Technology improvement in paper mill maintenance

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ABSTRACT

The concepts of Reliability, availability and predictive maintenance are discussed. The tools for improving the maintenance, reliability, performance are analysed followed by Case Study at ITC Bhadrachalam.

Paper Industry in the past two decades has undergone tremendous improvement in Technology for increasing the productivity. With the increase in speed and width of the paper machine, the thrust is now on large scale machines with high production rate. The concept of large number of small machines shifted to-few machines : yet times even one machine of high production. The concept drifts from maintaining a few machines as spare while few machines are operated for continuous availability of the machine for production.

Reliability :

(Trouble free operation between two repairs—MTBF) The reliability of a process equipment can be classified as

(1) Design reliability (2) Process reliability

(3) equipment/installation reliability.

The Design reliability gives the extent the machine is reliable with reference to the design parameters. (2) The process parameters frequently change and demand more output/less output due to change in product and corresponding changes in flow/speed of the equipment. This may necessitate revision in the prime mover capacity as well as strengthening the foundations. (3) The equipment and installation reliability also undergoes change with time due to wear out of components, sinking of the foundations etc. Design of any machine should ensure good.

a) Reliability

b) Availability

c) Maintainability

Design—Shortcuts :

In the field of high competition, manufacturers can have the tendency to take short cuts in the design of the equipments to keep the price low. The case is more severe when the designer has to select the dimensions or components in a border case. The choice of the manufacturer will tend to be on lower side which may not meet the reliability requirement of the user.

How to Improve the Reliability :

Reliability of the machine should be built-in even at the contract stage itself. The application of the machine with reference to the major products manufactured has to be discussed in detail with the manufacturer to avoid inadequacies in the future. Test trials are to be conducted if possible at the manufacturer's premises and pre—commissioning trials to be conducted at length.

Bath-Tub Curve :

The Equipments are expected to fail at one time or the other exhibiting a pattern of failure related to time, which can be seen as a Bath tub curve as developed by US Depertment of Defence in 1957.

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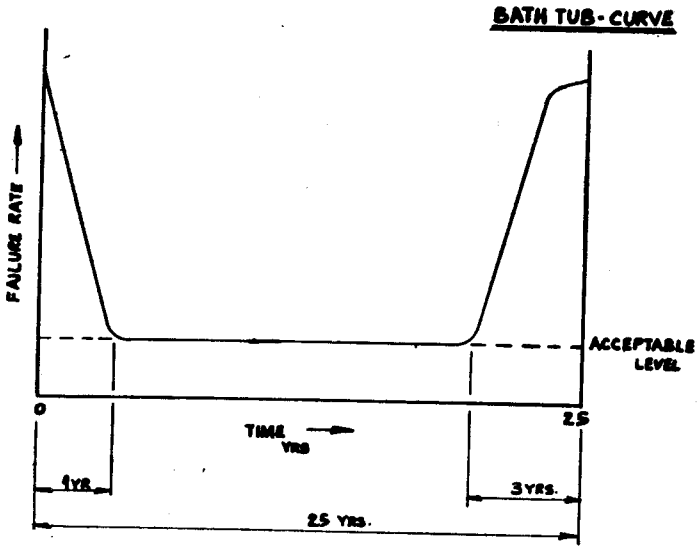
In the early stages of production functioning, the rate of failures is high. After that there is a stabilisation time where the failures are minimum. After certain time the failure rate increases again to show that the equipment is due for replacement rather than repair or to be renovated by changing major components to bring back the life to the original level to start the curve again.

A typical curve for paper machine main equipment is given below.



The curve applies to standard eqipments as well. But the period varies depending on the Design and Process Parameters. The useful working life of an equipment is given by the flat and uniform reliability period in the curve and it is the responsibility of the maintenance group to lengthen this flat portion of the curve.

Availability :

A machine is said to be available (up time) if it is under active utilisation for productive purpose or as standby. The machine is said to be non available (downtime) if the machine is under repair, or waiting for men/materials or for any other reason be represented as given below.

$$\text{AVAILABILITY} = \frac{\text{UPTIME}}{\text{UPTIME} + \text{DOWNTIME}}$$

The machine availability time factor is, therefore, all the more significant in respect of high speed high production machines, as non availability can cause serious production loss.

Breakdown Vs Preventive Maintenance :

We can not adopt the extreme alternatives of— 'Running the equipment until it fails and do the maintenances only when it breaks down' 'on one extreme or' to carry out preventive maintenance at very short regular intervals to avoid any failure' on the other extreme. In either case, it will result in large increase in both non availability and cost of maintenance. Preventive maintenance is time bound which is to be determined in advance' based on the history of the same or similar equipment. The method can be adopted for certain equipment like fan pumps, centricleaner pumps, stock pumps where it is possible to predetermine the overhaul period and execute the activity. This process does not envisage the prevailing condition of the machine before undertaking the maintenance. The equipment could be maintained at too large or two small interval.

Predictive Maintenance

With the advent in improvement in maintenance technology, supported by the developments in Electronics and Instrumentation, certain tools/gadgets are available to predict the condition of the equipment and enable us to predict the need for maintenance. Temperature of the body, sound/noise of operation, vibration, condition of lubricant generally will give a fair indication of the health of the equipment. The parameters can be precisely monitored and the possibility of failures be predicted to guide the way for PREDICTIVE MAINTENANCE.

The criticality of the equipment has to be carefully analysed and recorded. Direct on line equipment needs closer monitoring than the equipment which has an installed spare unit (infact good, predictive maintenance should do away with the concept of stand by units) which is ready to take over in case of failure of the unit. The non critical equipment can be maintained as per inspection calendar.

CAUSES :
1. Poor material
2. Poor design
3. Poor workmanship/maintenance
4. Lack of lubrication
6. Bad operation

Failure Analysis

Failure analysis is a key tool in prediction. The technical failures are to be critically analysed to reach the root cause. Attempt has to be made to arrive at the cause of failure of each component. Further criticality of each component has to be assessed to change/ modify the design, replace low life components, recommend correct tolerance limits and stricter test inspection practices. The entire history process has to be documented for future reference and in case of a similar repeated failure, the analysis has to be repeated based on the support of earlier information.

Vibration Monitoring :

Vibration levels in the equipment is measured at predetermined intervals by using vibration analyser.

The main objective is to detect changes in these levels that indicate the health conditions which serves as guideline to prevent failure Change in the Vibration amplitude is the principal parameter in vibration monitoring. The readings are taken regularly and recorded accurately as a graph to give the trend analysis from which can be evaluated possible failure and corrective timely action be taken. While trend is analysed, we have to bear in mind that the corrective action should be taken at the right time as the rate of change of vibration increases suddenly as a bearing approaches failure. With the advanced technology the observations of vibration can be fed into a computer for obtaining the trend analysis.

Bearing Monitoring Using Ultrasonics :

It is essential to monitor the critical high speed bearings and one of the methods is by Ultrasonic inspection technique. In the bearings, as the metal in the balls or races reach the fatigue stage, the resulting deformation of metal will generate increased emission in Ultrasonic sound waves. When a reading exceeds any previous reading by 20 to 30 DB, we can conclude that the bearing is in a failure mode. If the reading is more than 5 times the original value, it indicates total failure. As a ball passes over a pit in the surface, impact is produced. A similar effect is produced when a ball gets out of roundness and becomes flat over an area. These flat spots produce repetitive shrill sound. Rough sounds with a cracking mode indicates that the bearing is in a failure stage. High amplitude sound of the same mode as a good bearing indicates lack of lubrication.

Shock pulse meter has undergone tremendous change in technology in past decade. We are using SPM-43 A for the past 10 years and now plan to replace the system by SPM-2011A. In addition to the functions of shock pulse meter, vibration meter and tachometer, there is provision to store the data through a computer and analyse the same for timely decisions.

Whereas 10-15 DB is permitted for bearings in normal operation; an increase to 25-30 DB can be considered as the Bearing tending to fail and above 45 DB can indicate failure of the bearing. The correct condition can be analysed through series of readings taken at a specific intervals. We take weekly readings for press rolls. Dryer cylinders felt rolls, pumps, blowers and the like.

Alignment :

Correct alignment of equipment is an important function of maintenance. Alignment is of two categories.

a) Alignment of the total machine or equipment itself done at the initial stage of erection.

b) Alignment of drive shafts at the couplings between the driving end & the driven end. This has to be accurately done everytime one of the shafts—(driving or driven)—is disturbed or replaced. The tools available for alignment in the modern technology are

1. Theodolite
3. Engineers level
3. Insta-align or similar micro processor based analysers to be used together with dial guages.

It is generally assumed that the alignment after installation of the equipment will continue to be the same for years. There are many factors influencing the alignment such as sinking of the foundation, disturbing of the rolls, repositioning of the supports. It is essential to check the alignment with a precision instrument particularly because the modern paper machines are of high speed design. We use "Wild—Theodolite and Engineers level for paper machine alignment and also for the alignments of structures including chimney. Accurate operation will yield the correct results.

Corrosion :

Paper Mill equipments, in general, are prone to corrosion. Corrosion causes slow and uniform deterioration of plant, machinery and structures.

Corrosion is of the following types

1. Water corrosion
2. Chemical corrosion—acidic/alkaline
3. Stress corrosion (welding, temperature fluctuation)

The corrosion is particularly severe in the viscinity of Chlorine, Chlorine di-oxide, acid vapours which are inevitable for processing paper industry. Not running the equipment continuously can also cause corrosion.

Right selection of material, protection and condition monitoring is essential to minimise if not to totally avoid corrosion.

Whereas it is a common practice to provide concrete structure for the building including roof of Pulp Mill Building housing bleach plant equipment, we cannot avoid certain structures of steel particularly pipe racks. These have to be properly painted at regular intervals. Quality of concreting has to be improved to avoid corrosion of reinforcement using the right paint. Galvanising the structures will help to certain extent. FRP lining and polyurethane painting to protect the structure will be more promising. Care has to be taken while applying the paint to expose the parent uncorroded surface by using proper paint removers, rust removers : to apply proper primer and then the required paint or FRP lining. Protection of the outer surface of the pipelines and structures where they are exposed to Acid fumes, or where the chlorine and chlorine dioxide gas is predominant — is the need of the day. Continuous monitoring of the painted surface is also necessary, because in case of damage to the paint, a small exposed area will initiate corrosion and spread to other areas thereafter. Pipelines in the area should be of better qualilty stainless steel preferably 316L which will give better protection due to 2% molybdenum content. Critical components equipments should be of titanium, hast alloy C; SS 316 in the order.

We have observed severe corrosion to the concrete beams and columns in Bleaching area and have chipped, exposed the Tor Steel reinforcement, painted and done guniting to restore the health of concrete structure.

CASE STUDY AT ITC BHADRACHALAM

ITC Bhadrachalam paperboards is under production for about 14 years. After the stabilisation, the productivity is gradually increased by adopting various measures, one of them being improvement in the system of maintenance. We have been able to continue to achieve the lower down time not only on the paper machines but also in all the major production units, infact we have succeeded in improving the reliability.

One of the simplest steps taken by us is to thoroughly analyse each breakdown and to find the possible cause and take suitable corrective steps For every department/major equipment chart is prepared in each month for the previous 12 months against various sub-assemblies/causes. With this a kind of ABC analysis is made to adopt to major downtimes which has improved to a very great extent the reliability of equipment.

The following are a few cases of corrective measures taken by us for improving the Reliability of the equipment.

Coal Spreaders :

The Bearings of the coal spreaders of spreader stroker boilers used to fail at a very faste rate. Installed bearings are 6 per Boiler and the consumption used to be 120 for 2 Boilers. The Spreaders were supported on the Boiler Apron plate. The imbalance developed due do the uneven wear of the motor used to develop vibrations and knockout the refractory on the Apron Plate. In the absence of refractory, the bearing housings used to suffer direct heat exposure resulting in failure of the bearings. This is aggrevated by coal dust entering the bearings The problem was analysed. The shafts were extended and the bearing housings were supported on separate base rigidly. Water cooling jacket and labrynths were introduced for the bearing housings. The consumption of the bearings was brought down to 16 per year.

Soot Blowers of Soda Recovery Boiler :

The main shaft of the Soot Blower has a reciprocating motion as well as Articulating motion. This is

driven by a motor through a complex gear box. The drive was nearer to the furnace wall and was experiencing frequent failures. We have shifted the motors away from the furnace wall to bring down the failure rate. The manufacturer himself adopted this modification in the subsequent supplies of Soda Recovery Boiler.

Refiner Tackles :

By improving the metallurgy of the tackles; we could indeginise the tackle plates of Disc. Refiner. The original material was of Ni hard used to fail frequently due to inherent brittleness. The damaged teeth separated used to aggrevate the damage and sometimes used to carry out to the other refiners. The material was replaced by CA—40 which could give better depth of slot and hence improve the life.

Sleeves of Pumps :

The frequent demand for replacement of the rotor due to the sleeve wear and consequent gland packing failure and leakage was overcome by plasma coating 0.2 mm thick ceramic powder.

Pope Reel :

It was a surprise to note that the pope reel has worn out internally and developed a crack. The shell was of cast iron and end covers of mild steel. Water showers in the pope reel failed and a piece left out in the pope reel has caused a grove in the pope reel at a distance of 1 metre from drive sides. The thickness has reduced from 22 mm to 3 mm and a crack developed. We have assembled an MS ring in sectors in the rear side of the crack and welded MS webs connecting the MS drive side end cover. The cracked portion of the shell was relieved of the torsion and we could transit the power to the non drive side of the pope reel. We could operate the machine until alternate arrangements are made for nearly 2 years.

ISO Stack Shell :

ISO stack shell of paper machine has developed groves in the internal surface due to foreign material resulting in release of vacuum. We have applied Belzona in the shell and corrected the defect,

Chlorine Washer Journal :

Chlorine Washer Journal has worn out on drive side. We have machined the journal for groves in-si-tu and applied Belzona. We have polished the journal by Lathe tool post and directly mated it with brassliner of the bearing and it is under operation.

Metal Stitching of Cracks :

When a Dryer end cover has developed a crack, we could organise to stitch the end cover by metal stitching process and operate the machine for more than 10 months until we could make arrangements to replace the end cover by a new one.

Digester Shell :

By monitoring the thickness of the Digester Shells, we could detect that the thickness at the neck of the shell has got reduced to 14 mm from 22 mm and could take timely action to build up the worn out portion and restore the thickness.