

MODIFICATION OF MIXING BIN FOR PRODUCTIVITY IMPROVEMENT OF CEMENT PLANT

Sanjay Kumar Pandey¹, Manjit Singh²

¹M.Tech Scholar, Mechanical Engineering Department, BIST, Bhopal

²Professor, Mechanical Engineering Department, BIST, Bhopal

ABSTRACT

Historical estimates of productivity growth in India's cement sector vary from indicating an improvement to a decline in the sector's productivity. To improve the productivity of cement industry the problems have been identified through various ways in a selected cement industry. The critical areas for the improvement are identified in Mixing Bin of the plant. To improve the problems Demming wheel and PDCA is implemented and regular follow up for the improvement has been observed.

Keywords: Demming Wheel, PDCA Cycle, Mixing Bin

1. INTRODUCTION

The word productivity has become a catchword in the industrial field. It is a measure of the economic soundness of the means of production. The economic progress can be achieved by increasing the production coupled with increased productivity. Issues of productivity growth and patterns of substitution in the cement sector as well as in other energy-intensive industries in India have been discussed from various perspectives. Historical estimates vary from indicating an improvement to a decline in the sector's productivity. The variation depends mainly on the time period considered, the source of data, the type of indices and econometric specifications used for reporting productivity growth. Regarding patterns of substitution most analyses focus on inter fuel substitution possibilities in the context of rising energy demand. Not much research has been conducted on patterns of substitution among the primary and secondary input factors: Capital, labor, energy and materials. However, analyzing the use and substitution possibilities of these factors as well as identifying the main drivers of productivity growth among these and other factors is of special importance for understanding technological and overall development of an industry.

Industry has been founded on the theory of firm in microeconomics. Based on this theory, the cement factory owner can improve production productivity based on minimizing the breakdown and downtime of machines in the system to satisfy the required production demand. To show the effect of preventive maintenance system in the industry has been improved. In this research work the aforementioned mixing bin is under study in specific and an improvement tool is applied for the same. The improvement model depicts the behavior of continuous progress and rational body of knowledge of effective maintenance in the industry. Therefore, an integrated approach based on improvement model and the concept of preventive maintenance has been applied to improve the productivity. The approach and the application of the improvement model are being used in the cement industry (Satna Cement, Satna, MP, India).

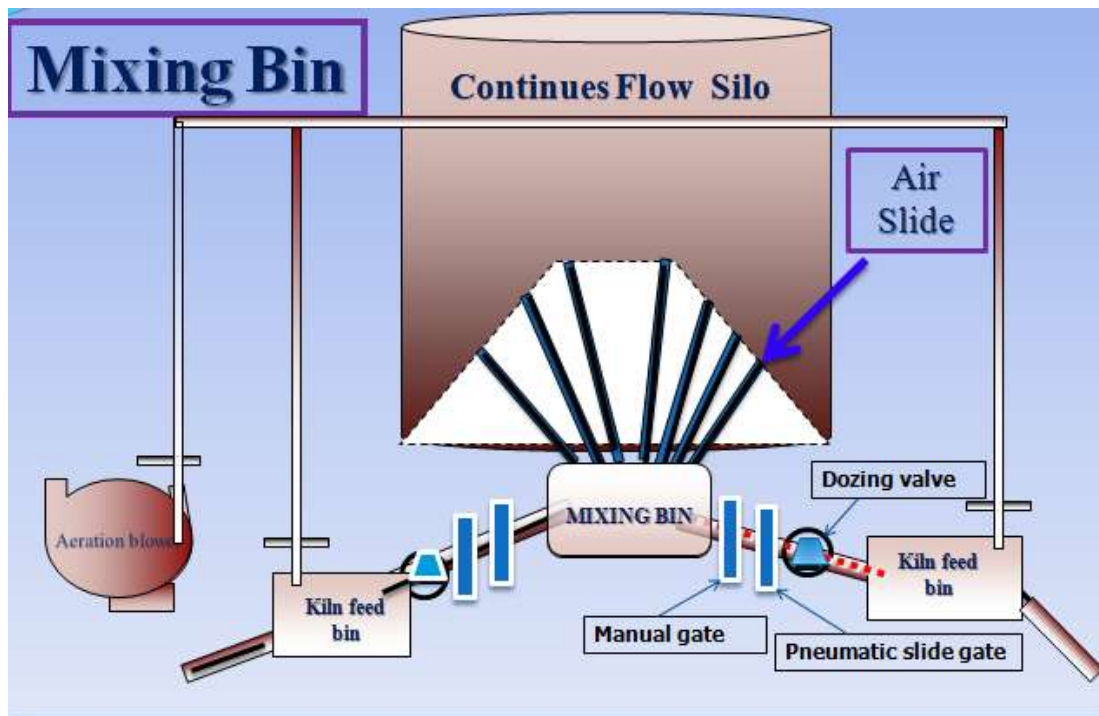
2. LITERATURE REVIEW

Cement factories are highly energy and cost intensive industries, and energy cost is 30 – 40% of the total production cost (Szabo et al, 2003). Clinker producing includes the following operations: preheating the raw material, precalcination, burning inside the kiln and clinker cooling (Sattari and Avami, 2007). In a typical cement plant, preprocessing unit is thermal energy intensive and accounts for about 90% of the thermal energy used in cements production process (Holderbank Inc, 1993). Assessing the thermal performance of cement industries fuel consumption is a major commodity to study (Worell et al,2000; Liu et al,1995). An appropriate method for thermal performance analysis must be adopted to achieve the principal objectives, such as maximizing the plant productivity, minimizing the raw material, minimizing the energy consumption of any cement industry. The objectives could be achieved by reducing the energy consumption of the plant that it means a search for energy efficiency leading to a productivity improvement (Rasul and Widiyanto, 2005). In Indian manufacturing industries the importance of improvement tool is highly recognised (Jitendra et. al, 2014).

The cement is mostly found everywhere in everyday life and it is hard to imagine a modern society without it. It provides the basic input to the construction industry which has major role among the modern global infrastructures and development processes. Furthermore for period of time the national development was measured by production and consumption size of the cement (Pipilikaki et al 2009, Treloar et al 2001). The cement industry operates in virtually all countries around the world; however more than 70 percentages of the global cement are produced and consumed in the developing countries where the construction development is much higher pace than the developed countries (John, 2003). Cement industry uses various specific machines such as mixing bin; grinding machines etc. In the selected industry the mixing bin is taken under study and a methodology is applied for the improvement. This whole industry and specially mixing bin requires an effective maintenance to run the machines and critical equipment smoothly and without hampering the production. Situation of not achieving the expectation of high machine utilisation and production rates, low breakdown rates, and trouble free operation processes within the cement production line has motivated the undertaken research to design an integrated framework by which the cement production line will be improved and enhanced.

2.1 MIXING BIN

- Mixing bin is located below the CF Silo where raw meal mixed and conveys to preheater.
- The material is extracted from the various gates of CF silo & raw meal mixed in mixing bin chamber for homogenization and then sends to the kiln through preheater for clinkerization.
- Fluctuation in material feed rate, causing problem to the kiln feed.



3. PROBLEM DIAGNOSIS & METHODOLOGY

To achieve the specified objective in the present research the real time implementation and observation has been adopted where real time data is observed and analysed to improve the system and to enhance the production.

Selected Cement Industry was established over twenty years ago, a pioneer in the private sector of Cement Industry of India. Due to confidentiality matter the exact name and layout has not been mentioned. From its humble beginnings with only few employees, Selected Cement Industry has grown into one of the major players in the industrial sector of the country. With Selected Cement Industry, it now employs in excess of 500 men and women. It is in the process of increasing it's paid up capital.

3.1 IMPLEMENTATION OF CONTINUOUS IMPROVEMENT TOOL

A characteristic of lean thinking associated with maintenance to improve the performance efficiency and reduce the waste is through the use of continuous improvement tool like Six Sigma. Further the two important method namely Demming wheel and PDCA cycle is used in six sigma and implemented sequentially. Figure 2, describe the details of Demming wheel and PDCA cycle. The next chapter discusses the details of steps taking mixing bin under study of the present thesis.

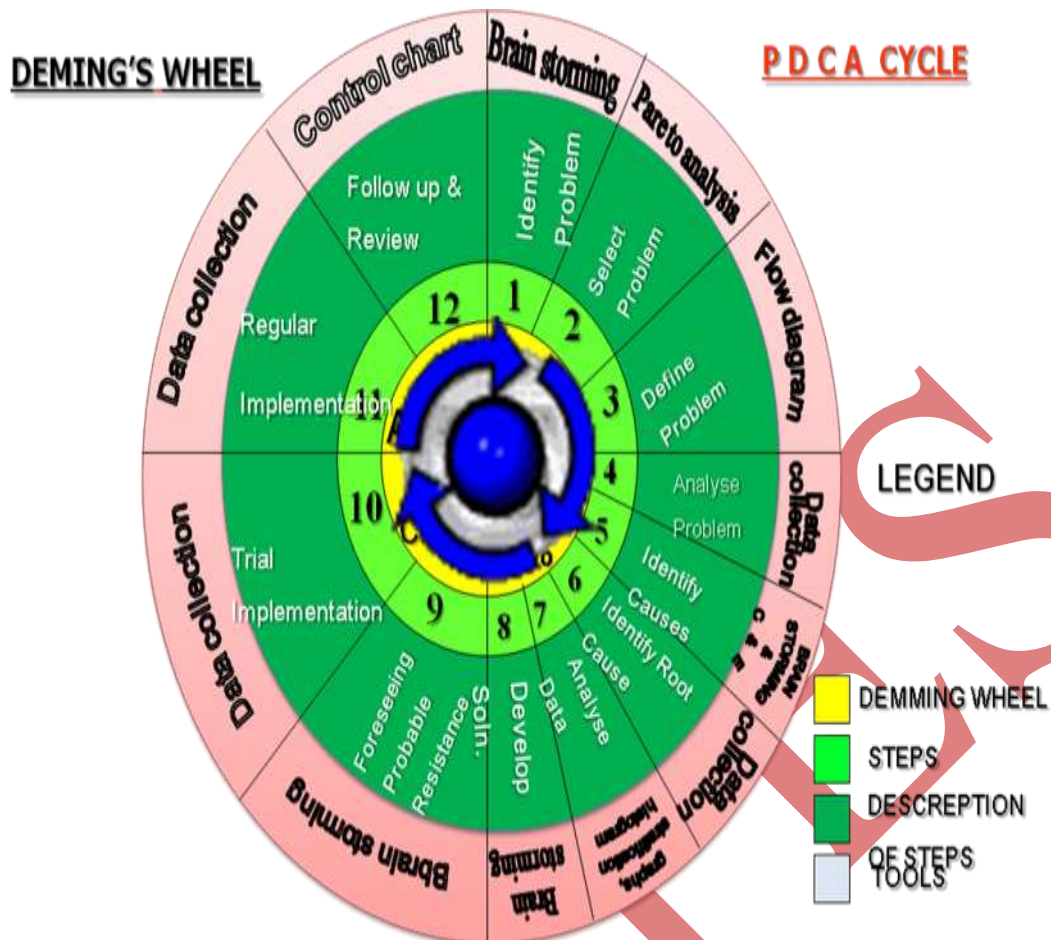


Figure 2: Demming wheel and PDCA Cycle

4. RESULTS

The step by step procedure, real time observations and its results have been discussed in the present section. Problems are identified in the first step and then analyzed minutely. Root causes for problems are also identified by matrix method. Various steps are discussed in the following sections.

STEP-1 IDENTIFICATION OF PROBLEM

The most common problems occurred in the company and on the shop floor have been identified through direct observation. Some of the problems are listed on the basis of operator's experience that they have faced during his service tenure. Most frequent occurring problems have been listed first then these are categorized into three categories 'A', 'B' and 'C'. The categories of problems are indicated according to the criticality of problems.



Figure 3: Plot of the Category type and problems

STEP-2 SELECTION OF PROBLEM

All the problems are codified and the most critical five problems have been selected with the help of team members and suggestions given by them. The broad area is selected for the problems. The team members have given some suggestion from unsolved problems and to solve the problems.

Table 1: Coding of Problems

S. No.	Code No.	Problems
1.	A-4	Leakage from K-6 belt conveyor discharge chute
2.	A-10	Continuous leakage of GP crusher inlet chute expansion joint during running of Gypsum circuit
3.	A-14	Insufficient air supply problem in Bag Dust Collector of Circular Stacker.
4.	B-12	No proper cooling of coal mill main drive gearbox by existing oil pump.
5.	C-52	Material leakage from pneumatic slide gate of mixing bin discharge air slide.

STEP-3: DEFINE THE PROBLEM

All the identified problems are defined as it is the third step of Six Sigma for continuous improvement. The problem is defined in broad. Its pros and cons are also studied accordingly. Following are the problems and its detail. Firstly the problem is defined and then its aims are also defined.

1. Material leakage from pneumatic slide gate of mixing bin discharge air slide.
2. Problems due to leakage

STEP-4: ANALYSIS OF THE PROBLEM

After the defining of problem and assigning the activity to team members, its analysis becomes the important. Modification of mixing bin and productivity improvement of cement plant (Mixing bin plays vital role in cement plant for clinkerization process) and action taken;

- ❖ During Up gradation of cement plant Old feeding equipments replaced with the new feeding equipments.
- ❖ New feeding system comprising one manual vertical slide gate one pneumatic slide gate and one dozing valve.
- ❖ New feeding equipment operated at higher frequency to maintain the material level in kiln feed bin.
- ❖ During operation of pneumatic valve, a huge quantity of material spilled from the pneumatic slide gate seal as result dust pollution was occurring.

- ❖ Due to above huge dust pollution, bad housekeeping was observed
- ❖ For cleaning of accumulated dust on the floor extra man power deployed.
- ❖ We have reduced the gap between the slide gate seal but the frequency of seal changing was increased.

STEP-5: IDENTIFICATION OF CAUSES

The identified problems are analysed and its various causes are also analysed. With the help of fishbone diagram the behavioral problem related to working force, problems in method, problems incurred in material and problems of machines are identified.

STEP-6: FINDING THE ROOT CAUSE

To find the root cause of the problems, in place of 5W (What, who, where, when and why) techniques 4 W & 1 H techniques have been applied. Further the root cause is identified for each enlisted problems. All the root causes of problems are analysed with the help of **applying 4 W & 1H (Except WHY)** technique. Table 2 shows the problems, culprit of that problem, location of problem and time to arise and how.

Table 2: Details of 4 W & 1 H

What is the problem	Material leakage from mixing bin pneumatic slide gate
Who is the culprit	Method
Where is the problem	In mixing bin pneumatic slide gate
When the problem arise	From the time of plant up gradation
How the problem arise	The faulty design of machine

STEP-7: DATA ANALYSIS

Data collection of the problem from August 2013 to February 2014 (7 Months)

Data of the identified problems have been collected from the period of seven month and frequency of problems is also noted down. For a particular problem the number of occurrence shows the criticality of the problem. Table 3 shows the details of collected data.

Table 3: Data collection of the problem

Month	Problem Occurred	Problem
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AUG-13	21 TIMES	Leakage of material from new equipment
SEP-13	14 TIMES	Leakage of material from new equipment
OCT-13	25 TIMES	Leakage of material from new equipment
NOV-13	30 TIMES	Leakage of material from new equipment
DEC-13	39 TIMES	Leakage of material from new equipment
JAN-14	36 TIMES	Leakage of material from new equipment
FEB-14	30 TIMES	Leakage of material from new equipment

EFFECT OF THE PROBLEM IN THE PLANT PRODUCTION

Losses occurred in seven months

August 2013 to February 2014 (seven months)

- Quantity of material leakage in one time = 2 ton approx.
- Losses in production = 390 ton approx / in seven months
- Minimize The Spillage

STEP-8: DEVELOPING THE SOLUTION

For the identified problem and after analyzing the collected data the specific suggestions have been made for the improvement. figure 4 shows the details of suggestion made.

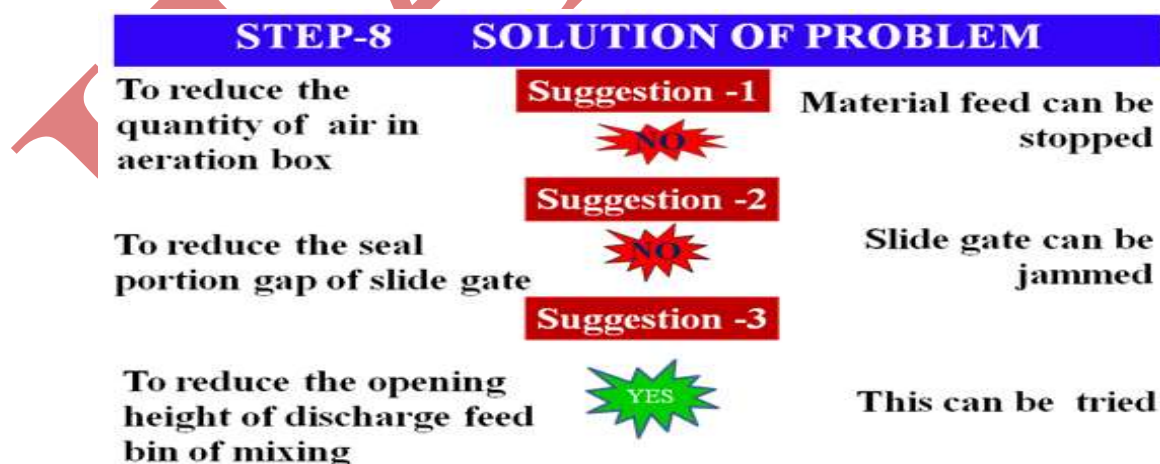


Figure 4: Suggestion made

5. CONCLUSION

This research has been conducted and written in relation to the implementation of improvement tool such as PDCA in the 12 different steps in a Cement industry. The study aims initially at scrutinizing the maintenance system and identification of problems of the industry and categorically concluded that the high rate of failure reigns in the mixing bin of the Industry. This can be attributed to the condition of equipment, due to negligence of the operator and shortage of spare parts. The underprivileged preventive maintenance system of the industry is also contributed to this effect. The line of investigation winds up that the effect of not involving the operator in minor inspection and restoration of equipment escalates unexpected number of failures which challenges to maintain the proactive maintenance programme.

In this paper, the theory of Demming wheel and PDCA tool as the continuous improvement program was used to find a model of optimal production productivity in cement industry. According to this work the failure rate of mixing bin inside the factory can be reduced and production can be improved. Therefore using this method problems can be reduced.

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