New PW Coke Oven Batteries 2A & 2B for JFE Steel Corporation at Kurashiki Plant

BY

A. Esposito, Head of Business Unit Coke, Paul Wurth Italia S.p.A. - Italy
M. Bisogno, Engineering Head Coke Oven Battery, Paul Wurth Italia S.p.A. - Italy
F. Strobino, Managing Director, Paul Wurth IHI Co. Ltd., - Japan

Keywords:
coke oven, top charging technology, pad-up reconstruction

Presenter: F. Strobino, Paul Wurth IHI, Japan
Summary

1 Introduction

2 Project Highlights
   - Project Constraints
   - Project Time Schedule

3 Technological Improvements
   - Heating and Combustion System
   - PW Design Tools – Combustion System
   - Bracing System
   - PW Design Tools – Bracing System
   - Refractory
   - PW Design Tools – Refractory
Paul Wurth Group: Global Player

- About **1,630** highly-qualified staff
- **26 Group members** in 17 countries, including 20 operational entities
- **Joint ventures**: TMT, Paul Wurth-IHI, P&A Industrial Engineering, Paul Wurth Kovrov
- Other countries covered by **Representations**
Summary

1 Introduction

2 Project Highlights

• Project Constraints
• Project Time Schedule

3 Technological Improvements

• Heating and Combustion System
• PW Design Tools – Combustion System
• Bracing System
• PW Design Tools – Bracing System
• Refractory
• PW Design Tools – Refractory
PW and PW-IHI have realized the New Top Charging Coke Ovens Batteries 2A and 2B for JFE Steel Corporation plant located in Kurashiki, Japan

Project includes:

- Engineering
- Procurement
- Erection Supervision
- Heating-up
- Commissioning

**COKE OVEN BATTERIES 2A & 2B**

**OVEN PARAMETERS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oven Height</td>
<td>6,55 m</td>
</tr>
<tr>
<td>Oven Length</td>
<td>15,05 m</td>
</tr>
<tr>
<td>Oven Width</td>
<td>0,423 m</td>
</tr>
<tr>
<td>Useful Volume</td>
<td>39,79 m³</td>
</tr>
<tr>
<td>Oven pitch</td>
<td>1,375 m</td>
</tr>
</tbody>
</table>

**COKE PLANT**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coke Production</td>
<td>0,976 Mt/y</td>
</tr>
<tr>
<td>Batteries 2A &amp; 2B</td>
<td>86 ovens</td>
</tr>
</tbody>
</table>
Pad-up of new Batteries 2A & 2B (43 + 43 ovens) in line with the existing batteries

New Batteries 2A & 2B built in the same place as the old-ones
  • Reuse of the existing stack and waste gas channel
  • Reuse of existing civil foundation, pinion wall and end-platforms

New Batteries in Line with the existing-ones
  • Constraints of existing old batteries
  • Same set of operating machines
## Project Time Schedule

<table>
<thead>
<tr>
<th>DEMOLITION</th>
<th>CIVIL WORKS</th>
<th>BUKSTAY &amp; WPP ERECTION</th>
<th>REFRACTORY ERECTION</th>
<th>HEATING-UP</th>
<th>FIRST COKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; month</td>
<td>9&lt;sup&gt;th&lt;/sup&gt; month</td>
<td>12&lt;sup&gt;th&lt;/sup&gt; month</td>
<td>14&lt;sup&gt;th&lt;/sup&gt; month</td>
<td>23&lt;sup&gt;rd&lt;/sup&gt; month</td>
<td>26&lt;sup&gt;th&lt;/sup&gt; month</td>
</tr>
</tbody>
</table>

**Summary:**
- **2015 DEMOLITION:** 4<sup>th</sup> month
- **2016 CIVIL WORKS:** 9<sup>th</sup> month
- **2016 BUKSTAY & WPP ERECTION:** 12<sup>th</sup> month
- **2016 REFRACTORY ERECTION:** 14<sup>th</sup> month
- **2017 HEATING-UP:** 23<sup>rd</sup> month
- **2017 FIRST COKE:** 26<sup>th</sup> month

**Image Description:**
- SEAISI 2017 – New PW Coke Oven Batteries 2A & 2B at JFE Kurashiki
Summary

1 Introduction

2 Project Highlights

- Project Constraints
- Project Time Schedule

3 Technological Improvements

- Heating and Combustion System
- PW Design Tools – Combustion System
- Bracing System
- PW Design Tools – Bracing System
- Refractory
- PW Design Tools – Refractory
PW has introduced in the new COB 2A & 2B all the latest technological solutions, with the final result of having in the same place two new State-of-The-Art Coke Oven batteries

- New Batteries Twin Flue design instead of Half Divided
- Optimized Combustion (emission and consumption reduction)
- Bracing System Taylor Made
- Heating-wall Stability Increased
TARGET
Gas Consumption minimization
NOx minimization
Constant Coke quality

HEATING WALL CONFIGURATION
• Twin-flue
  ✓ Waste gas recirculation
  ✓ 1 Level for Air Staggering

SOLE CHANNEL CONFIGURATION
• Symmetrical

HEATING GAS
• Compound (COG & MG)

COG FEEDING
• Under-jet
COMBUSTION MODELLING:
Combustion diagnosis of Existing Batteries
Combustion optimization in Pad-up project
Turn over point optimisation based on coke shrinkage

PW in house developed tool for heating flue combustion based on fluent CFD modelling:
• 3D Temperature profile of complete heating flues
• Air, Gas and Waste gas mixing
• NOx formation
• Unburned Gas concentrations
REGENERATOR MODELLING:
Waste gas thermal loss optimization in Pad-up and Hot-Repair/Re-checkering projects

PW in house developed tool for regenerator and checker brick optimization:
• Proper sizing of regenerator height
• Definition of regenerator wall fireclay-silica sliding joint position
• Increased regenerator efficiency by improved checker design
**TARGET**
Increase the battery life preserving refractory brickwork:
- No Tensile stress in refractory bricks
- No Leakage between oven and heating wall

**Bracing System Configuration**
Optimized solution taking into considerations plant constraints:
- Existing Oven and Heating wall width
- Interface with existing Machines

PW Top Charging force distribution for mid-size oven along heating wall 45 kN/m
**BRACING MODELLING:**

Bracing design optimization for Pad-up and hot repair projects introducing state of the art solution

Bracing force distribution defined according to battery type and heating wall design

In house developed tool for bracing system based on ANSYS modelling

FEM analysis on heating wall head, wall protection plate and door frame under thermal and mechanical loads

- Wall protection plate and door frame deformation to ensure the correct force transmission to refractory brickwork
- Wall protection plate and door frame stress to ensure equipment long life
TARGET

Strongest Heating Wall Refractory Design:

• Liner/Binder fixed Joints with Internal Hammer Head

• Tongue and Groove bricks connection between liner & binder and between different layers

• Combination in odd & even layers of different internal hammer heads creating proper liner overlapping to increase strength and gas tightness

• Thermal Shock Resistant bricks on oven contour
REFRACTORY DESIGN MODELLING:
In house developed tool for coke oven battery refractory design based on 3D modelling software:
• Automatic brick interference check
• Automatic bill of quantity generation
• Complete battery assembly avoiding brick assembly on workshop/site
Thank you for the attention!

SEAISI 2017 – New PW Coke Oven Batteries 2A & 2B at JFE Kurashiki
Contacts

Dr. Ing. Fabrizio Strobino, Paul Wurth IHI Co., Ltd.

Phone: +81-3-6630-4787
Fax: +81-3-3536-4014
Mobile: +81-80-1280-7857
e-mail: fabrizio_strobino@ihi-pw.jp

Paul Wurth International S.A.
Taiwan Branch
Kaohsiung, TAIWAN
Phone: +886 7 33 93 309
pwtaiwain@paulwurth.com

Paul Wurth IHI Co., Ltd.
Toyosu Center Building,
3-3, Toyosu 3-chome, Koto-ku,
Tokyo 135-6009 Japan
Phone: +81-3-6630-4786
contact@ihi-pw.jp

Paul Wurth Italia S.p.A.
Via di Francia 1, Genova I-16149, ITALY
Phone: +39 010 640 91
pwit@paulwurth.com