Trend of Titanium Parts for Motorcycles

K. Takahashi
Honda R&D Co., Ltd.
Contents

1. Introduction

2. Development of titanium parts for motorcycles

3. Trend of titanium parts for the future

4. Conclusion
Motorcycle Market Size

UNIT: million
2004 year
Materials of Sports models

- Titanium
- Mg
- Al
- Others
- Fe

~150kg

Light metal
Benefits of Weight Reduction

1. Improvement in fuel – efficiency

2. Improvement in engine performance

3. Reduction in toxic emissions
Contents

1. Introduction

2. Development of titanium parts for motorcycles

3. Trend of titanium parts for the future

4. Conclusion
Development of Processed Material

1987 Utilization of Recycled Titanium scrap

- Established a new grade for motorcycles (relaxing various restrictions)
Recycling Titanium Scrap

Scrap recycling process

- Sponge Ti
- Parent alloy
- Scrap
  - Melting in PPCF (Plasma Progressive Casting Furnace)
    - VAR
      - Ingot

Conventional process

- Sponge Ti
- Parent alloy
  - Compact forming
  - Electrode forming by welding
    - VAR 1
    - VAR 2

## Chemical composition

<table>
<thead>
<tr>
<th>Element</th>
<th>C</th>
<th>Al</th>
<th>V</th>
<th>Fe</th>
<th>O</th>
<th>N</th>
<th>H</th>
<th>Ti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ti64A</td>
<td>≤0.2</td>
<td>5.5 ~ 6.75</td>
<td>3.5 ~ 4.6</td>
<td>≤0.4</td>
<td>≤0.21</td>
<td>≤0.05</td>
<td>≤0.015</td>
<td>bal.</td>
</tr>
<tr>
<td>Ti64</td>
<td>≤0.1</td>
<td>5.5 ~ 6.75</td>
<td>3.5 ~ 4.6</td>
<td>≤0.3</td>
<td>≤0.20</td>
<td>≤0.05</td>
<td>≤0.0125</td>
<td>bal.</td>
</tr>
</tbody>
</table>

## Mechanical Property

<table>
<thead>
<tr>
<th>Mechanical Property</th>
<th>TS(MPa)</th>
<th>0.2%PS (MPa)</th>
<th>EL(%)</th>
<th>RA(%)</th>
<th>Charpy Value (J/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ti64A/Ti64</td>
<td>≥896</td>
<td>≥827</td>
<td>≥10</td>
<td>≥25</td>
<td>≥491</td>
</tr>
</tbody>
</table>
Example of Application

Connecting rod
Wt: 235g/pc
OD (Oxygen Diffusion) Treatment

- Hardened layer: ~20um
- Plot: Hardness (HV) vs. Distance from surface (um)

- HV values range from 800 to 0
- Distance from surface ranges from 0 to 80 um
Seizure Test

Condition
Disk speed: 5.4m/s
Oil: Engine oil (10W-30)

![Graph showing the time interval between oil supply stop and seizure](image)

- **SCM420 (carburizing)**
- **Ti-64A (OD+PTFE Coating)**
- **Ti-64A (non treatment)**

The time interval between oil supply stop and seizure.
Development of Raw Material

1987 Use of scrap Ti enabled
   Established grade for automobiles
      (various restrictions relaxed)

2002 Utilization of off-grade sponge
   Control of maximum allowable impurities
Utilization of Off-Grade Sponge

- **MIL SPEC.** Wrought Products for conventional use
- **NEW SPEC.** Wrought Products for motorcycles
- **Off-Grade** Alloy for steel production

【Titanium Sponge】
## Chemical Composition

<table>
<thead>
<tr>
<th></th>
<th>H</th>
<th>O</th>
<th>N</th>
<th>Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HTPR</strong>&lt;br&gt;(Honda Titanium Plate Refine)</td>
<td>0.013 max</td>
<td>0.10 max</td>
<td>0.020 max</td>
<td>0.52 max</td>
</tr>
<tr>
<td><strong>JIS</strong>&lt;br&gt;Class 2</td>
<td>0.013 max</td>
<td>0.20 max</td>
<td>0.050 max</td>
<td>0.25 max</td>
</tr>
</tbody>
</table>

**Ti:** Bal
### Mechanical Property

<table>
<thead>
<tr>
<th></th>
<th>TS (MPa)</th>
<th>0.2%PS (MPa)</th>
<th>El (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HTPR</strong></td>
<td>340 ~ 550</td>
<td>215 ~ 450</td>
<td>≥23</td>
</tr>
<tr>
<td><em>(Honda Titanium Plate Refine)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>JIS</strong></td>
<td>340 ~ 510</td>
<td>≥215</td>
<td>≥23</td>
</tr>
<tr>
<td><strong>Class 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- HTPR: High Temp Plate Refine
- JIS: Japan Industrial Standard
Example of Application

Exhaust system
Contents

1. Introduction

2. Development of titanium parts for motorcycles

3. Trend of titanium parts for the future

4. Conclusion
Positioning of Titanium materials

General-purpose domain
- Corrosion resistance materials
- Exhaust pipe Muffler

Direction of low cost
- CP off grade materials

Direction of development
- JIS class1
- JIS class2
- JIS class3
- Pure titanium
- Ti64 off grade materials

Direction of high strength
- Ti 64A
- 3Al 2.5V
- Ti 64
- Ti 6242S
- Ti 6246

Special alloy
- Ti - Zr - Ta - Nb
- ELI

Cryogenic materials
- Living body materials

Function domain

Mass production domain
- Con-rod IN / EX valve valve lifter
- Spring retainer

High strength domain
Contents

1. Introduction

2. Development of titanium parts for motorcycles

3. Trend of titanium parts for the future

4. Conclusion
Conclusion

I Reduction of material cost

II Improvement in infrastructure for processing

III Shortening of material lead-time
Thank you very much