High end stainless steel and nickel alloy seamless tubes for extremely demanding applications

12th International Stainless & Special Steel Summit
5th of September 2013

Nippon Steel and Sumitomo Metal Corporation (NSSMC)
Agenda

1. Overview of NSSMC
2. Global market of seamless stainless tube
3. NSSMC’s Seamless stainless tubular product
4. Strengths and characteristics of NSSMC as an integrated stainless tube manufacturer
5. Summary and Outlook
New Logo of Nippon Steel and Sumitomo Metal Corporation (NSSMC)

The central triangle in the logo represents a blast furnace and the people who create steel. It symbolizes steel, indispensable to the advancement of civilization, brightening all corners of the world. The center point can be viewed as a summit, reflecting our strong will to become the world’s leading steelmaker. It can also be viewed as depth, with the vanishing point representing the unlimited future potential of steel as a material. The cobalt blue and sky blue color palette represents innovation and reliability.
History

1857
The first western-style blast furnace allocated in Kamaishi, Japan is commissioned
   - Origin of Nippon Steel

1897
Sumitomo Cupper Plant (The first private company in Japan that started manufacturing cold-drawn seamless steel pipes.) established
   - Origin of Sumitomo Metals

1935
Sumitomo Metal Industries, Ltd. (SMI) is established

1963
Yawata Steel and Fuji Steel merge to form Nippon Steel Corporation (NSC)

2012
NSC and SMI merge to establish Nippon Steel & Sumitomo Metal Corporation.
Overview of Nippon Steel & Sumitomo Metal Corporation after merger

Nippon Steel and Sumitomo Metals integrated to Nippon Steel & Sumitomo Metal Corporation (NSSMC) on October 1st, 2012.

Aim to be the best steel maker with world-leading technologies and global network

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NSSMC Business Segments

A major global player with advanced technologies and superior services, especially in energy sector i.e. power generation and oil & gas development.
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5. Summary
Global Market Position of NSSMC
Seamless Stainless Tubes and Pipes – Global Share

Market Shares of Top 10 Producers on Value Basis 2012
(Total = EUR 4.2 billion, average price = EUR 8,795/t)

(Source SMR)
Global Market position of NSSMC Stainless tubes

NSSMC’s leading position in CF (cold finished) seamless tube & pipe

(Source SMR)
Global Market Position of NSSMC

NSSMC is the largest manufacturer of Ni Alloy tube & pipe of which majority is OCTG

(Source SMR)
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Applications of high end stainless steel and Ni-alloy seamless tube

Thermal Power

Nuclear Power

Petroleum and Chemical

Oil & Gas - OCTG & Umbilical

Reliable supplier of high quality stainless tubes for demanding applications
NSSMC Seamless Stainless Steel Production base

Amagasaki
High-end tubes & pipes for demanding energy applications

Hikari
Standard grade tubes & pipes (+Stainless shapes)

Wakayama
Standard grade pipes
Production facilities and capacity

<table>
<thead>
<tr>
<th>Production method</th>
<th>No. of units</th>
<th>Location of mills</th>
<th>Production capacity (tons/year)</th>
<th>Available production size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40 80 120 160 200</td>
<td>300 400 500 1000</td>
</tr>
<tr>
<td>(Hot finish)</td>
<td>1</td>
<td>Hikari Pipe &amp; tube</td>
<td>34.0 175.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Division</td>
<td>6.0 168.3</td>
<td></td>
</tr>
<tr>
<td>Ugine-Sejournet process</td>
<td>1</td>
<td>Amagasaki Works</td>
<td>36.0 275</td>
<td></td>
</tr>
<tr>
<td>(Cold finish)</td>
<td></td>
<td></td>
<td>6.0 219.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Hot finish)</td>
<td>1</td>
<td>Amagasaki Works</td>
<td>165.2 952.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>168.3 426.0</td>
<td></td>
</tr>
<tr>
<td>Ehrhardt Push Bench process</td>
<td>1</td>
<td>Amagasaki Works</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Cold finish)</td>
<td></td>
<td></td>
<td>219.1 508</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Wakayama Works</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mannesmann mandrel mill process</td>
<td></td>
<td></td>
<td>31.8 141.3</td>
<td></td>
</tr>
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</tr>
</tbody>
</table>

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Seamless tube Product mix in Amagasaki works

- **POWER**
  - 35%

- **Petrochem & Mechan.**
  - 21%

- **Oil & Gas**
  - 44%

- **FY2012 % of Sales**
  - Steel Tube Works

- **OCTG Umbilicals for Deep Offshore Development**

- Coal fired power plants (USC, SC)
- Nuclear power plants
- Biomass power plants
- Coal gasification plants

- Ethylene plant
- Urea plant
- GTL plant (Gas to Liquids)
Austenitic Stainless Steels and Ni based alloy for coal fired power plants

Original steel grades, SUPER304H®, TP347HFG, and HR3C have been registered according to major world standards.

Over 120,000 metric tons of tubes have been produced by NSSMC, and have been used in twenty-two USC power plant boilers in Japan, as well as in more than 200 boilers outside Japan.

Ni based alloys, HR6W and Alloy617, are available for Advanced USC boilers which is designed with 700 degree C steam temperature.

<table>
<thead>
<tr>
<th>Material Grade</th>
<th>Chemical composition</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPER304H®</td>
<td>18Cr-9Ni-3Cu-Nb-N</td>
<td>High strength and fine grained 18Cr-8Ni steel</td>
</tr>
<tr>
<td>TP347HFG</td>
<td>18Cr-11Ni-0.6Nb</td>
<td></td>
</tr>
<tr>
<td>HR3C</td>
<td>25Cr-20Ni-Nb-N</td>
<td>High strength and high corrosion resistance 25Cr-20Ni steel</td>
</tr>
<tr>
<td>HR6W</td>
<td>23Cr-45Ni-8W-Ti-Nb</td>
<td></td>
</tr>
<tr>
<td>Alloy617</td>
<td>22Cr-54Ni-9Mo-12.5Co-Al</td>
<td>High strength Ni based alloy</td>
</tr>
</tbody>
</table>
Austenitic Stainless Steels for biomass power plants

Biomass power generation will be one of the most hopeful methods to reduce carbon dioxide emissions in the future.

Fluidized Bed (BFB) and Circulating Fluidized Bed (CFB) boilers are widely used to utilize biomass fuels.

HR3C has been mainly used in BFB boilers, which use as high a ratio of biomass as fuel. TP347HFG and SUPER304H® are extensively used not only for BFB boilers but also in co-fired coal biomass CFB boilers.

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<td></td>
</tr>
<tr>
<td>HR3C</td>
<td>25Cr-20Ni-Nb-N</td>
<td>High strength and high corrosion resistance 25Cr-20Ni steel</td>
</tr>
</tbody>
</table>
# High-Alloy OCTG for Oil & Gas Upstream

**<Material applications for critical well conditions>**

<table>
<thead>
<tr>
<th>CO2</th>
<th>H2S</th>
<th>Temperature</th>
<th>Grade</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;0.2 bar</td>
<td>&gt;0.1bar</td>
<td>≤232°C</td>
<td>SMC276(16%Mo)</td>
<td>Nickel Alloy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤204°C</td>
<td>SM2050(11%Mo)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤177°C</td>
<td>SM2535(6%Mo)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤149°C</td>
<td>SM2535(3%Mo),SM2242(3%Mo)</td>
<td></td>
</tr>
<tr>
<td>≤0.1bar</td>
<td></td>
<td>≤250°C</td>
<td>SM25CRW, SM25CR</td>
<td>Duplex Stainless</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤200°C</td>
<td>SM22CR</td>
<td></td>
</tr>
<tr>
<td>≤0.03bar</td>
<td></td>
<td>≤200°C</td>
<td>SM17CRS</td>
<td>Martensitic-Ferritic Stainless</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤180°C</td>
<td>SM13CRS</td>
<td></td>
</tr>
<tr>
<td>≤0.003bar</td>
<td></td>
<td>≤180°C</td>
<td>SM13CRM</td>
<td>Martensitic Stainless</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤150°C</td>
<td>SM13CR</td>
<td></td>
</tr>
<tr>
<td>≤0.2bar</td>
<td>&gt;0.003bar</td>
<td></td>
<td>Sour Service &amp; High Collapse</td>
<td>Sour Service Carbon</td>
</tr>
<tr>
<td>≤0.003bar</td>
<td></td>
<td></td>
<td>High Collapse, High Strength, Arctic</td>
<td>Non Sour Carbon</td>
</tr>
</tbody>
</table>
Stainless Steels and Ni alloys for Chemical Industries

- All common stainless steel grades are available.

<table>
<thead>
<tr>
<th>Type</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austenitic</td>
<td>304, 304L, 316, 316L, 321, 321H, 347, 347H, 310, ⋅⋅⋅</td>
</tr>
<tr>
<td>Martensitic / Ferritic</td>
<td>405, 410, 430, 444, 446, ⋅⋅⋅</td>
</tr>
</tbody>
</table>

- Various high end alloys for critical conditions are also available.

<table>
<thead>
<tr>
<th>Type</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplex SS</td>
<td>22Cr (S31803, S32205), 25Cr (S31260, S32750), ⋅⋅⋅</td>
</tr>
<tr>
<td>High Ni alloy</td>
<td>Alloy 800/800H, 904L, 28, 20, 825, 254, ⋅⋅⋅</td>
</tr>
<tr>
<td>Ni-based alloy</td>
<td>Alloy 600, 601, 625, 690, 22, 276, 200/201, ⋅⋅⋅</td>
</tr>
</tbody>
</table>

- Wide available size rage to meet various tubing and piping system.
Stainless Steels and Ni alloys for Chemical Industries

Many original grades had been developed to resist critical environments.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Resistance to</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Austenitic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>347AP</td>
<td>Polythionic acid stress corrosion cracking w/o PWHT</td>
<td>Furnace tubes for petroleum refining plants</td>
</tr>
<tr>
<td>(18Cr-11Ni-0.2Nb)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Duplex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP3W</td>
<td>Chloride containing solution (e.g. Seawater)</td>
<td>Umbilical tubes and seawater heat exchanger tubes</td>
</tr>
<tr>
<td>(25Cr-7Ni-3.2Mo-2W-N)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP28W&lt;sup&gt;TM&lt;/sup&gt;</td>
<td>Urea corrosion and stress corrosion crack</td>
<td>Urea reactor tubes for urea plants</td>
</tr>
<tr>
<td>(27.5Cr-7.7Ni-2.2W-Mo-N)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High Ni</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HK4M</td>
<td>Carburization and oxidation Creep failure (high temperature strength: 700 to 1100℃)</td>
<td>Cracking tubes for ethylene plants Furnace pipes for hydrogen refineries</td>
</tr>
<tr>
<td>(25Cr-25Ni)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade HPM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(25Cr-38Ni-Mo-Si)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ni-based</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>845</td>
<td>Pitting corrosion and acid (Sulfuric, hydrochloric, etc)</td>
<td>Heat exchanger tubes for chemical industry, and highly corrosion resistant pipes</td>
</tr>
<tr>
<td>(22.5Cr-47Ni-3Cu-6Mo-3.5W)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>696</td>
<td>Metal dusting corrosion, carburization, and high-temperature strength</td>
<td>Heating furnace pipes for synthetic gas plants, high-temperature pipes for direct reduction iron plants</td>
</tr>
<tr>
<td>(25Cr-7Ni-3.2Mo-2W-N)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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1. Overview of NSSMC
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5. Summary
NSSMC’s Characteristics
Seamless tube manufacturer

- Integrated production system - from melting to shipment
  TOTAL QUALITY CONTROL

- Solid basis of technical development
  RESEARCH & DEVELOPMENT

- Global support and service network
  CUSTOMER SERVICE
Integrated Steel Manufacturing Production Process

Total Quality Control – from steel making to final product inspection
NSSMC Research & Development

Technical Research & Development Bureau

- Technical Research & Development Planning Division
- Steel Research Laboratories
- Advanced Technology Research Laboratories
- Process Research Laboratories
- R&D Labs at Steelworks

Map showing locations such as Amagasaki R&D Center, Hasaki R&D Center, Muroran R&D Lab, and others.
Overseas offices – Service Network
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Summary and Outlook

Energy development in the world could move into various directions. High-end seamless stainless demand is expected to increase accordingly.

NSSMC’s accumulated experiences, wide range of product lineups and advanced technology can cope with variety of customer requirements.

Power Development

Clean Energy

Higher efficiency
Clean Energy

Renewable Energy

Biomass CFB/BFB

USC material application

Coal fired

Solar Power

Ni based alloy development

Gas fired

Advanced-USC

Composite tubes

Nuclear Power

IGCC

USC material application

HRSG

Steam Generator Tubes
Summary and Outlook

Accumulated experiences and supply record of USC materials for various demand of Clean Energy applications

Fossil Fuel  ←  Energy development  →  Clean Energy

High NiAlloy ↑

Material Grade ↓

Carbon

Advanced USC
HR6W, Alloy617

USC
SUPER304H
TP347HFG
HR3C

HRSG
SUPER304H

Biomass CFB/BFB
SUPER304H
TP347HFG
HR3C

IGCC
Composite tubes

SOLAR: CSP
HR6W, Alloy617

Accumulated experiences and supply record of USC materials for various demand of Clean Energy applications

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Thank you for your attention.

For further information, please visit our website:

www.tubular.nssmc.com