RE-ENGINEERING AND BEST MAINTENANCE PRACTICES


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Abstract :

In this competitive open world environment, it has become a challenge for Pulp and paper Industry to sustain good performance. Adherence to the maintenance approach with best practices is one of the key to upkeep the Machinery health well in order to deliver a good quality of product at competitive cost to reach and retain the customers. It is necessary to have strong maintenance strategy to convertmaintenance function in to a profit centre with structured approach, techniques and continual improvements. ITC Ltd Paper Boards and Specialty Papers division - Unit Bhadrachalam isimplementingPlanned Maintenance programas a part of manufacturing excellence journey for the past 10 years. Continual learning cum implementation journey has resulted in productivity improvement, reduced unplanned stoppages and optimum maintenance cost.

INTRODUCTION

Planned Maintenance activity aims at maximising the plant availability at optimum cost, thereby improving the cost of competitiveness of the final product. The goals of Planned maintenance are to achieve zero Equipment failures and Breakdowns, eliminate un planned activities completely, Improve reliability & maintainability of machines through maintenance practices like Break down maintenance, Periodic Maintenance, Predictive maintenance, Corrective maintenance and maintenance prevention. ITC Ltd PSPD Bhadrachalam adhere to right maintenance plan for Equipment based on OEM recommendation and maintenance history. Tremendous focus is put on optimising the maintenance cost and improving in house skill competency of operators and technicians to support the maintenance strategy. The team approach and participation of operators in asset care, Kaizens along with Maintenance group resulted in overall Paper Machines Mechanical down times reduction. At present all the Mechanical breakdown down time are operating in the range of 0.2 to 0.4 % for all 7 Machines.Maintenance function is supporting to meet the production targets as per business plan.

Sharing some case studies on Re-Engineering and best practices in predictive Maintenance at ITC Ltd PSPD Unit Bhadrachalam.

Case Study: 1

Re-Engineering of Paper Machine #2 to Increase Machine speed and Reliability

Paper Machine#2 manufactures different types ofwriting cum printing paper with gsm ranging from 58-90.This Machine was commissioned in 1988 with the following parameters and system.

- Machine operating speed- 300 mpm
- Machine design Part components – 330 mpm
- Finished Deckle – 3100 mm
- Mechanical drive system – Sectional drive and open Gear system in dryer part.
- Electrical drive system – DC drives

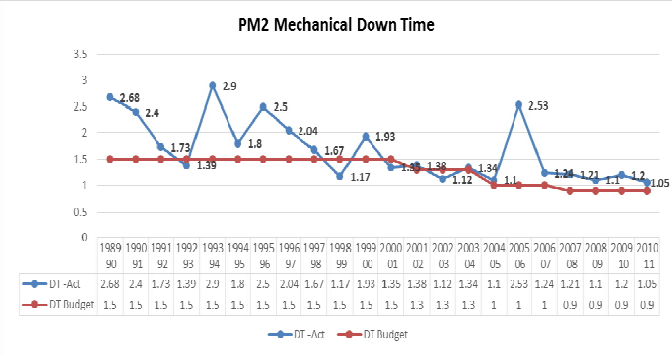
Reliability Scenario till 2011:

Reliability of Machine was uncertain due tofaults of Electrical drive system, high Vibrationsand frequent Break downs.

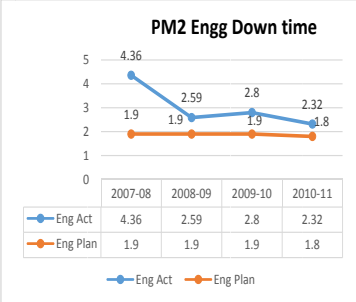
Maintenance Challenges were …..

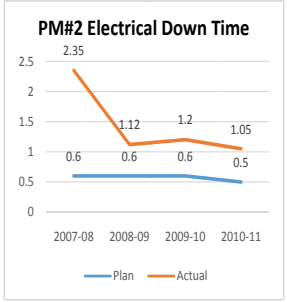
- Frequent Gear failure 8 no average/ annum
- Dryer Bearings failure 2no Average/ annum
- Felt Roll Bearing sleeve looseness issues
- Hard to access for inspection
- Large manpower
- Frequent Unplanned stoppages
- Interrupted production schedule
- Severe pressure on Maintenance crew
- Hasty working and fire hazard situations
- Steam Rotary joint failure -2no/ Month on average
- Machine speed limitation to 280 mpm in 70 plus gsm due to drying constraints.
- High Vibration levels 7- 11 mm/ sec
- Uncertain Reliability of overall system
- Frequent paper Breaks due to condensate splashing (12 Breaks/Month Average)
- Steam Consumption was about 2.60T/Ton of paper.

Machine Mechanical Down Time



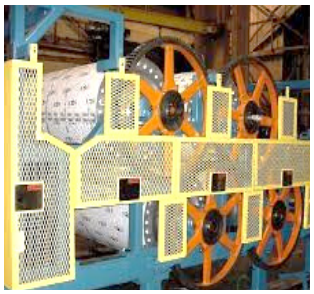
Total engineering down Time & Electrical Down time before Re-Engineering.



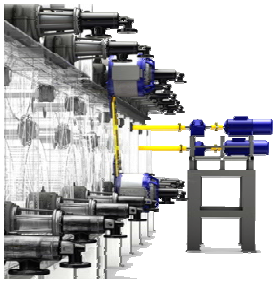


Re-Engineered the Machineat weak areas with following actions to operate at a speed of 330 mpm.

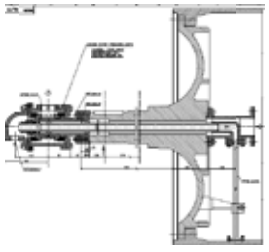
- ⊡ Dry end open drive gear conversion to felt roll silent drive system
- ⊡ Complete Machine DC drives conversion to AC drives
- ⊡ Rotary siphon conversion to stationary siphon and associated system
- ⊡ Re design of weak felt rolls and replacement
- ⊡ Over all 10% increase in machine speed for consistent operation.



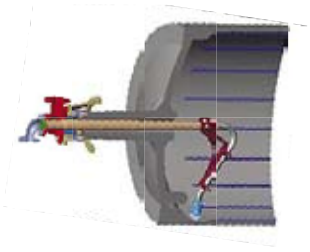
Open Gear System Existing



Modified to Silent drive System



Rotary Siphon



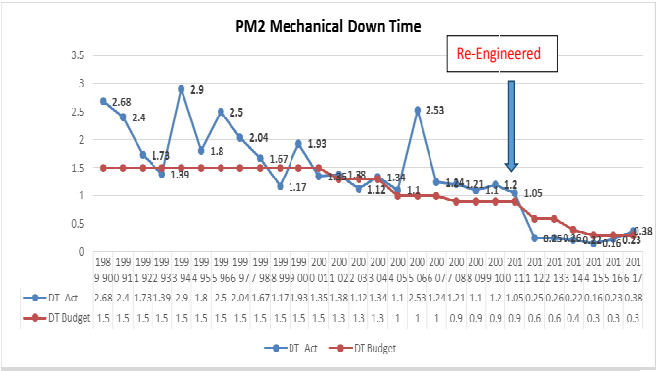
Stationary Siphon

Scenario after Re-Engineering in 2011

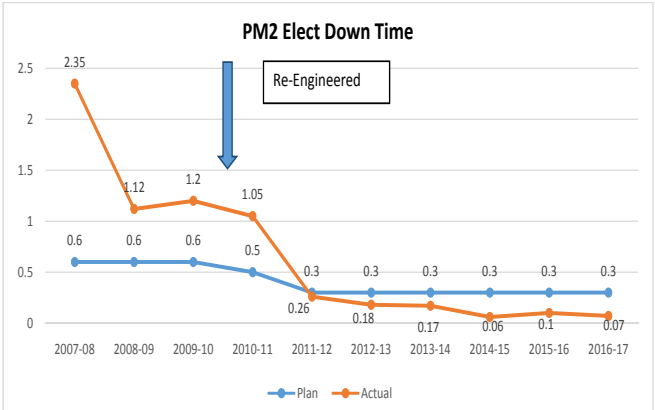
- Improved Productivity more than 10 %
- Low Maintenance demand
- Improved Machine availability
- Sustained Machine reliability
- Reduction in No. of Break downs
- Improved access for inspection
- Visibility on drive side improved
- Improved safety conditions on drive side
- Improved performance of Steam Rotary joints and no steam leaks
- Paper Breaks due to condensate flashing eliminated completely
- Maintenance requirement and cost minimised
- Maintenance crew are able to focus on developmental jobs
- Sheet drying across the deckle has improved significantly
- Paper tail pieces entering in to drive side dryer housing causing oil contamination was eliminated completely
- Specific steam consumption reduced by 0.3-0.4 MT/Ton of Paper.
- Improved Condensate recovery

Down Time trends after development

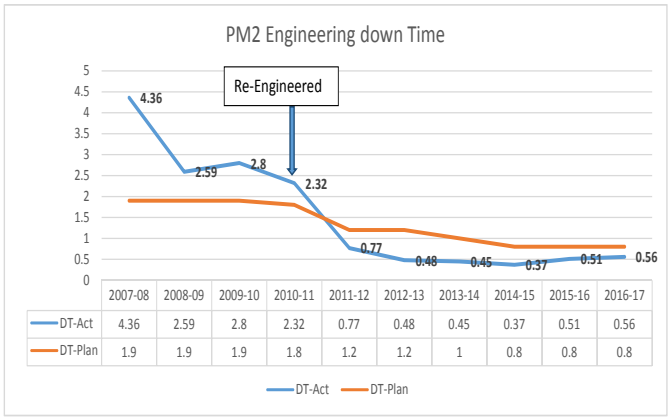
Mechanical



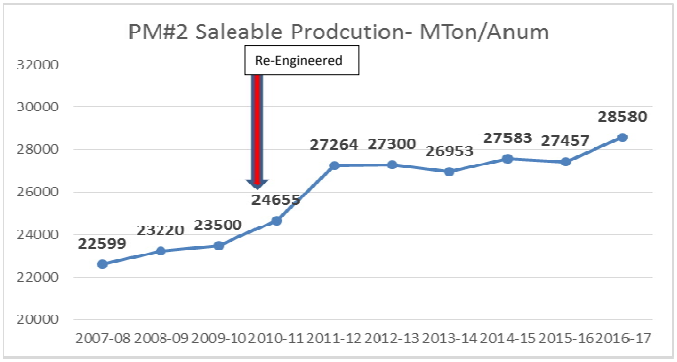
Electrical



Engineering



Machine Production Trend



After Re-Engineering implementation with available technology and best operation cum maintenance practices benefitted the organisation with an additional production of 2800 MT/annum.

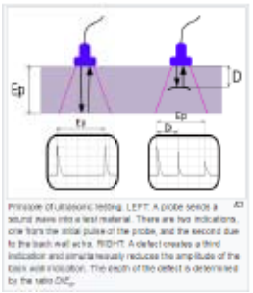
Re-Engineering Project was executed with a payback of 3 Years.

Case Study: 2

Application of Ultrasonic and Magnetic particle testing

….. for early detection of flaws in machine components.

In addition to Operator asset care program, Vibration analysis,thermography, ultrasonic thickness measurement, Run checks, stop checks, work shop checks(offline check), Maintenance Prevention approach for new setups, Oil analysis etc…



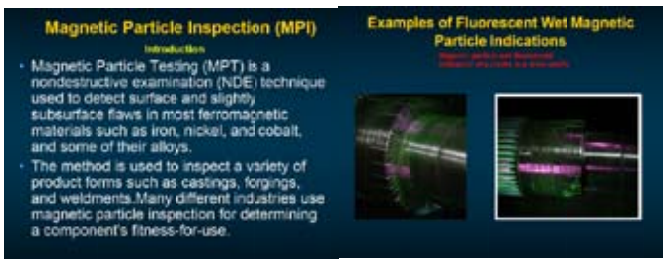
The Unit started on-site testing programme " NDT testing practice in the mode of Ultrasonic cum Magnetic particle testing for detection of internal flawsand surface cracks.

Ultrasonic testing is the method used for identifying the internal flaws in a component.

This instrument can detect internal Flaws or defects uo to a depth of 14.0 mtr

Magnetic Particle Testing(MPT):

Can detect surface and sub-surface flaws up to 4 mm depth from surface which cannot detect with naked Eye



Applicationsbeing used at Bhadrachalam..

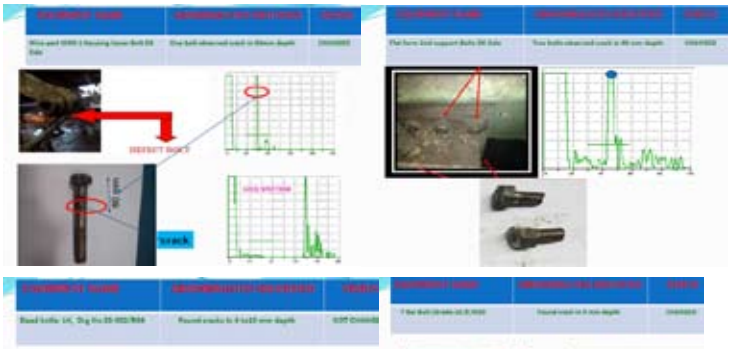
Introduced the technique with engagement of full time resources at Unit Bhadrachalam and found huge benefits for prediction of internal defects as given below

- Hidden cracks in bolts
- Roll journal inherent cracks
- Inspection of Components before assembly
- Inspection of incoming material defects at Engineering stores quality cell.
- Lifting Equipment Hooks, D-Shackle and Crane hoist drum
- Weld Joints
- Uncovered Roll shells etc.

Number defects identified across the Mill in a period of 11 Months

Sl no	Test Mode	No.of Defects identified on Machines in operation	No. of defects identified for Incoming Material.
1	UT Test	107	8
2	MPT Test	35	9
	Grand Total	**142**	**17**

Some of the identified defects are shown in below.



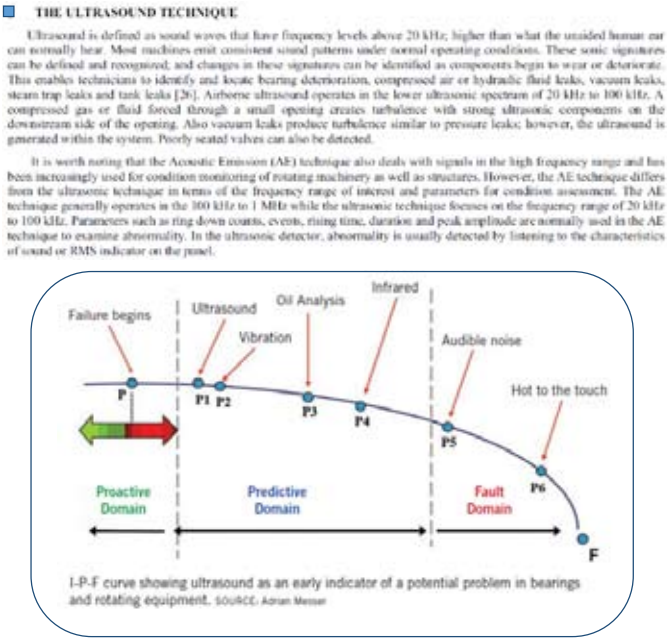
After implementation of the initiative for testing & inspection of old spares, operating machine, during shut downperiod and incomingmaterial, number defects predicted about 160. The technique helped in replacing the items early stage of failure and rejection of even newly defective received materials. This predictive approach is helping the maintenance crew with huge benefitsin terms of Cost saving, safety conditions improvement and elimination of unplanned stoppages.

Magnetic Particle Testing instrument: Make: Supermag and model yk-7AC/DC

Ultrasonic Testing instrument: Make GE measurement & Control, model :USM GO plus.

Case Study: 3

Best Maintenance Practice: Ultra Sound Technology for early detection of flaws in slow speed bearings.



THE ULTRASOUND TECHNIQUE

Ultrasound is defined as sound waves that have frequency levels above 20 kHz, higher than what the unaided human ear can normally hear. Most machines emit consistent sound patterns under normal operating conditions. These sonic signatures can be defined and recognized, and changes in these signatures can be identified as components begin to wear or deteriorate. This enables technicians to identify and locate bearing deterioration, compressed air or hydraulic fluid leaks, vacuum leaks, steam trap leaks and tank leaks [26]. Airborne ultrasound operates in the lower ultrasonic spectrum of 20 kHz to 100 kHz. A compressed gas or fluid forced through a small opening creates turbulence with strong ultrasonic components on the downstream side of the opening. Also vacuum leaks produce turbulence similar to pressure leaks; however, the ultrasound is generated within the system. Poorly seated valves can also be detected.

It is worth noting that the Acoustic Emission (AE) technique also deals with signals in the high frequency range and has been increasingly used for condition monitoring of rotating machinery as well as structures. However, the AE technique differs from the ultrasonic technique in terms of the frequency range of interest and parameters for condition assessment. The AE technique generally operates in the 100 kHz to 1 MHz while the ultrasonic technique focuses on the frequency range of 20 kHz to 100 kHz. Parameters such as ring down counts, events, rising time, duration and peak amplitude are normally used in the AE technique to examine abnormality. In the ultrasonic detector, abnormality is usually detected by listening to the characteristics of sound or RMS indicator on the panel.

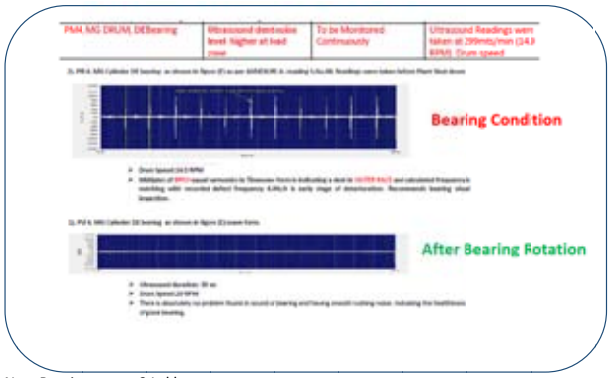
P-F curve showing ultrasound as an early indicator of a potential problem in bearings and rotating equipment. SOURCE: Adrian Messer

While vibration analysis is used for predictive maintenance of bearings operating at higher speed,Ultra Sound technique is more effective in detecting slow speed bearings abnormality.The Unit ITC PSPD –BCM Implemented this technique for bearings having rotational speed of less than 50 RPM such as PMill Presses, Filter units, MG Cylinder & large diameter Rolls etc.

Following is a good example of identification of defect at early stage.

PM#4 MG maximum rotational speed is 25 RPM at Machine speed 460mpm.

S.NO	BEARING NO : DE & NDE	No OF ROLLIN ELEMENTS	DRUM SPEED (drun dia:5410mm)
01	230/670 & 230/670	28	N= 402 m/s per min/5.41x3.14 = 20 RPM



New Bearing cost – 9 Lakhs.

Bearing replacement time 40 Hr.

Machine Contribution per Hr – 3.0 Lakh

Employed UT Technique, a dent in the bearing was identified and it was decided to rotate the bearing outer race to non-loading zone. The defect was identified so early that it was not visible to naked eye.

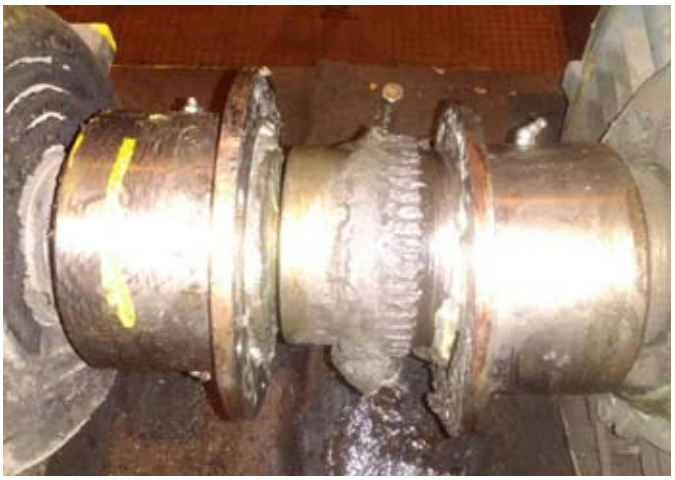
After shifting the bearing outer race,the bearing is running smoothly. This early detection of bearing defect helped to take corrective action and avoided deterioration cum demand of replacement.

Slow speed Equipment monitoring by Ultra sound technique has become a regular program at the Unit.

Case Study: 4

Best Maintenance Practice: Maintenance Prevention Approach (Re-Engineering)

Geared Coupling requires regular maintenance in terms of greasing, physical inspection at scheduled intervals. In spite of regular maintenance, Gear teeth wear out and coupling failures are quite common in drives which result in planned and unplanned stoppages.



PM2,4&5 drives were Equipped with Geared Couplings and one or two breakdowns on account of gear couplings in a year were common.

Gear couplingmaintenance related issues are…

- Schedule lubrication
- Physical inspection of teeth condition once in 6 months
- Gear Tooth Wear out
- Increased Backlash.
- Manpower involvement
- Grease cake formation
- Grease Spill over/oil bleed out dueto centrifugal forceat high rotational speed
- Coupling Hub Replacement due to tooth wear out.
- During long and extended production schedule Couplingstarves for lubrication.
- Result in 1 or 2 couplings failure /annum in each machine
- Down time of 2-4 Hrsin each stoppage.

Proposal:

Replacement of Gear couplings with spring disc coupling with proper redesigning.

All new machines are being provided with this design and in Existing Machines replacement is under progress.

Visible Benefits:

- No Regular Maintenance is needed

- No lubrication

-No Human error (Lub schedule missing)

- No Oil bleeding and contamination

- Zero Breakdowns due to Coupling

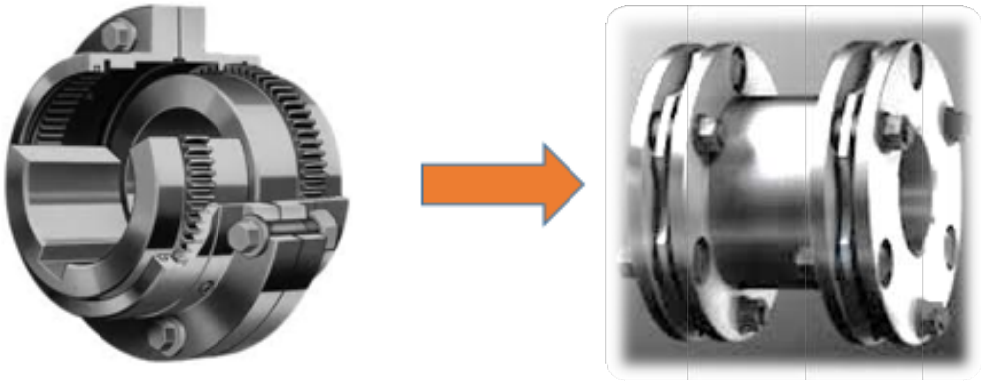
- Stop check become run check with the help of strobe scope.

Zero failures or replacements on PM7 which was commissioned in 2012 to till date.

PM#4&5 Existing Machines 40% drive couplings have been replaced.

Maintenance prevention approach improves machine efficiency and minimises unplanned stoppages and there by reduction in manpower &maintenance cost.

Conclusion:Adapting right Maintenance strategies, continual improvement in maintenance practices and Re-Engineering the machine would lead toconsiderable value addition to business in present competitive environment for sustenance in the Industry.



Acknowledgement

The authors would like to thank Shri Basab Ghosh- GM, Shri Ashish Avinash Gupta-GM Engineering& Shri B Makarand-Unit head Bhadrachalam for support and PSPD management for according the permission to publish the paper.