

ENERGY CONSERVATION IN BINANI CEMENT

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Summary

Increase in cost of power and fuel, increased competition and slackness in the market price have stimulated the awareness of energy conservation among Indian cement industries. Since the cost of fuel and power play major role in deciding the product cost, every small step taken in this field yields great benefit to the industry.

1. Introduction

Binani Cement Limited (BCL), initially a subsidiary of Binani Industries Limited, entered this competitive market in the year of 1997, Its 6-Stage II-String SLC Kiln, Vertical Roller Mills for Raw Material/Coal grinding and Ball Mills, for Cement grinding were supplied by L&T/FLS.

The Herculean task of selling the high quality cement at competitive price put the BCL at their toes to control the cost right from day one. This paper envisages various measures taken in the field of energy conservation at BCL.

2. Improvements

The improvements in the field of energy conservation at BCL were taken up in the following three stages:

- Improvement through increased capacity utilization
- Improvement through process optimization
- Improvement through modifications

3. Improvement through Increased Capacity Utilization

Increase in capacity utilization is mainly influenced by two factors,

- Increased production capacity of the equipment
- Improved availability of the equipment

Increase in Production capacity is achieved through various process optimization, modification and adopting new technology. BCL concentrated on all three factors. The following table shows the heights achieved so far:

Table: 1

Achievement in production capacity				
Equipment	Rated Capacity (TPH)	Capacity Archived TPH		
		1997-98	1998-1999	1999-2000
Crusher	1200	556*	717*	728*
Raw Mill	375	354	391	404
Kiln	198	172	203	210
Cement Mill	150 (at 3000 Blaine)	145	149	155

* Restricted due to insufficient transportation equipment

Improved availability of the equipment largely depends on the better maintenance practices and policies. Availability of plant equipment could be improved by adopting and implementing preventive maintenance practice properly. The frequency of checkup of equipment parts is reviewed from time to time and, in fact, it is a continuous process for betterment. The parts which were found damaged

during preventive maintenance checks are not only replaced, but also analyzed to find out the reason of failure, whenever possible, and improving the life thereof by changing design/material.

In addition to time based preventive maintenance, equipment health condition is also assessed on regular basis as a part of equipment condition monitoring activity. The feed back of condition monitoring activity is utilized while carrying out preventing maintenance. The activities of Technical Cell are being expanded further to support preventive maintenance activities.

In the beginning, long duration breakdowns are critically and systematically reviewed for finding out the actual reason(s) of failure and taking remedial actions to avert them. The results of such systematic analysis approach are quite encouraging, and gradually similar approach was extended to short duration repetitive breakdowns too.

Among the first line officers, the sense of equipment ownership was included and developed by forming groups. In total, five groups were formed for the whole plant from Mines department to Packing Plant department. These groups have been given free hand working to identify problems, reason of breakdowns in their section and coming forward with techno-economic feasible solutions and implementing them in a scheduled time-frame. All breakdowns are also discussed at high level on daily basis.

Another maintenance aspect is in-line with the quality policy of the company which states that 'We use good to produce good'. BCL does not compromise with the quality of spares because breakdowns are always costlier than the excess price paid for good quality of spares.

4. Improvement through Process Optimization

Optimization is an on-going process in all the industries. Few optimization studies carried out at BCL are enumerated in the following table. Some of these have been discussed in detail in the later part of the paper as case studies.

Table: 2

S. No.	Parameter Optimized	Value before optimization	Value after optimization	Benefits achieved
1	Dust concentration at raw mill outlet	530 gm/m ³	687 gm/m ³	0.50 kWh/ton of cement saved in raw mill fan
2	Raw mill hydraulic pressure	174 Bar (max.)	155 Bar (max.)	0.58 kWh/ton of cement saved in raw mill main drive
3	False air filtration in raw mill circuit	22.08 %	18.04 %	0.21 kWh/ton of cement saved in raw mill fan
4	Tertiary air temperature	850°C	876°C	5.30 kcal/kg of clinker saved
5	Silica modulus of raw mix	< 2.00 %	2.15-2.20 %	1.50 kWh/ton of cement saved in cement grinding
6	Bag house cleaning sequence operation	Continuous	DP based	0.38 kWh/ton of cement saved in RA fan
7	Secondary air temperature	960°C	1020°C	6.60 kcal/kg of clinker saved
8	String outlet temperature	310°C	295°C	8.4 kcal/kg of clinker saved

5. Improvement through Modification

At BCL, people with innovative ideas are nurtured and motivated, their ideas are given due respect and discussed at various levels. The resultant benefits is fruitful modifications few of such modifications are enlisted below and discussed in detail in the case studies.

Table: 3

S. No.	Equipment	Modification carried out	Benefits achieved
1	Primary air fan	Inlet duct connected with cooler ESP stack	1.5 kcal/kg of clinker saved
2	Primary air fan	V/F system installed	0.062 kWh/ton of cement saved
3	Bag house fan	SPRS system installed	0.06 kWh/ton of cement saved
4	Jet pulse filter operation	DP based operation	0.02 kWh/ton of cement saved
5	Cooler vent fan	SPRS system installed	0.02 kWh/ton of cement saved
6	Raw mill material feeding system	Reversible belt conveyer replaced with modified chute	0.02 kWh/ton of cement saved
7	Kiln shell cooling fans	Original blades replaced with FRP blades	0.03 kWh/ton of cement saved
8	Coal firing FK pump blowers	Pulley size reduced	0.03 kWh/ton of cement saved
9	Kiln feed re-circulation system	One air slide replaced by direct chute	0.02 kWh/ton of cement saved
10	Cement silo aeration system	Original system modified with open-type airslide	0.32 kWh/ton of cement saved
11	Packing plant	All electrical motors running below 60 % of rated load changed from DELTA to STAR arrangement	0.05 kWh/ton of cement saved
12	Cement mill	Isolation of JPF from the circuit by connecting dedusting lines to ESP	0.05 kWh/ton of cement saved
13	Electrical load centers	Energy saving panels provided in all the load centres	0.01 kWh/ton of cement saved

6. Case Study: 1**Objective**

To improve the dust concentration at mill outlet and to bring down the specific power consumption of raw mill fan.

Stage: 1

The operational philosophy followed during the initial period of plant operation was to run the raw mill fan at its maximum speed i.e. drawing maximum possible air flow by the mill fan and operate the mill with maximum achievable feed rate. The data collected during this stage are as follows:

Raw mill fan speed	:	100%
Raw mill fan damper opening	:	100%
Raw mill fan power drawn	:	2485 kw
Raw mill fan flow	:	748751 m ³ /hr
Mill output	:	397 tph

Dust concentration at mill O/L : 530 gm/m³
Nozzle Velocity : 48.58 m/sec

Stage: 2

The optimization process was taken in several cautious steps i.e. the fan was brought down slowly and the reject from the mill was allowed to increase Mill feed PID was tuned to suit the mill DP. This exercise was continued till, the nozzle velocity reached 41 m/s and the return material increased from a level of 15% to 20%. The data collected at this stage are as follows:

Raw mill fan speed : 95%
Raw mill fan damper opening : 100%
Raw mill fan power drawn : 2122kw
Raw mill fan flow : 626100m³/hr
Mill output : 431 tph
Dust concentration at mill O/L : 687 gm/m³
Nozzle velocity : 41.67 m/sec

7. Case Study: 2

Objective

To save electrical energy in primary air fan, as also to bring down the vibration levels in the fan.

Stage: 1

Ay BCL, 02 nos. primary air fan have been provided for kiln coal firing system (open fan as standby). The flow regulation was done through damper control. The fan normally was operated at 50% damper opening. The data collected at this stage are as under:

Fan Type : Centrifugal with axial inlet
Motor rated power : 75 kW
Motor operating power : 45-60 kW
Speed (max.) : 3000 rpm
Fan flow : 1111 m³/min
Static pressure : 625 mm WG

Stage: 2

It was observed that there is enough potential to bring down the speed of this fan, so extensive study was under taken and V/F panel was installed. The fan was switched over from damper control to speed control. At reduced operating speed, the fan vibration came down drastically. The equipment life has increased and at the same time, the ultimate aim of energy conservation is achieved. Data collected after the modifications are as under:

Fan type : Centrifugal with axial inlet
Motor rated power : 75 kW
Motor operating power : 32-40 kW
Present operating speed : 2300-2400 rpm
Fan flow : 118 m³/min
Static pressure : 625 mm WG

8. Case Study: 3

Objective

To save thermal energy by increasing primary air temperature.

Observation

In general ambient air is used as primary air in most of the cement plants. Normally, primary air contributes for 10% of the total combustion air. As lot of thermal energy is required to raise the primary air at ambient temperature to that of burning zone temperature, thought was given in this direction for exploring feasibility of using hot air as primary air. The result thus obtained is the following modification.

Modification

Going through the plant operational data, it was observed that cooler vent gas can provide the required hot air as primary air. The feasibility study was carried out, and finally it was decided to draw hot air from the cooler ESP stack. To enhance the regulation, one fresh air damper and one isolating damper were provided in the PA fan inlet duct. The fresh air damper is controlled automatically through a PID to maintain constant inlet temperature to avoid any fluctuation in the primary air momentum.

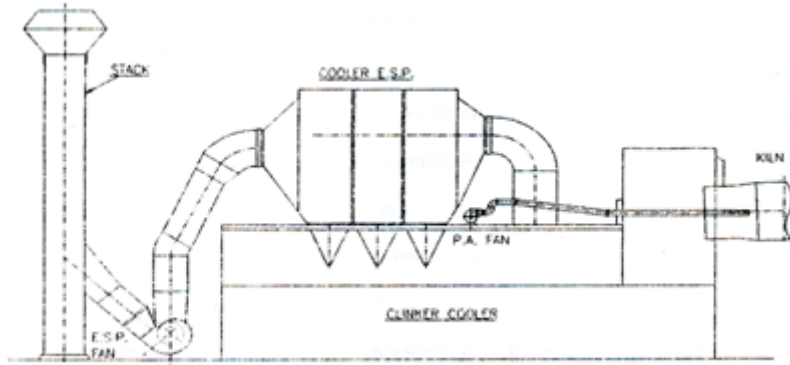


Fig. 1 – P.A. fan & duct sketch before modification

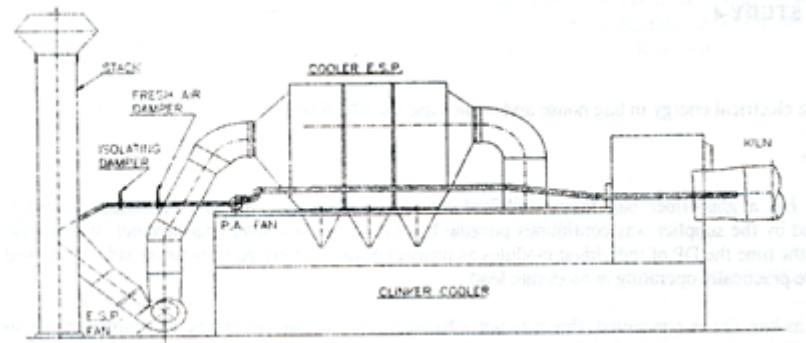


Fig. 2 – P.A. fan & duct sketch after modification

The data before and after the modification are briefed in the following table. The thermal energy saved is 1.5 kcal/kg of clinker.

Table: 4

Primary Air Optimization			
Parameters	Unit	Ambient Air	Hot Air
Temperature	Deg.C	47	167
Static pressure	mmWg	615	620
Dynamic pressure	mmWg	9.72	11.35
Gas density	Kg./m ³	1.1135	0.8102
Gas velocity	M/sec	13.09	16.57
Gas flow	M ³ /min	99	125
Gas flow	Nm ³ /min	85	80
Gas flow	Kg/min	110	101
Heat requirement for heating the primary air	kcal/kg of clinker	9.75	8.24

9. Case Study: 4

Objective

To save electrical energy bag house and to increase the life of bags.

Observation

Binani has a glass–fiber bag house supplied by M/s Kirloskar AAF. The operation philosophy as recommended by the supplier was continuous purging by reverse air in a sequential manner. It was observed that most of the time the D P of individual modules as measured was running on very lower side. It showed that the bags were practically operating at moderate load.

As far as bag life is concerned, this was not a healthy condition as, according to supplier, there should always be some coating over the bags to increase the life. So, an intermittent cleaning operation was devised i.e. the cleaning sequence stopped for certain duration and the DP was allowed to increase. When the DP reached a specified level, the cleaning sequence was started. The carrying capacity of the conveying equipment was also monitored. When all the trials went satisfactorily, a final modified operating philosophy was implemented.

The parameters before and after the modification are furnished in the following table:

Table: 5

Condition	Before modification			After modification		
	R.A. Fan kW drawn	Avg. run hr.	Total units/day	R.A. Fan kW drawn	Avg. run hr.	Total units/day
Raw mill running	127	18	2281	127	4	508
Raw mill not running	148	6	891	148	5	740
			3172			1248

The benefits achieved out of this modification are:

- Saving in electrical energy by way of reduced running time of R.A fan
- Increased bag life as the bags are exposed to stress for lesser time.
- Increased cloth area availability (as one module was always under cleaning in the earlier case).

10. Case Study: 5

Objective

To save electrical energy in process fans.

Observation

Process fans like bag house fan, calciner string fan, kiln string fan and cooler vent fan were required to be operated at lower speed instead of their rated speed to achieve required process parameter. Speed regulation is being done by introducing resistance in the motor circuit, in turn some amount of electrical energy is lost in the form of heat. It was stressed that if some devices are used to recover this, a considerable amount of energy can be saved. So, we went for installation of slip power Recovery system for all these four fans.

The saving achieved in each fan is as follows:

Table: 6

Equipment name	Normal operating speed	Power saved (kW)	Sp. power saved (kWh/ton of cement)
Bag house fan	60-80	125	0.06
Kiln string fan	85-93	24	0.10
Calcliner string fan	85-93	50	0.22
Cooler vent fan	60-70	45	0.20

11. Case Study: 6

Objective

To save electrical energy in kiln shell cooling fans.

Observation

The impellers of shell cooling fans (16 nos.) were made of cast iron. It was envisaged that, if the impellers could be converted to lightweight material, a considerable amount to electrical energy can be saved.

Modification

The cast iron impellers were replaced with lightweight FRP blades.

The data collected are as under.

Table: 7

Description	Rated power (kW)	Power drawn (kW)
Shell cooling fans with cast iron impellers	3.7	3.0
Shell cooling fans with FRP impellers	3.7	2.4

12. Energy Conservation Drive at Packing Plant

Objective

To optimize specific power consumption of packing plant.

Observation

During internal energy audit, it was observed that there is ample scope of saving electrical energy in packing plant. Accordingly, the following modifications were carried out and the saving achieved is 1.18 KWH /Ton of cement.

Table: 8

S. no	Job	Earlier	After modification	Saving in power
1	132 k.W compressor for 7 kg/cm ² air pressure	Two compressors were running in local all the time or 48 Hrs . running of single compressor	These compressors have been taken in DCS by putting two pressure switches in Cement Mill Air Line. Now effective running is only 28 hrs. approx.	0.325 KWH/Ton of cement
2	On Line change over of Truck Loaders	Earlier it was not possible the Bag Transport group was to be stopped while changing the Truck Loader	Necessary changes have been done in software to have on line change over of Truck Loaders without stopping the Bag Transport Group	0.1 KWH/Ton of cement

3	Compressors for silo Aeration	Compressors were running in local. They were running also when extraction was not required	Now compressors are running through DCS only one compressor is running when there is a requirement of Cement Extraction	0.03 KWH/Ton of cement
4	Cement Extraction Group	The group was running in local so there was a considerable idle running	After modification of cement silos, the complete extraction group is taken in Auto avoiding idle running	0.025 KWH/Ton of cement
5	Increase in TPH of packers	Nozzle availability was very poor. Avg. availability of nozzles were 9-10	After modification in H/W of individual spout, availability has been increased upto 11-11.5, which resulted increased TPH from 105 to 150	0.7 KWH/Ton of cement

Conclusion

Thus, we have discussed the approach, ways and means adopted to bring down the energy consumption at BCL. **“Droplets Make Ocean”** as rather big volume of production was involved, even a small step taken in this direction turned out to be a great gain.

Energy audit is an important tool as far as energy conservation is concerned. The internal energy audit team at BCL is well equipped with latest monitoring equipment and several competitive in-house developed softwares. Unless until the awareness about energy conservation is developed at the grass root level, the industry’s ultimate goal can not be achieved. People at all levels are trained through various programs conducted in–house as well as outside. Quality circle concept is also utilized to spread this awareness.

As is clear from our quality and environmental policies, BCL has inducted energy conservation as one of their main objectives in their ISO 9002 & 14001.

Reference book:

7th NCB International Seminar on
Cement and Building Materials
New Delhi, 21-24 November 2000