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GUIDANCE NOTE ON
INTERNAL AUDIT OF CEMENT INDUSTRY

INTERNAL AUDITING & ASSURANCE STANDARDS BOARD

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA

Statutory Body under an Act of Parliament

Headquarters: CMA Bhawan, 12 Sudder Street, Kolkata - 700016
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MISSION STATEMENT

"The CMA Professionals would ethically drive enterprises globally by creating value to stakeholders in the socio-economic context through competencies drawn from the integration of strategy, management and accounting."

VISION STATEMENT

"The Institute of Cost Accountants of India would be the preferred source of resources and professionals for the financial leadership of enterprises globally."

ABOUT THE INSTITUTE

The Institute of Cost Accountants of India is a Statutory body set up under an Act of Parliament in the year 1959. The Institute as a part of its obligation, regulates the profession of Cost and Management Accountancy, enrols students for its courses, provides coaching facilities to the students, organises professional development programmes for the members and undertakes research programmes in the field of Cost and Management Accountancy. The Institute pursues the vision of cost competitiveness, cost management, efficient use of resources and structured approach to cost accounting as the key drivers of the profession. In today's world, the profession of conventional accounting and auditing has taken a back seat and cost and management accountants are increasingly contributing towards the management of scarce resources and apply strategic decisions. This has opened up further scope and tremendous opportunities for cost accountants in India and abroad.

After an amendment passed by the Parliament of India, the Institute is now renamed as "The Institute of Cost Accountants of India" from "The Institute of Cost and Works Accountants of India". This step is aimed towards synergising with the global management accounting bodies, sharing the best practices which will be useful to large number of trans-national Indian companies operating from India and abroad to remain competitive. With the current emphasis on management of resources, the specialized knowledge of evaluating operating efficiency and strategic management the professionals are known as "Cost and Management Accountants (CMAs)". The Institute is the 2nd largest Cost & Management Accounting body in the world and the largest in Asia, having approximately 5,00,000 students and 85,000 members all over the globe. The Institution headquartered at Kolkata operates through four Regional Councils at Kolkata, Delhi, Mumbai and Chennai and 108 Chapters situated at important cities in the country as well as 11 Overseas Centres. It is under the administrative control of Ministry of Corporate Affairs, Government of India, New Delhi.

Internal Auditing and Assurance Standards Board (IAASB)

The Institute & eminent resource persons from our profession have felt the need for the constitution of board for Internal Audit. The Present Council for the first time has nurtured the Board to formulate and issue standards, guidelines and advisory for the Internal Audit Function. The Cost Accountants have been recognized by the Companies Act, 2013 and other regulatory bodies for appointment as Internal Auditors.

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FOREWORD OF PRESIDENT

It is my great pleasure to share that the Council in the year 2019 constituted Internal Auditing & Assurance Standard Board (IAASB), keeping in view the need arising on account of statutory provisions relating to appointment of cost accountants as Internal Auditors of the Companies Act, 2013.

As per Section 138 (1) of the Companies Act, 2013, companies fulfilling certain criteria are required to appoint an internal auditor and further Section 138(1) empowers Cost Accountants to conduct internal audit of the functions and activities of the company. Keeping this in mind and in line with the regulatory recognition of practicing Cost Accountants under section 138 (1) of Companies Act 2013 to be appointed as Internal Auditors, the present Council for the first time as a hall mark in the history of the Institute, has constituted the Board to formulate and issue standards, guidance notes, guidelines and advisory for the Internal Audit activities.

This Guidance Note focuses on Internal Audit in the Cement Industry. It also provides an insight into the general framework of Internal Audit mechanism vis-à-vis sector specific issues which are prevalent in Cement Industry.

On behalf of the Institute, I do acknowledge the sincere and persistent efforts of CMA Lakshmana Rao, Member of the Institute & Practising Cost Accountant who has been entrusted for preparation of this Guidance Note as an author and also extending sincere gratitude to CMA B.B. Goyal, Co-opted Member of IAASB and CMA B. Mallikarjuna Gupta, Member of the Institute for their enormous support and guidance as reviewers nominated by IAASB.

I am thankful to CMA Biswarup Basu, Vice-President of the Institute and also CMA P. Raju Iyer, Chairman of the Internal Audit Assurance &Standards Board (IAASB) for their relentless support without which, the formation and smooth functioning of the Board would have been difficult.

I am quite sure that the readers of Guidance Note will find it very useful in their professional life and will be benefitted to enrich their knowledge in the field of Internal Audit.

CMA Balwinder Singh

President

Dated: 15th Sept, 2020

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA

FOREWORD OF VICE- PRESIDENT

It gives me immense pleasure to present the Guidance Note on Internal Audit in Cement Industry prepared by the Internal Auditing and Assurance Standards Board (IAASB). I also extend my personal gratitude to the Council for formation of Internal Auditing & Assurance Standard Board (IAASB) taking into consideration the Statutory Provision of the Companies Act, 2013 wherein the Cost Accountants along with other professionals have been considered for taking up the assignment of Internal Audit.

The IAASB has been constituted to provide an opportunity to the members of the Institute to further their skills and knowledge in the field of Internal Audit by way of imparting specific training and providing guidance notes and standards for serving the industry in both the Manufacturing as well as the Service Sector.

I am sure that this Guidance Note would go a long way in strengthening and updating the professional expertise of Cost Accountants and all other stakeholders in the field of Internal Audit in delivering a far greater role and responsibilities in the years to come.

I would like to place on record my sincere gratitude to CMA Lakshmana Rao, author of this Guidance Note and also express my gratitude to CMA B.B. Goyal, Co-opted Member of IAASB and CMA B. Mallikarjuna Gupta, Member of the Institute for their enormous support and guidance as reviewers for imparting their expert knowledge in the field of Internal Audit in Cement Industry for finalization of this guidance note.

I am happy to be associated with board as a member and would like to extend my sincere thanks to CMA P. Raju Iyer, Chairman of the Internal Audit Assurance & Standards Board (IAASB) and to all the members of the board for their relentless efforts in bringing out this Guidance Note in the present form within a short span of time.

I wish all the success of the Board in its future endeavor.

CMA Biswarup Basu

Vice President

Place & Date: Kolkata, 15th Sept, 2020.

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA

FOREWORD OF THE CHAIRMAN

The Council of the Institute, under the able guidance and leadership of CMA Balwinder Singh, President and CMA Biswarup Basu, Vice President had constituted the Internal Audit Standards Board (IAASB) in the year 2019. This was a historic decision to promote the role of Cost & Management Accountants in the domain area of internal audit. The objectives and functions of the Board include development & issue of standards, guidance notes, implementation guides, technical guides, practice manuals, information papers and case studies etc. and to undertake their revision, where ever necessary.

The requirement of IAASB was the need of the hour considering the inclusion of "Cost Accountants" in the scope of Internal Audit as per provisions of Companies Act, 2013 and other legislations in force.

As the business activities and operations are undergoing continuous changes, auditing today, is not confined only to verification of documents and financial transactions but may also be suitably aligned with the developments in Artificial Intelligence and data mining. To assess the organization's performance, and to ensure the overall quality, credibility, consistency and comparability of the work performed by the Internal Auditors, it is necessary to follow the prescribed standards, policies, rules, and regulations covering various sectors.

To support & enable the Cost Accountants to qualitatively perform internal audit assignments, the Board felt the need for the preparation and development of Guidance Notes on Internal Audit for General requirement as well as for specific Industry /Service Sectors.

Considering the same, the board took up the assignment of preparation of Internal Audit Guidance Note on Cement Industry along with other Guidance Notes on Inter Audit which will be published very soon.

On behalf of the Institute as a Council Member and as a Chairman of IAASB, I sincerely thanked CMA Lakshmana Rao, Member of the Institute & Practising Cost Accountant who has dedicated his professional knowledge and expertise in preparing this Guidance Note as an author and also extending my sincere gratitude to CMA B.B. Goyal, Co-opted Member of IAASB and CMA B. Mallikarjuna Gupta, Member of the Institute for their enormous support, guidance and expertise as reviewers for finalization of this guidance note. I do also acknowledge and appreciate the support, expertise and guidance of all the members of the board for preparation and finalization of this guidance note.

I am sure that our members would find this Guidance Note as a very useful document for enriching their knowledge in Cement Industry and in furtherance to establish a lucrative career in Internal Auditing to tap the fullest potential of Internal Auditing and Assurance services.

CMA P.Raju Iyer
Chairman of IAASB

Place & Date: Chennai, 15th Sept, 2020.

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA

C O N T E N T S

CHAPTER 01

INTRODUCTION

1.1 INTRODUCTION

India is the second largest producer of cement in the world. Cement is one of the core industries which consumes huge quantity 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 from other normal manufacturing industries..Hence, it is important that an internal auditor conducting internal audit of a cement industry must clearly understand the details of these processes to be able to conduct effective internal audit

1.2 OBJECTIVES OF THIS GUIDANCE NOTE

- ► To create an understanding about cement industry
- ► To create an understanding the process of manufacture
- ► To update information on latest technological changes in cement industry
- ► To facilitate conduct of 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 in cement industry

1.3 SCOPE OF THE GUIDANCE NOTE

This guidance note is based on the practical experience in the industry focusing on the 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, this Guidance Note focuses much on OPC and PPC and 43 and 53 grades.

CHAPTER 02

OVERVIEW INTERNAL AUDIT

2.1 DEFINITION OF INTERNAL AUDIT

According to the 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 to 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 to ensure that risk management processes are efficient, effective, secure, and compliant.
- Examining and evaluating to ensure that the company's framework of risk management, internal control and governance processes are adequate and functioning properly.
- Advising and recommending to the management 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.
- Ascertaining the extent of compliance of policies, procedures, regulations, and legislations. Also checking compliance management systems of the organization.

- Achieve savings by identifying waste, inefficiency, and duplication of efforts across the organization.
- Efforts across the organization.

2.3 SCOPE OF INTERNAL AUDIT

- The scope of Internal Audit is based on the size of the company and nature of the organization in line with its vision, mission, and values.
- The scope should be commensurate with the efficacy of internal control system in vogue in the company
- The scope further depends on the level of automation and availability of the information system adapted in the company.
- Scope should l be within the framework of the assignment given by the Board or Audit Committee
- Scope further depends on the 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

After understanding the business from the above steps, a plan must be made as to how to conduct the 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 the team members must be allocated with concurrent communication among them .

2.4.3 Analyzing the processes and controls

Audit methodology shall include examination of documents, analysis of trend data 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 the draft report and obtain clarifications on the draft. Upon finalization of the draft, the final report shall be circulated to the top management along with recommendations for improvements, if any.

2.5 PLANNING

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

At the planning stage the auditor should -:

- ► Understand the objectives of the Internal Audit assignment
- ► Understand the scope of assignment from the engagement letter
- ► Understand the team required and whether any cross-functionals are required
- ► Understand the recent developments in the statutes 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 the process of 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 evidence to perform maximum level of audit. In selecting samples, the auditor must exercise utmost care as selection of 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 a combination of both based on the size of the business and the extent of complexity involved. Statistical sampling uses the theory of probability while 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 act of verifying documents such as sales invoice, purchase invoice, journal voucher, bank statement etc.

(3) Analytical procedures act as corroborative evidence and help 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 enquiries by collecting information from employees, management third parties etc. depending upon the seriousness of the transactions and the risk involved.

2.8 ANALYTICAL PROCEDURES

Analytical procedures mean the evaluation of financial and non-financial, qualitative, and quantitative information to establish a relation between business process and 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 a vital role in analytical procedures. With 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 in electronic or physical mode. Electronic documentation eases the work of documentation, and enables faster communication, and quicker access. Documentation can be divided into master documents and transactional documents. Review of key documents and reports will help to decide the scope of internal audit. This list is not an exhaustive but an indicative one.

Document	Source Department
Memorandum of Association (MoA)	Corporate / Secretarial
Articles of Association (AoA)	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	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 depending on the size of the organization

II. Audit Scope

- Clearly elaborate the audit scope; this is 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 other 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 limitations, if any 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, and 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 action taken on the observations made in the earlier reports and their adequacy or otherwise.

CHAPTER 03

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 to produce structures of long durability. Finally, in the year 1824 Joseph Aspedinpatented the 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 as detailed in the ensuing paragraphs.

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 a 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 replacement of OPC in some cases also used in 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 releases less heat on hydration.?? It is used in mass constructions such as dams, water treatment plants, marine offshore structures etc. Slag generated from steel plants is the main source of material.

3.2.4 Rapid Hardening Cement

It is a high strength cement and has similar properties like that of OPC but has 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 in setting when compared to OPC or PPC. It is basically used where quick setting is required due to rainy weather conditions and for structural repairs.

3.2.7 Low Heat Cement

This cement releases low heat on 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

Use of Sulphate Resisting cement is advisable in 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 while manufacturing in more quantities. It is expensive as compared to OPC and is used in architectural interiors, 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..

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, 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 units can be placed properly.

3.2.15 Expansive Cement

OPC shrinks after setting due to which cracks may appear. 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 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.

3.2.17 Portland Composite Cement (PCC)

Portland Composite cement (PCC) it a type of cement which is a combination where both slag and fly ash are used.

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 is 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/mm^2 (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/mm^2 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

43 Grade means the compressive strength of the cement after 28 days is 43 N/mm² when tested as per Indian Standards under standard test conditions This is used for plain concrete and plastering works. It is used where the 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	Electrostatic Precipitator
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

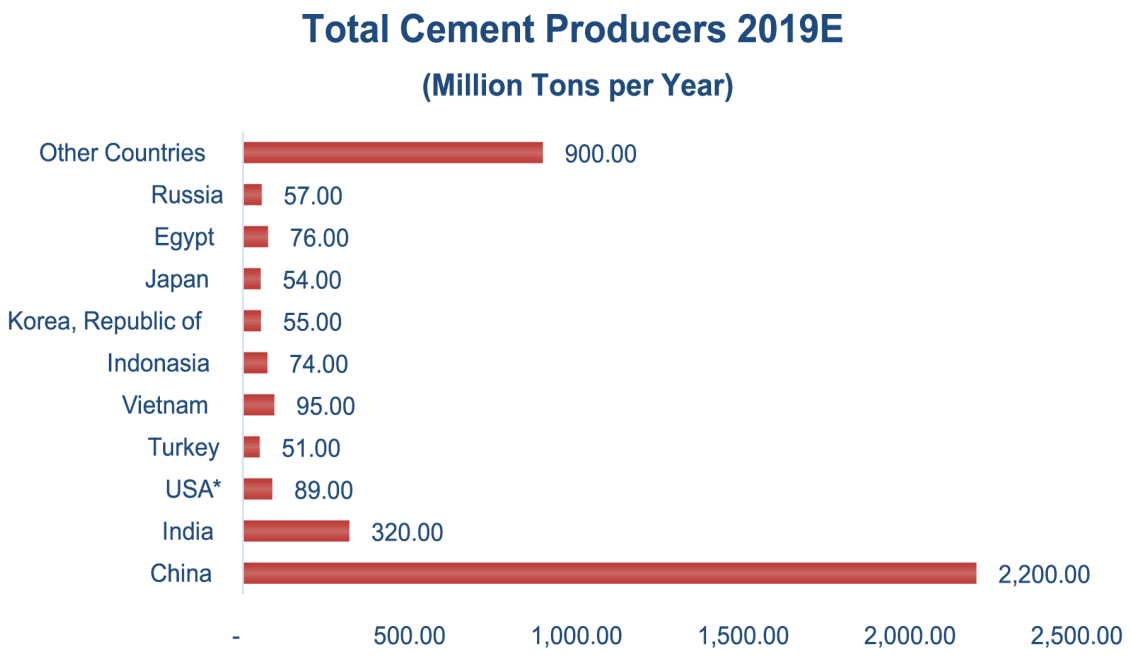
CHAPTER 04

OVERVIEW OF CEMENT INDUSTRY

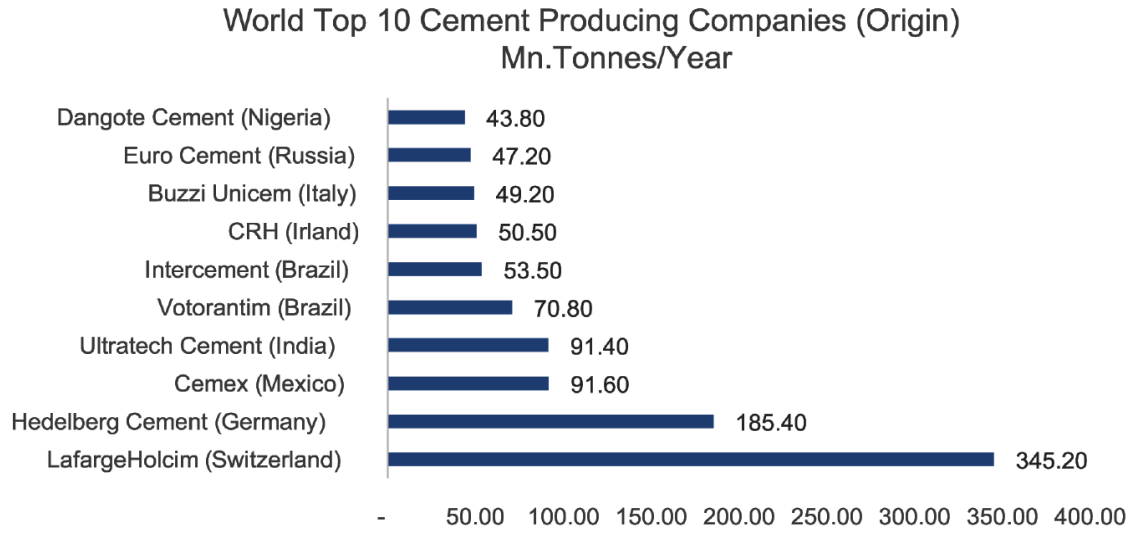
4.1 OVERVIEW OF WORLD CEMENT INDUSTRY

There were 159 countries and territories which produce cement either through integrated cement plants or grinding of imported clinker in 2017. World cement industry has seen consolidation during the last three years, the latest acquisition being 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 has taken the lead with highest production in the world, India stood at 2nd position.



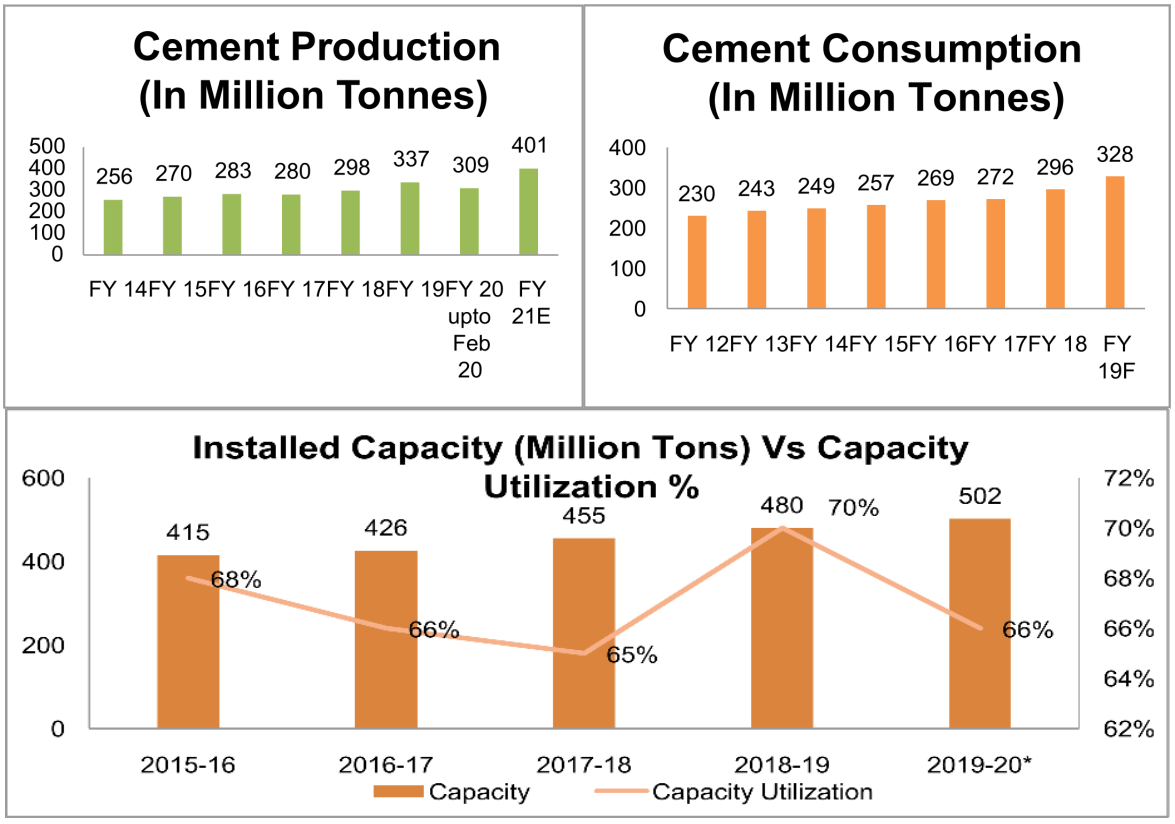
*Note: E –Estimate, * Includes Puerto Rico: Source: Cement Manufacturers Association, USGS Mineral Commodities Summary 2019, CRISIL*



Source: Beta Version of Global Cement Directory 2018

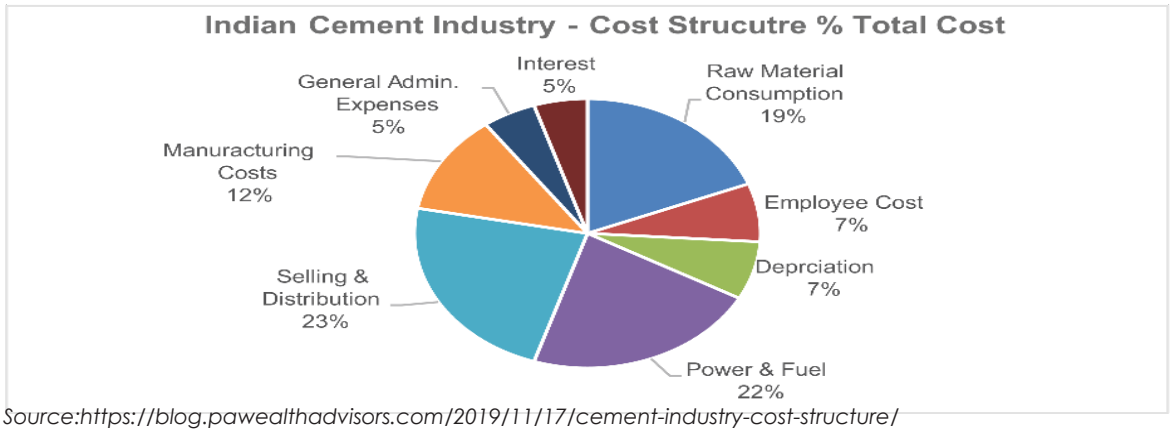
4.2 OVERVIEW OF INDIAN CEMENT INDUSTRY

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 types 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 with 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 consistently cement deficit for several years and its demand is met with cement purchases from other States of the country. As Meghalaya is rich in limestone and coal many national players and local players started setting up cement plants in that region. 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 the Government has taken many steps to increase the consumption of cement. In the latest Union Budget 2020-21 the Government extended the benefits under section 80 IBA of the Income Tax Act till 31 March 2021 to promote affordable housing. The Union Budget has allocated ₹ 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 expected to boost the demand of cement from the housing segment. The outlay of ₹ 27,500 crore under Pradhan Mantri Awas Yojana in Union Budget 2020-21 will accelerate the cement industry.

4.4 LEGAL AND REGULATORY FRAMEWORK

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

4.5 TECHNOLOGICAL DEVELOPMENTS

Good understanding of technology evolution and the process of manufacture enables the Cost and Management Accountants (CMA) to have a a grip over techno commercial aspects of the company or unit or a factory. Having knowledge about the product, components, engineering process and chemical compositionenables him in the preparation of cost statements, maintenance of cost records and accelerates the audit process. Keeping in view this, the following details with flow charts are made available about technology evolution of cement and the 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 wet process and dry process only.

4.5.1 Wet Process

In wet process the raw materials are homogenized by mixing, crushing, 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 and 1,600°C in horizontally revolving kilns. Coal or petroleum or natural gas is used in the kilns for burning to generate the required heat. High fuel requirement is

there 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 and 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 the 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 the 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 in dry process. The cost of production in wet process is higher when compared to dry process

4.5.4 Different Kiln Systems

Kiln is the heart of the cement plant evolved over a period of time. Initially there 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. Then came Cyclone Pre heater with energy consumption of 750-900 and power consumption of 25 KwH/Ton . Currently Pre-calciner has achieved energy consumption at 700-850 Kcal/kg and power consumption at 25 KwH/Ton.

CHAPTER 05

PROCESS OF MANUFACTURE

5.1 CEMENT MANUFACTURING STAGES

Cement Manufacturing involves mainly three stages.

Stage 1: Raw Material Preparation

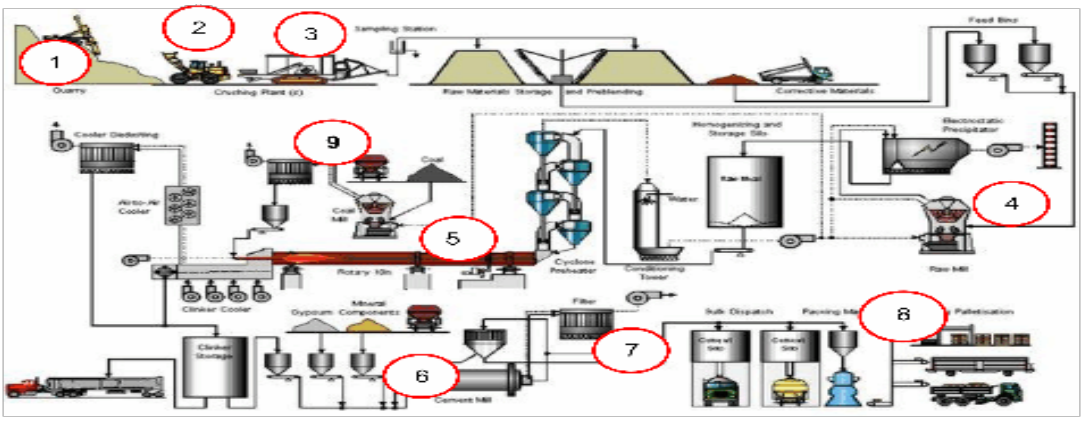
Stage 2: Pyro Processing and Cement Grinding

Stage 3: Cement Grinding and Despatch

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

Cement manufacturing broadly involves the following processes

1. Mining or quarrying
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 (Fe_2O_3), Water (H_2O), Sulphates (SO_3) and Gypsum ($CaSO_4.2H_2O$). Clinker is an intermediate product for manufacture of cement.

5.1.2 Clinker Chemistry

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	$4CaO.Al_2O_3.Fe_2O_3$	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

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

(Author: The details mentioned in 5.2 is more detailed presentation of box under 5.1)

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 deposits are just below the surface and 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 dump this 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 is thus in various sizes of limestone.

5.2.2 Limestone Transportation

These fragmented limestone (also called as boulders) are then loaded onto the dumpers using proclainers and transported to crusher hoppers. Enough dumpers of various capacities of 25 to 40 tons capacity are used to to cater to the requirement of crushers to ensure continuous feed to crushers.

5.2.3 Limestone Crushing

The dumped material as mentioned above, are 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 like Combined pre-homogenization of raw material components and segregated pre-homogenization of raw material components. The second method is widely used in the 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 with 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 ground by using Hyper Steel Grinding Media of different sizes. It is then pulverised in Vertical Raw Mills (VRM). In the mills the material is recirculated by air separator and is returned into the mills till it is finely ground and the finely ground 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 the greater the surface area of raw mix, the easier it is to burn and lower will bw 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 of 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 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 the Kiln. [Finely ground material as above is called kiln feed which is stored in continuous fluidized silo and extracted into weigh bin through air slides with the help of solenoid valves and transported to air lift pump by 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.] please check the bracketed portion. Does not read OK Cyclones are lined by Heysel blocks, low-grade alumina bricks and cartables. The kiln feed from Preheater String will enter the Pre-Calciner of another Preheater String through five Cyclones of first string. Another string material also enter the Calciner through number 1 to 5 Cyclones of number 2 string. Material entering the Calcineris heated upto 850 to 900°C by firing with pulverised coal and get calcined (up to 95%) and enter Rotary Kiln inlet via 6thCyclone of 2ndPreheater String. The kiln is lined with Alumina bricks. [High Alumina bricks and Magnesite bricks are ??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] check bracketed portion. 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 the 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 ground to fine power. Number one mill is a ball mill having hyper steel grinding media of different sizes.

Number two mill is a vertical roller mill having roller and fixed table. The finally 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 which travels 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.

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 hi-chrome grinding media of different sized finely grinds the 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 with cement weighing exactly 50 Kg l falling from the spout on the belt conveyor and then transported into truck/wagon. After loading of the required number of bags in the truck or wagon it will be moved further for delivery.

5.2.12 By-products

In the cement industry kiln dust may be treated as by-product which is used for concrete manufacturing.

CHAPTER 06

SPECIAL TRANSACTIONS RELATING 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 the type of cement.

6.2 TRANSPORTATION

In cement industry transportation of cement is through two types, ex-factory despatches and free on road (FOR) despatches. In case of ex-factory despatches, freight shall be paid by the customer and 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, burning of coal and calcination in a rotary kiln and cooling of clinker and mixing with Gypsum. This is an energy intensive process. 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 and cement mills.

CHAPTER 07

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 the important activity in excavating limestone from limestone mines. In carrying out audit of mining functions, 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 through quarrying of either open cast mines or underground mines. In India, most of the limestone mines are underground mines. Mines may be captive or leased for long periods up to 99 years. Limestone so excavated is transported either by way of conveyors or using dumpers to stock yards 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/licence has been obtained under 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 have been 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 is having prescribed qualifications.
- Check whether the mining function is 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 are transported to stock yard or crusher whether by 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 the above measuring techniques or by 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 outsourcing contractor is made based on the above measurement or any other manner.
- Check whether the royalty paid on quantity of limestone raised and quantity for which payment is made to outsourced contractor is the same or there is any difference.
- 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 percentage of handling and transportation loss allowed as per technical standards.
- Check whether any purchases of limestone has been made 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 from the mines is transported to crusher and the 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 affecting the productivity.
- Check how the logbook is maintained by the department for mixing additives and for production.
- Check whether timely calibration of hoppers is done and 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 are 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 as fuel for generating energy to burn the raw meal to produce clinker. Coal is received through wagons and unloaded with the help of wagon tipplers in the coal yard. It is them powdered 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 on 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 separately for different sources.
- Check how the quantity of shortages/pilferages 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 separately for different sources and grades.
- Check what is the ash content of different lots 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 installed at the 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 the heart of the cement plant wherein the raw meal is preheated in the preheaters and then sent to rotary kiln for burning along with coal. The temperature in the kiln touches as high as 1,8000 C. After gradual cooling the output formed as lumps are stored in the clinker silo. Kiln is one of the major energy consumption unit 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 is 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 the 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 of.

- Check if any good quality of clinker has been 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.
- Check the 'raw meal to kiln' conversion factors accounted for in the books.

7.5 INTERNAL AUDIT OF CEMENT MILL OPERATIONS

7.5.1 A Brief about Cement Mill Operations

Different types and grades of cement are manufactured in the cement factories . Clinker from the clinker silo is drawn and gypsum / fly ash are added in cement mills and ground 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 the cement mills and ground along with clinker. In case of Portland Pozzolanacement (PPC) gypsum and fly ash are also added in cement mills and ground 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%.are added.

7.5.2 Internal Audit Checklist (√) Cement Mill Operations

- Check how many cement mills are in operation.
- Check how many types of cement are manufactured.
- Check how the product mix is determined.
- Check the logbooks to know how the production is recorded.
- Check the number of cement silos and their full capacities.
- Check whether there were any rejections and if so how they were 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 is 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 with exactly 50 Kg cement a falling 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 are organized.
- Check how and when the last calibration was done for feed valves.
- Check whether tolerances prescribed in respect of weights and measures are followed in bag filling.
- Check whether the weighing scales and weigh bridges are calibrated and inspected by Weights and Measures Authorities.
- Check how many number of bags burst during the packing process and how they have been accounting for.

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 industry and consumes significant amount of electricity. Normally the entire power requirement is met in three different ways. 1) Purchase from State Government Electricity companies/ Boards, 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 through auction by IPPs.
- Check whether any power is generated captively using generator sets.
- Check whether the fuel used to run the generators is LSHS or Furnace Oil or Diesel.
- Check whether required plant load factor (PLF) has been achieved
- Check the reconciliation of electricity units consumed as per production reports vis-a-vis electricity bills received from State electricity Board/ distributing company.
- Check whether there is any difference between units consumed as per electricity bills and units reported by production department.
- Check transmission and distribution loss percentages of purchased power from IPPs and captively generated power.
- Check the cost of power purchased from various IPPs and State electricity Board/distributing company with power captively produced.
- Check how the wheeling charges are charged by IPPs and the impact of the same.
- Check compliances in terms of Thermal Power Plant under Renewal Purchase Obligations (RPO) under Section 86(1) (e) of the Electricity Act 2003 ("EA 2003") and the National Tariff Policy, 2006.
- Check how the above obligations are met.

CHAPTER 08

EFFECTIVENESS OF INTERNAL AUDIT IN CERTAIN AREAS

8.1 GOOD CORPORATE GOVERNANCE

Review of various 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 the raw material as fuel which will reduce the overall fuel consumption. In cement industry there is significant 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 3500C to 5000C and cooler vent air temperature ranges from 3000C to 3500C. With this there is potential to generate 2 to 6MWs. 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 installed 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 the capacity is underutilized. To overcome the 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 company are experimenting is 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 are following to reduce 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 reducing procurement costs. (6) One of the recent trends is that cement companies are focusing on ready-mix concrete going for forward integration leading to additional revenue.

8.4 VALUE CREATION

Various developments have taken place in pyro processing for conservation of energy. The main areas are pre-acclimation, 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, municipal waste, etc. A four -stage cyclone preheater + precalciner consumes heat of 740 to 760 Kcal/kg of clinker, a five -stage preheater

+ precalciner consumes heat of 715 to 730 Kcal/kg of clinker whereas a six -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 in cement industry.

8.5 RESOURCE UTILIZATION-ALTERNATE FUELS AND RAW MATERIALS (AFR) IN CEMENT INDUSTRY

Frequent price increase of coal in India make cement industry vulnerable to high fuel cost. Total energy consumption in cement industry with 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 the cost of production of cement. Keeping in view 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, etc. and these are co processed in the cement industry as alternate raw materials. In Japan and some European Countries AFR is being used successfully since last 3 decades. Recently one of the world's major cement producers' 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 compromising the quality of the cement, environment and occupational health and safety.

8.6 STRATEGIC PLANNING

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

- Companies invited foreign direct investment to reduce the interest burden on their debt.
- Major players acquired small plants in different geographical locations 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 in-house solar / wind power units to reduce electricity cost. Some companies in the industry are 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 and identified potential units where the product mix can be optimized.
- Companies established grinding units near the place of demand and by transporting clinker to grinding units 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 leads to changes in pricing and/or industry structure. Particularly in India the demand for cement fluctuates between summer and rainy season. During monsoon demand for cement will low and during summer and auspicious season the demand will be high. Companies are required 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 fluctuations Risk: This happens when energy costs rise, or when 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 scarce and cannot be supplied at

economical cost or in 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 CO2 emissions, dust spillage, gases, and fumes. Local society may protest against these high levels of emissions causing pollution of air.

Political risk: Due to Political instability or changes at State or Central level may disrupt the demand for cement or hike the cost of production.

Talent risk: Due to location of the factory or non-availability of skilled talent within the vicinity of the factory there could be talent attrition or shortage of skilled manpower

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

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

CHAPTER 09

KEY PERFORMANCE INDICATORS Vis-a-Vis BENCH MARKING

9.1 CAPACITY UTILIZATION

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

9.2 PRODUCTIVITY EFFICIENCY

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

INPUT/OUTPUT RATIOS FROM RAW MATERIAL TO CEMENT (Tons, Assumed, Ratios near Realistic)

Input Material	Pro-duction (Tons)	Consump-tion (Tons)	Consump-tion Ratio to Raw-meal	Consump-tion Ratio to Clinker	Consump-tion Ratio to OPC	Consump-tion Ratio to PPC
Limestone to Rawmeal		19,28,148	0.92	1.36	1.32	0.99
Shale to Rawmeal		17,340	0.01	0.01	0.01	0.01
Bausite 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 Raw-meal		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		

Raw meal 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 , better is the output. It also depends on pre-heater type whether five stage or six stage. Six stage preheatersare considered to be most advanced and give better input output ratio. The other input material of raw meal depends on the 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 added have direct bearing on the quality of limestone.

Gypsum to cement ranges from 5% to 3% of the total cement, as gypsum is used for setting-up time of the cement. In case of OPC, it is only combination of clinker and gypsum. PPC 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-ashis considered as ideal output ratio without affecting the quality of the cement. The addition of fly-ash can go upto 30% depending upon the product requirement and technology used.

9.3 MATERIAL CONSUMPTION AND WASTAGES

Use of waste materials in industrial processes as alternative fuels and raw materials (AFR) to recover energy and material from them is referred as co-processing. The high temperature and long residence time in cement kiln helps in disposing all types of wastes effectively without any harmful emissions. In co-processing, emissions are reduced and there is no residue after the treatment, which makes it more environmentally friendly and sustainable method of waste disposal in comparison to land filling and incineration.To reduce the cost 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 has progressed over a period in terms of energy consumption and achieved the status of the world's best energy efficient industry. Energy consumption levels achieved by the Indian Cement Industry and few other countries are tabulated as under:

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 seen that the world average of Specific Electrical Consumption is100-110 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 as compared to OPC. If a company is having market segment across the country, 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 capital requirement in cement industry is very high as this is a continuous process requiring bulk material. Cement is sold mostly on credit to dealers and direct parties. Hence, realization of debts is key to meet the working capital requirements in cement industry. At the same time, it is also highly labor oriented and therefore fixed expenses are high. Due to the heavy nature of the machinery and it parts, many being imported from original equipment manufacturers, significant amount of working capital is held in spares. That power purchased from State Electricity Boards also need to be paid in time is an important factor affecting working capital. Cement attracts 28% GST and therefore, any delay in realization of debts beyond a month may lead to working capital crunch. Also non-moving inventory locks the working capital to that extent. Following Table reflects the indicative analysis of non-moving inventory and its significance:

NON-MOVING INVENTORY SUMMARY (Sample) ₹ 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) ₹ Lakhs (Numbers are indicative)

SL. No.	Spares Inventory Group	A Category (Line Item Value above ₹ 100,000)		B Category (Line Item Value below Birr 100,000 and above INR 25,000)		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 figures are only indicative to provide better understanding of the inventory analysis. The Internal Auditor should analyze further into the reasons for such non-moving inventory and suggest alternative course of action to use at different place or whether the spares are 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 , operation of various machines, packing plant, captive power plants, loading, and unloading points etc. 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 affects 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 into variable cost. Similarly, at packing plants, the job of loaders is also outsourced on contractual basis where payment is made on the basis of 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 a quick 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 o Operations & Maintenance Contract
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 ENVIRONMENT AND SUSTAINABILITY

Cement industry has 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 Conservation GHG (CO_2) 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) 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 that 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_2 emission in 2020 and 0.50 per ton CO_2 emission in 2030. *(Source: http://knowledgeplatform.in/)*

CHAPTER 10

INTERNAL AUDIT OF FUNCTIONAL AREAS

10.1 INTERNAL AUDIT OF PRODUCTION FUNCTION

10.1.1 A Brief about Production Function

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 departments directly involved in production and see that there are no imbalances throughout the production chain. Production Department prepares and reports 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 had been 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 is 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 the requirement communicated by Marketing & Sales Departments

10.2 INTERNAL AUDIT OF MAINTENANCE FUNCTION

10.2.1 A Brief about Maintenance Function

The maintenance function in cement industry is 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 maintenance schedule.
- ► Check the list of major breakdowns during the audit period.
- ► Check the history-cards of maintenance of various machines and equipments.
- ► Check the impact of major breakdowns on production and profitability.
- ► Check whether any replacement of machines has taken place during the period and it is done by analysing cost-benefit of reuse versus replacement.
- ► Check whether all critical spares are in stock considering the lead time of spares procurement.
- ► 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 the day to day quality aspects of production at each stage and inward receipts of raw materials, fuel, stores, 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 (√) of Quality Control Function

- ► Check how the quality control procedure is being followed 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 Department without approval of Quality Control Department.
- ► Check how the rejects are determined by the Department and is there any procedure for acceptance of tolerance limits of various parameters.
- ► Check the procedure for rejects and its treatment and whether goods 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 is 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. Following checklist is suggested:

- ► Check whether there exists Project Management Office (PMO) and what are its role and responsibilities.
- ► Check the list of various small and continuous improvement (Kaizen) projects.
- ► Check the return on investment (RoI) envisaged for 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 procurement function deals with purchasing various raw materials, additives, fuels, stores, spares, packing material etc. The checklist could be as under:

- Check that there exists proper vendor evaluation policy.
- Check whether any rate contracts were made for supply of limestone additives viz., iron ore, bauxite, shale, and gypsum, fly ash, slag etc.
- Check whether materials are from single source and single supplier or multiple sources.
- In case of availability of multiple sources check whether the rates fixed are on the basis of competitive bidding .
- Check whether the orders are placed with approved vendors of the company.
- Check whether the price quoted was accepted; if not whether deviations approved by the competent authority.
- Check whether supplies have been made within the ordered period and evaluate loss/ gain in respect of delayed supplies.
- Check the parties' bills to ensure that they are in line with the grades of iron ore, bauxite, coal supplied.
- Check whether for 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.
- Check whether there is a proper system to avoid demurrage charges.
- Check whether there is a monitoring mechanism to ensure that all trucks loaded at mines delivered the goods at the railway siding or at plant within a reasonable period.
- Check compliance with the local purchase procedure and emergency purchase procedure .

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 the stores ledger.
- Check whether 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 critical spares have been identified and spares have been insured adequately.
- Check whether any ABC analysis is made and EOQ is followed.
- Check how the reordering levers are maintained for regular production items.
- Check how and by whom 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 stored to enable proper inspection by user the Department / Quality Control Department.
- Check whether dangerous goods like explosives are separately stored.
- In case of LSHS / HSD storage whether approval obtained from Chief Controller of Explosives.
- Check the reconciliation of empty cement bags with production, despatches as per production report and bags utilized.
- Check the frequency of physical verification of stored items so that 100 % coverage of all the items can be done over a period of time.

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, the distribution department is responsible for despatch of cement from factory to various customers, dealers and transferring cement to 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 with transporters for transportation of cement.
- ► Check agreements 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 conditions.
- ► Check the policy on standardization and repacking of clotted or otherwise damaged cement.
- ► Check the procedure of handling of cement at railheads and secondary transportation to C&F warehouses.
- ► Check whether any wharfage and demurrage charges have been 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 and 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 involves advertisement through hoardings, wall paintings, electronic and print media advertisements, 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 is further categorized into the following:

- Dealer sales (dealerships or trade segment)
- Direct parties' sales (real-estate builders, project contractors and Government work) also called non-trade segment

Sales through dealers within the country is 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 on the basis of certain criteria and as per the delegation of authority 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-factory ??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 what are the various events conducted for dealers meet and allotted expenditure.
- ► Randomly verify the wall paintings or hoardings placed at several places based on the photos to establish the authenticity.
- ► Check what kind of entertainment expenditure is incurred by the marketing team and whether it is within the limits and as per the marketing policy of the company.
- ► Check the policy relating to dealer appointment and termination.
- ► Check how the dealer evaluation is done and how credit limit is sanctioned.
- ► Check the list of approved price cards applicable to dealers with the Head of marketing and sales function

- Check the applicability of price cards, whether District-wise or any 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 is applicable for non-trade segment.
- Check how the price is fixed for non-trade segment and whether the price is approved as per limits of the 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 if the price charged 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 whom sale of cement is 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 on such delayed payment.
- Check randomly whether overdue interest is correctly calculated and charged to customers with delayed payment.
- Check whether any such overdue interest is waived to any of the customers.

- Check whether such waiver is done with the approval of the authorized authority.
- 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 Departments
- Check chart of accounts and accounting manual of the company.
- Check various accounting policies of the company and if they are followed consistently.
- Check whether there has been any change in accounting policy during the period.
- If there is a change in the policy, assess its impact on the books of account of the company.
- Check whether the internal control system in vogue in the company is commensurate with the 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 cases if any, and whether any representation of the same instrument is done with approval. of such change.
- Check the list of dealers who are habitual defaulters in payment (cheque return cases)
- Check the ageing analysis of all customers and find the reasons for outstandings of more than 90 days

- Check the list of bank guarantees taken from non-trade (direct) customers and check if all such guarantees are in force.
- Check whether any tendercfloated, participations thereat, , EMDs paid and outstanding EMDs yet to be received with ageing analysis.

Accounts Payable

- Check the ageing of creditors to know if any payment is due beyond 90 days and reasons thereof.
- Check whether any payments made towards technical knowhow or royalty to foreign collaborator.
- Check if there is any rate variations and how they are accounted for with suppliers / vendors and relevant purchase orders.
- Check whether any imports made towards high value of spares viz kiln bricks and 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 at the quantity in stock.
- Check whether the stocks are arranged in proper geometrical shape to enable measurement using mathematical formulae.
- Check whether dipsticks used to measure stock in silos are calibrated and show correct reading.
- Check whether scrap generation properly measured and accounted for.
- Check whether damaged stock separately stored and not counted with 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 reconciliation within the returns in Forms 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 in respect of major transactions.
- 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 rated goods to ensure they are in confirmation with the policy / notifications.
- Check whether any notices issued and pending for action and reasons for such notices.
- Reconciliation of e-way bill with reference to invoices generated and also with e-invoices when applicable.

Income Tax

- Check whether monthly TDS receipts are deposited within the time limit and correct rates of TDS are applied.
- Check whether any advance payment of tax was due and has it been paid in time
- Check whether any foreign payments are made, and if so are they in accordance with provisions of FEMA.

Insurance

- Check the insurance coverage for all fixed assets of the entity
- Check the insurance coverage for work-in-progress and finished cement

- Check how the quantities are determined and reported to insurance authorities.
- Check whether any claims were made during the earlier period and the nature of the claims.
- In cement industry coal is a self-burning material; hence check whether any such incidents happened and if so, its impact or intensity
- Check whether all incoming material covered by transit insurance.
- Check how the transit insurance coverage had been made for outgoing material.
- In cement industry outgoing material is the responsibility of the transporter; therefore check whether any coverage had been made to such outgoing material.

10.10 INTERNAL AUDIT OF COST ACCOUNTING FUNCTION

- Check and understand the cost centre master and how it is designed.
- Check whether cost accounting system is a standalone one or an integrated one.
- Check the grouping of cost centres.
- Check the cost centre categories like 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 abnormal items.
- Check the valuation of inventory under Cost Accounting Standard vis a vis the books of accounts/ financial records. Difference if any, to be reconciled.
- Check how the internal consumption of clinker is determined.
- 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 developedin-house.
- 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 of all transaction with user id and time details is generated.
- Who approves changes in the system.
- Check the list of power users, super users, and transaction users.
- Check the data redundancy and backup procedure.
- Check the business contingency plan
- Check whether proper controls exist for preventing data leakages.
- Understand the Security architecture and assess whether it is foolproof.
- Check whether any maker and checker policy exists and is followed without any violation'
- Check what is the password generation policy and whether there is any sharing of password between employees.
- Check whether the user ids of employees who 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.
- As cement industry is governed by Cement Wage Board recommendation check if such recommendations are followed.

- Check whether there is any production incentive scheme in vogue and if so, random calculation checking of the same be done.
- Check the leave policy and calculation of leave encashment.
- Check bonus calculations, normally followed in cement industry apart from statutory bonus to applicable employees and ex-gratia paid to others .
- Check compliance with the provisions of Employees' Provident Fund & Miscellaneous Provisions Act, 1952 and Rules made there under.
- Check the status of submission PF Annual Return .
- Check pending provident fund settlement cases– whether proper follow-up is being made .
- Check the reasons for long pending cases of PF settlement and report thereon.
- Whether the company maintains the register of bonus (Form-C) and has complied with 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 and provision for gratuity is made on the basis of actuarial valuation.
- Check whether the employer has obtained declaration form from employees covered under the ESI Act and submitted the same to the E.S.I.
- Check whether ESI contributions are deposited with the authorities and returns filed in time.

CHAPTER 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 on Spares Capitalized particularly for Raw Mill, Coal Mill, Kiln and Cement Mill	To understand the volume of insurance spares
4	Stores and Spares not moved for more than 24 months	To understand non-moving stores and spares and analyse whether they are insurable spares or not
5	Delegation of Authority Manual and any other Manuals of the Company	To ensure that the expenditures are incurred as per the delegation of power 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 shortage or surplus
13	Review of insurance policies	To understand whether all fixed and current assets, and risks associated there with are sufficiently covered
14	Escalation Clauses	To understand the value, volume and 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 there is no revenue leakage on account of weight losses
18	Input / Output Ratios of Raw Mill, Kiln and Cement Mill	To ensure that the inputs/ out puts 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	Purchase of different grades of coal and landing cost of the same as imported or domestic	To understand the Calorific Value (CV) of different grades of coal received and its impact on fuel consumption vis a vis coal quality, landing cost.

21	Refractory Lining and Grinding Media replacement policy	To understand that the consumption of the refractories and grinding media is in line 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 from 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 organization's EHS Policy, risks or otherwise of non-compliance
33	ERP Process Document	To understand the process flow of all the business processes.

CHAPTER 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 ensure more safer work and environment too. Industry 4.0 is widely used to gain importance in cement industry too with names such as Cement 4.0, Cementability, Plants of tomorrow etc. The following are some of the areas where Industry 4.0 is used in the 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 transmit e on near-real time data on the minerals while drilling and to the 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

RFID and GPS enabled dumpers are used to track their movements to avoid unwanted stoppage by the drivers to increase the number of trips per each dumper. Also, RFID enables t loading of required full capacity of limestone quantity, helps in proper measurement, and avoid wastage of raw material.

Industry 4.0 in Kiln Operations

Kiln isa highly energy-intensive process and hence using advanced Kiln Control Systems (KCS) close monitoring of the process is possible and control the temperature at the

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 Mill are the grinding mills in the 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.

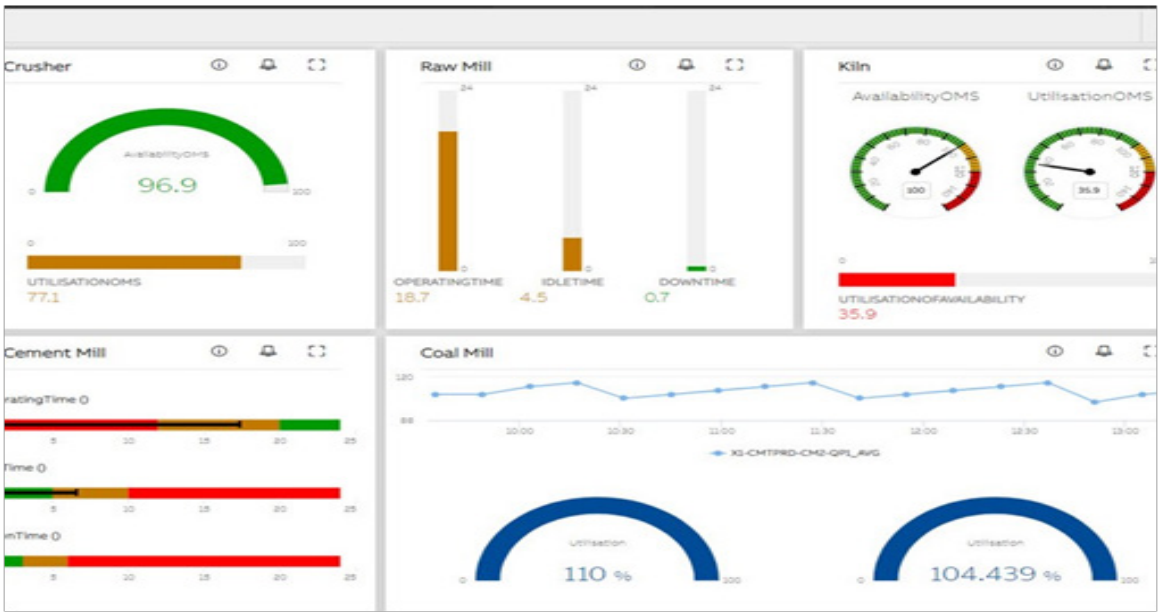
Digital Twins

Digital twins are used in end-to-end optimization of processes including simulating 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 help in tracking the vehicles on real time basis avoiding demurrage charges and 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)



CHAPTER 13

COST OF SETTING-UP A NEW CEMENT PLANT IN INDIA

Capital expenditure (CapEx) of setting-up of a new cement plant in India depends on various factors such as the following -

- Greenfield Cement or Brown field Cement Plant
- Integrated Plant or Cement Grinding Unit
- Debottlenecking or Expansion
- Geographical Region -Northern or Southern or Eastern or Western or Central

Greenfield projects are normally costlier than brown field projects. On an average basis, in India, CapEx for setting up an integrated green field cement plant ranges from ₹5,500 per ton to ₹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 ₹1,700Crores to ₹2,100 Crores of capital expenditure. Brownfield integrated cement plant for the same capacity may be completed at half the Capex 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 the 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 with effect from1stJanuary 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 form major part of the total capital cost to set up a cement plant. These costs primarily depend 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.

CHAPTER 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 and 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 cement 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, Ultra Tech cement announced plans to invest Rs 940 crore (US$ 134.50 million) to increase the production of premium products for strengthening its position in the 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 company presently has no cement plants in India) is planning to invest US$ 700 million in India by 2022. However, in view of the present COVID 19 pandemic the above developments and investments may hit a roadblock.

The following is the list of cement companies in India.

LIST OF CEMENT COMPANIES AND NUMBER OF 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 ChandiDurga 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	MawmluhCherra 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	SakarniPlaster (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 GhantakarnaMahavir Cement Pvt. Ltd.	1
110	Shree Jagjothi Cement Ltd	1
111	ShriKeshav 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	SreeJayajothi 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	VardhamanInfratech 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.aspdownloaded 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			

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, 1981as amended in 1987
- Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988
- The Environment (Protection) Act, 1986 as amended in 1991
- Hazardous Waste (Management and Handling) Rules, 1989 as amended in 2000 and 2003
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 as amended in 2000
- Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
- Environmental Impact Assessment Notification, 2006 as amended from time to time

- Batteries (Management and Handling) Rules, 2001.
- Public Liability Insurance Act, 1991 as amended in 1992
- The Petroleum Act, 1934
- The Explosives Act, 2008
- The Gas Cylinder Rules, 2004
- The Static and Mobile Pressure Vessels (Unfired) Rules, 1981
- The Motor Vehicles Act, 1988
- The Mines Act 1952
- The Merchant Shipping Act, 1958as 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 Legal Metrology Act (which replaced the The Standards of Weights and Measures Act, 1976) and Packaged Commodities Rules
- Cement Cess Rule, 1993
- Companies Act, 2013
- Income Tax Act, 1961
- Goods and Services Tax Acts 2017. (CGST,SGST etc)
- The Customs Act, 1962
- Companies Audit Report Order (CARO) 2020.

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Behind every successful business decision, there is always a CMA