EXPOSURE DRAFT GUIDANCE NOTE ON INTERNAL AUDIT OF CEMENT INDUSTRY

The Institute of Cost Accountants of India

(Statutory Body under an Act of Parliament)

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1 INTRODUCTION

1.1 Introduction

India is second largest producer of cement in the world. Cement is one of the core industries which consumes high amount of energy (fuel and power). Conserving the natural resources is one of the important aspects of any industry. Cement industry is the largest consumer of limestone. There are several aspects which differentiates Cement Industry fromany other normal manufacturing industry.Hence, it is important that any internalauditor conducting internal audit of a cement industry must clearlyunderstand the details of these processes to be able to conducteffective internal audit

1.2 Objectives of this Guidance Note

- ✓ To create understanding about cement industry
- ✓ To create understanding process of manufacture
- ✓ To update on latest technological changes in cement industry
- ✓ To facilitate to conduct internal audit in an efficient manner
- ✓ To establish objectivity of approach towards consistency in audit
- ✓ To facilitate an easy approach of internal audit function of the industry
- ✓ To develop and monitor control frameworks of the industry
- ✓ To support corporate governance of cement industry

1.3 Scope of the Guidance Note

This guidance note is prepared based on the practical experience in the industry focusing on nature of the industry internal controls, checks and balances and

operational aspects applicable to cement industry. Though there are many types and grades of cement, in this guidance note focuses much on OPC and PPC and 43 and 53 grades

2 OVERVIEW INTERNAL AUDIT

2.1 Definition of Internal Audit

As per Institute of Internal Auditors (IAA) Internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes.

Internal Audit is continuous process of appraisal of an organization's operations, evaluation and monitoring of risk management reporting and control practices. It is an independent and objective oriented assurance and consultancy activity designed to add value and improve an organization's operations

2.2 Objectives of Internal Audit

- Reviewing the operational efficiency and efficacy of internal control system of the organization
- Assessing risk management and to ensure that risk management processes are efficient, effective, secure, and compliant.
- Examining and evaluate company's framework of risk management, internal control and governance processes are adequate and functioning properly.

- Advising and recommending the management for improvements in internal control and Internal Financial Controls on Financial Reporting.
- Safeguarding the assets of the entity.
- Reviewing and ensuring adequacy of information systems security and control.
- Evaluating the enterprise performance.
- Ascertainment of the extent of compliance of policies, procedures, regulations,andlegislations.Checking compliance management systems of an organization.
- Achieve savings by identifying waste, inefficiency, and duplication of effort across the organization.
- effort across the organization.

2.3 Scope of Internal Audit

- The scope of Internal Audit is based on size of the company and nature of organization in line with the vision, mission, and values.
- The scope should in commensurate with the efficacy of internal control system in vague in the company
- Scope further depends on level automation and availability information system adapted in the company

- Scope shall be within the framework of the assignment given by the Board or audit committee
- Scope further depends on special assignment as directed by the Board / Audit Committee.

2.4 Methodology

2.4.1 Understanding the business

The internal audit team must be given access to all the records, systems, information, staff of the organization to obtain the overall basic understanding of the business. This will be giving a fair view of the business and facilitate formal and informal information of the business.

2.4.2 Identifying the risk areas

As understood the business from the above steps a plan must be made how to conduct audit and focusing on risk areas. For this purpose, the internal audit team must categorize the audit areas into low risk, moderate risk and high risk and accordingly team must be allocated with concurrent communication among the team members.

2.4.3 Analyzing the process and controls

Audit methodology shall include examination of documents, analysis of trend data, and verification of assets, interaction with process owners and linkage between the business processes. As far as possible the internal audit team must use computer-based tools to analyse data and various trends.

2.4.4 Communicating and Recommendation through Report

The internal audit team must be communicating the process owners, division or department heads and notifying them the deficiencies if any identified during the audit from time to time. The team must circulate draft report and obtain clarification on the draft. Upon the finalization of draft, final report shall be circulated to the top management along with recommendations for improvements if any.

2.5 Planning

Well planned is half-done. So planning is very important to complete the audit within time limit and with use of optimum resources with quality reporting. The audit plan should flexible enough to take care of any unforeseen events and any additional auditing-in-depth activities to be done. A well-drawn audit plan in discussion with the team members will help in covering all the areas given in the audit scope, devote proper time and thought on the given assignment. It also helps in completing the audit assignment in a cost-effective manner. The entire audit work involves 4 stages i.e., (1) Planning (2) Execution (3) Reporting and (4) Tracking (Follow-up). The PERT model.

At the Planning Stage:

- Understand the objectives of the Internal Audit Assignment
- Understand the scope of assignment from the engagement letter
- Understand the team required whether any cross-functionals required
- Understand the recent developments of the Statues applicable

- Understand the recent development in the industry and technology
- Understand the Business Processes
- Understand the overview of the Internal Control System
- Conduct an initial meeting with stakeholders

2.6 Sampling

Audit sampling is application of audit procedures to less than 100% of items within a population of audit relevance such that all sampling units have a chance of selection in order to provide the auditor with a reasonable basis on which to draw conclusions about the entire population.

The use of sampling in auditing is widely adopted as it facilitates the auditors to obtain minimum amount of evidence to perform maximum level of audit. In selecting sample auditor must exercise utmost care as selection wrong sample leads to drawing wrong conclusion about the entire audit work. The audit team can follow either statistical sampling or non-statistical sampling or combination of both based on size of the business and the extent of complexity involved. Statistical sampling uses theory of probability on the other hand non-statistical sampling largely depends on auditors' experience and judgemental capacity.

2.7 Evidence

Audit evidence helps the auditors to form a strong opinion of the control system and acts as a proof of the transaction performed. Evidence can be formal or informal, written or verbal. Evidence should be sufficient, reliable, relevant and

from a right source. Types of audit evidence are (1) Physical examination which means physical examining of a workplace, inventory asset etc the auditor would like to see or seen. (2) Documentation is the verifying documents such as sales invoice, purchase invoice, journal voucher, bank statement etc. (3) Analytical Procedures acts as corroborative evidence and helps in forming an opinion and deciding whether an area of operation or function requires auditing in depth or not. Analytics sometimes also helps in judging the internal control system (4) Confirmations are mostly obtained from third parties such as banks, insurance agencies vendors or customers to establish the authenticity of the transactions (5) Observations and (6) Enquiries are another way collecting information from employees, management third parties etc depending on the seriousness of the transactions and risk involved.

2.8 Analytical Procedures

Analytical procedures are evaluation of financial and non-financial, qualitative, and quantitative information to establish a relation between business process, transactions. These are used to assess the risk, to conduct effective tests, to understand the efficacy or otherwise of the internal control system. In the modern-day audit big data and data analytics pay vital role performing analytical procedures. With the automated statistical calculations, data can be uploaded to the application and the system given results drive the conclusion.

2.9 Documentation

Audit documentation is the record of audit program, planning evidence collected, methodology followed, analysis made conclusions drawn, reply received on draft report etc. The documentation can be electronic or physical. Electronic documentation eases the work of documentation, faster communication and quicker access. Documentation can be divided into master documents and transactional documents Review of following key documents and reports will be helpful to decide scope of internal audit of cement industryThis list is not an exhaustive one but an indicative.

Name of the document	Source Department
Memorandum of Association	Corporate / Secretarial
Articles of Association	Corporate / Secretarial
AGM /EGM Resolutions	Corporate / Secretarial
Board Minutes	Corporate / Secretarial
Organization Chart	Corporate / Secretarial
Standard Operating Procedures	Respective Departments
Delegation of Authority Manual	Finance & Accounts
Accounts Manual	Finance & Accounts
Costing Manual	Finance & Accounts
Annual Operating Plan (AOP)	Finance & Accounts
Procurement Manual	Purchase / Commercial
Stores Manual	Purchase / Commercial
Rate Contracts of raw materials viz, iron ore	Purchase / Commercial
Human Resources Manual	Human Resources
Mining Lease Approval	Mines Department
Weight & Measures Approval	Quality Control / Assurance
Consent for Authorization (CFO)-Pollution Control	Quality Control / Assurance
Mining Lease Agreements	Mines Department
Quantity of Limestone Raised and Transported	Mines Department
Production Reports for the period	Production Department
Power Purchased & Generated Reports	Production Department

Power purchase agreements for IPPs	Production Department
SOPs of various departments	Respective Departments
Ageing Analysis of stores inventory	Stores Department
Warehouse & Transportation Agreements	Logistics Department
Despatch Reports for the period	Logistics Department
Dealer Folders (Trade Segment)	Respective Sales Branches
Agreements with Direct Parties (Non-Trade)	Sales & Marketing Dept
Export Contracts	Sales & Marketing Dept.
Ageing Analysis of Customers	Sales & Marketing Dept.
Agreements relating to various advertisements	Sales & Marketing Dept.

2.10 Internal Audit Report Contents and Follow-up

I. *Executive Summary*

- Provide a summary of the audit assignment preferably not exceeding two pages however depending on the size of the organization

II. *Audit Scope*

- Clearly elaborate the audit scope, this a key to understand the areas of audit covered

III. *Audit background*

- Describe the background of the assignment whether routine audit or special assignment or any reason for conducting the audit

IV. *Audit Methodology*

- Clearly explain the methodology of the audit conducted, viz tools used, samples drawn, interactions made with officials etc,

V. *Summary of Audit observations*

- Provide a summary of audit observations of each area preferably dividing into observations of operational areas, functional areas, taxation, compliances etc., in the following format

Sl.No.	Observation in brief	Details of observation	Response from Auditee

VI. Limitations

- Describe any limitations during the audit

VII. Details of audit observations as Annexures

- Provide transaction-wise list of instances preferably in the form of annexure substantiating the observations mentioned

VIII. Recommendations for Improvement

- Based on the information and explanations received, provide recommendations for improvements in the operational areas, processes.

IX. Financial Impact

- Based on the above, quantify the impact in financial terms if possible and report the same in this part

X. Risk grading and Dashboard

- As far as possible, understand the risks and grade them in High, Medium, and Low with color codes Red, Orange and Green respectively

XI. Conclusion

- Give conclusive remarks in this section

XII. Action taken report

- Please note the actions taken on the observations made in the earlier reports and their adequacy or otherwise

3 GLOSSORY OF TERMS IN CEMENT INDUSTRY

3.1 Cement

The word Cement originated from old French Ciment from Latin Caementum (means quarry stone, stone chips making mortar). Cement is a bonding material that would bind stones, bricks etc into solid mass. The Egyptians discovered lime and gypsum mortar as a binding agent for building structures such as Pyramids. The Greeks made further improvements and finally Romans developed that produces structures of long durability. Finally, in the year 1824 Joseph Aspedin patented basic process of slow-setting cement. He named it as 'Portland Cement' due to the fact of its appearance and hardness it resembled the upper Jurassic rock found in the region of Portland in Southern England (*Lafarge 2004*)

3.2 Types of Cement

Presently there are more than 20 types of cement available in India which are used in modern construction based on their utility and purpose. In India, there are 16 types of cement in use which are detailed below

3.2.1 Ordinary Portland Cement (OPC)

This is the most common type of cement manufactured all over the World. This is basically used for masonry works including plastering to give fine finish of walls, structures etc.

3.2.2 Portland Pozzolana Cement (PPC)

This is a variation of Ordinary Portland Cement (OPC) which also includes pozzolanic material fly ash generated from thermal power plants, rice husk ash

and volcanic ash. In India fly ash is the most used pozzolanic material. PPC is used as a replacementof OPC in some cases also used mass constructions, underwater constructions like bridges, dams etc

3.2.3 Portland Slag Cement (PSC)

Slag is used in manufacturing Portland Slag Cement. It is less expensive than OPC and is also less heat of hydration. It is used in mass constructions such as dams, water treatment plants, marine offshore structures etc.

3.2.4 Rapid Hardening Cement

It is a high strength cement it has got similar properties that of OPC but more fineness than OPC. Due to this property it helps in gaining early strength. It is basically used in prefabricated construction such as flyover prefab castings, railway track beams etc.

3.2.5 Extra Rapid Hardening Cement

Calcium Chloride is added to get extra hardening and it gives comprehensive strength. It is used in cold weather concreting.

3.2.6 Quick Setting Cement

Quick setting cement is faster when compared to OPC or PPC. It is basically used where quick setting is required due to rainy weather conditions and structural repairs.

3.2.7 Low Heat Cement

This cement releases low heat of hydration and has got more initial setting time as compared to OPC. It is used for massive constructions such as gravity dams, thick pavements, hydraulic structures, retaining walls etc.

3.2.8 Sulphate Resisting Cement

Sulphate Resisting Cement is advisable in the areas where concrete is vulnerable to sulphate attack. It is used where concrete has exposure to seacoast or saline ground water.

3.2.9 High Alumina Cement

High Alumina Cement is obtained by melting bauxite during manufacturing OPC. It attains high strength in lesser time when compared to OPC. It is used where concrete structures are subjected to high temperature workshops, refractories, foundries etc

3.2.10 White Cement

White Cement is obtained by adding lime and China Clay in more quantities while manufacturing. It is expensive when compared to OPC and is used in architectural purposes, tile grouting, time adhesive etc.

3.2.11 Coloured Cement

Coloured Cement is obtained by mixing 5 to 10% mineral pigments to OPC. These pigments impart colours to cement. It is used in grouting of tiles, colour combinations matching tiles, decorative works etc.

3.2.12 Air Entraining Cement

Various air entraining agents such as resins, glues are added along with clinker to produce air entraining cement. It is used basically to fill-up gaps in concrete works due to excessive amount of water during casting of concrete members.

3.2.13 Hydrophobic Cement

Hydrophobic Cement is made by adding admixtures such as naphthalene soap, acidol, oxidised petroleum etc., to OPC. It is used in extremely wet conditions, in cold and rainy weather conditions. In India it is mostly used in North Eastern States.

3.2.14 Masonry Cement

This cement is produced by adding plasticising material such as limestone, hydrated lime in the clinker during manufacturing OPC. It remains in plastic state for longer time so that masonry unites can be placed properly.

3.2.15 Expansive Cement

OPC shrinks after setting due to which cracks can be formed. Expansive Cement is used to avoid formation of shrinkage cracks. Expansive Cement expands as it starts setting and does not shrink during and after hardening. This is used to avoid shrinkage cracks while grouting anchor bolts and pre-stressed concrete ducts.

3.2.16 Oil Well Cement

Oil Well Cement is manufactured by adding retarders to OPC. There is no chemical effect of oils on oil well cement. It is used in under high temperature and high-pressure conditions and is mostly used by petroleum industry to fill gaps between rocks and steel castings of the oil wells.

3.3 Grades of Cement

There are three different grades of cement based on their compressive strength. The grade of cement is differentiated in terms of strength. The strength of

cement generally measured as compressive strength. Compressive strength is the strength of cement moulded in a standard cube after 28 days. Compressive Strength is measured in Mega-pascal (Mpa) or in N/mm² (Newton per Square Millimetre)

3.3.1 33 Grade Cement

33 grade means the compressive strength of the cement after 28 days is 33 N/mm² when tested as per Indian Standards under standard test conditions. This grade is used for general construction work under normal environment. However, due to availability of higher grades, 33-grade is not manufactured in India.

3.3.2 43 Grade Cement

When tested as per Indian Standards under standard test conditions. This is used for plain concrete work and plastering work. It is used where setting time is not a necessary criterion.

3.3.3 53 Grade Cement

53 grade means the compressive strength of the cement after 28 days is 53 N/mm² when tested as per Indian Standards under standard test conditions. 53 grade cement has faster setting time when compared to 43 grade cement. It is mostly used for structural purposes and Reinforced Cement Concrete (RCC).

3.3.4 Acronyms

Acronym	Description
AFR	Alternate Fuels & Raw material
BIS	Bureau of Indian Standards
BoM	Bill of Material
C&F	Clearing & Forwarding
CFO	Consent for Authorization
CMA	Cement Manufacturers Association
CMA	Cost & Management Accountant
CMD	Contracted Maximum Demand
ERP	Enterprise Resource Planning
ESP	ElectrostaticPrecipitator
GCT	Gas Conditioning Tower
GCV	Gross Calorific Value
GPS	Global Positioning System
IPP	Independent Power Producers
kCal	Kilo calorie
KCS	Kiln Control System
KPI	Key performance Indicators
KwH	Kilo-watt Hour
MCS	Mill Control Systems
Mpa	Mega-pascal
N/mm^2	Newton per Square Millimetre
OPC	Ordinary Portland Cement
PA Fan	Primary Air Fan
PLF	Plant Load Factor
PMO	Project Management Office
PPC	Portland Pozzolana Cement
PSC	Portland Slag Cement
RFID	Radio Frequency Identification
RCC	Reinforced Cement Concrete
RoI	Return on Investment
RPA	Robotic Process Automation
UHV	Useful Heat Value

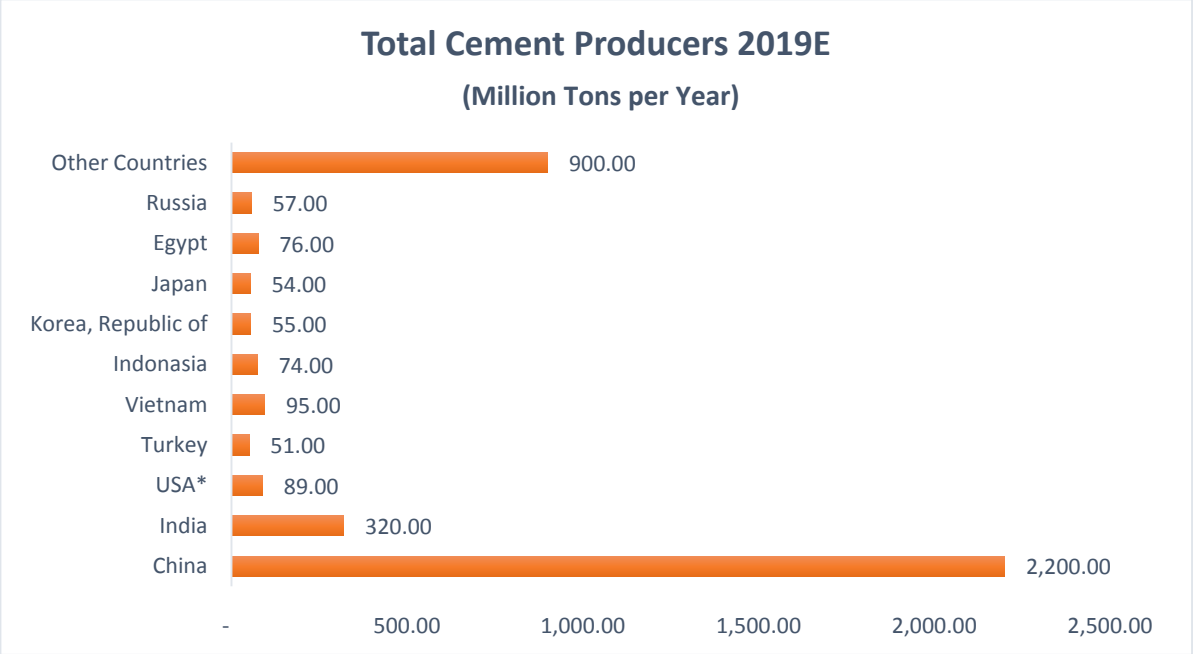
VRM	Vertical Raw Mills
XRF	X-Ray Fluorescent

4 OVERVIEW OF CEMENT INDUSTRY

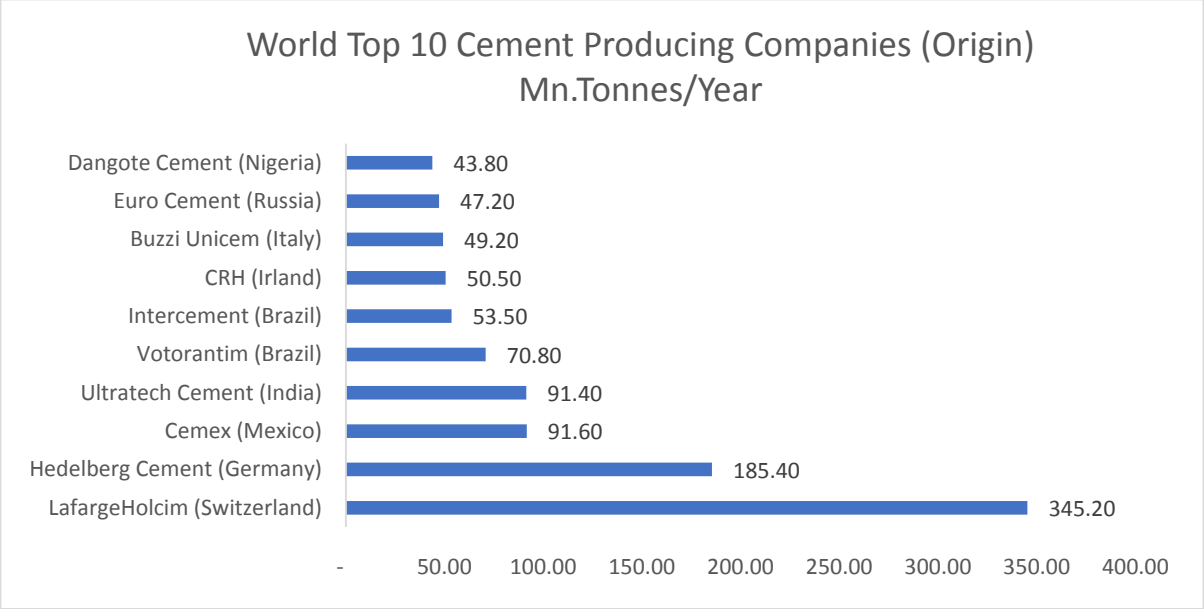
4.1 Overview of World Cement Industry

There are 159 countries and territories produces cement either through integrated cement plants or grinding of imported clinker in 2017. World cement industry has seen consolidation in last three years, the latest acquisition was Italcementi by Hidelberg Cement.

There are 2,948 cement plants across the world producing cement with a combined capacity of approximately 4 Billion Tonnes per year. While China taken the lead with highest production in the world, India stood at 2nd position.



Note: *E –Estimate, * Includes Puerto Rico: Source: Cement Manufacturers Association, USGS Mineral Commodities Summary 2019, CRISIL*

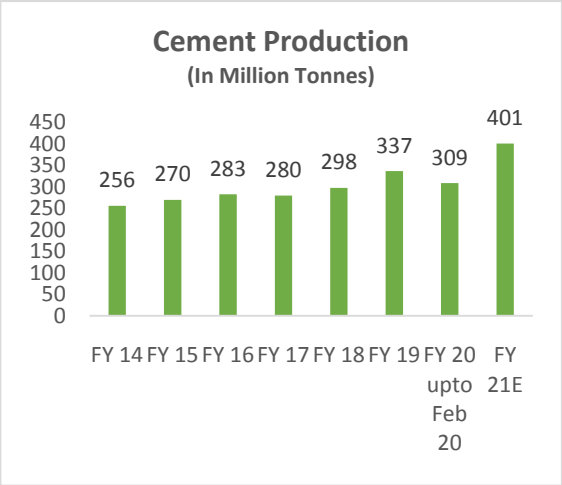


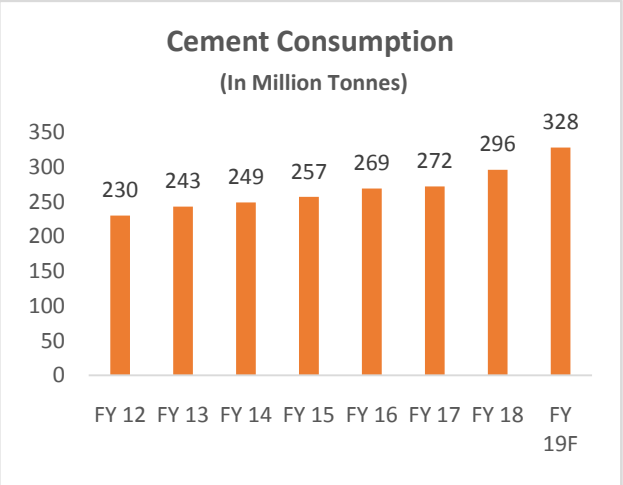
Source: Beta Version of Global Cement Directory 2018

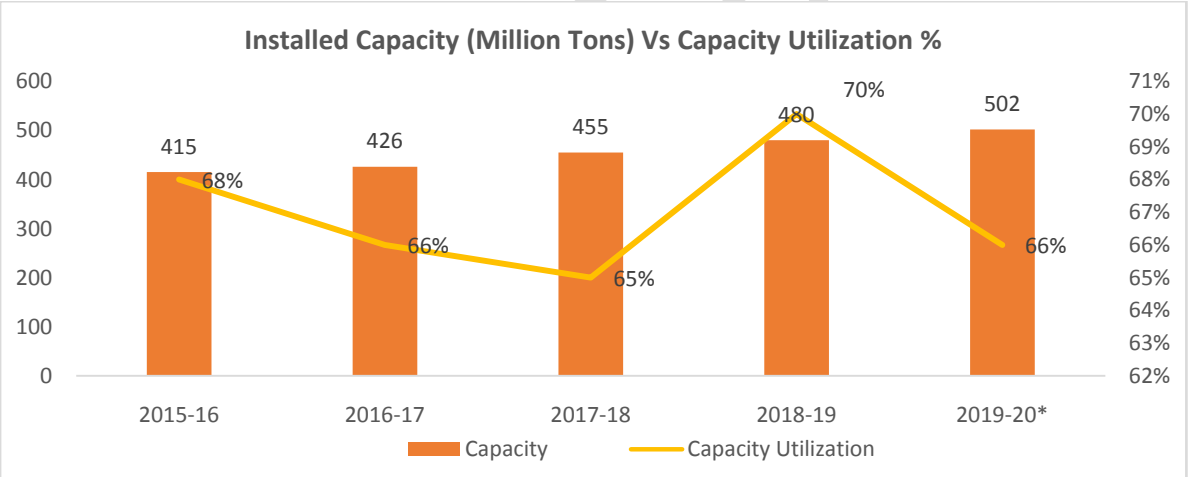
4.2 Overview of Indian Cement Industry

With nearly 320 Million Tonnes of cement production capacity, Indian cement industry is the World second largest producer of cement after China. Indian Cement Industry is engaged in production of many of the aforesaid type of cement and 43 and 53 grades of cement as per the specifications set by Bureau of Indian Standards (BIS) and the quality on par with best in the World. It is expected that by the year 2020 cement production in the country may touch 550 Million. Approximately 98% of the capacity is in the private players and the rest is in the hands of public sector in India. Currently, India has 185 large and more than 365 mini cement plants with united Andhra Pradesh leading with 40 large cement plants. Almost 94% of the production is met by large plants and the rest is met by mini plants. The North-Eastern (NE) region of the country is consistentlycement deficit for several years and is met with cement purchases from otherStates of the country. Another important feature of cement industry

in India is, it is cyclic in nature. The consumption is closely correlated to climatic conditions. The demand peaks in March, April and May and touches lowest in the months of August and September.

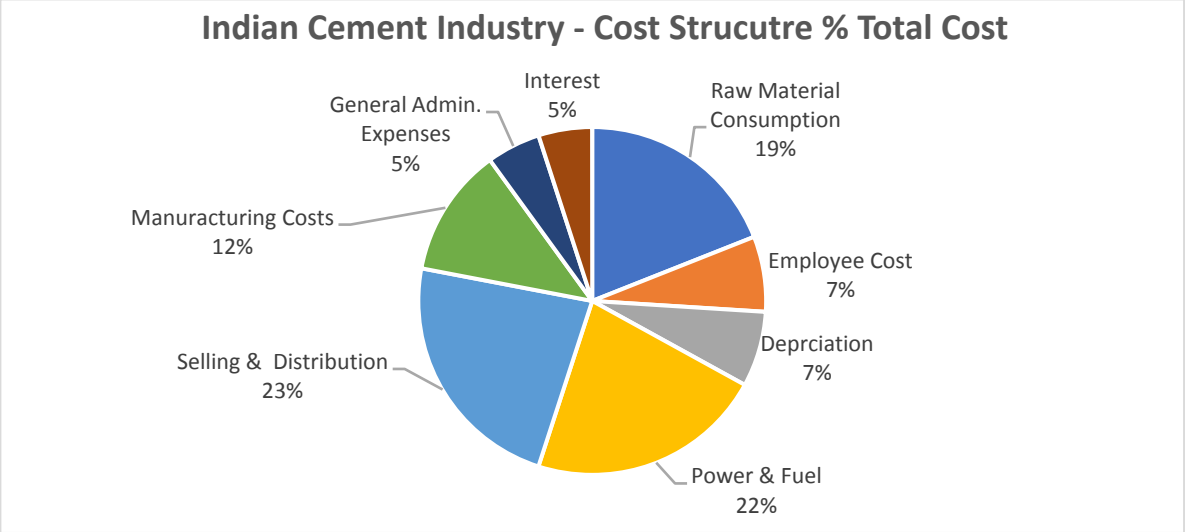






Source: CMA, Exchange Filings, CARE Ratings ** April 2019-January 2020 (% rounded-off)*

As per Cement Manufacturers Association (CMA), Indian Cement industry is sitting on 150 Million Tons surplus capacity. Capacity utilization is a challenge in the current situation of rate of consumption of cement in India



Source:https://blog.pawealthadvisors.com/2019/11/17/cement-industry-cost-structure/

4.3 Government Rules & Policies

To boost the cement industry government has taken many steps to increase the consumption of cement. In the latest union budget 2020-21 Government has extended benefits under section 80 IBA of the Income Tax Act till March 2020 to promote affordable housing. The Union Budget has allocated Rs 139 billion for Urban Rejuvenation Mission AMRUT and Smart Cities Mission. Government's infrastructure push combined with housing for all by the year 2022, Smart Cities Mission and Swachh Bharat Abhiyan is going to boost cement demand in the country. The move is expected to boost the demand of cement from the housing segment.An outlay of Rs 27,500 crore has been allotted under Pradhan Mantri Awas Yojana in Union Budget 2020-21 will accelerate the industry.

4.4 Legal and Regulatory Framework

Cement industry is widely under the lens of various regulatory and policy issues. It is being one of the major consumers of natural resources, regulatory aspects of environmental protection, mines, pollution control are the major challenges apart from various labour and other laws

4.5 Technological Developments

Good understanding of technology evolution and process of manufacture enables Cost and Management Accountants (CMA) a grip over techno commercial aspects of the company or unit or a factory. Having knowledge about the product, components, engineering, and chemical composition eases the preparation of cost statements, maintenance of cost records and accelerates the audit process. Keeping in view of this, the following details with flow charts are made available about technology evolution of cement and process of manufacture. There are broadly three process technologies 1) Wet Process 2) Semi-dry Process and 3) Dry-Process. However, we will be discussing about Wet Process and Dry Process only.

4.5.1 Wet Process

In wet process raw materials are homogenized by mixing, crushing, and grinding and blending so that approximately 75% to 80% of raw material is sieved. The crushed and sieved material is then mixed with 30% to 40% of water to make it slurry (paste). The slurry is then heated at a temperature between 1,500°C 1,600°C in horizontally revolving kilns. Coal or petroleum or natural gas are used in for burning to generate required heat in the kiln. High

fuel requirement to evaporate 30+% slurry water. Wet Process is easier to control chemistry and better for most of the raw materials, however, due to high consumption of water, fuel and low productivity, wet process has become uneconomical and it is obsolete

4.5.2 Dry Process

Dry process is a significantly advanced technology compared to wet process. In dry process raw materials are firstly crushed and reduced to required size in crushers. Dry air is then passed through these raw materials. There materials are pulverized into fine powder in ball mills and tube mills and stored in hoppers and then sent to Kiln for further processing

4.5.3 Difference between Wet Process Dry Process

In case of Wet process, the physical state of raw mix (Slurry) will be in liquid state and in case of dry process the raw mix (raw meal) will be in solid state. Due to this reason, process time in wet process will be more than the dry process. As a result, power, fuel, and water consumption in wet process is significantly higher than dry process. Cost of production in wet process is higher when compared to dry process

4.5.4 Different Kiln Systems

Kiln is heart of the cement plant, over a period Kiln system evolved. Initially they were long wet kilns with high energy consumption of 1300-1650 Kcal/Kg and power consumption of 17-25 KwH/Ton. The next level it moved to Long Dry with energy consumption of 1100-1300 Kcal/Kg with power consumption

of 20-30 KwH/Ton. It was improved further to LEPOL energy consumption of 950-1200 Kcal/Kg with power consumption of 30 KwH/Ton. Further with Cyclone Preheater energy consumption750-900 power consumption of 25 KwH/Ton and currently Pre-calciner energy consumption achieved at 700-850 Kcal/kg and power consumption at 25 KwH/Ton

5 PROCESS OF MANUFCTURE

5.1 Cement Manufacturing Stages

Cement Manufacturing involves mainly three stages.

Stage 1: Raw Material Preparation

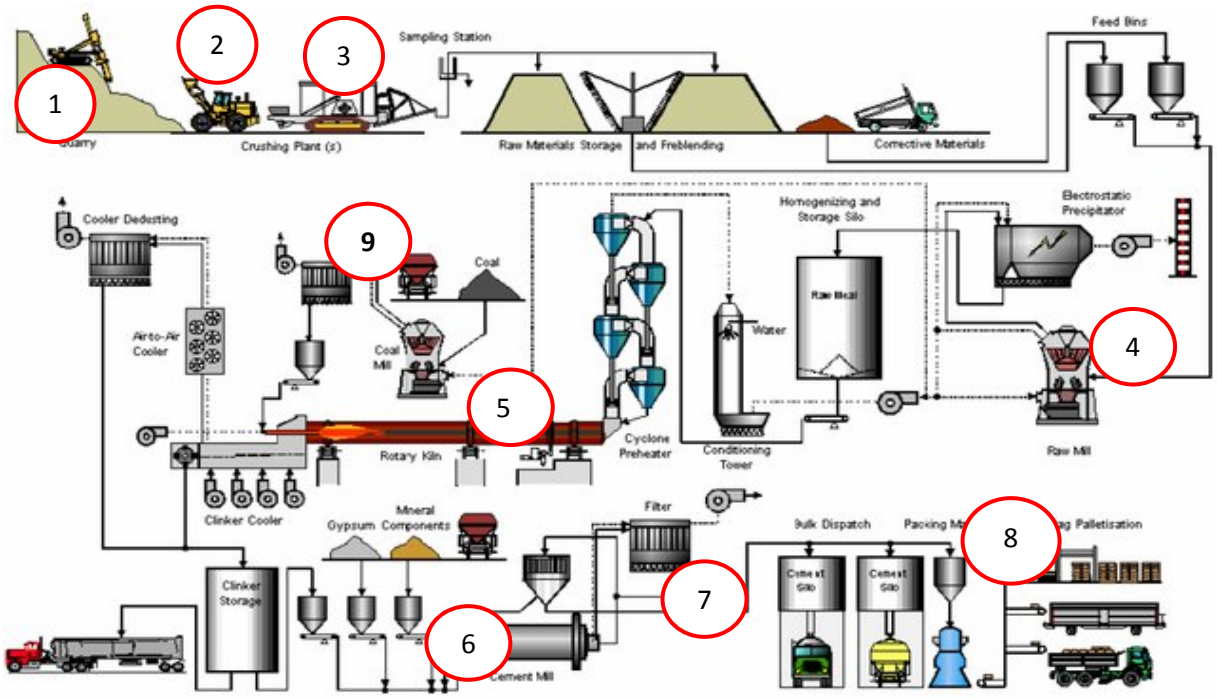
Stage 2: Pyro Processing and Cement Grinding

Stage 3: Cement Grinding and Despatch

In stage 1, required raw material are crushed mixed and homogenised through milling process. In stage 2, after performing milling operation as above, a fine power is produced called as raw meal, and then preheated to required temperature where chemical reaction takes place to form an intermediate called clinker. In stage 3, a small percentage of gypsum is added to clinker and finely grounded in cement mills. Some other additives in small percentages are also added at this stage to produce various types of cement. The fine grounded powder is called cement.

Further, cement manufacturing broadly involves the following processes

1. Mining or querying 2. Transportation 3. Crushing 4. Raw Meal Grinding
5. Clinkering 6. Cement Grinding 7. Cement Storage 8. Packing *9. Coal Mill*



Cement Manufacturing flow chart *(Source:*https://www.cementequipment.org)

5.1.1 Portland Cement Chemical Composition

Cement is a mixture of Calcium Oxide (CaO), Silicon Dioxide (SiO_2) Aluminium Oxide (Al_2O_3), Iron Oxide ($Fe2O_3$), Water (H_2O) and Sulphates (SO_3) and Gypsum ($CaSO_4.2H_2O$). Clinker is an intermediate product for manufacture of Cement.

5.1.2 Clinker Chemistry is as follows

Material Name	Chemical Notation	Composition (% of Clinker)
Tricalcium Silicate	$3CaO.SiO_2$	50 to 70
Dicalcium Silicate	$2CaO.SiO_2$	15 to 30
Tricalcium Aluminate	$3CaO.Al_2O_3$	05 to 10
Tetra calcium Alumina ferrite	$4CaO.Al_2O_3.Fe2O_3$	05 to 15

5.1.3 Influence of Mineralogical Composition

Category	Nature	Material Content
Principal	Calcareous	Limestone, Chalk, Marble, Shell, Sledges etc
Principal	Siliceous	Clay, Sandstone, Phyllites, Rocks, Fly sash, Shale
Supplementary Correctives	Argillaceous	Bauxite, Laterite, Iron Ore, Cinders
Special Additives	Grinding Aid	Triethanolamine Sodium Polyphosphate
Special Additives	Mineraliser	Sodium Fluorosilicate

5.1.4 Influence of Mineralogical Composition

Mineral	Influence
Calcium Carbonate	Crystalline Calcite & Marble Dissociate at Higher Temperatures Compared to Amorphous Limestone
Silica & Silicates	Increase of Silica in Raw Mix By 1.5% (As Free Quartz) Reduces C_3S by 20% Silicates React More Readily Than Free Silica / Quartz
Magnesium Compounds	Presence of Magnesium Silicate Ensures Even Distribution of Fines Periclase Crystals
Aluminosilicates of Clay	Combined Source of Silica & Alumina in Reactive Form on Breakdown of Crystal Structure
Ferruginous Compounds	FeO is Highly Reactive at Low Temp. Hematite (Fe_2O_3) & Magnetite (Fe_3O_4) Are Reactive at High Temp Above 9000°C.

5.2 Process of Manufacture of Cement (Writeup)

1. Limestone Raising 2. Limestone Transportation 3. Limestone Crushing 4. Pre-blending or Pre-homogenization 5. Raw Meal Grinding 6. Homogenization 7. Pyro-processing or Clinkering 8. Coal Milling 9. Cooling 10. Cement Grinding 11. Packing

5.2.1 Limestone Mining (Quarrying)

Limestone is a sedimentary rock composed of Calcium Carbonate with occasional presence of Magnesium. These sedimentary rocks are deposited on the surface or underground. In some place's limestone deposits are in heaps

appearing like hills. In India most of the limestone deposited are deposited just below the surface hence they are called open cast mines. Underground mining is used when deposits are too deep for surface mining or there is a restriction on use of land. In case of open cast mining, initially, approximately 0.70 to 2.0 meters over burden is removed to clear the limestone deposits by dozer. Dumpers and proclainers are used to heap and dumpthis over burden to stack at one side. Limestone deposits are then drilled with drilling machines and jackhammers to an average depth of 10 meters. These drill holes are filled with required quantity of explosives and then blasted. The fragmented material thus having various sizes of limestone in different sizes

5.2.2 Limestone Transportation

These material of different sizes of limestone (also called as boulders) is then loaded into the dumpers using proclainers and transported by dumpers to crusher hoppers. Enough dumpers of various capacities 25 to 40 tons capacity to kept place to cater the requirement of crushers to ensure continuous feed to crushers.

5.2.3 Limestone Crushing

The dumped material as mentioned above, in the crusher is moved to compact crushers supported by blow bars to crush the material into different sizes as per the crusher specification. The output from the crusher is then transported to limestone stockpiles by belt conveyors and stackers.

5.2.4 Pre-blending or Pre-homogenization

The crushed material is transported to pre-homogenizing yard and stacked and reclaimed in a particular manner either in line, chevron, windrow, or circular method. The material is then reclaimed by cutting cross section of the stockpile. This will result in mixing of various layers of stockpile while extracting. This system of pre-homogenization is called as stacker reclaimer. There are various types of stackers and reclaimers. Pre-homogenization is required to reduce the fluctuations in raw material quality, increased capacity of the over plant and selective quarrying for better quality of limestone. Pre-homogenization is done in different methods. Combined pre-homogenization of raw material components and segregated pre-homogenization of raw material components. The second method is widely used in cement industry.

5.2.5 Raw Meal Grinding

Crushed limestone at stockpile is transported to limestone hoppers by reclaimers and belt conveyor. Bauxite, Iron Ore and Laterite are fed into the additive hoppers by the help of pay loaders and belt conveyors which will be used for correction of limestone to achieve desired composition of Raw-Meal. Limestone along with Bauxite, Iron Ore and Laterite are fed into Raw Mills by corresponding weigh feeders at belt conveyor. The above said materials are finely grounded by using Hyper Steel Grinding Media of different sizes. It is then pulverised in Vertical Raw Mills (VRM). In the mill's material is recirculated by air separator and is returned into the mills till it is finely

grounded and the fine grounded material is transported to continuous fluidized silo and stored by using air slide and bucket elevator. The suction in mills is developed by Raw Mill Fan.The granulometry, that is fineness and particle size distribution of the raw mix greatly affect its burnability. The finer the particle size and the greater the surface area of raw mix, the easier it is to burn and the lower the sintering temperature required. However, after certain fineness level which may vary from mix to mix further lowering the fineness may have no significant effect on burnability.

5.2.6 Homogenization

Homogenization is a continuous operation homogenizing and storage of silo for feeding and extraction of raw meal for clinker production. The silo is built as a cylindrical structure of concrete with an elevated bottom which is supported with columns. In the bin hopper, from extraction holes the material is guided to the hopper bin which is mounted on load cells. The weighing signals from these cells can be used for to keep the material level with narrow limits and the tank is also provided with air injection for blending of the material. The operational principle of homogenization by Controlled Flow (CF) Silo is to extract raw meal from outlets in the silo bottom at different rates and mix the material extracted from these outlets in small mixing tank.

5.2.7 Pyro Processing or Clinkering

Kiln is a continuous stream process vessel in which feed and fuel are held in dynamic balance. Five distinct process functions Viz., Drying, Preheating,

Calcining, Sintering and Cooling are performed in Kiln. Finely grounded material as above is called kiln feed and is stored in continuous fluidized silo is extracted into weigh bin through air slides with the help of solenoid valves and transported to air lift pump by the way of air slide bucket elevator, screw conveyors and dozed valve and conveyed 20-30% into preheater string and 70-80% of material into another preheater string of cyclones by bucket elevator and air slides. Cyclones are lined by Heysel blocks, low-grade alumina bricks and cartable. The kiln feed from preheater string will enter the pre-calciner of another preheater string through five cyclones of first string. Another stringmaterial also enter the calciner through number 1 to 5 cyclones of number 2 string. Material entered the calciner is heated upto 850 to 900°C by firing with pulverised coal and get calcined (up to 95%) and enter Rotary Kiln inlet via 6^{th}cyclone of 2^{nd} preheater string. The kiln is lined with Alumina bricks. High Alumina bricks and Magnesite bricks and castable at the tip of the Kiln. In the Kiln, firing fine coal, which was collected from fine coal hopper and PA Fan and pumped through burner pipe burns material. The flue gases are taken out by 1 and 2 ESP fans through preheater 1 and 2 fans along with fine particles. Before going out fine gases are sent through GCT's ESPs for collection of particles and such fine dust is reutilized in the Kiln circuit.

5.2.8 Coal Mill

Coal received from Collieries by wagons are unloaded by wagon tipper with aid of side arm charger after weighment and transported to coal crusher. Raw coal

is stacked in the coal stockpile by coal stacker after crushing (normally below 50 mm size). This coal is transported to raw coal hoppers by coal reclaimer and belt conveyors and fed into number 1 mill through table feeder and number two mill through weigh feeder and grounded to fine power. Number one mill is a ball mill having hyper steel grinding media of different size. Number two mill is a vertical roller mill and having roller and fixed table. The final ground fine coal is transported to fine coal bins by a fan through bag filters and Cyclones.

5.2.9 Cooling

The burnt and nodulized material coming out of kiln is called clinker and travel through cooler compartments where material temperature is reduced to 110°C with the help of cooler blowers and the hot gas generated here is utilized by way of secondary air in the kiln and pre-calciner. In the cooler outlet clinker dumps are crushed on crusher and transported to clinker stockpile by dee bucket conveyor and stored. The fine particles from the cooler.

5.2.10 Cement Grinding

Clinker is extracted from clinker stockpile and transported through belt conveyors into clinker hoppers of cement mills. Gypsum is fed and transported to Gypsum hoppers by pay loader and belt conveyor. Clinker and Gypsum from the hoppers are fed into the mils through weigh feeders. In the mill using hi-chrome grinding media of different sized finely grinds Clinker and Gypsum. The finely ground product is called cement which is transported to cement silos by bucket elevators, air slides and belt conveyor. The fine particles from the

mills collected from Electrostatic Precipitator with ESP Fan are transported to silos. The cement is stored in respective cement silos of different grades. The number silos required are decided based on production capacity of each grade. The cement mills can be open circuit or closed circuit.

5.2.11 Packing Plant

The cement from cement silos are extracted from the bottom of the silo by air slides and transported to rotary screen by air slides elevators and then into rotary packers by feed valves. The bags will be filled cement completion of one round of exactly 50 Kg cement and fell from the spout on the belt conveyor and transported into truck/wagon. After completion required number of bags in the truck or wagon it will be moved further for delivery.

5.2.12 By-products

In cement industry Kiln Dust may treated as by-product and is used for concrete manufacturing.

6 SPECIAL TRANSACTIONS TO CEMENT INDUSTRY

6.1 Packing

Packing in cement is very vital due to the nature of the cement. Moisture solidifies cement and may create lumps. OPC, PPC cements are normally despatched in

a) Bulk Cement–Naked Cement filled in bulk tankers and transported for bulk consumption without waiting for storage.
b) Jumbo Bags–1 to 1.50 Tons capacity
c) Traditional Bags-50 Kgs, 25 Kgs or 5 Kgs based on type

6.2 Transportation

In cement industry transportation of cement is made in two types. Ex-factory despatches and Free on Road (FOR) despatches. In case of ex-factory despatches, freight shall be paid by the customer hence freight shall not be accounted in the books. In case of stock transfer to warehouses and FOR supplies transportation cost involves

a) Primary Rail / Road Freight: Freight from factory to customer destination (FOR Customers)
b) Primary Rail / Road Freight: Freight from factory to warehouses or C&F agents depots (stock transfer)
c) Handling Charges: Clearing & Forwarding (C&F) Charges to C&F agents for unloading, loading for further shipment and storage charges at C&F depots, handling at port

d) Secondary Road Freight: Transportation from C&F depots to customer (FOR) supplies

e) In case of exports, primary transportation from factory to ports by road or rail, handling at port, clearing charges etc

The transportation may be with company's own fleet or by engaging third party agency

6.3 Pollution

Cement manufacturing involves mining, crushing, and grinding of raw materials, coal and calcination in a rotary kiln and cooling of clinker and mixing with Gypsum. This is very energy intensive. Dust is generated from mining and grinding activities and gases from calcination process. To control pollution, bag filters and Electrostatic Precipitator (ESP) are used at raw mills, coal mill, cement mills.

7 INTERNAL AUDIT OF OPERATIONAL AREAS OF CEMENT PLANT

7.1 Internal Audit of Mining, Mining Transport Operations

7.1.1 A Brief about Mining and Mining Transport Operations

Mining is of the important activities in excavating limestone from limestone mines. To carryout audit of mining function, the following are the important points to be considered.

As discussed earlier, the main raw material used in manufacturing cement is Limestone. This limestone is excavated from limestone mines through quarrying either from open cast mines or underground mines. In India, most of limestone mines are underground mines. Mines may be captive or leased for long period up to 99 years. Limestone so excavated is transported either by way of conveyors or using dumpers to stock yard and from there to crushers.

7.1.2 Internal Audit Checklist (✓) for Mining and Mining Transport Operations

- ✓ Check whether the mines are captive or leased?
- ✓ Check whether the approval obtained Mines and Minerals (Development and Regulation) Act 1957
- ✓ If leased? What is the period of lease? Also check the remaining lease period
- ✓ Check whether any recent assessment is made in respect of limestone deposits available for the remaining period of lease under the lease agreement
- ✓ Check whether the lease agreement prescribes a condition of backfilling the same at the end of the lease period?

- ✓ Check whether proper permissions obtained from the respective state / local authorities for storage of explosives under Explosives Act
- ✓ Check whether required registers are maintained for usage and stock of explosives under Explosives Act
- ✓ Check whether valid permissions from local authorities available to undertake blasting activities using explosives?
- ✓ Check whether the head of the mining function having prescribed qualification
- ✓ Check whether the mining function equipped with required number of mining engineers
- ✓ Check whether proper SOP available for safety measures? How is the checklist made and followed?
- ✓ Check how the limestone from mines transported to stock yard or crusher whether conveyor belt or using dumpers
- ✓ Check how the excavated limestone is measured? Whether by weighments or number of trips of dumpers?
- ✓ Check how the royalty payment is made? Whether based on above measuring techniques or any other manner
- ✓ Check whether quarrying activity is outsourced or self-managed?
- ✓ If it is outsourced, check the rate per ton of limestone excavated
- ✓ Check whether payment to outsource contractor is made based on above measurement or any manner

- ✓ Check whether the royalty paid on quantity of limestone raised and quantity for which payment is made to outsourced contractor is same or not?
- ✓ Check how the crushed limestone is stacked? Whether it is stored in a geometrical shape to facilitate measuring during physical verification?
- ✓ Check how the consumption is drawn for crushing at Crusher hopers
- ✓ Check what is the normal handling and transportation loss percentage allowed as per technical standards
- ✓ Check whether any purchases of limestone in case of emergency or otherwise?

7.2 Internal Audit of Crushing and Raw Mill Operations

7.2.1 A Brief about Crushing and Raw Mill Operations

The limestone excavated is transported to crusher and crushed material is then transported to pre-homogenizing yard and stacked and reclaimed in a particular manner. Limestone along with other additives viz iron ore, bauxite, shale, laterite etc., are processed in Raw Mill and the output is called Raw Meal. The proportion of additions of additives depends on the quality of limestone excavated from the deposits

7.2.2 Internal Audit Checklist (✓) Crushing and Raw Mill Operations

- ✓ Check how the main raw material (limestone) and other additives viz, iron ore, bauxite, shale are stacked and measured

- ✓ Check how the pre-homogenization is done as this is one of the key factors effecting productivity
- ✓ Check how the logbook is maintained of the department for mixing additives, production
- ✓ Check whether timely calibration hoppers is done if so, how they are maintained
- ✓ Check how the mill feed is accounted in the logbooks
- ✓ Check whether valid Bill of Material (BoM) is available and who authorizes the same
- ✓ Check whether any changes made to BoM and who approves changes in BoM
- ✓ Check how the quality parameters are decided of the input additives and output from raw mill
- ✓ Check how the batch size is determined and recorded
- ✓ Check how the output (Raw Meal) is measured and production recorded
- ✓ Check whether any batch rejected and what is the treatment of such rejected batch

7.3 Internal Audit of Coal Mill Operations

7.3.1 A Brief about Coal Mill Operations

Coal is one of the important materials used in generating fuel to burn the raw meal to produce clinker. Coal is received through wagon and are unloaded with

the help of wagon tipplers in the coal yard. It is them powered in coal mill and burnt to generate heat. There may be cement plants using imported coal or indigenous coal or a mix of both depending on the availability and cost-effectiveness. The most commonly available coal in India is bituminous type which is used in cement industry too. The most important aspect in coal is the Gross Calorific Value (GCV). The more the GCV it produced the best heat. As per the old grading based on Useful Heat Value (UHV) there are 6 grades of coal available in India, UHV > 6200 kCal/kg is considered as A grade and UHV >1300 kCal <=2400 kCal is considered as G grade. If the UHV is more it requires lesser amount of coal per ton of clinker production. In India, the specific heat consumption of the kiln ranges from 650 kCal/kg clinker to 900 kCal/kg clinker depending the age and technology of the plant.

7.3.2 Internal Audit Checklist (✓) Coal Mill Operations

- ✓ Check the source of coal from where it is purchased whether imported or indigenous
- ✓ Check whether the stacking of imported coal and indigenous coal is done separately
- ✓ Check whether the unloading of coal is manual or automatic
- ✓ Check the procedure for determining handling loss and whether it done for different sources separately
- ✓ Check how the shortages/pilferages quantity is determined and accounted

- ✓ Check how the sampling is drawn to determine the quality of coal and GCV of the coal received
- ✓ Check how the ash content of the coal is determined and whether it is determined for different sources and grades separately
- ✓ Check what is the ash content of different receipts of coal and their source
- ✓ Check how the material is issued to coal mill and how the issued quantity is recorded
- ✓ Check whether all safety procedures are in place in handling and stacking of coal. As coal may have self-burning property whether fire-safety equipment is placed at coal handling plant
- ✓ Check how the coal consumption is recorded

7.4 Internal Audit of Kiln Operations

7.4.1 A Brief about Kiln Operations

Kiln is heart of the cement plant where in raw meal preheated in the preheaters and then sent to rotary kiln for burning along with coal. The temperature in the kiln touches as high as $1,800^0$ C and gradually cooled, formed as lumps and stored in clinker silo. Kiln is one of the major energy consumptions point when compared to all other processes in the cement plant.

7.4.2 Internal Audit Checklist (✓) Kiln Operations

- ✓ Check how the raw meal is transferred to cyclones and kiln?

- ✓ Check the logbooks of raw meal transfer to establish the qualitative parameters as this determines the clinker quality
- ✓ Check the frequency of replacing kiln bricks
- ✓ Check how the clinker is stored whether in silo or in open condition
- ✓ If in open condition what is the age of clinker in open condition
- ✓ Check what the age of clinker to assess the usage or damage of the same as this an important intermediate production with high value
- ✓ Check how the clinker is transported to cement mills
- ✓ Check how the feed of clinker to cement mills is measured
- ✓ Check how the clinker quality is determined
- ✓ Check whether any clinker output is rejected
- ✓ Check how the rejected clinker is handled whether reprocessed or disposed
- ✓ Check any good quality of clinker sold to third parties
- ✓ Check how the clinker production is recoded and accounted
- ✓ Check the highest and lowest productivity levels recorded during a period to establish productivity variations

7.5 Internal Audit of Cement Mill Operations

7.5.1 A Brief about Cement Mill Operations

Different types and grades of cement is manufactured in cement mills. Clinker from the clinker silo is drawn and gypsum and / fly ash are added in cement mills and grinded along with clinker to produce cement. Gypsum is important

to allow required setting time. In case of Ordinary Portland Cement (OPC) only gypsum is added in cement mills and grinded along with clinker. In case of Portland Pozzolana Cement (PPC) gypsum and fly ash also added in cement mills and grinded along with clinker to PPC. In case of PPC fly ash can be added up to 30% gypsum up to 5% and clinker up to 65%. In case of OPC gypsum up to 5% and clinker up to 95%.

7.5.2 Internal Audit Checklist (✓) Cement Mill Operations

- ✓ Check how many cement mills are in operation
- ✓ Check how many types of cement is manufactured
- ✓ Check how the product mix is determined
- ✓ Check the logbooks how know how the production is recorded
- ✓ Check the number of cement silos and what are their full capacity
- ✓ Check whether any rejections and how their treated, whether disposed or reprocessed
- ✓ Check whether separate silos are available for 43 grade, 53 grade cement and PPC and are stored accordingly
- ✓ Check whether any clinker purchased from outside and processed or is only captive clinker
- ✓ Check whether any dead / condemned stock of cement available and whether it is forming part of the good quality cement

7.6 Internal Audit of Packing Plant Operations

7.6.1 A Brief about Packing Plant Operations

Cement from cement silos are extracted from the bottom of the silo rotary packers by feed valves. In case of bag packing it will be filled cement completion of one round of exactly 50 Kg cement and fell from the spout on the belt conveyor and transported into truck/wagon. Cement is despatched either in packed condition (bags) mostly for retail customers or naked condition (closed tankers) to bulk customers.

7.6.2 Internal Audit Checklist (✓) Packing Plant Operations

- ✓ Check how the packing operations organized
- ✓ Check how when the last calibration is done for feed valves
- ✓ Check whether tolerances prescribed by weights and measures are following in bag filling
- ✓ Check whether the weighing scales and weigh bridges are calibrated and inspected by Weights and Measures Authorities

7.7 Internal Audit of Power Generation & Distribution Operations

7.7.1 A Brief about Power Generation & Distribution Operations

Cement industry is one of the major power intensive and consumes significant amount of electricity. Normally the entire power requirement is met in three different ways. 1) Purchase from State Government Electricity companies, 2) Independent Power Producers (IPPs) and 3) Captive generation using generator sets, or wind or solar power within the premises

7.7.2 Internal Audit Checklist (✓) Power Generation & Distribution

- ✓ Check what is the Contracted Maximum Demand (CMD) for the factory as a whole
- ✓ Check how the entire power requirement is met?
- ✓ Check whether any purchase of power is made through power exchange by auction by IPPs
- ✓ Check whether any power generated captively using generate sets
- ✓ Check whether the fuel used to run the generators whether LSHS or Furnace Oil or Diesel
- ✓ Check whether required Plant Load Factor (PLF) achieved
- ✓ Check the reconciliation of electricity units consumed as per production reports vis a vis electricity bill received from State electricity company
- ✓ Check whether any difference between units consumed as per electricity bill and units reported by production department
- ✓ Check transmission and distribution loss percentages of purchased power from IPPs and captive generation
- ✓ Check the cost of power purchased from various IPPs and State electricity company with that of power captively produced
- ✓ Check how the wheeling charges are charged by IPPs and the impact of the same

8 EFFECTIENESS OF INTERNAL AUDIT IN CERTAIN AREAS

8.1 Good Corporate Governance

Review of other compliances and their reports provide an instant and good insight into the activities of the entity. These may include audit reports of various third parties and any self-initiated audits

- ✓ Statutory Audit Reports
- ✓ Secretarial Audit Reports
- ✓ Cost Audit Report
- ✓ Tax Audit Report
- ✓ Physical Verification Reports
- ✓ Quality Control Audits
- ✓ Mines Safety Audit
- ✓ Environmental Audit Reports
- ✓ Energy Audit
- ✓ Due diligence Reports if any

The above list is only indicative but not exhaustive. The list varies from case to case depending on the size of the organization and complexity of the structure.

8.2 Efficiency Improvement (Waste Heat Recovery for Power Generation)

Waste heat in cement kilns are normally used for drying raw material as fuel which will reduce the overall fuel consumption. In cement industry there are significant amount of wastage of heat. Waste heat recovery enhances the productivity and efficient use of fuel. In dry process cement plant (most of which are now dry process) nearly 30 to 40% of total heat input is rejected as waste heat from the exit gases of preheaters and coolers. Also, in some of the cement plants having preheaters, exit gas temperatures range from 350^0C to 500^0C and cooler vent air temperature ranges from 300^0C to 350^0C. With this there is potential to generate 2MW to 6MW of power from waste heat alone. However, this depends on the size of the cement plant.

In cement industry, there is a good potential for recovery of waste heat. It is possible to generate steam from this waste heat, which could be used in some other process like desalination of sea water for cement plant in coastal areas.Drying of materials such as slag, pozzolana etc. is another possible application, already in practice in many cement plants. Normally, hot excess air from clinker cooler is used for this purpose. It is also possible to generate electricity from the waste heat. Normally, steam produced in waste heat boiler incorporated to recover heat from preheater gases/ cooler exhaust gases is used in a steam turbine to generate electrical energy

8.3 Cost Control, Cost Competitiveness

Cement industry is highly competitive industry and predominantly and capacity is underutilized. To overcome problem of underutilization of capacity companies have resorted to various cost control measure to gain the market position. Striving to become a cost leader companies adopted various ways and means viz (1) setting up captive power plants, and/or up-gradation of technology to enhance productivity purchasing electricity through power exchanges form IPPs etc. (2) Companies particularly from west cost of India started exporting cement and clinker where the net sales realization is encouraging. (3) Another strategy big companies are experimenting setting up of retail stores to reduce supply chain costs. (4) Bulk cement supply in necked form in tankers are also one of the options companies following to reduce on packing cost, transportation cost and to avoid multiple handling losses. (5) Companies having multiple plants in different locations are resorting to centralized purchasing of materials, spares etc., to gain economies of scale in the form of discounts thereby reduced procurement costs. (6) One of the recent trends cement companies are focusing on ready-mx concrete going for forward integration leading to additional revenue.

8.4 Value Creation

Various developments have been taken place pyro processing for conservation of energy. The main areas are Preacclimation, 5 to 6 Stage Preheater with high efficiency low pressure cyclones, gas cooling water spray systems in the

preheater down comer ducts, low primary air burners, modern kiln seals with low leakage and maintenance, high heat recuperation efficiency (up to 78 %) clinker cooler, improved refractory systems, high efficiency fans (up to 82 %), use of alternative fuels like pet coke, tires, waste oil, rice husk, municipalwaste, etc. A 4-stage cyclone preheater + precalciner consumes heat of 740 to 760 Kcal/kg of clinker, a 5-stage preheater + precalciner consumes heat of 715 to 730 Kcal/kg of clinker whereas a 6-stage preheater + precalciner consumes heat of 685 to 705 Kcal/kg of clinker. This is very significant improvement in heat consumption which is one of the major cost elements of cement industry

8.5 Resource Utilization-Alternate Fuels and Raw Materials (AFR) in Cement Industry

Frequent price increase of coal in India made cement industry vulnerable to high fuel cost. Total energy consumption in cement industry of dry process plants comprises of 75% fuel and 25% electricity. Almost 99% of the fuel (thermal energy) is used for pyro-processing or in kiln (clinker burning). Power and fuel accounts for almost one-fourth of cost of production of cement. Keeping in view of its significance, globally the focus was more to reduce fuel cost in cement industry with alternate fuels or raw material.

There are various waste material available viz., used tyres, industrial wastes, non- recyclable waste oils, non-recyclable solvents, waste plastics, non-recyclable packaging materials, contaminated soils, trade rejects, segregated fractions from municipal solid waste etc and low-grade fuels are co processed extensively as antirave fuels or energy sources.

At the same time, to address the problem of fast depleting natural resources, certain alternates are also evolved from several wastes having raw material value viz., mill scale, steel slag, waste fractions from aluminium sources, effluent treatment plant (ETP) sludge, bottom ash, fly ash, drilling mud, lime sludge, etcare co processed in the cement industry as alternate raw materials. In Japan and some European Countries AFR being used successfully since last 3 decades. Recently one of the world major cement producers cement plant in the USA has achieved *negative fuel cost* by using alternate fuels. In India too, efforts have been made to accelerate use alternate fuels. In fact, one oldest manufacturer of cement has started a journey towards zero fuel cost without comprising quality of cement, environment and Occupational Health and Safety

8.6 Strategic Planning

Cement is highly competitive industry where there many major players as well as mini units. To sustain in the market in the long-term Strategic planning different companies in the industry adopted different strategies depending on their location, age of plant and other market related strategies. These include:

- ✓ Companies invited Foreign Direct Investment to reduce the interest burden on their debt.
- ✓ Major players acquired small plant in different geographical area to gain advantages on acquiring market share near to the location as well as to gain scale of economies

- ✓ Some of the plants upgraded the technology and machinery to reduce their fuel consumption
- ✓ Companies established inhouse solar / wind power units to reduce electricity cost. Some companies in the industry purchasing power from IPPs at a lower cost on power exchanges
- ✓ Companies stated using alternate fuels and material to reduce over-all cost of production
- ✓ Companies changed product mix to and identified potentials units where the product mix can be optimized
- ✓ Established grinding units near the place of demand and transporting clinker to grinding units and cement is produced. This saves enormous amount of time for setting-up an integrated cement plant with reduced capital cost.

8.7 Risk management

Market Demand Risk: Changes in demand leading to changes in pricing and/or industry structure. Particularly in India the demand fluctuates for cement between summer and rainy season. During monsoon demand for cement will low and during summer and auspicious season the demand will be high. Companies to factor these market demand fluctuations.

Legal and compliance risk: Cement industry is prone to various environmental regulations. Hazardous workplaces, blasting burners, mills and heaters and explosives required more attention to comply with safety standards.

Energy price fluctuationsRisk being that energy costs rise, or that certain alternative fuels become unavailable. Fuel mix and energy efficiency are key areas of focus for all plants, and that it uses 'derivative instruments' to hedge part of its exposure to these risks.

Raw materials risk: Raw materials that are scare and cannot be supplied at economical cost or suitable quality' (e.g. sand and limestone) lead to sudden stoppage of production.

Sustainability risk: The cement industry is associated with significant negative externalities, such as high CO_2 emissions dust spillage, gases, and fumes. Local society may march protest these high levels of emissions.

Political risk: Due to political instability or change in part at state or central level may lead disrupt the demand for cement or cost of production may go high.

Talent risk: Due to location of the factory or non-availability of skilled talent with in the vicinity of the factory may lead to talent attrition or shortage of skilled manpower

Cyber risk: The increasing use of technology may lead to cyber risks such data breach or key information missing etc.

Financial and Insurance Risk: Liquidity, interest rates, foreign exchange fluctuation, under insurance of assets may increase the risk.

9 KEY PERFORMANCE INDICATORS *Vis-a-Vis* BENCH MARKING

9.1 Capacity utilization

Cement industry produces various types of cement in factory. The throughput of cement differs from type of cement to type of cement. Since clinker content in OPC is higher, OPC gives lesser throughput than PPC. Also, clinker being sent outside the factory for grinding purposes on job work basis to make cement. Throughput differs from grinding unit to grinding unit based on the infrastructure available. In view of these factors it is difficult to determine exact installed capacity in terms of cement. Determining the installed capacity in terms of clinker is more appropriate in technical terms. capacity utilization

9.2 Productivity efficiency

Productivity and efficiency of Portland cement manufacturing is shown in the below table in the form input / output. Replacement of clinker with alternate material like fly ash or slag are critical to efficiency and productivity

INPUT / OUTPUT RATIOS FROM RAW MATERIAL TO CEMENT (Tons Assumed, Ratios near Realistic)						
Input Material	**Production (Tons)**	**Consumption (Tons)**	**Consumption Ratio to Rawmeal**	**Consumption Ratio to Clinker**	**Cosumption Ratio to OPC**	**Cosumption Ratio to PPC**
Limestone to Rawmeal		19,28,148	0.92	1.36	1.32	0.99
Shale to Rameal		17,340	0.01	0.01	0.01	0.01
Bauxite to Rawmeal		1,400	0.00	0.00	0.00	0.00
Laterite to Rawmeal		68,179	0.03	0.05	0.05	0.03
Iron Ore to Rawmeal		53,170	0.03	0.04	0.04	0.03
Flyash to Rawmeal		27,913	0.01	0.02	0.02	0.01
Total		20,96,150	**1.00**	**1.48**	**1.43**	**1.07**
Rawmeal	20,96,150	20,92,498		1.48	1.43	1.04
Clinker for OPC		11,04,917			**0.97**	
Clinker for PPC		3,04,725				**0.72**
Total Clinker	14,13,850	14,09,642				
Gypsum to OPC		36,363			**0.03**	
Gypsum to PPC		13,408				**0.03**
Flyash to PPC		1,02,687				**0.24**
Cement OPC	11,41,280					
Cement PPC	4,20,820					
Total Cement	**15,62,100**				**1.00**	**1.00**
Coal meal to Clinker		2,17,160		0.15		

Rawmeal to Clinker ratio in the above case is 1.48. Normally this ratio ranges from 1.55 to 1.48 depending on the size of the cement plant and technology used. The lesser the ratio is better the output. It also depends on pre-heater type

whether 5stage or 6stage. 6stage preheaters considered to be most advanced and gives better input output ratio. The other input material of raw-meal depends on quality of limestone. If the limestone quality is very high, to balance the same more quantity of additives are used. Hence, the number of additives and quantity of the same added have direct bearing on quality of limestone.

Gypsum to Cement ranges from 5% to 3% of the total cement, as Gypsum is used for setting-up time of cement. In case of OPC, it is only combination of clinker and gypsum. In case of PPC it is the combination of clinker, gypsum and flyash and in case of slag cement it is combination of clinker, gypsum, and slag. In case of PPC or slag cement, lesser utilization of clinker and more of fly-ash refers ideal output ratio without denting the quality of cement. The addition of fly-ash can go upto 30% depending the product requirement and technology used.

9.3 Material consumption, Wastages

Use of waste materials inindustrial processes as alternative fuels and raw materials (AFR) to recover energy and material fromthem is referred as Co-processing. The high temperature and long residence time in cement kiln helpsin disposing all types of wastes effectively without any harmful emissions . In Co-processingemission are reduced and there is no residue after the treatment, which makes it more environmentallyfriendly and sustainable method of waste disposal in comparison to land filling and incinerationTo

reduce the costs of fossil fuel consumption (non-renewable source), the technique of co-processing has been employed for introducing alternative fuels as part of the manufacturing process. This provides a lower cost of production, introducing fuel waste from different industrial activities, besides contributing to the reduction of environmental liabilities; they generate waste when discarded in inappropriate places. Solid waste is mixed into other raw materials, dried and ground in a dryer mill, and burnt in a kiln equipped with a New Suspension Pre-heater (NSP). During these processes, the waste, together with other raw materials, becomes clinker. This clinker and about 3% gypsum are mixed and ground together to make the final cement product.

9.4 Utilities and Energy Efficiency

Indian cement industry progressed over a period in terms of energy consumption and achieved world best energy efficient industry.

Best specific energy consumption levels achieved by the Indian Cement Industry

Country	Specific Electrical Energy Consumption (KW/ton of Cement)	Specific Thermal Energy Consumption (Kcal/Kg Clinker)
India	***82***	***725***
Spain	92	836
Germany	100	836
Japan	100	836
Brazil	110	884
Italy	112	908
China	118	956
Mexico	118	1003
Canada	140	1075

USA	141	1099
World Average	**100-110**	**850-860**

Source : CII Publication - Indian Cement Industry , May 2015

From the above, it is understood that the world average of Specific Electrical Consumption 100-110 KW/Ton of Cement and Specific Thermal Energy Consumption is 850-860 Kcal/Kg of Clinker. As against the world average some of the cement plants in India achieved 82 KW/Ton of Cement and 725 Kcal/Kg of Clinker. This is one of the best energy efficiency indicators of cement industry in India.

9.5 Segment profitability

Segment profitability in cement industry depends on the variety of cements being produced. In case of Portland cement based on product products it can be segmented into OPC and PPC. PPC gives higher realization and profitability compared to OPC. If the company having market segment across the country, in which case segments can be made into North, South, East and West. In case of forward integration and companies having Ready Mix Concrete (RMC) units, segmentation can be made for OPC, PPC and RMC.

9.6 Working capital & inventory management

Working requirement in cement industry is very high as this is a continuous process and bulk material. Cement is sold mostly on credit to dealers and direct parties. Hence, realization of debtors is key to working capital in cement industry. At the same time, it is also highly labor oriented, therefore fixed expenses are high. Due to the heavy nature of the machinery and it parts, may

being imported from original equipment manufacturers significant amount of working capital held in spares. Power purchased from State electricity boards also be paid in time is an important factor effecting working capital. Cement attracts 28% GST therefore, any delay in realization of debtors beyond a month may lead to working capital crunch. Any non-moving inventory locks the working capital to that extent. Given below the indicative analysis of non-moving inventory and its significance

NON-MOVING INVENTORY SUMMARY (Sample) Rs. Lakhs*(Numbers are indicative)*

SL. No.	Inventory Group	Number of Items	Value	Value Proportion
1	Bricks	94	23,963	16.60%
2	Explosives	4	2,936	2.03%
3	General Stores	10	45	0.03%
4	Oil and Lubricants	8	150	0.10%
5	Packing Material	1	968	0.67%
6	Spares –Heavy Eqp	789	12,373	8.57%
7	Spares - Electrical	283	34,062	23.60%
8	Spares - General	111	8,023	5.56%
9	Spares - Mechanical	572	61,258	42.44%
10	Spares - Tools	92	562	0.39%
	Total	1,964	1,44,344	100.00%

NON-MOVING INVENTORY CLASSIFICATION (Sample) Rs. Lakhs (Numbers are indicative)

SL. No.	Spares Inventory Group	A Category (Line Item Value above Rs 100,000)		B Category (Line Item Value below Birr 100,000 and above INR25,000)		C Category (Line Item Value below 25,000)		Total	
		Nos.	Value	Nos.	Value	Nos.	Value	Nos.	Value
1	Bricks	3	8,130	22	11,024	69	4,808	94	23,963
2	Explosives	1	2,746	0	0	3	190	4	2,936
3	General Stores	0	0	0	0	10	45	10	45
4	Oil and Lubricants	0	0	0	0	8	150	8	150
5	Packing Material	0	0	1	968	0	0	1	968

6	Spares –Heavy Eqp	6	3,159	0	0	783	9,213	789	12,373
7	Spares - Electrical	5	15,987	16	6,619	262	11,455	283	34,062
8	Spares - General	2	5,906	2	915	107	1,200	111	8,023
9	Spares - Mechanical	11	20,296	44	21,137	517	19,823	572	61,258
10	Spares - Tools	0	0	0	0	92	562	92	562
	Total	**28**	**56,227**	**85**	**40,665**	**1,851**	**47,451**	**1,964**	**1,44,344**

Ideally there should not be any non-moving inventory. However, the above is indicative numbers given to provide better understanding of the inventory analysis. Thee internal auditor should analyze further into the reasons for such non-moving and suggest alternative course of action to use at different place or whether the spares kept on emergency due to longer lead time of procuring the same.

9.7 Manpower efficiency

Cement is highly labor-intensive industry. Manpower use is high in quarries, limestone transportation vehicles, operators of various machines, packing plant, captive power plants, loading, and unloading points. Though there is a significant automation taking place in these areas, comparatively manpower deployment is high in cement industry. In cement industry efficiency of manpower in quarries significantly effects the output of the limestone production. Of late, many cement companies are outsourcing the job of limestone excavation and transportation on contractual and per ton basis. This is helping companies to convert fixed cost in variable cost.Similarly, at packing plants, the job of loaders also outsourced on contractual basis where payment is made on number of bags loaded or unloaded rather than fixed employment.

9.8 Risk mapping

Risk mapping can be done for each operational and functional area based on overall industry perspective, geographical location of the factory, market size etc. The following is an illustrative risk mapping matrix of some of the areas for understanding

Risk Mapping Matrix

Sl. No.	Operational / Functional Area	Risk Involved
1	Production	o Input v/s Output ratio monitoring o Abnormal production losses o losses and approvals o Consumption Measurement and accounting o Reconciliation of quantity, produced, stored, and dispatched
2	Quarrying	o Excavation and overburden removal o Blasting schedule,output, and safety o Seasonal productivity impact o Quantity measurements and wastages o Contract labor deployment
3	Captive Power Generation	o Load balancing o Plant Load Factor (PLF) o Connectivity parallel to grid
4	Packing Plant	o Contract Labor deployment o Shift optimization o Power consumption o Machine balancing

5	Inventory	o Obsolete inventory o Inventory aging o Measuring Work-in-Process, stock in silos o Empty bags reconciliation
	Logistics	o Availability of trucks and wagons to required destinations o Fuel price escalation o Turnaround time of trucks and route optimization o Stock in transit monitoring and reconciliation o In transit damages, clotting, torn bags etc
	Sales Marketing	o Credit limit exceeding cases o Receivables monitoring and delay o Frequent price changes and price card updating o Debit notes and credit notes

9.9 Environmental, and Sustainability

Cement Industry travelled a long way with many ups and downs to achieve sustainable and green production. Some of the measures taken to achieve sustainable production are State-of-the-Art Production facility and Technology, Energy Efficiency Improvement, Environment protection, Water ConservationGHG (CO2)Emission Reduction, Consistent efforts to reduce Energy Consumption in coordination with Bureau of Energy Efficiency (BEE), Successful Implementation of PAT (Perform, Achieve, Trade) cycle -1(2012-15)(4.8 % reduction in Energy Consumption) and PAT cycle (2017-20) is under

implementation.*(PAT scheme is a regulatory instrument to reduce specific energy consumption in energy intensive industries, with an associated market-based mechanism to enhance the cost effectiveness through certification of excess energy saving which can be traded*)

Some of the Best Practices led to reduction in carbon footprint in cement industry are Waste Heat Recovery, Replacing Conventional Fuel with Alternate Fuels,Participating in CDM Projects under Kyoto Protocol of UNFCCC,Adopting Renewable Energy (Wind, Bio-Mass, Solar etc.) and Clinker Substitution with Fly Ash and Slag

CO_2 emission level reduced from 1.12 per ton of cement produced in 1996 to0.7 per ton of cement.Target of 0.58 per ton CO_2emission in 2020 and 0.50 perton CO_2emission in 2030. (Source: http://knowledgeplatform.in/)

10 INTERNAL AUDIT OF FUNCTIONAL AREAs

10.1 Internal Audit of Production Function

10.1.1 A Brief about Production Function in Cement Plant

Production department in cement plant covers from limestone crushing to packing plant. The main responsibility of production function is to coordinate with all the operational department directly involved in production and see that there are no imbalances throughout the production chain. Production prepares and report daily production, production hours of various mills, break down hours and despatches.

10.1.2 Internal Audit Checklist (✓) Production Function

- ✓ Check whether daily production report with all work-in-progress (raw meal, coal meal, clinker) details and cement grade-wise is prepared
- ✓ Check whether cumulative production of different production centres are reported on daily basis
- ✓ Check the WIP and finished stock reported in production report and cross verify from the stores / despatches report
- ✓ Check whether any rejection of cement and clinker reported in the production report
- ✓ Check the Bill of Material (BoM) of the finished product of cement
- ✓ Check who approves any changes to BoM
- ✓ Check how the production schedule is made

- ✓ Check whether production is made as per requirement communicated by Marketing & Sales Department

10.2 Internal Audit of Maintenance Function

10.2.1 A Brief about Maintenance Function in Cement Plant

The maintenance function in cement industry broadly divided into 1) Civil Maintenance 2) Mechanical Maintenance 3) Electrical Maintenance, 4) Mines and Heavy Equipment Maintenance 5) Utilities Maintenance etc. However, this may change based on size of the plant and production capacity. One of the important maintenance activities in cement industry is replacement of kiln bricks.

10.2.2 Internal Audit Checklist (✓) Maintenance Function

- ✓ Check whether there is any planned maintenanceschedule
- ✓ Check list of major breakdowns during a period
- ✓ Check the history-cards of maintenance of various machines and equipment's
- ✓ Check the impact of major breakdowns on production and profitability
- ✓ Check whether any replacement of machines taken place during a period and it is done by analysing cost-benefit of reuse vs replace
- ✓ Check whether all critical spares are in stock considering the lead time of spares
- ✓ Check whether mines-heavy equipment have separate maintenance schedule and are done during kiln maintenance

10.3 Internal Audit of Quality Control Function

10.3.1 A Brief about Quality Control Function in Cement Plant

Quality Control function in cement industry takes care of day to day quality aspects of production at each stage and inward receipts of raw materials, fuel, stores, and spares etc. Quality Control department is also responsible for the following certifications, surveillance audit and timely compliance of production related statutory matters.

- ISO-14000 Environmental Management System
- ISO-18000 Safety Management System
- ISO-27000 Information Security Management System
- ISO-5001 Energy Management System

10.3.2 Internal Audit Checklist (✓) Quality Control Function

- ✓ Check how the quality control procedure following for at stage of production i.e., limestone raising, crushed limestone, homogenization, additives, raw-meal, coal-meal, clinker, cement and at packing plant
- ✓ Check how the inward receipts at stores are inspected and samples drawn for verification
- ✓ Check whether any material issued to production without approval of quality control department
- ✓ Check how the rejects are determined by the department and is there any procedure acceptance of tolerance limits of various parameters

- ✓ Check the procedure rejects and its treatment whether goods are returned are retained and destroyed

10.4 Internal Audit of Projects Function

10.4.1 A brief about projects function in Cement Industry

Projects function in cement industry responsible for expansion of existing factory, enhancement of infrastructure facilities and enabling continuous improvement plans towards cost reduction, pollution control, substitution of alternative sources of spare parts, substitution of Alternate Fuels & Raw material (AFR), waste management projects etc.

- ✓ Check whether there exists Project Management Office (PMO) and its roles and responsibilities
- ✓ Check the list of various small and continuous improvement (Kaizen) projects
- ✓ Check the Return on Investment (RoI) envisaged of the above projects in the project report
- ✓ Check whether any projects are on for Alternate Fuels & Raw material, waste heat recovery etc and their cost benefit analysis

10.5 Internal Audit of Procurement Function

10.5.1 A brief about procurement function in Cement Industry

In cement industry procurement function deals with purchasing various raw material additives, fuels, stores, and spares, packing material etc.

- ✓ Check that there exists proper vendor evaluation policy
- ✓ Check whether any rate contracts entered for supply of limestone additives viz., iron ore, bauxite, shale, and gypsum, fly ash, slag etc
- ✓ Check whether materials are single source and single supplier or multiple sources available
- ✓ In case of availability of multiple sources check whether the rates fixed are competitive bidding
- ✓ Check whether the orders are placed with approved venders of the company
- ✓ Check the price quoted is accepted, if not deviations approved by competent authority
- ✓ Checking whether supplies have been made within the ordered period and evaluate loss/ gain in respect of delayed supplies.
- ✓ Checking the parties' bills to ensure that they are in line with the grades of iron ore, bauxite, coal supplied.
- ✓ Checking whether excavation of raw material from mining area, there is a proper system of weighment, that the same passes through the weigh bridge and proper entries of quantities are made.
- ✓ Checking whether there is a proper system to avoid demurrage charges?
- ✓ Checking whether there is a monitoring mechanism to ensure that all trucks loaded at mines are delivered at the railway siding or at plant within a reasonable period?

- ✓ Checking the local purchase procedure and emergency purchase procedure and comply the same

10.6 Internal Audit of Stores Function

- ✓ Obtain a list of outstanding indents and cross-check with purchase department.
- ✓ Obtain a list of outstanding deliveries and cross-check with the Purchase department
- ✓ Check how the pending indents and deliveries are monitored and executed
- ✓ Check how the inward material are received into stores, how they approved and recorded in stores ledger
- ✓ Check whether there a proper bin card system is followed
- ✓ There will be many high value items of spares in cement industry such as kiln bricks, motors, spares etc
- ✓ Check whether any identification of critical spares and insurance spares
- ✓ Check whether any ABC analysis is made. Whether EOQ is followed
- ✓ Check how the reordering levers are maintained for regular production items
- ✓ Check who how the indenting is done for non-regular items
- ✓ Check how the GRIR (Goods Receipt and Inspection Report) is prepared
- ✓ Check whether material under inspection is separately stores to enable proper inspection by user department / quality control department

- ✓ Check whether dangerous goods are separately stored
- ✓ In case of LSHS / HSD storage whether approval obtained from Chief Controller of Explosives
- ✓ Check the reconciliation of empty cement bags to reconcile between production, despatches as per production report and bags utilized

10.7 Internal Audit of Distribution and C&F Warehouse Function

10.7.1 A brief about Distribution and C&F warehouse function in Cement Industry

In cement industry, distribution department is responsible despatch of cement from factory to various direct customers, dealers and transferring cement C&F warehouses through railway racks and trucks. The C&F agent is responsible for receiving the cement, storing, repacking, standardization of damaged bags and reporting the same to the company. Billing is done from warehouses based on the orders received from respective sales team.

10.7.2 Internal Audit Checklist (✓) Distribution and C&F warehouse Function

- ✓ Check agreements entered with transporters for transportation of cement
- ✓ Check agreements entered with C&F agents and charges applicable
- ✓ Check the policy on transit losses and damages, whether any recovery made from transporters for pilferage, damages etc
- ✓ Check the transit insurance and its terms and condition
- ✓ Check the policy on standardization and repacking of clotted or otherwise damaged cement

- ✓ Check procedure of handling of cement at railheads and secondary transportation to C&F warehouses
- ✓ Check whether any wharfage and demurrage charges paid and reasons thereof, on account of C&F agent or on account of the company
- ✓ Check the age-wise analysis of finished stock (cement) at warehouses

10.8 Internal Audit of Marketing & Sales Function

10.8.1 A brief about Marketing and Sales function of Cement Industry

In cement industry normally marketing and sales functions are combined. Marketing & Sales team takes care of advertisement, sales promotion, brand promotion, sales forecasting, sales generation, interaction with customers, coordination with logistics team, warehouses etc.. The expenditure of involves advertisement through hoardings, wall paintings, electronic media and print media advertisement, dealer meetings, annual foreign trips to dealers who achieves targets or to exclusive dealers. Sales is further segmented into export and domestic sales. Domestic sales further categorized into the following

- Dealer Sales (Dealerships or trade segment)
- Direct parties' sales (Real-estate builders, project contractors and government work) or also called non-trade segment

Sales through dealers within the country further segmented into state-wise and district-wise. There will be sales offices across various districts, and they will be reporting to sales head (General Manager or Vice President).

The dealership appointment is made based on certain criteria and per Delegation of Authority laid down by the company. Also, some amount of security deposit is collected based on the credit limit approved to each dealer. Sales price to dealers is fixed based on price cards approved by the competent authority and the price varies from district to district or cluster to cluster. Normally the price mentioned in the price card is FOR price. In cases where dealer arranges his own transportation, the billing is made on Ex basis giving adjustment to fright as applicable to the destination.

Direct Sales includes sales to real-estate builders, contractors, and government. Direct sales orders are generally procured or canvassed through service dealers (canvassing agents). Canvassing agents are paid a pre-determined amount of commission for soliciting orders from various direct parties. Price is fixed as floor price.

10.8.2 Internal Audit Checklist (✓) Marketing and Sales function of Cement Industry

- ✓ Check approved budget for marketing expenditure
- ✓ Check the breakup of marketing expenditure incurred through different channels
- ✓ Check which are various events conducted for dealers meet and allotted expenditure
- ✓ Randomly verify the wall paintings or hoarding placed at a place based on the photos to establish the authenticity

- ✓ Check what kind of entertainment expenditure is done by the marketing team and is within limits and as per the marketing policy of the company
- ✓ Check the dealer appoint and termination policy of the company
- ✓ Check how the dealer evaluation is done and how credit limit is sanctioned
- ✓ Check the list of approved price cards applicable to dealers with head of marketing and sales function
- ✓ Check the applicability of price cards whether district-wise or any other geographical location-wise
- ✓ Check whether the same price cards are communicated to finance and accounts department to effect discounts applicable if any
- ✓ Check whether any floor-price applicable for non-trade segment
- ✓ Check how the price is fixed for non-trade segment and price approved as per limits authority
- ✓ Check the criteria for monthly, quarterly, annual discount policy of dealers, price cards, circulars, or any amendments thereto
- ✓ Check the range of quantities on which various quantity discounts are applicable
- ✓ Check price charge to non-trade segment is in line with the floor price and respective contract entered with the parties
- ✓ Check how the service dealer commission is paid on various non-trade party orders canvassed through them

- ✓ Check are there any commission agents or consignment agents through which sale of cement made and agreement entered thereto
- ✓ In case of payment through cheque/DD, who bears the charges whether dealer/direct party or the company
- ✓ Check whether any load diversions (sales made to one party and delivered to another party) are made
- ✓ Check whether such diversions are made with the consent of both the parties and necessary credit notes are issued in this regard
- ✓ Check whether any cash discount is applicable to dealers for early / timely payment of their dues
- ✓ Check whether any overdue interest is applicable for delayed payment and rate of interest of such delayed payment
- ✓ Check randomly whether overdue interest is correct calculated and charged to customers with delayed payment
- ✓ Check whether any of such overdue interest is waived to some of the customers
- ✓ Check whether such waiver is done with approval the approval of authorized.
- ✓ Check how the after sales complaints of trade segment and non-trade segments are handled

10.9 Internal Audit of Finance & Accounts Function

Accounting Policies

- ✓ Check the delegation of authority manual of financial and non-financial powers vested with various heads of department
- ✓ Check chart of accounts and accounting manual of the company
- ✓ Check various accounting policies followed by the company and are followed consistently
- ✓ Check whether there is any change in accounting policy during the period.
- ✓ If there is a change in policy assess the impact of such change on the books of account of the company
- ✓ Check whether the internal control system in vogue in the company is in commensurate with size and nature of the company
- ✓ Check the treatment of normal and abnormal loss in the books of account

Accounts Receivable

- ✓ Check the list of customers segregating the same into trade (dealership) and non-trade (direct customers)
- ✓ Check the credit limit exceeding cases and find the reasons for the same
- ✓ Check the list cheque return cased if any, and whether any represent of the same instrument is done with approval
- ✓ Check the list of dealers who are habitual in cheque return

- ✓ Check the ageing analysis of all customers and find the reasons for outstanding more than 90 days
- ✓ Check the list bank guarantees taken from non-trade (direct) customers and check all such guarantees are in force
- ✓ Check whether any tender participations made, EMDs paid and outstanding EMDs yet to receive with ageing analysis

Accounts Payable

- ✓ Check the ageing of creditors do know any payments due beyond 90 days and reasons thereof
- ✓ Check whether any payments towards technical knowhow or royalty to foreign collaborator
- ✓ Check whether any rate variations and how they are accounted with suppliers / vendors and relevant purchase orders
- ✓ Check whether any imports made towards high value of spares viz kiln bricks and insurance spares which are normally imported in cement industry and payments made thereof

Inventory

- ✓ Check how the inventory of raw material, stores and spare are valued
- ✓ Check how the work-in-progress is measured and valued.
- ✓ Check how the clinker and cement stock in silos are measured to arrive quantity in stock

- ✓ Check whether the stocks are arranged in proper geometrical shape to enable to measure mathematical formulae
- ✓ Check whether dipsticks used to measure stock in silos are calibrated and showing correct reading
- ✓ Check whether scrap generation properly measure and accounted
- ✓ Check whether damaged stock separately stored and not counted in good stock
- ✓ Randomly check whether stock shown in packing slips are matching with weighbridge stock and stock shown in invoice or delivery challan

Taxation & Insurance (Goods & Services Tax Act)

- ✓ Check whether all the returns viz., GSTR-1, GSTR-9, 9C are filed in time
- ✓ Check whether any reconciliation is made with GST returns vis a vis books of account
- ✓ Check the reconciliation within the returns file GSTR-1 vs 3B, 3B Vs GSTR-9 etc
- ✓ Check whether GSTR-2A reconciliation is made from time to time and treatment of lapsed Input Tax Credit
- ✓ Randomly check the eligibility of ITC of major transaction
- ✓ Check whether credit / debit notes are issued within the time limit prescribed in CGST Act

- ✓ Check or Confirm the stock lying with Job-workers and ensure credit is claimed accordingly.
- ✓ Check the reversal of ITC in case of any supply of exempted goods or services
- ✓ Check the nature of *zero* rated and *nil*ratedgoods to ensure they are in confirmation with policy / notification
- ✓ Check whether any notices issued and pending for action and reasons for such notices

Income Tax

- ✓ Check whether monthly TDS payments are deposited within the time limit and are correct rates of TDS applied
- ✓ Check whether any advance payment of tax is due and paid in time
- ✓ Check whether any foreign payments are made, and they are in accordance with provisions of the Act

Insurance

- ✓ Check the insurance coverage for all Fixed Assets of the entity
- ✓ Check the insurance coverage particularly for work-in-progress and finished cement
- ✓ Check how these quantities are determined and reported to insurance authorities
- ✓ Check whether any claims made during the earlier period and its nature

- ✓ In cement industry coal is a self-burning material, hence check whether any such incidents happened and its impact or intensity
- ✓ Check all in incoming material covers by transit insurance.
- ✓ Check how the transit insurance coverage for outgoing material
- ✓ In cement industry outgoing material is the responsibility of the transporter, check whether any coverage made to such outgoing material

10.10 Internal Audit of Cost Accounting Function

- ✓ Check and understand the cost centre master and how they are designed
- ✓ Check whether cost accounting system is a standalone one or an integrated one
- ✓ Check the grouping of cost centre groups
- ✓ Check the cost centre categories into production, utilities, services, marketing, and administration
- ✓ Check the flow of data from various departments
- ✓ Check the allocation, apportionment and absorption methods followed
- ✓ Check whether non-cost items are categorized and not included in the cost
- ✓ Check the list of non-cost items and items of abnormal in nature
- ✓ Check the valuation of inventory under Cost Accounting Standard vis a vis in the books of account of financial records. Any difference to be reconciled

- ✓ Check how the internal consumption of clinker is arrived
- ✓ Check whether cost accounting records as per CRA 1 of Companies (Cost Records and Audit) Rules 2014 are maintained for clinker and cement.

10.11 Internal Audit of Information Security and ERP

- ✓ Whether there is an approved blueprint for the ERP system implemented in the company
- ✓ Check whether it is cloud-based third party ERP or is it in-housed developed
- ✓ Check whether any annual license fee payable
- ✓ Check how the licenses are optimized
- ✓ Check whether different control levels are defined?
- ✓ Check randomly whether every transaction has a time stamp?
- ✓ Check whether a log generated of all transaction with user id and time details?
- ✓ Who approves any changes in the system?
- ✓ Check the list of power users, super users, and transaction users?
- ✓ Check the data redundancy and back procedure
- ✓ Cheche the Business Contingency Plan
- ✓ Check whether proper controls exists for data leakages?
- ✓ Understand the Security architecture and assess whether it is full proof
- ✓ Check whether any maker and checker policy exist and is followed without any violation

- ✓ Check what is the password generation policy and whether any sharing of password between employees
- ✓ Check whether the user ids of employees left the organization are deactivated

10.12 Internal Audit of Human Resources Function

- ✓ Check the organizational Human Resource Policy
- ✓ Check whether any wage agreement entered with worker-unions if any
- ✓ Cement Industry is governed by Cement Wage Board recommendation
- ✓ Check whether there is any production incentive scheme in vogue and if so, random calculation checking of the same
- ✓ Check the leave policy and calculation of leave encashment
- ✓ Check the bonus calculations, normally in cement industry apart from statutory bonus to applicable employees, ex-gratia paid to others
- ✓ Check the compliance with provisions of Employees' Provident Fund & Miscellaneous Provisions Act, 1952 and Rules made there under.
- ✓ Check the status of submission PF Annual Return
- ✓ Check the cases of pending Provident Fund Settlement – Whether proper follow-up is being made
- ✓ To check the reasons for long pending cases of PF settlement and to report thereon.
- ✓ Whether the company maintains the register of Bonus (Form-C) and other provisions contained in Payment of Bonus Act,1965.

- ✓ Check the calculations of allocable surplus and allowable surplus for bonus computation
- ✓ Whether register of Gratuity along with calculation sheets are maintained, provision for gratuity is made based on Actuarial valuation or not?
- ✓ Check whether the employer has obtained declaration form from employees covered under the ESI Act and submit the same to the E.S.I.
- ✓ Check whether ESI contributions are made and deposited with the authorities and returns filed in time

11 COST AUDIT OF CEMENT INDUSTRY

Cement is covered Companies (Cost Records and Audit) Rules, 2014 subject to turnover limits as specified in the rules. Portland cement and clinker are covered under CTA Heading 2523

Sl. No	Particulars to be Reviewed	Need for Review
1	Key Performance Indicator (Please refer KPI List in Cost Control Chapter of this Guidance Note)	To understand the overall operational and financial performance
2	Minutes of Cost Savings / Cost Control Committee	To understand the initiatives of Cost Control/ Cost Governance aspects of the Company
3	Insurance Spares Capitalized particularly for Raw Mill, Coal Mill, Kiln and Cement	To understand the volume of insurance spares

	Mill	
4	Stores and Spares not moved for more than 24 months	To understand non-moving stores and spares and to analyse whether they are insurance spares or not
5	Delegation of Authority Manual and any other Manuals of the Company	To ensure that the expenditure is made as per the delegation of power issued and are within the limits.
6	Price Cards, Discount, Rebates, and Incentives	To understanding the pricing policy, volume of discounts, rebates vis a vis debit notes / credit notes issued to customers
7	Liabilities and Provisions	To understand the need for such provisions and to assess the liability
8	GST Monthly and Annual Returns	To assess the liability and to corroborate landing cost of input material, sales made, and input claimed
9	Claims Received from Railways, transporters, and insurers	To understand the long pending claims receivable and nature of such claims and its impact on profitability
10	Demurrages not admissible in Cost Statements as Selling and Distribution Overheads	To understand the reason for such expenditure and to assess the contractual obligation or otherwise of the demurrage whether controllable or not
11	Sundry Debtors Aging and Credit Policy	To understand the recoverability or otherwise, and to assess the Debtors Turnover Ratio
12	Physical Verification Reports	To understand the areas of physical verification carried out, frequency and reasons for any shortages or surplus

13	Review of insurance policies	To understand whether the all fixed and current assets are sufficiently covered, and risk associated therewith
14	Escalation Clauses	To understand the value, volume and its impact of such escalation claims on profitability
15	Advances and Deposits	To understand the ageing of such advances, need, and recoverability or otherwise.
16	ISO Certification and surveillance audit findings and list of Non-Conformity Reports (NCR)	To ensure that the systems and procedures are followed in line with ISO standards and they follow established standards
17	Weigh Bridge Calibration Reports	To ensure that weighment is proper and no revenue leakage on account of weight losses
18	Input / Output Ratios of Raw Mill, Kiln and Cement Mill	To ensure that he input out put are in line with the industry established standards
19	Handling Losses and moisture corrections for Limestone, Coal, Fly Ash and Gypsum	To assess the normality or otherwise of the moisture and handling losses vis a vis Quality Control lab reports and its impact on input output ratio
20	Coal Purchased under different grades and landing cost of the same as imported or domestic	To understand the Calorific Value (CV) of different grades coal received and its impact on fuel consumption vis a vis coal quality, landing cost.
21	Refractory Lining and Grinding Media replacement	To understand the consumption of the refractories and grinding media is in line

	policy	with the overall production as this is a significant cost item of spares
22	Transportation Contracts, C&F Contracts	To understand the live contracts, price escalation policy and to analyse the transhipments avoidable or otherwise
23	Subsidies if any	To understand the nature, extent and purpose of subsidy received
30	Sources of Power Purchased and Department-wise Consumption	To analyse the cost of power of various sources and consumption norms of each department vs actual
31	Contract Labour and Agreements	To understand the deployment of contract labour and verifying the same with wage agreements vis a vis compliance
32	Environment, Health and Safety Policies (EHS)	To understand the organizations EHS Policy, risks or otherwise of non-compliance
33	ERP Process Document	To understand the process flow of all the business process

12 INDUSTRY 4.0 IN CEMENT INDUSTRY

Industry 4.0 is the application of disruptive technologies such as Drones, Robotic Process Automation (RPA), Internet of Things (IoT), Artificial Intelligence (AI), Augmented Realty (AR), 3D Printing, Digital Twins etc., to optimize the process performance, reduction in operating costs, improve quality and more safer work and environment too. Industry 4.0 widely used to gain importance in cement industry too with names Cement 4.0, Cementability, Plants of tomorrow etc. The following are some of the areas where Industry 4.0 used in Cement industry

- Near real-time analysis of limestone while quarrying
- Analytics driven predictive maintenance
- Predictive quality analysis
- Alternate fuel optimization
- Advanced Process Controls
- Digital Twins

Industry 4.0 in quarrying (mines) operations: Limestone is the predominant material used in cement manufacturing. The quality of limestone extracted determines the mix of other additives such as Iron ore, Shale, Bauxite, Laterite etc. Smart X-Ray Fluorescent (XRF) analysers are attached to drilling machines. These analysers analysis the mineral data on near-real time data while drilling and sends to plant managers which enable them to analyse the

quality of limestone and decide on the additives to be mixed. Smart block modelling of mines helps in smart management of loading operations to obtain homogeneous feed of the material which reduces the time of homogenization with improved quality.

Industry 4.0 in Limestone Transportation: The RFID and GPS enabled dumpers are used to track the movements of the same to avoid unwanted stoppage of these by the drivers to increase the number of trips per each dumper by tracking them real time. Also, RFID enable to load required full capacity of limestone quantity, helps in proper measurement, and avoid wastage of raw material.

Industry 4.0 in Kiln Operations: Kiln is highly energy-intensive process hence using advanced Kiln Control Systems (KCS) close monitoring of the process is possible and to control the temperature at required levels. This enables saving in fuel cost and improved lifespan of refractory material of the kiln.

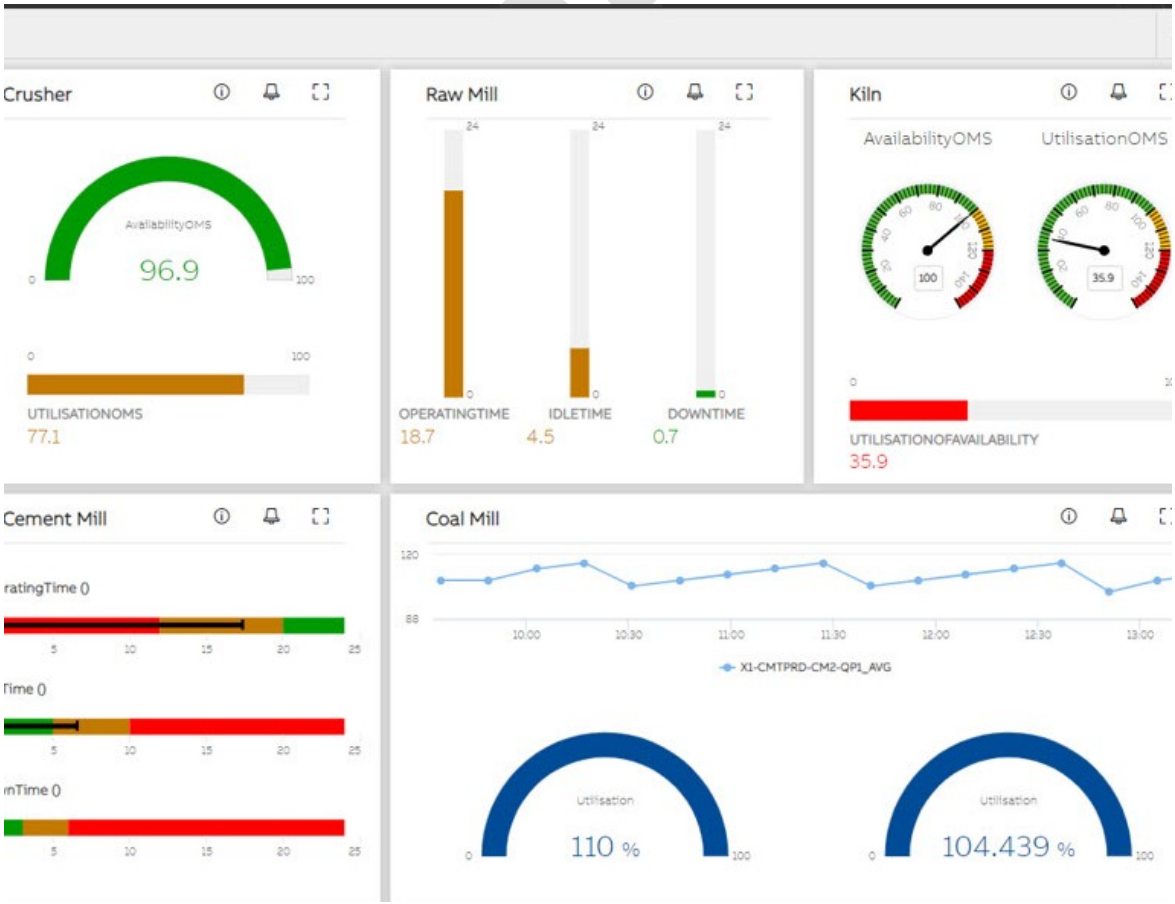
Industry 4.0 in Mills Operations: Raw Mill, Coal Mill and Cement Mills are the grinding mills in cement industry. These mills consume high energy and a little saving in energy in mill operations entails greater financial benefits. MCS software helps in optimized grinding, homogeneous milling, improved quality, and smoother operation through increased lifespan of mills.

Digital Twins: Digital twins used in end to end optimization of processes including to simulate the environment measuring the near-real-time analysis of

environmental parameters and taking corrective action to control pollutants within the acceptable limits.

Automation in Logistics, Warehouse operations and Inventory: The RPA enabled invoicing and GPS enabled trucks for movement of finished products to warehouses and customers helped in tracking the vehicles on real time basis avoiding demurrage charges, timely delivery of material to customers. This further helps in standardization and repacking losses at warehouses and to track quality complaints like clotting of cement. Drones are widely used in stock-tacking of clinker, cement, and high value of spares in open space.

Integrated Information Dashboard (Sample)



13 COST OF SETTING-UP A NEW CEMENT PLANT IN INDIA

The Capital Expenditure (CapEx) of setting-up of a new cement plant in India depends on various factors mentioned below.

Greenfield Cement or Brownfield Cement Plant

Integrated Plant or Cement Grinding Unit or Debottlenecking or ExpansionGeographical Region -Northern or Southern or Eastern or Western or Central

However, Greenfield projects are normally costlier than brownfield project. On an average basis, in India, CapEx for setting up an integrated green field cement plant ranges from Rs.5, 500 per ton to Rs.7, 500 per ton based on the plant annual capacity and geographical location of the plant. For example, setting up an integrated greenfield cement plant with a capacity of 3 Million Tons per annum requires approximately Rs.1,700 Crores to Rs.2,100 Crores capital expenditure. In case of a brownfield integrated cement plant for same capacity may be completed at half of the capex cost mentioned above. Further, Capex may also increase or decrease based on the geographical location of the cement plant. It also depends on the make, machinery and technology used in construction of the cement plant. The breakdown of Capex is as follows

Land acquisition Cost

Buildings

Plant and Machinery

Infrastructure and Utilities

Pre-operative expenses

13.1 Land Acquisition Cost

Land acquisition is a continuous activity in cement industry. The incremental land adds further to augment future mining or expansion activities. With the implementation of new 'Land Acquisition, Rehabilitation and Resettlement Act, 2013 commenced on 1st January 2014 land acquisition cost have increased as the compensation shall be paid based on the calculation provided in the said Act.

13.2 Building, Plant, Machinery, Equipment and Civil Works

These forms major part of total capital cost to set up a cement plant. Cost primary depends on make of the machinery, vendors, and negotiation skills. As per industry estimates currently, the cost of plant and machinery, building and civil works forms approximately 67% of the total capital cost.

14 APPENDIX

14.1 Know the latest about Cement Industry

India is the second largest producer of cement in the world. No wonder, India's cement industry is a vital part of its economy, providing employment to more than a million people, directly or indirectly. Ever since it was deregulated in 1982, the Indian cement industry has attracted huge investments, both from Indian as well as foreign investors.

India has a lot of potential for development in the infrastructure and construction sector and the cement sector is expected to largely benefit from it. Some of the recent major initiatives such as development of 100 smart cities are expected to provide a major boost to the sector.

Expecting such developments in the country and aided by suitable government foreign policies, several foreign players such as Lafarge-Holcim, Heidelberg Cement, and Vicat have invested in the country in the recent past. A significant factor which aids the growth of this sector is the ready availability of the raw materials for making cement, such as limestone and coal.

According to data released by the Department for Promotion of Industry and Internal Trade (DPIIT), cement and gypsum products attracted Foreign Direct Investment (FDI) worth US$ 5.28 billion between April 2000 and December 2019.In October 2019, UltraTech cement announced plans to invest Rs 940 crore (US$ 134.50 million) to increase the production of premium products for

strengthening its position in eastern markets.Emami Cement (Nu Vista Ltd) currently has three cement manufacturing assets with a capacity of 5.6 million tonnes.In May 2019, SEBI approved Emami Cement Ltd.'s initial public offering (IPO).JK cement will spend Rs 1,700 crore (US$ 246.7 million) to increase its production capacity to 15 million tonnes by the end of 2020.As of December 2018, Raysut Cement Company (This Oman based presently no cement plants in India) is planning to invest US$ 700 million in India by 2022. However, in view of present COVID 19 pandemic the above developments and investments may hit a roadblock. The following are the list of cement companies in India.

LIST OF CEMENT COMPANIES AND NUMBER CEMENT PLANTS IN INDIA		
Sl.No.	**Name of the Cement Company**	**Number of Cement Plants**
1	A P Cement Concrete and Allied Products Company	1
2	Aadi Cements Pvt Ltd	1
3	ACC Limited	17
4	Aditi Industries	1
5	Aditya Cement	1
6	Agarwal Min Chem Ltd	1
7	Alcon Cement Company Pvt. Ltd.	1
8	Allwin Industrials	1
9	Ambuja Cement Ltd	15
10	Anjani Portland Cement Ltd	1
11	Ashtech India Pvt Ltd	1
12	Asian Concretes Cement Ltd	1
13	Bagalkot Cement & Inds.Ltd	1
14	Barak Valley Cements Ltd	1
15	Bharti Cement Corpn. Pvt. Ltd	1
16	Bhavya Cement Limited	1
17	Birla Corporation Ltd	5
18	Burnpur Cement Limited	1

19	Cement Corporation Of India Ltd	10
20	Century Textiles and Industries Ltd	4
21	Chalukiya Cements	1
22	Chettinad Cement Corporation Private Limited	4
23	Creative Housewares Pvt. Ltd	1
24	Dalmia Cement (Bharat) Ltd	8
25	Deccan Cement Ltd	1
26	Dhandapani Cements Private Limited	1
27	Diamond Industries	1
28	Eurotech Cements and Products	1
29	Goldstone Cements Ltd	1
30	Great India Cement Pvt. Ltd.	1
31	Green Valliey Industries Limited	1
32	Gujarat Sidhee Cement Ltd	1
33	H K Cement Industries Private Limited	1
34	Hebbal Cements	1
35	Heidelberg Cement India Ltd	3
36	Hemadri Cement Ltd	1
37	Hemawati Cement Industries	1
38	Hi-Bond Cement (India) Pvt Ltd	1
39	India Cements Ltd	10
40	J & K Cement Corporation	1
41	J.K. Cement Ltd	6
42	J.S.W. Cement Ltd	6
43	Jagdamba Industries Limited	1
44	Jaiprakash Associates Ltd	9
45	Jammu And Kashmir Cements Ltd	1
46	Janta Cement Industries	1
47	Jay Shree Kripa Cement Pvt. Ltd.	1
48	Jcl Cement Pvt Ltd	1
49	Jindal Shakti Cement	1
50	Jk Lakshmi Cement Ltd	4
51	Jsk Cement Pvt. Ltd	1
52	Jud Cements Ltd	1
53	K R Associates	1
54	K. J. S. Cement Ltd	1
55	K.C.P. Ltd	2
56	Kakatiya Cement Sugar &Amp; Industries Ltd	1
57	Kalburgi Cement Pvt Ltd.	1
58	Kalyanpur Cements Ltd	1
59	Kamdhenu Cement Ltd	1
60	Kashi Sales Corporation	1
61	Kd Cements	1
62	Keerthi Industries Ltd	1
63	Kesoram Cement	2

64	Khyber Industries Pvt Ltd	1
65	M.N.S. Associate	1
66	M/S. Vijay Cements	1
67	Ma Chandi Durga Cement Pvt Ltd	1
68	Maharaja International, U/O Pawan Cement Co. Pvt Ltd.	1
69	Malabar Cements Ltd	2
70	Mancherial Cement Ltd	1
71	Mangalam Cement Ltd	1
72	Marce Cement Works Ltd.	1
73	Mawmluh Cherra Cements Ltd	1
74	Meghalaya Cements Ltd.	1
75	Mpl Cement and Sponge Private Ltd	1
76	My Home Industries Private Limited	3
77	Ncl Industries Ltd, Simhapuri Cement Plant	1
78	New Kishan Cement Pvt Ltd	1
79	Nirma Limited	1
80	Nu Vista Limited	4
81	Nuvoco Vistas Corp. Ltd.	6
82	Ocl India Ltd	3
83	Orient Cement	3
84	Panyam Cement &Amp; Mineral Industries Ltd.	1
85	Parasakti Cement Ltd	1
86	Penna Cement Industries Ltd	6
87	Praja Cements Pvt	1
88	Prism Johnson Ltd.	1
89	Purbanchal Cement Ltd	1
90	R.V.R Exports and Imports	1
91	Rain Cements Ltd	3
92	Ratna Cements (Y) Ltd, Yadwad	1
93	Raymond Cement Industries	1
94	Reliance Cement Company Private Limited	1
95	Rnb Cements (P) Ltd	1
96	S.A.L. Steel Limited	1
97	Sagar Cement Ltd	3
98	Sakarni Plaster (India) Pvt. Ltd.	1
99	Sanghi Industries Ltd	1
100	Saurashtra Cement Ltd	1
101	Shekhwati Cement	1
102	Shiva Cement Limited	1
103	Shiva Industries	1
104	Shivalik Cement Industries	2
105	Shivay Cement Pvt Ltd	1
106	Shree Cement Ltd	16
107	Shree Digvijay Cement Co. Ltd	1
108	Shree Ganesh Concrete Pvt Ltd	2

109	Shree Ghantakarna Mahavir Cement Pvt. Ltd.	1
110	Shree Jagjothi Cement Ltd	1
111	Shri Keshav Cements and Infra Ltd.	2
112	Shri Lakshmi Industries	1
113	Shri Ram Industries	2
114	Shriram Cement Works	1
115	Shristi Cement Ltd	1
116	Sita Cement Ltd.	3
117	Sree Jayajothi Cements Pvt. Ltd.	1
118	Sri Chakra Cements Ltd	1
119	Sri Lalitha Cement Industries Ltd	1
120	Srikalahasthi Pipes Limited	1
121	Star Cement Limited	3
122	Sunrise Cement Industries	1
123	SVS Cement Products	1
124	T.C.C Industries	1
125	T.T.S. Cement	1
126	Tamil Nadu Cements Corpn. Ltd.	2
127	Tatachemicals Ltd	1
128	The Ramco Cements Limited	7
129	Top-Tech Cement Co. Pvt. Ltd	1
130	Toshali Cements Private Limited	2
131	Trichy Concrete Industries	1
132	Trinetra Cement Limited	1
133	Udaipur Cement Works Limited	1
134	Uddyam Cement Private Limited	1
135	Ultratech Cement Ltd	40
136	Ultratech Nathdwara Cement Ltd	2
137	Uma Cement Industries	1
138	Vadraj Cement Ltd.	1
139	Valley Cement Industries	1
140	Vardhaman Infratech Company	1
141	Viket Sagar Cement	1
142	Wonder Cement Ltd	1
143	Zuari Cement Ltd	3
	Grand Total	**330**

Source *https://eaindustry.nic.in/cement/report2.asp downloaded on 19-06-2020*

14.2 Efficiency Analysis Templates

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
A	**LIMESTONE EXCAVATION**				
1	Limestone Excavated	MT			
2	Explosives Consumption per Ton	Rs			
3	Manhours Deployed	Hrs			
4	Output per Manhour	MT			
5	Excavation Hours Deployed	MT			
6	Output per Hour of Excavation	MT			

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
B	**LIMESTONE TRANSPORTATION**				
1	Limestone Transported to Crusher	MT			
2	No. of Dumper Hours Deployed	Hrs			
3	Output per Hour of Excavation	MT			
4	Diesel & Lubricants Consumption per Ton	Rs			

x

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
C	**CRUSHER**				
1	Available Hours	Hrs			
2	No. of Hours Run	Hrs			
3	Available Capacity	MT			
4	Actual Output	MT			
5	Capacity Utilization	%			
6	Output per Hour	MT			
7	Power Consumption per Ton	KWH			
8	Stores & Spares per Ton	Rs			
9	Manhours Deployed	Hrs			
10	Manhours per Ton	MT			

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
D	**RAW MILL**				
1	Available Hours	Hrs			
2	No. of Hours Run	Hrs			
3	Available Capacity	MT			
4	Actual Output	MT			
5	Capacity Utilization	%			
6	Output per Hour	MT			
7	Power Consumption per Ton	KWH			
8	Stores & Spares per Ton	Rs.			
9	Manhours Deployed	Hrs			
10	Manhours per Ton	Hrs			

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
E	**COAL MILL**				
1	No. of Hours Run	Hrs			
2	Actual Output	MT			
3	Output per Hour	MT			
4	Power Consumption Per Hour	KWH			
5	Stores & Spares per Ton of Coal grinded	Rs.			

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
F	**KILN**				
1	Available Hours	Hrs			
2	No. of Hours Run	Hrs			
3	Available Capacity	MT			
4	Actual Output	MT			
5	Capacity Utilization	%			
6	Output per Hour	MT			
7	Power Consumption per Ton	KWH			
8	Energy Consumption per Ton	KCal			
9	Stores & Spares including lining bricks/Ton	Rs.			
10	Manhours Deployed	Hrs			
11	Manhours per Ton	Hrs			

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
G	**CEMENT MILL**				
1	Available Hours	Hrs			
2	No. of Hours Run	Hrs			
3	Available Capacity	MT			
4	Actual Output	MT			
5	Capacity Utilization	%			
6	Output per Hour	MT			
7	Power Consumption per Ton	KWH			
8	Energy Consumption per Ton	Kcal			
9	Stores & Spares per Ton	Rs.			
10	Grinding Media Consumption per Ton	Rs.			
11	Manhours Deployed	Hrs			
12	Manhours per Ton	Hrs			
13	Clinker per ton of Cement	%			
14	Gypsum per ton of Cement	%			
15	Fly Ash per ton of Cement	%			
16	Slag per ton of Cement	%			

Sl.No.	KEY INDICATOR	UOM	STD	Current Year	Previous Year
H	**PACKING**				
	Loading of Cement per Shift	MT			
	Power Consumption per Ton	KWH			
	Stores and Spares per Ton	Rs			

Sl.No.	KEY INDICATOR	UOM	STD	CY	PY
I	**FUEL**				
1	Coal Consumption per Ton Clinker	MT			
2	Fuel Oil / LSHS Consumption per Ton Clinker'	MT			
3	Alternative Fuels Consumption per Ton	MT			
4	Total Energy Consumption per Ton	Kcal			
J	**POWER**				
1	Power Purchased SEBs	KWH			
2	Power Generated IPPs				
3	Power Generated	KWH			
4	Fuel Consumption per KWH Generated	Rs.			
5	Stores & Spares Consumption per KWH	Rs.			
6	Plant Load Factor (Own Generation)	%			

14.3 List of relevant laws, Rules, Regulations, Government Policies, Orders, etc.

- Air (Prevention and Control of Pollution) Act, 1981 amended 1987
- Water (Prevention and Control of Pollution) Act, 1974 amended 1988
- The Environment (Protection) Act, 1986, amended 1991
- Hazardous Waste (Management and Handling) Rules, 1989 amended 2000 and 2003
- Manufacture Storage and Import of Hazardous Chemicals Rules, 1989 amended 2000
- Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
- Environmental Impact Assessment Notification, 2006 and amended from time to time
- Batteries (Management and Handling) Rules, 2001.
- Public Liability Insurance Act, 1991 amended 1992
- The Petroleum Act, 1934
- Explosives Act, 2008
- The Gas Cylinder Rules, 2004
- The Static and Mobile Pressure Vessels (Unfired) Rules, 1981
- The Motor Vehicle Act, 1988
- The Mines Act 1952
- The Merchant Shipping Act, 1958 amended in 2002 and 2003
- Cement (Quality Control) Order, 2003
- Limestone and Dolomite Mines Labour Welfare Fund Act, 1972
- Mines and Minerals (Development and Regulation) Act, 1957
- Mineral Conservation and Development Rules, 1988
- Indian Electricity Act 2003
- Employees' Provident Funds & Miscellaneous Provisions Act, 1952,
- Factories Act, 1948, Payment of Gratuity Act, 1972,

- Industrial Dispute Act, 1947, Employees State Insurance Act, 1948,
- Payment of Wages Act, 1936,
- Minimum Wages Act, 1948
- The Standards of Weights and Measures Act, 1976
- Cement Cess Rule, 1993
- Companies Act, 2013
- Income Tax Act, 1961
- Goods and Services Tax Act 2017.
- The Custom Act, 1962
- Companies Audit Report Order (CARO) 2020.