Dry Quenching of Coke & its Significance in SAIL

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JSPL, Raigarh

Introduction

Dry quenching of coke is a process which recovers sensible heat from hot coke by circulating inert gas.

The recovered heat is utilized in a Waste Heat Boiler to generate steam.

The generated steam is used for power generation or to drive loads which are directly connected to steam turbines such as exhausters, blowers etc.

A CDQ plant prevents quenching emissions associated with wet quenching.

A CDQ Plant reduces CO₂ emission associated with production of equivalent amount of power from a fuel fired boiler.
Cooling Chamber
Gas Circulating Fan
Boiler
Dust recovery facility
Coke bucket and carriage
Coke charging and discharging facility
Charging Crane
Deducting facility
Components of a CDQ Plant

A Typical CDQ Configuration

Lifting crane
Coke Bucket
Cooling Chamber
Boiler
Mill Fan
Impact of CDQ

Coke Quality
M10 value improved by 0.3 to 1.0%
Moisture content reduced to 0.2 to 0.5%

Environment
Savings in emission of CO₂ (approx. 130kg/t of coke) if the equivalent power is generated by burning fossil fuel.

Energy Recovery
Recovery of sensible heat from hot coke.
Around 12MW power generated from steam through fully condensing turbine for a 100tph capacity CDQ Plant.

Comparative analysis of COB with dry quenching Vs COB with wet quenching for 1.0Mtpa coal throughput

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameter</th>
<th>Tall battery with wet quenching</th>
<th>Tall battery with dry quenching</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Micum Indices</td>
<td>M10 – 8.0</td>
<td>M10 – 7.0</td>
<td>There will be a one point improvement in M10 with dry quenching which results in 2.5% increase in BF productivity and 2% reduction in coke rate.</td>
</tr>
<tr>
<td></td>
<td>Coke Price</td>
<td>20000</td>
<td>Rs/t</td>
<td>Considered for calculation purpose</td>
</tr>
<tr>
<td></td>
<td>Coke rate</td>
<td>400</td>
<td>kg/thm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2% reduction in coke rate</td>
<td>8</td>
<td>kg/thm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HM Production per day from the BF coke generated from a 7m COB</td>
<td>4436</td>
<td>t/day</td>
<td>Considering 350 working days in BF</td>
</tr>
<tr>
<td></td>
<td>Therefore, coke saving</td>
<td>35488</td>
<td>kg/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12420.8</td>
<td>t/y</td>
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<tr>
<td></td>
<td>Cost savings due to coke savings</td>
<td></td>
<td>248416000 Rs /y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Net margin /t of HM</td>
<td></td>
<td>24.84 Rs in Cr /y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increase in HM production in BF due to 1 point improvement in M10</td>
<td></td>
<td>3000 Rs /t (Assumption)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Therefore, increase in HM production</td>
<td></td>
<td>2.5 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Therefore, net margin from the incremental HM production</td>
<td></td>
<td>110.9 t /day</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>116445000 Rs /y</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.64 Rs in Cr /y</td>
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<tr>
<td>2</td>
<td>Coke Moisture</td>
<td>4-5%</td>
<td>&lt; 0.5%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Power generation</td>
<td>9.5 MW</td>
<td></td>
<td>Considering 4tph of steam requirement for 1MW and 3MW internal consumption in CDQ plant</td>
</tr>
<tr>
<td></td>
<td>No. of units per year</td>
<td>78660 MWh (1 unit = 1kWh)</td>
<td></td>
<td>Considering 345 working days per year for CDQ plant</td>
</tr>
<tr>
<td></td>
<td>Cost per unit</td>
<td>5 Rs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Savings from power generated</td>
<td>393300000 Rs /y</td>
<td></td>
<td>39.33 Rs in Cr /y</td>
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<td>4</td>
<td>Reduction in CO2 emissions per annum</td>
<td></td>
<td>Consider 220 kg of CO2 per tonne of steam produced by burning coal</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>264000 kg/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>91080 t/y</td>
<td>Considering 345 working days per year for CDQ plant (Cost benefit not considered)</td>
</tr>
<tr>
<td></td>
<td>Total Benefits in a tall battery because of CDQ Plant</td>
<td>= Rs 75.81 Cr/y</td>
<td></td>
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CDQ Plants in SAIL

Parameters
- No. of chambers
- Capacity of 1 chamber in terms of cooled coke
- Temperature of coke charged into the chamber
- Temperature of cooled coke
- Temperature of circulating gases before the boiler
- Temperature of circulating gases in blowing device
- Time of coke holding in the chamber
- Specific blowing rate
- Specific generation of steam

Value
- 4
- 50 tph
- 1000±50°C
- ≤ 200°C
- 750-800°C
- 160-180°C
- ≤ 2h
- 1450-1500 Nm³/h/t of coke
- 0.45 – 0.47 t/t of coke @ 6.6MPa, 500°C
Factors affecting selection of CDQ Plants in SAIL

Layout & Logistics – COB#1&2, BSL

CL of oven s from end oven COB#2 to CDQ Chamber - 336m
CL end oven COB#2 to CDQ Chamber - 336m

Coal Tower

COB NO.2
COB NO.1
Quenching Tower

High Speed – 200 m/min
Acceleration – 0.1m/s²
Deceleration – 0.1m/s²
Avg. Cycle time – 7 min
Conclusion

CDQ plants of 1.0Mtpa and above coke processing capacity is techno-economically feasible in the current scenario.

retrofitting of existing batteries with CDQ plants wherever feasible.