"Best Practices in Energy Efficiency in Cement Sector - A path for Decarbonization" under the Knowledge Sharing Platform initiative.

"INNOVATIVE METHODS/PRACTICES FOR ENERGY EFFICIENCY AND INCREASING PRODUCTIVITY IN CEMENT PLANTS."

BY- RAJNI KANT MANAWAT
(Ex. Technical Advisor- Dalmia Cement,
Ex. V.P. Shree Cement Ltd.)
Mob: +91- 94374 95279

Source: IBEF, Ministry of Commerce, GOI

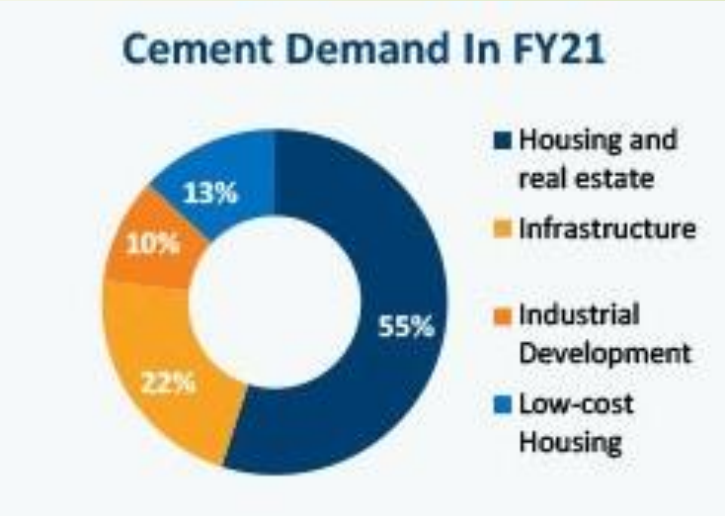
OVERVIEW: INDIAN CEMENT INDUSTRY

- Indian Cement Industry is internationally recognized as one of the most energy- efficient and environmentally friendly industry.
- 2nd largest Cement producer, next to China.
- Installed capacity of 545 Million Tonnes at present.

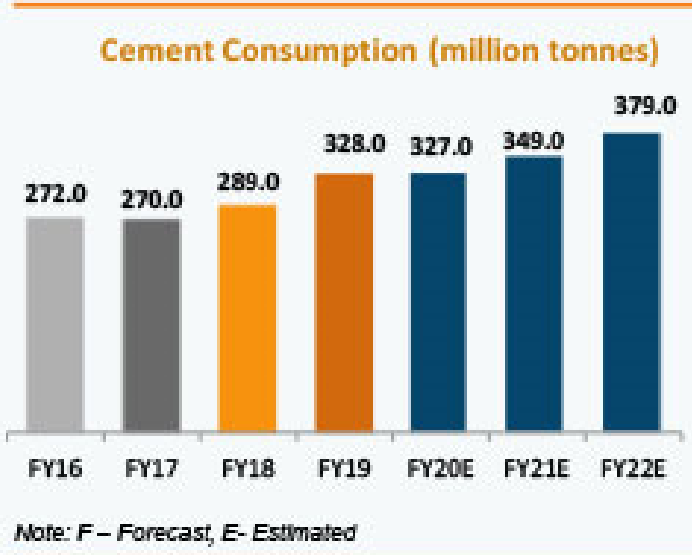
Source: IBEF, Ministry of Commerce, GOI

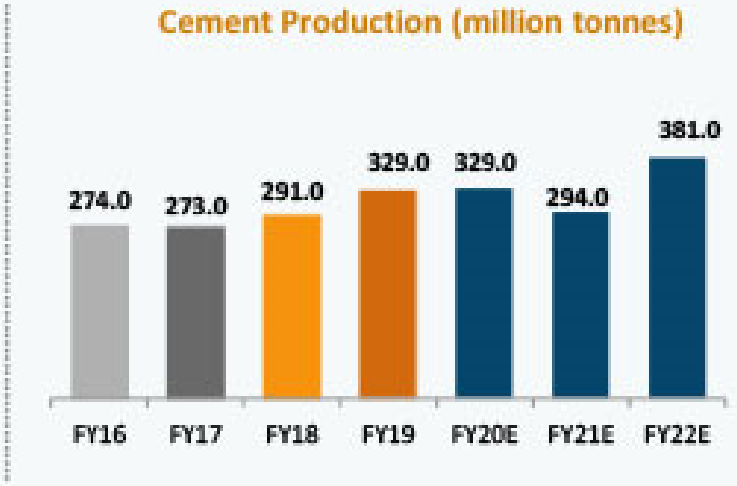
OVERVIEW: - INDIAN CEMENT INDUSTRY

- India's overall cement production accounted for 294.4 million tonnes (MT) in FY21 and 329 million tonnes (MT) in FY20.
- The demand of cement industry is expected to reach 550-600 MT per annum (MTPA) by 2025 and 800 Million Tonnes by 2030 under high demand scenario.



KEY TRENDS





Source: IBEF, Ministry of Commerce, GOI

OVERVIEW: INDIAN CEMENT INDUSTRY

- Indian cement plants are comparable with the best in the world in respect of production facilities, technology, energy efficiency.
- 99.5 % of installed capacity through dry process technology.
- Kiln Capacity ranging from 800-14000 TPD.

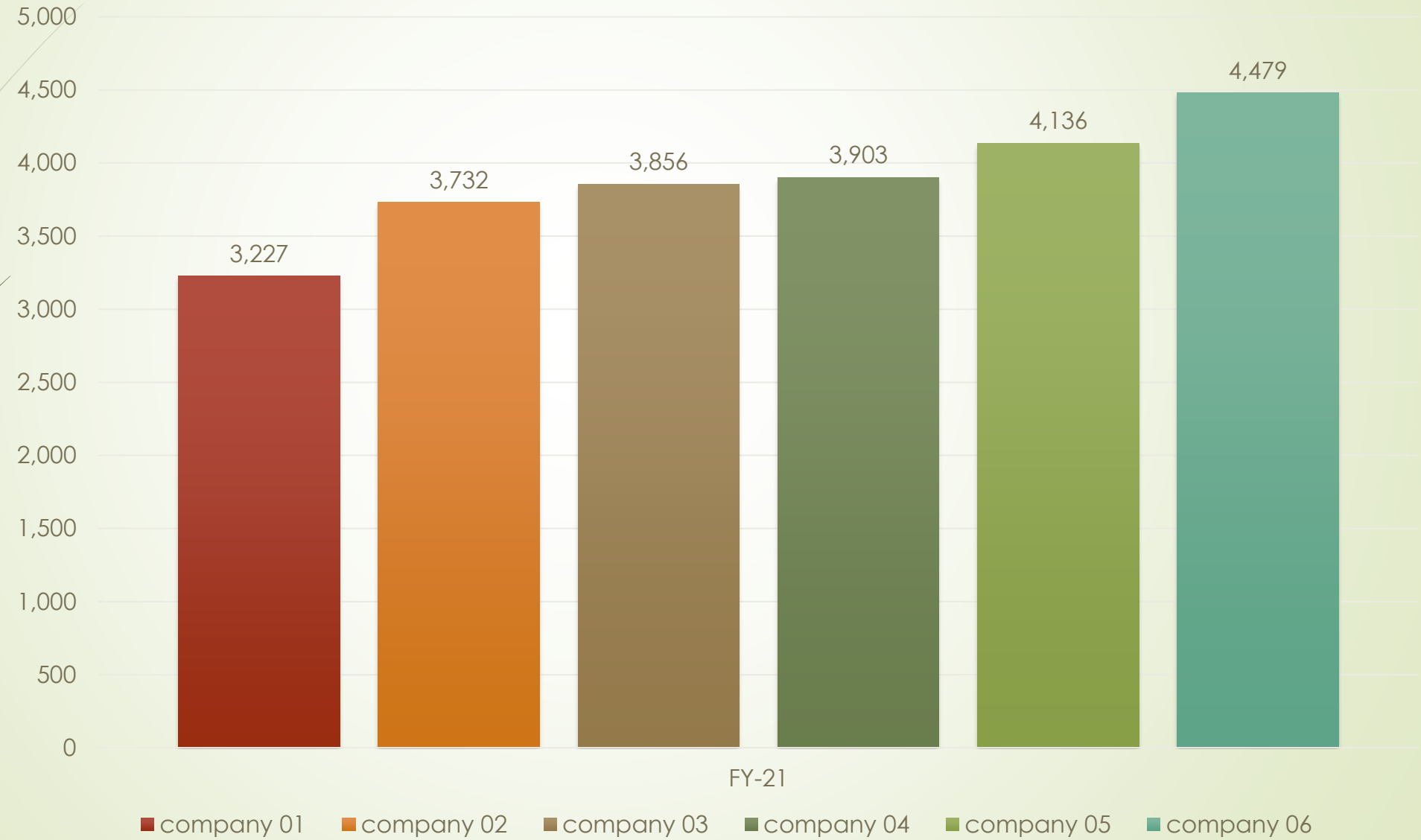
Source: IBEF, Ministry of Commerce, GOI

Conclusion of Study of 330 cement plants.

- Average per tonne of clinker power consumption 57 units. (Benchmark is 45 units)
- Average heat consumption is 741 kcal per tonne of Clinker and benchmark is 655 KCal/Clinker.
- Average cement grinding power consumption is 33 units but benchmark is only 18 unit.
- Best specific energy consumption levels achieved i.e 660 kcal/kg-Clk and around 47 kWh per tonnes of cement, which are comparable with the best achieved levels in the world.

Source: ICICI Direct Reasearch

COST OF PRODUCTION ON PER TONNE BASIS OF TOP CEMENT PLAYERS



	Global Technology Plants
Mining and Material Handling	Computer aided
Crushing	In-pit crushing & conveying
Conveying of Limestone	Pipe conveyors, Overland Belt conveyors
Grinding	VRM's, Roller Presses with dynamic classifier & Ball Mill
Pyro- Processing	Dry – 6/5 stage preheater – High Efficiency Cooler – Multi Channel multi fuel Burner – Co-generation of power – Co-processing of AFR – Low NO_x/SO_2 emission technologies
Blending & Storage	- Continuous Blending - Multi- chamber silos - Dome silos
Packing & Dispatch	- Bulk - Palletizing & Shrink Wrapping
Process Control	- DDC - Fuzzy Logic expert system

How cement is made ?

- Extracting raw materials
  - Crushing and transportation
- Raw material preparation I:
  - Storage and homogenization
- Raw material preparation II:
  - Drying and raw grinding
- Burning
- Cement grinding
- Loading and shipping
- Quality control and environmental responsibility

Source: CII 2021

Power Consumption in Cement Plant- Benchmark

BENCHMARKING NUMBERS			
Sr. No.	Section	Unit	Specific Energy Consumption (SEC)
1	Crusher	kWh/MT Limestone	0.58
2	Raw Mill - VRM	kWh/MT raw meal	10.64
3	Raw Mill – Roller Press	kWh/MT raw meal	12.99
4	Coal Mill – VRM-Pet Coke Grinding	kWh/MT Pet Coke	36.00
5	Six Stage Preheater-kiln SEC	kWh/MT Clinker	15.45
6	Six Stage Preheater – Clinkerization	kWh/MT Clinker	42.59
7	Thermal SEC (6 Stages)	kcal/kg clinker	676
8	Overall SEC upto Cement	kWh/MT Cement	56.10
9	Cement Mill – VRM(PPC)	kWh/MT cement	18.80
10	Cement Mill – VRM(OPC)	kWh/MT cement	24.00
11	Cement Mill VRM (PSC)	kWh/MT cement	31.90
12	Ball Mill(PPC)	kWh/MT cement	27.00
13	Ball Mill +RP(PPC)	kWh/MT cement	20.39
14	Packing Section	kWh/MT cement	0.58

THE CONCEPT OF ENERGY MANAGEMENT IS TO REDUCE THE LOSS OF ENERGY AND COST OF PRODUCTION. IT CAN BE DONE IN VARIOUS WAYS, SOME OF WHICH INCLUDE:

- Optimization of the cement production process at every level
- Optimal planning of production schedules
- Energy audit and analysis
- Usage of low-cost fuel or alternative fuel
- Recovery of heat and utilization
- Reduce specific power consumption

BEST PRACTICES FOR ENERGY EFFICEINCY DURING SHUT DOWN

- **Use Ceramic Paper for reducing radiation losses**
  - Paste the ceramic paper (5 mm Thick) on cyclones plates than apply the Calcium silicate blocks and ensure there is no gaps between blocks.
    - After that apply dense Bricks.
  - In calcination zone in Kilns- Ceramic paper can be used.
- **Reduce Al %**
  - Use the 30 to 40 % Al bricks in TAD and Preheater due to low thermal conductivity.
  - But use high % Al in bottom cyclone and pyro clone.
  - In Calcination zone use 40% Al bricks (For reducing the spooling also)
- **Use Heat Resistant paint to reduce radiation losses**
  - Kiln, PH Cyclones, TAD, Hood, Cooler
  - **Prevent Radiation Losses from Kiln Shell (1-3 Kcal/Kg-clg) by using heat resistant paints available in market**

Prevent Radiation Losses from Kiln Shell (1-3 Kcal/Kg-clg) by using heat resistant paints available in market

BEST PRACTICES FOR ENERGY EFFICEINCY DURING SHUT DOWN

- **Welding of cyclone down pipe flanges**
  - Welding of the cyclone down pipe flanges to avoid the false air. Check downpipe expansion joint (Telescopic plate).
- **Close the main doors & Pocking hopes properly.**
  - During shut down all main doors and pocking holes should be close with asbestos / Ceramic ropes.
  - Use graphite ropes in flaps movement area.
  - If possible, do bricks lining in main doors then close the doors.
- **Check all down pipes flaps**
  - If found any damage, it should be replaced/repaired to avoid short circuiting of flue gases.
- **Check dispersion plates**
  - During shutdown all dispersion plates to be checked. If found damage or de-shaped, the needs to be changed.
  - Side gap of dispersion plate to castable should be minimum to avoided material dropping
- **Kiln inlet outlet seal**
  - Both Kiln outlet and inlet seal should proper maintenance during shut down for reduce false air

BEST PRACTICES FOR ENERGY EFFICEINCY DURING PLANT OPERATIONS

- **PH outlet Temp.**
  - PH out let temp should be in limit. If PH out let temp is high means heat loss
- **Clinker Temp.**
  - Clinker temp should be 80 +/- ambient temp.
  - If clinker Temp. is high we waste the heat (Can be used in cooler boilers)
- **SAT**
  - Always try to maintain SAT 1200 deg, Higher the temp means low required fuel &
    - Kiln became more stable & Lowers the heat consumption
- **TAT**
  - Always try to maintain TAT 900 deg plus, Higher the temp means low required fuel
    - Kiln became more stable & Lowers the heat consumption

BEST PRACTICES FOR ENERGY EFFICEINCY DURING PLANT OPERATIONS

- **Oxygen %**
  - Kiln should be run in oxidizing condition but excess O2 increases the fuel consumption.
  - At Inlet 1.5--2.2 % O2 is more then sufficient,
- **Close monitoring of False air**
  - Install gas analyzer in all sections and do close monitoring.
  - False air display in CCR on LCD TV with monitory loss per day.

PROBLEMS CAUSED BY FALSE AIR INFILTRATION

- Increase PH exit oxygen
- Decrease PH exit temp.
- Increase PH fan power
- Decrease oxygen and tendency of forming CO at kiln inlet
- Cyclone 6 material temperature decrease
- Gradual decrease of BZT
- High free lime

HEAT RECUPERATION

- Heat recuperation is a process of recovering heat from the cooler.
- Cooler uses large volume of air to cool clinker. cold air passes over the hot clinker. hence clinker temperature reduce and air temp. increases.
- Hot air used as a secondary air in kiln, tertiary air in calciner and hot gases to mills WHRB.
- The degree of heat recuperate indicate the efficiency of cooler.
- Temperature of clinker leaving from cooler is lesser that the cooler efficiency is high.

PROCESS PARAMETER DEPENDS ON.

- Clinker temperature at cooler inlet.
- Clinker bed distribution.
- Grate speed .
- Cooling air flow and distribution.
- Cooling air temperature.
- Clinker granulometry.

For perpetual pyro process in a kiln the heat required is only heat of clinker mineral formation, ie., **380 - 400** Kcal/kg clinker. **280 – 350** Kcal/kg clinker is wasted which is about 40 - 45 % .
The dream of design engineer is to make heat losses to minimum and how to optimize the heat consumption.

CONCLUSION

- "It is desirable to operate the kiln at the lowest fuel consumption. This must be consistent with the highest practical output at an acceptable market quality."

Rajni Kant Manawat
PROCESS EXPERT SERVICES
Mob: +91- 9437495279
Off.: G-2, Anant Sneh Heights,
New Navratna complex, Bhuwana,
Udaipur- 313004, Rajasthan
Email: manawatrk@gmail.com