Maintenance Strategies and Case Studies in Paper Machines

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ABSTRACT

In today's globalization scenario, the success lies in reducing manufacturing cost. This has made the organizations to focus on maintenance as a profit center. The need of the hour is to reduce unexpected breakdowns and increase MTBF. This has made the maintenance managers to focus on a systematic approach towards maintenance of Paper Machine equipment for increased productivity. This has been well illustrated by presenting the actual expenditures and budgets of last many years in paper machine section at ITC-PSPD to illustrate the advantage of planned maintenance.

1. INTRODUCTION

In today's globalization scenario, lot of focus in being paid on Maintenance to make the Maintenance activity also as a profit center for organization. The maintenance staff is often caught in a vicious existing system in the mill and they quite often find it difficult to break off it to maintain a steady progress towards their planned targets.

2. The maintenance scenario we frequently see in the mills:

Sometimes the maintenance scenario is more focused towards breakdown maintenance and do not lead towards good productivity and efficient operation. Some of the points are-

- Recurring repair of assemblies.
- Hasty working, which may lead to accidents.
- Recurring breakdowns.
- Too much pressure on Maintenance team for production loss due to Breakdowns.
- No time for technical discussions.
- No time for attending meetings.
- Attending lot of un planned shuts.
- Not maintaining the Maintenance records.
- Lack of trained persons to adopt changing technologies.
- No time to scan through technical Manuals.

3. How to achieve the Maintenance team goals in line with organizational goals.

Maintenance team needs a systematic approach to the machinery and to adopt strategies for delivery the goods. They should try for zero breakdowns between planned shuts. Maintenance is seen as valued player and pride for achievements. Continuous reduction in total cost of maintenance should be tried with reliable performance. Let us share with you, some of our concepts, strategy adopted, small achievements and cracked down issues.

Maintenance is an activity, which has to keep the equipment always at its original condition with no operating defects and with due care for deterioration with time.

A good maintenance practice reflects in delivering the goals with zero defects, to the assigned capacity with zero accidents.

The previous scenario of machines

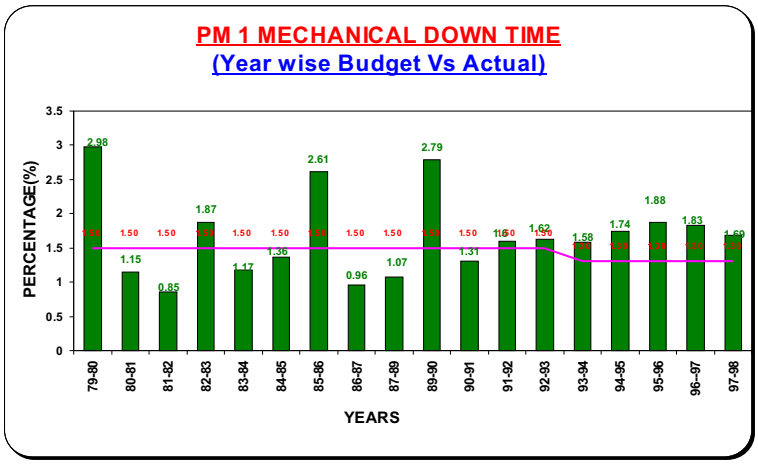
4. Down time trends up to 1998:

The mill had not adopted a very systematic approach till 1998 and the year wise budget and performance is shown in Fig 1 to 3 respectively for PM1, PM2 and PM4. In some of the years, the actual expenditure is more than the budget

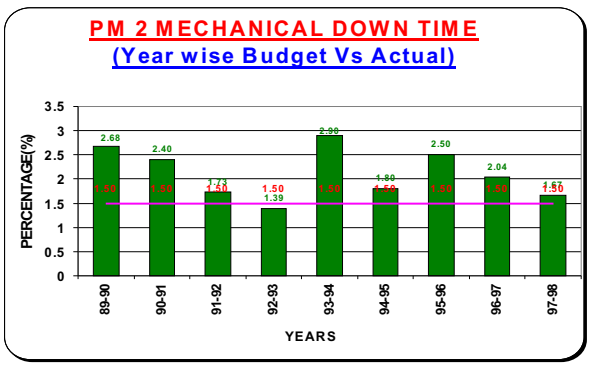
5. Maintenance Concepts:

Concept thought process started and converted them into actions in sequential manner. Journey of maintenance from breakdown culture to total productive maintenance has yielded the desired results.

PM 1



PM 2



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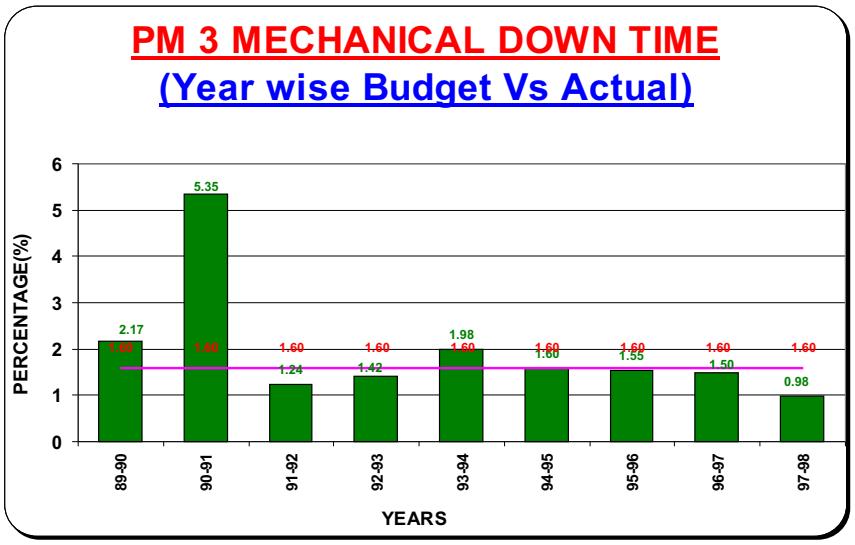
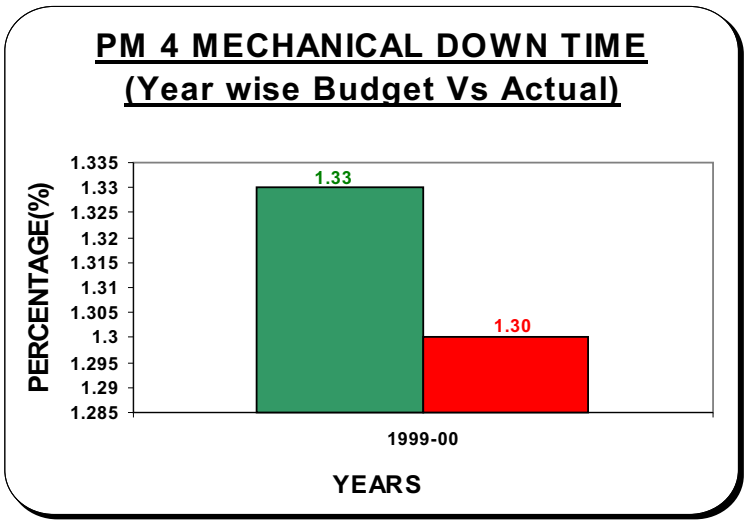
PM 3



PM 4



1. Preventive Maintenance
2. Predictive Maintenance.
3. Reliable predictive (Root cause analysis)
4. Total productive Maintenance

Preventive Maintenance:

Schedules are prepared basically from OEM recommendations, past experiences and criticality of equipment, Master schedule, and Monthly schedule, Implementation.

Scheduled inspection of equipment.

Lubrication schedules.

Scheduled preventive replacements.

Predictive Maintenance: Initially started with all equipment, later on evaluation refined the schedules.

Initially started with SPM vibration measurement, oil analysis, Grease sampling, seen good results.

Root cause analysis: identify the root cause of problem and conclude on actual sources.

Identify the root cause of the problem like structures strengthening, cracks detection, journal failure analysis, wear debris analysis, unbalance, alignment, MOC changes etc.

Total productive Maintenance strategy

We are in phase transition to implement total productive maintenance methodology implementation.

The benefits of Maintenance by production department (Jishu Hozen) is seen in terms of identification of defects at very initial stage and which do not lead to major breakdowns.

For the direction of special maintenance crew, planned maintenance pillar activity is initiated. Summary of equipment data is completed. Criticality analyze of equipment division matrix is done. Condition appraisal for critical equipment is under progress.

DMT's are activated for analyze of day to day issues by using the tools, Why-Why analysis, Fishbone diagram, Visual controls etc.

6. Case Studies.

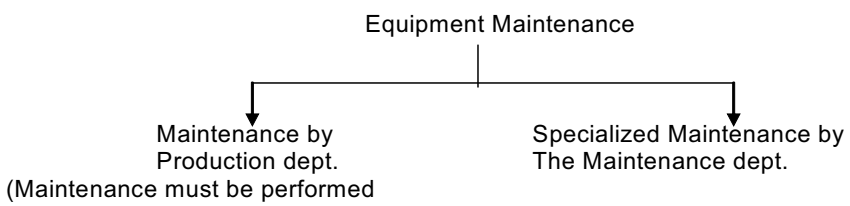
1. Vacuum fans for Formers in PM1.

Four formers were provided with 12 fans of speed 4300 rpm

- Frequent Breakdowns
- Downtime of about 2 ½ Hrs every month.
- Quality rejections about 10 ton/month.
- Modified the fans with direct drive type replaced all 12 with four fans only.
- Zero Breakdown.
- Zero quality rejections.
- Zero Mechanical maintenance, except inspection.
- No spares cost, No repair / overhauling.

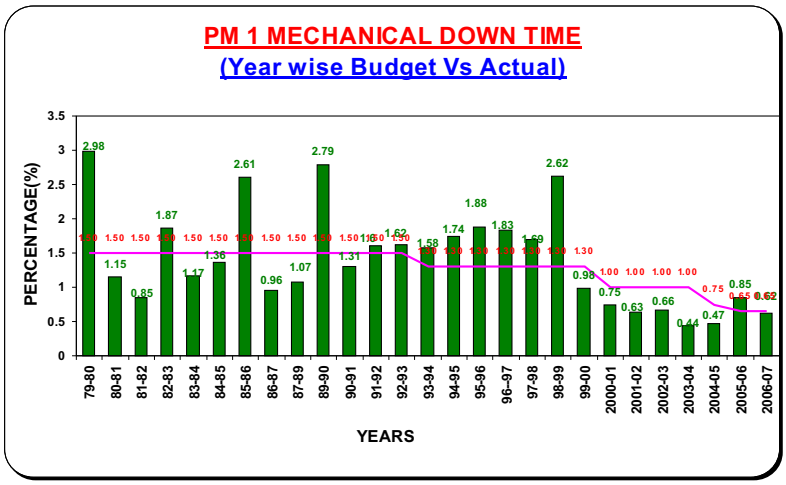
2. Felt rolls bearing failures.

- Frequent bearing failures.
- About 2-3 Hrs. Down time, one time stoppage of Machine in one month due to this reason.
- Scoring, case failure, sleeve loose, lack of grease.
- Judge the bearing condition by

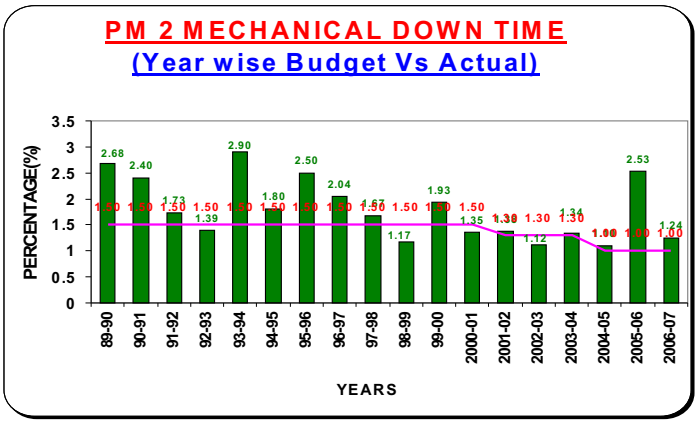


(Maintenance must be performed
With clear roles, we must decide whom
Will maintain what parts equipment)

PM 1



PM 2



physically inspection.

Implementations:
- Vibration analysis.
- Grease sampling.

This enabled us to detect the defects at its initial stage and taking corrective actions during planned shutdowns. Also analyzing the failure analysis after bearing change.

- Fitment
- Bearing clearance.
- Alignment
- Lubrication
- Water entry / caustic wash

Taking corrective actions accordingly.

3. lead roll 12, PM 3

Recent example. Recurring problems
A bearing is failed 3 times in two months span.
Down time is 9 Hrs.

Initially could not identify the reason later found entry of caustic was the contributor for bearing failure.

- Modified sealing arrangement.
- Guard provided over the housing to prevent foam entry.
- No breakdowns from past 6 months.

4. PM 4, Head box vibration issue

Problem: The PM4 TL headbox vibration levels were very high at machine speeds above 300MPM. This has become a major constraint in increasing the speed of the machine.

Analysis: Detailed vibration analysis was conducted at different speeds to assess the cause of high vibration severity at the head box. It could be seen that predominant vibration is occurring at 380 mpm with predominant vibration frequency at 300 cycles/min.

Trials were conducted till 440 mpm and it could be seen that vibration levels are decreasing beyond 380 mpm, indicating resonance as the major cause of the vibration. It could also be seen that the vibration levels are less at the drive end compared to non-drive end side.

Conclusion: Resonance indicated at the head box at 380 mpm due to insufficient support system.

It is suggested to increase the machine system rigidity by providing additional cross tie beams for the supporting columns of head box. This increase in stiffness will help to change the natural frequency of the entire structure, which in turn will help to avoid overlapping of the exciting frequency with the natural frequency.

Action Taken: The issue was referred to Dr V.Ramamurthy, professor in IIT, Chennai. . He has gone through the vibration analysis and suggested strengthening the structure longitudinally to improve the natural frequency substantially.

The structure was strengthened as per the advice of the professor and the vibration readings dropped down substantially.

RESULT:

Detailed vibration analysis was conducted after providing cross tie beams, at various speeds. Significant improvement could be observed after providing cross tie beams between columns. The effect of the resonance has drastically come down from 845 microns to 11 microns.

5. PM 4, Diluter issue:

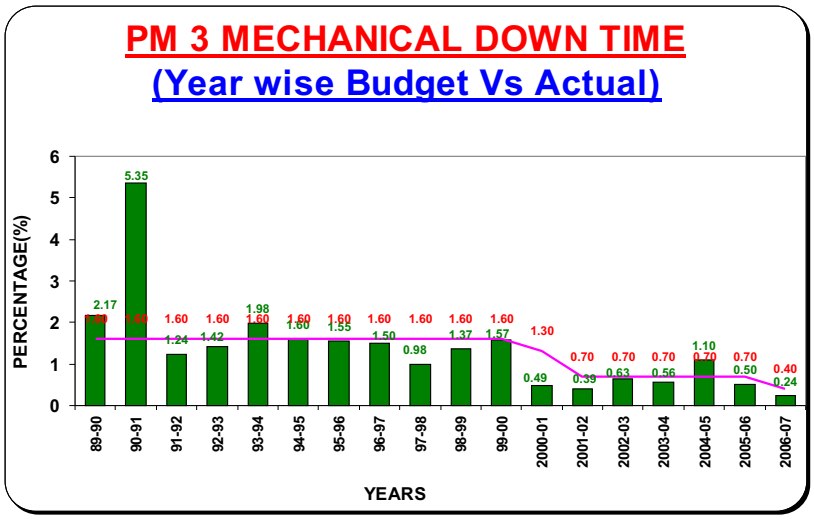
Equipment Supplier: M/S Cellier

Problem: The diluter is having very high vibration levels at speeds between 395 to 475 RPM. This was causing frequent failure of the loadcells and fixtures.

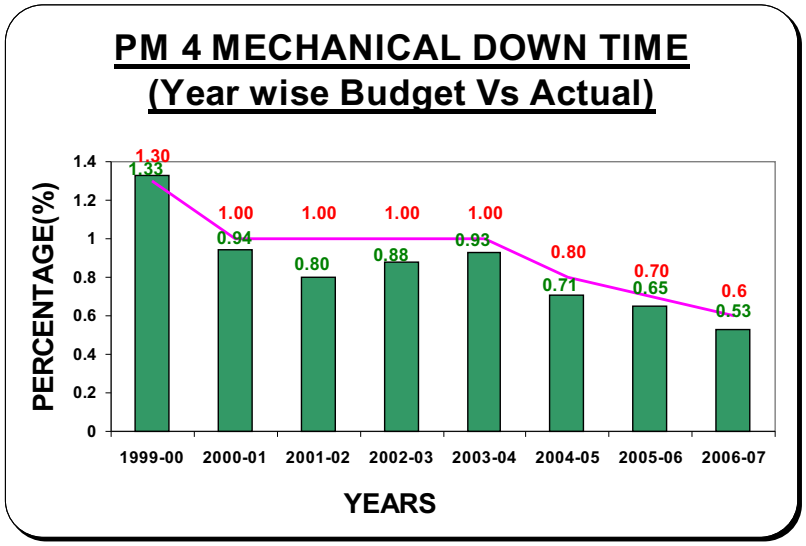
Study: Vibration analysis was conducted on the equipment at 2 load conditions of 5 tons and 7 tons. The study was conducted at various speeds between 100 rpm to 650 rpm.

With 5 tons load:

PM 3



PM 4



The behavior of the agitator is fairly stable upto a sped of 350 RPM and maximum vibration velocity was only 2.8 mm/sec. When the speed increased from 350 rpm, there was significant increase in vibration amplitude especially at the speed of 450 rpm. (500 microns and 18 mm/sec). Further increase in the operating speed did not indicate any major increase in the vibration amplitudes upto the full speed of 650 rpm.

At 7 tons load:

When the system was operated at the load of 7 tons, the behavior was fairly stable. The vibration amplitudes were significantly lower at the speeds below 400 rpm as well as at speeds above 400 rpm. The vibration amplitudes at the speed of 550 rpm were 54 microns and 2.2 mm/sec compared to the vibration amplitudes of 450 microns and 14.3 mm/sec at the operating speed of 400 rpm.

Analysis:

The agitator is operating close to the resonance condition in the speed range of 390 to 475 rpm. The vibration levels, when the agitator runs at 5 ton load is more. Unbalance is present in the agitator.

Recommendation: to redesign the rotor so that the resonance frequency is altered to higher speeds.

Action taken: Referred the problem to the equipment supplier, who suggested a new rotor design.

Result: After replacing the rotor, the vibration level are much below the healthy zone at all speeds and loads.

6. PM 4 MG touch roll vibration

Problem: The vibration levels of MG tough roll and its structure was high at speeds above 330 mpm.

Vibration study:

Detailed vibration analysis was conducted at various speeds and various product grades. The analysis revealed that the structure rigidity is very near to its resonance frequency and is getting excited at the resonance frequencies.

Conclusion: to change the natural frequency of the structure by increasing the rigidity.

Action Taken: the issue was referred to Dr V. Rama Murthy, a professor in IIT Chennai. He conducted a finite element analysis for the structure and suggested to join both the cantilever beams of the structure by 20 mm thick Ms plate. The same suggestion was implemented.

Result. The vibration levels which were as high as 420 microns and 36 mm/sec came down to normal levels.

CONCLUSIONS:

The benefits of systematic approach to maintenance can be well appreciated from the down time trends since 1999.

From the above detailed analysis, we can conclusively say that systematic approach to maintenance has helped in

1. Reduction of Downtimes.
2. Developing a systematic work culture.
3. Reduce stress on maintenance people.
4. Improved house keeping.
5. Developing a habit of learning in the people.
6. Reduction in maintenance expenditure with improved productivity.