Journal of Mines, Metals and Fuels, *71(12A): 40-46; 2023. DOI: 10.18311/jmmf/2023/43589*

Print ISSN : 0022-2755

Journal of Mines, Metals and Fuels

Contents available at: *www.informaticsjournals.com/index.php/jmmf*

Essence of PPC (Production, Planning and Control) in Enhancing Productivity at Fly Ash Brick Manufacturing Industry

Abhijit Chakraborty*, Indrajit Bhattacharjee and Nilmoni Chakraborty

Department of Mechanical Engineering, Global Institute of Management and Technology, Krishnagar – 741102, West Bengal, India; chakrabortyabhijit100@gmail.com

Abstract

Effective upkeep of equipment and facilities When it comes to the day-to-day operations of the industry that manufactures fly ash bricks, accurate planning and the scheduling of work are of the utmost importance in order to increase overall production. It is necessary to have a work force that has been appropriately trained in order to achieve successful maintenance optimization. Additionally, it is necessary to have management that is efficient in addition to an organisational structure. In order for the job to be completed successfully, it is vital that the key resources needed by the fly ash brick business be employed in an efficient and effective manner. This is necessary in order for the task to be completed. This is due to the fact that the industry is dependent on these resources in order to do the task. In this section of the essay, we are going to discuss the process of working, beginning with work initiatives.

Keywords: *Maintenance, Planning, Productivity*

1.0 Introduction

In terms of cement production, India is the second largest country in the world, behind only China. China is the largest producer of cement. In the year 2000, the nation's annual capacity was somewhere around 120 million tonnes, but by the year 2011, it had increased to approximately 140 million tonnes. it is estimated that it has climbed to somewhere in the vicinity of 300 million tonnes, having been approximately 120 million tonnes in the year 2000. This demonstrates that the cement capacity is expanding at a pace of approximately 10% each year. When compared to sectors in many other countries, the cement sector in India is light years ahead in terms of specific energy usage, both in terms of thermal and electrical energy. In other words, India's cement industry uses a fraction of the energy that other industries do (energy use per unit of production)[1].

The rapid rate at which construction projects are being undertaken in India is contributing to an increase in the demand for raw materials and sources of energy in the country. Because of this demand, natural resources including land, water, minerals, and fossil fuels are subject to substantial constraints. As a direct result of this, there is an increase in the price of several goods as well as of energy. In light of this, there is a need to establish and pursue industrial activities, which can help in maximizing economic and social gains while also reducing environmental harm. Specifically, this requirement arises from the fact that there is a need to

**Author for correspondence*

create and pursue industrial activities. These pursuits require further development and should be actively pursued. The increasing pace of urbanization in India has led to an upward trend in the amount of electricity that is consumed by individuals inside the nation on a per capita basis. Coal-fired power stations are responsible for providing around 57% of India's total electrical production, as indicated by the most recent figures produced by India's Central Electricity Authority (CEA). Coal is the source of around 27% of the world's total energy sources and is responsible for approximately 38% of the world's power generation[2]. Over the next thirty years, it is projected that these percentages will not change significantly from their current values. There are now 167 thermal power stations in operation in India. These thermal power plants are powered by coal or lignite. These power plants consume around 625 million metric tonnes of coal each and every year (around three fourths of the total coal used in the country). Fly ash production in the years 2017 and 2018 reached approximately 196 million tonnes as a direct result of this issue, which led to the production of a vast quantity of fly ash.

The amount of fly ash that is being produced has been on the rise, and this trend is anticipated to continue into the foreseeable future because of the growing demand for power and the prevalence of coal as a source of energy. Fly ash is a fine, grey powder that is formed when coal is burned to produce electricity. In order to satisfy the growing demand for energy in the country, thermal power generation that is based on coal is anticipated to continue to play a significant role in the future as well. This is as a result of the fact that it is anticipated that the coal reserves in India would be around for more than a hundred more years. All of the involved stakeholders are faced with a formidable obstacle when it comes to the responsible disposal of such a massive quantity of fly ash[3].

1.1 Production of Fly Ash and Applications of it

Power plants that run on coal are responsible for the generation of around 76% of India's total electricity. There are now 167 thermal power units powered by coal and lignite that are operational in India. These power stations consume around 625 million metric tonnes of coal on an annual basis when combined. In recent years, India's growing reliance on coal has made fly ash one of the country's most significant sources of industrial solid waste. This is mostly due to the fact that fly ash can be easily transported and disposed of.

1.2 Utilization Potential in Cement and Concrete

It is possible to use fly ash in cement in one of two ways: either 1) during the creation of Pozzolana Portland Cement (PPC) or 2) as an additive in design mix concrete together with Ordinary Portland Cement (OPC), aggregates, and water. Both of these methods have their advantages and disadvantages. Pozzolana Portland cement is the name given to either of these two processes. Both the production of fly ash and the making of cement are extremely significant industries in China and India, which are two of the most important marketplaces in the world. Following China in both the manufacturing of cement and the generation of fly ash places India in the position of holding the second place spot. The following table, in which all of the figures are presented in million tonnes, offers a comparative analysis of the two countries in terms of the quantity of cement that is manufactured and the quantity of fly ash that is utilized. A comparison of the statistics from the two countries demonstrates that China makes use of a greater percentage of the fly ash that is generated during the manufacturing of cement and concrete than India does (24.25 per cent as opposed to 26.62 per cent). The proportion for China is significantly larger than that of India[4]. In spite of this, India uses a far larger percentage of fly ash in its total cement production (18.44%) than China does (10.72%). The amount of fly ash utilized in the production of cement is significantly higher than was previously thought, according to research that was conducted solely on the cement industry. This amount is approximately about 25% (when including PPC's contribution of 70%), which is about 25% higher than what was previously thought.

1.3 Preplanning, Planning and Control

It is possible to think of the processes of preplanning, planning, and control as taking place in a specific order across time. This is something that is possible to do. The planning for the preproduction phase is completed before the production itself gets underway. Meetings for control are held all the way through the production process, but the planning session happens right before production starts.

1.3.1 Preplanning

It is a process that is carried out in order to create and design a work or production, as well as to create and install an appropriate layout or tools. It also refers to the process of creating and installing an appropriate layout or tools. In order to facilitate the creation of an appropriate design, it may involve many functions of the organization and draws on aspects such as forecasting, product design, jigs and tool design, machine selection, and estimating. In a nutshell, the decisions concerning what will be made and how it will be made are made during the preplanning stage of the process[5]. In the event that no advance planning is done for any of the individual manufacturing processes, it is possible that the end result will be an excessive output that cannot be sold at a profit. Additionally, it is crucial in certain operations, like establishing a new plant, as planning ahead can spot and prevent potentially expensive mistakes. This makes it one of the most important aspects. Because of this, it is considered to be one of the most important aspects. As a result of this, it serves as an indispensable component of the overall operation.

1.3.2 Planning

At this stage, decisions are being made regarding both the location of the manufacturing and the schedule for the production. It includes both the order in which activities are carried out, which is referred to as outing, and the schedule for manufacturing, which is referred to as scheduling. In addition to this, it outlines procedures for the planning and supply of material, as well as the loading of machinery and the delivery of goods. It is necessary for it to have historical records of performance in addition to control statistics, the latter of which can be derived from preplanning, cost control, or progress, in order for it to be able to carry out its functions in an appropriate manner.

1.3.3 Control

This refers to the stage in the process where a decision is made on whether or not the planned activity will really take place. Control launches the plan at the proper moment through the utilisation of dispatching, and after that, control makes the required modifications in order to account for any unforeseen conditions that may occur in the future through the process of advancing. It needs the measurement of actual results, the comparison of those results with the action that was intended, as well as the feeding back of information to the planning stage in order to make any required revisions. a. Material control, machine utilisation, labour control, cost control, quality control, and overall control all follow the same pattern of control[6].

It is the relationship between the amount of resources used to produce a good or service. The ratio of resources used to produce goods or services to the total amount of those goods or services generated can also be used to define productivity. The ratio of inputs to outputs is referred to in this second definition of productivity[7]. Productivity is defined by the International Labor Organization (ILO) as the proportion of "output of work" to "input of resources" used to create a good. The output to input ratio is used to determine productivity. The standard statistic used in the determination of productivity is the ratio of output to input. Thus:

$$\text{Productivity} = \frac{\text{Value of the output}}{\text{Value of the input}}$$

1.4 The Concepts of Production Planning and Scheduling

It seems likely that defining the concept of "production planning" as "the planning of production" is the most efficient approach to do so. Rephrasing the term "production planning" as "the planning of production" In the context of this conversation, the term "manufacturing operations" refers to the process of putting in place the policies, methods, and facilities that are necessary for manufacturing activities in order to manufacture the product that will be required in the not too distant future. In the end, it is connected to capacity planning as well as product determination, which involves selecting which goods will be produced and in what quantities. Product determination involves deciding which products will be produced and in what quantities. The process of choosing what products will be manufactured and in what quantities is known as "product determination."

In addition to this, it is oriented toward the future[8].

It makes preparations in advance to ensure that the inputs consist of not just machines and raw materials, but also the knowledge and experience of people, control systems, financial resources, and a variety of different kinds of inventories. The process of ensuring that everything is available at the appropriate moment in order to fulfil the production target is the essence of production planning. The production system is subject to a number of limitations, including the requirements of the market in terms of price, quality, and delivery, the availability of financial resources, and the inherent limitations of the product, such as the amount of time needed to complete a process or its specific storage requirements. Planning must take into account both the restrictions and the goals of a work in order to ensure that the activity will be finished in a manner that is congruent with both of those aspects[9].

1.5 Production

The transformation of the conceptual design into a real-world, operational system marks the beginning of the phase of the project known as "implementation.". During the period of implementation, the employees of the user departments will be responsible for completing particular duties. In order to guarantee that these responsibilities are finished in accordance with the necessary timetables, supervision and control are required[10].

Production is the process through which commodities and services are brought into existence, and it is this process that is responsible for the term "production." The purpose of production systems is to produce some good or service by bringing together a variety of resources, such as labour, materials, and capital, in an organized manner with the end goal of accomplishing this goal. The production system can take place in a wide number of locations, such as retail stores, banks, hospitals, and even hospitals themselves. We are, in point of fact, dealing with the operational stages of any organization that accepts any sort of an input into the system, which is then being processed within the system in order to provide a good or service as an output.

1.6 Controls

The fundamental control principles are adhered to by all of the various types of managerial controls, including production control, quality control, budgetary control, and cost control, amongst others. The core cycle of events that take place within the control consists of the following steps: action, feedback, evaluation, and adjustment. These occurrences have the form of a closed-loop circuit due to the continual and ever-shifting nature of the dynamic in which they take place. There are a total of seven steps that are obligatory for the establishment and implementation of operating controls in a business. The discussion of these processes will take place in the conventional order in which they are carried out.

2.0 Objectives of the Study

1. To study on concepts of production planning and scheduling
2. To study on manufacturing of fly ash bricks

3.0 Methodology

Bricks made from fly ash are increasingly popular among builders and engineers due to their high strength, uniformity, and low consumption of mortar plastering. This is one reason why fly ash bricks are the most common type of building material used today. On top of this, it is eco-friendly bricks, which save the environment from the

Figure 1. Fly ash bricks.

damage caused by burnt clay bricks and preserve the top agricultural soil, which was the primary raw material in burnt clay bricks. In addition to this, it protects the top agricultural soil. Bricks made from fly ash are a type of masonry unit that may be found in the construction of structures. It is common knowledge that they belong to the category of high-quality yet cost-effective building materials. Figure 1: they are composed of water and fly ash of Class C. Bricks formed from fly ash are produced by first applying a pressure of 4,000 pounds per square inch (psi) to a mixture of water and Class C fly ash, and then curing the mixture in a steam bath at 66 degrees Celsius for a period of 24 hours. Bricks can be made more durable by adding a chemical that entrains air.

The brick is said to be self-cementing because there is a high concentration of calcium oxide in the class C fly ash. Because the process of producing fly ash bricks is energy efficient, which means that it helps conserve energy, it also contributes to a decrease in mercury pollution, and it is more cost effective than conventional mud bricks, it is regarded to be a good alternative to using traditional mud bricks[11].

3.1 Manufacturing of Fly ash Bricks

If there is a shortage of fly ash, you have the option of selecting a mixing ratio that will allow you to make a profit and remain competitive in the market. The majority of machine manufacturers recommend the two mixing ratios shown below when it comes to the production of fly ash bricks. At the same time, you have an obligation to make certain that the level of quality is maintained. Figure 2: Normal bricks made from clay are noticeably heavier than the bricks made from fly ash, despite the fact that the fly ash bricks are noticeably more robust. Fly ash is now being stored as waste material in significant numbers around thermal power stations, which is generating major concerns with regard to the degradation of the environment.

4.0 Result

4.1 Evaluation of Compressive Strength

After curing at various temperatures (40 degrees Celsius, 80 degrees Celsius, 100 degrees Celsius, and 120 degrees Celsius) and concentrations of fly ash (0%, 30%, 40%, and 50%), values for compressive strength were calculated. (Twenty-eight to Fifty-Six Days). Numbers displaying compressive strength range from 0 (the weakest) to 100 (the strongest) (the strongest) in Figure 3. We also show the range of compressive strength values for fly ash at different temperatures. These findings show how cementer placement affects compressive strength at different curing ages. For this information, refer Table 1[12].

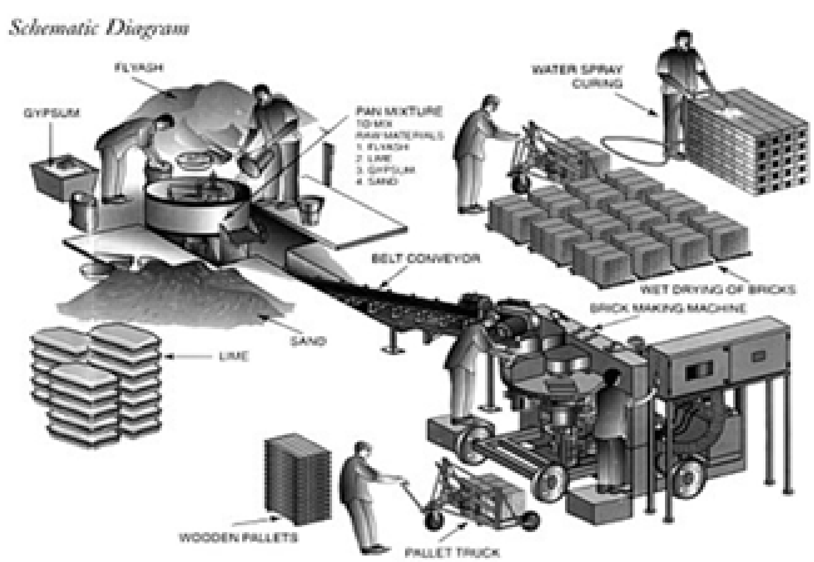

Figure 2. Schematic diagram.

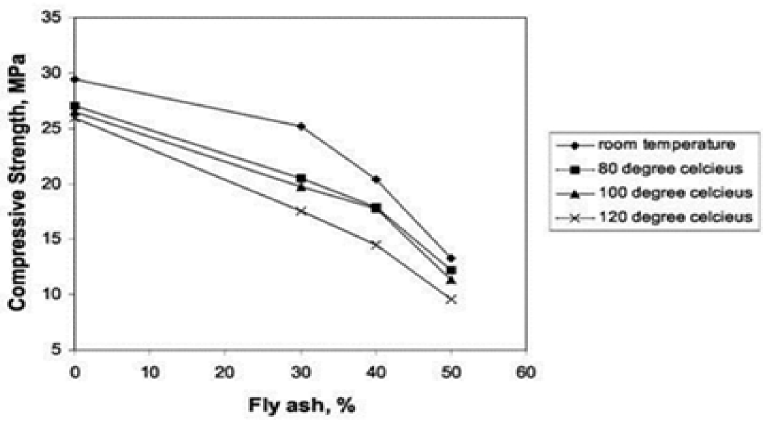

Figure 3. Compressive strength vs fly ash(56 days).

Table 1. Standard for the size

Length(mm)	Width(mm)	Height (mm)
190	90	90
190	90	40

Table 2. Class designation of burned clay based on strength

Class Designation	Average Compressive strength	
	Not less than (N/mm^2)	less than (N/mm^2)
350	35	40
300	30	35
250	25	30
200	20	25
175	17.5	20
150	15	17.5
125	12.5	15
100	10	12.5
75	7.5	10
50	5	75
	3.5	

Result: 75 to 150kg/cm^2 The provided bricks have an average compressive strength of 7.5 Newtons per square millimetre (or) Bricks Made From Common Clay and Their Specification

Dimensions: The following specifications will serve as the standard for the size of clay bricks in Table 1.

Classification: The typical burned clay is going to be categorized according to the average compressive strength, which is presented in the Table 2.

Efficiency and effectiveness in the production process are directly tied to the degree of productivity that can be reached, which is a function of the production process itself. Productivity is a function of the production process[13]. When we are having a conversation about the preventive maintenance plan that the fly ash brick business adheres to, we make it a point to take into consideration the affects that this timetable has on the many different working locations. When it comes to developing changes to maintenance[14], there are generally speaking two key goals that should be pursued: the first of these is to lower operating expenses, and the second of these is to enhance the quality of the brick.

5.0 Conclusion

It is imperative that more building materials be produced for the various elements of construction, and if this were to happen, the role of alternative and innovative options would come into sharp focus. This is because it is imperative that more building materials be produced for the various elements of construction. This is especially true when one takes into consideration the limited availability, growing costs, and concerns surrounding energy usage as well as the environment in relation to old and conventional materials. A requirement that has been felt has led to the study of the possibility of employing cutting-edge building materials and technologies, in particular those that conceal waste material such as ash. This is a necessity that has been taken into consideration. There would need to be a number of institutional supports for land, including land, financial, regulatory, and media support, as well as assistance for marketing and testing, and development of awareness. It would also be necessary to dramatically boost a few of the ongoing activities that are already underway. In order to achieve better strength, energy savings, and conservation, there would first and foremost need to be entrepreneurial activity for the production of appropriate fly ash-based walling, roofing, and flooring materials, such as Portland Pozzolana Cement and other cements. These materials would be used to construct buildings. The use of fly ash in the country has remained at a level of less than 10% during the course of the previous five years, and it is very feasible that it will take many more years before the ultimate goal of 100% utilization is realised.

6.0 References

1. Bailey and Hubert. Productivity Measurement. Lowe and Brydone printers Limited, Thetford, Norfolk, Great Britain, 1980. vol. ed. (213); 2016. p. 5
2. Chatterjee B, Singh KK, Goswami NG. Fly ash utilization for value added products, February, 1998. Hong Kong: AME Publishing; 2014. p.1-12.
3. Das, A K. Coal ash utilization: An alternative technology, Journal of CAII, September,1999. College Park (MD)]: University of Maryland; 2008. p. 174.
4. Enofe M G. Maintenance impact on Production Profitability - A Case Study, Spring 2010. [dissertation], College Park (MD): University of Maryland; 2008. p. 56.
5. Gunasekaran A. Improving productivity and quality in manufacturing organizations. Int J Prod Econ. 2019; 36:169-83. https://doi.org/10.1016/0925-5273(94)90022-1
6. HMSO. Report on maintenance engineering. Department of Industry Committee for Technology. London: HMSO; 2018. p. 56.
7. Juran J M, Gryna F M. Juran"s Quality Control Handbook. New York: McGraw-Hill Book Company; 2013. 44.
8. Madu C. Reliability and quality interface. Int J Qual Reliab Manag. 1999; 16(7):691-8. https://doi.org/10.1108/02656719910286198
9. Peters V J. Total service quality management. Managing Service Quality. 1999; 9(1):6-12. https://doi.org/10.1108/09604529910248759
10. Ross K W. Assembly-line job satisfaction and productivity. Ind Eng. 2013; 26:44-5.
11. Shah Y M B. Total productive maintenance: A study of Malaysian automotive SMEs. Proceedings of the World Congress on Engineering 2012 Vol III, WCE 2012, 2012 Jul 4-6, London, U.K; 2016.
12. Tsang A H C, Chan P K. TPM implementation in China: A case study. Int J Qual Reliab Manag. 2014; 17(2):144-57. https://doi.org/10.1108/02656710010304555
13. Tsang A H C. Measuring maintenance performance - A holistic approach. Int J Oper Prod Manag. 2012; 19(7):691-715. https://doi.org/10.1108/01443579910271674
14. Vashisth D S, Kumar R. Analysis of a redundant system with common cause failures. Int J Eng Sci Technol. 2016; 3(12):8247-25.