When less is more

Though the Indian cement industry is highly efficient when it comes to energy consumption, rising fuel costs are pushing the industry to consume less and save more. It is more than money that is saved as processes become energy efficient. Indian Cement Review quizzed Holtec Consulting on how we can make our cement plants more energy efficient and get more from less.

Holtec Consulting, a leading consulting company, has been focused on serving the global cement industry for the last forty six years. It also offers comprehensive services in the areas of power, highways and bridges and engineering support services for bulk material handling and structural steel detailing. Its portfolio of services spans all disciplines of engineering, business consulting, geology and mining, project and construction management, environment management, performance enhancement, logistics, etc. In addition, Holtec operates and maintains cement plants globally for its clients and provides solutions encompassing the integrated delivery of services and products through its domestic and international group entities.

The company has 800+ clientele comprising of cement producers, equipment and service providers, EPC and construction firms, infrastructure developers, investing and funding bodies and all other relevant stakeholders through 3,600+ consulting assignments in over 80 countries. **Kamal Kumar, Chief General Manager** of **Holtec Consulting** shares some facts about the energy efficiency status of the Indian cement industry and ways to conserve power with readers of the Indian Cement Review. Excerpts from the interview.

How energy efficient is the Indian cement industry?

The data available from various sources indicate that the thermal energy consumption and the specific electricity consumption of Indian cement industry is definitely better than the rest of the world average. See table 1.

The Indian cement industry's average specific electrical energy consumption is 82 kWh/ tonne of cement compared to the world average in the range of 100-110 kWh/ tonne of cement. Average specific thermal energy consumption is 725 Kcal/ kg clinker compared to the world average of about 850-860 Kcal/ kg clinker.

The energy consumption of the cement industry is strongly linked to the type of kiln technology used. In India, the increasing share of dry process kilns with preheaters and pre-calciner has had a positive impact on energy consumption in clinker production.

S. No.	Country	Specific Electrical Energy Consumption kWh/ t of Cement	Specific Thermal Energy Consumption Kcal/ kg clinker
1	India	82	725
2	Spain	92	836
3	Germany	100	836
4	Japan	100	836
5	Korea	102	884
6	Brazil	110	884
7	Italy	112	908
8	China	118	956
9	Mexico	118	1003
10	Canada	140	1075
11	USA	141	1099

Table 1: Comparison of electrical and thermal specific energy consumption for a few selected countries around the world.

What are the most common energy drainers in a cement plant?

Grinding (Raw material and coal and clinker) sections consume the major share about 50- 60 per cent of total electrical energy consumption in a cement manufacturing process.

Common energy drainers are divided into two categories. The thermal energy drainers and the electrical energy drainers.

Common energy drainers are:

- False air ingress in preheater
- High radiation from kiln shell and high temperature drop across TA duct
- High temperature of clinker leaving cooler
- High heat loss through preheater exit and cooler vent

A few common electrical energy drainers are:

- Idle running equipment like crushers, belt conveyors, air side blowers, compressed air purging in bag filters and bag filter fans
- Process fans operating with dampers

The energy consumption of the cement industry is strongly linked to the type of kiln technology used.

- Operation of low efficiency process fans
- Pneumatic transport of material
- Improper ducting, high pressure drop across ducts and cyclones
- Inefficient operation of compressors and pumps
- Leakage in compressors
- Use of only ball mills for grinding

Generally, energy drain is in the range of 1-10 per cent of total energy consumed, depending upon plant age, operations, technology used etc.

Which sections or process in a cement industry have highest scope for energy conservation?

Total energy consumption in a typical dry process cement plant is 75-80 per cent fuel (thermal energy) and 20-25 per cent electricity (electrical energy). 99 per cent of the fuel consumption is used for clinker burning or pyro-processing. Hence, pyro-processing has highest scope about 5 - 40 per cent for improvements in terms of energy efficiency. Some of the major energy efficiency improvement activities include alternative fuel utilisation and waste heat recovery addition of stage in preheater.

Even though the our cement industry has made a significant improvement in energy efficiency through various measures, use of alternate fuels and raw materials (AFR) is a major potential area for improvement. Present thermal substitution rate by use of AFR is in the range of 0.5 to 1 per cent whereas developed countries achieved as high as 40 per cent TSR.

It is said that repairing or retrofitting of existing plants can improve energy efficiency.

How much can cement plant gain from such revamps?

Definitely, energy efficiency improves with retrofitting of existing cement plants. The extent of savings or gain however depends on the age of the plant, present operations and energy consumption. As per our experience with some of the plant operation audits, saving potential can be expected with retrofitting of existing cement plants. Please see table 2.

What kind of energy saving measures or technologies do you usually recommend to your clients?

Recommendations on energy saving measures vary from plant to plant. Several measures are available for improvement and conservation of energy in a cement plant. Applicability of each measure however needs to be established for an individual cement plant through a detailed plant operation audit study. Some of the commonly recommended energy conservation measures in a cement plant are:

Thermal Energy Saving Measures:

- Reducing false air in preheater
- Reducing return dust by improving top stage cyclone efficiency upto 92-95 per cent in preheater

Age	Technology	Saving Potential	
		Thermal savings, Kcal/kg of clinker	Electrical savings, kWh/ t of cement
Cement plants installed pre 1990	❖ 4 stage suspension preheaters with conventional control systems ❖ Ist generation coolers ❖ Ball mills for grinding	50 - 60	20 - 25
Cement plants installed post 1990	❖ 5 and 6 stage suspension preheaters and precalciner with improved control systems ❖ 2nd generation coolers ❖ VRM's and roller press for grinding	20 - 30	5-10
Large modern cement plants	❖ 6 stage suspension pre-heaters, pre-calciner and latest generation high efficiency coolers ❖ Roller press in finish mode and VRM with reject handling system for grinding	10-20	3 – 5

Table 2: Saving potential depends on plant age.

S. No.	Recommendation / Action Plan	Thermal savings, (Kcal/kg clinker)	Electrical savings, (kWh/ t of clinker)
	Without/Minimal Investment		
1	Reduce damper loss in full open condition and reduce PH fan speed.	-	1
2	Improved gas cooling in the gas conditioning tower (GCT).	-	0.6
3	Pressure at VRM inlet to be maintained as -40 to -50 mmWG as against -120 mmWG.		1
	With Minor Investment (Less than 15 Lakhs)		
4	False air leakage arresting in preheater tower	6	19 kW
5	Reducing the return dust quantity in the PH exit gas	6 – 8	-
6	Replacement of the existing conventional type 4th stage PH cyclone to LP, high efficiency cyclone.	-	0.6
7	Replacement of pneumatic transport system by mechanical transport system for raw meal silo feed		2.25
8	Replacement of the existing classifier in VRM by a new generation, high efficiency classifier		1.5
	With Major Capital Investment (More than 15 Lakhs)		
9	Increasing the residence time in Pre-Calciner (PC) for capacity upgradation of the pyro-processing section	Improved fuel combustion in PC resulting savings of 4 kcal/ kg clinker. Increased clinker production	-
10	Stage addition Converting the existing 4 stage PH to 5 stage PH.	10-13	-
11	Close circuiting of cement mill	-	1 kWh/ t of cement (increase in output by 8 tph)
12	Installation of roller press in cement mill circuit	-	5 kWh/ t of cement (Increase in Output)

Table 3: Typical recommendations with benefits thereof.

- Improving overall cooler efficiency by converting initial 7/8 rows of moving grates to energy efficient stationary plates and installing new generation high efficiency grate plates in subsequent compartments
- Using preheater or cooler vent air for drying of additives used in cement grinding instead of HAG
- Installation of Waste Heat Recovery systems
- Co-processing of alternative fuels in a cement plant

Electrical Energy Saving Measures:

- Interlocking apron feeder speed (rpm) with crusher main drive to ensure optimum loading of main drive motor in a crusher.
- Reducing the feed size of limestone to ball mill / VRM for improving the overall grinding efficiency.
- Pressure drop (DP) optimisation in a Reverse Air Baghouse (RABH) by installing VFD for RA fan
- Converting the air swept ball mills to mechanical discharge mill
- Replacing static separators in ball mill circuit with dynamic separator
- Installing mechanical recirculation system in VRMs
- Installing latest generation classifier in mills
- Replacement of pneumatic conveying to mechanical conveying
- Converting screw conveyors to air slides wherever possible
- Applying CFD technique for reducing the pressure drop across cyclone
- Replacing fan damper for process fans with VFD

Could you share some examples of how you helped cement companies reduce energy bills?

Holtec is providing energy audit and plant operations studies to the

S. No.	Sector	No of Identified DC's	Annual Energy consumption (Million toe)	Share Consumption per cent	Apportioned Energy reduction for PAT Cycle -1 (million toe)
1	Power (Thermal)	144	104.56	63.38	3.211
2	Iron and Steel	67	25.32	15.35	1.486
3	**Cement**	**85**	**15.01**	**9.10**	**0.815**
4	Aluminum	10	7.71	4.67	0.456
5	Fertiliser	29	8.20	4.97	0.478
6	Paper and Pulp	31	2.09	1.27	0.119
7	Textile	90	1.20	0.73	0.066
8	Chlor-Alkali	22	0.88	0.53	0.054
	Total	478	164.97	100	6.686

Table 4: National target of energy saving amongst all sectors.

cement Industry both in India and abroad. So far more than thirty such studies have been done. Typical recommendations are categorised in three categories:

1. Without or with minimal investment
2. With minor investment
3. With major capital investment

Few typical recommendations are shown in table 3.

What is your view of the PAT scheme introduced by the Bureau of Energy Efficiency?

Introduction of Perform, Achieve and Trade (PAT) Scheme for energy intensive industries improves energy efficiency and facilitates cost effectiveness by certifying energy saving that could be traded through its market based mechanism.

The key goal of the PAT scheme under the National Mission for Enhanced Energy Efficiency (NMEEE) is to mandate specific energy efficiency improvements for the most energy intensive industries.

Kamal Kumar,
Chief General Manager
Holtec Consulting

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The scheme builds on the large variation in energy intensities of different units in almost every sector.

Reduction Targets for DC's vary from:

- 3.99 per cent to 6.87 per cent for PPC major product
- 4.23 per cent to 6.00 per cent for OPC major product
- 3.71 per cent to 5.13 per cent for PSC major product
- 5.01 per cent to 5.12 per cent for white cement major product

Above targets generally appear to be achievable by DCs of Indian cement sector. (Source: BEE document).

The energy intensity reduction target mandated for each unit is dependent on its current efficiency level. The reduction target is less for those which are more efficient and higher for the currently less-efficient units.

National target of energy saving among all sectors is summarised in table 4.

Summary of energy saving targets set for the cement sector alone include:

Total energy consumption : 15.01 Million toe

No of notified Designated Consumer (DC's) : 85

Total reduction of cement Sector : 0.815 million toe

PAT scheme covers 478 designated consumers in 8 sectors, consuming about 165 million toe of energy. The National Target is reduction of 6.686 million toe at the end of 1st PAT Cycle (by 2014-15) and thereby reducing India's CO_2 emissions by 24 million tons / year in 2014-15.

The energy savings certificates (ESCerts) issued will be tradable on special trading platforms to be created in the power exchange. The direct benefit for the participating industries in this period is reductions in input costs related to energy of approximately Rs 6,800 crores. Total energy efficiency projects planned in 2012 -15 by the industry covered under PAT is 205 and the total anticipated investment is around Rs 17,021 Crores. ICR