MAINTENANCE STRATEGIES FOR IMPROVING PRODUCTIVITY IN PAPER INDUSTRY

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Most of us would agree that the Indian Pulp and Paper Industry has not updated its technology with the passage of time. Majority of us are operating old machines which have become obsolete in advanced countries of the West. Part of our ills are compounded by the fact that we are not able to make a substantial investment in renovating/modernisation of plant because of poor health of the paper industry. Under these circumstances the subject matter of the talk assumes a very high priority. In improving productivity of Pulp & Paper Mills the maintenance section has to play a very significant role interms of increased machine availability time, reduction in maintenance costs and modification to achieve more value added products etc.

MAINTENANCE FUNCTION

Maintenance Engineering is a sophisticated multi disciplinary technology that must combine the high skill, judiciously and intelligently applied past experience, detective techniques, process knowledge and entire spectrum of analytical engineering The stress on maintenance function is on predicting failures and taking preventive action before failures.

Till 1950s corrective, breakdown or repair on failure was in vogue. In 1960s preventive maintenance schedules were drawn mostly based on the guidence of machinery suppliers and modified as per the experience gained. The condition monitoring based maintenance which has made impressive strides in 1970s and 1980s in the Western world has yet to form firm foot hold in Indian industry. Since 1970s some of us present here have invested in condition monitoring instruments e.g. Vibration monitors, Temperator monitors, Ultrasonic thickness tester, leak detector etc. but have not adopted condition monitoring based maintenance as full fledged policy.

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The fact of the matter is that there is such a wide variation in paper mills in India that no one type of maintenance can give the best results. The number of pulping streets captive power generation facilities, the size number of paper machines, the geographical locations of the plant are many factors which come into play while deciding on optimum maintenance management policy.

Before proceeding further on the question of strategy we will briefly discuss type of failures, various maintenance systems advantages, & disadvantages of these systems.

The unscheduled outages of equipment result in increased downtime, increased maintenance cost and reduced production ultimately resulting in increased cost of production. In any sophisticated process industry failures do take place and these cannot be completely avoided or eleminated. However its reoccurence can be reduced to a great extent with regular analysis and remedial measures. Failures can, in general, be grouped into two broad categories:

1. Uncontrollable or random failures:

   These failures are not predictable in time scale and include failure of electrical/electronic components.

2. Controllable or gradual failures due to wear and tear corrosion, fatigue etc.

   Mostly for the moving parts of the equipment which are subject to wear and tear, some degree of predictability is possible with careful measurements from time to time review and analysis of these observations.

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MAINTENANCE SYSTEMS:

A. Break down/corrective maintenance.

In no case such maintenance is acceptable now because all the jobs under such type of maintenance are to be done on war footing without any proper planning and few of the numerous disadvantages of this system are given below:

i) No prior warning of failure
ii) Uncontrolled shut downs
iii) Production loss and delays
iv) Secondary damages resulting in longer repair times.
v) Large stocks of spare parts required
vi) More maintenance staff.

B. Preventive Maintenance.

To avoid the situation stated above, the required maintenance work is done before the actual failure takes place. This is called preventive/Fixed time maintenance. This is commonly applied maintenance system in most of the Indian Pulp & Paper Mills, to reduce the down time and increase reliability of the machines. The time intervals are fixed on the recommendations of the machinery suppliers/data available with the experience of mean time between failures. The main advantages of this system are:

i) Reduces unforeseen failures of the equipment and makes it more reliable and safe.
ii) Use of maintenance staff cost effectively.
iii) Allows work to be planned in advance.
iv) Proper assessment of required spares in advance is possible.

But the disadvantages on the other hand are:-

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i) Maintenance interval will be shorter than mean time to failure, increase the maintenance cost.

ii) Excessive work/overhauls under this system sometimes induce failures.

iii) This can only be effectively applied where deterioration is time base and/or age related.

CONDITION MONITORING BASED MAINTENANCE/PREDICTIVE MAINTENANCE

Under CMBM the objective is to use condition monitoring techniques to assess the condition of the machinery while it is in operation/ shut and from the information thus gathered predict the correct time to undertake maintenance work which may be clubbed with the planned shut of the machines e.g. wire change, felt change or wash up in case of paper machines. With this system the total quantum of maintenance work can be reduced to a large extent, and the optimum life of spare parts and use of maintenance crew achieved.

Critical equipments on which the production is full dependent e.g. Paper Machines, Feed Pumps, ID fan of the boilers etc. need predictive maintenance. Due to many process and machine transients machine behaviour needs continuous monitoring not only during normal operation but also during start up and shut downs.

The various techniques used in CMBM/Predictive maintenance are briefly listed below:

1.	Smell, look, feel & listen	:	Eye, ear, fingers.
2.	Viberation	:	Shock pulse meter, Vibration monitor and recorder
3.	Thermal	:	Contact thermometers pyrometers, Thermocouples, resistance thermometers and infrared scanning cameras etc.
4.	Lubricants	:	Analysis of oil samples.

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5. Corrosion : Ulterasonic thickness tester.

6. Leak/crack detector : Ultrasonic flow detector.

VIBRATION MONITORING

The vibration monitoring can help in detecting a wide variety of faults in rotating machines. The measurements taken near bearings of machines/shafts can help in detecting and distinghishing between imbalance, misalignment, defective bearings, mechanical looseness and electrical defects. The recording of magnitude, frequency and phase angle of vibration can help in detecting the cause of vibration and trend when plotted can indicate the approximate time to failure. Now most of high speed sophisticated machines e.g. turbines, DG sets are provided with on line vibration monitoring system which can be interfaced with the computer system to process the data faster and more accurately and turn it into meaningful information. But for lesser critical application portable vibration meter is used to log the vibration levels periodically.

Apart from vibration measurements shock pulse method is also widely used for monitoring the condition of ball and roller bearings. SPM detects development of mechanical shock waves caused by the impact between two masses. The instrument is simple to operate and its information can indicate the lack of lubrication in the bearing or permanent damage caused to it giving warming to engineer to plan its replacement.

THERMAL MONITORING

By thermal monitoring is meant observing the variation in temperature of any equipment without stopping the machine by either contact sensors or infrared scanning cameras from a distance without any physical touch. The variation in operating temperatures can help the engineers in assessing the prevailing situation

and predict the maintenance plan. In critical equipments e.g. high capacity alternators, turbines etc. contact thermometers are provided on the bearings which indicate the temperature of these bearings and in case it crosses the desired limits an alarm gives the warning to take the corrective action immediately.

LUBRICANTS ANALYSIS

The significance of the lubricating oil analysis must not be overlooked. This does'nt only indicate the lubricity of the oil but speaks lot about the health of machinery components that it is lubricating.

CORROSION, LEAK/CRACK DETECTION

Pressure vessels e.g. digesters etc. are subjected to corrosion. Wall thickness of these pressure vessels can be measured periodically and cracks in welding or any leaks in joints can be checked by means of ultrasonic thickness tester and ultrasonic flaw dextectors.

Predictive maintenance is an attrattive concept as the maintenance action is performed only/just before the defect has progressed sufficiently. To make the unit unserviceable in near future but before the actual failure.

The advantages of condition monitoring based maintenance can be listed as:

1. Shutdown of machine before actual failure of machine/ equipment avoids secondary damages.

2. Maintenance work can be planned.

3. Causes of failure can be analysed.

4. On the basis of cause analysis improvement required can be done.

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5. Optimum use of spare parts and manpower.
6. Reduction in down time.

But certain constraints in such a maintenance system are-

1. Lot of efforts required to organise CMBM.
2. Involved cost due to imported instruments.
3. Lack of skill available.
4. In small mills cost of savings may be less than the cost of monitoring.

AID OF COMPUTERS IN MAINTENANCE MANAGEMENT

Either of the two systems predictive or preventive maintenance need lot of information for decision making, failure analysis, Maintenance cost control, reducing spare parts inventory etc. No doubt engineers in Pulp and Paper industry have been carringout maintenance with manual information systems but during the past decade the cost of inputs and cost associated with maintenance have tremendously increased eroding the profitability of the industry and even areas which were considered to be of least importance have become potential areas for cost reduction and improved productivity. This has compelled the maintenance Managers to have a fresh look at the existing information systems and evolve a new process of decision making. Under the prevailing circumstances to depend only on the skill of maintenance engineer, his memory and the record whatsoever he keeps is not feasible. The manual information system is proving to be inadequate. Now the maintenance Managers/engineers require uptodate information about failures, history, down time, cost associated with it, resources available for correct and effective decision making. The use of computer can help to a great extent in providing following information in a split second.

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1. Equipment catalogue
2. Equipment history record
3. Breakdown frequency analysis
4. Down time analysis
5. Manpower utilisation analysis
6. Analysis of scheduled and unscheduled maintenance.
7. Maintenance cost.
8. Spare parts management, inventory control, pending orders etc.
9. Preventive maintenance schedules.
10. Information on repair time for future planning.
11. Graphic reporting.
12. Generation of work orders.
13. Work order back log analysis.
14. Generating automatic purchase order to Vendors.

This information reduces lot of monotonous clerical work of engineers and also help in increasing productivity through:

1. Reduced down time, optimised maintenance cost.
2. Increased life and reliability of equipment.
3. Optimised stock quantities of spare parts.
4. Obtaining faster, better and more reliable information.

There is absolutely no doubt that at initial stages introduction of computer into maintenance system requires lot of additional work to generate data e.g. equipment catalogue, preventive maintenance schedules. History cards, workers order cards etc, and the system is to be designed to suit the working of a particular mill, but once this is systematically achieved the results are bound to be helpful and encouraging

DESIGN OUT MAINTENANCE

Over and above the preventive and predictive maintenance plans certain design out maintenance efforts can help in reducing downtime

hence increased productivity e.g. with the breakdown/failure analysis it may be noticed that there are some repetitive failure of some equipment and a careful study may reveal that a small modification/redesigning of equipment might eliminate these repetitive failures. The following are three distinct ways in which redesign can help in plant improvement.

1. Redesigning the critical units to reduce failures by modifying/replacing weak components which do not withstand the loads imposed.

2. Minimise the effect on production of the failure of critical unit e.g. providing storages between processes or installing standby units wherever possible.

3. Modifying the use of critical unit soas to make less severe loads applied to failing components.

Over and above the maintenance plans certain small efforts can help in reduced down time hence increased productivity a few of these are being mentioned briefly herewith.

1. Stardisation of common items is very helpful in reducing replacement time during breakdown e.g. similar motors are installed at various pumps and other equipments. If common couplings based on the torque rating of equipments are standardised the spare pumps motors can have identical couplings reducing replacement time and requirement of spares.

2. Material of construction of various equipment/spare parts is yet another critical area which does not get the desired attention. Proper selection of material of construction can increase life of component considerably and make equipment more reliable. The same holds good for spares procured. Although in the absence of proper testing facilities in small mills it may be difficult to exercise a stringent control but as the test labs viz Quality Marketing centres etc. are wide spread where such facilities are available, these should be utilised.

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3. Dynamic balancing of rotating parts is generally not given the due significance by the maintenance engineers. Once an investment is made on vibration monitor/analyser for CMBM it can be used for dynamic balancing, even at site, in case of big fans.

4. Value analysis at the time of purchasing spares , standbys and new equipment is of prime importance. The cost of servicing loans has become high, we must use it conservatively and effectively.

5. Quality control programme in plant maintenance with an aim at "Zero defect in plant maintenance" should be applied. A slight negligence on the part of workmen or supervisor increase the possibilities of errors being committed in the repair/maintenance jobs, Even putting a wrong man at wrong place can also result in such errors. So due care must be given to avoid such incidents by making proper check test, giving proper consideration in assigning job to particular worker so that the job done once is not repeated.

6. Latest modern techniques should be adopted to improve the working of maintenance department e.g. liquid sprays are available which improve and maintain electrical properties by way of avoiding corrosion to conducting and insulating parts. These can be particularly more helpful in pulp mills and caustic soda chlorine plants wherein the presence of chlorine and moisture (specially in rainy season) gets condensed on electrical parts and forms a film of HCL which is electrically conducting in nature and breaks insulation. This at times result in flashing occurance which not only disrupts production but also damages the equipment.

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Similarly adoption of solid state starters which have features of soft starting is very suitable where frequent ON OFF are required. The application of starting voltage gradually from zero or some present minimum to full applied voltage reduces surges on motor by reducing starting current, even mechanical system coupled so these motors do not get the starting jerks, hence get increased life of the equipment.

7. TRAINING AND DEVELOPMENT

The last but not the least is training of Maintenance engineers & crew. Unfortunately in our country this aspect is mostly neglected. Mostly the Supervisors/workers after appointment are put on the job to learn for themselves at the Shop floor. With whatsoever one acquires from there, he is put on responsible job and the end result, it unsatisfactory maintenance.

Every mill should have a well defined training programme from the maintenance staff for in-house training and specialised training in training institutions such as Indian Institute of Foreman Training Kansabahl, Advanced vocational training system institutes, Hyderabad, NITIE Bombay etc.

Craftsmen can be sent to the workshop of the machinery suppliers for specialised training.

Seminar conducted by National Productivity Council and Machinery manufacturers can also help in development of maintenance staff.

We have recently learned that Indian Institute of Condition Monitoring has started certificate/diploma/post diploma/Advance Courses on the subject. This could be a forerunner to the modernisation of maintenance practices.

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CONCLUSION

The maintenance function is clearly to undertake maintenance and improve the existing plant employing all the strategies in to hand to increase productivity and profitability of the organisation. A judicious combination of Preventive and Predictive maintenance system should be derived for the mill according to the conditions prevailing. With the aid of computer proper information & system should be developed to optimising the use of all available resources. In coordination with the production/commercial department efforts should be made to improve quality of product and introduce value added products to the existing range of production. Should try to incorporate modern technologyies and concepts to improve productivity.