Best Practices in Energy Efficiency in Aluminium Smelting
BEE Knowledge Exchange Platform – 2015

Vedanta Smelter, Jharsuguda
VISION

“We will be the world’s most admired company that consistently defines the leading standards in our businesses, making our stakeholders proud to be associated with us”

MISSION

“Our mission is to be a world class, diversified resources company that provides superior returns to its shareholders, through high-quality assets, low-cost operations and responsible corporate citizenship.”

VISION, MISSION & VALUES

ENTREPRENEURSHIP

GROWTH

SUSTAINABILITY

EXCELLENCE

TRUST

VALUES

Entrepreneurship

Growth

Sustainability

Excellence

Trust
NATURAL RESOURCE-OUR BUSINESS

“Think Locally Act Globally”
ENERGY CONSERVATION

“Neither a campaign nor an initiative
It is our habit and culture”
ALUMINIUM – ENERGY INTENSIVE

- Energy: 68%
- Other Cost: 32%
- Electricity: 98%
- Fuel: 2%
**ENCON PROJECTS (2011-14)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of ENCON Projects</td>
<td>81</td>
</tr>
<tr>
<td>Energy Savings (M kWh)</td>
<td>385</td>
</tr>
<tr>
<td>Energy Savings (MT of fuel)</td>
<td>4020</td>
</tr>
<tr>
<td>INR Saving (Cr.)</td>
<td>112</td>
</tr>
<tr>
<td>INR Investment (Cr.)</td>
<td>3</td>
</tr>
</tbody>
</table>

“Small investments and high returns”
## MAJOR ENERGY SAVING PROJECTS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Title of the Project</th>
<th>Energy Savings (MWh/Annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reduction in Stub To Carbon voltage drop</td>
<td>109824</td>
</tr>
<tr>
<td>2</td>
<td>Reduction in Pot voltage</td>
<td>62078</td>
</tr>
<tr>
<td>3</td>
<td>Improvement of current efficiency of pots.</td>
<td>45060</td>
</tr>
<tr>
<td>4</td>
<td>Implementation of slotted anode in pots</td>
<td>34330</td>
</tr>
<tr>
<td>5</td>
<td>Reduction of compressed air consumption</td>
<td>19535</td>
</tr>
<tr>
<td>6</td>
<td>Reduction of dead pot voltage and crossover voltage.</td>
<td>8715</td>
</tr>
<tr>
<td>7</td>
<td>Optimization of Compressor running</td>
<td>5310</td>
</tr>
<tr>
<td>8</td>
<td>Online addition of pots into circuit by fuse blown technology.</td>
<td>2324</td>
</tr>
<tr>
<td>9</td>
<td>HTM heater set point optimization in GAP.</td>
<td>1808</td>
</tr>
<tr>
<td>10</td>
<td>Reduction of the Specific Energy consumption of Wire Rod Mill.</td>
<td>1269</td>
</tr>
<tr>
<td>11</td>
<td>Improve Rodding shop availability.</td>
<td>589</td>
</tr>
</tbody>
</table>
### MAJOR FUEL SAVING PROJECTS

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Title of the project</th>
<th>Fuel Savings (MT/Annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reduction of HFO consumption in Anode Baking Furnace</td>
<td>3051</td>
</tr>
<tr>
<td>2</td>
<td>Optimized usage of compressor in Metal Transport Vehicle</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>Reduction of diesel consumption in production vehicles by improving engine efficiency</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Optimization of LPG burner use for ingot Casting.</td>
<td>15</td>
</tr>
</tbody>
</table>

“Save Today for a better Tomorrow”
SMALL GROUP ACTIVITIES 2014-15

Rectifier
- No. Of Projects : 4
- Yearly Saving : 355 MWh
- Employees : 10

Utility
- No. Of Projects : 6
- Yearly Saving : 4082 MWh
- Employees : 8

Cast House
- No. Of Projects : 5
- Yearly Saving : 3791 MWh
- Employees : 25

Carbon
- No. Of Projects : 21
- Yearly Saving : 13087 MWh
- Employees : 120

Potline
- No. Of Projects : 6
- Yearly Saving : 184 MWh
- Employees : 200

Yearly Saving :- 22 M KWh

“We value every small Contribution”
ENERGY CONSUMPTION TRENDS

Total SEC-Smelter (GJ/MT)

- 2011-12: 59
- 2012-13: 55
- 2013-14: 54
- 2014-15: 53.5
- TARGET: 52.9

HF0-Kg/MT

- 2011-12: 70
- 2012-13: 64
- 2013-14: 54
- 2014-15: 48.2
- TARGET: 45

AC-KWh/MT

- 2011-12: 14623
- 2012-13: 14024
- 2013-14: 13818
- 2014-15: 13866
- TARGET: 13566

"Save What ?? Save a Watt"
ENCON JOURNEY

- Energy Audit by CII (2010)
- Energy Audit by TERI (2011)
- EnMS Implemented (2012)
- Slotted Anode (2012)
- Fuse Technology (2012)
- Clamp Drop (2012)
- Cathode (2013)
- ISO 50001 Certified CII Award BEE Award (2013)
- GMEA award CII Award Russian Govt.- Award NECA -1st Prize (2014)
- HFO & Stub to Carbon (2014)
ENERGY OBJECTIVES 2015-2016

- Reduce DC Energy Consumption from 13566 to 13322 KWh/Ton
- Reduce Auxiliary Energy Consumption from 397 to 382 KWh/Ton
- Reduce HFO Consumption from 48.2 to 45Kg/Ton
Formation of Energy Cell

APEX COMMITTEE

CORE COMMITTEE

COORDINATING COMMITTEE

SGA TEAM

Energy review structure

Corporate Sustainability Review

Monthly Operation Review by COO

Management Review by Plant Head

Review in energy cell meeting by Energy Manager

SBU Level Energy Performance Review

“Top to Bottom approach”
“Automation leads to Perfection”
Magnetic Field Compensation Of Electrolysis Cells

Cathode Modification Of Electrolysis Cells

Up-gradation of Pot Control & Feeding System

Waste Heat Recovery

“Measure to Control - Benchmark to Better”
Cathode Modification
**CATHODE MODIFICATION**

<table>
<thead>
<tr>
<th>Technical Invention</th>
<th>Result (kWh/MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Geometry of collector bar</td>
<td>76.8</td>
</tr>
<tr>
<td>Change in % of graphite in cathode block</td>
<td>60.8</td>
</tr>
<tr>
<td>Change in % of graphite in ramming paste</td>
<td>32.0</td>
</tr>
<tr>
<td><strong>TOTAL ENERGY SAVINGS</strong></td>
<td><strong>169.6</strong></td>
</tr>
</tbody>
</table>

Savings/Year – 88 M KWh

“Every Unit counts”
Reduction of HFO Consumption
PREHEATING CURVE MODIFICATION

RESULT

• Preheating temperature increased from 740°C to 800°C
• HFO injection reduced from 78 to 76 Hrs.

Preheating curve modified to improve pitch volatile combustion
REDUCTION OF FALSE AIR INGRESS

Gap between burner stand & ring

Gap covered with packing coke

The gap between the flue and burner base, flue hole cover, thermocouple base had false air intake

Effective sealing by Packing Coke
**REDUCTION OF RADIATION LOSS**

**BEFORE**
- Flue Hole Covers were modified to reduce radiation losses.
- Metallic cylinder and nets were replaced with ceramic wools and holding plates.
- Insulation in the new design is farther from heat source.
- Cast Iron Rings were replaced by refractory rings.
- Redesigned covers surface temperature was lowered by 73°C.
- Modified covers were Rs.700 cheaper than the original design.

**AFTER**

![Redesigned Flue Hole Cover](image1)

**Energy Efficiency**

<table>
<thead>
<tr>
<th>Cover Surface Temp. (°C)</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>258</td>
<td>185</td>
</tr>
</tbody>
</table>

**Before**

**After**

- Heat Loss Reduction
- Insulation Improvement
- Lower表面 temperature
- Cost Efficiency

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[Image Credit: Vedanta]
HFO consumption reduced from 63.8 to 46.6 kg/MT of baked anode

Annual HFO Saving is 4800 MT resulting in cost saving of 20 Cr.

“Improvement is an Infection”
Reduction of Stub to Carbon mV Drop
REDUCTION OF STUB TO CARBON mV DROP

Resistance at the gap filled by Cast Iron between the Steel Stub & Carbon Anode
The contact resistance between Cast Iron & Carbon is a function of the Contact Pressure. The Contact Pressure is a function of Cast Iron Composition. The Carbon Equivalent of the Cast Iron was improved by Graphite addition instead of Amorphous Carbon.
The button at the bottom of the stub hole was removed to improve the contact pressure between Cast Iron & Carbon by reducing the air gap at the corners.
Reduction in Stub to Carbon mV drop = 66 mV per Pot

Savings/Year is 110 M KWh

“Every milli Volt Counts”
Reduction in Cast Iron Spillage
Reduction in Cast Iron Spillage

PROBLEM DEFINITION:
- Cast iron spillage during casting
- Cleaning and Re-melting it
- Spilled cast iron is 127 ton/month.

INTERVENTION:
- Ladle Spout Modification.
- Cabin visibility improved
- Cleaning of bath from stubs

BENEFITS:
- Cast iron spillage reduced by 87 ton/month.
- Energy saved 0.7 M KWh/Year
- 12000 Man-Hours saved per year.
- Total cost savings is Rs. 25 lakhs / year.

“Opportunity Everywhere”
Cooling Fan Running Hours
We required higher draft to reduce HFO consumption which will increase power consumption. We searched for opportunities to save energy.

INTERVENTION:
- Cooling fans stopped 4 Hours in every fire cycle

BENEFITS:
- Energy consumption from 6912 KWH/day to 5760 KWH/day
- Energy saving: 0.4 M KWh / Year
- Cost saving: Rs. 10 lakhs / year

“Conserve here to Consume there”
Energy Reduction Billet Homogenization
Energy saving in homogenizing furnace

PROBLEM DEFINITION:

- Power consumption in homogenizing furnace was high at 220KWH/ton.

INTERVENTION

- Replaced Rock wool to Rock wool + Cera wool sandwich

BENEFITS

- Power consumption reduced from 220 KWH/ton to 212 KWH/ton.
- Energy saved 1 M KWh/ year
- Cost savings is Rs. 25 lakhs/year.

“Kaizen for a Khazana”
Reduction in ID Fan Power Consumption
PROBLEM DEFINITION:

- Power consumption of ID fan running with loading of 16.82 MW.

INTERVENTION

- Pot flow balancing.
- Hooding efficiency improvement
- Leakage reduction
- Improved gaskets for flange joints

BENEFITS

- ID fan loading reduced to 16.33 MW.
- Energy savings – 4.3 M KWh / Year
- Cost savings- Rs.1 Crore / Year

“Basics karo Bindass Raho”
Coming Together is Business
Thinking Together is Process
Working Together is Success
Keeping Together is Progress

“Bottom to Top Approach”
Efforts towards GHG emission reduction:

- Adoption of new technology.
- Stepping in towards renewable energy sources.
- Creating awareness among employees and stakeholders.
- Reduction in no. of light vehicle by 50%. Vehicle with aging less than 3 years only allowed & ensuring PUC certificate for every vehicle.
- Increasing the load ability in transportation to reduce carbon emission.

### Inventory

<table>
<thead>
<tr>
<th>Year</th>
<th>Scope 1 Emissions CO₂ emission (MT)</th>
<th>Scope 2 Emissions CO₂ emission (MT)</th>
<th>Scope 3 Emissions CO₂ emission (MT)</th>
<th>Total reduction in emissions intensity since baseline year study CO₂e (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 2012-13 (Base Year)</td>
<td>16330076</td>
<td>398</td>
<td>Not determined</td>
<td>16330474</td>
</tr>
<tr>
<td>FY 2013-14</td>
<td>15948488</td>
<td>2607</td>
<td>207040</td>
<td>15951095</td>
</tr>
</tbody>
</table>

### Mitigation

- Drastic reduction of 2.3% from base year (2012-13)
HENCON & SIEMENS

Automation in cooling tower to control fan switching in bake oven

Reactor Venturi modification and air chamber plug modification of all air slide air chamber in FTP

Automatic switching of lighting circuit

Elimination of unwanted usage of compressor in MTV

Checking of pressure problem in MTV by using plant air

Energy saving - 0.7 M KWh/year

“Sabka Saath Sabka Vikash”
Harnessing Solar Energy

Solar Water Evaporator

Solar Cell & LED Lighting

Eco Ventilators

Energy Saving – 5000 KWh/year

“Future of Energy”
<table>
<thead>
<tr>
<th>Title Of The Project</th>
<th>Potential Savings/Annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Magnetic Field Compensation</td>
<td></td>
</tr>
<tr>
<td>2. Cathode Modification</td>
<td>324000 MWh</td>
</tr>
<tr>
<td>3. Up-gradation of Pot Control &amp; Feeding System</td>
<td></td>
</tr>
<tr>
<td>4. Reduction of Compressed air consumption</td>
<td>4380 MWh</td>
</tr>
<tr>
<td>5. Use of High Density High weight anodes to reduce HFO &amp; Energy consumption</td>
<td>360MT Carbon, 833 MWh, 220 MT HFO</td>
</tr>
<tr>
<td>6. VVFDs in fans and pumps</td>
<td>700 MWh</td>
</tr>
<tr>
<td>7. Reduction of HFO consumption by waste heat recovery</td>
<td>460 MT</td>
</tr>
<tr>
<td>8. Use of Solar Water Heater</td>
<td>120 MWh</td>
</tr>
<tr>
<td>9. Use of Energy Efficient Lights</td>
<td>83 MWh</td>
</tr>
<tr>
<td>10. Solar Photovoltaic Cell in administrative block.</td>
<td>60 MWh</td>
</tr>
<tr>
<td>11. Lighting energy savers in street lighting system.</td>
<td>31 MWh</td>
</tr>
<tr>
<td>12. Bio gas Plant for cooking in canteen.</td>
<td>1642 Kg</td>
</tr>
<tr>
<td>13. Waste Heat recovery from flue gases from BO &amp; Potroom</td>
<td>To Be Estimated</td>
</tr>
<tr>
<td>14. New Technology to reduce RO Rejections</td>
<td>To Be Estimated</td>
</tr>
</tbody>
</table>
AWARDS & RECOGNITIONS
AWARDS & RECOGNITIONS

Energy Conservation Category

- National Award for the “Most Energy Efficient unit in Aluminium sector” from honorable President of India.
- Recognized as “Excellent Energy Efficient Unit” at 15th National Award for “Excellence in Energy Management” organized by CII.

Sustainable Performance Category

- Silver Category IMEA Award by Frost & Sullivan.
- "Challengers Award - Mega Large Business" against "Frost & Sullivan’s Green Manufacturing Excellence Awards 2014".
- “Odisha EHS Award” by CII.
- CSR award under two categories at “Odisha CSR conclave 2014”
- Chairman’s Performance Award – Q1, Q2 CY’13 & Q1, Q2 CY’14.
- Sustainability Award – Winner in H2 & Runners up in H1 of 2013-14.
- Engineering Excellence Award 2013 by Engineering Watch for best innovation and engineering Marvel.
- CPP has won 14th National Award For Excellent Energy Efficient Unit-2013 By CII.
- 1st Prize for National Energy Conservation Award 2012 by BEE.
- International Green Apple Award for reduction in GHG emission by introduction of slotted anodes for Smelter-I.
"The more energy we save, the more we save the next generations"

“We are focussing on renewable energy not for laurels but to lighten homes of the poor and bring a change in their lives"

“Energy can be saviour of generations”"
It takes One will To transform A million

At Vedanta
We harness our Collective will To make Energy Conservation A Way of Life