Selective Refining of Bagasse and Writing and Printing Papers From A Blend of Bagasse and Eucalyptus

SWAMY VEERABHADRA G. P.

ABSTRACT

This work was carried out by the author in the Technical University of Trondheim. Norway, under the guidance of Prof. H.W. Giertz during the one year's M.S degree course in Pulp and Paper Technology, under the common wealth scholarship programme for the year 1985-86.

The availability of the forest based raw materials has come to such a low level that the pulp and paper industries are starving for want of raw materials. The Governnents are putting severe restrictions on deforesttation to maintain the ecological balance. Thus it is quite imperative for the pulp and paper industries to go in search of alternative raw materials. One such alternative is to go for the sugar cane begasse.

At present, advanced technologies are available for processing bagasse into an useful fibrous raw material for making almost all varieties of paper by blending certain other types of pulps. For developing countries like India, at this period of raw materials crisis, bagasse can be a boon, if it can be properly utilized by the paper industries.

This paper deals with mainly two aspects, In one aspect a study has been made on the fractionated refining of the bagasse rejects and blending it back with the accepts. The aim of the study was to find out whether the fractionated refining would improve the quality and strength properties of the pulp or not, when compared with that of the whole pulp refining. Basides this an effort has also been made to evaluate the effect of different alkaline cooking conditions on the screened and unscreened yield and the kappa numbers of both the accepts and rejects of depithed bagasse. The second aspect deals with the production of writing and printing grades of paper by using a furnish of bagasse chemical pulp and eucalyptus-cold soda refiner mechanical pulp (CSRMP). The aim was to improve the light scattering properties of the paper.

1. COMPOSITION OF BAGASSE (OVEN DRY BASIS)

1.	Water solubles	—	8 – 10%
2.	Pith	—	30%
3.	Epidermis and Dirt	—	5%
4.	Fibrous material (Vascular bundles)	—	55%

(1) PITH OR PARANCHYMA :

This part is the container of the juice scattered all over the cross section of the sugar cane. It is non-fibrous in character. Each cell of the pith is filled with the tiny droplets of saccheriferous juice. When the sugar cane is subjected to crushing under high pressure in the sugar mill rolls, the juice will be squeezed out, by bursting open the cell wall. Thus each cell has a broken wall. The cell wall length varies from 0.2-0.8mm. Pith is non-fibrous in charactor. It is the most undesirable component for paper making as it consnmes much chemicals, resists drainage on the wire and wash fitters and contributes nothing towards the paper strength due to its non-fibrillated nature.

Typical for the pith cells is that they are extremely thinwalled. Even it does not act as an opacifying material as one can imagine because pith cells are so thin that they can not split in the plane of the wall. The walls are only broken down to smaller flakes with the same thickness as that of the original pith cell wall[3].

EPIDERMIS :

It is the outer most layer of the stalk. It is non-fibrous in nature and very much resistant to digestion. It contains waxes and is an undesirable element in the stalk for pulp production.

VASCULAR BUNDLES :

These are the fibrous materials randomly scattered and embedded in the pith cells throughout the cross-section of the sugar cane. The central vascular bundles constitute fibres of small diameter with thin cell wall and large lumen when compared with the wood fibres. These fibres can be pulped very easily with a relatively low amount of chemical at low concentration and at relatively low temperature. These fibres are pentosan rich and easily separated on chemical treatment. They have excellent fibre bonding characteristics as easily collapsible on consolidation, but paper produced from these fibres has poor tear strength and low opacity. These fibres produce drainage resistance drastically when subjected to beating.

Approximately 50% of the dry weight of the stalk consists of high quality fibre bundles which are concentrated in the hard, dense rind layer of stalk. Because of this dense and compact structure they form a rind which protects the sugar juice inside the pith until the cane is ready for processing. The fibres in the rind layer[1,2] are larger than the scattered fibrous elements in the centre of the stalk, and are more resistant to chemical action than either the pith or the interior fibres. Nassar[3] however found that the average fibre length in the inner and outer parts of the cane stalk is similar. The pulp produced from this rind vascular fibres possesses good tearing strength and has strength properties that are similar to those of sulfite wood pulps. It is difficult to separate these two fractions mechanically from raw bagasse. This can be done as suggested[2] by Cusi if a mild chemical treatment is given to bagasse.

In cusi process, the depithed bagasse is impregnated with cooking liquor (8-10%) and cooking is carried out in a continuous digester for a short time (15 min.) at 170°C with soda or sulphate. The pulp produced is a mixture of cooked and uncooked fibre bundles. The two fractions are separated by screening at a low consistency. The accepted fraction, from screening consists of easily cooked short fibres and vessel elements from the central vuscular bundles and the rejected fraction, consists of bundles from chemically resistant rind vascular portion. The 'rejects' fraction is refined to a desirable degree of hydration and recombined wiht the 'accepts' fraction to produce a wide varieties of paper.

The average length of bagasse fibre is 1.7mm and the diamater 0.02mm. The fine structure of fibres is similar to that of wood, with one primary wall and three distinct secondary wall layers[4,5]. The chemical composition of bagasse fibre is nearly the same as hardwood; Ash-2%, Lignin-21%, Pentosans-30% and Cellulose-53%.

2. SODA COOKING OF BAGASSE IN AUTOCLAVES—A COMPARATIVE STUDY RAW MATERIAL; DEPITHED BAGASSE FROM THAILAND :

A series of cooks were performed in a set of 2 litre autoclaves with a fibre, liquor ratio of 1:7. Amount of sodium hydroxide charged was varied from 8 to 16% on OD fibres. A constant cooking temperature of 170°C and cooking times of 30 minutes was maintained in all the cases except for the 14% alkali charge where the cooking time was varied in order to study the effect of increased cooking time on the yield and the kappa number. No pre-steaming was done and in order to reduce the impregnation time to as minimum as possible, the cooker was heated to 170°C before the autoclaves were mounted on to the Acolus in the cooker. In this way, the time taken to cooking temperature was only 15 minutes. The pulp was washed throughly and difibrated in the wennberg propeller for 5 minutes. The pulp was screened in tht NAF Water jet apparatus with 2mm perforations, using a water jet pressure of 2.0 KP/cm². The accepts and rejects were collected and the Kappa numbers of them were found-out.. The results are presented in table No I and the diagrams 1, 2 and 3 show the dependance of yield on the alkali charge, the dependance of accepts fraction on the alkali charge and the influence of cooking time on the kappa number in prolonged cooks.

TABLE—1

SODA PULPING OF DEPITHED BAGASSE

Cooking conditions		Yield, %			Kappa No.	
NaoH on OD weight of fibres	Minutes at 170°C	Total	on total Screened%	on total Rejects%	Screened	Rejects
8	30	76	50	50	59	74
10	30	66	65	35	40	60
12	30	64	83	17	29	43
14	30	64	90	10	25	47
14	60	63	95	5	22	43
14	120	59	100	—	26	—
14	180	59	100	—	29	—
16	30	54	96	4	19	41

As can be seen from the table No. I, with alkali charges at 14%, the kappa number decreased slightly at 60 minutes cooking compared to that of 30 minutes. But with the same alkali charge at higher cooking times viz 120 and 180 minutes, there is a rise in the kappa numbers, which indicates the redeposition of lignin when the alkali has been consumed. This lignin redeposition is a result of lignin condensation reactions. The lignin coated fibres thus obtained are bad in quality.

The factor determining the degree of digestion, is the amount of alkali charged as shown in figure 1 and 2. While using well depithed bagasse, as in the present study, the yields are relatively high. Using 14% NaOH charge, a bleachable pulp is obtained with a yield of about 64 percent and kappa number of 22. The pulps to be used unbleached, in the yield range of 66 percent, will require 10-12% alkali, such pulps contain shives which can be easily defibered while refining hot, with associated black liquor, with 8% alkali charge a semi chemical type pulp with an yield of 76 percent can be obtained.

The kappa numbers of the rejects are found to be higher than that of the accepts as the rejects consists of relatively uncooked and chemically resistant fibre bundles from the rind Vascular bundles which are not properly delignified.

This study confirmed the earlier works done on this subject.

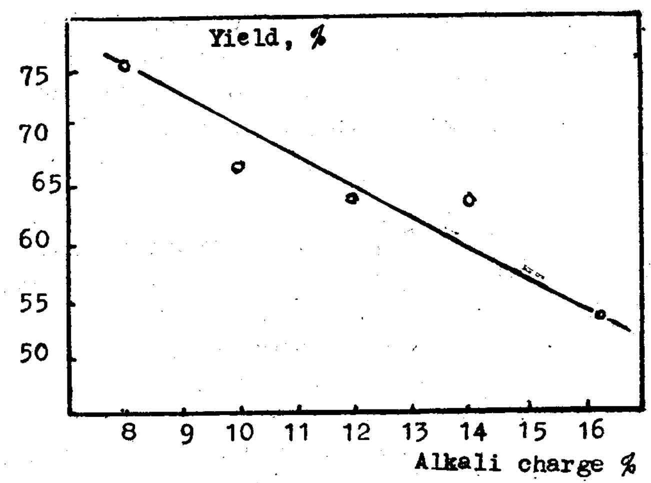


FIG. I

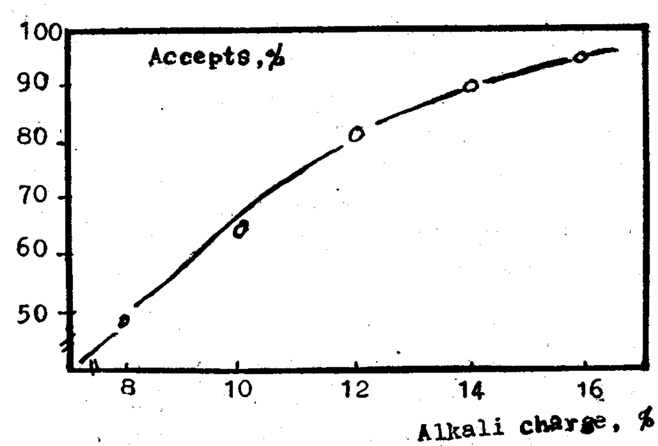


FIG II

(3) SODA COOKING OF BAGASSE IN A 50 LITRE CAPACITY DIGESTER

This experiment was carried out with an intention of producing a high yield bagasse pulp using NaOH as the cooking chemical. The idea was to produce enough quantity of bagasse rejects and subsequently to refine them in a laboratory sprout waldron 12" disc refiner to produce an acceptable quality pulp. The aim of the study was to see that how far the fractionated refining of rejects would improve the quality and the strength properties of the pulp. The purpose of blending back the 'rejects', refined to the required freeness values, with the 'accepts' in the same ratio as fractionated from the original pulp was to imitate the commercial practice.

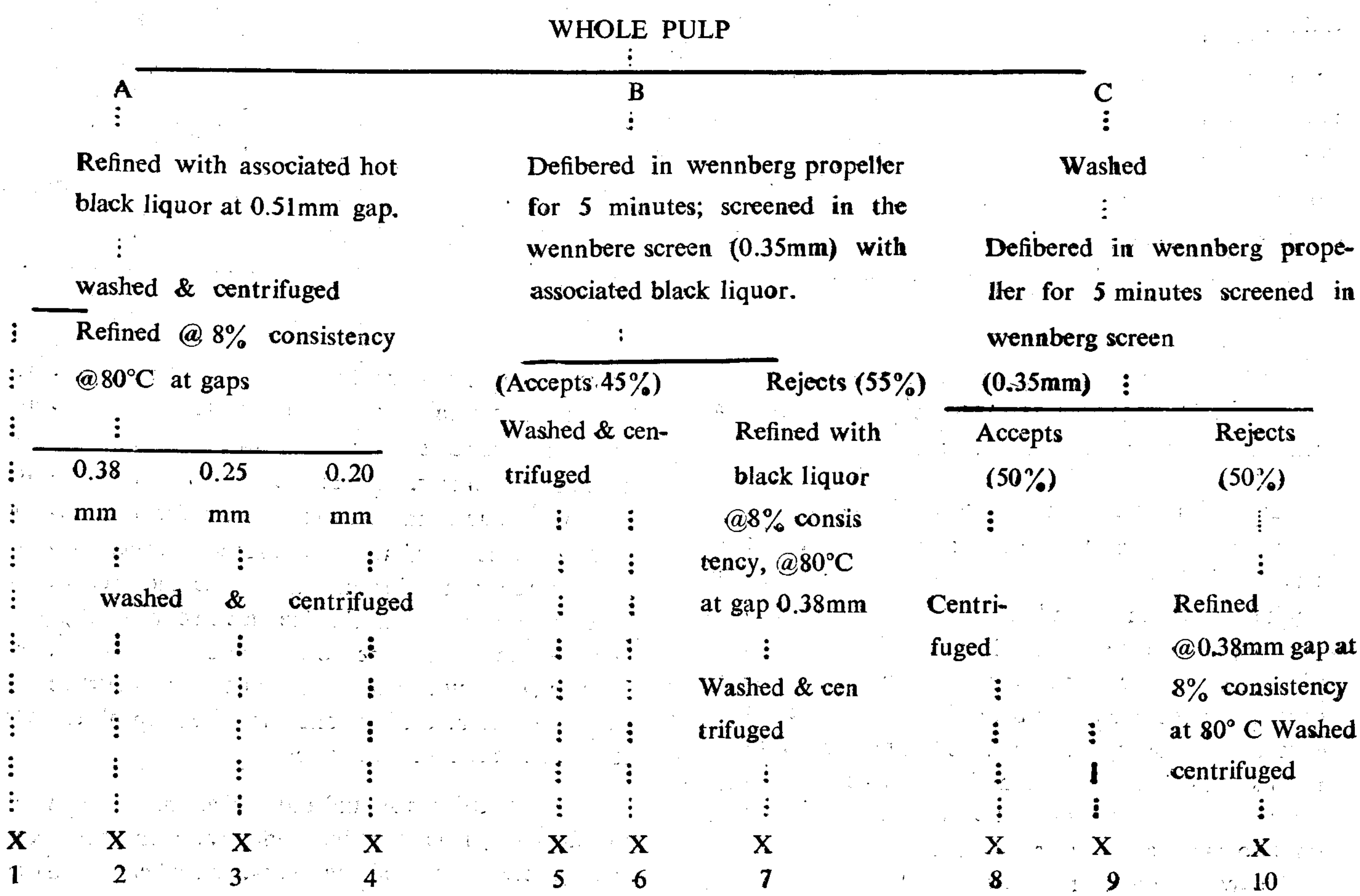
EXPERIMENTAL WORK :

Raw material:—Commercially depithed bagasse from Thailand.

FIRST TRIAL :

Bagasse cooked (OD)	(Kg)	2 84
NaOH on OD fibres	(%)	8.60
Fibre to liquid ratio	—	1:6.4
Cooking temperature	(°C)	170
Time to cooking temperature	(minutes)	90
Cooking time at 170°C	(minutes)	30
Yield obtained	%	73.14
Kappa number of the pulp	—	66

The pulp after cooking was processed as per the plan shown below.



'X' refers to the handsheet making and strength properties determination confirming to the scan standards.

And wherever the term refined is used it refers to the refining done in a laboratory sprout waldrom 12" disc refiner.

The kappa numbers of the accepts and rejects in both the parts 'B' and 'C' found to be respectively 56 and 76. The results are presented in table No. 2.

On comparision with the pulps in 'B' and 'C' the pulp in 'A' seems to be better in terms of strength properties. This pulp was found to be free from shives also. In 'B' and 'C', the refining action given to the rejects was enough to defiberate them so that, there would not be any shives left in the refined pulp. As shown in column Nos. (7) and (10) the accepts and rejects were mixed in the some ratio as fractionated from the whole pulp to imitate the commertial practice. In part 'A', the pulp developed more tensile index and

TABLE—2

SODA COOKING WITH 8% ALKALI CHARGE

	Whole pulp refining				Fractionated refining					
	A				B			C		
	1	2	3	4	5 Acpt.	6 Rejt.	7 5+6	8 Acpt.	9 Rejt.	10 8+9
Slowness, SR	21	38	51	66	25	19	22	18	18	18
Drainage time, Sec.	4.1	7.0	9.0	19.0	5.6	3.0	4.0	4.4	3.1	3.5
Basis weight, g/m²	68	71	68	70	68	69	68	67	67	67
Density, g/m³	474	602	619	680	457	457	440	485	472	482
Tensile Indes, KNm/kg.	56.4	72.0	73.5	77.4	45.7	42.5	43.6	51 3	45.9	49.2
Tear Index, Nm²/kg.	9.3	6.9	6.1	5.6	5.2	6.9	6.3	5.9	7.9	7.3

As can be seen in the table No. 2, in part 'A', the whole pulp containing both accepts and rejects has been refined to various slowness values.

The tensile index and tear index Values in column (1) are more than the tensile index and tear index values as reported in column Nos. (5) ann (8) respectively for the accepts in 'B' and 'C'. Even the properties of the rejects, refined to 19 and 18 °SR values in both 'B' and 'C' under the column Nos. (6) and (9) respectively are lower when compared to the reported values in colum (1) for the whole pulp. The properties of the mixed stock of the 'accepts' and 'rejects' as reported in column Nos. (7) and (10) are also lower when compared to the properties as reported in column No. (1) for the whole pulp, refined to the slowness of 21 °SR.

density values upon refining to higher slowness figures. The tear index was lowered drastically. The drainage time also increased steeply with the refining. The increase in tensile was mainly due to the easily collapsible, thin walled and medium and short fibres of the central vascular bundles, whose specific surface area has been increased by beating and hence the increase of interfibre bonding strength. The increase in the drainage time was due to the fines produced by the thin walled paranchyma cells, which have filled the interstices in the skeleton structure of long and medium fibres and have sealed the sheet altogether.

The 'rejects' being stiff and containing lot of lignin did not show much bonding efficiency even after receiving a slight mechanical refining action when compared to the accepts.

SECOND TRIAL :

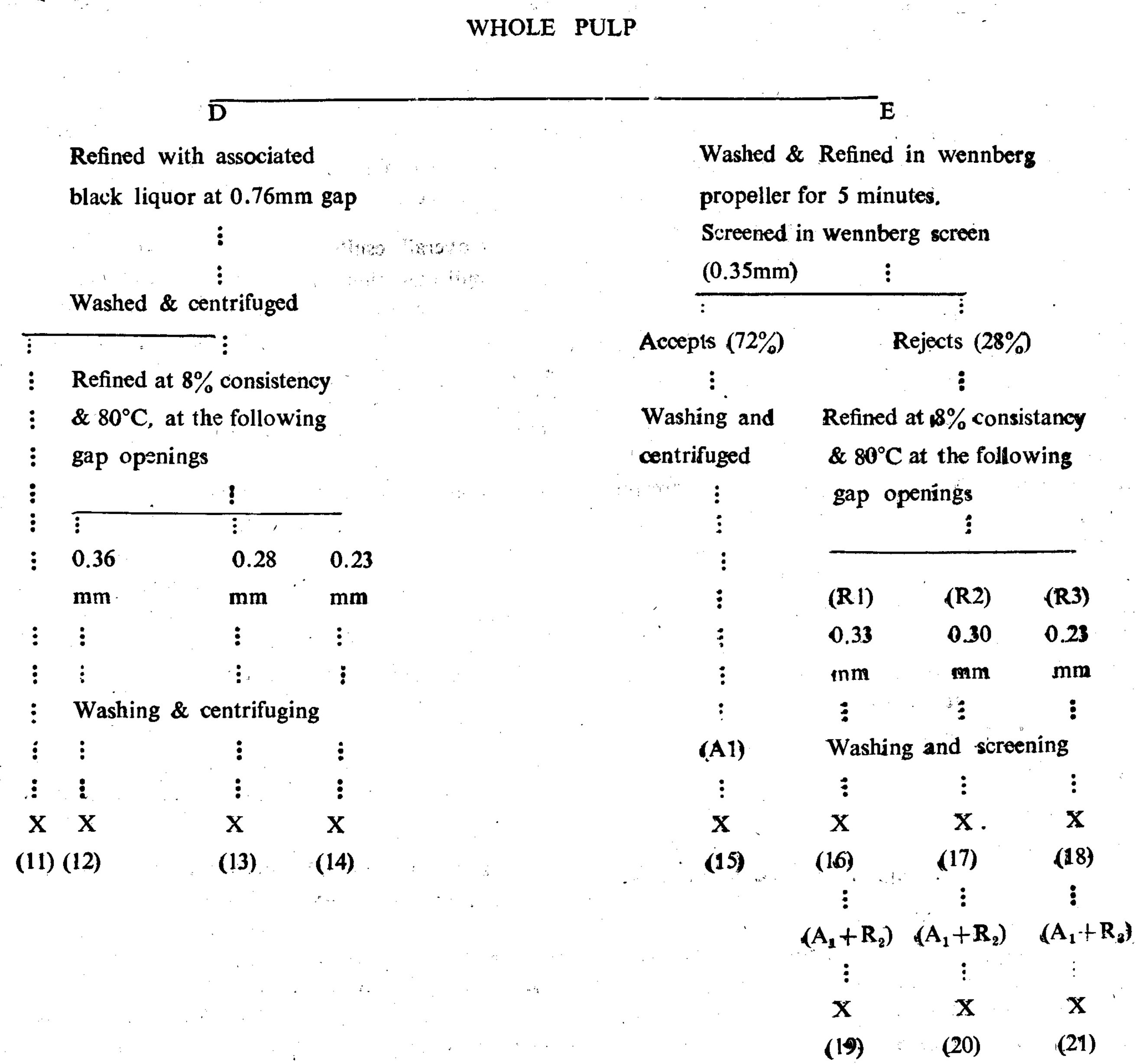
Bagasse cooked (OD)	(kg)	2.84
NaOH on OD fibres	(%)	12.0
Fibre to liquor ratio	—	1:6
Cooking temperature	(°C)	170
Time to cooking temperature	(minutes)	20
Cooking time at 170°C	(minutes)	30
Yield obtained	%	64
Kappa number of the pulp	—	37

The pulp after cooking was processed as per the plan shown below,wheie :

'X' refers to the handsheet making and strength properties determination confirming to the scan standards.

And refining refers to refining done in the laboratory sprout waldron 12" disc refiner.

The kappa numbers of the accepts and rejects were found to be 30 and 48 respectively. The results obtained are presented in table No. 3.



TABLE—3

SODA COOKING WITH 12% ALKALI CHARGE

	Whole pulp refining				Fractionated refining						
		D			E						
	11	12	13	14	15 A1 Acept.	16 R1	17 R2	18 R3	19 A1+ R1	20 A1+ R2	21 A1+ R3
Slowness, °SR	20	47	51	67	18	15	16	22	17	17	20
Drainage time, Sec.	3.8	6.9	9.4	12.0	4.0	2.8	2.8	3.0	3.4	3.4	3.6
Basis weight, g/m²	69	65	66	65	65	66	65	66	68	69	67
Density, kg/m³	507	653	689	703	476	465	478	496	458	472	489
Tensile index, KNm/kg	60.7	80.1	83.0	84.3	38.1	45.2	48.5	45.9	52.8	54.7	56.2
Tear index, Nm²/kg	7.64	7.32	7.03	6.66	7.34	8.73	8.40	9.10	7.62	7.59	7.90

It can be seen that the results reported in the above table are similar to the results observed in table No. 2 under the trial No. 1. Density, Drainage time and the tensile index have increased with refining and the tear index has suffered in part 'D'. Under part 'E', the tear value for rejects in column (16) is more than that of the whole pulp in column (11). The rejects on refining have developed the tear index values upto 9.1 from 8.73, for a slowness value of 22 °SR.

The tensile index in column (11) for the whole pulp is more than the tensile index values as reported in the column numbers (15) and (18) respectively for accepts and rejects, refined to 22 °SR. The tear index in column (11) on the other hand is lesser than that as reported in the column Nos. (15) and (18) respectively for the accepts and rejects in 'E'. The tear values of rejects in 'E', refined to 15, 16 and 22 °SR values in column numbers (16), (17) and (18) respectively, are in the increasing order and are higher than the accepts (15) and the whole pulp ((11), (12), (13) and (14)).

The tear index in column No. (21), which is a mixture of the accepts (at 18 °SR) and rejects, (refined to 22 °SR) is higher than the tear value in the column No. (11). But the tensile index in this case is also lower than that of column No. (11).

In general, as per the results presented in the table No. 3, there is no much difference in the strength properties of the pulps of parts 'D' and 'E'. Depending upon the end use requirement of the paper in question, the pulp may be processed in either of the ways. Whole pulp refining results in the increase of tensile index and the fractionated refining of rejects results in the increase of the tear index.

The overall results as obtained in both the tables 2 and 3 indicates that the fractionated refining of the rejects and accepts does not give much advantage over the whole pulp refining, in terms of quality and the strength properties of the pulps. But the selective refining of rejects seems to be advantageous to get better drainage control on the machine wire.

The idea of using the associated black liquor while refining the pulps was to see that whether it will have any beneficial effects on the quality of the pulps and on refining conditions. But the screening and refining operations in the presence of the associated black liquor did not give any such benefits, rather, it created some handling and foaming problems.

4. WRITING AND PRINTING PAPERS FROM A BLEND OF BAGASSE CHEMICAL PULP AND EUCALYPTUS–COLD SODA REFINER MECHANICAL PULP.

—Improving the light scattering properties of the bagasse based paper —A study.

The first trials for producing paper and board from sugar cane bagasse began some 150 years ago. However, it was in 1939, when technical and commercial success was attained with the start up of two paper mills, Paramonga (Peru) and Taiwan Pulp and Paper

Co., Ltd., (Tatu, Taiwan), although the Taiwan Mill had to shutdown because of world war - (II) 6.

The manufacturing of paper made from bagasse requires a series of modifications, mainly to the paper machine, in ordér to compensate for deficiencies of the non-wood pulps. These deficiencies are related to slow drainage characteristics, poor formation, poor wet strength characteristics and high shrinkage. Above all, when the production of writing and printing papers from bagasse is considered, one may encounter serious problems regarding the quality and as well as the strength of the paper. One such problems with the bagasse based papers is the light scattering properties or printing characteristics or one may call also the optical properties. Bagasse due to its inherent nature and fibre morphology fails to accomplish this property to the papers produced out of it.

As per casey[7] the pulp to be used for the production of printing and writing papers should have good light scattering properties. It is also true that the bagasse pulp is particularly suitable for the production of bleached paper grades such as printing, writing and tissue, as strength properly requi.ements are low, in such papers[6]. To overcome the defficiency of bagasse, of not imparting enough optical properties to the paper, it was thought that a pulp, rich in these properties should be blended with it in some proportions. One such pulps is the bleached eucalyptus —CSRMP, a chemi-mechanical pulp produced in the yield range of 80% which is sufficiently rich in these properties.[9]

Experimental Work :

The pulps required for this study were made available by M/s. The Mysore Paper Mills Ltd , (Eucalyptus-CSRMP), Bhadravati and M/s. Mandya National Paper Mills (Bleached bagasse pulp), Belagola. The samples were received in shipment bags at around 50% moisture content, having a slowness value of 22 °SR and a freeness value of 450 CSF ml respectively for the bleached bagasse chemical pulp and the bleached eucalyptus CSRMP. The bagasse pulp was found to contain some sandy white particles, later confirmed as calcium carbonate particles, which might have carried over from the bleaching unit. The eucalyptus—CSRMP was too knotty and fluffy.

Pulp Evaluation :

The pulp, both before and after the refining were evaluated for the strength properties by drawing representative samples from the shipment bags.

The pulps before refining were disintegrated thoroughly in a laboratory disintegrator as per SCAN-C 18:65 and standard hand sheets were made out of them. The sheets were subjected to paper testing confirming to scan standards and the results obtained are tabulated in the table No. 4.

Another set of pulp samples were subjected to refin'ng in several batches, with different gap openings, at 25% consistency in a laboratory sprout waldron 12" disc refiner. The refined pulps were disintergrated in the laboratory disintegrater and handsheets were prepared. The handsheets were tested for the strength properties. The testing confirmed the scan standards. The results obtained are presented in the table No. 4.

Additives are not added while making to handsheets in both the cases.

Table No. 4— Strength properties, before and after refining of bagasse chemical pulp and eucalyptus—CSRMP.

Parameters	Bagasse refining			Eucalyptus refining		
	Before	After		Before	After	
Freeness °SR/CSFml.	22	33	42	453	340	260
Basis weight, g/m²	62	66	64	63	66	66
Density, kg/m³	626	651	688	289	355	379
Brightness, % ISO	75	74	73	48	47	47
Scan opacity, %	82	82	81	96	97	97
Light scattering co-efficient, m²/kg	38	39	36	52	54	56
Tensile index, KNm/kg	43	44	49	13	23	26
Tear Index, Nm²/kg	3.2	2 9	2.3	1.6	2.2	2.6

It can be observed that the optical properties like, opacity and light scattering co-efficients of bagasse are very much lower compared to that of the eucalyptus. However, the brightness value of the eucalyptus pulp is lower when compared to that of the bagasse pulp. The tensile index of the bagasse from 43 at 22 °SR has been increased upto 49 on further refining to 42 °SR, while the tear has been dropped from 3.2 to 2.3, whereas in the case of eucalyptus both tensile index and tear index values have been increased upon further refining as reported in the table No. 4. Hence, it was decided to refine eucalyptus pulp alone to freeness value of 260 ml CSF during stock preparation before the experimental paper machine run, to keep up the paper strength properties at higher level.

Stock Preparation :

(a) Bagasse Pulp :

About 19 kgs. of OD bleached bagasse pulp was soaked in hot water and defibered in the hydrapulper at 5% consistency, for about two hours. The pulp was found to be hydrated to a slowness value of 38 °SR. No refining was done.

(b) Eucalyptus Pulp :

About 11 kgs. of OD bleached eucalyptus pulp was soaked over night in hot water to soak it well so that all the knots and fluffy bundles would disintegrate in the hydrapulper. The pulp at 5% consistency was defibered in the hydrapulper was passed through ROP refiner, almost repeatedly for about three times to reach a freeness value of 260 ml/CSF.

(c) Toffe :

This is a bleached chemical pulp (80% spruce and 20% pine). 20 kgs OD pulp was disintegrated in the hydrapulper at 5% consistency for about one hour. The pulp was refined in the claflin cone refiner for 20 minutes to a slowness value of 22 °SR.

All three pulps were diluted to around 1.8% consistency and stored in separate chests awaiting for the machine runs. Since the pulps available were scarce in quantity extreme care was taken to process them in each and every stage.

Internal sizing was done by adding 1% rosin and 2% alum on OD pulp. Enough time was given for the rosin size to mix up with the fibres before the addition of alum. The clay was added as per the plan shown below and a poly acrylamine retention aid was used for the retention of the clay in the paper.

Plan of the machine runs :

Run No	1	2	3	4	5	6	7
Bagasse, %	50	70	70	70	80	80	80
Eucalyptus, %	50	30	30	30	20	20	10
Tofte, %	0	0	0	0	0	0	10
Clay, %	0	0	10	15	10	15	15
Retention aid	0	0	+	+	+	+	+

Paper making :

The experimental paper machine (SIMCA) has the following general specifications.[8]

— Width, 50 cm.

— Drainage elements are wet suction boxes, table rolls, dry suction boxes and a vacuum couch.

— Press sections with one straight and one reverse press.

— 13 drying cylinders arranged in 5 (5-2-1-1-1) velocity groups in the first part of the dryer section, after which a horizontal size press is placed followed by 3 drying cylinders in the second part.

— Calender with 5 rolls.

In order to be able to produce the desired number of paper samples for the different furnishes, from a limitted amount of pulp, the following procedure was practiced.

1. The machine was run at a speed of 25m/min. at a basis weight of 70 g/m².

2. To start and stabilize the machine conditions, the machine was started on a toffe pulp. When the machine was adjusted to the correct basis weight and the proper drying conditions, the trial pulp was taken on the machine without rupture of the paper web. If necessary, the draws in press and drying section were adjusted.

3. The experimental paper machine is equipped with 3 machine chests. Shifting from one to another is performed without breaking the paper webs. When the machine conditions were stable, shifting to furnish took place, and usually only minor adjustment had to be made.

The representative paper samples were collected from each runs and kept for conditioning in the condition room and the paper properties were tested. The experiments were done confirming to the seam standards. The results are presented in the table No. 5.

It can be seen from the results presented in the table No. 5 that the optical properties like opacity and light scattering co-efficients of all the papers in all the machine runs are more than the values as reported in the table No. 4, for the bagasse pulp alone.

There is a minimum of 11 and maximum of 14 points rise in the opacity values and a minimum of 4 and maximum of 10 points rise in the case of light scattering co-efficeints for all the papers made out of the bagasse and eucalyptus furnishes, when compared to the values of the bagasse paper alone as reported in the table No. 4. This a very good improvement.

In the case af brightness values, there is no much increase, instead they have come down to very low levels Even if we take the mathematical average of the brightness values corresponding to the ratio of the pulps used in each furnish, the minimum and maximum brightness value in the table No. 5 would have to be around 53 and 73 respectively. Whereas in actuality, the minimum and maximum values obtained are around 51 and 67 respectively. Thus, there is a difference of about 6-12 points in the brightness values. The reason for this is probably, the hot water soaking and the subsequent refining action given to the pulps, which might have reduced the brightness values of the pulps to such a low level. The eucalyptus pulp was refined repeatedly, each time having some marginal improvement in the CSF values, to achieve the required freeness of 260 CSF ml.

In run Nos. 2, 3 and 4 the furnishes used are the same which consists of 70% bagasse and 30% eucalyptus. In all the three rnns from 2 to 4 there is a gradual rise in the values of density, brightness, opacity, light scattering co-efficient and smoothness. At the same time, the tensile index values have gradualy decreased. This is due to the presence of the clay in the papers in different proportions as reported in the table No. 5. The influence of clay on strength properties of the papers is shown in the figures 4, 5 and 6.

TABLE—5

STRENGTH PROPERTIES OF THE PAPERS MADE ON THE EXPERIMENTAL PAPER MACHINE.

Run No.		1	2	3	4	5	6	7
— Basis weight (g/m^2)		69	69	72	68	71	72	75
— Density (kg/m^3)		544	624	631	647	747	890	716
— Brightness (%ISO)		51.4	55.2	55.6	56.7	57.6	58.9	87.4
— Scan capacity (%)		96	93	95	95	94	95	93
— Light, Scatt. co-effecient (m^2/kg)		47	42	45	48	43	46	45
— Ash retained (%)		—	0.9	3.7	9.0	6.0	9.0	12.0
— Garly air resistance (Sec.)		18	45	44	50	93	108	309
— Bendtsen smoothers (m/min.)	Top	— 727	652	620	550	409	218	176
	Bottom	— 540	450	435	397	282	148	100
— Tensile index (KNm/kg)	MD	— 43	50	47	41	43	35	40
	CD	— 25	27	25	22	23	21	21
— Tear index (Nm /kg)	MD	— 2.9	3.2	3.2	2.9	2 6	2.5	3.6
	CD	— 3.5	3,7	3,6	3.4	3.0	2.9	3.7

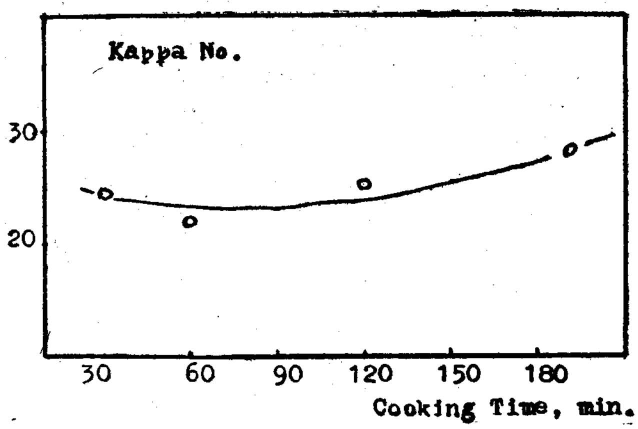


FIG III

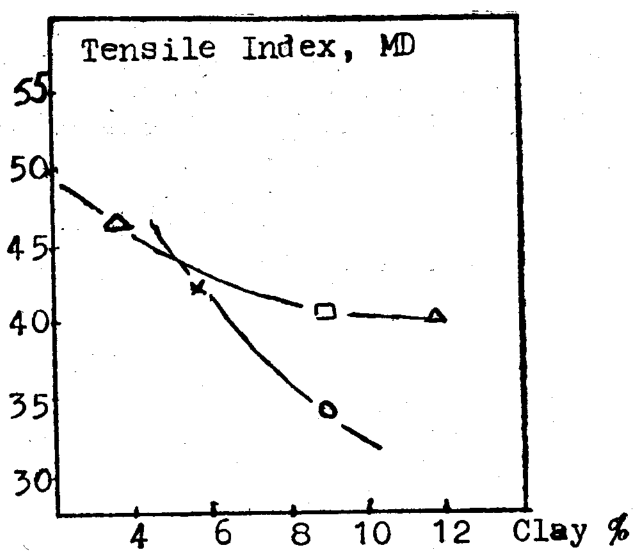


FIG. IV

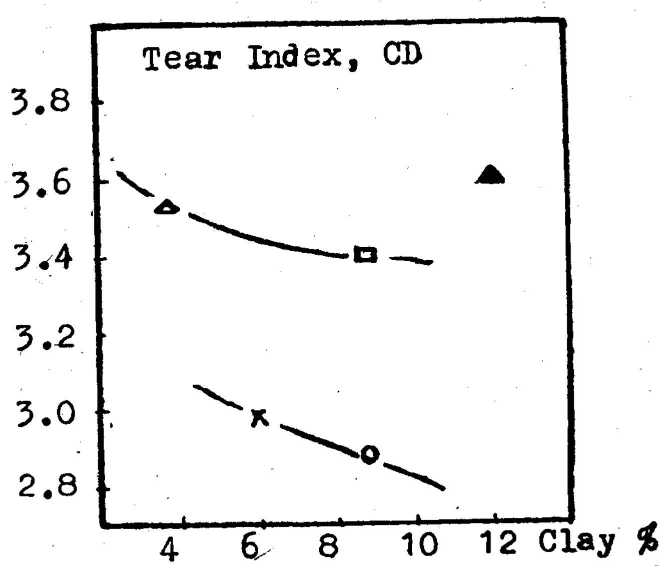


FIG. V

■ = Run no.2 } 70% Bagasse,
△ = Run no.3 } 30% Euca.
□ = Run no.4 }
x = Run no.5 } 80% Bagasse,
c = Run no.6 } 20% Euca.
▲ = Run no.7 - 80% Bagasse,
10% Euca,
10% Tofte
(Chem. pulp).

FIG. VI

The same thing repeats with run Nos. 5 and 6 also. In the case of run No. 7, in addition to bagasse and eucalyptus, about 10% softwood chemical pulp is also being used. This has resulted in the better bonding, inspite of the presence of 12% clay in the paper. The brightness of the paper has also been increased due to very high brightness (85%) of the softwood pulp. A slight decrease in the values of opacity and light scattering co-efficients in run No. 7 is due to the presence of 10% softwood furnish.

CONCLUSION :

(1) A high yield semichemical pulp in the yield range of 66-75%, with 8-10% NaOH charge and a bleachable pulp in the yield range of 55 to 65%, with 14-16% NaOH charge on OD bagasse fibres can be obtained. In all the cases a cooking time of more than 30 minutes is not recommended as it adversely affect the pulp quality due to the lignin redeposition on the fibres, owing to the lignin condensation reactions.

(2) The selective refining of the bagasse rejects, at 8% consistency with or without the associated black liquor does not give a significant advantages over the whole pulp refining to the same slowness values. However, drainage on the wire may be controlled by the selective refining of the bagasse rejects.

(3) The basic light scattering properties of the bagasse based papers can be improved to an acceptable level by blending the eucalyptus CSRMP pulp in different proportions. The ratio of 70 : 30 and 80 : 20 of bagasse chemical pulp and eucalyptus CSRMP appears to be a good choice. However,

further studies in this regard are essential before starting the commercial production.

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