Fluidized Bed type CMC utilizing Coke Oven Exhaust Gas

CMC (Coal Moisture Control)

Nippon Steel & Sumikin Engineering Co., Ltd.
1. Introduce of CMC
   Outline and Process flow and Merits

2. CMC’s Drying Method
   Comparison of Drying Method

3. Fluidized Bed type CMC
   Nippon Steel & Sumikin Engineering’s FB type CMC and Chinese One

4. Experiment for Comparing two FB type CMC
   Drying Efficiency and Fluidized Bed Condition

5. Conclusion
Outline of CMC

Coal Blending

Bin

Existing Coal Transferring System

Wet Coal
Approx. 10% Moisture

CMC
(Coal Moisture Control)

Dry Coal
Approx. 6–7% Moisture

Drying Wet Coal and Reducing Coal Moisture
**CMC Process Flow**

- **Wet Coal** (Approx. 10%)
  - Heat
  - **Dryer**
  - **Bag Filter**

- **Coal Blending Machine**
  - **Coke Oven**
  - **Dry Coal** (Approx. 6–7%)
Global circumstances and Role of CMC

- Prevention of Global Warming
- Expanding Demand for Iron (in Asia)
- Expanding Demand for Coal (in Asia)

Needs

- Energy Saving
- Coke Production Increase
- Increase the Amount of Low-Quality Coal Usage

CMC can meet those needs.
Merits of CMC

Reference: Merit of Coke Oven Waste Heat-recovery type CMC
(Actual case of coke ovens in Japan when the moisture content is reduced by 4%)

- Energy Saving of Coke Oven
  (Approx. 340MJ/t-coal)

- Coke Quality Improvement
  ($D_{15}$: Approx. 1.7%)

- Coke Production Increase
  (Approx. 11%)

Fifth International Iron and Steel Congress (1986) p312
Comparison of Drying Method

STD (Steam Tube Dryer)

Wet coal → Air (Exhaust) → Dried coal

CIT (Coal in Tube)

Wet coal → Air (Exhaust) → Dried coal

FB (Fluidized Bed)

Exhaust gas + Fine Coal → Fluidized Bed → Coke oven exhaust gas

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## Comparison of Drying Method

<table>
<thead>
<tr>
<th>Type</th>
<th>STD</th>
<th>CIT</th>
<th>FB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying method</td>
<td>Multi-Tube · Steam Inside · Indirect Heat Transfer</td>
<td>Multi-Tube · Coal Inside · Indirect Heat Transfer</td>
<td>Fluidized Bed · Direct Heat Transfer</td>
</tr>
<tr>
<td>Heat resource</td>
<td>Steam</td>
<td>Steam</td>
<td>Coke Oven Exhaust Gas</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>Need External Heat Source</td>
<td>Need External Heat Source</td>
<td>Utilizing Waste Heat</td>
</tr>
<tr>
<td>Maintenance Cost</td>
<td>A lot of Machine Parts (Rotary Drum · Fatigue, Wear)</td>
<td>A lot of Machine Parts (Rotary Drum · Fatigue, Wear)</td>
<td>Box type Structure (Few Machine)</td>
</tr>
</tbody>
</table>

### Notes:
- **lowest cost** indicates the most cost-effective option.
Heat resource for drying coal is unnecessary.
2 Kinds of FB type CMC

- Nippon Steel & Sumikin Engineering’s FB: Drying coking coal after pulverization.
  - Coal → Pulverizer → Fluidized Bed Dryer → Coal

- Chinese FB: Drying coking coal before pulverization.
  - Coal → Fluidized Bed Dryer → Pulverizer → Coal

Differences (Depending on Grain size)
  - drying efficiency
  - fluidized condition
Drying Efficiency = \frac{(1) \text{Evaporative Latent Heat}}{(2) \text{Heat Value Required for Drying}}

Nippon Steel & Sumikin Engineering's FB is Suitable for CMC!
**Fluidized Bed Condition**

- **Large Particle**
  - High Temp.
  - Low Temp.

- **Small Particle**
  - Uniform Temp.

Different Type:
- Coal

- **Fluidized bed temperature (℃)**
  - 1.3mm
  - 5.34mm
  - 8.88mm
  - 13.24mm

- **Time (sec)**

Small Grain Size $\rightarrow$ Few Partial Overheat or Excess Drying

Nippon Steel & Sumikin Engineering’s FB is Suitable for CMC!
**Conclusion**

- **CMC have three merits.**
  1. Energy Saving of Coke Oven (Approx. 340MJ/t-coal)
  2. Coke Quality Improvement (DI\textsubscript{150}: Approx. 1.7%)
  3. Coke Production Increase (Approx. 11%)

- **Energy and maintenance cost is the lowest by drying Nippon Steel & Sumikin Engineering’s FB type CMC to compare to STD and CIT.**

- **Drying coal by FB dryer case,**
  
  Small Grain Size \[\leftrightarrow\] High Drying Efficiency
  
  Few Partial Overheat or Excess Drying

  So, drying after pulverization is suitable for FB dryer.
Thank you!

Nippon Steel & Sumikin Engineering Co. Ltd.