

Utilisation of Bagasse For Paper Making- An Overview

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ABSTRACT

India is the largest sugarcane producer in the World with an annual cane generation of around 300 million tonnes. Of this only 50% is consumed for production of sugar and generation of bagasse by sugar mills. Bagasse is the residue left over after extraction of Juice from sugarcane. Various grades of papers like printing and writing, packaging, coated papers and newsprint are manufactured in the country using substantial percentage of bagasse pulp in the furnish. Nearly 20% of our paper production is from bagasse.

This article provides an overview with the status of bagasse based paper making in our country.

INTRODUCTION

India and China lead the bagasse pulp production in the World. India is said to produce around 28% World's bagasse pulp while China produces about 22%. The Indian Paper Industry is primarily dependent on three major raw material sources viz., Forest, Agricultural residues and Secondary fibres. With dwindling forest resources and the resultant scarcity for forest based raw materials like Wood and Bamboo, the paper industry in India will increasingly depend on agricultural residues and secondary fibers in the years to come. The present distribution of raw material-wise paper production is shown in Fig.1. Paper production from forest based raw materials which was more than 60% during the early eighties has dropped to around 37% today.

BAGASSE-RELEVANCE IN INDIA

India is the largest producer of sugar cane. The sugar industry is bound to grow in this country due to high level of population. The potential for generation of bagasse in the sugar mills and the usage of bagasse in paper making is detailed in Table-1. As can be seen, the potential for use of bagasse is tremendous. This is evident from the fact that India at present has the largest and perhaps the only successful bagasse based newsprint mill in the World. There are also large and medium scale mills producing printing and writing paper from bagasse with one of them even producing coated papers with chlorine dioxide bleached chemical bagasse pulp. Many small

scale mills also use bagasse for production of kraft paper used as fluting medium in the packaging industry. However, bagasse is mainly used to produce bleached chemical bagasse pulp for printing and writing grades.

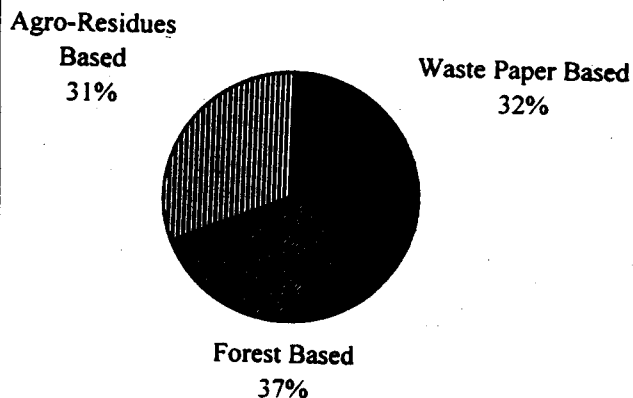
Fast depleting forest cover, inability to take up plantation in a large scale, absence of an organised waste paper collection system are some of the reasons for our country to look at an agro-based raw material for paper making.

However, among the various agricultural residues, Bagasse has emerged as the most suitable raw material that can be used for the manufacture of good quality paper, primarily for the following reasons:

- India has tropical climatic conditions favouring growth of sugarcane.
- Bagasse being a by-product of an organised industry, large quantities are available at a single point and hence collection and transportation are easier.
- Bagasse is an annual cash crop.
- The technology for manufacture of paper from bagasse and chemical recovery systems are well established.

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Fig.1. Raw Material Wise Distribution of Paper Production in India



The incentive being given by the Govt of India by way of concessional excise duty for paper containing not less than 75% bagasse pulp will further support the growth of bagasse based paper making in this country.

BAGASSE AS A RAW MATERIAL FOR PAPER MAKING

Bagasse is the fibrous residue that is left after the extraction of sugar juice from cane. A typical comparison of the proximate analysis of various raw materials including bagasse is given in Table-2.

Following are the inferences:

Potential for usage of Bagasse for paper making			
Particulars	1994-95	(Million tonnes)	
		2000-01	2005-06
Sugar production	14.6	20.0	25.0
Cane crushed	146.0	200.0	250.0
Bagasse generated	43.8	60.0	75.0
Potential usage for paper making %	7	10	12
Potential usage for paper making	3.1	6.0	9.0
Possible Pulp production	0.6	1.1	1.6
Possible paper production with 75% bagasse pulp in the furnish	0.7	1.4	2.2

- Bagasse has a much higher 1% NaOH solubility when compared to other raw materials except straw. This indicates that Bagasse is susceptible to deterioration during storage. Hence adequate precaution has to be taken to ensure that bagasse is stored in a manner which will ensure minimum degradation.
- Bagasse has a much lower value for Alkyl-Benzene Extraction when compared to other raw materials and hence the presence of wax

Table-2

Proximate analysis of raw materials

All figures in %

Sl No.	Property	Bagasse depithed	Bamboo	Soft wood (Pine)	Hard wood (Eucalyptus)	Wheat straw	Rice straw
1	Hot water solubility	5.9	11.1	2.0	5.24	10.5	15.5
2	1% NaOH solubility	31.6	28.0	12.2	14.55	40.1	49.4
3	A/B Extraction	1.7	8.0	2.0	2.6	5.3	7.4
4	Lignin	26.9	32.0	28.8	29.90	17	10.6
5	Hollocellulose	66.1	56.6	69.0	69.4	70.7	70.2
6	Pentosans	28.9	20.3	8.6	19.3	25	24
7	Ash	2.6	3.4	0.2	0.08	7	14.8
8	Silica	2.0	3.0	0.13	0.05	5	11.5

and resins is much lower in bagasse. Due to this, the presence of pitch is minimised in bagasse pulp.

- Bagasse has a higher pentosan content when compared to other raw materials. Beta and Gamma Cellulose content is more in bagasse. This ensures good bonding characteristics for bagasse pulp.
- The lignin content in bagasse is much less than that in bamboo and wood. Hence the chemical requirement for bagasse pulping is much less when compared to that required for bamboo or wood. Of significance is the fact that the structure of lignin in bagasse is more open and hence mild cooking conditions are adequate.
- The hollocellulose content is comparable to that of wood, indicating that the yield will be similar to that of wood based raw materials.
- The ash content in bagasse is higher than that of wood based raw materials but still much less when compared to straw.

ISSUES FOR CONSIDERATION

BAGASSE PROCUREMENT

- As already detailed in Table-1 due to excellent growth potential for the sugar industry, bagasse will be available in plenty in our country. However, efforts have to be made to ensure that atleast a part of the bagasse available is diverted for paper making.
- The location of the paper mill plays a major role in ensuring availability of bagasse. It would be ideal if the paper mill is located within a radius of 50 kilo meters of the nearby sugar mills.
- In order to ensure reliability in the supply of bagasse, paper mill has to strive for a long term agreement or commitment for supply of bagasse by the sugar mill.
- It is equally important to maintain good relationship with the sugar mill apart from gaining their confidence through reasonable price, regular offtake, prompt payment etc.

- Bagasse has several alternate uses which make its availability for paper production a function of changing circumstances. Hence bagasse procurement techniques pose a challenge for any bagasse based paper mill. Traditionally in India, bagasse that is left over after meeting the fuel requirements of the sugar mill was being collected and used for paper making. With the setting up of large paper mills based on bagasse, a breakthrough has been achieved in obtaining bagasse by substitution where the entire bagasse generated by the sugar mill is released against the supply of steam or alternate fuel. It is always advantageous, if possible, to tie up atleast 50% of the requirement of bagasse on fuel substitution basis. While it is expensive, it ensures reliable availability of bagasse atleast to the extent of 50% of the paper mills' requirement. This will also give the paper mill additional muscle power to negotiate with other nearby sugar mills to obtain surplus bagasse.
- It is also, in the interest of the paper mill, essential to keep all the options for use of alternate raw materials open. Pulping system has to be flexible.

Co-generation of power by sugar mills seems to be a major threat for the paper industry to obtain bagasse. Many sugar mills are establishing projects for co generation of power based on bagasse. Apart from using bagasse generated by their sugar mills, these co generation projects compete with paper mills like ours to procure bagasse from other nearby sugar mills. It should also be noted that for these sugar mills to use bagasse as fuel, the quality of bagasse in terms of contamination is irrelevant. While paper mills struggle to get good quality bagasse from sugar mills, the cogeneration projects collect even contaminated bagasse and use them as fuel.

It is for the industry to work towards spreading the message that the paper mill can offer an assured offtake of bagasse at a reasonable price so as to discourage the sugar mills from establishing cogeneration projects.

BAGASSE STORAGE

Invariably the most important and at the same time the most neglected area in an agro based mill is the 'storage'. Depending upon bagasse procurement methodology, location of depithing operation etc each

mill has to devise its own storage system. In India and all over the World, small mills adopt baled storage while large mills use the wet bulk storage method. Sugar mills operate for only six months in a year. Hence bagasse has to be necessarily stored to take care of the off-season period. Bagasse storage is further complicated by the deteriorating nature of bagasse and paper mills will have to adopt a storage method which will ensure supply of well preserved bagasse for paper making. Following issues need careful consideration:

- Baled storage is prone for fire. Periodical measurement of stack temperature, installation of suitable fire hydrant systems are important. Water can be sprinkled to keep the stack surface wet.
- Wet bulk storage offers many advantages but capital and operating costs are high. In addition the back water requires good treatment due to high BOD.

BAGASSE PREPARATION

The preparation of agricultural raw material before it enters the cooking cycle is the most important single step to ensure sustained production of good

quality paper. Some of the practical issues that need to be kept in mind for effective utilisation of bagasse for paper making are:

- Bagasse is a bulky raw material and hence is difficult to handle.
- Sand and grits that enter the bagasse during harvesting of cane and during the retrieval after storage, has to be removed before pulping.
- Judicial recycling of back water in the preparation system.
- Maximise removal of pith in moist form (at about 50% moisture) so that this pith can be burnt in boilers at sugar mill or paper mill. If more pith is generated in wet form, its disposal will be a problem.

BAGASSE PULPING

Pulping of a well prepared bagasse is an established technology. Following aspects require consideration:

- High bath ratio in the digestion to ensure minimum shives content in bagasse pulp.

Table-3

Properties of printing & writing paper (non surface sized) produced from various furnishes

Sl No.	Property	Units	Furnish #1 CBP-75% HWP-25%	Furnish #2 HWP-100%
1	Burst factor	-	20	25
2	Tear factor	-	42-45	54-59
3	Breaking Length	m	4500-5300 2500-3400	5800 3700
		MD CD		
4	Smoothness	m/min	160-300 80-220	200-400 100-300
		Top side Wire side		
5	Porosity	m/min	400-500	800-900
6	Wax pick	Top side	8	7
		Wire side	9	8
7	Brightness	% ISO	80-82	76-78
8	Opacity	%	90-91	93
9	Bulk	cc/g	1.3-1.4	1.5
10	Ash	%	9-10	12-14

- At all stages the system has to preserve freeness of bagasse pulp. Install a low consistency cold blow from digester.
- Minimise washing loss. Look at addition of a sweetener pulp, if possible.
- Air entrainment is to be avoided. Otherwise System will be highly foamy.
- Bagasse is easily bleachable. Hence mild bleaching is adequate. Use less bleaching chemical.

CHEMICAL RECOVERY

Bagasse pulping generates large volume of weak black liquor. Evaporation plant is invariably the bottleneck in most bagasse based mills. The following have to be taken care of:

- High carry over of fibres with weak black liquor.
- High scaling tendency in evaporator tubes due to silica.

Systems in recovery boiler and recausticising plant are conventional.

STOCK PREPARATION AND PAPER MAKING

- The freeness of unrefined bleached bagasse pulp itself will be of the order of 30 deg shopper reigler while for tropical hard wood the freeness of bleached pulp will be of the order of 20-22 deg. It is therefore essential to ensure a very gentle refining of bagasse pulp in order not to generate fines and develop high degree SR.
- Wet web strength of bagasse pulp is inferior to wood pulp and therefore the machine configuration particularly the draw between wire and press, press and the first group for drying cylinders are extremely important.
- Addition of ash requires close monitoring since bagasse pulp is weak in nature and cannot take more ash when compared to pulp from hard wood or soft wood.

QUALITY OF PAPER FROM BAGASSE

For the purpose of comparison, the properties of bagasse based printing and writing paper having 75% bagasse pulp and 25% hard wood pulp is com-

pared with printing and writing paper from 100% hard wood pulp. Table-3 details the properties of printing and writing paper produced from the above two furnishes.

Following are the inferences:

Strength Properties

- Tear factor low due to short fiber length and physical damage during cane crushing at sugar mills.
- Burst factor and breaking length are comparable due to better bonding characteristics.

Optical Properties

- Brightness stability and Whiteness index are higher. Paper appears brighter and whiter.
- Opacity is lower, made up partly by filler addition.

Printing Properties

- Smoothness high. Bagasse pulp forms sheet of higher density and good formation.
- Printability is superior. Bagasse sheet has high smoothness, good formation and lower ink absorbency.
- Surface strength is superior. Wax pick is higher due to better bonding.
- Bulk and Porosity are lower. Bagasse pulp helps to form a more compact sheet.

CONCLUSIONS

Bagasse is an excellent raw material for paper making particularly for bleached printing and writing grades. Bagasse has certain deficiencies like being bulky in nature, presence of sand and grit and susceptibility to deterioration during storage. The papers made from bagasse have lower bulk, opacity and strength properties when compared to that from softwood. If these deficiencies are recognised, understood and addressed, then bagasse can be used for production of good quality paper grades. The use of bagasse for manufacture of newsprint has also been demonstrated, though the operating parameters and the quality of newsprint sheet are being optimised. Particularly in tropical agro-based countries, bagasse will find increasing usage for paper making.