International
Journal
Of Advanced Research in Engineering & Management (IJAREM)
ISSN: 2456-2033 || PP. 01-05

A NEW THINKING TO EDUCATE YOUNG AND RE-ENERGISE OLD PAPER MILL PERSONNEL.

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1. INTRODUCTION

To–day Indian Paper Industry is passing through in bad stage. Many paper mills are closed, some are running in loss and only some big ones are in good shape. For this sorry stage of this Industry there are strong reasons. Similar situation may rise in any developing country. Now, we have to find out ways and means to overcome such crucial situation. There are various seminars on this issue. It is true paper industry need modern technology and modern machinery. But these will require huge finance and more time. Together with all these one more effort is to be done which I realised in my paper mill life for 50 years.

After working for 50 years in pulp and paper mills along with its allied industries such as pulp and paper mill machinery I realised the feeling of a technically qualified person's mental condition working in a paper mill. Of-course that feeling came in my mind after working nearly for eight years in paper mills. I simply felt downgraded and regretted and could not under- stand relationship and justification of my knowledge I gathered during my study and the nature of my work of in the paper mill.

Passage of time and paper mill activity taught me so many things. Later on so many young papermill personnel shared with me same feeling. I pondered over this point and realised the reason of such feeling. A qualified person seeks always some knowledgeable information connecting with his/her work. Later on I realised there are hardly any book on paper mills where from one can get some information about all areas of pulp and paper mill.

Of-course there are lots of books of paper technology of very high standard but not a single one on paper mills through which paper mill personnel both fresh and experienced can learn. Actually all-round paper mill knowledge is a combination of different branches of engineering and paper technology along with some factory rules and regulations. Hence paper mill personnel need such a system of learning for both young who eager to learn and old who were once masters in their field but now forgotten a lot due to day-to-day routine mill work.

Now question is what should be that system of learning? Automatically it will be a resultant of assimilation of knowledge of all the activities of a large integrated pulp and paper mill right from raw material handling to finished product along with Recovery plant, Power &Boiler House, Water and Effluent Treatment plant, laboratory, etc. Besides, the course will cover all engineering calculations relating to find out the capacity of each section of the mill, each equipment and even each pipe lines size carrying steam at different pressure, stock at different consistencies, different type of liquids such as black, white, green liquor, fresh water, back water, etc. It will also guide to handle paper mill project of any size based on any raw material.

It is quite natural a sensible person will be eager to know the extent of this course. Endeavour is being made to give the short summary of the course. The course is so designed that the willing paper mill personnel who are eager to go up will definitely need this course.

2. SHORT SUMMARY OF THE COURSE

The course covers wide range of subjects from raw material to finish product from practical viewpoint. It is broadly divided in the following sections.

2.1 Paper from virgin fibre. It deals with various raw materials such as wood, bamboo, both rice and wheat straw, rag and cotton linters indicating salient practical problems for each raw materials. Special attention has been given to bagasse pulping for its potentiality in sugarcane growing countries along with modern method of bagasse storage and idea of installation of industrial complex based on bagasse just side of a sugar mill comprising of distillery paper and particle board plant with backup data. Sufficient practical data have been provided for bagasse cooking in a continuous digester, pulp washing indicating calculations of dilution factor and soda loss. Similar data are also available for pulp bleaching. Idea of blow heat recovery system has been incorporated with a schematic diagram. Treatment of imported (purchased) pulp has been also taken care of and

way for mixing with short fibre has been indicated. Paper from rag pulp is now-a-days a forgotten story . It is only used for currency paper. The writer from his experience has given a complete picture of such pulping.

2.2 Paper from secondary fibre. Due to shortage of virgin fibre and ever increasing demand of paper role of secondary fibre is very important. For last two decades all the new paper mills in some countries have come based on waste paper only. Now- a- days due to development of suitable equipment and de-inking chemicals it is possible to produce good quality of paper from waste paper. Details of waste paper pulping and cleaning, de-inking both washing and flotation , dispersions with calculation of quantity of steam consumption along with bleaching and sludge recovery have been provided. Modern thinking of de-inking process has been incorporated also.

2.3 Equipments of pulp mill. Almost all the equipment of pulp mill has been taken care of indicating calculation for their size determination in special cases. Special care of centrifugal pump has been taken indicating co-relation between capacit, head and power . Steps for mass and water balance of the system indicating rejects at required places has been indicated. Idea to calculate the pipe line size of stock at different consistencies has been given to eliminate any confusion in this regard.

2.4 Stock preparation and approach flow system. Preparation of alum , rosin , clay wet end starch , dyes , etc. has been indicated with proper sequence of addition in the stock . Mottling problem has been discussed indicating its solution. Sketches for modern approach flow system for moderate and high capacity paper machine are shown with calculation of head of fan pump.

2.5 Paper machine. Discussed different types of paper machines including cylinder moulds. Special care has been taken to find out the size of the paper machine indicating wirelength, press configuration, no of dryers , MG size if required along with its ideal position in the dryer group. Design aspect of each section has been consider including head box and high velocity hood for MG. Calculations of water balance of Fourdrinier paper machine has been indicated along with vacuum calculations of wire part elements. Steam and condensate system is discussed along with indication of effect of condensate accumulation in the dryer on production. Calendar part is also taken into consideration covering temperature control, calendar barring , role grinding , etc. Fundamental calculations of role crowing has been also explained along with some details of MOC of calendar roles. Regarding paper machine drive detailed presentation regarding line shaft drive, sectional dive and even silent drive have been done.

2.6 Recovery Section. It deals with recovery of such cooking chemicals along with generation of steam and power.
Integrated pulp and paper mills if not equipped with well designed and efficiently operated chemical recovery system anybody will term this industry as callous contributing all sorts of environmental problems of our planet, be at water pollution, air pollution, depletion of green cover or accumulation of undesirable solid waste. Another important factor for this unit is that integrated pulp and paper mill project will not be viable at all in absence of this unit for the following reasons :-
- It recovers costly chemical used for cooking raw materials.
- It generates heat energy which if properly designed will produce electricity as a by-product besides producing steam for the process**.**
- It reduces pollution load in the effluent.
Though there are various processes available for making pulp from virgin fibrous raw material, sulphate pulping or commonly known as Kraft Pulping is best suited for recovery plant for this process generate suitable chemical complex matter which attribute to efficient chemical recovery system. Sulphite process though older than sulphate process, is no longer being employed due to non availability of a satisfactory recovery system. In the acid sulphide process where Calcium bi sulphite and Sulphur di oxide are employed as pulping chemicals, the cost of the chemicals was so low that the spent liquor was preferred to drain in the stream which cannot be done now a days.
Recovery Section mainly consists of following units,

2.6.1 Evaporator Which consists of multiple units - numbers may vary from 4 to 8 depending upon the raw material, design, quality and quantity of Black Liquor and its final concentration.

Such battery of evaporators is generally known as MEE which concentrate the Black Liquor at 45 to 50 % from 8 to 11 % from BSW.

2. 6.2 Direct Contact Evaporator. Arrangement for further concentration of Black Liquor (70 to 75%, minimum 60%) before firing to Recovery Boiler to be done. This arrangement may consists of a) Cyclone evaporator or b) Cascade evaporator along with the precipitator or c) The Venturi evaporator scrubber or d) Combination of (a) and (c).

2.6.3. Recovery Boiler. Here concentrated Black Liquor is burned in a specially designed boiler to generate high pressure super heated steam to generate power and bleed off steam for evaporators to concentrate Black Liquor. The smelt, the product of burnt Black Liquor when mixed with weak White Liquor, Green Liquor is produced. Generally pressure of steam of recovery boiler and fluidized bed boiler is kept same for steam turbine.

2.6.4. Re-cousticizing Plant. Here Green Liquor so produced is converted to White Liquor for direct use in digester as cooking liquor main constituent of which is NaOH and Na2S. The cost of chemical recovery system as detailed above may be as high as 35 % of the total plant equipment cost for large integrated pulp and paper mill. In case of small integrated pulp and paper mill (capacity up to 50 TPD) the cost may be as high as 50 %. The capital cost of the

recovery cycle is thus substantial both for large and small mills. Still considering economic pressure and environmental pressure, role of recovery plant is very important. On other hand it is indispensible. Hence a complete knowledge and process detailing will be necessary for this plant.

3. MISCELLIANEOUS

3.1 Some Rules & Regulation regarding factory. In whatever position you are, you need to know some important rules and regulations of factory as you are a part of it.

3.1 Electricity Power. Before selection of paper mill site it is absolutely necessity to be sure that un-interrupted electrical power is available .There are instances in our country many paper mills were closed due to lack of uninterrupted power supply.

3.1 Steam and Power requirement. Suitable Boiler and required power generating set to install. Different examples are provided to understand the subject.

3.4 Energy calculation of an integrated Pulp and Paper Mill - a Case study. This helps one how to calculate total energy required paper mill.

3.5 Conservation of Energy. A decade back we used to consider to reduce fibre cost, chemical cost or direct labour cost to bring down the cost of production. But now we focus on conservation of energy.

3.6 A typical calculation of Heat Energy Balance. This explain one how and where energy is flowing.

3.7 Effluent treatment. This is most important and care to be taken since beginning. Many mills are closed for negligence in this area. IPPTA committee have come to a conclusion that a scheme is to be formulated for paper plant of 30 TPD and above where there is no Recovery plant.

3.8 National Environment standard in Pulp &Paper Industry. From 1st April,2005 it may be seen that National Environment Standard is getting stiffer and stiffer as years advances for obvious reasons.

3.9 Basic Calculation of Effluent treatment. Though this area falls in the hands of specialised department still it is necessary that paper mill personnel should be aware of basic method of calculation.

3.10 Process water Treatment Plant. This area paper mill personnel can take care if the required knowledge is available with them.

3.11 Pipe Line Colour Code. TAPPI has come forward with universally accepted pipe line colour code system to follow as a standard practice to avoid confusion.

3.12 Mensuration. To facilitate some calculation in paper mill some data are provided.

3.13 Development of Paper Mill Plant and Machinery. With passage of time numerous development have taken place in paper mill plant and machinery.

3.13.1 Head Box. A stable and even flow of stock out of head box is important when aiming for good paper quality and machine performance. That is why various design in this equipment have come up.

3.13.2 Forming Board. Along with Head box this part has also developed side by side as it is associated with it.

3.13.3 Forming Section. Now-a-days forming table of Fourdrinier paper machine can be termed as e-table.

3.13.4 Shoe Press. With SHOE-PRESS roll we can have higher nip presser. For press part modification to increase higher production it has a very important role.

3.13.5 Soft calendering. It offers effective smoothness.

4. BIGGER PARENT ROLL SIZE

5. DISTRIBUTED CONTROL SYSTEM

Now-a-days instrumentation plays very important to run paper plant efficiently and economically.

6. COATING OF PAPER AND BOARD

Paper and Board does not possess very good smooth surface for good printing. For this reason coating is necessary.

7. SAICA PROCESS

For the production of high yield semi chemical pulp based on straw and other Agriculture residues. In this process capacity should be 100tpd or more. The process consists of straw handling and feeding, cooking and two stage washing, Refining and cleaning.

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8. STEPS TO DRAW DETAILED PAPER PROJECT PROCEDURE

This is an endeavour to show the reader how this course is utilised to draw a paper mill project.

9. MORE ABOUT MOULDS

Some more further details have been incorporated such as Mass and Water balance and types of moulds.

10. SOME TABLES

10.1 conversion chart. shore durometer–pusey and jones plastometer.
10.2 Loss of Head in Feet due to friction of water in pipes per yard
10.3 team carrying capacity of pipes in Pounds per hour for different velocity.
10.4 Conversion Table

11. ROLE OF ENZYMATIC DE-INKING

12. SAMPLE CALCULATION TO FIND OUT STEAM PIPE LINE SIZE FOR DRYER & M.G

13. SILENT DRIVE

14. APPENDIX

14.1 Project Cost and Budgeting. This topic will help paper mill personnel to prepare a preliminary project report to examine the feasibility of the project.
14.2 Paper From Secondary Fibre-Introduction
14.3 Paper Mill Laboratory. Practical knowledge of different testing usually performed in paper mill along with laboratory equipment is provided.
14.4 Speciality Paper including Tissue Paper. Necessary practical knowledge to make tissue paper along with Tissue paper making machine is provided as explained at the end of this write-up..
14.5 F/M and MLVSS in Effluent Treatment. This idea is necessary to check calculation of effluent treatment calculations.

15. CONCLUSION

There are many developing countries where there are many paper mills but not a single Institute of paper technology. Sometime it is not possible to send its own staff to the Institute for study. Moreover every paper mill will prefer to have its own Institute in mill itself. For this circumstance above short and effective course to educate and train suitable staffs say three in numbers of the particular mill in three months who will act as teachers for this course besides their usual mill duty. . Budget for this course will be very small which a paper mill of moderate capacity can afford easily. In this way it is possible to establish an Institute if Paper

Technology in every paper mill of moderate capacity This effort can bring a new horizon in paper industry in such country.

The writer has just concluded his write-up .But he will be satisfied if he is allowed to show one of the topics of the course just to show to the reader to what extent the course is limited. The topic is Tissue paper.

Now-a-days it has been observed great importance is being given in tissue paper making. Many international seminars ,trade shows and conferences are regularly held every year at various places particularly in advanced countries on tissue paper. World estimated production is around 21 million tonnes. It is used for various purposes such as hygienic tissue, facial tissue, paper towels, wrapping tissue, toilet tissue, etc. Each such use some specified quality.

Tissue paper is of low GSM ranging roughly varying from 13 GSM to 48 GSM.

We shall concentrate on soft tissue as it is popular and commonly used in the world.

Soft tissue paper is different from flat tissue having the same GSM. This difference is imparted in two different ways 1) by addition of some softening chemicals which of-course weaken the hydrogen bonds of cellulose fibres. 2) by providing the specially designed creeping doctor at the MG cylinder and reeling the creeped paper on the pope reel. The ideal location of the creeping doctor will be max. 500 mm (circumference) before the cleaning doctor.

Now a tissue paper machine differs from a standard Fourdrinier paper machine in the following areas, 1)Head Box consistency 0.2 to 0.4% 2) FPR (First Pass Retention) varies between 35% and80%. FPR is measured in percent (difference between solid per100 ml of flow comes on the wire and solid of 100 ml of flow drains through the wire just after the forming board). This varies 35% to 80% depending on the type of tissue machine and its forming wire design. Wire designs are Mono filament (single layer), double layers/ 2.5 layers with 8 shafts/16 shafts and three layers. FPR variations depends not only on wire design but also on head box consistency . Minimum FPR will be for 13 GSM and maximum FPR will be for 48 GSM. 3) pick-up felt which picks up the paper sheet at 12% -16% consistency from the wire. The special pick-up felt is provided with suitably designed required nos. of Yule boxes so that % of solid of paper web is increased up to 32% before entering the press. Pick-up will take place just before the Forward Drive roll. 4) Dryer part consist of only MG cylinder/ normally called yankee dryer (of suitable size to match the production) provided with standard doctor along with a creeping doctor (creeping angle is maintained between 19 to 25 degrees) After the paper leaves the creeping doctor it is fed to the Pope Reel.MG is invariably provided with High Velocity hood as shown in Fig 4.3 and pocket ventilation. 5)The Pope Reel is kept at lower (8% to 20% depending upon degree of creep) speed than the dryer speed for obvious reason. After Press, solidity of paper generally reaches to 46% and after MG it reaches to

Raw Material.—Tissue paper can be manufactured either from100% virgin bleached pulp,100% white paper cutting or combination of both.

Process.—Technically there is not much difference besides the above. If it is made from 100% bleached virgin pulp care to be taken regarding refining so that ultimate freeness of the pulp comes to 28 degree to32 degree SR freeness in the machine chest to have quick dewatering at stages before the yankee dryer.

REFERENCES

[1]. A.B Chaterjee, *Paper Mill Manual* (Mamata Chatterjee, IND, 2015)