CRITICAL EVALUATION OF THE PLANT MAINTENANCE OF A LARGE MANUFACTURING ESTABLISHMENT

By

L.A. ADEKOYA [1], I.O. AWE [2], O.O. IZE-BALOGBAN [2], J. J. CHIKWE [3], S. J. OJOLO [4]

[1]Department of Mechanical Engineering, Obafemi Awolowo University
[2]Department of Industrial Maintenance Engineering, Yaba College of Technology
[3]Department of Mechanical Engineering, Yaba College of Technology
[4]Department of Mechanical Engineering, University of Lagos

ABSTRACT

Maintenance operations have become indispensable in the industries. The mission is to service or restore plants to a given state and more often these days a preventive rather than a curative role is attributed to maintenance, since it is believed that preventive maintenance is cheaper than repair.

Taking a Bottling Company as a case study, the actual preventive maintenance programme carried out on the plant machineries and equipment was appraised by monitoring the preventive maintenance crew on their routine / periodic maintenance work within the plant. The performance of the crew was measured against the standard preventive maintenance guidelines issued by the factory management.

It is observed that the performance of the maintenance team was below expectation as compared with the standard set by the Company, thereby leading to a decline in the total production output.

1.0 INTRODUCTION

In the nature of things, virtually nothing 'made by man' is indestructible, but the useful life can be extended by carrying out repairs at predetermined intervals by an activity known as maintenance.

Maintenance is a combination of any action carried out to retain the equipment in or restore it to an acceptable condition at an acceptable cost (BSI, 1994). Maintenance to an acceptable standard refers to the standard set by the organization, which varies from one organization to another, and it depends upon the types of machineries of the industry and commensurate with the value placed on the need for a high standard (Claude, 1998). In some instances, the required standard of maintenance is also laid down by statutory regulations and must be

observed accordingly.

Maintenance is a science since its execution relies, sooner or later, on most or all the sciences. It is an art because seemingly identical problems regularly demand and receive varying approaches and actions, and because some managers, foremen and technicians display greater aptitude for it than others show or even attain. It is above all a philosophy because it is a discipline that can be applied intensively, modestly or not at all, depending upon a wide range or variables that frequently transcend more immediate and obvious solutions. Moreover, maintenance is a philosophy because it must be carefully fitted to the operation or organization it serves (Lindley, 1995).

The inevitability of less than 100% reliability of any equipment ultimately necessitates its maintenance. Also, in systems of any complexity certain trimming adjustments are necessary at various stages of assembly to maximize performance. Thus, a vital consideration in the design of the components and equipment of a system is the question of how quickly and easily a unit in that system can be adjusted or repaired (Kolade, 1997).

In order to take advantage of maintenance to increase production efficiency, a system of maintenance procedure has to be rigorously pursued. It is the effect of this procedure that can affect the increase in production efficiency. The maintenance planner has to consider the following types of procedure in order to planning schedule (Ejehu, 1999).

a) Preventive maintenance
b) Predictive maintenance
c) Running maintenance
d) Breakdown maintenance

The maintenance methods depend on the use and type of equipment. Whatever it may be, all the methods are derived from two basic concepts:

Preventive Maintenance: This corresponds to a desire for programming and planning of the work, broken down into systematic preventive maintenance and conditional preventive maintenance.

Corrective/Remedial Maintenance: This corresponds to a reactive attitude to more or less random event (emergency and definite repairs).

If a sufficient history is not available, the choice of method to be applied must be done in agreement between the production and maintenance departments. The maintenance

department is charged with verifying the reasons for this choice with respect to the history of the equipment and modifying, if any the method for reaching the most economical solution in each case.

2.0 MATERIALS AND METHODS

The evaluation of the plant maintenance activities of the Nigerian bottling company Plc, Ikeja 'A' plant was carried out by first listing the machinery and the standard schedule on each. Table 1 shows the list of machinery, their locations and the number of expected preventive maintenance tasks to be carried out on each.

The preventive maintenance team carries out their activities between 0600 hours and 1200 hours daily. No production takes place during this period. The machineries are test-run by both the maintenance and production crews between 1200 hours and 1400 hours to ascertain the level of performance and adjust where necessary before they are handed over to the production team for full production by 1400 hours. The maintenance actions necessary afterwards are handled by the shift technicians.

In general, the daily preventive maintenance tasks carried out within 10 days were analyzed and the percentage mean performance was determined statistically from the data generated for each of the machines. The same thing was done for the weekly maintenance tasks based on 8 weeks programme. The monthly maintenance schedule was studied for 3 months on the five machines concerned, while the quarterly (based on 1 quarter) was appraised on two machines and yearly maintenance programme was appraised on one machine scheduled for these tasks.

3.0 RESULTS AND DISCUSSIONS

Table 1: Summary of percentage of maintenance tasks actually performed on machinery

No.	Machine/ Plant	Location	Number of maintenance tasks									
			Daily		Weekly		Monthly		Quarterly		Yearly	
			E	P%	E	P %	E	P%	E	P %	E	P %
1	Filler	Bottling Hall	20	83.5	14	58.9	12	66.7	-	-	-	-
2	Bottle Washer	Bottling Hall	18	70	19	82.2	19	66.7	-	-		-
3	Conveyor	Bottling Hall	7	41.4	-	-	10	90	-	-	-	-
4	Blender	Bottling Hall	7	100	1	50	-	-	--	--	-	-
5	Case Washer	Bottling Hall	14	0	5	0	-	--	-	--	-	-
6	Crowner	Bottling Hall	20	21.5	13	58.7	-	-	3	66.7	-	-
7	Packer &Unpacker	Bottling Hall	15	42.7	6	50	-	-	-	-	-	-
8	Air Compressor	Compressor Room	14	80.7	12	70.8	-	-	8	62.5	-	-
9	Cooling (Ammonia) Compressor	Compressor Room	21	92.9	7	76.8	-	-	-	-	-	-
10	Boiler	Boiler Room	16	48.8	9	84.7	8	91.7	-	--	5	80
11	Water Treatment Plant	Quality Control Annex	6	40	5	90	-	-	-	-	-	-
12	CO_2 Plant	Quality Control Annex	43	86.7	6	54.2	-	-	-	-	-	-
13	Syrup Plant	Quality Control Annex	9	44.4	5	82.5	-	-	-	-	-	-
14	Pumps	Attached to Some Equipment	6	45	3	66.7	-	-	-	-	--	-
15	Line Equipment Control Panel	Bottling Hall	-	-	-	-	28	94.1	-	-	-	-

Legend: E = Expected, P = Performed

The percentage of preventive maintenance tasks that were actually carried out on the filler was appreciably high (83.5%). This is on the recognition of the fact that the filler plays a very important role during the process of bottling. Thus, the machine is always put in an ever-ready position on a daily basis. The table reveals that not all the daily expected routine maintenance tasks were executed as scheduled. This may be due to time factor and number of technicians attached to the equipment. However, an average of 58.9% of the weekly maintenance task was performed out of the total number of weekly scheduled preventive maintenance tasks. This may be due to the limited number of maintenance staff invited for weekend overtime maintenance assignments. Moreso, on monthly basis, an average of 66.7% preventive maintenance schedule were carried out on the filler. The low number of tasks accomplished was due to insufficient maintenance personnel to complete the assignment.

The daily preventive maintenance tasks on the bottle washer, being major equipment was high (70.0%). Technicians' hands were always on 'deck' for the daily routine tasks. However, few of the tasks could not be completed due to lack of spare parts, tools and shortage of maintenance staff. At the weekends, most of the planned maintenance tasks were carried out as scheduled to pave way for smooth operation of this machinery at the beginning of another week. It was noted that priority was given to the maintenance of the bottle washer due to the starting role it played in the bottling process. 82.2% of the actual weekly maintenance tasks were achieved due to high allocation of technicians. Also, 66.7% of the scheduled preventive maintenance tasks were carried out monthly.

The mean maintenance tasks carried out on the conveyor daily was 41.4%. Except there was major breakdown, most of the maintenance activity were usually carried out monthly, averaging 90.0%.

Full preventive maintenance activities were carried out on the blender as scheduled daily. The bottling process actually started from the blender, thus, it has to be checked fully before the start of the production daily. Moreso, at the end of every week, the air level controller was removed for cleaning with methylated spirit. The actual weekly maintenance carried out was a mean of 50.0%.

The case washer was not in use during the period of appraisal as reflected in the tables. Thus, no maintenance activity was carried out as scheduled daily and weekly, showing zero performance.

Since the cases are packaging materials which need occasional cleaning.

Very little (21.5%) preventive maintenance activities were carried out on the crowner daily, while a higher (58.7%) were carried out weekly and a much higher (66.7%) were performed quarterly. This was due to the high level position of the crowner and the opinion of the technicians that the equipment is rugged.

A mean of 42.7% maintenance tasks were performed on the packer and unpacker equipment daily, while 50.0% tasks were performed weekly. The most common maintenance routine carried out daily was the check on air lines for leakage, while that of weekly was cleaning of the panels.
This was due to low frequency of breakdown of the equipment.

About 80.7% of the daily maintenance tasks were carried out while 70.8% were carried out weekly on the air compressor. This was a reflection of high maintenance level since compressed air is a major catalyst in the bottling process. However, the table shows that 62.5% is the quarterly maintenance tasks carried out, the most important of which was the renewal of air filter.

Since bubbling and foaming are not desirable in the bottling process, a lot of maintenance efforts (92.9%) are concentrated on the cooling (ammonia) compressor on a daily basis. In addition, weekly maintenance tasks cover 76.8% of the scheduled programme.

Less than half (48.8%) of the daily maintenance schedule were carried out on the boiler as shown in the table. Due to the nature of operation of the equipment, most of the maintenance activities took place weekly (84.7%), monthly (91.7%) and annually (80.0%).

On daily basis, an average of 40.0% actual tasks was performed out of the scheduled activities on the water treatment plant. The bulk of the preventive maintenance tasks were performed weekly, averaging 90.0%.

The table shows a mean of 86.7% daily maintenance tasks performed on the water treatment plant. This is high so as to keep

the plant in good operation at all times. However, 54.2% account for the actual weekly maintenance tasks performed out of the expected schedule.

An average of 44.4% tasks was performed daily on the syrup plant out of the schedule activities. The bulk of the maintenance tasks were carried out weekly, representing a mean of 82.5%.

The rate of maintenance of pumps on a daily basis is averagely low (45.0%) as compared with the plan. More of the planned weekly schedule was executed, it shows 66.7%.

The line equipment control panel is schedule for preventive maintenance monthly and out of the 28 tasks slated as activities, an average of 94.1% was performed.

4.0 CONCLUSIONS

From the analysis of the results, it can be concluded that the Periodic Preventive Maintenance schedule as written out by the plant based on the conditions of the machines was not adhered to as expected.
The attitude of the technicians towards periodic preventive maintenance was below expectation of the standard of a large manufacturing company. The Maintenance department was under-staffed. Thus, the few number seemed not coping effectively with the enormous routine preventive maintenance activities.

5.0 RECOMMENDATIONS

There is a need to improve the quality of the in-plant technical training of the maintenance staff. Senior members of the maintenance department could be made to improve their technical management skills at well-established training institutions.

Some of the old machines which are principal to the bottling process, especially the fillers and bottle washers should be changed for new and modern set which will lead to higher production efficiency due to better plant availability.

There is a need for the plant management to improve on production and maintenance incentive in line with the current product pricing as a means of staff motivation.

It is suggested that manufacturing plants should focus very much on periodic preventive maintenance, as it will reduce accidents, reduce downtime of the machinery, reduce breakdown cost, increase production capacity and subsequently increase the revenue of the companies.

6.0 REFERENCES

1. Afolabi, P.O., 1996. "Maintenance of Poclain Crane: An Engineer's Report". An Unpublished Report, Mechanical Engineering Department, Yaba College of Technology, Lagos.

2. British Standard Institute, 1994. "BS 3811: Manufacturing and Maintenance Functions". British Standards Institution, London.

3. Claude, M., 1998. "How to Succeed in Maintenance". Industrial Maintenance Specialized Series; Part One (French Technical Support Programme), Yaba College of Technology, Lagos.

4. Ejehu, S.N.C., 1999. "Studies into the Organisation of a Large Maintenance Workshop". An Unpublished B.Sc. Thesis, Mechanical Engineering Department, University of Lagos, Akoka, Lagos.

5. Kolade, B., 1997. *"Increasing Production Efficiency Through Maintenance"*. Text Delivered on the 2nd Graduation Lecture of the Metallurgical Training Institute, Onitsha. Engineering Handbook", Fifth Edition.

6.Lindley, R.H., 1995 "Maintenance Introduction to Theory and Practice of Maintenance. McGraw-Hill Book Company Inc., Washington, D.C., pp 1.1-1.22.