National Council for Cement and Building Materials

OPTIMISATION OF GRINDING PERFORMANCE OF VERTICAL ROLLER MILLS

Vol 3 No 9 AUGUST 1989

NCB TECHNOLOGY DIGEST

OPTIMISATION OF GRINDING PERFORMANCE OF VERTICAL ROLLER MILLS

INTRODUCTION

IN cement manufacturing process, grinding operations consume approximately 70 percent of the total electrical energy. The wide applicability of the Vertical Roller Mills (VRMs) for grinding raw materials and coal in recent years has resulted in lower energy consumption (15–25%), high product consistency and long term stable operation as compared to conventional ball mill systems.

This Technology Digest highlights the work done by NCB to evolve methodology for optimum operation and maintenance of VRMs, particularly in Indian conditions, taking into consideration the typical characteristics of raw materials and fuel available to the cement industry.

NEED FOR OPTIMISATION

The operational experience on VRMs in India has revealed that although these mills are associated with certain advantages, yet a number of problems have been reported which are invariably on mechanical performance of the mills. Some of the plants are also facing operational problems with respect to output rate, product consistency, false air infiltration, specific power consumption, excessive vibrations, etc. Keeping this in view, NCB carried out a detailed study on the performance of various types of vertical roller mills installed in Indian Cement Plants in order to diagnose the problems faced and to evolve a methodology for optimising the grinding performance of these mills.

VERTICAL ROLLER MILL SYSTEMS

Several designs of Vertical Roller Mills have come into existence, each claiming certain advantages over the other. The basic components like grinding table, rollers, hydro-pneumatic loading gear, louvre ring, classifier are present in all the systems with varying shapes and designs of individual components. The main differences between the various types of these mills are in roller suspension, power requirement for the separation and specific power requirement for proper grinding. The shapes of rollers and table of different mill systems are given in Fig 1.

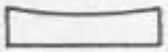
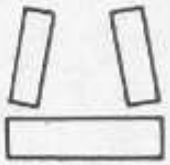
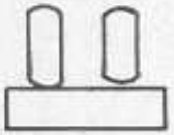
MILL SYSTEM	A	B	C	D
SHAPE OF TABLE				
LINERS OF TABLE	SEGMENTAL	IN SECTIONS	SEGMENTAL	SEGMENTAL
SHAPE OF ROLLERS				
LINERS OF ROLLERS	SINGLE PIECE	SINGLE PIECE	SEGMENTAL	SEGMENTAL
NO OF ROLLERS	2, 3 OR 4	2 PAIRS OF ROLLERS	3, 120° SPACING	3, 120° SPACING

Fig. 1 Shape of Rollers and Table in Different Mill Systems

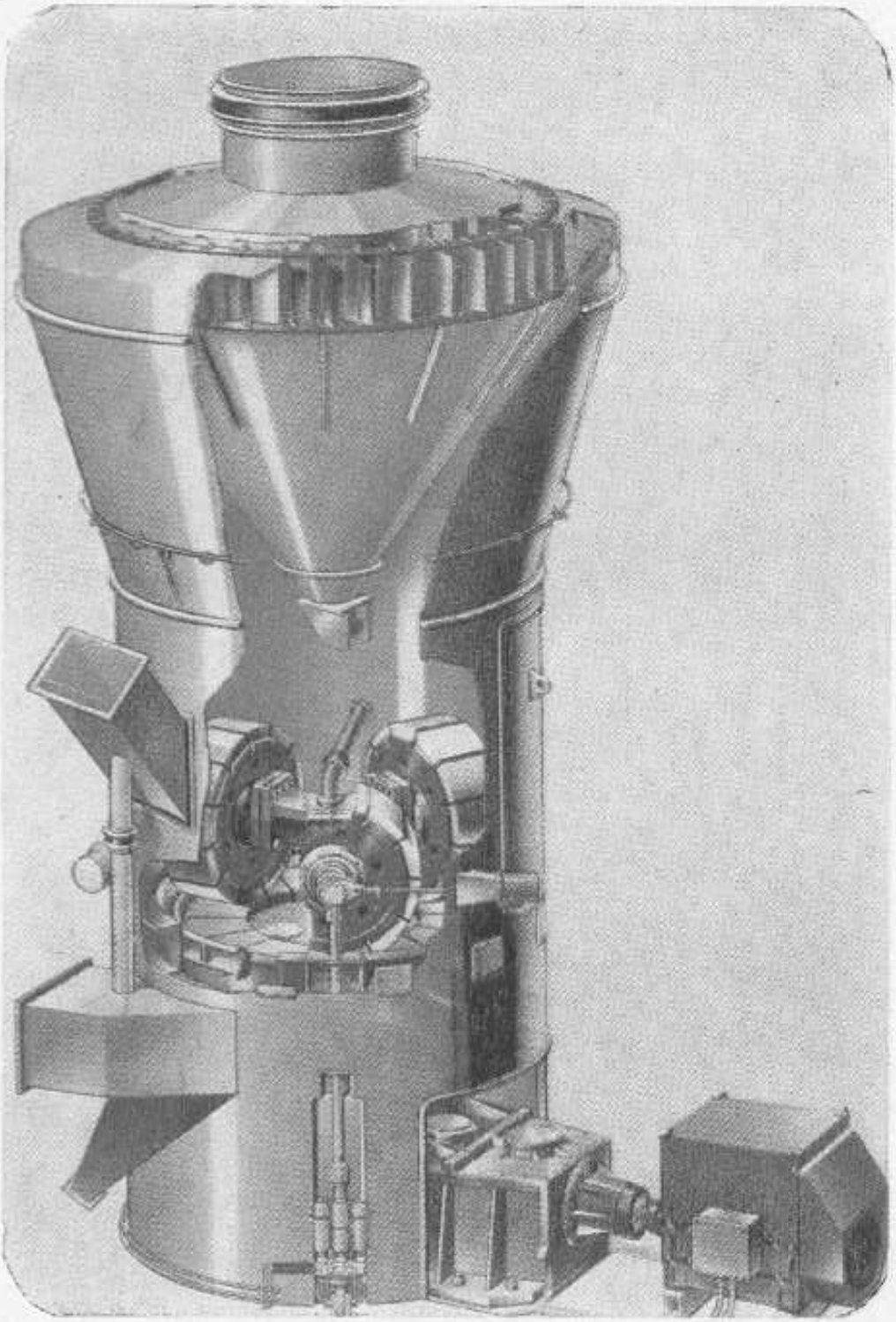
PLANT STUDIES

NCB studies on various designs of VRMs were conducted in 12 selected cement plants, out of 21 plants installed with these mills. In these plants, the operating efficiency has been found to be in the range of 70–120 percent and time utilisation has large variations from as high as 100 percent to as low as 20 percent. Roller and table liner wear rates and specific power consumption are comparatively higher in most of the VRMs installed in Indian Cement Plants, whereas the output rates are quite comparable to the rated values. Large variations have been found in pressure drop maintained across the mill in different plants. Based on these plant studies, the various operational problems can be enumerated as follows:

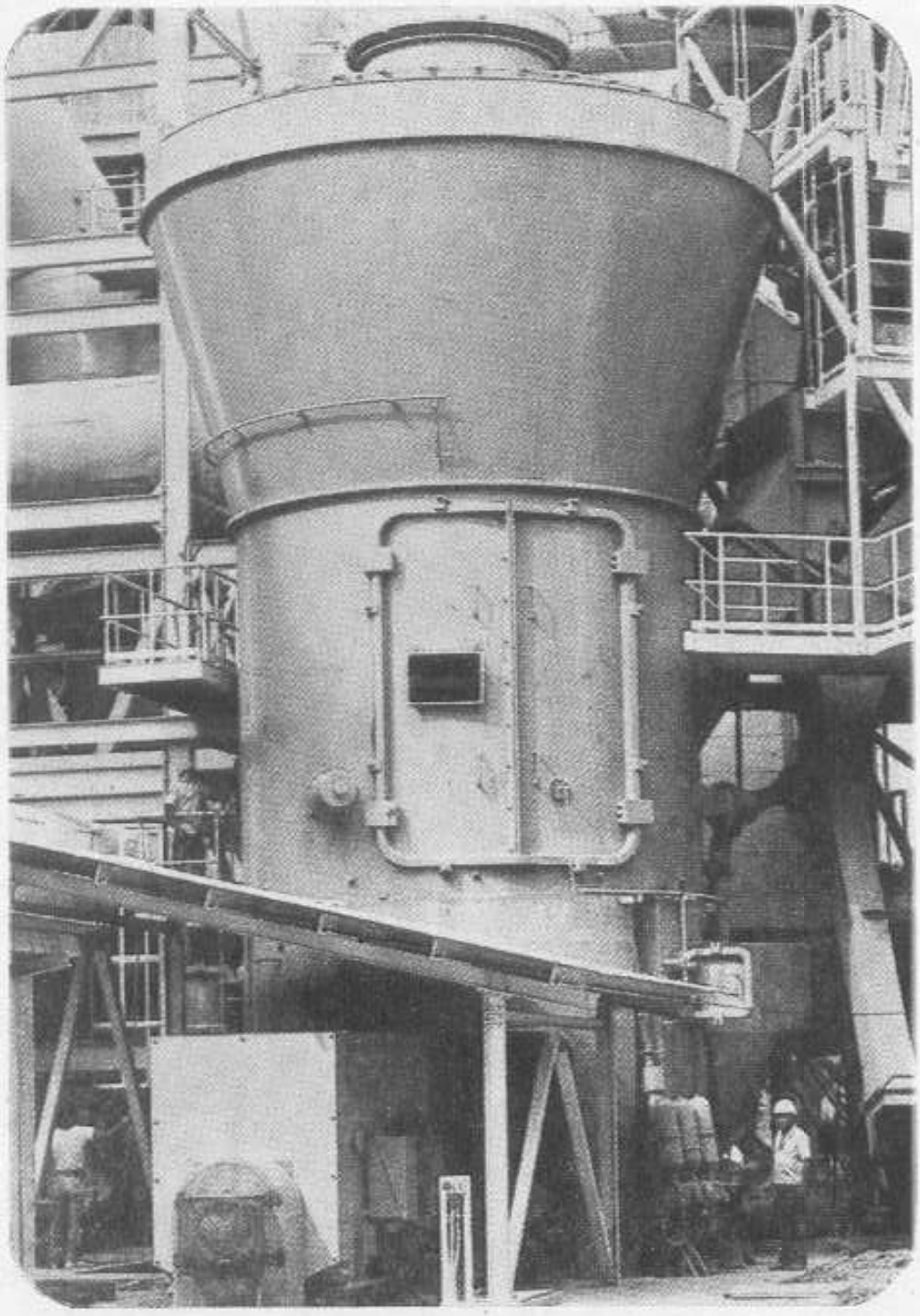
— High rate of wear of table and roller liners
— Poor control of draft and flow rate
— Infiltration of false air
— Difficulty in maintaining required fineness
— Excessive vibrations
— Feed fluctuations in automatic control
— Excessive and uncontrolled moisture through feed material
— Irregular flow of material particularly during start-up of the mill

The vertical roller mills operate under heavy shocks and vibrations and because of the very nature of the operating grinding force, these mills are most susceptible to mechanical problems. The mechanical problems encountered during plant studies, are enumerated as follows:

— Failure of gear box and thrust bearing for grinding table
— Decay and contamination of lubricants
— Failure of roller bearings
— Cracks on roller tyre assemblies and grinding table wear segments
— Failure of accumulator of hydraulic pressure system
— Idle running of conveying system for reject materials
— Difficulties in maintaining requisite hydraulic pressure



A Sectional View of Vertical Roller Mill



Vertical Roller Mill Installed in a Cement Plant

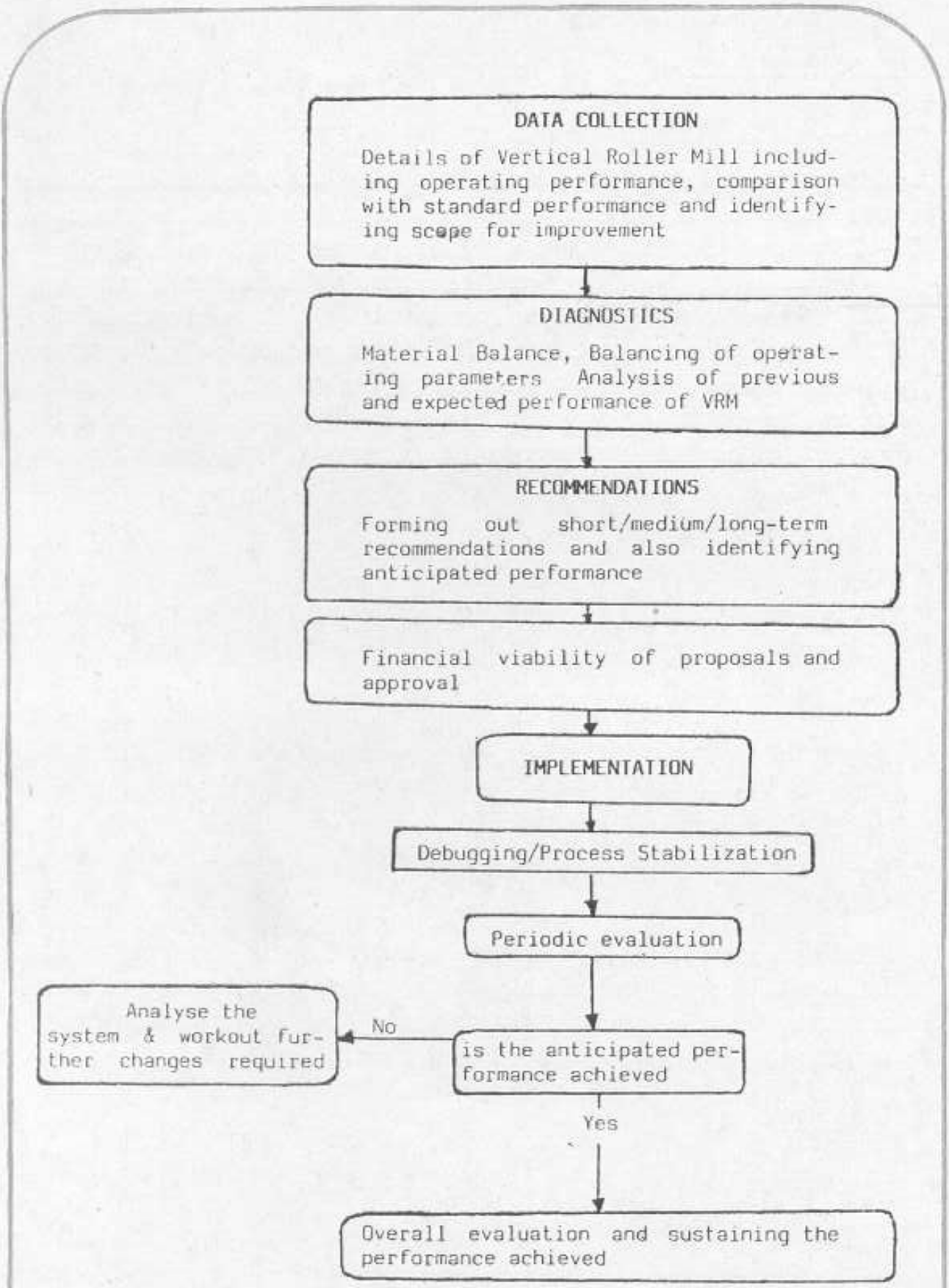


Fig. 2 Optimisation Approach

METHODOLOGY FOR OPTIMISING THE VRM's GRINDING PERFORMANCE

The balancing of operating parameters like bed height, feed size distribution, grinding pressure, gas flow rate, pressure drop across the mill, etc is the first and foremost requirement for optimising the grinding performance of VRMs. Apart from this, proper classifier setting, timely replacement of liners, use of quality liners and segments and well designed preventive maintenance schedule can ensure trouble-free operation at rated output and optimum specific power consumption. Modernisation in terms of incorporation of external recirculation system, improved design of louvre ring, use of roll crusher prior to roller mills, incorporation of high efficiency classifier and microprocessor based self tuning controller, can be quite useful for improving the performance of existing mills. The optimisation approach for existing vertical roller mills is given in Fig 2.

NCB EXPERTISE

NCB has evolved guidelines for optimum operation and maintenance of Vertical Roller Mills. NCB renders technical assistance related to (a) optimising the performance of these mills, (b) preventive maintenance system, (c) training of manpower for required skills and (d) incorporation of external recirculation system in the existing mills.

Prepared by : S/Shri J P Saxena, Kamal Kumar, A K Dembla, D Bhaskar Rao and P V R Murthy

Edited by : Shri S S Kalra

Printed, published and edited by Shri S K Khanna on behalf of National Council for Cement and Building Materials, M 10 South Extension II, New Delhi 110 049 and Printed at Indraprastha Press (CBT), Nehru House, New Delhi 110 002

Regd. No. : RN 47303/86