ENERGY SAVING TECHNOLOGIES FOR STEEL PLANTS

AT

INDIA-JAPAN BUSINESS FORUM FOR ENERGY EFFICIENCY, CONSERVATION AND RENEWABLE ENERGY

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2. DRY TYPE MULTI VESSEL ELECTROSTATIC PRECIPITATOR
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1. 2019 COMPANY PROFILE
Pursue synergies and Business developed from steelmaking.
2. DRY TYPE MULTI VESSEL ELECTROSTATIC PRECIPITATOR

Dry type Multi Vessel Electrostatic Precipitator system

[ Dry MVEP ]

in Blast Furnace Gas Cleaning Plant
LINEUP OF NSENGI SECONDARY GAS CLEANING SYSTEM AT BF

NSENGI deals with all products related to secondary GCP

- ① VS-VS
- ② VS - ESCS
- ③ Bag Filter system
- ④ Dry MVEP system

Secondary GCP at BF

- Wet type GCP
- Slit type
- ESP type
- Filter type

- Dry type GCP
- ESP type

※ TRT (Top pressure Recovery Turbine)
※ GCP (Gas Cleaning Plant)
※ ESCS™ (Electrostatic Space Cleaner Super)
※ ESP (Electrostatic Precipitator)
## Feature Comparison of Wet Type GCP with Dry Type GCP

<table>
<thead>
<tr>
<th></th>
<th>WET type GCP</th>
<th>DRY type GCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>A large amount of polluted water is generated.</td>
<td>“ZERO Liquid discharge” (Drastic reduction in water consumption)</td>
</tr>
<tr>
<td>Energy recovery</td>
<td>Energy recovery is low.</td>
<td>Energy recovery is high (TRT recovered electric energy is greatly up)</td>
</tr>
</tbody>
</table>

Dry type GCP becomes main stream because of Ecological Aspects
### Feature Comparison of Dry Bag Filter & Dry ESP

<table>
<thead>
<tr>
<th>Type</th>
<th>Bag Filter</th>
<th>Dry type GCP</th>
<th>ESP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Pals jet type Bag Filter system</td>
<td></td>
<td>Dry MVEP system</td>
</tr>
<tr>
<td>Operation</td>
<td>It is necessary to control the temperature of the blast furnace gas at the top spraying water.</td>
<td>No special precautions.</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Regular filter cloth replacement is necessary (High costs).</td>
<td>Normally only maintenance (regular visual inspection) etc.</td>
<td></td>
</tr>
<tr>
<td>Space</td>
<td>Wide Space is necessity.</td>
<td></td>
<td>Compact.</td>
</tr>
<tr>
<td>CAPEX and OPEX</td>
<td>The vessel is numerous (18 ~ 20 unit). Construction cost is high.</td>
<td></td>
<td>The dust collecting vessel is few (4 ~ 5). Weight is small.</td>
</tr>
</tbody>
</table>

Dry MVEP system is more cost competitive than Bag Filter.
## PERFORMANCE COMPARISON

<table>
<thead>
<tr>
<th>Type</th>
<th>Wet type GCP</th>
<th>Dry type GCP</th>
<th>MVEP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VS-VS</td>
<td>VS-ESP</td>
<td>Bag filter</td>
</tr>
<tr>
<td><strong>Figure</strong></td>
<td><img src="image" alt="Figure" /></td>
<td><img src="image" alt="Figure" /></td>
<td><img src="image" alt="Figure" /></td>
</tr>
<tr>
<td><strong>Pressure loss</strong></td>
<td>Poor (3000 mmAq)</td>
<td>Good (700 mmAq)</td>
<td>Good (1000 mmAq)</td>
</tr>
<tr>
<td><strong>Gas temp.</strong></td>
<td>Poor (80 degC)</td>
<td>Poor (80 degC)</td>
<td>Very Good (150 degC)</td>
</tr>
<tr>
<td><strong>Max Temp. constraint</strong></td>
<td>Good (350 degC for DC)</td>
<td>Good (350 degC for DC)</td>
<td>Poor (250 degC)</td>
</tr>
<tr>
<td><strong>TRT Power generation</strong></td>
<td>Poor (15 MWh)</td>
<td>Good (17 MWh)</td>
<td>Good (19 MWh)</td>
</tr>
<tr>
<td><strong>Abailability</strong></td>
<td>Very Good (100 %)</td>
<td>Very Good (100 %)</td>
<td>Poor (90 %)</td>
</tr>
<tr>
<td><strong>Electricity Generated</strong></td>
<td>Poor (127 GWh/year)</td>
<td>Good (143 GWh/year)</td>
<td>Very Good (152 GWh/year)</td>
</tr>
<tr>
<td><strong>Water consumption</strong></td>
<td>Poor (100 t/h)</td>
<td>Good (50 t/h)</td>
<td>Very Good (5 t/h (After TRT))</td>
</tr>
</tbody>
</table>

*) Calculation result at 3,800m³ BF
CONCLUSION

Dry GCP is better in Ecological aspect (no polluted water and higher energy recovery)

The reason why we propose the Dry MVEP system compared with bag filter

1. High operational stability
2. Easy maintenance (only regular visual inspection)
3. Saving the installation space
4. Low CAPEX and OPEX
The latest technology of CDQ (Coke Dry Quenching) System
As such a high temperature

OUTLINE OF CDQ

Cooling process of hot coke

- Water Quenching
  - CWQ (Coke Wet Quenching)
- Dry Quenching
  - CDQ (Coke Dry Quenching)

Cooling the hot coke with water / Non-heat-Recovery

Cooling the hot coke in a close space with inert gas:
  - Recover the heat to generate the electric Power
  - Reduce the emission of dust & gas.
OUTLINE OF CDQ

Electric Power Generation

- Charging Equipment
- Pre-Chamber
- Cooling Chamber
- Secondary Dust Catcher
- Blower
- Sub-Economizer
- Cooled Coke: 200°C

- Primary Dust Catcher
- Boiler
- Steam

- 1000°C
- 980°C
- 130°C
- 170°C
- Generator
ADVANTAGES OF CDQ

- Saving Energy
- CO₂ Reduction
- Environmental improvement
- Improvement of Productivity at BF
SAVING ENERGY & CO2 REDUCTION

CDQ 200t/h

Sensible heat of coke

CO2: Small amount

Electric Power 36MW

Heavy Oil Firing Boiler

Heavy oil approx. 12t/h

Fossil fuel

CO2: 36 t/h

CDQ Boiler

Steam

Electricity 36MW
ENVIRONMENTAL IMPROVEMENT

**CWQ**
(Coke Wet Quenching)

OPEN SYSTEM

Dust: 300~400 g/t-coke

**CDQ**
(Coke Dry Quenching)

CLOSED SYSTEM

Dust: Less than 3 g/t-coke
IMPROVEMENT OF PRODUCTIVITY AT BLAST FURNACE

Installation of CDQ

Quenching with inert gas

Waterless

Cooling gradually

Blast Furnace

※Actual result in NSSMC-group

Coke quality improvement

Moisture content of Coke

Nearly ZERO

Coke strength after CO$_2$ reaction (CSR)

2.5% UP

Drum Index (DI)

1.5% UP

Keeping the coke strength

Benefit of CDQ at Blast Furnace

Reduction of coke ratio

6 kg/t-pig iron

Increasing of bony coal (low quality coal) ratio of charging coal

Iron productivity limit

100 kg/t-pig iron

Injection limit of pulverized non-coking coal

8%
## TECHNOLOGY DEVELOPMENT HISTORY

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</thead>
<tbody>
<tr>
<td>Start</td>
<td>56</td>
<td>75</td>
<td>110</td>
<td>118</td>
<td>150</td>
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<tr>
<td></td>
<td>180</td>
<td>175</td>
<td>200</td>
<td>190</td>
<td>280</td>
</tr>
</tbody>
</table>

Profile:

- World’s largest CDQ 280t/h
THANK YOU