BEE: Best Practices in Energy Efficiency in Cement Sector
Ambuja Cements Ltd. (MCW)

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Cement Plant:

1. Electrical energy reduction in Cement mills by Grinding media optimization
2. Improving Clinker quality & increasing fly ash absorption
3. Installation of Efficient Turbo Blowers
4. Optimization of compressors
5. Cooler fans’ Inlet modification
6. Best practices of maintenance

Power Plant:

1. Retrofitting of MP turbine to HP turbine
2. Reduction of Aux. power consumption by various measures.
Specific electrical energy consumption Cement mill

Reduction in specific electrical energy consumption in Cement Mill No. 3 by 4 kWh/t cement
## Specific electrical energy consumption Cement mill

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Actions taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Media pattern change, increased finer ball charge in 2nd chamber</td>
</tr>
<tr>
<td>2</td>
<td>Replacement of Worn out intermediate diaphragm plates, Separator static &amp; rotor vanes</td>
</tr>
<tr>
<td>3</td>
<td>Sepol inlet duct air guide vanes adjusted.</td>
</tr>
<tr>
<td>4</td>
<td>Sepol bag filter exit &amp; Fresh air blancing done to get max. separation efficiency.</td>
</tr>
<tr>
<td>5</td>
<td>Regular Inspection of Separator fan &amp; cleaning of inlet box.</td>
</tr>
<tr>
<td>6</td>
<td>Regular Inspection of BE lip plate for any recirculation.</td>
</tr>
<tr>
<td>7</td>
<td>Mill discharge hood modification to increased fineness of bag filter product.</td>
</tr>
<tr>
<td>8</td>
<td>Hood arrangement for all aux. equipment venting</td>
</tr>
</tbody>
</table>
**Improving Clinker Quality**

**Change of the raw mix design :**
- Silica Ratio increased from 2.38 to 2.48
- Liquid content reduced from 26.81 to 26.53
- High purity corrective material used to maintain raw mix composition without increasing limestone pile LS target.
- The raw mix control QCX-online done on moduli value.
- Limestone Saturation factor reduced from 115.1 to 112.7.

**Change in Clinker Quality**
- Clinker LSF maintained at same level of 92%.
- Clinker SR increased from 2.38 to 2.45.
- Clinker AR increased from 1.46 to 1.52.
- Improvement in clinker strength.

<table>
<thead>
<tr>
<th>Year</th>
<th>LSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>115.1</td>
</tr>
<tr>
<td>2014</td>
<td>113.8</td>
</tr>
<tr>
<td>2015</td>
<td>112.7</td>
</tr>
</tbody>
</table>
Improving Clinker Quality


Increase in Fly ash Absorption

<table>
<thead>
<tr>
<th>Year</th>
<th>% Fly ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2013</td>
<td>27.70</td>
</tr>
<tr>
<td>Year 2014</td>
<td>30.00</td>
</tr>
<tr>
<td>Year 2015 (Updated)</td>
<td>31.60</td>
</tr>
</tbody>
</table>


![Graph showing energy consumption over years](chart.png)
Installation of Energy efficient Turbo Blowers

Power saving by installing K turbo blowers for kiln firing & PC firing in place of conventional PD blowers. It has number of features such as

- High efficiency even at partial load
- Flow control by VFD
- Remote monitoring & operational control from CCR
- Lower maintenance cost
- Low noise & vibration
- Life of more than 15 years
- HMI colour display of parameters like discharge pressure, inlet flow, air temperature, speed of motor, input power etc.

Achieved energy saving 40 % in PC firing & 51 % in Kiln firing blowers.

Also achieved better run time & less maint. expenses
Optimization of Compressors

Energy saving by optimizing compressors for pre-clinkerization & post-clinkerization by centralizing the compressors in their respective headers with installation of Intelligent flow controllers.

Godrej IFC installed at the outgoing lines after the Air dryers to control the flow & maintaining the constant pressure in the application within the variation of 1 psig. This system facilitate to run the compressor in a very optimized way by maintaining desired air pressure.

This system prioritizes & sequences the compressors according to their efficiency, thus reducing the loss of productive energy. Through this system all the compressors can be controlled & operated from desk.
### Savings from optimization of Compressors:

<table>
<thead>
<tr>
<th></th>
<th>POST -CLINKERISATION</th>
<th>PRE-CLINKERISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily energy saving achieved</td>
<td>1388.61 KWh/day</td>
<td>1826.85 KWh/day</td>
</tr>
<tr>
<td>Energy saving per year</td>
<td>458241.3KWh/year</td>
<td>602860.5KWh/year</td>
</tr>
<tr>
<td>% Energy savings achieved</td>
<td>11.36%</td>
<td>12.29%</td>
</tr>
</tbody>
</table>
Modified Fan I/L by Bell Mouth

Modification of cooler fans’ inlet Bell Mouth reduced the suction pressure from 10 to 4 mbar, because of less resistance.

*Achieved energy saving of 232 Kwh/day*

**Before modification**
- Increased pressure drop across fan, because of small diffuser placed

**After modification**
- Decreased pressure drop across fan, By installing new bell mouth
### Modified Fan I/L by Bell Mouth

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Kiln Feed (TPH)</th>
<th>Cooler under grate pressure (Mbar)</th>
<th>Fan inlet static pressure (Mbar)</th>
<th>Fan discharge pressure (Mbar)</th>
<th>Fan 2A (Amps)</th>
<th>Fan 2B (Amps)</th>
<th>Fan 2A (KW)</th>
<th>Fan 2B (KW)</th>
<th>Saving Kw/Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>12.03.2014</td>
<td>507</td>
<td>69.7</td>
<td>-10</td>
<td>75</td>
<td>146</td>
<td>140</td>
<td>85</td>
<td>84.53</td>
<td></td>
</tr>
<tr>
<td>After</td>
<td>28.03.2014</td>
<td>514</td>
<td>69.9</td>
<td>-4</td>
<td>76</td>
<td>141</td>
<td>137</td>
<td>81.08</td>
<td>78.78</td>
<td>3.92</td>
</tr>
</tbody>
</table>

- Savings achieved for 2A = 94.08 (Kw/Day)
- Savings achieved for 2B = 138 (Kw/Day)
- Budgeted Kiln running Hrs 2014 = 6952 Hrs
- Hence, Kwh saving in 2014 = 67226 Kwh/Annum
- Rs. Saving = 2,62,180 Rs./Annum
Solution Oriented Approach

- Optimization of Raw Mill dam ring height Saving in Specific Power.
  Saving: 1 KWh/tclk (96 Lacs Rs. per annum)

- Increase Raw Meal Residue on 212 Micron from 3.8 to 4.2 %.
  Saving: 0.40 KWh/tclk (38.4 Lacs Rs. per annum).

- Sepol vent air adjusted (10% of the total air) by installing VVVF drive in Sepol bag filter fan. Saving: 13 kWh per mill (15.4 Lacs Rs. per annum)
**General Maintenance Practice**

Daily Walk-by inspection

- Simple visual, audible, smell and touch inspection of the equipment or area
  - Reading parameters, such as vibration, voltage, current, fault messages, etc.
  - Observing items such as slip ring-carbon brush contact on MV motors
- Blowing, cleaning, greasing, oiling and also finding out the abnormal condition of the equipments.
- Sharing information to the internal and external customer

- Burning smell, Chemical smell
- Vibration and temperature monitoring
- Unusual Sound, Noise
- Bang!
- Oil, water, grease leaks, cleanliness of the area, loose bolts, smoke, ....and many more
Condition Based Monitoring

- Vibration Monitoring & analysis of major drives
- Oil analysis of all Power & Distribution Transformer
- IR/PI Value Testing of Electrical Equipments
- Protection Relay Testing during annual shutdown.
- Overhauling of HT/LT Motors during annual shutdown as per Conditioning Monitoring Report therefore no motors failures during last 3-4 yrs
- Thermography of LT switch gears done & its point attended.
- HT/LT Switchgears Maintenance during annual shutdown.
Reduction in Specific Electrical Power

Specific Electrical Power (KWH/T Cem)

- 2011: 79.57
- 2012: 78.99
- 2013: 76.45
- 2014: 77.34
- 2015 May YTD: 76.13
TSR and Sp. Heat Consumption

**Thermal Substitution Rate (%)**

- 2011: 0.57
- 2012: 1.35
- 2013: 2.26
- 2014: 1.98
- 2015 May YTD: 4.82

**Sp. Heat Consumption (Kcal/ kgClk)**

- 2011: 718
- 2012: 722
- 2013: 714
- 2014: 718
- 2015 May YTD: 735
Energy Efficiency Measures Taken in CPP
Completed retrofitting of Kawasaki supplied Steam Turbine (Fully Condensing type) with a new turbine (bleed cum condensing type) of similar capacity consisting of LP and HP heaters to achieve the objective of improving the Turbine Efficiency and Heat Rate.

<table>
<thead>
<tr>
<th>Component</th>
<th>Heat Rate (kCal/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP Turbine (Existing)</td>
<td>3045</td>
</tr>
<tr>
<td>HP Turbine (New)</td>
<td>2445</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net heat rate saving after retrofit of the turbine</td>
<td>600.00 Kcal/Kwh</td>
</tr>
<tr>
<td>Annual savings (approx)</td>
<td>Rs 4.5 Crores</td>
</tr>
<tr>
<td>Fuel savings (approx)</td>
<td>50 Tons/Day</td>
</tr>
</tbody>
</table>
## Station Heat Rate

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S H R</strong> (Kcal/kwh)</td>
<td>3720</td>
<td>3658</td>
<td>3608</td>
<td>3521</td>
</tr>
<tr>
<td><strong>Coal (Lac Tons)</strong></td>
<td>3.97</td>
<td>3.66</td>
<td>3.17</td>
<td>2.93</td>
</tr>
</tbody>
</table>

1. 100% Loading of HP turbines.
2. Maintaining design vacuum levels across the STGs.
3. Online Steam leakage arresting.
4. Good Quality of coal.
## CPP Aux. Power Consumption

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux. Power Consumption (%)</td>
<td>12.19</td>
<td>11.41</td>
<td>11.24</td>
</tr>
<tr>
<td>Aux. Power Units (Mio Kwh)</td>
<td>37.47</td>
<td>33.12</td>
<td>33.04</td>
</tr>
<tr>
<td>Coal Consumption (Lac Tons/annum)</td>
<td>3.66</td>
<td>3.17</td>
<td>2.93</td>
</tr>
</tbody>
</table>

1. Installation of VVVF drives for reduction in Aux Power
2. FRP blades replaced with aerodynamic fans in Cooling Tower
Benefits of ISO 50001-2011 Certification
With ISO 50001-2011 certification, our organization achieved many benefits, some are as below:

- This standard has helped a lot to meet current and future voluntary/mandatory energy efficiency targets or GHG emission reduction legislation. It will help to reduce greenhouse-gas (GHG) emissions and carbon footprint.
- Increased energy savings which will reduce energy costs for producing one ton of cement via a structured approach of managing energy consumption.
- With this system we know better about equipment efficiency. By integrating our existing management systems, we can align our Energy Management System (EnMS) with existing management systems for additional organizational benefits.
Benefits of ISO 50001-2011 Certification

- Increased energy awareness among staff members at all levels.
- Improved corporate image and credibility with all stakeholders and customer.
- Enhanced security of energy supply as we have identified our energy risk exposure in areas within the organization and getting remedial measure against it.
- Improved operational efficiencies and maintenance practices
A significant improvement of the energy performance level from an initial energy baseline.

A systematic approach (plan-do-check and act) that leads to continuous energy efficiency improvement. ISO 50001 enables organizations to:

- Develop a policy for more efficient use of energy
- Fix energy efficiency targets and objectives to meet the policy.
- Use data to better understand and make decisions concerning energy use and consumption
- Measure the results of energy efficiency improvements
- Review the effectiveness of the energy policy.
- Continual improvement in efficiency through Energy management system.
Experience of Early Adoption of ISO 50001 EnMS

- ISO 50001 facilitates engagement (commitment and agreement) of management and has a positive contribution towards the energy targets.
- EnMS creates awareness and a commitment about energy (i.e. consumption, use, efficiency, renewable sources) within the organization.
- It improves the ability of organizations to mitigate energy risks.
- It strengthens the competitiveness of organizations and reduces the impact of price fluctuations.
- ISO 50001 facilitate the establishment of a benchmarking process.
- EnMS allows organizations to gain credible external visibility of energy saving measures.