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14 September 1988
English

STRENGTHENING THE NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS OF INDIA CAPABILITY IN PRODUCTIVITY ENHANCEMENT OF THE CEMENT INDUSTRY

DP/IND/84/020/11-19/31.4.B
INDIA

Technical Report : Productivity Improvement through Industrial Engineering Practices.

Prepared for the Government of India
by the United Nations Industrial Development Organisation,
acting as executing agency for the United Nations
Development Programme

Based on the work of H.H.Brandt, Expert in productivity improvement and industrial engineering for the cement industry

United Nations Industrial Development Organisation
Vienna

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This report has not been cleared with the United Nations Industrial Development Organisation which does not, therefore, necessarily share the views present.

EXPLANATORY NOTES

The following abbreviations have been used in this document:

Rs:	Indian Rupees at the exchange value towards the United States dollars 7 US $ = Rs: 100.00
NCB	National Council for Cement and Building Materials (of India)
CPE	Committee for Production Enhancement
PLM	Plant Maintenance Department, NCB
PON	Process Optimization Department, NCB
ENE	Energy Conservation Department, NCB.

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A B S T R A C T

Purpose of Project	:	To improve the industry's productivity and the technological levels of the various units of the cement industry in India by strengthening the national centre, the National Council for Cement and Building Materials.
Post Title	:	Expert in Productivity Improvement through Industrial Engineering Practices.
Number	:	DP/IND/84/020/11-19/31.4.B
Objectives	:	Effectively diagnosing technological problems and productivity constraints. Formulating programmes and methodologies for solving technical problems and improving productivity. Implementing the above-mentioned programmes and methodologies to enable NCB, in co-operation with the industry, to achieve an increase in the utilization of capacity, a reduction in kiln down time and the establishment of a central data base at the NCB for monitoring the various productivity indicators.
Duration	:	One Month
Main conclusions and recommendations	:	It has been concluded that the improvement of good industrial engineering practices are required for a large number of the Indian Cement Plants. It is therefore recommended that the activities of NCB are reinforced by the employment of well experienced and trained specialist engineers for cement plant operation and maintenance. This will enable NCB to increase the required industrial engineering service to the Indian Cement Industry comprising: Technical audits of cement plant, introduction of systems for planning and monitoring of production, maintenance, stores and purchases control as well as specialist assistance (in plant) during major maintenance and repairs.

TABLE OF CONTENTS

INRODUCTION

The present expansion and modernisation of the cement industry in India requires that certain key activities, such as manpower planning, mangement, inventory and maintenance planning and other advanced techniques in the field of industrial engineering must be strengthened.

The National Council for Cement and Building Materials, which is attached to the Ministry of Industry, is the national centre devoted to research and technology development and transfer, educational and industrial services. NCB provides the necessary technological services to the cement industry at the national level. The Institute has an on-going programme of productivity enhancement and modernization, and a number of cement plant, have already derived benefits from the same.

Since August 1985 UNDP have been requested to provide experts to assit NCB in the productivity enhancement of the cement industry and a number of experts have already completed missions of one to five months duration.

The mission described in this report was accomplished in one month from 15.8.88 to 14.09.88 including time of travelling, briefing and debriefing at UNIDO and UNDP. The actual number of work days in India for the project was only 16. The duration of the mission was initially planned for two months, but was reduced to one month at the time of the final appointment of the expert. The reason for this was not explained to the expert.

The original objectives of the activities (ref page 3) comprised the effectively diagnosing of productivity constraints at the Indian Cement Industry as well as formulating and implementing programmes and methodologies to enable NCB in cooperation with the industry to achieve increases in the utilisation of plant capacities.

In view of these objectives 16 work days is a very short time which only permits fractions of the objectives to be accomplished. However, it is planned that the activities shall be continued by NCB for the accomplishment at all the original objectives.

During the mission the following activities were accomplished :

* Preparation and presentation of papers entitled 'Plant Inspection Report' (Technical Audit) and 'Kiln Runfactor'. See Annexure No 4 and 5.

* Discussions with NCB management and staff concerning industrial engineering practices at cement plants in general.

* Preparation of 10 questionnaires for technical audit report. See Annexure No 6.

* Plant visit at India Cements Limited.

* Preparation of technical audit report for India Cements Limited. See Annexure No 7.

* Preparation of Terminal Report.

RECOMMENDATIONS

To assit the Indian Cement Industry in productivity enhancement i.e. optimization of plant performance, and to centralize, consolidate and develop all know-how related to industrial engineering practices for the cement industry, it is recommended that NCB should take the following steps.

1 A permanent group of 7 engineers for 'Industrial Engineering Services' should be formed within the organization of NCB. The 7 engineers should have the following minimum qualifications:

* One Senior Engineer, M Sc or B Sc in mechanical or chemical engineering with 8 years of experience from cement plants at management level.

* Two Mechanical Engineers, B Sc with 5 years of experience as maintenance engineers and Chief Engineer at cement plants.

* Two Process Engineers, B Sc with 5 years of experience as Production Engineers/Manager at cement plants.

* Two Assistant Engineers, B Sc in mechanical or chemical engineering with one year of experience from cement plants. The two engineers should be regarded as trainees and be replaced after two years service in the group.

2 The group 'Industrial Engineering Services' (NCB) should develop, coordinate and perform the following services required by the cement industry.

* Technical audits.

* General trouble shooting concerning productivity constraints.

* Systems for production reporting and recording.

* Systems for preventive maintenance.

* Systems for stores and spare-parts procurement.

* Personnel organisation and job descriptions.

3 The group 'Industrial Engineering Services' (NCB) should work closely together with other specialist groups/departments at NCB, in particular with PLM, PON and ENE.

4 The group 'Industrial Engineering Services' (NCB) should be responsible for the programming, supervision, caretaking and optimal utilization of foreign experts in cement plant management and industrial engineering, visiting the NCB from UN and other organisations.

5 NCB should empower a project committee to investigate the requirement and feasibility of a centralized requisitation and exchange of vital, common spareparts for the cement plants, e.g. kiln supports, gears, bearings and big electric motors.

The project should test if NCB should offer to organise a 'club' of cement producers, where each member is providing vital spare parts in stock for others 'club members'. This should provide a mutual assurance against long time production stops caused by lack of vital spareparts.

INDUSTRIAL BACKGROUN

A) Cement Production in India

The installed capacity of the Indian cement industry is at present approximately 53 million tonnes. During the fiscal year ending March 1988 a total of approximately 43 million tonnes was produced. The cement consumption for 1988 in India was 61 kg per capita. For

comparison the consumption of cement in world average is 200 kg per capita and for industrial countries 300-500 kg per capital.

According to the latest information there are 93 cement plants in India with capacities of 600 t/24 h and above. In the past few years, there has been a tremendous growth in mini cement plants (200 t/24 h) and in tiny cement plants (20-100 t/24 h). In April 1988, there were 54 mini cement plants in operation with combined production capacity of 2.90 million tonne/year and about 90 plants were in various stages of erection. When commissioned, their combined capacity will be more than 3.80 million tonne/year. The first mini cement plant was commissioned in 1981, and this type of operation has shown strong growth since 1985.

Additionally, there are about 80 tiny cement plants in operation and an equal number under various stages of erection. The total capacity of these is more than 2 million tonne/year. These plants use limestone from small deposits in various parts of the country and are able to sell their product near the plants. Some sources within the industry believe that the mini and tiny cement plant will pay a major role in the future development of Indian cement industry.

The number of large capacity production units are also being increased. Last year 4 new production lines of capacities from 1500 t/24 h to 3300 t/24 h were commissioned either as expansions of old plants or as complete new plants. This year a total of 6 new production lines of capacities from 1500 t/24 h to 3000 t/24 h will be commissioned in India.

The cement price in India is Rs: 900 to Rs: 1200.00 per long tonne (63 - 84 US$ per long tonne), depending on if the cement is sold at the government controlled market or at the free market. The government controlled market is 20% of the national consumption.

Tax is 30% of the sales price and Rs:0.75 of the official price is contributed to the administration of NCB. To maintain a uniform price situation it is normally recognized in the country, that approximately 25% of the cement price is used for packing and transport. This provides the cement producers with a price limit of Rs:405.00 per long tonne excluding packing transport and tax at the government controlled market and Rs:705.00 per long tonne excluding packing transport and tax at the free market.

B) **Activites of NCB**

The Cement Research Institute of India was founded in 1966 and was later transferred to the National Council for Cement and Building Materials (NCB). While the corporated headquarters of NCB are at Delhi, the main facilities of the Council are based at a large modern building complex at Faridabad, 34 km from Delhi. Five smaller units of NCB are placed on the following cities of India: Ballabgarh, Hyderabad, Patna, Tiruchirapalli and Madras. The total number of scientists, engineers and admininstrative personnal employed by NCB is approximately 500.

The major activities of NCB concerns the manufacture and use of cement and building materials and comprise in general the following centres :

(CRI) Cement Research Institute

(CDI) Construction Development Institute

(CCP) Centre for Consumer Production

(CTQ) Centre for Standardization, Calibration, Testing and Quality Control

(CPE) Centre for Productivity Enhancement

(CEI) Centre for Enviromental Improvement

(CIS) Centre for Industrial Information Services

(CCE) Centre for Continuing Education and Human Resources Development.

NCB is attached to the Ministry of Industry, and is controlled by the Board of Governors. The management system of NCB is shown by Annexure No 2.

PROJECT ACTIVITIES

A) Programmes and Methodologies

The original duties of the mission was to pay frequent visits to cement plants for the identification of specific areas in Indian Cement Plants, which require the application of industrial engineering practices.

It was suggested during the first meeting at NCB that efforts should be maid to visit three different cement plants. However, due to the short time at the mission (16 work days) a programme was prepared for two plant visits. After NCB had been in contact with the chosen plants, it was found that due to unforeseen reasons at the plants, only one plant visit would be possible, namely M/s India Cements Limited at Sankarnagar.

To achieve optimal benefit and experience from the plant visit it was decided with NCB that the visit should be planned and performed as a Technical Audit. It was also decided by NCB that the objectives of the mission should be adjusted to and concentrated on the development of Technical Audit Services.

A special project group formed within the organisation of NCB and headed by Dr S N Yadav from PON, has for some time been responsible for the development of Technical Audit Services, which will be offerred by NCB to the Indian cement plants. The project group is formed by engineers from the three departments under CPE, namely PLM, PON, and ENE. An organisation plan for the three departments and the project group is shown by Annexure No 3.

During the preparation time for the plant visit to India Cements Limited, a set of 10 questionnaires for Technical Audits were prepared. Copies of the questionnaires are shown by Annexure No 6. The questionnaires were used during the plant visit, and should be developed further by NCB as a standard questionnaire for Technial Audits and for general collection of technical data for NCB-files. The questionnaires should be completed jointly by plant management and NCB engineers and should be attached to the Technical Audit Reports.

Before the actual plant visit a paper concerning 'Plant Inspection Reports' i.e. Technical Audits was prepared by the expert and delivered as a lecture to engineers from NCB. A copy of the paper is shown by Annexure No 8. The paper should be considered as a guideline for the preparation of Technical Audit Reports and should be used before, during and after the plant visits.

It is recommended that after some tests and adjustments, this paper is used as a standard guideline for all Technical Audits which are prepared by NCB. This will promote a uniform performance and reporting on Technical Audits.

B) Visit to Cement Plant

Accompanied by Dr S N Yadav and Mr S Ghosh, Mechanical Engineer, PLM, the expert visited the cement plant of India Cements

Limited, Sankarnagar, from 1.9.88 to 4.9.88. The visited plant is one of the major Indian cement plants and is situated as the most southern cement plant of India, approximately 130 km east of the city of Trivandram.

During two days a general inspection of the plant and quarry was performed in accordance with the guidelines of the Technical Audit. After the visit a principal Technical Audit Report has been prepared, a copy of which is shown by Annexure 7. It should be noticed that a complete and thorough Technical Audit normally will require a plant visit of two to three weeks duration.

The general conclusion of the 'Technical Audit' at India Cements Limited, Sankarnagar was that the introduction of simple industrial engineering practices are required at the plant, to improve the planning and coordination of maintenance, cleaning and major repairs.

Before departure from the cement plant a meeting was held at the plant between management and staff of the cement plant and the visiting team. At the meeting the expet lectured on industrial engieering practices in relation to the actual situation at the cement plant. The meeting ended with fruitful discussion on general maintenance problems at the cement plant.

C) Industrial Engineering Methodologies

Industrial engineering practices applicable within the cement industry offers a very wide span of methodologies and hardware which should be carefully chosen from for the proper and beneficial use in each individual cement plant.

During the mission this has been discussed in general with management and staff at NCB and a lecture concerning 'Kiln Runfactor' was prepared and presented by the expert. A copy of this paper is shown by Annexure No 5.

However, the limited duration of the mission did not permit more detailed work or papers to be completed concerning specific industrial engineering methodologies.

CONCLUSIONS

Based on a two days visit to one cement plant (India Cements Limited, Sankarnagar) and on conversations with engineers and management at NCB, it is a rather limited background on which the following expert conclusions are founded, concerning the technical problems and the needs of industrial engineering for the Indian Cement Industry.

It has been observed during the mission that constraints related to the availability of raw materials, coal and electric power etc are hampering the efficient utilsiation of the installed cement producing machinery. This requires an extra effort by the plant personnel at all levels to plan, maintain and monitor the production and maintenance activities at the cement plants.

It is concluded that productivity enhancements can be achieved in general for the Indian Cement Industry, by the introduction and improvement of industrial engineering practices. This should provide for improved cement quality and reduced cost of cement production.

A special group initially of seven engieers is required whtin the organization of NCB, to consolidate and develop knowhow related to industrial engineering practices for cement plants and to provide industrial engineering services for the Indian Cement Plants.

ACKNOWLEDGEMENT

I would like to express my sincere thanks to Dr H C Visvesvaraya, Chairman and Director General and all staff at the National Council for Cement and Building Materials with whom I have worked, for the hard support and cooperation which facilitated the work of the missions.

Annexure 1

PERSONS MET

Dr H C Visvesvaraya	:	Chairman and Director General of NCB and Director of Committee for Productivity Enhancement.
Dr A K Mullick	:	Director of NCB
Mr J P Saxena	:	Acting Director of CPE and Chief of ENE/NCB
Mr Kamal Kumar	:	Chief of PON/NCB
Mr O P Jain	:	Chief of PLM/NCB
Dr S N Yadav	:	Head of project for Technical Audits NCB
Mr S Ghosh	:	Engineer at PLM/NCB
Mr B M S Rao	:	Engineer at PLM/NCB
Mr A K Mishra	:	Engineer at PLM/NCB
Mr V Gupta	:	Engineer at PLM/NCB
Mr N Lokanathan	:	General Manager India Cements Limited, Sankarnagar
Mr S Gopinath	:	Production Manager India Cements Limited, Sankarnagar
Mr K K Biran	:	Chief Mines Supdt India Cements Limited Sankarnagar

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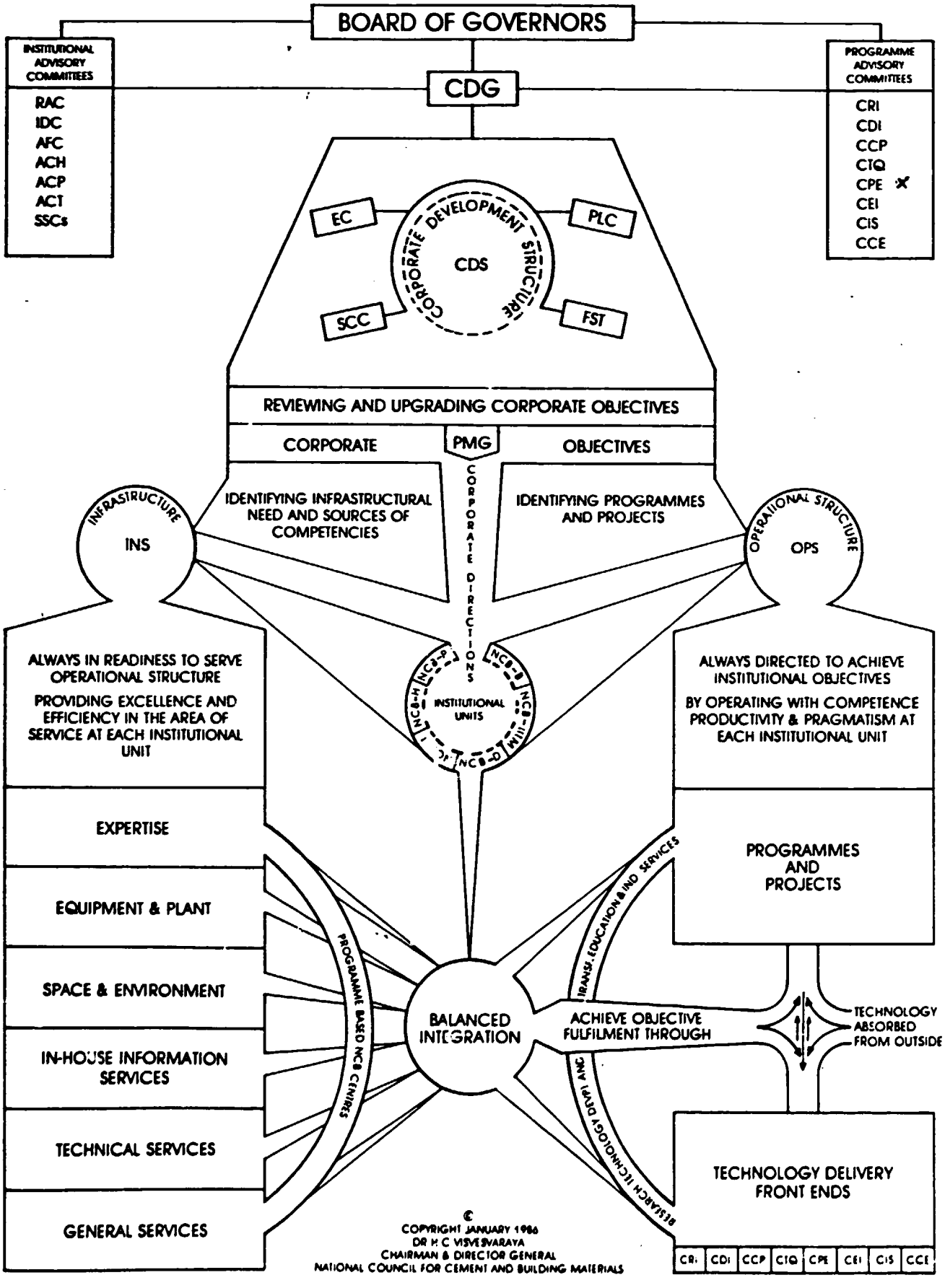
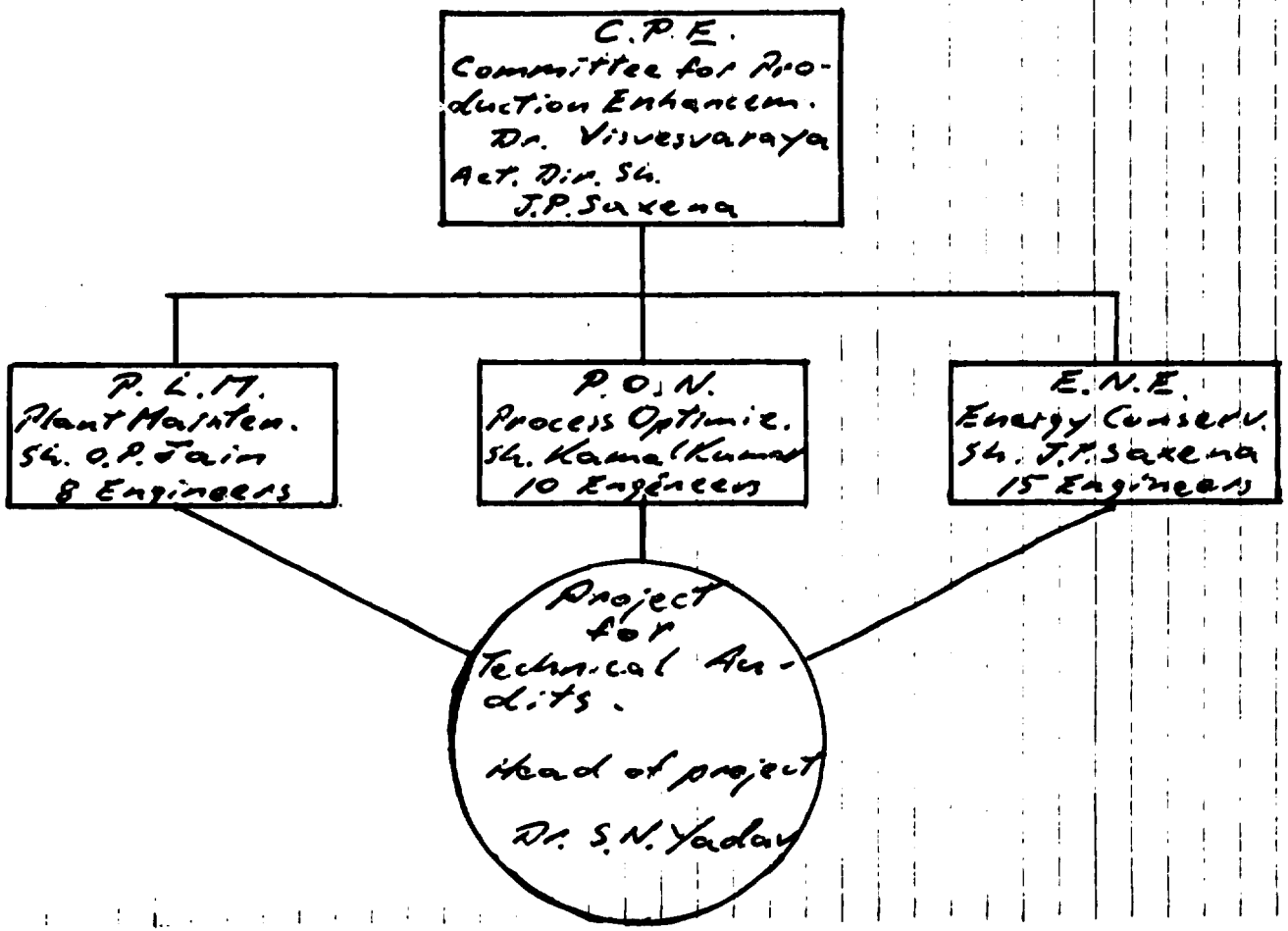
Annexe no. 2

NCB MANAGEMENT SYSTEM

(MATRIX METHOD OF TECHNOLOGY DEVELOPMENT MANAGEMENT BY OBJECTIVES)



The Committee for Production Enhancement CPE is in line with other Programme Advisory Committees reporting to the Board of Governors. See matrix at Annexe no. 2.



Annexe no. 3.

Anexo no 4.

PLANT INSPECTION REPORTS
"Technical Audit"

1 **Technical Service to Cement Plants in general**

Technical service is often provided from engineering and consulting companies to cement producers in the following four categories

a) Technical Assistance

Performed by specialists in erection, repair, maintenance and process. Usually on daily fee basis.

b) Technical Consulting Service

Performed by senior engineers with experience in plant operation or by team of experienced specialists. Usually on contract basis.

c) Secondment of Personnel

Engineers or specialists seconded to work as staff on long term for cement company. Usually on contract basis.

d) Management Contract

Management team i.e. managers, engineers and specialists to work with local managers and staff for the operation of cement plant and training "on the job" of local personnel. Always on contract.

2 Technical Audit

This paper concerns technical consulting service to cement plants and will in particular focus on the contents of plant inspection reports also called Technical Audits.

It is suggested that the following guidelines should be used by the engineer or the team of engineers responsible for the preparation of a Technical Audit. The guidelines should be used as a check list before, during and after the visit at the concerned cement plant. It will not be necessary to follow the guidelines slavishly, however, the sequence of the points in this guidelines will promote a necessary standardization of the Technical Audit Reports.

2.1 Preparation before plant visit

* Interviews with colleagues and others who have been at the cement plant and who could possess information of value concerning the plant.

* Prepare a V.I.P list i.e. a list of persons indicating name and designation, to meet during the plant visit.

* Read and if necessary collect copies of reports or correspondance etc concerning the cement plant.

* Collect copies of the following documentation : Plant lay-out drawing; Flow-sheet; Important drawings; Plant description and technical instructions/recommendations from suppliers if required.

* Correspondance with plant management requesting "Questionnaire" to be filled-in (See enclosures 2-4) and other documentation to be prepared for the Technical Audit.

* Prepare travelling, accommodation and receive confirmation in writing (telex) from plant management that the programme of the technical audit is accepted and that V.I.Ps will be present during plant inspection.

2.2 Preparation of Report

2.2.1 Report Cover

The final report is mounted in a cover (plast file) of which the front page is carrying the following information :

- Name of cement company
- Name of cement plant
- Technical Audit Report
- Date of Audit
- Prepared by (names)

2.2.2 List of Content

The first page of the report should show the list of content with number and title of each chapter and with reference to the page No. Beneath the list of content the list of enclosures is indicated by title and number of each enclosure.

For example, the first page with list of content and list of enclosures is attached (See Encl: 1).

2.2.3 General

This first chapter of the report should concern the following information :

* Name of the cement plant.

* The time of the plant inspection (i.e. Date - from-till).

* The major objectives of the visit.

* Names and designation of personnel contacted during the plant inspection.

2.2.4 General feature of the Plant

A short schematic summary of the characteristics of the cement plant, comprising the following points :

a) Geographical position of plant including meter above sea level, climatic temperatures and rain fall.

b) Description of infrastructure i.e. roads, rail road, sea or inner transport, power supply, population area etc.

c) Major installations (kilns, mills), year of installation and manufactured by.

d) Flow-sheet (enclosure)

e) Process Type

f) Theoretical production capacity of each production line.

g) Latest production output in tonne per year of each cement quality.

h) List of all major cement producing machinery including major quarry machines with the following points specified. The list should follow the sequence of process flow.

- * Machine type and dimensions
- * Suppliers/Manufactured by
- * Theoretical and actual capacity
- * Power consumption and RPM.

i) Rates of production and run-factor for each production line.

j) Raw materials used.

k) Situation in short concerning sale of the produced products.

l) The power supply for the plant.

m) Type of carburant and how it is supplied.

n) Water supply.

o) Workshops, tools, PM and spare-parts stores.

p) Personnel, number, organisation and training.

Some of the above points might be supported by photos taken during the visit. It is important to bear in mind that the content and the quality of the report is not only of great value to the management of the plant but also to colleagues of your own organisation who will deal with the same cement plant in future.

2.2.5 Description of actual plant conditions (See list of content points 4-9).

Based on the actual inspection of the plant a description of the conditions of the plant installations should follow the sequence of the process flow.

Each production department should be dealt with in separate sections.

The following points must be memtioned in the description of each installation and machine.

* Condition of machine
* Major repairs and PM
* Bottlenecks or other problems in process flow
* Prepared repairs and modifications

2.2.6 Piant administration

Description of administration as required concerning the following points :

* Management Control systems
* Marketing and distribution of cement
* Personnel situation.

2.2.7 Summary of Conclusions and Recommendations

The summary shall be a short and clear resume of the essential findings, conclusions and recommendations, which is contained in maximum two pages.

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Enclosure 1

LIST OF CONTENT

Page No

ENCLOSURES

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Annexe no 5.

KILN RUNFACTOR

Modern cement production is a continuous process due to the kiln operation for clinker burning. Once a kiln has been started, it must be in continuous stable operation at longest possible time, to obtain longest possible utilization of the expensive kiln refractory lining.

The runfactor, defined as the time the kiln is producing clinker relative to the time available, obviusly has a major influence on the yearly production output and on the maintenance costs.

Statistics shows that a large number of kilns have an average runfactor of 82.2%, but there are big variations, from plant to plant. There is no significant difference between wet and dry kilns, but, the age of the installation, the complexity of the system and a number of external factors all influence the value for individual kilns. Examples of reasons for stops of kilns are shown in figure 1.

There is a definite correlation between runfactor and kiln size. Excluding all low figures which are probably due to special causes and considering only the optimum values, it is found that good wet kilns have runfactors from 95% for small kilns, decreasing steadily to arround 80% for 3000 t/d kilns. For good dry kilns the 3000 t/d kilns have a slightly higher runfactor of about 83%.

It is also a general experience that the funfactor decreases when the output is forced above a certain limit, and there are examples where the annual production is decreased by increasing the daily output.

The refractory lining of the kilns especially the burning zone linings have a major influence on the runfactor. The consumption of basic burning zone bricks varies normally between

0.5 and 1.0 kg/t clinker, but occasionally increases to 1.5 kg/t. The consumption of kiln refractory lining depends in general on six conditions :

* Quality of raw mix;
* Formation of coating;
* Operation regularity;
* Quality of refractories;
* Installation work of refractories;
* Kiln shell ovality.

The specific brick consumption has been found to be independent of kiln diameter, all other conditions being equal which means that the lifetime of a lining decreases with increasing diameter.

The expected lifetime of basic lining relative to the kiln diameter is given in figure 2. The curve may be higher or lower depending on actual conditions but the trend is the same.

It will appear that even in big kilns, a reasonable lifetime is obtained. There are several examples of 6 m diameter kilns having a burning zone life of 6 and even 8 months.

For the runfactor it is unfortunate that the down-time for renewal of the lining tends to increase with the kiln diameter. For smaller kilns, the down-time is usually 1-2 days per month of operation. In bigger kilns, similar results are only obtained by mechanizing the removal of old lining and by using a kiln rig to place the bricks as quickly and well as possible. Typically, a kiln stop for relining of 25 m burning zone in a 6 m diameter kiln would require 2 days for cooling, 2 days for removal of old lining, 3.1/2 days for relining and 1 day for heating, in total 8.1/2 days. When a 6 months lining life is obtained, this means that lining repairs alone will reduce the maximum obtainable runfactor to 95%.

The life of a lining will depend on the number of kiln stops. A statistical study at a plant showed that the lining could stand 16 full stops, the shorter stops being weighted according to their length.

Without stops the lifetime would be several years, so that the biggest contribution to wear comes from cooling and heating.

As the amount of basic bricks installed per tonne of production decreases with increasing kiln size more money can be spent on brick quality. As an example the cost of a complete burning zone lining in a 1000 t/d kiln is approx. equivalent to the profit from 8 days production, while in a 4000 t/d kiln only the profit from 4 days production is involved.

Figure 1

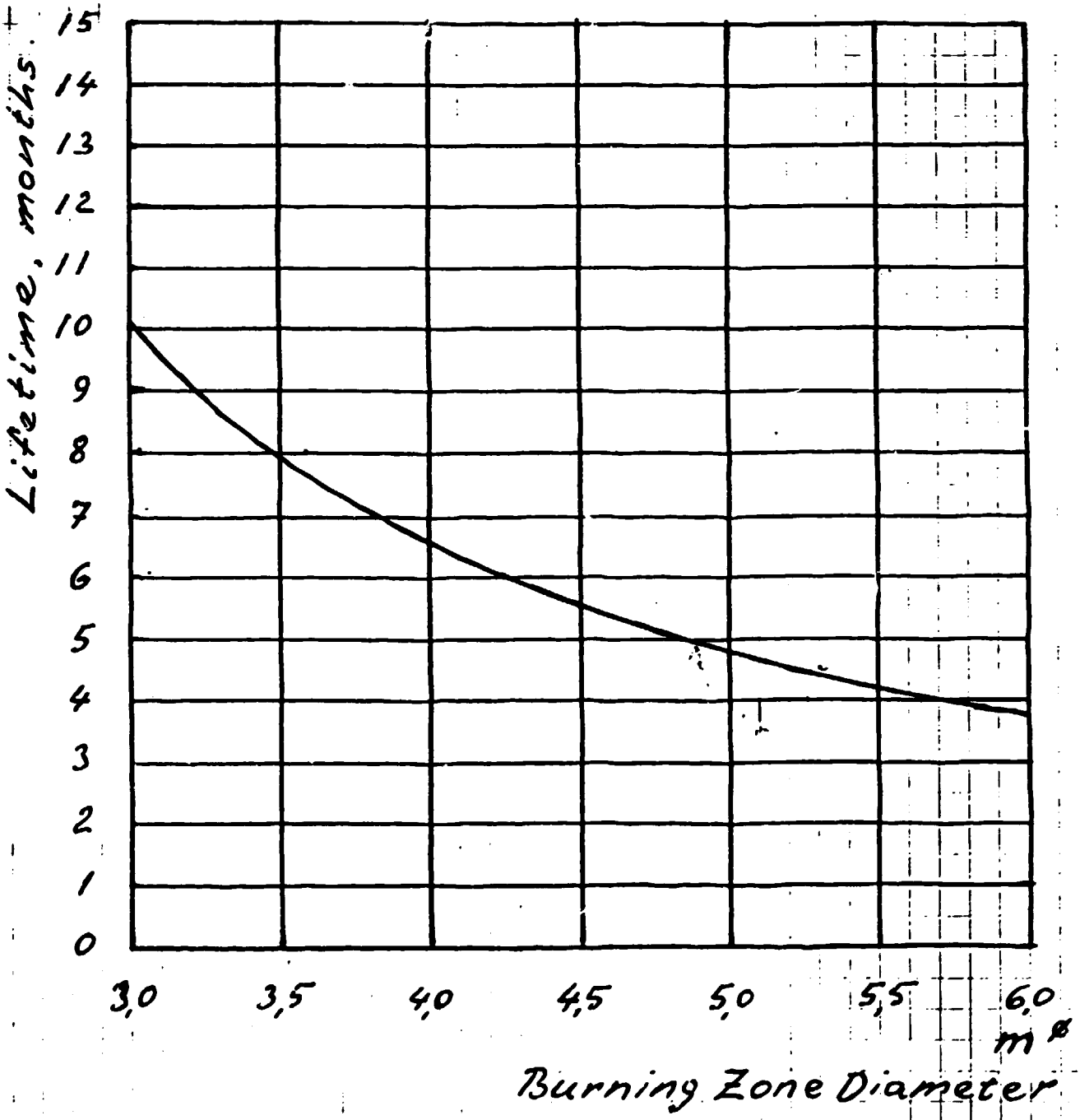
RUNFACTORS AND REASONS FOR KILN STOPS

		Long Wet	4-Stage Preheater	4-Stage Preheater
OUTPUT	t/d	1100	1600	3000
Stop hours	%			
Lining		5.9	7.0	3.4
Process		0.8	1.9	2.7
Mech. & Elec		5.1	8.8	8.8
Others		3.0	3.0	3.0
RUNFACTOR		85.2	79.3	82.1

F.9.1.

Fig. 2

AVERAGE LIFETIME OF BASIC BURNING ZONE LINING.



QUESTIONNAIRES

* General data regarding process and quality.
* Quarrying of raw materials.
* Raw mill department
* Crushing of raw materials
* Kiln department
* Cement mill department
* Packing and despatch
* Storage facilities
* Cost of cement and clinker production
* Grinding media charge and distribution.

....

Name of Plant .....

GENERAL DATA REGARDING PROCESS AND QUALITY

1. Type and quality of Clinker and Cement sold last year.

ITEM	QUANTITY SOLD, TONNES	BLAIN (AVERAGE)
(a) Clinker		
(b) Cement		
(i) OPC		
(ii) PPC		
(iii) PSC		
(iv) Other		

2. Composition of Raw Materials

ITEM	% COMPOSITION						
	LOI	CaO	SiO_2	Fe_2O_3	Al_2O_3	MgO	Alkalies
LIME STONE							
CLAY							
SAND							
BAUXITE							
LATERITE							
SLAG							
COAL ASH							

3. Clinker production parameters

	Heat consumption kCal/kg clinker	Clinker liter weight (Average)	Average clinker temperature at cooler outlet (°C)
kiln no. 1			
kiln no. 2			
kiln no. 3			
kiln no. 4			
⋮			

4. General remarks regarding procen constraints.
(Any problem being faced in the plant may be indicated here)

Data supplied by

Name .....

Date .....

Name of Plant .....

~~QUARRY SECTION~~ QUARRYING OF RAW MATERIALS

S.N.	ITEMS	PRODUCTION t/year	Type of Transport and km.	MAJOR EQUIPMENTS QUARRY & TRANSPORT	TYPE OF EXPLOSIVES
1.	LIME STONE				
2.	CLAY				
3.	SAND				
4.	OTHERS				

DATA SUPPLIED BY

NAME .....

DATE .....

Name of Plant .....

CRUSHING ~~SECTION~~ OF RAW MATERIALS

1. No. and type of Crushers .....

2. Power consumption (kwh/t) .....

3. Normal running hours/day .....
   and days/week; .....
   wear on hammers .....
   (gms/t of material crushed)

4. General remarks concerning production constraints.

Data supplied by

NAME .....

DATE .....

Name of Plant : .....

Raw Mill Department

1. Mill no. / Total no. of mills ...../.....
2. Type of mill .....
3. Closed / open circuit .....
4. Mill Dimensions .....
5. Supplier .....
6. Year of Installation .....
7. Rated Capacity (TPh) .....
8. Actual average Capacity (TPh) .....
9. Last years total production (T) .....
10. No. and type of mill feeders .....
11. Types and quantities of mill feed components
    (a) components L.S. / clay / sand / .....
    (b) % composition .....
12. Type of mill drive and motor capacity kW/rpm of mill. .....

13. No. of compartments .....

14. Type of lining in each compartment and its material of construction. .....
.....

15. Type of diaphraghms. .....

16. Grinding media charge for each compartment. (Data may be provided in enclosed sheet no. I)

17. Power consumption (KWh/t) .....

18. Average moisture content of raw material. .....

19. Means of Raw Material Drying. .....

20. Type of Seperator .....

21. Type of dust collector used. .....

22. Type of mill bearing .....

23. Type of feed control. .....

Data supplied by

Name .....

Date .....

Name of Plant .....

Kiln Department.

1. Kiln no. / Total no. of kilns ..... / .....

2. Type of Process .....

   (If Dry, No. of cyclones and precalcinators) .....

3. Kiln dimensions. .....

4. Supplier .....

5. Year of Installation .....

6. Rated Capacity (TPD) .....

7. Actual average capacity (TPD) .....

8. Last years total production (T) .....

9. No. of days of operation (Days) .....

10. Ash Content in coal .....

11. Type of Clinker cooler .....

12. No. of Kiln Supports .....

13. Kiln Speed (Rpm) .....

14. Kiln drive motor capacity (kW) .....

15. Power Consumption (KWh) for kiln department and clinker (average for last year) .....

16. Kindly attach sketch of kiln

17. Type of burner .....

18. Type of coal mill .....

19. Capacity of coal mill .....

Data supplied by

Name .....

Date .....

Cement Mill Department

1. Mill no. / Total no. of mills ..... / .....
2. Type of mill .....
3. closed / open circuit .....
4. Mill dimensions .....
5. Supplier .....
6. Year of Installation .....
7. Rated capacity (TPh) .....
8. Actual Average capacity (TPh) .....
9. Last years total production (T) .....
10. NO. and type of mill feeders. .....
11. Types & quantities of mill feed components
    a) components L.S. / clay / sand / ....
    b) % composition ....
12. Type of mill drive and motor capacity kw/rpm. of mill .....
13. NO. of compartments .....
14. Type of lining in each compartment & its material of construction .....

15. Type of diaphraghms ....

16. Grinding media charge for each compartment (Data may be provided in enclosed sheet no I;

17. Power consumption (kwh/t) .....

18. Type of water injection method and indicate the compartment .....

19. Type of seperator .....

20. Type of Dust collector .....

21 Type of mill bearing .....

22. Type of Cement transportation and storage silo. .....

23. Type of feed control. .....

Data supplied by

Name .....

Date .....

Name of Plant .....

PACKING & DESPATCH

1. No. and type of Packing machines, including their rated capacities (TPH) .....

2. Type of bags (a) Material .....
   (b) Ply No. .....

3. Means of bulk loading .....

4. No. of Despatch points and type .....

Data Supplied by

NAME .....

DATE .....

Name of the Plant .....

STORAGE FACILITIES

1. No. and type of Raw materials stores (Preblending facilities) .....

2. Homogenisation and storage Silos for raw meal / slurry
   (a) No. .....
   (b) Type .....
   (c) Capacity .....

3. Clinker storage
   (a) Type .....
   (b) Capacity .....

4. Coal storage facilities
   (a) Type .....
   (b) Capacity .....

5. Gypsum storage facilities
   (a) Type .....
   (b) Capacity .....

6. Cement storage facilities
   (a) Type .....
   (b) Capacity .....

7. Storage for spare parts and consumables .....

Data supplied by

NAME .....

DATE .....

COST OF CEMENT AND CLINKER PRODUCTION

S.N.	ITEM	COST/UNIT (Rs.)	Usage/t of clinker	Usage/t of Cement	At production of t/year		At production of t/year	
					Rs/t of clinker	Rs/t of Cement		
1.	Explosives		kg					
2.	Lubricants		kg					
3.	Diesel and Petrol		l					
4.	Coal		kg					
5.	Electricity		KWh					
6.	water		m^3					
7.	Spare parts		Rs					
8.	Grinding media		kg					
9.	Refractories		kg					
10.	Gypsum		kg					
11.	Paper		-					
12	Man Power		Rs					
13.	Slag		kg					
14	Fixed Cost		Rs					
	TOTAL COST		Rs.					

Data Supplied by

NAME .....

DATE .....

Enclosed Sheet no. I

Grinding media charge distribution

Mill no. .....

Material to be ground .....

Compartment number	Size distribution	
	Size (mm)	weight (Tonnes)
1.		
2.		
3.		

kindly indicate the material of construction and suppliers for Grinding media used in each compartment.

Enclosed Sheet no. I

Grinding media charge distribution

Mill no. .....

Material to be ground .....

Compartment number	Size distribution	
	Size (mm)	weight (Tonnes)
1.		
2.		
3.		

kindly indicate the material of construction and suppliers for Grinding media used in each compartment.

Annexe no. 7.

REPORT ON VISIT

TO

M/S INDIA CEMENTS LIMITED SANKARNAGAR

from

01 to 04 September 1988

By

H H BRANDT UNDP EXPERT

S N YADAV NCB EXPERT

S GHOSH NCB EXPERT

LIST OF CONTENTS

ENCLOSURES

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II GENERAL

In compliance with the NCB Productivity Enhancement programme and to improve plant performance through Preventive Maintenance and Industrial Engineering practices a visit took place at the India Cements Limited, Cement Plant at Sankarnagar from 01.9.1988 to 04.9.1988.

The visiting team comprised the following experts :

Mr H H Brandt	UNDP Expert
Dr S N Yadav	NCB Expert
Mr S Ghosh	NCB Expert

The main objective of the visit was to develop the activities of NCB related to Technical Audits and to assit the management of M/s India Cements Limited to improve the plant performance.

The list of personnel from India Cements Limited interacted with NCB team is given in Enclosure No 1.

III GENRAL FEATURES OF PLANT

M/s India Cements Limited is located at Sankarnagar at a distance of 10 kms from Tirnulveli district headquarters of Tamilnadu State. Transport to and from the plant is well facilitated by highway No 7 infront of the plant and by southern Railway of National Railway System which is connected to the rail siding of the plant.

The plant was commissioned in 1949 with a single kiln and four more kilns were added to the production line. At present the plant is running with four wet process kilns as kiln No 1 has been scraped since 1981. The total rated capacity of the plant is approx 800000 tonnes cement per annum while the total production during 1987-88 was of _____ tonnes.

Coal supply to the plant is from the Singrani and Western Coal Fields. Due to high ash content in the coal from the National suppliers, 15-20% of the coal consumption is sweetened by high quality coal improted from Australia and China. The power supply is from Tamilnadu Electricity Board with maximum demand 15 MVA. The plant has also its own captive power generation to meet 40% of the maximum demand.

Following technical data concerning the general features of the plant are shown at the questionnaire 1 to 11 by Enclosure 2.

1 Flowsheet of the plant
2 General data regarding Process & Quality
3 Quarrying of Raw materials
4 Crushing of Raw materials
5 Raw mill department
6 Kiln department
7 Cement mill department
8 Packing and Despatch

9 Storage Facilities

10 Cost of Cement & Clinker production

11 Grinding media charge distribution

The total number of workers at the plant has recently been reduced from 1700 to 1200 and the total number of workers at the quarry is 700.

A project has been started for the installation of a new dry process kiln with four stage preheater and calciner supplied by Polysius W.G. The capacity of the new production line will be 3000 t/24 hr and the commissioning of this plant is expected ultimo 1989. The new installations comprise in general Vertical Roller Mill, Kiln and Storage for Raw meal and clinker. The new production plant will include the existing quarries, crushing plants, cement mills and packing plant. Some of the Raw mills will be converted for cement milling and only the existing kilns No 4 and 5 will remain as spare production capacity after the commissioning of the new kiln.

IV DESCRIPTION OF ACTUAL PLANT CONDITIONS

Based on the actual inspection of the plant during the two days visit, the following observations were made :

a) Quarrying & Crushing

Limestone is presently quarried at seven deposits of different quantity and quality.

Limestone is transported by dump trucks of 25 tonnes capacity and by private haulers. Distance from quarries to the plant varies from 1 km to 80 kms. Some of the limestone are manually crushed at the quarries before transporting to the plant while limestone from nearby quarries is crushed by Jaw crusher capacity 300 t/h supplied by L&T/FLS. Due to high MgO content the crushed limestone is sorted by hand picking from the belt conveyor. At the largest quarry near to the cement plant, quarrying is performed by drilling and blasting at six different benches.

B) Raw Mill

Slurry is presently produced by fine slurry mills of total capacity of 210 tph. Originally six slurry mills have been installed but one mill is now dismantled. The feed of each new mill was previously by separate feeders for clay and limestone for each Raw mill. The feed hoppers for each mill was served by two travelling slewing cranes at the raw material store. However, presently only one feeder is functioning for each mill. For the continuous feed of clay and limestone which eliminates the dosaging of raw mateial components for the slurry mills. This situation nreduces the possibility of proper slurry production and requires that all adjustments of slurry quality is performed by circulation of slurry between six slurry silos and three slurry basins. General house keeping needs improvement.

C) **Kiln Department**

There are four kiln running at present, out of finve kilns originally installed. Kiln No 1 was scraped in 1981. The Kiln Nos 2, 3, 4 and 5 are of the rated capcities 348, 750, 672 and 600 tonnes per day respectively.

After the commissioning of the new 3000 tpd dry process kiln, Kilns No 2 and 3 will be scraped whereas Kilns 4 and 5 will continue as standby. General inspections of all the four kilns were performed. During the inspections of the four kilns, the following observations were made :

1 **Clinker Conveyor**

There is four drag chains and a bucket conveyor for carrying clinker from the kilns to the clinker storage yard. Sketch showing the arrangement is attached as Enclosure No ____.

It was observed that in the tunnel housing the longest drag chains No 3 and 4 is full of dust, spillage of clinker, seepage of water, and high temperature, making it impossible to attend promptly to the failures and breakdowns.

Recommendation and Suggestions

Plug the leakages of the clinker from the hopper, cleaning of the tunnel should be done at regular intervals and it is recommended to install a vaccum cleaner for the purpose. Proper ventilation of the tunnel must be ensured and cause of water seepage should be looked into.

2) **Lubrication**

Most of the supporting roller bearings were either running dry or running with contaminated lubricants. Girth gear and Pinions were also running with contaminated lubricants. The lubricants were more like grinding agent than lubricating agent. Due to this there is every possibility of wear on the teeths.

Recommendations and Suggestion

Cleaning of the Girth gear, Pinion and Roller bearings should be done with transformer oil and fresh lubricants be added and also ensuring that proper covers are there for sealing the lubricants. A team be comprised specially to lookafter the lubricantion and its proper functioning.

3) **Kiln Alignment**

Probelm of shell cracking, deformation of kiln shells and improper floating of kilns were observed, which may result to shorter life of Refractory lining, wear of Girth gear and pinion, wear of rollers and tyres.

Recommendation and Suggestions

Alignment of the kilns should be performed after replacing the deformed shells. Proper skewing of rollers be done for ensure floating of kiln.

4) It was also observed that heat shields and inspection covers were missing, leading to reduce life of bearings and contamination of lubricants.

Recommendation and Suggestions

Heat shields should be placed over the roller bearings in the burning zones, and inspection cover be placed.

5) To avoid further development of pitting and cracks at rollers and tyres, oil should immediately be removed from the surfaces of all rollers and tyres.

6) Kiln No 2

1 R.H. Roller at pier No 1 damaged.

2 Repicement of shell: done at 11 stations during May and June.

3 At live ring No 3 formation of pitting and groove were observed.

4 At kiln drive motor variation in noice indicates misalignment t kiln or bend in kiln.

Recommendations & Suggestions

1 R H Roller be replaced at Pier No 1.

2 Alignment of kiln No 2 needs checking.

3 Provision for inspection door in the housing to check the backlash of Girth gear and pinion.

7) **Kiln No 3**

1 Lubricant of Girth gear and Pinion contaminated.

2 Sealing of housing drive station not proper.

3 Gear springs are loose.

8) **Kiln No 4**

1 Supporting roller bearing housing downside on both side of the kiln sinking at pier No 1.

2 Excessive spillage of clinker from clinker cooler.

3 Leakage of oil from upside bearing of RHS roller.

4 Welding of kiln shell between tyre 3 and tyre 4 by longitudinal stiffner rings.

5 Lubricating oil in kiln drive Gear box overfilled.

9) **Kiln No 5**

1 Heat shields over the RHS Roller bearing at Pier No 1 missing.

2 Oil cups missing inside the housing and oiling done by outside pumps.

3 Dust area due to clinker, spillage from cooler.

4 Shell in Burning zone badly deformed.

5 New crack developed in welding on the kiln shell near Tyre 3. Surrounding hot due to bad refractory conditions.

6 The RHS roller of pier 2 developed cracks.

7 Excessive wear on Girth gear nd pinion due to contaminated lubricants.

8 Floating of kiln not proper.

D) **Cement Mill Department**

There are four cement mills of capacities 44, 44, 44 and 42 tph. The same cement mills will be used for the new production line to be commissioned in late 1989. So maintenance planning and good hous keeping is required. During the inspection following observation were made :

1 Proper cleaning of cement mill department is needed.

2 Charge to the mill is to be adjusted properly so that the mill gives the rated output.

3 Feed to the mill is through rotatary table feeders with such type of feeding arrangement; there is not accurate control over the feed.

4 Corrosion of ducting leading to false air entry and causing improper draft at mill.

5 Cement mill No 4 is a close circuit mill but at present the separator is not working.

6 No provision for electronic ears in cement mill No 1, 2 and 3.

Following general recommendations are given for the cement mills.

1 Vaccum cleaners should be installed.

2 The present arrangement of feeding to the mill is obsolete and it is a must that weigh feeders be installed for getting proper quality and output.

3 The problem of corrosin of duct should be looked into and remedial measures be taken to arrest the false air entry.

4 It should be ensured that the separator of cement mill is commissioned at the earliest to get the rated output.

5 Electronic ears should be installed at the earliest.

E) **Packing Department**

There are four rotary packers each with a capacity of 100 tph. The same packing mchines are to be used for the new production line.

SUMMARY OF MAIN CONCLUSIONS AND RECOMMENDATIONS

The introduction of simple industrial engineering practices are required at the cement plant to improve the planning and coordination of maintenance, cleaning and major repairs.

It is important that not too much but what absolutely is needed for the proper and safe operation is inverted on maintenance of the cement making machines, which will be scraped after the commissioning of the new kiln.

Cement mills, packing plant, kilns IV and V and other machines to be used at the new production line starting ultimo 1989 should immediately be repaired and proper maintenance should be continued for the protection of this important installations on which the future cement production will rely.