Preventive Maintenance Practices in Pulp & Paper Mills

N.K. Naik, R.M.Mathur, B.P.Thapliyal, A.K.Goel and T.K.Roy

ABSTRACT

Pulp & paper is one of the highly energy intensive industry and energy cost component accounts to about 25 % of the total manufacturing cost. One of the major reasons of high-energy consumption is poor house keeping and maintenance resulting in excessive down time. The poor maintenance not only results in higher energy consumption but also leads to lower rate of production.

In order to control and minimize the machine and equipment downtime a planned preventive maintenance routine has to be adopted by the mills, on a regular basis. During various energy and process audits conducted by CPPRI, it has been observed that not much attention is paid to proper maintenance and house keeping of major processes, machines and equipment. By following simple measures and preventive maintenance of some of the high energy consuming equipments, mill can save up to 10 % in energy consumption and result in significant reduction in downtime. The present article highlights section/ equipment wise preventive maintenance practices to be followed by pulp & paper mills.

INTRODUCTION

Energy is one of the major inputs for economic development of any country and assumes critical importance in view of ever increasing energy needs. Escalating energy demands with rise in industrial activities, have imposed serious threat of energy security on account of depleting primary energy resources and sizable import bills. To achieve the targeted growth in GDP, our country needs commensurate input of energy, mainly commercial energy in the form of coal, oil, gas and electricity. Energy being an important element of the infrastructure sector it is necessary to ensure its availability on sustainable basis. Considering the fact that the demand for energy is growing manifold and the energy sources are becoming scarce and costlier, its conservation emerges out to be the least cost effective option in any given strategies, apart from being environmentally benign.

The preventive maintenance and good house keeping is a pre requisite for achieving energy conservation targets. The pulp and paper industry utilizes a variety of equipments and instruments and their preventive maintenance and good house keeping is a challenge for maintenance and technical personnel.

The present paper highlights equipment wise preventive maintenance strategies for pulp & paper mills, which can be followed to reduce the machine downtime & achieve higher productivity.

Central Pulp & Paper Research Institute, Saharanpur

MAINTENANCE OF BOILERS

The life of any steam generating plant is dependent upon the amount of care and attention it receives while under steam and during idle periods. Proper and planned maintenance of the boiler will increase the operating efficiencies and decrease the outages of the boiler plant.

Maintenance of boilers can be divided mainly into three categories:

1) Annual Survey
2) Periodical Preventive Maintenance
3) Attention of breakdowns during operation

Annual survey:

According to rules and regulations for operating boilers, formulated by the Government, every boiler shall have to be taken out of service, once in a year for through cleaning, repair and inspection.

This Involves;

- Empting and opening of Boilers
- Removal of accumulations of grease, scale sludge and soot
- Inspection of the boiler furnace wall and flue gas passage
- Inspection of water tube boiler arches
- Inspection of generating tubes and super heater tubes
- Over hauling of boiler mountings

Any defective generating or super heater tube should be changed during this time. The tubes which show the sign of over heating, bulging, distortion should be changed immediately.

Instruments: Draught gauge piping should be thoroughly cleaned. All the instruments leads and sampling points should be cleaned also. Instruments should be checked for their correctness of functions and repaired if required.

Scheduled Preventive Maintenance:

It can be divided into two categories:

1. Maintenance whilst in operation;
2. During periodical shut down.

Maintenance during operation involves followings:

Feed Pumps: All stand by pumps should be run for at least one hour each week to ensure they can be relied on for immediate service incase of emergency.

High and Low Water Alarms: High and Low water alarms should be tested once a fortnight by raising and lowering the water level in the steam drum to the levels at which the alarm should be operated. This test is performed on the hand feed regulator with the automation regulator isolated.

Soot Blowers: Soot blowers should be lubricated regularly.

Bearings of motors fans, feed pumps, etc**.** all bearing should be oiled or greased regularly.

Maintenance during periodical shutdown involves over hauling, cleaning and replacement repair of defective parts of breakdown or failure. Generally during this maintenance the gas passages are cleared by taking out the soot accumulated during running, leaking tubes are changed, boilers washed, leaking valves are ground or machined, valve glands are repacked and leaky flange joints renewed.

The greater part of the refectories should last for year without attention, but in the regions subjected to more intense heat or scouring action, they may in time fuse or spall. These parts should be repaired or replaced periodically to avoid accelerated deterioration and consequent damage to other parts by overhauling.

Casing leakages: Air infiltration through boiler casing should be checked and stopped.

Lubrication : A lubrication schedule should be established, based on the manufacturers recommendation and plant operating experience.

De-scaling of tubes:

Should be carried out regularly as suggested by boiler supplier / manufacturer

Mechanical cleaning is unsuitable or ineffective for cleaning complete power plant tubes line, super heater tubes etc. Further it takes long time to complete the cleaning operation.

Examination of the Boiler Scale:-

Before beginning the chemical removal of boiler scale, its composition must be determined by qualitative analysis. The amount of deposit on the inner surface of the boiler tube is the sum of the under mentioned components:

(a) Deposit arising as a result of corrosions of boiler tube e.g. Magnetite (Fe3O4) and ferric oxide (Fe2O3)

(b) Scale due to evaporation residue, which was left from contaminants in boiler water. This class of scale formers are calcium sulfate and silica.

An examination should be conducted to find out the type of scale before descaling.

Based on this the quantity of acid chemical should be selected and estimated.

Instruments: All instruments should be checked for accuracy as incorrect instruments mislead and may results in inefficient operation than if no instrument has been provided.

Attention Of Breakdown During Operation

Regarding breakdown during operation, it may be any thing between the generating tube failures to the gearbox trouble of the mechanical stoker. The breakdowns can be attended to sometimes by shutting the boiler altogether or sometimes in the running conditions, according to the nature of the breakdown.

Boiler plants maintenance work should be performed on established schedule to prevent equipment from being forced out of service owing to failures.

MAINTENANCE OF STEAM TRAPS

In most of pulp & paper mills, maintenance of steam traps is not a routine job and is neglected. In view of their importance as steam savers and to monitor plant efficiency, the steam traps require considerably more care than is given. One may consider a periodic maintenance schedule to repair and replace defective traps in the shortest possible time, preferable during regular maintenance shut downs in preference to break down repairs.

Dirt is one of the most common causes of steam traps blowing steam. Dirt and scale are normally found in all steam pipes. Bits of jointing material are also quite common. Since steam traps are connected to the lowest parts of the system, sooner or later this foreign matter finds its way to the trap. Once some of the dirt gets logged in the valve seat, it prevents the valve from shutting down tightly thus allowing steam to escape. The valve seal should therefore be quickly cleaned, to remove this obstruction and thus prevent steam loss. In order to ensure proper working, steam traps should be kept free of pipe-scale and dirt. The best way to prevent the scale and dirt from getting into the trap is to fit a strainer. Strainer is a detachable, perforated or meshed screen enclosed in a metal body. It should be borne in mind that the strainer collects dirt in the course of time and will therefore need periodic cleaning. It is of course, much easier to clean a strainer than to overhaul a steam trap.

Sight glasses are useful in ascertaining the proper functioning of traps and in detecting leaking steam traps. In particular, they are of considerable advantage when a number of steam traps are discharging into a common return line. If it is suspected that one of the traps is blowing steam, it can be quickly identified by looking through the sight glass.

ELECTRICAL MOTOR MAINTENANCE

Inadequate maintenance of motors can significantly increase losses and lead to unreliable operation. For example, improper lubrication can cause increased friction in both the motor and associated drive transmission equipment. Resistance losses in the motor, which rise with temperature, would increase. Providing adequate ventilation and keeping motor cooling ducts clean can help dissipate heat to reduce excessive losses. The life of the insulation in the motor would also be longer: for every 10^0 C increase in motor operating temperature over the recommended peak, the time before rewinding would be needed is estimated to be halved.

A checklist of good maintenance practices to help insure proper motor operation would include: Inspecting motors regularly for wear in bearings and housings (to reduce frictional losses) and for dirt/dust in motor

ventilating ducts (to ensure proper heat dissipation).

Checking load conditions to ensure that the motor is not over or under loaded. A change in motor load from the last test indicates a change in the driven load, the cause of which should be understood. Lubricating appropriately. Manufacturers generally give recommendations for how and when to lubricate their motors. Inadequate lubrication can cause problems, as noted above. Over-lubrication can also create problems, e.g. excess oil or grease from the motor bearings can enter the motor and saturate the motor insulation, causing premature failure or creating a fire risk.
Checking periodically for proper alignment of the motor and the driven equipment. Improper alignment can cause shafts and bearings to wear quickly, resulting in damage to both the motor and the driven equipment.

Ensuring that supply wiring and terminal box are properly sized and installed. Inspect regularly the connections at the motor and starter to be sure that they are clean and tight.

PUMP MAINTENANCE

Pumps are the 'Hearts' of any process industry Pulp & paper being one of them. Performance of pumps are directly linked with the efficiency, and reliability of a process. One of the ways to ensure good performance of pump is to maintain them in a planned manner.

Majority of the pumps used in pulp & paper industry are centrifugal pumps. Maintenance and operation for centrifugal pumps fall into two categories.

1. Routine preventive maintenance.
2. Major overhaul or repairs

Routine Maintenance

Routine maintenance can be classified as work done primarily to rectify the effects of normal wear in a pump

Overhaul or repair are carried out to rectify the results of excessive wear, overheating, damage from solids in the liquids or injury or wear due to any other cause.

A maintenance record for the pump must be kept and preserved to monitor machine performance.

Daily Observation of Pump Operation: When operators are on constant duty, hourly and daily inspections should be made and any irregularities in the operation of a pump should be recorded and reported immediately. This applies particularly to changes in sound of a running pump, abrupt changes in bearing temperatures, and seal chamber leakage. A check of pressure gages and of flow meters, if installed, and vibration should be made routinely during the day. If recording instruments are provided, a daily check should be made to determine whether the current capacity, pressure, power consumption or vibration level indicates that further inspection is required. If these readings are taken electronically, trending charts should be produced to allow observation to changes as a function of time. Certain trends may allow for scheduled outages to address deterioration of specific performance values.

Semi annual Inspection: The following should be done at least every six months.

1. For pumps equipped with shaft packing, the free movement of stuffing box glands should be checked, gland bolts should be cleaned and lubricated, and the packing should be inspected to determine whether is requires replacement.

2. The pump and driver alignment should be checked and corrected if necessary.

3. Housing for oil lubricated bearings should be drained, flushed, and refilled with fresh oil.

4. Grease lubricated bearings should be checked to see that they contain the correct amount of grease and that it is still of suitable consistency.

Annual Inspection; A very thorough inspection should be performed once a year. In addition to the semiannual procedure, the following items should be considered:

1. Vibration trend should be reviewed. If the pump is trending toward unacceptable vibration levels.

a. The bearing should be removed, cleaned, and examined for flaws and wear.

b. The bearing housings should be carefully cleaned.

c. Rolling element bearing should be examined for scratches and wear.

d. Immediately after cleaning, rolling element bearings that are considered acceptable of reinstallation should be coated with oil grease. If there is any sign of damage, or if the bearings were damaged during removal, they should be replaced with new bearings of the correct size and type per the manufacturer's instruction book.

e. The assembled rotor or major rotor components if the rotor is not assembled of shrink-fit components should be checked for balance prior to reassembly in the pump.

2. For pumps equipped with shaft packing, the packing should be removed and the shaft sleeves - or shaft, if no sleeves are used should be examined for wear.

3. For pumps equipped with mechanical seals, if the seals were indicating signs leaking, they should be removed and return to the seal manufacturer for inspection, possible bench testing, and refurbishment.

4. When coupling halves are disconnected for an alignment check, the vertical shaft movement of a pump with sleeve (journal) bearing should be checked at both ends with packing or seals removed. Any movement exceeding 150 % of the original design clearance should be investigated to determine the cause. Endplay allowed by the

A list of possible causes of mechanical problem

Mechanical problems – general			
S.No	**Details**	**S.No**	**Details**
1	Foreign matters in impellers	13	Parts loose on the shaft
2	Misalignment	14	Shaft running off – center because of worn bearings
3	Foundation insufficiently rigid	15	Pump running at or near critical speed
4	Loose foundation bolts	16	Too long a shaft span or too small a shaft diameter
5	Loose pump or motor bolts	17	Resonance between operating speed and natural frequency of foundation, baseplate, or piping
6	Inadequate grouting of base plate	18	Rotating part rubbing on stationary part
7	Excessive piping forces and moments on pump nozzles	19	Incursion of hard solid particles into running clearances
8	Improperly mounted expansion joints	20	Improper casing gasket material
9	Starting the pump without proper warm up	21	Inadequate installation of gasket
10	Mounting surfaces of internal fits (at wearing rings, impeller, shaft sleeves, shaft nuts, bearing housings, and so on) not perpendicular to shaft axis	22	Inadequate tightening of casing bolts
11	Bent shaft	23	Pump material not suitable for liquid handled
12	Rotor out of balance	24	Certain couplings lack lubrication.
Mechanical Problems – sealing area			
25	Shaft or shaft sleeves worn or scored at packing	29	Excessive clearance at bottom of stuffing box allows packing to be forced into pump interior
26	Incorrect type of packing for operating conditions	30	Dirt or grit in sealing liquid
27	Packing improperly installed	31	Failure to provide adequate cooling liquid to water-cooled stuffing boxes
28	Gland too tight, prevents flow of liquid to lubricate packing	32	Incorrect type of mechanical seal for prevailing conditions.
		33	Mechanical seal improperly installed
Mechanical Problems – bearings			
34	Excessive radial thrust in single volute pumps	39	Improper installation of rolling element bearing such as damage during installation, incorrect assembly of stacked bearings, use of unmatched bearings as a pair, and so on.
35	Excessive axial thrust caused by excessive wear at internal clearances or, if used, failure or excessive wear of balancing drive	40	Dirt getting into bearings
36	Wrong grade of grease or oil	41	Moisture contaminating lubricant
37	Excessive grease or oil in rolling element bearing housings	42	Excessive cooling of water cooled bearings
38	Lack of lubrication		

Table -2

Check List for Routine Maintenance of Air Compressor			
S.No.	**Name of The Job**	**Date Carried Out**	**Remarks**
1.	Check the V- belt tension		
2	Drain the moisture from inter Cooler and After cooler		
3	Check the lub- oil pressure		
4	Check direction of rotation of flywheel from flywheel end.		
5	Check oil level in crankcase		
6	Drain moisture from the Air receiver		
7	Drain moisture from the Moisture Trap		
8	Clean moisture trap Filter element with petrol and dry these thoroughly before fitting.		
9	Cleaning of suction Filter		

Table: 3

Check List for Scheduled Maintenance of Air Compressor				
S.No.	**Name of The Job**	**Carried Out on date**	**Fault Findings**	**Remarks**
1.	Open the inspection cover of cylinder water jackets and clean it			
2	Clean the suction and delivery valves, check the condition of spring plates, Valve Plates and cushion plates and replace if necessary.			
3	Check and clean decompressor system.			
4	Clean the inter cooler and after cooler elements			
5	Clean primary oil filter.			
6	Clean secondary oil filter and replace the element			
7	Drain the lub – oil from crankcase and refill it.			
8	Check the tube leakage of intercooler and after cooler element and if found gag, the leaking tube by taper copper socket.			
9	Check all nuts and bolts and tighten if necessary.			
10.	Check the v-belt alignment.			

bearings should also be checked. If it exceeds that recommended by the manufacturer, the cause should be determined and corrected.

5. All auxiliary piping, such as drains, sealing water piping, and cooling water piping, should be checked and flushed, as necessary. Auxiliary coolers should also be flushed and cleaned.

6. Pump equipped with stuffing boxes should be repacked. And the pump and driver should be realigned and reconnected.

7. All instruments and flow-metering devices should be recalibrated, whenever feasible, and whenever possible the pump should be tested to determine whether proper performance is being obtained. If internal repairs are made, the pump should again be tested after completion of the repairs.

Complete Overhaul: It is difficult to make general rules about the frequency of complete pump overhauls as it depends on the pump service, the pump construction and materials, the liquid handled, and the economic evaluation of overhaul costs versus the cost of power losses resulting from increased clearances or of unscheduled downtime. Some pumps on very severe service may need a complete overhaul monthly, whereas other applications require overhauls only every two to four years or even less frequently.

A pump should not be opened for inspection unless either factual or circumstantial evidence indicates that overhaul is necessary. Factual evidence from mill experiences imply that on falling performance significantly or when the noise or driver load indicates trouble the complete over haul should be considered. Circumstantial evidence should refers to past experience with the pump in question or with similar equipment on similar service.

In order to ensure rapid restoration of service in the event of an unexpected overhaul, an adequate store of spare parts should be maintained at all times

The relative complexity of the repairs, the facilities available at the site, and many other factors enter into the decision whether the necessary repairs will be carried out at the installation site or at the pump manufacturer's plant.

COMPRESSED AIR SYSTEM:

Compressed air performs many functions in a pulp & paper mill. It is required for controlling process parameters, pneumatic instruments, cleaning of equipments etc. Reliability of operation is directly related to the quality of compressors air fed to various instruments and control systems. So, it is imperative that maintenance of compressor and compressed air system needs skilled and training personnel.

For obtaining highest output, best performance and for efficient operation, a carefully executed maintenance of all compressors is needed. The maintenance work involved with Air Compressor may be Routine Maintenance and Scheduled Maintenance.

Routine Maintenance: Routine maintenance of Air Compressors comprises of simple checking, inspection, lubrication and cleaning of the equipment. It may be carried out daily or after short running hours. A format of routine maintenance check list for compressors is Shown in table -2

SCHEDULED MAINTENANCE:

Scheduled maintenance comprises of critical cleaning, checking and inspection, lubrication and replacement of simple replaceable and fast wearing items. It is carried out after a pre determined period. And reported as shown in table -3

CONCLUSION:

For minimizing machine and equipment down time a plant preventive maintenance schedule as shown above may be adopted by the mill. The mill should constitute teams of technical members for area wise selected equipments to look after the preventive maintenance activities. A schedule chart should be prepared for boiler, steam traps, motors, pumps and air compressor maintenance clearly indicating the daily, monthly and annual observation in predefined formats for various equipments. This will lead to identification of preventive measures to be taken up well in time before any failure takes place, and would minimize the downtime to a sizable limits.

ACKNOWLEDGEMENTS:

Authors are thankful to Ms. Asma Yasmeen, Project Assistant, Computer application for Compilation and documentation activities.

REFERENCES:

1. Igor J. Karassik, Joseph P. Messina, Paul Cooper, Charles C. Heald Pump hand book (Third addition) Mc Graw Hill publication.

2. Pump maintenance, February 2004 - National Power Training Institute.

3. Compressor and Compressed Air, March 1997 National Power Training Institute.

4. B.P. Thapliyal, R. M. Mathur & A. G. Kulkarni, Development of Energy Consumption Norms for Recycled Fiber and Market Pulp Based Mills under Energy Conservation Act 2001, 181 190, International Conference on Pulp & Paper Industry, Indian Paper 2006, 11-12 November 2006.

5. Energy Efficiency in Thermal Utilities, Guide Book for the national Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.

6. Energy Efficiency in Electrical Utilities, Guide Book for the national Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.

7. Shri B.E Limzerwala, Care and maintenance of Boilers, Souvenir, Certificate Course on Boiler Efficient Operation and Maintenance, H1- H6.