P. DAS

In a Paper Mill of any magnitude the production and productivity can be improved by better maintenance of plant. In an integrated pulp and paper mill, there will be so many process and service Departments and each Department has its role for improving productivity; but here we will discuss only about maintenance of Paper Machine Department in view of the fact if Paper Machine stops, there will be direct loss of production which will affect on profitability. The object of writing this report is to give some guidance for maintenance, if the procedures are followed already then this report will be for checking only.

The objective of maintenance is :

- 1) To keep the plant running at maximum productive efficiency consistent with quality.
- 2) To keep the plant running free from non-planned shut downs and to keep the period of shut-downs to the lowest levels.
- 3) To conserve the life of the plant and equipment and obtain optimum utilisation.

If the above objectives are to be fulfilled a very well organised maintenance Department will be required. It will be the duty to avoid break-down maintenance and implement preventive maintenance successfully.

In a Paper Machine, the greatest advantage is that there will be some downtime losses for changing machine clothings and maintenance jobs can be attended during the above time. In most of the Paper Mills, annual shut-downs of several days are taken and all maintenance jobs are undertaken. But if a very well planned maintenance schedule is made and the jobs are distributed throughout the year the Annual shut-down can be reduced to a great extent if not being eliminated altogether .

In West Coast Paper Mills, only few years ago about 10-12 days Annual shut used to be taken for each of the two machines. But during past few years, this time has been reduced to less than 2

P. Das, Tech. Asst. to Chief Engineer, The West Coast Paper Mills Ltd., Dandeli (N.K.), Mysore State. Improve Productivity by better Maintenance

With the rising cost of raw materials, labour, spare parts and equipments, the manufacturing cost of paper is going high. So it is felt if down-time and production loss could be reduced by better maintenance, increased productivity would be assured. In a pulp and paper mill, paper machine constitutes a significant part. In this report some guidance for maintenance of paper machines is given.

The maintenance programme hand-outs received by the author during his industrial training in European paper mills and the experience of the West Coast Paper Mills Ltd., Dandeli, India have made it possible to make this report meaningful. The principles and procedures laid here are being followed in West Coast, resulting in very much improvement. The previous Annual shut-downs of 8-10 days of each paper machine have been reduced to less than 2 days. This year no necessity was felt for any Annual shut-down; as all the maintenance jobs have already been attended. Besides this, the down-time due to mechanical maintenance is being reduced by 20-25 per cent during past few years. This in itself is no mean achievement.

days for each machine by proper planning of maintenance jobs and distribution of maintenance jobs throughout the year. This year no necessity was felt for taxing Annual shut. The total downtime of machine due to mechanical maintenance is being reduced by about 20-25% every year. Whenever machine shut is taken for changing machine clothings, most of the maintenance jobs are attended. This is a remarkable achievement.

The performance of any machine or equipment deteriorates due to wear and tear, impact or fatigue and ultimately it will stop if no maintenance is carried out . In order to run the machine an intensive planning and scheduling are necessary and preventive measures are to be taken.

The first step of implementation of Paper Machine is planning and scheduling. Planning can be devided into long term i.e. a) lubrication and b) inspection and short term i.e. replacement of parts and c) repairs and overhauling.

To plan the schedule, the first step is to consider the following factors which will determine the importance of an equipment.

1) Effect of stoppage 2) Frequency of stoppages 3) Loss due to stoppages 4) Cost of repair 5) Availability of spares (8) Availability of man power 7) Time for repair etc.

After finding out the importance of the equipments there are to be categorised

and schedule of lubrication inspection, overhauling and replacement of parts are to be made accordingly.

LUBRICATION

Lubrication plays a vital role in preventive maintenance. A complete survey of the plant equipments is to be made to assertain the proper requirement of lubricant. It is better to get the lubricant list from the machinery manufacturers. If any alternative or equivalent is recommended by the oil company, the same is to be approved by the manufacturer of the plant.

Some opines that it is necessary to reduce the variety of oils and greases. But this may not be economical in all cases.

In West Coast Paper Mills, the following lubricants are used for Paper Machine.

- 1. Shell Talpa 20 : used for hydraulic system and rewinders etc.
- Shell Talpa 30: used for line-shaft bearings, couch and press roll bearings, drive gear boxes for dryers P.I.V. gear box, Thickner gear box, Resin cooker gear box, Vickery gear box, couch-pit agitator, all white metal bearings, Rotary unions, calenders, china clay pumps etc.
- 3. Shell Tellus 69: used for central oil lubrications.
- 4. Shell Turbe 29: used for all pumps Refiner bearings (i.e. service side) In-set pulper agitators etc.

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- 5. Shell Macoma 275 : used for couch roll and press roll gear boxes, refiner coupling etc.
- Shell vitrea 69 : used for vacuum pumps, shake mechanism gear box, M. G. gear box etc.

Colour code system should be used for the lubrications. Say for examples there are 6 grades of lubricants. Each grade will be marked with a particular colour in the drum. For carrying the lubricant from the drum, the bucket should distributed. The schedule details should state clearly the machine and the points to be lubricated and the routes to be followed by the oiler or greasers. The lubrication service card should be maintained for each equipment, showing when the lubrication was done and when it is due again. In order to ensure proper lubrication job, Maintenance Shift Engineer of the plant should give random checking. The proforma of a lubrication service card is given below : ing of equipment are must as a part of long term planning of maintenance. In a paper mill maintenance Department the following should be checked. PUMPS: In all pumps like storage chest, cycling chest, mixing chest, broke chest, machine chest, rosin, talcum slurry, alum, china clay, white water, couch-pit, fibre recovery, pulper, condensate etc. The checking may be done as stated below:

Checking of glands, bearings, oil seals, couplings, pins, bushes, alignments etc.

LUBRICATION SERVICE CARD

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also have the same colour. Also the lubricating points on the equipment should have colour tags of same colour. The lubricating point on the equipment should have colour tags of various shapes as circles, triangles, squares etc. so as to denote the frequency of application as daily, weekly, monthly or quarterly. Alternatively at the lubricating point on the equipment alphabets like 'D' represents daily, 'W' represents weekly etc. may be written of the same colour as the lubricant.

If the number of lubricants are more, the colour code system may not work without mistake. In that case, the lubricants in the drums will be marked as 'A' 'B' 'C' 'D' etc. The bucket for carring the lubricant should be marked 'A' on its body and the lubricating point on the equipment should have colour tags of various shapes as circles. triangles, etc. as stated above. The colour or number code system will work satisfactorily only when educated or trained person will be available; otherwise it will be a failure.

It is essential to develop lubrication chart for each equipment. It will state all the lubricating points, the grade of lubricant for each point, the method of application and frequency of application. If this is maintained no lubrication point will be missed and the checker need not to depend upon the memory of the oiler or greaser.

Once the chart is made for all the equipments, the lubrication job is to be correctly planned. The job is to be scheduled in such a way that the work-load on the oiler or greasers is uniformly To get maximum benefits from lubrication system, it is essential to have periodical checkings. The level of oils, greases in containers the alarm signals, timers, pressure switches, filters, starters, etc., should be periodically checked and immediate action should be taken as soon as any defects are found. The lubrication form for all these systems should be prepared and properly scheduled.

Good result will be obtained if oiling and greasing are done by trained lubricating man. The importance of lubricants, its use at the correct place and correct intervals, the cost of lubricants, avoiding wastage of lubricant due to improper handling etc., are to be known to lubricating man and a feeling is to be developed about cost consciousness. If the failure or break-down if any equipment is reduced, the lubricating man should be given some incentive so that he may continue his job with interest. It is observed that normally lubricating man losses his interest in job, as it is a very routine job. So it will be better to change the lubricating man every a few years.

For using correct lubricant at correct place and correct intervals it is very much desired to introduce colour code or symbol system. This could be possible only when literate lubricating man is available.

In West Coast a schedule has been made for lubrication daily, weekly or monthly and the system is working very effectively.

INSPECTION AND CHECKING

As stated before, inspection and check-

By feeling it can be understood if the bearings are alright or not. The bearings should not be hot.

AGITATORS : In all agitators like storage chest, cycling chest, mixing chest, broke chest, machine chest, couch pit, hydra pulper, etc., checking may be done as below :

Checking of shafts, bearings, 'V' belts and any other leakages.

DRIVE GEAR BOXES: In all drive gear boxes, oil level and leakages are to be checked up.

CRANE AND HOIST: In all the cranes and hoists wire rope guide ring, gear boxes, coupling bolts etc. are to be checked up.

REFINERS : Cooling water line, drainage covers, lock washer etc. are to be checked.

CENTRI CLEANERS: Cones, volute chamber and other elements are to be checked.

SAVE ALLS: Scrapers, brackets, chains, rollers, etc. are to be checked. FELT CONDITIONERS: Lead screws, bushes, bearings, gear-boxes, fibre tops, boses etc. are to be checked.

COUCH BROKE THICKENER: Spray pipes wooden strips, gear boxes, bearings, oil seals etc. are to be checked. PULPER: Re-tightening of foundation bolts, and 'V' belts, glands, greasing, bearings, general conditions of pulper etc. are to be checked.

REWINDER: Couplings, Tambour roll pedastals, brake bands, knife devices are to be checked.

CUTTER MACHINE: P.I.V. gears, oil level, layboy, ropes, pulleys, rollers,

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cones, collars, shafts/etc. are to be chc-cked.

CORE MAKING MACHINE : Shafts clutches, bolts, 'V' belts, gears, pumps, pipe lines etc. to be checked.

CORE CUTTING MACHINE: Shafts, clutches, 'V' belts etc are to be check-ed.

AIR COMPRESSORS: Cooler, receivers, oil chamber, safety valves, 'V' belts are to be checked.

Besides, dryer cylinders bearings, leakages of steam lines, and valves sound of belt shiftner, level of central oil lubrication hydraulic oil circulation, some grease points dryer bearings etc. are to be checked.

The advantage of checking of an equipment is that it can save the complete stoppage; say, for example a pump is giving much trouble i.e. load is varying too much the fluctuation of current is too much. By checking, say it was known that there is some leakage and one flange is removed and another flange was replaced, but even then the fluctuation of current was not stopped. The pump is therefore to be removed. After opening say it was known that the bearings were not in good condition. So the bearings are to be replaced and the pump is to be overhauled.

If there is a standby of the above pump the job can be attended any time otherwise earliest opportunity is to be found out for the above maintenance job without affecting much production loss.

Another Example :— An important hoist of a lift of that was checked. Say it was observed that the cage is running out of balance, some of the angles and channels are bent, the wire rope also is not good. So immediately, the bent channel and angle sections are to be replaced, or welded. The wire rope is to be changed with a new one as it is very risky to run with a little damaged wire rope.

All the above checkings should be attended daily and a schedule is to be made for special checking of an equipment on a particular day. From checking it can be decided if an equipment requires further maintenance, replacement of spare parts or complete overhauling. Some important equipment may have to be overhauled even before schedule, if found necessary after inspection.

This will help in reducing breakdown and saving in the following way.

- a) unreliable production in terms of quality and quantity over a specific period.
- b) greater material losses.
- c) sometimes capital replacements.
- d) unplanned working of operation and maintenance labour and
- e) heavy depreciation.

In West Coast an extensive checking schedule has been made and followed and thus efficiency has been improved. While changing paper machine wire the following can be done:

- 1) Bresst roll: Brackets, studs, spring plates, I belts, pins and wire rope checking.
- 2) Head box : Sluice valves checking and overhauling, spray pipes cleaning.
- 3) Holy roll: Drive gear box sprocket, chain-checking and greasing.
- 4) Dandy roll: Support rolls checking or replacing.
- 5) Water jet cutters and filters: checking.
- 6) Felt conditions: Cleaning of shoes, clamp and hose pipe checking or replacing; lead screw and bush bearing greasing.
- 7) Brushing refiner Gland packing checking or replacing.
- 8) Pipes : Spray pipes checking or replacing.
- 9) Doctor blades : Checking or replacing.
- Ring; used for sealing steam in a rotary union of dryer cylinders checking or replacing.
- 11) Line shaft bearing: Checking or replacing
- 12) Dryer cylinder : Service and drive side bearing checking.
- 13) All felt guide rolls and other points inside the hood and on the drive side of the dryer part which cannot be greased while machine is running are to be properly lubricated.
- 14) Central oil lubrication : Nozzles checking or replacing.
- 15) Some important pumps : Gland packings, coupling pins and bushes alignment etc. of the following should be checked or replaced

a) machine chest pumps, b) fan pump, c) seconding verjet feed pump, d) cough pit pump, e) white water pump, f) fibre recovery pump, g) condensate pump etc.

- 16) Gear boxes : some important gear boxes checking or replacing.
- 17) 'V' belts : Some important 'V' belts of centri-screen, vacuum pumps, fibre recovery pumps etc. — checking.
- 18) Save-all : Complete checking, greasing the pedastal bearings, etc.

REPLACEMENT OF SPARE PARTS

For better maintenance, it is very essential to have an adequate stock of spares, accessories and tools. Standardisation of spare parts should be made as far as possible to reduce inventory and facilitate repair work with minimum effort and time. So well in advance, the requirement of essential spare parts is to be planned and indented to Stores. It is a very common experience, that machine down-time is more because of nonavailability of spares. So it will be the duty of Stores Department to keep the maximum and minimum level of spares recommended by the Maintenance Department.

Due to shortage of foreign exchange, now-a-days it is another task to have import substitution of parts and spares of the machine and equipments, originally imported. How an imported can be substituted ? In West Coast we consider the following :

i) By casting or fabricating an identical part.

ii) By reconditioning worn-out parts which were originally imported.

iii) By selecting an alternative type of material in making a part which was originally imported.

- 1) When any spare is required, firstly it is considered if the spare parts can be made in the Maintenance Department.
- 2) If not, it is sent to Workshop for manufacturing.
- 3) If for one reasons or other it cannot be made in Workshop, the indent is sent to Stores for getting it done in the local Workshop. If it is not possible, Quotations are called from various engineering firms and best one is selected based on quality and cost of the product.

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To implement the ideas, first the drawing of the spare parts is taken. Drawing is taken from the spares which are kept in Stores. In some cases, when the plant is shut either for overhauling or periodic planned shut is taken, the drawing of the required equipment or spare parts is taken.

Alternatively, when any part or equipment is imported, the drawing of the same is taken before installing the equipment, or replacing the part.

The manufacture of paper machinery is a special field of engineering, requirement of a particular mill is so varied and specific that a plant and machinery manufacturer is to give utmost consideration in the lay-out, design and construction. Unlike a factory producing a series of products or having mass production, a factory making parts, components or equipment for in paper mill requires a large projects and design staff and it will have to conform to the demands of individual mill. So vigorous export is to be made to locate a manufacturing party, who can supply the right part accurate to dimension consistant in quality and giving reasonable life.

If right type of spare part is not available for not knowing the composition of metallurgy of the spares, some alternative is to be sought. Say, if S.S. spare part is not available, M.S. product duly rubber-lined may be tried.

Sometimes foreign exchange can be saved by reconditioning of parts, originally imported. Say, reconditioning of refiner rotor or stater.

In order that maintenance cost due to replacement of parts does not go high, every care is to be taken to recondition worn-out parts; whenever any new spare parts or equipment will be issued from Stores, the concerned Department will make sure that the worn-out part will be reconditioned and used in future. This operation will help very much in cost reduction programme.

Further application of operation research theory may be applied in replacing a part.

OVERHAULING

In order to derive maximum productivity from a particular equipment, it is to be ever hanced before it fails. The cost of breakdown maintenance in many cases is much more than preventive maintenance in most cases. To make a schedule of overhauling of equipments firstly the importance of an equipment is to be found out as stated earlier. Then the equipments are to be categorised as stated below :

- a) Equipments which can be overhauled at any time without requiring plant shut.
- b) Equipments which requires planned plant shut for overhauling with the consent of process department.
- c) Equipments which requires overhauling only once in a year and to be attended during annual shut of the plant.

To carry out the above, good planning is required and the following factors are to be considered and schedule is to be made.

- i) Visualising the work contained in the job.
- ii) Time required for the job.

iii) Man power requirement of various categories say fitter, welder, helpers etc.

iv) Availability of spare parts and materials.

v) Requirement of tools and tackles.

- vi) Allocation of job to individuals and setting up of time.
- vii) If possible cost of man power and materials.

For the overhauling of equipments under category 'A' there will be no difficulty. For overhauling the equipments under category 'B' the advantages of down time for changing machine clothings are to be taken. In West Coast all such maintenance and overhauling jobs are attended during felt and wire change. Sometimes stoppage hours are taken little more than required for changing machine clothings. This helps for a better upkeepment and ultimately reduces the stoppage hours for annual shut down.

Normally in a Paper Machine all the chest pumps and agitators and important gear boxes are to be overhauled lwice in a year. Some important pumps may be overhauled even thrice in a year. The cranes and hoists are to be overhauled once in a year. Based on the day to day's experience, the schedule is to be reviewed at least once in a year. Once the above factors are known and got standards may be set-up. Job standardisation will help very much in successfully overhauling the equipment with minimum down time.

Whenever standby capacities are provid ed it is to be observed that the standby unit is utilised only when the other one fails. Under no circumstances both the units should be utilised together. The standby equipment should always be kept ready duly overhauled.

ORGANISATION

To carry out all the jobs under preventive maintenance, a very well known maintenance organisation and record keeping are required. The status of the Maintenance Department should be the same as the Process Department. The Departmental Head should delegate his responsibilities to his Deputy and Shift Engineers for executing the jobs. When the responsibility is given the Deputy or Shift Engineers, interest vigour loyalty, initiativeness etc. are noticed amongst them and the efficiency goes up. Some jobs should be attended during the shifts, while some other should be attended during general shift only.

The maintenance department should have periodical staff meeting for discus sing the following :

- 1. Programming repairs.
- 2. Planning major/minor overhauls.
- 3. Planning component reconditioning.
- 4. Planning spare parts manufacturing
- 5. Reviewing progress of work.

The maintenance team will have to work in consultation of the production or other departments and in consideration with availability of man-power and spare parts either in Workshop or in Stores. It will be desirable to have planned work for each worker at least one day in advance. A separate work schedule should be specially made for Sundays and Holidays. A system for follow-up of planned jobs work orders issued for repairs as soon as had conditions are noticed, new work installation and plant alternations should be made. To have proper utilisation of time and man-power, work standards for repeatative and non-repeatative are to be set-up.

RECORD KEEPING

Paper work for initiation, authorisation and record is very much important in the Maintenance Department. The following records are very much essential.

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- 1. Log book system for reporting shift jobs.
- 2. History cards for major equipments.
- 3. Instruction manuals, part drawings etc. on all equipments.
- 4. Past history of equipment regarding
 - a) Man hours utilised.
 - b) Time taken.
 - c) Spare replaced or repaired.
 - d) Cost incurred.
 - e) Other relevant particulars.
- 5. Record for knowing the total machine and man-hours lost due to
 - a) Break-down.
 - b) Planned and scheduled mainten ance.
 - c) Periodical plant shut-down.
 - d) Preventive maintenance.
 - e) Non utilisation of machine for any reason.
 - f) Idle man hours.

We can therefore consider the following for the maintenance of the plant.

Activities :

- 1. Plan activities.
- 2. Make schedule of lubrication, inspection and overhauling.
- 3. Arrange spare parts.
- 4. Have job standard.

- 5. Know man power and time requirement.
- 6. Consult process department and know what else to be attended.
- 7. Have staff meeting.
- 8. Delegate responsibility.
- 9. Have periodical maintenance shutdown of plant.
- 10. Follow planned and scheduled maintenance.
- 11. Avail shut-down due to process requirement.
- 12. Give training to personnels.
- 13. Inform Stores to keep the stock of spare parts.
- 14. Follow cost reduction programme a) recondition worn out parts
 - b) standardise your requirements.

Record :

- 1. Have log book for shift activities.
- 2. Have card for History of equipments and maintain.
- 3. Record breakdown and its frequency.
- 4. Have instruction manual and parts drawings.

Review:

1:

1. Past activities and evaluation of present activities.

- 2. Production and down time losses due to maintenance, breakdown, planned and scheduled maintenance, periodical plant shut-down, preventive maintenance, non-utilisation of machine or idle man hours.
- 3. Evaluation of life of spares or equipments.
- 4. The ratio of
 - a) Skilled to unskilled maintenance crew.
 - b) Supervisor to skilled workmen.
 - c) Production to maintenance staff and workers.
- 5. The ratio of
 - a) Maintenance cost to the cost of equipment.
 - b) Total maintenance cost to manufacturing cost.

Replan :

Based on the review orientate thinking, replan your activities, modify the schedule and increase productivity.

CONCLUSION:

If the procedures stated in this report is followed there will be definite reduction of down-time and production losses, better upkeepment of the plant, longer life of the equipments, more effective use of men and time and last but not the least the maintenance cost will be reduced and all these will increase productivity.

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