Regenerative Burner
(High Efficient Combustion Technology)
as Energy Saving in Indian Steel Mills

April 29, 2015
New Delhi, India

CHUGAI RO CO., LTD.

Presenter: Masashi Imajo
Content

◆ Chugai Ro Profile

◆ Background
  Q : Why did Japan develop High Efficient Combustion Technology ?
  Q : How did Japan develop Regenerative Burner ?

◆ Outline of Regenerative Burner System

◆ Ongoing Demonstration Project in India
Chugai Ro Co., Ltd. Profile
(as of March, 2014)

Established: 1945

Head Office: Osaka, Japan

Capital: INR 325 Crore (JPYen 6,176 Mil @ ¥1.9/INR)

Annual Turnover: INR 1,422 Crore (JP Yen 27,016 mil @ ¥1.9/INR)

Employees: 470 (including 330 engineers)
Products of Chugai Ro

- Walking Beam Type Reheating Furnace
- Continuous Galvanizing Line
- Heat Treatment Furnace
- Various kinds of Burner

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18% of energy consumption in Japan is being used in the industrial furnaces.

(= Approx. 40% of whole industrial segment in Japan.)

With the conventional combustion technology, the effective heat for the industrial furnace was just 35%.

(= 65% of energy in the furnace was being wasted to the air with waste gases.)

As Japan, does not have enough fossil fuel in the country, this was not only big issue for energy saving but also a question about global warming in the world.

With this back ground, METI and NEDO started to work with Japanese Steel Mills and Industrial Furnace Suppliers to develop High Efficient Furnace in 1990’s.
Background (History of Regenerative Burner)

1980s
- Original Regenerative Burner was developed in UK
- Large NOx emission?

1990
- Innovative combustion theory was discovered in Japan
- NOx emission vs Utilization of combustion preheated air in high temp. area
- Dilemma??

1993 ~ 1999
- Combustion in high temp air combustion to reduce NOx
- Development High Efficient Furnace
- Dilemma was solved

1998 ~ 2000
- METI designated NEDO to implement …
- Field test of RCB
- - JFE Steel
- - NSSMC
- - Chugai Ro
- - Others

~ 2015
- Proven Regenerative Burner in the market
- More than 300 patents granted each other
- Resulted in
  - • 30% energy saving
  - • 50% NOx emission cut off
Outline of Regenerative Burner
### Difference in heat recovery between Conventional type and Regenerative Burner

<table>
<thead>
<tr>
<th>Combustion Air preheat by</th>
<th>Recuperator (Conventional Burner)</th>
<th>Regenerator (Regenerative Burner System)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion air temperature (@ Burner)</td>
<td>450°C</td>
<td>1150°C (90% of WG temp.)</td>
</tr>
<tr>
<td>Fuel saving rate</td>
<td>20% (@ 450°C Combustion Air temp)</td>
<td>50% (@ 1150°C Combustion Air temp)</td>
</tr>
</tbody>
</table>
Composition of RCB

- Fuel Change Valve "OPEN"
- Fuel Change Valve "CLOSE"
- Air Change Valve "OPEN"
- Air Change Valve "CLOSE"
- W.G Change Valve "CLOSE" →
- W.G Change Valve "OPEN" ←
- W.G Flow Valve "OPEN"
- Induced Draft Fan "OPERATING"
- Air Flow Valve "OPEN"
- Combustion Air Blower "OPERATING"

Outline of Regenerative Burner

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Control Principle for RCB

1) While one of the burners “A” is working as combustion, the other burner “B” is working as an exhaust.

2) Burner (“B”): Waste heat of the gas is recovered in the regenerator in the process of exhaust.
   
   Regenerator plays the same role of recuperator in waste gas flue. (instead of conventional type heat recovery.)

3) Burner (“A”): Combustion air receives heat from the regenerator of the burners when burner “B” is being heat recovered in the process of exhaust at the same time.

4) When the preset cycle time passes, the burners exchange their roles of combustion and exhaust.

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After an internal (60 sec.)
Revamping Outline with RCB by NEDO model project

Case 1: Revamping with regenerative burner only 1 zone

<table>
<thead>
<tr>
<th>Zone</th>
<th>Energy Saving Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-firing</td>
<td>5 - 8%</td>
</tr>
<tr>
<td>Pre-heating</td>
<td></td>
</tr>
<tr>
<td>Heating</td>
<td>4 - 6%</td>
</tr>
<tr>
<td>Soaking</td>
<td>1%</td>
</tr>
</tbody>
</table>

Case 2: Revamping with regenerative burner all zone

<table>
<thead>
<tr>
<th>Zone</th>
<th>Energy Saving Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-firing</td>
<td></td>
</tr>
<tr>
<td>Pre-heating</td>
<td>10 - 15%</td>
</tr>
<tr>
<td>Heating</td>
<td>10 - 15%</td>
</tr>
<tr>
<td>Soaking</td>
<td></td>
</tr>
</tbody>
</table>

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Ongoing Demonstration Project in India

NEDO Project:
International Demonstration Projects for the Technologies and Systems such as **Energy Consumption Efficiency**

Project Name:
Demonstration Projects of **High Performance Industrial Furnace** (Republic of India)

**Phase 1:** Basic Feasibility Study (completed)

**Phase 2:** Feasibility Study prior to NEDO Model Project Implementation
(being in process now, talking with Indian candidates for further step)

**Phase 3:** NEDO Model Project Implementation

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Ongoing Demonstration Project in India

NEDO Model Project Scheme

1. Consignment supply of Regenerative burner system

2. Voluntary assignment of Regenerative burner system

3. Gratuitous conveyance with its conditions to be decided between MOS and USER

MOU

NEDO

CR

MOS

ID Contract

Model Project User

Provisional

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Advantages for User with NEDO Model Project

1) Free for Regenerative Burner to disseminate Regenerative Burner in India

2) Large Energy Saving by reducing fuel consumption

Obligations of NEDO Model Project User

1) Providing operational data for WBF with RCB system for sales promotion

2) Assistance for sales promotion for RCB System in Indian market with NEDO, MOS and CR