V. Kannan,
M. Jagannathan,
S. Arunachalam,
P.M. Trikkanad,
S.G. Rangan,
N. Ravindranathan.

Rapid Continuous Pulping of Bamboo And Hard Wood

This paper deals with the design features of Pandia Continuous Digester installed at Seshasayee Paper and Boards Limited. This is a unique piece of equipment, capable of pulping agricultural residues like bagasse and chips from bamboo and hardwoods. Perhaps this is the only one of its kind in the world which pulps hardwoods and bamboo by the continuous pulping method producing chemical pulp for making quality writing and printing papers.

'Pandia' is the abbreviated form of Paper and Industrial Appliances.

Introduction

Pulping is the first step in paper making. Chemical pulping methods are adopted for making pulp from cellulosic raw materials for the manufacture of quality writing and printing papers. In chemical pulping process, delignification is effected by the use of cooking chemicals and steam. Chemical pulping is done by the batch process of cooking by the use of stationary or rotary digesters and by the continuous pulping process which have come into vogue during the last two decades.

Continuous Pulping

Most industrial processes were initially operated discontinuously because of the generally simpler equipment needed. However as production increased to a large scale, the advantages of continuous operation were realized. Since 1960, there has been a large increase in use of continuous pulping systems. Rapid continuous systems are widely used for semi chemical pulping and is suited for cooking agricultural residues like bagasse and straw.

V. Kannan, Supervisor, Pulp Mill

M. Jagannathan,
Shift-in-charge, Pulp Mill

S. Arunachrlam,
Assistant Superintendent, Pulp Mill

P. M. Trikkanad,
Superintendent, Pulp Mill

S. G. Rangan,
Production Superintendent
N. Ravindranathan,
Deputy General Manager

Seshasayee Paper And Board Ltd.

The objective of continuous pulping are to shorten the time of processing taking advantage of modern automatic controls, thus reducing capital and operating costs and for producing more uniform pulp.

Continuous pulping is well suited to soda, sulphate and sulphite processes. There are many systems of continuous pulping available today :

1) Pandia or Defibrator System
2) Kamyr System
3) M and D Bauer System
4) Esco System.

Except Kamyr, other systems are rapid continuous pulping processes. The Kamyr system is slow continuous pulping process.

Pandia Continuous Digester at Seshasayee Paper & Boards Ltd.

The Pandia Continuous system at Seshasayee Paper and Boards consists mainly of (a) The Screw feeder (b) Two tubes with timing screws and (c) Discharger. There are other auxiliary equipments such as chips weigh scale, blow back valve, conveyors. (*Refer sketch at the end*).

Bamboo and woods chips are taken to the Pandia digester from the chips conveyor through a pneumatically operated gate and weigh scale conveyor. The weighing platform is a suspended belt conveyor which is oonnected through levers and pivots to the dial head of the weigh scale. The dial head is so located that it is visible from operating room and the feed rate can be suitably adjusted by adjusting the solenoid operated pneumatic gate. A totaliser attached to dial indicates the total quantity of chips drawn into the digester. The chips pass through another conveyer to the crew feeder.

Screw Feeder :

The screw feeder is designed to feed the raw material into the digester against a steam pressure of 11 kg/cm^2. The screw feeder is equipped with a tapered feed screw and therefore pushes the raw material forward under inereasing comnression through the tapered throat and forms in the plug pipe a continuously moving plug of suffieient density to seal off effectivelv the high pressure steam in the digester without any leakage. The size of the screw feeder in Seshasayee Paper and Board is 16" and material of construction of screw is carbon steel. The feeding capacity varies with size and speed of screw.

Inlet Chamber and Blow Back Valve

The inlet chamber is the first portion of the pressurised section of the Pandia system. The raw materials reach this chamber in a compact mass forming a plug which passes to the digester tube No. 1 for chemical treatment. The inlet chamber is mounted directly on the inlet branch of the digester tube and on top of this chamber are located the main steam and liquor inlets. Opposite to the inlet from the screw feeder is placed a stop valve known as blow back valve. This is actuated by a double acting pneumatic cylinder, the stroke of which is 36". The function of the blow back valve is to prevent the escape of steam from the digester with consequent loss of pressure in the system should the plug of raw material coming from the screw feeder fail as a seal. The operation of the valve is made automatic by connecting it with the Electrical "low load" of the screw feeder motor.

Pandia Tubes :

Intimate mixing of chips and cooking chemicals and steam takes place in the tubes and cooking take a place.

The Pandia digester at Seshasayee Paper and Boards have tubes of 42" dia and 39'-10" length. A conveyor screw termed "time control" screw extends the full length of each tube and its pitch and speed of rotation controls the period the raw material requires for treatment. The cooking time for various raw materials are different and can be adjusted accordingly by adjusting the speed of the time screw to suit the raw material. The tubes are made of steel and clad with stainless steel.

Discharger :

The functiou of the discharger is to transfer the digested pulp from the high pressure zone to atmospheric pressure continuously and uniformly. The discharger unit is suspended from digester outlet flange. An adjustable worm gear driven valve allows of accurate opening and closing of the valve. The constant speed impeller driven by a bevel gear unit wipes the face of the orifice clean to prevent accumulation and clogging with pulp. The discharger unit is driven through a clutch with a shear pin. In case of jamming, the discharger load goes high and the shear pin breaks. A small oil pump dirven by the same shaft as the discharger stops when the shear pin breaks. The contact of the pressure switch on the oil line opens and trips the discharger motor. Tripping of this motor trips in turn motors of Tube No. 2, 1, and conveyors.

Thus a sequence control system prevents overloading of motor and jamming of pulp in the system.

Instrumentation and Control

The instrumentation and control plays an important role in maintaining the quality of the product and the economy of the operation of Pandia. This being a continuous digester provides scope for a high degree of instrumentation and control which includes :

a) **Chip feed control :**

   Consisting a pneumatically operated gate, two solenoid valves, switches and a weigh scale.

b) **Liquor feed control :**

   Consisting a level indicator for the liquor tank and a flow recorder.

c) **Digester temperature and pressure control :**

   Having a pressure record controller, steel bulb thermometer with mercury as indicator and a temperature recorder.

d) **Cooking time control :**

This is achieved by varying the speed of the Pandia tube screw conveyors.

e) **Blow back valve control :**

This works in conjunction with the screw feeder load to avoid any blow back.

f) **Discharger control :**

The control of the blow is done by restricting the steam flow through an orifice valve.

g) **Safety devices :**

Exist for discharger and a sequence control system prevents overloading of motor and jamming of pulp in the system.

Comparison of Pandia Continuous Digester and Stationary Digester

The Kamyr continuous digester and the stationary digester scores over the design of Pandia continuous digester—in that, in these digesters, steam does not come in direct contact with the fibre or the pulp. Only the indirectly slowly heated cooking liquor is circulated throughout the chip bed when delignification takes place without affecting the strength of cellulose.

In the design of Pandia, foreign matter blocking the orifice valve was a common and frequent source of trouble experienced not only by Seshasayee Paper and Boards but mills in other countries of the world, where this type of digester had been installed. The inside stainless steel cladding of the 40′ long digester tubes often gave way and the dislodged pieces from the cladding worked their way to the discharger and blocked the orifice valve which is the pulp outlet.

As cooking is done slowly, indirectly in the stationary digester, the quantity of knots is low for a particular K. No. of pulp and for the same K. No. and quality of pulp, the knots from the Pandia digester will be slightly higher when wood and bamboo are cooked.

Alkali consumption in the Pandia is marginally higher at 19–20% total active alkali on B.D. chips whereas in the Stationary Digester it is 17.5 to 18.5%.

Steam consumption in Pandia is 50% higher than in the Stationary Digester due to :

a) Pulp has to be blown continuously through an orifice valve—by steam only. Here steam cooks the chips and blows the pulp into the tank. If steam consumption is controlled, due to back pressure building up, feeding will be affected. Hence a minimum flow has to be maintained for a particular feed rate, causing higher steam consumption.

b) The orifice often gets choked with knots, washers or foreign matter and more steam has to be used to blow them into the blow tank through a larger opening to avoid production loss.

Stationary digester pulp has 15—20% better strength characteristics than the Pandia pulp as seen from Table I.

Table I
Comparative Strength Properties of Pandia And Stationary Digester Pulps

Month and year	Pandia BF	Pandia TF	Pandia BL	Pandia DF	Stationary Digester BF	Stationary Digester TF	Stationary Digester BL	Stationary Digester DF
June '69	40	70	5600	76	51.2	70	7212	138
July '69	36	63.7	5417	77	50.7	66.6	6919	229
Sep. '69	37	76	5400	140	48	75	6800	300
Dec. '69	34	80	5556	66	40	72	6000	150
Jan. '70	30.8	58.2	4573	29	53.6	71.4	6753	570
March '70	21.4	35	4269	7	38.1	70.8	6811	204
May '70	29	68.3	5750	53	43.8	75.0	6764	225
19.8.70	34.2	62.6	5397	100	46.3	73.7	6709	210
21.8.70	33.3	77.8	5185	82	43.7	80.7	6105	160

The average strength characteristics of Pandia pulp and Stationary Digester pulp, for each month in the recent past are presented in the Table I

Table—II
Beater Evaluation

Date	Pandia BF	Pandia TF	Pandia BL	Pandia DF	Stationary Digester BF	Stationary Digester TF	Stationary Digester BL	Stationary Digester DF
19.8.70	26.2	60.7	4145	35	33.0	73.5	5133	97
21.8.70	30.8	73.4	5004	91	36.3	75.0	5756	130

In all these cases the pulps were ball milled for 20,000 revolutions. Standard sheets were made and tested. On the 19th and 21st of August 1970 beater evaluations were also done with the Pandia pulp as well as Stationary Digester pulp and results shown in Table II.

Conclusion

The rapid continuous pulping as done in the Pandia digester does not differ widely from the batch process with regard to the sequence of chemical action involved in pulping. The Pandia digester though designed for pulping agricultural residues, is capable of making fairly good quality chemical pulp by the kraft process for the manufacture of quality writing and printing papers.

Apart from producing good quality chemical pulp, 'Pandia' is capable of producing high yield pulp by the semi-chemical process. Considering the substantial saving in initial investment compared with batch digester, Pandia Continuous Digester is definitely superior in spite of the fact that chemical and steam consumptions are slightly higher than in a stationary digester and the pulp produced by Pandia digester has marginally lesser strength. When the paper industry is seized with the problem of conservation of raw material, continuous pulping equipment like Pandia is bound to become very popular.

References

1) Teehnical papers presented at *Ippta* by Seshasayee Paper and Boards Limited.
2) Pulp and Paper by James P. Casey, Volume I.
3) Instrumentation in Pandia by Messrs B.G. Sundar, S.G. Rangan and N. Ravindranathan, Volume III No, 2, *Ippta* 1971.