Experience of Running Vapour-Liquor Phase Kamyr Continuous Digester with Bamboo at Nagaon Paper Mill and Future Development Proposals

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ABSTRACT: *The first Vapour - Liquor Phase* ***kamyr*** *continuous digester started in India at Nagaon Paper Mill, Jagi road (Assam), a unit of Hindustan Paper Corporation Ltd. on 16th October, 1985 based on Bamboo as basic raw material.*

A brief description of process, different operational problems faced during start-up of the plant are discussed and remedial measures taken to overcome those problems have been outlined.

Future development proposals such as (i) Installation of Help bin instead of conventional Chip Bin to solve chip feeding problems, (ii) Installation of alkali meter in cooking zone circulation system, (iii) Installation of Kamyr 3 Flash system, (iv) Installation of Oxygen delignification and (v) Oxygen bleaching Plant have also been high-lighted.

INTRODUCTION

Nagaon Paper Mill, Jagi road (Assam) is situated in a bamboo rich rigion and the mill production capacity is 300 TPD Writing/ Printing grades of Paper. The Mill has already achieved 70% capacity utilization and it is expected that the mill will soon achieve 100% capacity utilization also.

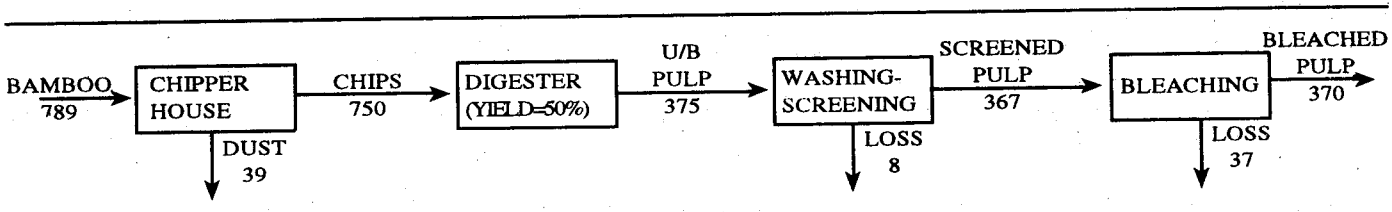
The Pulp Mill is equipped with a modern Chipper House (having 6 Nos. KLOCKNER Chippers), KAMYR Continuous Digester, Pulp Washing, Screening and Cleaning Plant (having HOOPER Pressure Screens) and 5 - stage Dorr Oliver Bleaching Plant.

The heart of the Pulp mill is the vapour - liquor phase KAMYR digester having installed capacity of 375 BDMT unbleach pulp/day.

RAW MATERIAL SPECIFICATIONS

Sl.No.	Biological Name	Local Name	AV. Fibre Length (mm)	% Cellulose Content
1.	Bambusa Tulda	Jati	2.93	64.36
2.	Dendrocalamus Hamiltonni	Kako	3.06	63.26
3.	Dendrocalamus Longispathus	Bholuka	3.50	62.96
4.	Tenoshachym Dulloa	Dolu	3.63	64.64
5.	Oxytenanthera Nigrocilliata	Kaligoda	3.55	66.72
6.	Bambusa arundinacea	Kotoha	2.78	57.56

Nagaon Paper Mill (HPCL)
P.O. Kagaj Nagar, Jagi Road - 782413 (ASSAM)



OVERALL MATERIAL BALANCE OF MAIN STREAM:
(ALL FIGURES ARE IN BDMT/DAY)

INPUT		OUTPUT	
Chips	= 2.0MT	BD Pulp	= 1.0MT
Water in Chips	= 2.0MT	Liquor to recovery	=11.03MT
Wt. of white liquor	= 4.52MT	Liquor in pulp off washer	= 9.0MT
LP steam to steam vessel	=0.027MT	Steam from flash tank No.2	=0.379MT
MP steam to heaters	=0.396MT	Exhaust from steam vassel	=0.111MT
MP steam to digester top	=0.647MT	HP condensate	=0.396MT
Wash liquor	=12.33MT		
	Total = 21.92MT		Total = 21.92MT

COOKING CONDITIONS

BASIS : 375 BDMT Pulp/ Day

Chip moisture	=	50%
Chip bulk density	=	175 kg/M^3 (BD)
Chip temperature	=	30°C
White liquor charge	=	22% AA as NaOH on BD chips
White liquor strength	=	110gpl AA as NaOH
White liquor sulphidity	=	20%
White liquor Temperature	=	75°C
Salt cake losses	=	14 kg $NaSO_4$/ BDMT pulp
MP steam pressure	=	11.5 kg/cm^2 (abs)
LP steam pressure	=	4.0 kg/cm^2 (abs)
Dilution factor	=	3.33 T/BDT pulp
Temperature in top separator	=	110°C
Temperature in cooking zone	=	168°C
Temperature in vapour phase	=	158-160°C
Wash liquor temperature	=	75°C
Temperature in wash zone	=	130°C
Temperature of pulp at blow line	=	80°C

BRIEF DESCRIPTION OF PROCESS

The mode of transport of bamboo to the mill site is mainly by road. The bamboo yard is designed for storage of three months. The bamboo bundle size is about 30 cm X 1.83M long. The bundled bamboo is conveyed to chipper house through water flumes. In the chipper house there are 6 nos. Klockner chippers and 2 nos. Rechippers and 2 nos. KMW chip screens provided. The chips is stored in 2 nos. chips silos having 24 hrs. capacity. The chips from silos are conveyed by belt conveyor via a chip washing plant where mainly silica/ dirt etc. are removed. The washed chips is conveyed to chip bin having about half hour storage capacity. The bin is having a conical bottom having a vibrating plate which is vibrated by one vibrator. The vibrator is driven by a 0.5 KW motor and due to the shaking action the chips fall in chip meter. The chip meter regulates the production rate and having a speed range from 7 to 21 RPM. It is having 7 pockets in the rotor and its capacity is 260 Lit/Rev.

From the chip meter the chip falls into the pockets of LP feeder. The rotor is inserted into a housing with two vertical openings. The chips fall into one pocket and when the rotor has rotated half a turn the pocket emties down into the steaming vessel where a steam pressure of 0.5 to 1.5 kg/cm^2 exists.

In the pre-steaming vessel, the chips are steamed and heated upto 110°C for 2-3 minutes. The pre-steaming is done by flash steam from primary flash tank. The pre-steaming helps better impregnation of white liquor into the chips. A screw conveyor inside steaming vessel moves at 6 or 8 RPM and carries the chips upto the mouth of chip chute. A constant liquor level in chip chute is always maintained. The chip displaced liquor goes to a constant level tank.

The chips then fed into the pockets of HP feeder through which it is fed into the digester. The rotor has through type of pockets. Chips from the chip chute with associated liquors are flushed into the pockets when in vertical position. The chips are retained on a coarse grid below the feeder. When this pocket rotates 90° to the horizontal position; the contained chips are flushed into the high pressure system with liquor from the top circulation pump. The chips are transported by means of the top circulation liquor to the inverted top separator. A chip chute circulation pump circulates the liquor from HP feeder bottom grid to chip chute via two inline drainers.

From the HP feeder the chips along with white liquor enters the bottom of inverted to separator. The top separator is designed in such a way as top allow the chips to be drained of liquor through the screen before the chips fall into the digester. The liquor separated from the screen of top separator goes back to top circulation pump.

The digester top vapour phase is maintained by direct steam. The chip level in the digester is kept 1.0-1.5 Meter below the top separator. A liquor level is maintained below the chip level. A vapour phase and liquor phase temperature of 158°C and 168-170°C are maintained respectively. A cooking zone external heater circulation (C6) is provided. After the cooking zone the plug enters upper and lower wash zone. External counter-current heating circulation is done in wash zone. The wash liquor from decker-cum-washers seal tank is utilized for digester bottom ring dilutions. After the cooking zone the spent liquor is extraced through extraction strainers to primary and secondary flash tanks.

The vapour separated out from primary flash tank is utilized in steaming vessel and vapour from secondary flash tank is utilized for hot water generation in condenser. Temperature at Hi heat washing zone is about 120-130°C and retention is about 4 hrs. After the pulp crosses the wash zone it is blown to blow tank. The blown pulp consistency is maintained by speed of bottom scrapper provided at digester bottom. A cold blow temperature of about 80°C is kept here. Two blow lines are provided (one is stand by) through which pulp is blown to blow tank at around 8-9% consistency.

PROBLEMS EMS FACED DURING AND AFTER START UP

Chip bin hanging and poor feeding

Due to green/ semi green bamboo used severe hanging problem was faced for quite long time which was a bottleneck for lower production.

Later one more vibrator has been installed in front side of bin, and also after use of seasoned bamboo this problem was overcome. Installation of help bin will be taken up shortly to eliminate the problem of poor chip feeding.

Chip meter jamming

After start up of the digester chip meter used to trip on overload due to jamming of its sides with dust. This problem was overcomed by installing HP liquor jet lines from both sides (Fig. 1).

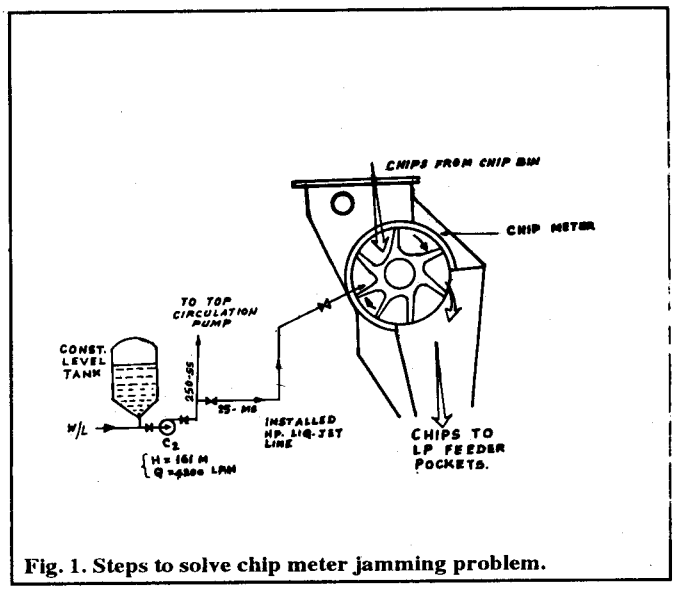


Fig. 1. Steps to solve chip meter jamming problem.

Steaming vessel overload

Due to high percentage of sliver, steaming vessel takes high load at higher rate of chip meter speed. Silver content was reduced at chipper house and in addition installation of HP white liquor jet line at the mouth of steaming vessel has helped to solve the problem.

Poor liquor extraction and high liquor level

Extraction strainers gets jammed frequently which causes high liquor level inside the digester. Once liquor level goes high more blow has to be done and there starts the problem of also not effective sometimes. Periodical digester strainer cleaning is done and also caustic boiling is done from time to time.

This problem was partly solved (as per advice of KAMYR's representative) by installing extra vertical slots in the launder of each extraction strainers. In future extraction strainer slots may be changed (as per KAMYR's design).

Leakage from outlet device

The outlet device shaft has been changed after its top bearing got damaged. This was a major job undertaken in presence of KAMYR's representative.

High chemical consumption

Due to low sulphidity (since ESP was under renovation), high bath ratio due to more surces of dilution and extraction strainer jamming the chemical consumption remained high.

After white liquor sulphidity has improved, weak liquor dilution at chip meter and dilution along with rejects going to chip bin have been cut off, one blow line is made of smaller size to control digester level the chemical consumption in digester has minimised.

FUTURE DEVELOPMENT PROPOSALS

1. Installation of help bin (Fig. 2)

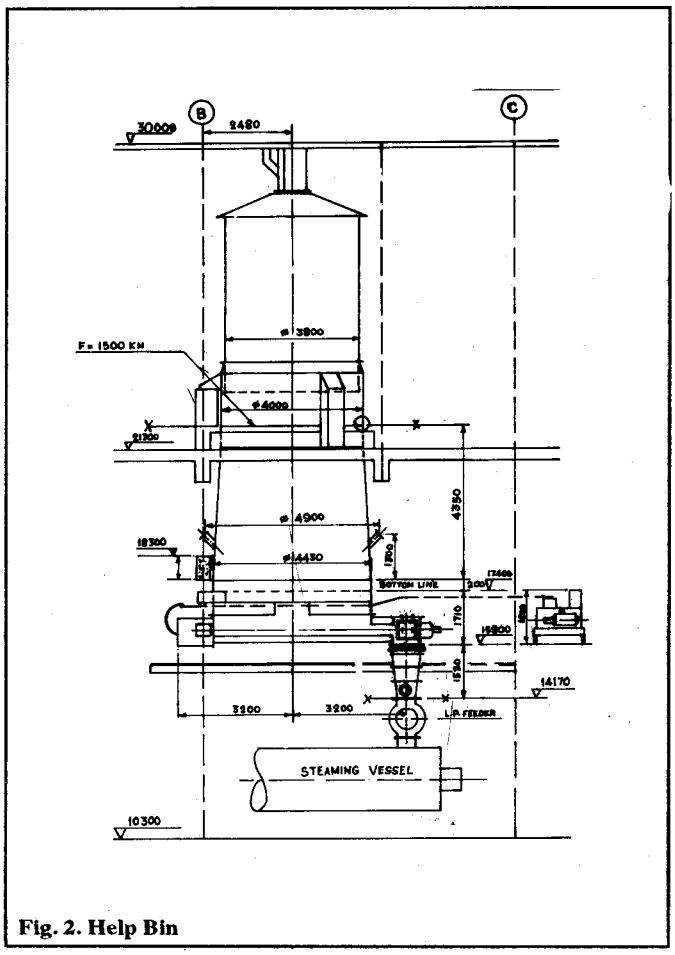


Fig. 2. Help Bin

The initial problem of frequent jamming at different places of chip bin causing less through-put from digester has initiated the management to think for other sorts of chip feeding arrangement which will take care of poor quality chips also.

This problem was refered to different chip bin manufacturers. M/s Kone Wood, Finland has developed a modified chip feeding device - called as "Help Bin", which the mill will install shortly.

The help discharger is a hydraulically-operated unit suitable for discharging difficult materials having four arms rotating back and forth on the bin bottom and a discharging screw located under the bottom. The rotor is operated by hydraulic cylinders located under the bin bottom. The discharging capacity is controlled by regulating the discharging screw speed.

The old chip bin top cylindrical portion over 21.3 meter floor will remain unchanged. The portion below this will be removed and instead a divergent bottom help bin will be installed. The existing vibrators, chip meter will be removed and after the discharging screw the chips will fall directly to the pockets of LP feeder.

Flash steam will be used for per-steaming of chips. There are four nozzle connected for LP steam injection. Gamma ray level detectors are provided in the bin as well as in the chute ahead of LP feeder.

2. Installation of Alkali Meter

To have better control on cooking parameters M/s KAMYR AB has developed an instrument to control the alkali requirement at cooking zone which is called alkali-meter (Fig.3).

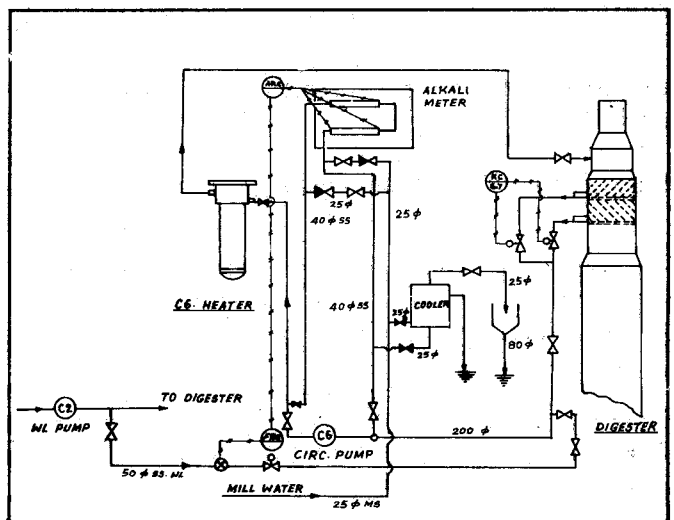


Fig. 3. Alkali meter

The alkali recorder controller (ARC) will be in cascade control with flow recorder controller (FRC) for liquor addition in cooking zone. This will result in more

uniform cooking and more uniform pulp quality. This is a part of the total white liquor charged to the digester.

3. Installation of 3-Flash System (Fig. 4)

For improving the heat economy and odour control the digester can be furnished with three flash tanks for evaporation of the hot black liquor being extracted from the upper part of the wash zone. In the first flash tank, the black liquor temperature will be reduced from 155°C to 145°C (approx). The generated steam will be utilized

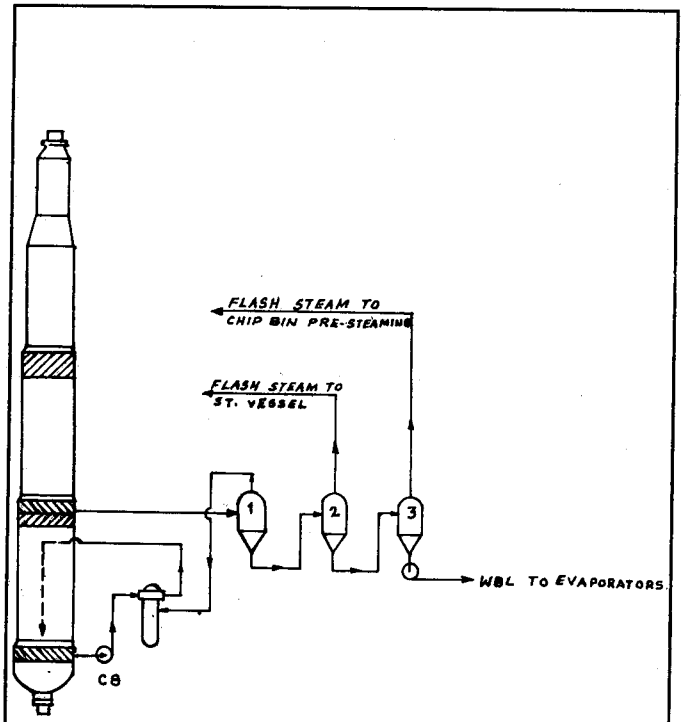


Fig. 4. Flash System

in the Hi-Heat zone heating circulation. In flash tank No.2 the black liquor will be flashed to 120°C and steam from this flash tank will be used for steaming vessel at approximately 1.0 kg/cm^2. In the No. 3 flash tank the black liquor will be flashed to 105°C and this steam will be utilized for preheating of chips in the chip bin.

Three stage flashing in operating since 1976 at Schaumaun Mill and Enso-Gutzeit Mill, Finland. Three stage flashing can reduce steam consumption in a Kamyr digester by 20% compared to two stage flashing. The production of hot water will be reduced but the amount of low level heat available is normally sufficient. The 3 stage flashing system is flexible. Steam from the third stage can be used either in the chip bin for atmospheric pre-steaming or for hot water preparation depending on demand.

The odour control is improved as the main part of the malodorous and volatile compounds are released in the flash tank. They leave the system through the Hi-heat exchanger and the condensate and the non-condensables can be sent to separate treatment.

4. Installation of Oxygen Delignification And Oxygen Bleaching Plants

OXYGEN DELIGNIFICATION

The oxygen delignification process has become quite common in modern Pulp Mills during the last ten years. Thus a majority of Swedish Pulp Mills have adopted this technique, mainly to meet. environmental requirements. It is now the most efficient way of reducing the polluting discharges from Bleach Plants.

The oxygen stage normally is placed immediately after the cooking and washing and is followed by a final washing. In that way organic substance dissolved during oxygen stage can be transferred to Evaporators and burnt together with black liquor from the cooking without being contaminated with chlorine compounds from the following bleaching stages. It is proposed to install such a oxygen delignification plant in near future for ECF bleaching at Nagaon Paper Mill. The Plant may be retrofitted in the existing Pulp Mill with minimum expenditure.

BLEACHING

The existing bleaching sequence at Nagaon Paper Mill is C-E-H-E-D. After installing the oxygen stage the bleaching sequence will be C-E/O-H-E-D. The advantages of oxygen delignification at alkali extraction stage is well proven.

CONCLUSION

Although various problems have been faced during and after start-up of the Vapour-Liquor Phase KAMYR

Digester, the Plant problems have been solved gradually and with the help of proposed development programmes it is expected that the NPM Pulp Mill will be one of the ideal pulp producing unit in the country.

ACKNOWLEDGEMENT

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