Outlook on Current Titanium Trends in Japan

International Titanium Association 2015
October 5, 2015

Kazuo, Kagami
Chairman of The Japan Titanium Society
President & Representative Director of Toho Titanium Co., Ltd.
Agenda

1. Introduction of Japan Titanium Society

2. Outlook of Japan’s Titanium Industry 2015

3. Japan’s Efforts for Developing Titanium Industry

4. New Applications of Titanium

5. Conclusion
1. Introduction of Japan Titanium Society

1.1 Foundation and Activities

- **First titanium organization in the world!**
  - Founded in 1952 just after start of commercial production of sponge titanium by Kroll method

- **Contribution towards the steady growth and development of the titanium industry in Japan**
  - Application development
  - Technical investigation
  - Market survey
  - International task
  - Education
  - Environment

http://www.titan-japan.com/indexe.htm
1. Introduction of Japan Titanium Society

1.2 Organization of JTS

- General Meeting
- Board Meeting
- Executive Meeting

- Awards Committee
- Application Development Committee
- Administration Committee
- Editorial Committee
- Environment Committee
- Technical Committee
- ISO / TC79 / SC11 Committee
- Academia–Industry Cooperation Committee
- Secretary

- Desalination & Environment
- Construction & Ocean Eng.
- Medical Appliances
- Associate Members Committee
  - Water Service WG
  - Fastener WG
  - Welfare & Medical WG
  - Sanitary WG
  - West Japan Branch
  - Materials Sub-comm.
  - Anti-Corrosion Properties
  - Non Destructive Inspection, etc.

19 Corporate Members
175 Corporate Associates
31 Individual Members

As of Sep 1st, 2015
1. Introduction of Japan Titanium Society

2. Outlook of Japan’s Titanium Industry 2015

3. Japan’s Efforts for Developing Titanium Industry

4. New Applications of Titanium

5. Conclusion
Sponge shipment for 2015 is expected to make recovery.
Mill demand is getting better gradually for industrial market.
Agenda

1. Introduction of Japan Titanium Society

2. Outlook of Japan’s Titanium Industry 2015

3. Japan’s Efforts for Developing Titanium Industry

4. New Applications of Titanium

5. Conclusion
### 3. Japan’s Efforts for Developing Titanium Industry

#### 3.1 Programs under Industrial-Academia-Government Cooperation

##### 3.1.1 “Development of Advanced Titanium Alloy & Production/Processing Technology for Next Generation Aircraft Structure”

<table>
<thead>
<tr>
<th>Stage</th>
<th>1st stage 2008~2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Material and process development</td>
</tr>
<tr>
<td></td>
<td>• Sheet forming process using partial heating</td>
</tr>
<tr>
<td></td>
<td>• Forming machine to fabricate large size parts</td>
</tr>
<tr>
<td></td>
<td>• Fabrication process of sintered parts</td>
</tr>
<tr>
<td></td>
<td>Common technology development</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>2nd stage 2013~2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• <strong>Bonding</strong> methods</td>
</tr>
<tr>
<td></td>
<td>• Powder metallurgy</td>
</tr>
<tr>
<td></td>
<td>• Non-destructive inspection</td>
</tr>
</tbody>
</table>

Reference: “Recent topics of titanium research and development in Japan”

Ti-2015 Plenary Session  Aug. 17th 2015  San Diego
3. Japan’s Efforts for Developing Titanium Industry

3.1 Programs under Industrial-Academia-Government Cooperation

3.1.2 ISMA project
- Innovative Structural Materials Association
- Purpose: Weight reduction of transportation equipment (ex. Automobiles)

<table>
<thead>
<tr>
<th>Non-ferrous metal materials</th>
<th>Process</th>
<th>Multi-materials for vehicle weight reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>Structure control</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Titanium (alloys)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Japan’s Efforts for Developing Titanium Industry

3.1 Programs under Industrial-Academia-Government Cooperation

3.1.3 SIP (Cross-ministerial Strategic Innovation Promotion program)

- Purpose: “Structural material for innovation” including heat resistant metallic materials (Titanium alloys, TiAl, Ni based alloys etc.)
- Application: Power generator, Aircraft, etc.
3. Japan’s Efforts for Developing Titanium Industry

3.2 Industry Initiatives

3.2.1 Flexible and Easy Processing Alloy – TNCZ
(Daido Steel Co., Ltd.)

- Developed for medical application
- Widely applicable material to sports, leisure etc.

**Advantage**
1. Flexible (similar modulus to bone)
2. High forming capability
3. Biocompatibility (non-toxic elements)

---

**Graphical Data**

- **Low Young's Modulus and Flexibility**
  - Ti-6Al-4V (Annealing)
  - DAT55G(ST)
  - β-C (ST)
  - Ti-15-333(ST)
  - DAT51(ST)
  
- **Flow stress (MPa)**
  - Ti-6Al-4V DAT51
  - TNCZ
  - Ti-20Nb-5Cr-4Zr

- **Compressive ratio (%)**
  - DAT51
  - Ti-6Al-4V
  - Ti-15-333
  - β-C

---

**Notes:**

- ST: Solution treatment
- Low Flow Stress and high forming capability

---

12
3. Japan’s Efforts for Developing Titanium Industry

3.2 Industry Initiatives

3.2.2 Process of Direct Cast Titanium Slabs

- Slab cast technology by electron beam (EB) melting
- Omitting of break-down and cutting process maintaining quality
- Industrial applications mainly for thin sheet products
14

Agenda

1. Introduction of Japan Titanium Society

2. Outlook of Japan’s Titanium Industry 2015

3. Japan’s Efforts for Developing Titanium Industry

4. New Applications of Titanium

5. Conclusion
4. New Application of Titanium

4.1 Fuel Cell Separator on Automobile “MIRAI” by TOYOTA

Special titanium sheet has applied to power train of fuel cell vehicle (FCV): “MIRAI”: The 1st commercialized FCV using high pressure hydrogen.

“MIRAI”
(Toyota Motor Corporation)
4. New Applications of Titanium

4.2 Connecting Rod for Motorcycle Made by Alloy Super-TIX®51AF

Super-TIX®51AF  (Ti-5Al-1Fe by Nippon Steel & Sumitomo Metal Co., Ltd.)

Advantage
• Balance between Machinability and Hot workability / High strength (≈ Ti-6Al-4V)

Application
• Connecting rod for motorcycle ≈ lighter and lower power loss
4. New Applications of Titanium

4.3 Devices for Ocean Thermal Energy Conversion (OTEC)

• OTEC power plant equips PHE with high efficiency (+20%) and reliability.
• PHEs are using high heat transfer titanium sheet HEET™ (Kobe Steel Co., Ltd.), which has uneven pattern on the surface.

• OTEC demonstration plant is now running at Kume-jima, Okinawa, JAPAN and Kona, Hawaii, USA.
4. New Applications of Titanium

4.4 Building / Monument

- Temple Roof Tiles, Hongwan-ji Kagoshima Betsuin
- Shrine Archway “Torii”, Kashima-jinja
- Temple Roof Tiles, Senso-ji main hall
- Roofing, Kyushu National Museum
1. Introduction of Japan Titanium Society

2. Outlook of Japan’s Titanium Industry 2015

3. Japan’s Efforts for Developing Titanium Industry

4. New Applications of Titanium

5. Conclusion
5. Conclusion

Sustained Efforts

We, Japanese Industries and JTS, intend to encourage the transition from titanium being a metal with enormous potential to one that can be found in products everywhere.

Thank you!