

Review of World-Wide Technological Developments in Pulping of Bagasse for Newsprint and Other Grades

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ABSTRACT

This paper reviews the technological developments that have taken place in pulping of bagasse for manufacture of newsprint as well as other grades such as fine paper, corrugated medium, particle board etc. The reviews have generally been restricted to technological development of commercial interest. A techno-economic comparison of the commercial processes in vogue for manufacture of newsprint has been made. Also some of the processes developed at pilot plant stage and being offered as a process for commercial exploitation in the manufacture of bagasse newsprint are also discussed. This paper also reviews some of the latest pulping processes such as Nitric Acid Pulping, Naco Pulping Process etc. This paper also addresses areas where technological developments required, or that will take place, to improve the utilisation of bagasse for various grades of paper.

Although utilisation of bagasse for manufacture of pulp and paper at commercial scales has been in vogue since last 5 decades, most of the technological development have been in the areas of depithing and storage i.e. fibre preparation system. Since most of the problems in pulping and paper making were attributable to inefficient depithing and poor storage techniques, the developments in efficient depithing and wet pile storage have certainly contributed to the growth in utilisation of bagasse for various grades including the particle board. However, in the area of pulping, the focus has been only to manufacture of newsprint grade pulp for manufacture of bagasse newsprint. A detailed account of various attempts to produce bagasse newsprint during the last 3 decades has been covered by Dr. Joe Atchison in his various papers (1). The manufacture of commercially acceptable newsprint using high percentage of bagasse in the furnish has not been successful, until recently, when the break-through eventually was achieved at the Tamil Nadu Newsprint and Papers Limited (TNPL) for whom Beloit-SPB Process was specifically developed. This mill produced the world's first commercially acceptable newsprint in October 1985. The details of the process and the commercial exploitation of this process at TNPL were presented in the International Seminar on Bagasse Newsprint held in Madras in April 6, 1986.

This break-through in the manufacture of bagasse newsprint has created tremendous interest and confidence in the paper industry which has entertained a long time serious doubts and misgivings for producing acceptable newsprint utilising substantial amount of bagasse. Additionally, the enormous developmental work carried out by various research institutions and organisations for development of suitable process for manufacture of bagasse newsprint has helped to understand better, characteristics of bagasse and its utilisation for various other grades such as corrugated medium, particle board etc.

Review of Comparison of Bagasse Newsprint Mills

In Table 1 comparison of three bagasse based newsprint mills that are commercially operating based on various processes are given. From the comparison, it can be seen that Beloit-SPB Process is the only process that does not use any long fibre softwood pulp, but still has commercially acceptable opacity and strength properties. The details of the development of the process and the commercial break-through achieved were presented in the TAPPI Pulping Conference, Toronto, 1986^{2,3}.

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TABLE 1
COMMERCIAL INSTALLATION—COMPARISON OF BAGASSE NEWSPRINTS

PROCESS	Units	BELOIT-SPB	CUSI	PEADCO
MILL LOCATION		TNPL-INDIA	TUCUMAN-ARGENTINA	LETJES-INDONESIA
FURNISH		MBP-50% CBP-35% HW-15%	SCBP - 75% GWD - 15% SBK - 10%	SCBP/SCSP - 40% TMP-B 45% SBK - 15%
PROPERTIES :				
- BASIS WEIGHT	gsm	50.6	49.6	50.8
- CALIPER	microns	85.0	67.0	78.0
- TEAR FACTOR (CD)		44.0	61.0	53.0
- PRINTING OPACITY	%	93.5	88.0	93.3
- SCATTERING CO-EFFICIENT	cm ² /g	450.0	437.0	407.0
- BRIGHTNESS	°GE	50.5	59.0	56.0
- MACHINE SPEED	mpm	630.0	600.0	NA

MBP — MECHANICAL BAGASSE PULP
 TMP-B — THERMO MECHANICAL PULP (BAGASSE)
 SCBP — SEMI CHEMICAL BAGASSE PULP
 SCSP — SEMI CHEMICAL STRAW PULP

SBK — SEMI-BLEACHED KRAFT
 GWD — GROUNDWOOD PULP

However, for purpose of quick comparison of the various processes, flow diagrams are presented in Fig. 1 Beloit-SPB Process, and Fig 2 - Cusi Process. The flow diagram for Peadco Process adopted at Let jes, Indonesia is not available. Cusi Process cannot be strictly called a process for newsprint since it does not produce mechanical pulp that normally gives high scatter. That is why the Cusi Process, in spite of using 15% groundwood has a lower scattering co-efficient which is a more representative parameter for comparison than opacity. It should be noted here, comparing printing opacity of different newsprint could be misleading if due corrections are not given for basis weight and brightness and secondly lowering the brightness would increase the opacity, but may still give rise to print through due to poor ink absorbancy.

The reasons for lower opacity, more precisely, lower scattering co-efficient in Cusi Pulp was investigated in detail by carrying out pilot plant trials at the

Herty Foundation, Georgia. The results of the investigations were published in the TAPPI Pulping Conference 1984, Sanfrancisco⁴. The results of these investigations have enabled understanding various schemes for semi-chemical pulping and their potential techno-economic implications. A schematic diagram of various semi-chemical pulping process is given in Fig. 3.

Review of Proposed Processes for Bagasse Newsprint.

A comparison of various processes that have been developed at pilot plant/semi-commercial scale is furnished in Table 2. It can be seen from the table, that excepting the Sands Process⁵ and Beloit-SPB Process, all other processes recommend use of long fibre pulp to the extent of 15—20%. Referring to the Sands Process, it is difficult to accept that as a truly bagasse newsprint process, since the use of bagasse in the furnish is only limited to 60% and it further relays

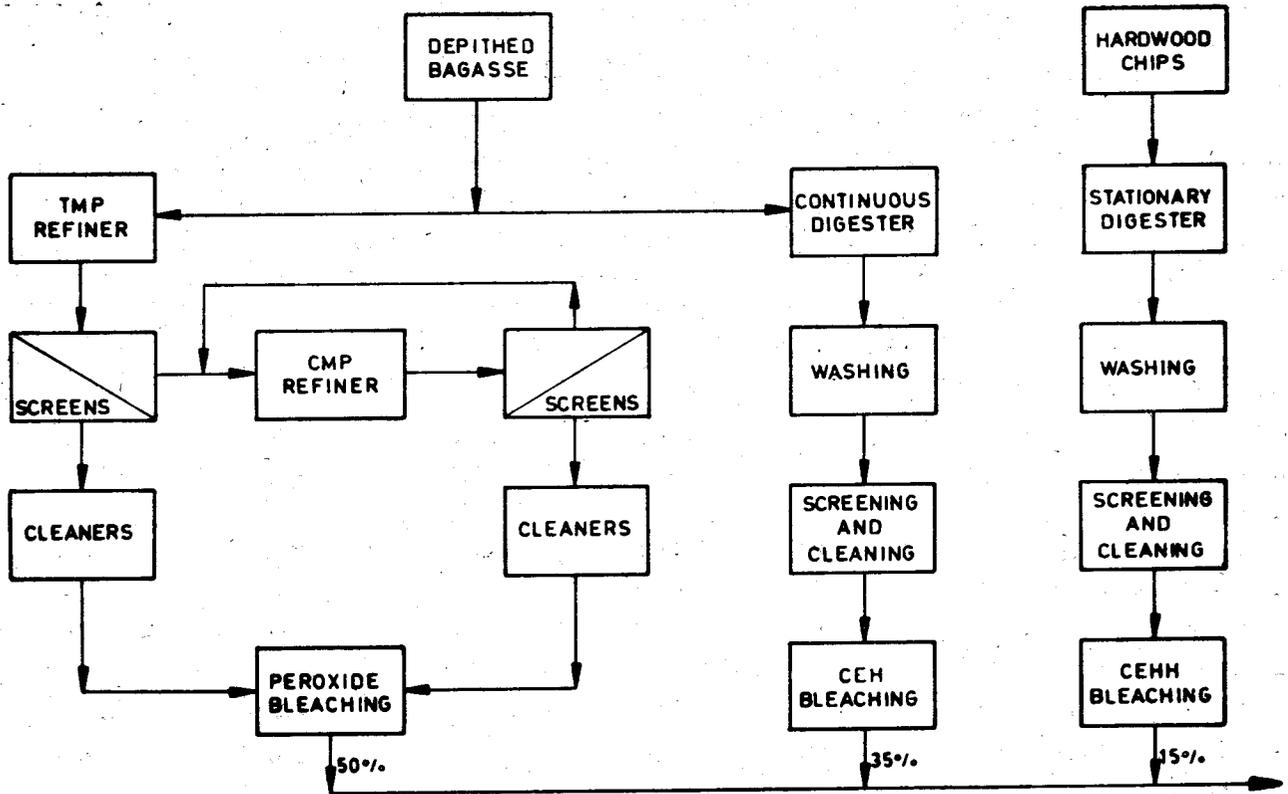


FIG. 1. BELOIT - SPB PROCESS FLOW DIAGRAM

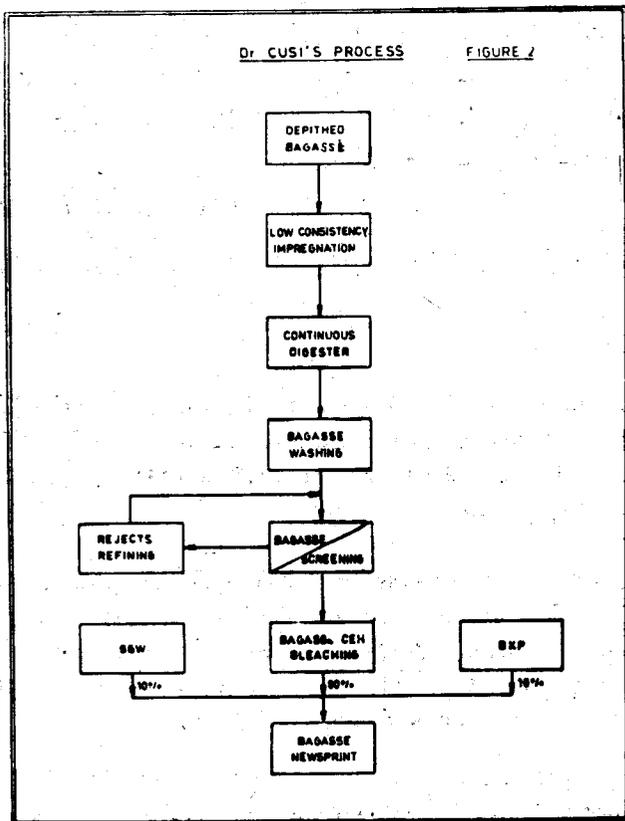


FIG 2

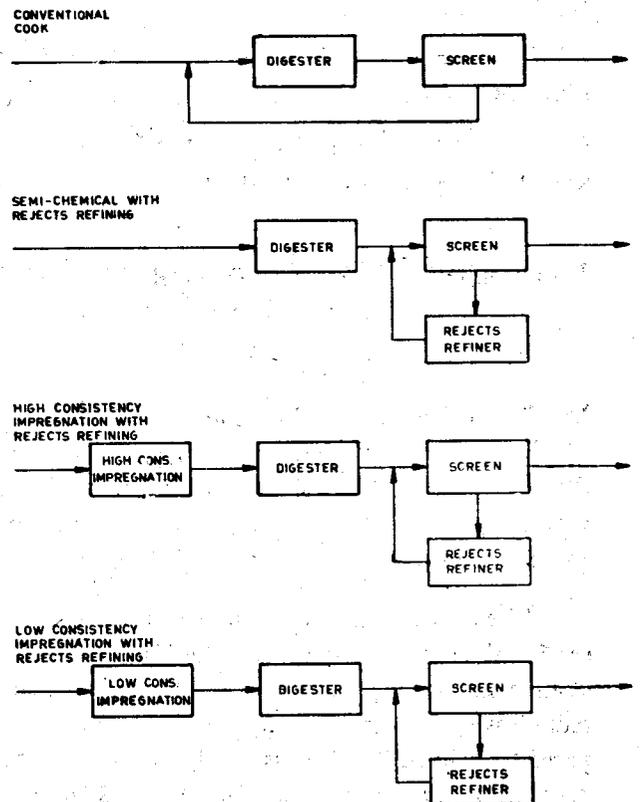


FIGURE 3. SYSTEMS

TABLE 2
PILOT PLANT TRIALS — COMPARISON OF BAGASSE NEWSPRINT

PROCESS	Units	CUBA-9	GIRIS-HZ	SUNDS	C.E. BAUER	BELOIT-SPB
FURNISH		CMP-B-80% SBK -10% GWD -10%	CTMP-B-85% BKP -15%	CBP 60% CMP-HW40%	CTMP-B-85% BKP -15%	MBP-50% 60.0 CBP-35% 40.0 HW-15%
PROPERTIES :						
— BASIS WEIGHT	gsm	52.0	51.2	52.0	51.0	50.4 50.0
— CALIPER	micron	86.0	80.0	NA	85.0	92.0 95.0
— TEAR FACTOR (CD)		45.0	62.0	NA	62.0	41.0 41.0
— PRINTING OPACITY	%	91.0	86.4	92.0	89.0	92.0 94.0
— SCATTERING CO-EFFICIENT	cm ² /g	NA	NA	440.0	NA	480.0 500.0
— BRIGHTNESS	°GE	52.0	47.0	57.0	52.0	58.4 56.0
— MACHINE SPEED	mpm	600	50	30	100	730 730

NA — NOT AVAILABLE

CMTP-B — BAGASSE CHEMI THERMO-MECHANICAL PULP

CMP-B — BAGASSE CHEMI-MECHANICAL PULP

SBK — SEMI BLEACHED KRAFT

GWD — GROUNDWOOD

BKP — BLEACHED KRAFT PULP

CBP — CHEMICAL BAGASSE PULP

MBP — MECHANICAL BAGASSE PULP

HW — HARRDWOOD CHEMICAL PULP

CMP-HW — HARDWOOD

CHEMI-MECHANICAL PULP

Note :—CHEMICALS USED FOR CTMP/CMP IS 2-4% AS Na₂O AND FOR BLEACHING 2-4% AS H₂O₂ IN ALL CASES EXCEPT SUNDS.

heavily on the hardwood for the principal component of the furnish i.e. mechanical pulp. Therefore, this furnish conflicts with the primary objective of producing newsprint from bagasse which is to replace hardwood whose availability is dwindling day by day.

The closest commercial success is the Cuba-9 Process⁶ since they have run the furnish at close to commercial speeds. However, the brightness is reportedly lower in spite of using peroxide bleaching compared to Beloit-SPB Process. The strength and optical properties are lower than the Beloit-SPB process in spite of using 20% long fibre pulp.

Since these three Processes viz. Cuba-9, Giris-HZ and C E Bauer are using basically bagasse CTMP/CMP, a typical flow sheet of Giris-HZ CTMP Process is shown in Fig. 4⁷.

Yet another process i.e Nitric Acid Pulping Process⁸ claims to offer a high yield for bagasse chemi-mechanical pulp. However, there is no provision for chemical recovery and further the consumption of expensive peroxide is as high as 5%.

The processes using high percentage of CMP/CTMP do not address the problem of recovery of chemicals

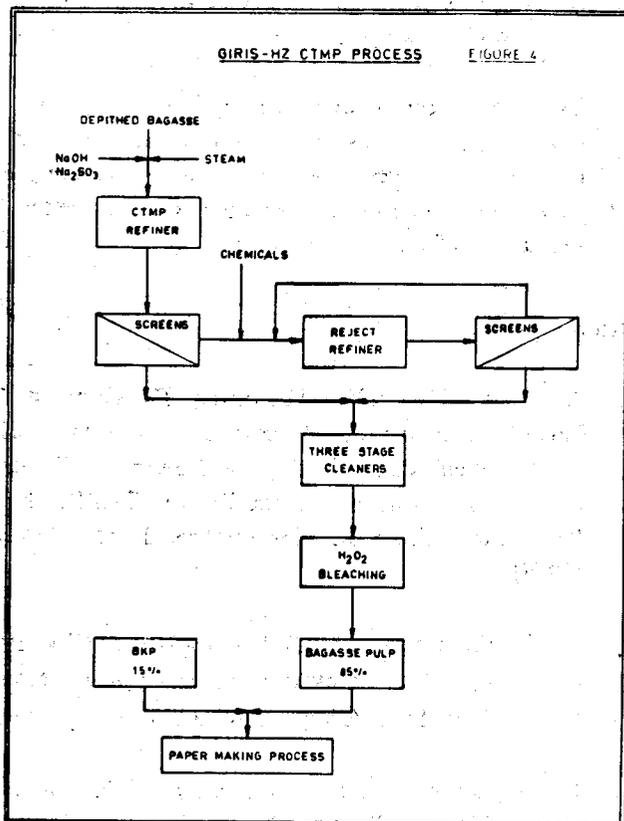


FIG. 4

from the weak spent liquor as a result of which not only the overall make-up chemical consumption is found to be higher than Beloit-SPB Process, but also the load on effluent treatment plant going up.

The comparison of these processes lead us to following conclusions :

1. High consistency impregnation is preferable than low consistency pre-impregnation for newsprint grades because of the higher scattering of the former pulp
2. Mechanical pulping of bagasse is an integral part of any process to produce newsprint from bagasse fibres
3. The amount of mechanical pulp in the furnish is dictated by sheet brightness, the initial brightness of bagasse and the relative economics of bleaching
4. Heterogeneity of bagasse demands that mechanical bagasse pulp be a mixture of TMP and CMP
5. The combination of TMP and CMP, as against straight CMP/CTMP, helps to reduce chemical consumption and BOD load in the effluent

Development in the Manufacture of Corrugated Medium

One of the biggest mills for producing corrugated medium in the world is the Felixton Mill in South Africa which produces about 150,000 tonnes per annum of corrugated medium⁹. This mill was the first mill to adopt Ritter wet bulk storage system in 1956. The wet storage system and the subsequent bagasse washing the depithing system have contributed to better fibre preparation and less silica and sand in the pulp. The high yield soda pulp is carried out in a 3-tube defibrator digester. Based on their experience to achieve a concolor value for the corrugated medium, they recommend a temperature during cooking below 140°C and a controlled and a selective active alkalinity. The mill employs a three-stage refining sequence in series for bagasse, using one as hot-stock pre-refining and other two as fibrillation stages. Recently Morcapel Paper Mills in Venezuela have published interesting results in the TAPPI Pulping Conference 1984¹⁰, where they have used a mixture of sodium carbonate and sodium hydroxide solution basically to reduce the consumption of more expensive sodium hydroxide. This process again utilises a good wet storage system followed by a moist depithing of bagasse and a continuous digester for cooking. The cooked bagasse is refined in a hot stock refiner at low consistency (4.5%).

In both these processes, it can be seen that the semi-chemical pulp is directly refined without any fractionation step ahead of refining. If the pulp is fractionated and the rejects are refined and added back to the accepts, it is believed that the strength properties would be much improved,

Miscellaneous Products and Processes

The use of bagasse in multi-wall sack has been well established in Peru, Phillipines and Thailand. The bagasse in the furnish is about 60-70% and the balance is imported softwood pulp. Again here the imported pulp can be reduced if a fractionation of bagasse chemical pulp is done to separate the long fibres and refine them separately to develop the strength potentials of the long fibre.

In the manufacture of reconstituted panel board, there has been some recent developments in using pressurised refiners. The two plants—one in Khonkaen, Thailand and the other in Tuxtepec, Mexico—have used

bagasse TMP successfully and have produced medium density fibre board^{11,12}. The manufacture of oriented stand board (OSB) also becomes feasible now, with the commercial success achieved at Ecuador in the separation of rind fibres from the cane. Rind chips can also be used for manufacture of excellent wafer boards.

The Naco process¹³ developed by Sunds Defibrator jointly with Italian Institute provides an interesting alternative to conventional bagasse pulping especially for small scale. With its low lignin content, bagasse lends itself ideally suitable for oxygen delignification. Also, the first oxygen bleaching stage installation at Kimberly Clark, Orizaba, Mexico¹⁴ lends strength to the development of a high brightness but strong bleached pulp with lower chlorine consumption.

Conclusion :

To sum up, the recent development in bagasse pulping have contributed enormously to the better and higher utilization of bagasse in various grades, especially in newsprint.

In the opinion of the author, the future developments would be dictated by commercial exploitation of following techniques/concepts :

- 1 A more efficient depithing system that will reduce the loss of useful fibre that occurs in the existing systems.
- 2 The installation of Tilby cane separator in new mills for separation of rind fibres. This system will make revolutionary change in our approach to fibre preparation and pulping of bagasse.
- 3 The preservation of brightness in storage of bagasse for use in newsprint grades.
- 4 The fractionation of bagasse before and after pulping depending on the grades of the paper to be produced.
5. High intensity mixing and pre-impregnation steps ahead of cooking.
6. The use of batch digesters to reduce capital cost and maintenance cost.
7. The refining strategies for high consistency and low consistency refining.

8. The use of oxygen delignification both in cooking and bleaching stages.

Considering the scope and extent of work to be done in developing the above areas leading to commercial success, one can say that there is a challenging but exciting period ahead, in effective utilisation of bagasse for pulping.

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