

Planned maintenance system - A development in maintenance

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Maintenance was considered as an expenditure oriented activity and hence it used to be undertaken whenever there was break down of machinery. With the growing demand for Qualitative and Continuous performance alongwith the technology, the machinery became very complicated/sophisticated in design and its maintenance. This has compelled the Managers to focus attention on the developments and improvements in maintenance systems and the results is "Planned Maintenance Systems". It ensured minimum disruption of production due to sudden break downs. The authors wish to bring to focus the Salient Features of Planned Maintenance for the benefit of the personnel involved in maintenance function in industry

Maintenance is very common word, but it becomes very difficult to define it when it is related to a factory, where there are various types of equipments and machinery. In simple words we can define it as a group of activities required to keep the plant & machinery in such a condition where it can produce the results in most optimum way. To add further, such activities must ensure minimum cost and down time.

In old days maintenance meant repairs/replacement of defective parts when the machinery stopped working. It was also called "Break down Maintenance". With the ever increasing technological and engineering development in the process industries, and the requirement from plant & machinery to perform their function with "Zero-downtime", the importance of maintenance function was felt, and it was considered as a necessary facet of the whole plant operation. The maintenance department was called upon to ensure availability of machines, services and building needed by other part of organisation for the performance of their function at optimum return on investment. Naturally this resulted in development of maintenance systems.

Planned Maintenance System or Schedule Maintenance System :

The circumstances mentioned above resulted in a system called "Planned Maintenance system". The aim

of Planned maintenance system is not other than to keep the function and strength curve in its original place i.e. to slow down or arrest the degradation of the component properties. The degradation is caused by external factors like weather & environment; internal factors like material of construction, design of equipment; duty being called to perform and operation. The pattern of above factors also change with time. Generally the degradation is arrested or slowed down by lubrication; anti - corrosive treatment, adjustments etc.

Reliability & Maintainability :

The success of planned maintenance system depends very much on the Reliability and Maintainability of the equipments. Reliability of an equipment is a function of its design; quality of manufacture and assembly. It also includes the selection of correct material for components, suited to the environment and media being handled. The more reliable is the equipment, less will be the demand on maintenance, thus giving more available time for its functioning.

Maintainability is a function of more complicated factors, design being the most prominent. Some designs are simply much superior to the others in the

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speed of diagnosis, access, removal and refitting, adjustments or replacements, that can be achieved with various levels of technical skill, tools and testing equipments.

Thus the good selection of plant and machinery is also an important factor for a good and effective planned maintenance system.

Objectives of Planned Maintenance System :

The main objectives of the planned maintenance system are—

- a) To maximise the plant availability by keeping the downtime to a minimum.
- b) To achieve high "mean time between failures" by having longer Run-time of equipment.
- c) To keep the maintenance cost at optimum level by:
 - i) having low density maintenance staffing, and
 - ii) maximum spares availability with minimum inventory levels.

Supports (Infrastructure) For Planned Maintenance System :

Like any other system, the planned maintenance system needs following supports and infrastructure to achieve its objectives successfully—

- a) A proper maintenance system.
- b) A well structured maintenance department which can meet the requirements of the Planned Maintenance system.
- c) Appropriate technical personnel and trained work force to carry out the various jobs required by maintenance system.
- d) Availability of equipment in time for activities required under planned maintenance system.
- e) Availability of correct material and spares at the required time.
- f) Accurate monitoring and feed back regarding condition of plant & equipment.

Planned Maintenance System : How it Works :

The planned maintenance system consists of mainly 3 important schedules viz—

- 1) Inspection Schedule
- 2) Lubrication Schedule and
- 3) Overhauling/repairing schedule

The schedules, which are back bone of the planned maintenance system are prepared very judiciously after taking into consideration the local environmental conditions and the duty being performed by each equipment. These schedules, once prepared, are put into practice and the observations regarding condition of components of equipments are recorded as accurately as possible.

All the activities of maintenance cost money, whether in the form of man power, spares or downtime. Also whereas under-maintenance causes frequent breakdowns and disrupt the production schedule, the over-maintenance increases the down time and expenditure. Further each assembly done after dismantling may not be as accurate as the previous one, frequent dismantling should be avoided. In view of all these, the maintenance schedules are normally reviewed every 3 years and the frequency of schedules are increased/decreased after a careful study of observations recorded while practicing the schedules.

Records to be Maintained :

For the support of the planned maintenance system, following main records are to be maintained essentially—

- (i) Equipment specification cards
- (ii) Equipment History cards
- (iii) Schedule jobs completed Record
- (iv) Pending Scheduled jobs Records

Equipment Specification Card :

This card contains all important details of the equipment. Usually following informations are maintained in this card :

- (a) Code number
- (b) Short /Long description of Equipment
- (c) Location
- (d) Asset Register Reference
- (e) Order No., Date and Value
- (f) Suppliers/Manufacturers Name and Address
- (g) Suppliers/Manufacturers Reference No;

- (h) Complete Specifications including Name Plate Details
- (i) List of spares with specifications and quantity
- (j) Date of Installation/Commissioning

Equipment History Card

All the inspections, Lubricant replacements and maintenance jobs done, including break downs along-with observations comments are recorded date wise on this card. This also includes the details of spares consumed, new or repaired ones. The entries of jobs done start from and including date of commissioning. This is the most important document and should be maintained as accurately as possible.

From the data entered in this card following analysis can be done—

- (a) Whether the frequency of Schedule jobs is optimum
- (b) Consumption of spare parts
- (c) Whether the consumption of spares is reasonable or it need qualitative change.
- (d) Any maintenance job of repetitive nature, its study and reasons
- (e) Analysis of break downs and its nature.
- (f) Quantum of maintenance being done - whether equipment needs replacement

Thus we see that it is the most useful record for the maintenance engineers.

Schedule Jobs completed Record

This record shows that how far we are able to complete the job on schedule. This also gives the degree to which we are successful in implementation of our Planned Maintenance System.

Pending Schedule Jobs Record :

The planned jobs which could not be done on schedule are listed in this record. The reasons for not attending the jobs are also given which may be :—

- (a) Non availability of equipment from process department
- (b) Non availability of spares and components, and
- (c) Shortage of Man Power

This record helps us in follow up of

- (a) Jobs not done as per schedule but to be taken up on top priority
- (b) Procurement of spares and components required urgently. If the percentage of pending jobs due to non availability of spares and components is high, then a review of procurement system is also needed.
- (c) Streamlining the use of available manpower within the section or arranging the manpower from other sections and Workshops during a particular period.
- (d) Rescheduling of starting month of certain jobs, if the manpower is not fully utilised in some months while in other months jobs remain pending due to non availability of man power.

Breakdown Analysis :

In spite of the best efforts of maintenance department and implementation of the Planned Maintenance Schedules, some breakdowns do occur. These breakdowns may be of casual nature or repetitive nature. The possible reasons of the breakdowns may be any one or combination of the following :

1. Incorrect assembly of the equipment after overhauling.
2. Misalignment while putting back on foundation.
3. Improper material of the spares and Components.
4. Spurious and reconditioned Bearings.
5. Spares and Components dimensionally not correct.
6. Blow Holes/fine hair cracks in the cast components
7. Rotating parts dynamically unbalanced.
8. Lack of Lubrication
9. Foreign material entering the equipment
10. Wrong and faulty operation

To avoid the reoccurrence of such unscheduled stoppages, each break down should be analysed thoroughly and as far as possible correct reason for the breakdown should be ascertained. In case of repetitive breakdowns, the analysis should be properly done by 2/3 engineers out of which one or two can be from other sections/areas. Then necessary steps must be taken to prevent the breakdowns.

A separate record must be maintained for each breakdowns giving the maximum details like date and time of breakdown, equipment, the component/spares affected., observations, man power employed, time taken and spares used in repairs, and the findings of breakdown analysis. These records will be very useful for future reference.

Down Time Analysis :

Down-Time can be defined as the time when the machine is not giving useful production. Each mill has its own way of interpretation about it. Some mills include production loss due to breakages on the machine and others also include the rejection of paper at Pope Reel.

For controlling and analysing the down-time, it can be broadly divided into following heads—

(1) Operational Reasons

Wire and Felt change; washing of wire and felts, repairs to wire and felt; putting the ropes of rope carrier system, wash-up of the system for quality change etc.

(2) Maintenance Reasons

Breakdowns, Planned Maintenance Jobs etc.

(3) Other Reasons :

Stoppages due to trouble in other sections like Pulp Shortage; Utilities shortage etc.

(4) Misc Reasons

Stoppages due to external reasons and beyond the control of section, like S. E. B. Power failure. Declared Holidays; Labour problem; Shortage of Raw Material and Chemicals; etc.

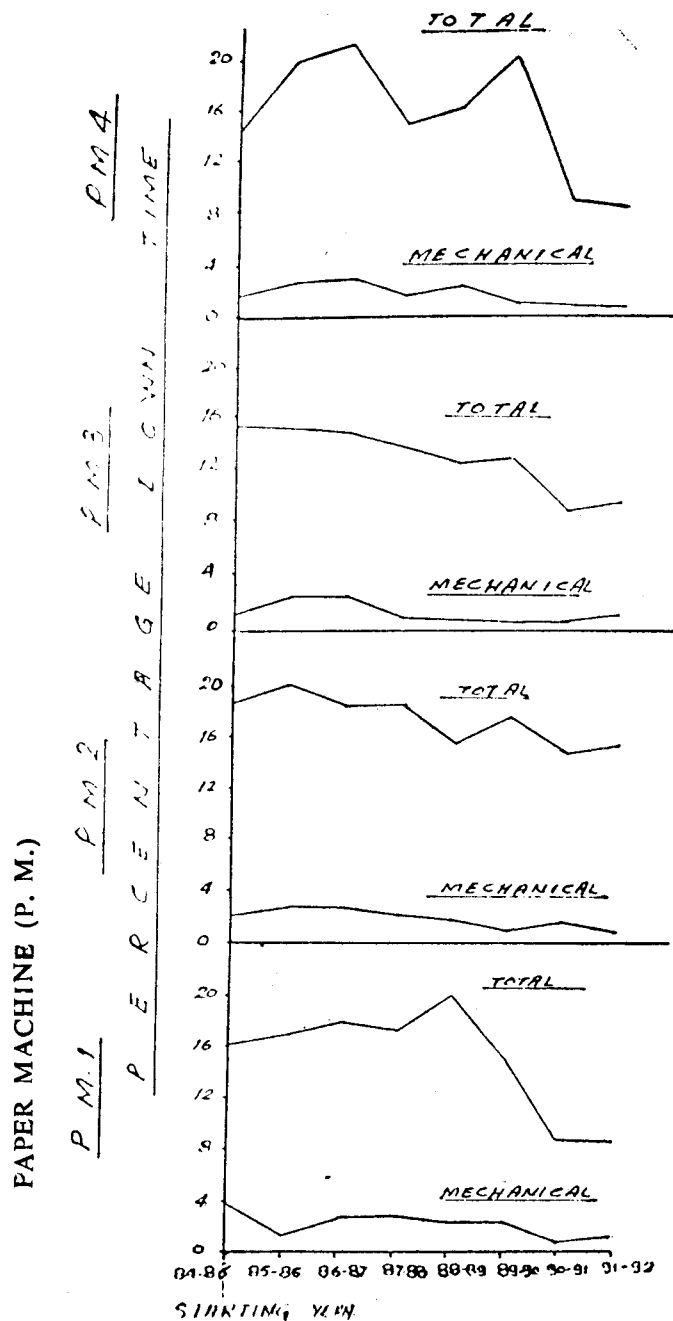
Normally 7 - 10% down time is considered fairly reasonable. Of course, it very much depends up-on the type of machine, standby equipments provided; production pattern and quality changes, quality and strength of operational and maintenance personnel, type of maintenance system being followed and level of supervision. All these factors affect the down time.

A careful study and objective analysis can certainly reduce the down time to a minimum. A graph

showing the percentage of downtime due to Mechanical break down and total downtime from 1984-85 to 1991-92 is enclosed given below.

APPENDIX—1

Comperative Statement of Mech. Downtime on Paper Machines Effected by "Planned Maintenance"



Aid of Computer in Planned Maintenance System

- i) When the size of the mill is large and the number of equipments increase considerably, it becomes very difficult to maintain the records regarding—
- (a) The jobs to be done in a particular week/month
 - (b) Recording of jobs done alongwith observations
 - (c) To carry forward the planned jobs not done and continue to carry forward every week/month till they are complete.
 - (d) To change/revise the schedule of the job which was pending and completed in other months.
 - (e) Equipment History card.
 - (f) Collecting the required data from above records for study and analysis of the break downs
 - (g) To find the effectiveness of planned maintenance schedules i.e. what types of jobs and what jobs are being attended or remain pending
 - h) To maintain the specification of every equipment, and revisions, if any.
- ii) To prepare a consolidated list of all equipments of a particular type in the mill alongwith detailed specification required at the time of procurement of new equipment.
- iii) To over come all above problems, the help of computer is taken. By developing suitable programmes, and feeding the basic data, all the required data can be printed out in a matter of minutes. In fact, the computer has become an integral part of the Planned Maintenance system for large size mills.
- iv) The computer aided Planned Maintenance System comprises of—
- a) Condification of all the equipments including spare units.
 - b) Preparation of various schedule i.e. Inspection, Lubrication & overhauling schedule.
 - c) Feeding of maintenance schedules to field staff at a predetermined interval i.e. weekly or monthly and get the feed back regarding the jobs done/not done.
 - d) Preparation of Equipment Specification card.
 - e) Preparation of Equipment History card.
 - f) Develop the work process system between the Information centre and the field staff.
 - g) Recording of all data & informations received from field staff.
- A few typical formats of inspection schedules, overhauling schedules and equipments history card are enclosed.
- v) After maintaining the data as above, we can retrieve the informations in whatever format we like after preparing a suitable software programme. Generally following informations are needed to be retrieved for a good control on implementation of Planned Maintenance system.
- a) Total number of Jobs of the month i.e. Planned jobs, Pending jobs upto previous month and unplanned jobs (Breakdowns).
 - b) % of unplanned jobs (Break downs) on total jobs attended.
 - c) % of Planned job of the month attended.
 - d) Total number of jobs could not be attended with break up (in no. & %) reason-wise i.e. due to non-availability of men, material and equipments.
 - e) Production time loss due to unplanned jobs (Break down).
- A typical format showing the monthly analysis of jobs is enclosed.
- Different types of periodic reports on effectivity of maintenance system can also be had as per requirement of management. Without Computerisation of the planned maintenance system, it will be very difficult and time consuming to prepare such reports and even its accuracy will always be doubtful.

Daily Physical Inspection Shedule for day of the week
SHIFT-A

Code No.	Description	Oil Level	Bearing	Vibrat ion by Touch	Gland Lea Kage	Acce Sibi Lity	Guard	Ligh Ting	Others
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APPENDIX-3 A

Location History Report as on 09-08-1993

Location Code	Specification	Job Type	Instl Date	REP Date	Page No. 1	Days
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APPENDIX-3 B

Monthly Complete overhauling Schedule for
Month of the year 92

Code No.	Description	Current CD Equip	Job Type	Time Reqd HRS	Job Done Date	REPL/ O.H.	CD	Time Taken HRS	Head Crew	Postponment Reason	Since
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APPENDIX-4

Equipment History Report as on 10-08-1993
Equipment Code :

Code	Description	Job Type	Date of Instl	Date of REP	Time (HRS)	Spares Used	Major Rect.	Head Crew
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Mechanical Maint. Departments Monthly
Analysis Statement
For the Month of : O 1993 Group : A

Total Schedule jobs Planned	(A) :	0 00
Total Schedule Jobs Done	(B) :	0 00
Total Postponed Jobs	(C) :	0 00
Due To — MATERIAL —	(D) :	0 00
Due To — MANPOWER—	(E) :	0 00
Due To — SHUT	(F) :	0 00
Total No. of Break Down Jobs	(G) :	0 00
Total No. of Prescheduled Jobs	(H) :	0 00

Thus the Computerisation has helped the management to a greater extent in monitoring & controlling the various activities of maintenance by making available lot of informations at a finger touch.

Predictive Maintenance/Condition Monitoring :

The latest concept in the maintenance of Plant & Machinery is Predictive Maintenance or Condition Monitoring based Maintenance Programme. Though it is very common in foreign countries, it has still to make a headway in Indian Industries. To ensure maximum availability of machine, it should only be stopped just when the failure is imminent. But in Planned Maintenance system, the machine or parts are overhauled on a regular basis regardless of its condition. This often results in excess downtime.

What is Predictive OR Condition Monitoring Based Maintenance System :

In this system, the condition of a part or machine is determined at regular interval during its operation

and is recorded for analysis. The condition monitoring is done by non-destructive methods in running condition. The characteristics measured generally are—

- * Vibration
- * Noise/Acoustics
- * Temperature
- * Thickness (for corrosion)
- * Lubricant Analysis

The following condition monitoring equipments are available and should be selected as per requirements :-

- 1) Hand-help Meters and Analysers.
- 2) Portable Data Collectors/Analysers
- 3) Vibration Analyser/Data base Management Software.
- 4) Permanent On - line Data Aquisition and Analysis equipment.

Whenever any deviation from the normal condition of the machine is noticed during the regular interval checking, the frequency of such condition monitoring is increased and machine is allowed to operate to a point where further operation will endanger the safety of machine or men. This also gives sufficient time to plan the shut of machine with least dislocation of production. Also some other works are also programmed alongwith the shut of the machine. Thus maximum number of jobs are carried out with minimum downtime.

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