial Batteries

Nov. 25th, 2014

GS Yuasa International Ltd.
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2. Advanced Technology - Lithium Ion Battery (including some references)
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<tr>
<th>Corporate profile</th>
<th>GS Yuasa Corporation</th>
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<tbody>
<tr>
<td>Corporate name</td>
<td>GS Yuasa Corporation</td>
</tr>
<tr>
<td>Established</td>
<td>April 1, 2004</td>
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<tr>
<td></td>
<td>Merger between Japan Storage Battery Co., Ltd. (established in 1917) and Yuasa Corporation (established in 1918)</td>
</tr>
<tr>
<td>Head office</td>
<td>Kyoto, Japan</td>
</tr>
<tr>
<td>Capital</td>
<td>33 Billion yen (USD330 Million)</td>
</tr>
<tr>
<td></td>
<td>*Estimated 1USD=100JPY</td>
</tr>
<tr>
<td>Net sales</td>
<td>350 Billion yen (US$3.5 Billion)</td>
</tr>
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<td></td>
<td>*Estimated 1USD=100JPY</td>
</tr>
<tr>
<td>Number of employees</td>
<td>Consolidated 12,235 (as of 2012)</td>
</tr>
<tr>
<td>Listed securities exchange</td>
<td>Tokyo stock exchange</td>
</tr>
<tr>
<td></td>
<td>Osaka securities exchange</td>
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History of GS Yuasa

In 1917
Genzo Shimadzu

Founded Japan Storage Battery Co., Ltd. Shimadzu-san succeeded in developing the first lead acid battery in Japan. He is a holder of 178 patents in over 12 countries.

In 1918
Shichizaemon Yuasa

Founded Yuasa Battery Manufacturing. During World War I, Yuasa-san expanded the company to provide batteries worldwide. He developed the first EV batteries in Japan and introduced them to Ford, GM.
GS Yuasa Major Products

**Automotive battery / Motorcycle battery**
- Automotive battery
- Motorcycle battery

**Power supply system**
- DC power supply
- AC uninterruptible power supply
- Photovoltaic power conditioner

**Industrial battery**
- Stationary battery
- Small valve regulated lead acid battery
- Traction battery

**Lighting / UV system**
- Ceramic-metal- halide-lamp
- DUV cleaner for FPD glass

**Others**
- Lithium-ion battery for EV
- Lithium-ion battery for HEV
- Large lithium-ion battery
- Charger for Lithium-ion battery
Global Network

36 overseas affiliates in 16 countries

Manufacturing (consolidated)
Sales (consolidated)
Manufacturing (equity method)
Sales (equity method)
Sales Balance by Segment

Year: 2013

Sales US$ 3.5 Billion

- Automotive battery 23%
- Industrial 12%
- Automotive 30%
- Lighting 3%
- Other 8%

Domestic Sales 47%
Oversea Sales 42%

*Estimated 1USD=100JPY
GS Yuasa As a Global Supplier..

High End Supplier for all world class Telecom Operators

<table>
<thead>
<tr>
<th>Country</th>
<th>Industrial Battery</th>
<th>Japan Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Telstra (Telestra)</td>
<td>9%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Grammenphone</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>China Mobile</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td>China Unicom</td>
<td></td>
</tr>
<tr>
<td>Hongkong</td>
<td>PCCW</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>KDDI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NTT</td>
<td></td>
</tr>
<tr>
<td>Taiwan</td>
<td>Chung HWA Telecom</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>True Corporation</td>
<td></td>
</tr>
<tr>
<td>U.K</td>
<td>British Telecom</td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>AT&amp;T</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Verizon</td>
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Source: GY Independently Investigate
Lead-acid and NiCd Battery Plant

GS Yuasa group has 9 plants for industrial battery in the world.
Lithium-ion Cell Plant

GS Yuasa group has 5 plants in Japan.

- **Osadano plant**
  - SOP: Feb 2011
  - Capacity: HEV 300k/ year

- **Kusatsu plant**
  - SOP: Jun 2009
  - Capacity: 7k/ year

- **Ritto plant I & II**
  - SOP: Apr 2012 – Jan 2013
  - Capacity: 50k/ year - 60k/ year

- **Kyoto plant**
  - SOP: Dec 2010
  - Capacity: 10k/ year

(Capacity: EV Equivalent number per year)
Products and Applications for Lithium Ion Battery

Industrial Hybrid
- Hybrid bus, light rail, gantry crane, heavy equipment
- System Engineering, performance and life modeling
- Field Support

Automotive
- US Support for vehicle programs
- Field support for battery testing/remanufacturing
- Warranty Analysis/Test

Aerospace
- Battery assembly, design, and test for space craft systems
- Life and performance modeling
- Technical support

Stationary
- Telecom
- Grid/Storage battery system development
- Solar + Battery system
- Technical support
- System Engineering

Aircraft
- Manufacturing and Test (planned for 787 production expansion)
- Technical support
- System Engineering
- Field Support

Train
- E3 solution system
- Hybrid train
- System Engineering
- Field Support
Major Benefits of Lithium ion Battery

- Cyclic Life Performance
- Deep Discharging
- Quick Charging
- Light Weight and Compact
## Comparison of Cyclic Performance with Competitor

<table>
<thead>
<tr>
<th></th>
<th>Lithium</th>
<th>VRLA</th>
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<tr>
<td></td>
<td>French Competitor</td>
<td>Korean Competitor</td>
</tr>
<tr>
<td>Cyclic</td>
<td>4300</td>
<td>4000</td>
</tr>
<tr>
<td>DOD(%)</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>EOL(%)</td>
<td>70</td>
<td>-</td>
</tr>
<tr>
<td>Chemical</td>
<td>NMC</td>
<td>LMO</td>
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</table>
Field Trial with Thailand and Hong Kong Telecom Carrier

GS Yuasa Lithium ion Battery Module (50Ah, 48V) has been installed in Thailand and Hong Kong since Oct. 2014.

Many more field trial will be starting in India, Pakistan, Ecuador and Africa from Dec. 2014.
Zero Emission by Li-ion Battery System

We provided a **240kWh energy storage system** for East Japan Railway Company’s Solar Power System “Zero Emission Station Project” with MITSUBISHI Electronics. (LIM50E-12 × 6 series × 19 parallels)

< Appearance of Eco-station Model of Hiraizumi >
Zero Emission by Li-ion Battery System

240kWh Energy storage system installed at Hiraizumi station (JR East).

- The system can store energy on sunny days from the solar panels enough to supply all of the power the station needs.

- The system can even store excess energy to supply the necessary power during nighttime and inclement weather.
Cochrane Project (ESS) in Chile

Cochrane Project Overview
20MW/5MWh
2MW-PCS/500kWh-Battery Container × 10 systems
THANK YOU!!