1. History of Japan’s Titanium industry
   【Titanium Sponge】
   - Launch of titanium sponge in Japan
   - Technological development and production volume shift
   【Titanium Mill Products】
   - Launch of mill products in Japan
   - Technological development and production volume shift
   - Recent application development

2. Outlook of Japan’s Titanium Industry  2012
OSAKA Titanium technologies, Co., Ltd. started Ti sponge production.

The Japan Titanium Society was established.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>Dr. Kroll visited Japan to give a lecture on Ti sponge manufacturing technologies.</td>
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<tr>
<td>1954</td>
<td>Toho Titanium Co., Ltd. started Ti sponge production.</td>
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Technological Development for Sponge Production

<table>
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<tbody>
<tr>
<td>Chlorination</td>
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<tr>
<td>Reduction / Vacuum Separation</td>
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<tr>
<td>Electrolysis</td>
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<tr>
<td>Briquetted Chlorination</td>
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<tr>
<td>Fluidized Chlorination</td>
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<tr>
<td>Separately operated</td>
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<tr>
<td>Combined into one process (5MT)</td>
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<tr>
<td>Up-sized to 10 MT</td>
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<tr>
<td>Further Up-sized to 13MT</td>
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<tr>
<td>Mono-polar cell</td>
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</tr>
<tr>
<td>Multi-polar cell</td>
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</tbody>
</table>
Technological Development for Sponge Production

Chlorination

Briquetted Chlorination

Fluidized Chlorination
Technological Development for Sponge Production

Reduction / Vacuum Separation

Separated operated

Combined into one process (5MT)

Up-sized to 10 MT

Further Up-sized to 13MT

Ti sponge from 5MT and 10 MT
Technological Development for Sponge Production

Titanium Sponge Power Consumption (Index)

Index

- Titanium Sponge Total Power Consumption
- Mg Electrolysis Power Consumption

- Other Process
- Process Integration
- Up-sized Batch (5MT to 10MT)
- Mg Electrolysis
- Multi-polar Cell
- Mono-polar Cell
Technological Development for Sponge Production

This improvement is the result of accumulated operational technologies over many years.

‘80 → ‘90
Multi-pole type
Up-sized

‘00 → ‘06
Up-sized
All 5-pole type
Shift of Titanium Sponge Production

- Annual production (in MT)
- Data from 1952 to 2010
Shift of Titanium Sponge Export Volume

- Export volume (in MT)
- Percentage of export

Year: 1952-2010
- Export volume:
  - 0% to 100%
- Percentage of export:
  - 0% to 100%

Export volume:
- 5,000 to 30,000 MT
1949

**Kobe Steel** began the R & D of Titanium.

1954

**Sumitomo Metal Industries** started production.

1955

**Kobe Steel** started production.

1971

**Daido Steel** started production.

1984

**Nippon Steel / NKK** started production.
Using rolling mill for steel enabled mass production.
Shift of Mill Products Shipment

Annual Shipment (in MT)

- 25,000
- 20,000
- 15,000
- 10,000
- 5,000
- 0

Shift of Mill Products Export Volume

- Export volume (in MT)
- Percentage of export

- Data highlights a trend in export volume and percentage over several years from 1963 to 2010.
Recent Application Development

Desalination Plant
Condenser (Power Plant)
Titanium
Haneda Airport
Roof of Sensouji Temple
Sponge production capacity in Japan

- 2009: 40,000 MT
- 2010: 55,000 MT
- Apr. 2011: 55,000 MT
- Jul. 2011: 60,000 MT
- Feb. 2012: 65,000 MT
Outlook of Japan’s Titanium Industry 2012

Titanium feedstock price with other raw materials

Price Index (02/1Q=1)

Iron Ore
Metallurgical Coal
Petroleum (Dubai)
Titanium Feedstock

02 03 04 05 06 07 08 09 10 11 12 '13
Outlook of Japan’s Titanium Industry 2012

Ratio of middle/low quality feedstock in sponge production

- TiO2 90 – 92%
- TiO2 94 – 96%
Mill shipment /
Actual shipment 2008 through 2011, and forecast for 2012

Outlook of Japan’s Titanium Industry 2012
Conclusion

• For the past 60 years, Japan’s titanium industry has continued to tackle with innovation, overcome difficulties, and developed with the world titanium industry.

• We will continuously do our best to provide a stable supply of high quality titanium and together develop the world titanium industry.