A FLEXIBLE ROLLING CONCEPT FOR EFFICIENT AND COMPETITIVE PLATES AND COILS PRODUCTION

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Executive Vice President
Danieli Wean United
SUMMARY

DANIELI INNOVACTION:

1) WIDE PLATE & STECKEL MILL
2) PLATE / STECKEL MILL
3) JIANGYING XINGCHENG 3500 mm - P.R. OF CHINA
4) EVOLUTION OF HIGH STRENGTH PLATES
5) DANIELI AUTOMATION
6) CONCLUSIONS
PLATE / STECKEL MILL

CONTINUOUS PROCESS
✓ Meltshop
✓ Medium/Thin Slab Caster
✓ Hot/Cold charge in the WB furnace
✓ Steckel mill rolling
✓ Down-coiler for coiled plates
✓ In-line plate finishing facilities

ADVANTAGES
✓ Energy saving through hot charge
✓ Higher rolling temperature
✓ Reduced number of rolling passes
✓ No need of a roughing stand
✓ Lower rolling power
✓ Thinner final gauges
✓ Tighter geometrical tolerances
PLATE MILL PRODUCTION

WIDE PLATE MILL

✓ Production of wide discrete plates
✓ Heavy plate thickness (>200 mm)
✓ Multipiece rolling with 6 slabs
✓ Production of up to API X120 grade
✓ Increased as rolled strength
✓ Cross rolling strategy required

PLATE & STECKEL

✓ Production of discrete plates & coiled plates
✓ Up to 90% of hot charge
✓ Heavy wide slab: up to 70 t
✓ Pipe grades up to API X80 (coils and plates)
✓ Production of jumbo coils (25 x 3,250 mm)
✓ Final plate width = entry slab width
PLANT REFERENCE PRODUCTION 1.3 Mt/y

WIDE PLATE MILL

Yield: 92% - 94%
Max plate width: 5.2 m
Thickness tolerance (light gauges): 60µm
Plant area: 230,000 m²
Man power: 260

PLATE & STECKEL

Yield: 94%
Max plate width: 3.25 m
Thickness tolerance (light gauges): 40µm
Plant area: 110,000 m²
Man power: 180
High-strength steel production via accelerated cooling and direct quenching
### SLABS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>150 ÷ 200 mm</td>
</tr>
<tr>
<td>Width</td>
<td>1,500 ÷ 3,250 mm</td>
</tr>
<tr>
<td>Length</td>
<td>6,000 ÷ 15,000 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>up to 70 t</td>
</tr>
</tbody>
</table>

### COILS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>2.5 ÷ 25.4 mm</td>
</tr>
<tr>
<td>Width</td>
<td>1,500 ÷ 3,000 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>up to 53 tons</td>
</tr>
</tbody>
</table>

### FINISHED PLATES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>4.5 ÷ 50 mm</td>
</tr>
<tr>
<td>Width</td>
<td>1,500 ÷ 3,250 mm</td>
</tr>
<tr>
<td>Length</td>
<td>3,000 ÷ 18,000 mm</td>
</tr>
</tbody>
</table>
Between February and May 2008, JiangYin XingCheng Iron & Steel Co. has awarded two New Plate Mills to Danieli.

- **ONE 3,500 PLATE & STECKEL MILL**
- **ONE 4,300 WIDE PLATE MILL**

JYXC, a leading producer of special steel long products, has now entered into the flat product market with an overall capacity of the two Mills exceeding 2.9 Mtpy of wide plates and coils.
JYXC 3500 mm Plate & Steckel Mill: rolled first plate on 28th April 2010
1 Slab water descaler
2 Entry/Exit Steckel furnace
3 Reversing rolling stand with vertical edger
4 Drum flying shear
5 Cooling section
6 Downcoiler and coil conveyor line
7 Hot plate leveler
8 Cooling beds
9 Double side trimming shear disk type
10 Dividing shear rocking type
11 Cold leveler
12 Finished plate handling facility
FINISHING MILL

FEATURES
✓ Four High Mill
✓ Mae west type mid-housing blocks blocks for positive work roll bending
✓ HAGC hydraulic force cylinders in bottom mill window
✓ Top backup balance

TECHNICAL DATA
✓ Separating Force: 80000 kN
✓ Work Roll Diameter: 940 mm
✓ Work Roll Barrel Length: 3750 mm
✓ BUR Diameter: 1950 mm
✓ BUR Barrel Length: 3450 mm
✓ WR Bending: 2500 kN
✓ Main Drive: 2 x 8000 kW
CONTINUOUS SLAB CASTER

- X70 - Low Carbon HSLA
- Soft reduction: LPC
- Solid fraction @ Soft reduction: 70%
- Casting speed: 1.0 m/min
- Tundish temp.: 1536-1547 ºC
- Surface quality: free of crack
- Result: Mannesman class 1

ROLLING MILL

- X70 - Low Carbon HSLA
- Rolling temp. first stage: 1095 ºC
- Rolling temp. second stage: 870 ºC
- Mill exit temp: 780 ºC
- Ultimate tensile strength: 620 Mpa
- Yields strength: 530 Mpa
- 4 months after start-up
X80 - Pipe line steel
Rolling temp. first stage: 1030 °C
Rolling temp. second stage: 900 °C
Waiting thickness: 3.5H
Mill exit temp: 800 °C
Ultimate tensile strength: 680 Mpa
Yields strength: 600 Mpa
DWTT: 80~95%
12 months after start-up
PRODUCTION DATA AND QUALITY REPORT OF ALLOY TOOL STEEL

- P20CH - Alloy tool steel
- Charge temp.: ≥300 C
- Rolling temp. first stage: 1050 C
- Rolling temp. second stage: 920 C
- Mill exit temp: 880 C
- Ultrasonic testing: GB/T2970 II
- Heat treatment: Q+T  N+T
- Flame cutting tem.: ≥100 C
- 11 months after start-up

<table>
<thead>
<tr>
<th>Product</th>
<th>Minimum hardness of surface</th>
<th>Maximum hardness of surface</th>
<th>Minimum hardness of center</th>
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</thead>
<tbody>
<tr>
<td>P20CH</td>
<td>30HRC</td>
<td>36HRC</td>
<td>28HRC</td>
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</table>
MECHANICAL PROPERTIES OF 12MnNiVR HEAVY PLATE

<table>
<thead>
<tr>
<th>Thickness</th>
<th>YS</th>
<th>TS</th>
<th>EL</th>
<th>vE(J) at -20°C</th>
<th>vE(J) at -40°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>570</td>
<td>655</td>
<td>20</td>
<td>277/301/277</td>
<td>284/250/246</td>
</tr>
<tr>
<td>20</td>
<td>645</td>
<td>710</td>
<td>22</td>
<td>246/225/243</td>
<td>243/183/163</td>
</tr>
<tr>
<td>39</td>
<td>650</td>
<td>705</td>
<td>21</td>
<td>249/243/256</td>
<td>188/265/256</td>
</tr>
<tr>
<td>65</td>
<td>570</td>
<td>665</td>
<td>24</td>
<td>290/285/290</td>
<td>228/205/236</td>
</tr>
</tbody>
</table>

- 12MnNiVR PRESSURE VESSELS
- Rolling temp. first stage: 1030 °C
- Rolling temp. second stage: 900 °C
- Mill exit temp: 800 °C
- ACC, final temp.: 630°C
- Heat treatment: Q+T
- 12 months after start-up
Plate Quality Model main features:

- **YS** Real-time mechanical properties monitor for Quenched & Tempered Plates
- **UTS** Monitor over the length, across the width, and through the thickness
- **HV** Metallurgical model suite and materials properties database
**BENEFITS**
- Reduction in Process Design
- Better control on quality of Q&T plates
- Reduction in sampling
- Reduced time to customer

**ACCURACY**

<table>
<thead>
<tr>
<th>Property</th>
<th>± Value</th>
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</thead>
<tbody>
<tr>
<td>UTS</td>
<td>27.0 MPa</td>
</tr>
<tr>
<td>YS</td>
<td>27.0 MPa</td>
</tr>
<tr>
<td>HV</td>
<td>16</td>
</tr>
</tbody>
</table>
✓ State-of-the-art technological and dimensional controls
✓ Fast response
✓ User friendly-design
AUTOMATION - L2 CONTROL SYSTEMS

- Process-oriented models
- Production Management
- Quality Monitor in real time
- Reporting systems
High-Strength plates and cooling systems and advanced equipment.

Flexible production:
Plate and coil production on demand.

Improved **yield & quality**
Key factor for any competitive production.