Applications for Effective Maintenance

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Effective Maintenance comprises of locating the potential sources of troubles and repairing them before a break down occurs. By Effective Maintenance trouble can be avoided through proper oiling, greazing and adjusting. Its purpose is to maintain equipment in optimum conditions. Correction of the defects decreases the cost of the repairs and also maintains the performence efficiency of the machinery with regard to quality and quantity as :

"Stitch in time saves nine."

It requires the scientific approach which consists of :

1) Periodic inspection of plant assets and equipment.
2) Up-keep of plant to eliminate such conditions, or to adjust a repair for such conditions.

So, if the maintenance is a planned one then the following advantages can be obtained.

1) Less production down time.
2) Less over time pay for maintenance crew.

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In recent years there has been a vast development of the maintenance in Pulp and Paper Plants in our country. In order to improve the maintenance in the Mills, the following points may be followed :

1) Drawings with proper tolerances to be made available to the engineers and the inspecting authority should be directly under the top management.

2) Interchangeability of matching components to be achieved.

3) While selecting the materials for different components latest improvements in metallurgy may be considered so that corrosion and wear are minimised.

4) Lubrication should be effective to avoid premature failure of bearings etc.

5) Proper ventilation and cooling may be provided for electric motors and switch gears.

6) The maintenance staff be well trained to have the daily visual inspection.

7) Safety devices and some automatic cut-off arrangements may also be used.

8) Scaling problem may be dealt with great care.

9) Magnifying glasses may be provided to detect cracks in machine components and tell tale joints.

10) Welding technology may carefully be applied in order to save the vibrating components from undue stresses.

11) Good concrete foundation should be utilised to prevent vibrations.

Normally, the machine parts are designed with a very high factor of safety and if the parts are properly balanced statically and dynamically, the only reason of faliure can be poor maintenance. Our endeavour, therefore, must be to improve the maintenance of machine components so that the life of machine may increase and down-time is minimised.

3) Less strain on maintenance facilities due to reduced repetitive repairs.

4) Less men power, as simple repairs can be done before break downs.

5) Better quality of products and lesser rejections.

6) Increased life of equipment.

7) Less standby equipment needed.

8) Better industrial relations due to more profits and higher incentive loans.

9) Greater safety of Workers.

10) Less unit cost of manufacture.

Now, the question arises, as to how to plan the maintenance programme in orber to achieve the above mentioned objectives and advantages.

Thereafter our aim should not only be to pursue a system of planned maintenance. but we should aim at corrective maintenance, which may be defined as the study of all break downs.

Hence, in planning the maintenance programme, we have to keep the following points in order :

1. Preparation of equipment charts.
2. Scheduled repairs.
3. Scheduling.
4. Job Priority.
5. Preparation of Check Lists.
6. Reponsibilities/obligations of the top management.

1. Preparation of Equipment charts : For proper planning of effective maintenance, it is essential to have complete records regarding plant inventory, equipment specifications and service history of all equipments. Only with the help of these records we can effectively plan and schedule our maintenance programme. If these datas are not available these must be collected, analysed and systematically recorded. This may require lot of efforts and time, but these are absolutely essential for any planned maintenance and there are no short cuts for these.

A simple equipment chart is given in TABLE No. 1 which may be modified and adopted to individual needs.

"Good Maintenance is Good Management"

Maintenance can be made good and effective when it is carried out under good management with proper Routine and Schedule Programmes. The basic object of the applications for effective maintenance is to ensure that the plant facilities and equipment can continuously meet or perform their designed characteristics most economically and in the least possible down-time. In order to achieve the above objectives, it is essential to adopt a Scientific and planned approach to the maintenance task.

It is becoming increasingly difficult to find working capital. Banks are drawing out finances with the credit squeeze. Interest rates have been raised to more than 15%. And the Reserve Bank has imposed restrictions on loans taken by companies. It is important to conserve our resources to combat in-flationary trends in our economy. This means increasing productivity, making maximum use of existing capacity, reducing inventories and outstandings. How can we do this ? Our answer to this problem is the applications of Effective Maintenance. This is reclaiming worn out parts, prolonging service life of new parts and thereby affecting reduction in inventory and increase in savings.

Table–1

"Equipment Record"

Description		Maker	Sl. No.
Supplier		Address	Other Accessories
Date	Ordered: Received: Installed:	Specifications	
Location			
Lubrication		Bearing & Belting Details:	
Drive Details:		Spare Part Details:	
Miscellaneous Informations			

2) **Scheduled Repairs** "A calender of inspection is called schedule."

These types of repairs are divided into three different categories.

a) Routine up-keep.

b) Periodic Inspection.

c) Contingent Work.

a) **Routine Up-Keep** : This is done in every shift, or once daily or at regular short intervals depending upon its particular requirements. This includes the works like adjusting, lubricating, cleaning, checking, etc. while the equipment is running.

b) **Periodic Inspection** : This covers work at prescribed intervals depending upon the type of equipment, its working conditions, age, etc. and includes visual inspections like teardown inspectioning, overhauls, Scheduled replacement of parts.

c) **Contingent Work** : This includes work at indefinite intervals when the equipment is shut for the other reasons than maintenance.

For example, doing necessary repairs of various parts of a paper machine when it is shut for wire or felt change.

3) **Scheduling** : The following points should be taken into consideration for proper scheduled inspection and repairs :

a) Age, condition and value of the equipment.
b) Working conditions.
c) Safety requirements.
d) Hours of operation.
e) Susceptibility to wear and tear due to dirt, friction, corrosion etc.
f) Susceptibility to damage due to vibration, over loading etc.
g) Susceptibility to loose adjustments, with proper manufacturing tolerances etc.
h) Service Records.

Keeping these points in view, the inspection and repair schedules should be prepared, which are mainly of two types :

i) Master Schedule.
ii) Detailed Schedule.

i) **Master Schedule** : This includes a large sheet on which every piece of an equipment in a plant is listed, as shown in Table—2.

Table–2

"Master Maintenance Scnedule"

Sl. No.	Equipment	1	2	3	4	52
		C				
			L			
				O		
					X	

The above chart shows days or weeks across the top and the equipment list down the left side, itemwise. Date of inspection is shown on the chart by various symbols to show 'C'–for cleaning, 'L'–for adjustment, 'O'–for overhaul and 'X'–for part replacement, etc. etc.

This schedule shows only overall work load for comparatively long periods for future planning. Its main idea is to maintain a proper balance between work capacity and work load.

ii) **Detailed Schedule**: In this case, there should be separate cards for each vital component of equipment in the plant, which should have more details regarding effective maintenance reqiurements.

While preparing detailed schedules, due consideration should be given to work capacity and skill of each group within the maintenance department. In these schedules exact dates of inspection and overhauling should be maintained, which should be strictly followed.

4) **Job Priority** : This brings us to job classification. For most of the jobs three classes of priorities are generally found to be adequate.

Priority-I : These jobs take precedence over all other jobs and represent tasks that are absolutely essential for successful operation of the plant.

Priority-II : These are the jobs that are desired to be completed as soon as practicable and take precedence over all jobs except priority I-job.

Priority-III : These are the jobs that are desirable but which may be completed at convenience.

5) **Preparation of Check Lists** : After inspections are carried out in accordance with the schedules, reports should be prepared and submitted for necessary analysis and action by the maintenance crew.

For carrying out inspections, check tests should be used, the check list should be prepared for each equipment or a plant as necessary. If properly designed these check lists can also serve inspection reports. What is however important is that, nothing should be left to memory, but put in writing.

The preparation of check list will comprise the following points.

a) Work Order : Each work order should define the general nature of the job and show the responsibility of the various groups accountable for completion of the task, with relations of man-hours and materials allotted to each group for their part of the job and a statement of the required completion time of the job.

b) Job Numbering : Every job except very minor jobs should be allotted a job number. A simple system is to use a three part code number. The first part indicates priority, the second part the group having the responsibility for completion of the task. And the last showing a sequence of issue of work orders bearing the particular priority.

C) Estimating the time taken for each Job : The basic principle of estimating the time is to reduce each task into basic job elements and establish values for each element. The sum of all elements give estimate for the whole task.

The estimation of labour requirement may also be done, the idea is to break-up the big job in smaller components and find out what various crafts are needed for completing each component and a sum of all these will give the total labour requirement of the project.

b) Recovery Analysis : Records are useless if not analysed periodically and find better ways of doing a job and in this connection the following points should be considered.

i) Revise frequency of inspection if required.

ii) Redesign the weak parts which often give trouble.

iii) Substitute better materials where needed.

iv) Change methods of operations if needed.

v) Use better equipment if the old one is not efficient and need too-much maintenance.

e) Standardization : Standarization of equipment is very essential for any planned maintenance. If proper thought is given, in most places the types of equipment can be substantially reduced in most plants. This will greatly help in reducing inventory of spares and maintenance cost.

f) Use of Better Tools : Better tools should be used for accurate repairing and reducing repair time, such as power tools, mechanical aids for material handling, modern hydraulic tools for mounting and dismounting of bearings, couplings, pulleys etc. Specially designed tools and fixtures for special repetitive type of jobs to expedite work.

Use may be made of modern tools like dial gauges. stethoscopes, vibration analysis–X–ray equipment, ultrasonic equipment, corrosion meters and gauges etc. for quick diagnosis of faults in the equipment, without stating or dismantling the same. This will give washing of the impending trouble well in advance so that necessary corrective action may be taken before equipment breaks down.

g) Improved Inspection Methods : Industrial Engineering methods of time and work study should be applied to reduce inspection and repair time. Routine for inspection should be so arranged that least walking has to be done. Inspection check tests should be so designed that every item comes according to inspection sequence.

h) Scientific Approach

i) Maintain open mind, don't be restricted by past practices, precedents, traditions and habits.

ii) Observe the present methods critically to find possible improvements.

iii) Keep in touch with latest development in methods and equipment and apply them whenever possible, without fear of consequences.

Experience Gained by failures is the foundation for success

i) Maintenance Manual : Maintenance manual dealing with day to day operations, instructions

for inspecting, checking, adjusting, repairing and overhauling various equipments involved in a plant may be prepared. This should also include inspections on general items like mounting and discounting of bearings, scraping metal bearings, levelling and aligning equipments, proper methods of using various tools etc.

It will go a long way in reducing supervision and improving maintenance of plant if such a manual is provided to each worker and supervisor and they are educated in using that manual strictly as far as possible. For this we have to make use of critical path method.

j) Critical Path Method

Critical path method is a very powerful tool for planning and carrying out big jobs in the shortest possible time and in the most efficient way, which can be utilized profitably in addition to other control mechanisms.

6) "Responsibilities/Obligations of the top Management."

(a) Long term planning is as important as short term planning as a means of avoiding emergency repairs. Maintenance and repair organisations must be systematically built and the maintenance personnel should have adequate and due status and sufficient authority and independence to carry out its functions. The Maintenance Engineers should be involved at the project stage itself.

(b) Many factors will affect the choice of Maintenance Organisation for each enterprise, such as type of industry, size of the plant, availability of skills etc. However, the Top Management must recognise the vital need for such an organisation and have its aims and objectives clearly identified. It was generally recognised that persons in charge of maintenance should not report to the Production Manager, but to a higher level of management that coordinates the activities of these two departments.

(c) Over organisation can be as harmful as under organisation since it may also increase the over-all cost of production.

(d) It was recognised that motivation, training and upgrading of maintenance personnel play an effective role in improving maintenance activities upgrading. Upgrading would naturally cover both management and labour. Apart from in-plant training, the need for post-graduate training was stressed.

(e) 'Contract' maintenance may be resorted to plug in any lack of expertise within the organisation.

(f) Maintenance Improvement Group could be set up to study failures and procedures of maintenance which, in turn, will provide feedback of information on performance data.

(g) Where certain inspection procedures, which are essential for ensuring safety of personnel and equipment result in prolonged stoppage or production, details of these could be provided if beyond the control of management with suggestions for improvement. Provision of stand-by equipment would require benefit analysis and consideration on merits of the case.

Conclusion

Effective Maintenance is the backbone of any industry. Its origin comes from an old maxim "Prevention is better than Cure", which provides the life tonic for the plant and machinery, if followed in a planned way and this boosts up the over all economy of the plant.

Every minute of down-time on any equipment affects the whole process resulting in the Direct and Indirect losses of money as follows :

Direct Losses

i) Damage to machinery reducing its life.

ii) Loss in production leading to reduced productivity and profits.

Indirect Losses

i) Labour paid but no production.

ii) Spoil-age of intermediary products in process.

iii) Defective product preceding and following down-time.

iv) Interest on investment.

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References

1) Kimball, D.S. 'Principles of Industrial organisations'(1965).

2) Tara Chand 'Industrial Orgasation' (1965).

3) Hiscok, W.J. 'Factory Layout, Planning and Progress'.

4) Walker, P. F. 'Management Engineering, The Design and Organisation of Industrial Plants.

5) Audels. 'New Mechanical Dictionary.'

6) EXTRACT from the Annexure dealing with the obligations of various organisations in achievement of objectives of National Plan for Maintenance, to letter No. DPI-5(35)/75/4797 of 17.10.75 of DGTD.

7) Morrow, L. C. 'Maintenance Engineering Hand book'.