HOLTEC

INNOVATION IN ENERGY CONSUMPTION

SYNOPSIS

In the cement industry, during the last few years there has been a steep rise in the cost of production as the cost of energy inputs has increased sharply. Studies have revealed that energy cost constitute about 40% of the cost of Cement production. In order to be cost competitive, it is essential to improve energy efficiency of the cement plants.

We, in India, are still lagging behind on energy management front compared to the world standards. Owing to the ever increasing cost, there is a growing awareness now to optimise the energy cost both electrical and thermal. This awareness has necessitated formulation of requisite strategy to minimise energy consumption in the plants and to maximise the profitability of the operations. This paper deals with the innovations in energy consumption to reduce the overall energy costs and the subject matter has been dealt with under the following broad heads :

(1) Energy consumption scenario - an analysis

(2) Recent technological developments

(3) Energy conservation - future options

1.0 INTRODUCTION

With the energy resources becoming scarce and costlier, the stress on energy conservation has been growing in the Industries. Cement industry is one of the major energy consuming industries and need to be accorded high priority in energy conservation efforts. In cement industry, old wet, semidry and modern dry process plants with suspension preheaters and precalciners are playing their complimentary roles in meeting the country's demand for cement. In terms of raw material and fuels, the Indian cement industry has to cope with low quality and harder to grind materials thus adding to the energy bill. Thus conservation of energy has become very important, being one of the efficient ways to reduce the cost of production.

2.0 ENERGY CONSUMPTION SCENARIO : AN ANALYSIS

2.1 Energy Utilisation

The energy performance in the Indian Cement Industry is not as good as compared to the best results achieved in some other countries. To some extent, that is due to relatively inferior quality of energy inputs primarily coal and power available, the various types of process and the lower quality and harder to grind materials.
Based upon the studies conducted by CII-CMA, the overall weighted average specific energy consumption (thermal and electrical) of the Indian Cement Industry on the basis of the 1993-94 data is given in Table 1 :

PROCESS	THERMAL ENERGY Kcal/Kg clinker			ELECTRICAL ENERGY Kwh/ tonne of OPC 33		
	Avg	Min	Max	Avg	Min	Max
WET PROCESS	1480	1280	1827	122	95	180
DRY PROCESS WITH SP	880	810	990	118	106	143
DRY PROCESS WITH PC	805	720	930	110	86	125

Table 1 : Process wise Specific Energy Consumption

2.2 Energy Cost

In the Cement Industry during last few years, there has been a steep rise in the cost of production as the cost of energy inputs has increased sharply.

The energy cost as a percentage of manufacturing cost which was 20-25% in 1980 has risen to 40% during 1993-94. This is mainly due to increase in energy prices over the years. Relative increase in the energy cost shown in the following Table 2 :

YEAR	ENERGY COST AS % OF TOTAL COST OF PRODUCTION
1986-87	24
1991-92	32
1993-94	40

Table 2 : Relative increase in Energy cost

2.3 Energy Consumption Vs Cost

The percentage energy consumption and energy cost are given in Table 3 :

PROCESS	ENERGY CONSUMPTION %		ENERGY COST %	
	Electrical	Thermal	Electrical	Thermal
WET PROCESS	6.62	93.38	38.95	61.05
DRY PROCESS WITH SP	10.34	89.66	50.90	49.10
DRY PROCESS WITH PC	10.52	89.48	51.40	48.60

Table 3 : Process wise Energy consumption and Energy costs

From the above figures it is clear that for Dry process plants, the electrical energy contributes to about 10% of the total energy consumption whereas the the cost of total electrical energy works out to 50% of the total energy bill.

3.0 RECENT TECHNOLOGICAL DEVELOPMENTS

The efficiency in energy utilization is closely related to technological developments. Research work directed towards energy efficiency has resulted in development of many energy efficient equipment and system which have been absorbed by the cement industry in recent years.
The adoption of these technological improvements has resulted in significant energy savings, both thermal and electrical.

The technological developments which have taken place for reducing the specific energy consumption are :
- Crushing and grinding system
- Pyroprocessing system
- Material handling system
- Process control and Instrumentation
- Electrical drives and high efficiency fans

3.1 Improved Crushing And Grinding Systems

Communition is a highly energy intensive process in the Cement Industry consuming about 60-75% of total electrical energy used for the grinding of raw material, coal and clinker. Various technological improvements include :-

- Vertical Roller Mill
- High Pressures grinding Roll
- Horizontal Impact Crushers
- High efficiency separators

The typical specific power consumption for different type of grinding system for grinding clinker to 3200 Blaine is given in Table 4:

SYSTEM	TYPICAL POWER CONSUMPTION KWH/TONNE OF OPC
Tube mill in closed circuit	35
HPGR in finish grinding	28
Vertical Roller mill	30
Horo mill	29

Table 4 : Typical Power consumption - Clinker grinding Kwh/tonne of OPC at 3200 Blaine

3.2 Pyroprocessing Systems

Pyroprocessing includes preheating, precalcining, burning and cooling as the major components and is the most important thermal energy consumption centre in the cement plant. Conversion from wet process to dry process technology for cement manufacturing has been the major technological achievement bringing about drastic savings in thermal energy. Next came suspension preheater technology with varying stages of cyclones. Dry process cement plants with 4 stage suspension preheater systems has already become common and there are now new plants equipped with double string 5/6 stage of preheater. The development in the area of pyroprocessing includes:

- Wet to Dry conversion
- Development of 5/6 stages preheater system
- Low pressure drop cyclone preheater system
- Improved multichannel / multifuel burners
- Development of Precalciners
- Development of high efficiency Clinker cooler

The typical specific heat consumption for various types of kiln option is given in Table 5:

KILN SYSTEM	HEAT CONSUMPTION KCAL/KG CLINKER
Wet process	1400 - 1500
Long dry process	1100 - 1200
4 stage cyclone preheater	800 - 850
4 stage cyclone preheater + Precalciner	780 - 850
5 stage cyclone preheater + Precalciner	720 - 750
6 stage cyclone preheater + Precalciner + High Efficiency cooler	Less than 700

Table 5 : Typical specific heat consumption in various Kiln systems

3.3 IMPROVED MATERIAL HANDLING SYSTEMS

Pneumatic conveying of pulverised materials has proved most attractive in fifties and sixties in Indian Cement Industry because of its low maintenance requirements and operating flexibility. Developments of new improved mechanical conveying system - bucket elevator has resulted in power savings upto 60-70%.

Typical values of power requirements for various conveying system is given in Table 6 :

TRANSPORT SYSTEM	TYPICAL POWER CONSUMPTION KWH/TONNE OF MATERIAL
Air slide	1.10
Dense Phase pump	0.53
Screw Pump	1.20
Bucket Elevator	0.41

Table 6 : Power requirements of various Material conveying systems

3.4 Instrumentation And Process Control

The Instrumentation and Process Control is a primary requirement to maintain and sustain energy conservation. The improved control system encompases large scope of technological improvements including instrumentation, automation, software and computer hardware. Installation of Expert Control Systems have also been taken up in some new plants and the overall operation and energy efficiency is reported to have improved tremendously with the introduction of such systems.

The installation of X-ray analysers, online bulk material analyser for effectively monitoring and controlling the quality of raw materials are recommended for improved operations in terms of consistancy of production as well as energy conservation.

3.4 Electrical Drives And High Efficiency Fans

Variable speed drives either DC or AC are available to save energy where machines like fans, kilns, coolers, feeders are required to run at different speeds for different outputs.

Energy efficient variable speed control of fans using electronic devices such as slip power recover systems (SPRS) and variable frequency invertor (VFI) is now possible and are now being used in many cement plants.
High efficiency fans with over 80-90% efficiency are now available in comparison to the 55-70% efficiency of conventional fans. High efficiency fans result in power saving.

4.0 ENERGY CONSERVATION - FUTURE OPTIONS

There is a considerable scope that exists for substantial energy conservation through adoption of energy efficient equipment/systems like roll press, 5/6 stage preheaters, high efficiency controls, etc. The other areas which need considerable attention for energy efficiency in cement manufacture are :

- Energy conservation by product substitution
- Energy recovery and reuse
- Use of alternative fuels

4.1 Energy Conservation By Product Substitution

Utilisation of waste by-products like fly ash and granulated blast furnace slags for the manufacture of portland pozzolana cement (PPC) and portland slag cement (PSC) result in substantial savings in specific energy consumption. The relative energy savings (typical) in % which can be effected by the product substitution is given in Table 7:

TYPE OF CEMENTS	% CLINKER / % SUBSTITUTION	ENERGY CONSUMPTION %	
		THERMAL	ELECTRICAL
Ordinary Portland Cement, OPC	100 / 0	100	100
Portland Pozzolana Cement, PPC	85 / 15	84	83
Portland Slag Cement, PSC	50 / 50	47	86

Table 7 : Typical Energy Savings by product substitution

4.2 Energy Recovery And Reuse

In cement plants use of exhaust gases from preheater/cooler has been in vogue for drying of raw materials/slag/coal while grinding for quite some time. However, use of these exhaust gases for production of electrical energy by installing waste heat recovery boilers and feeding steam to turbo alternators has still not found favours in Indian Cement Industry, presumably because of investment constraint and availability of technology.

With the energy scenario available, probably it is the time now for the industry to consider and go to energy re-use through co-generation.

4.3 Use Of Alternative Fuels

Coal, the major fuel for Indian Cement Industry, often has to be hauled over long distances sometimes even 1000 kms adding to the energy bill on this account. Further, since the tempo of industrialisation is steadily accentuating the demand for coal, thereby causing an imbalance in the supply situation and the deterioration in coal quality is making it difficult to sustain cement quality. It therefore, becomes imperative to look for alternate sources of fuel for sustained

production as well as for reduction in energy costs. In this context, use of lignite and natural gas appears to be most promising. The emergence of natural gas in India has also raised hopes to insulate the cement industry from the effects of high ash and varying quality of coal. Natural gas has the potential to be used either as the main fuel or as a sweetening fuel for modulating the quality of coal. Similarly, Indian lignites which are characterised by low ash content which is in the range of 5-15% on dry basis can be an effective source of fuel.

5.0 CONCLUSIONS

The technological developments in Indian Cement Industry have been very fast during and after eighties and industry is making all efforts to reduce energy consumption by adopting these developments. While encouraging results have been achieved in reducing energy consumption, much more is yet to be done. For improving energy efficiency the cement industry has to adopt.

- Energy efficiency designs for new plants
- Incorporation of energy efficient technology in existing plants
- Setting up norms and bench marking for further improvements

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