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FINAL TEST REPORT

PHASE 1 A

ON

JUTE PULPING

FOR

UNIDO, VIENNA

BY

I V A

IMPCO-VOEST-ALPINE
Pulping Technologies GmbH

February, 1996

This final report for phase 1a replace the first and second interim report and all submitted preliminary reports.

TABLE OF CONTENT:

1. INTRODUCTION

This project was initiated at the request of

I T C Limited TRIBENI TISSUES DIV.

and was carried out under the contract No. 94/028, UNIDO Project DWG./IND. 2/316 between

IMPCO - VOEST-ALPINE Pulping Technologies Gmbh, Linz, AUSTRIA

and

UNIDO, Vienna, AUSTRIA

In that agreement the objectives of the work were stated to be the determination of:

1. Conditions necessary to produce pulp from jute with the following processes:
   1. Kraft Pulping (Sulphate)
   2. Kraft AQ Pulping
   3. Soda Pulping
   4. Soda AQ Pulping
   5. Alkaline Sulphite Pulping
   6. Alkaline Sulphite AQ Pulping

   to reach a Kappa of 13+- 2 with Indication of yield results.
2. Selecting the optimum conditions of each process and repeating the cook,
3. Physical properties of the pulp produced under the optimum condition.
4. Bleachability of pulp produced under the optimum condition.
5. Pilot plant test at CPPRI with the selected final pulping process executed by CPPRI
6. Bleaching sequences using 2 chlorine-,2 ECF- and 2 TCF-sequences
7. Physical properties of bleached pulp

2. RAW MATERIAL

The raw material for this project was shipped to IVA from the I T C Limited TRIBENI TISSUES DIV, Calcutta, INDIA.

Fibre analysis measured at CPPRI laboratory

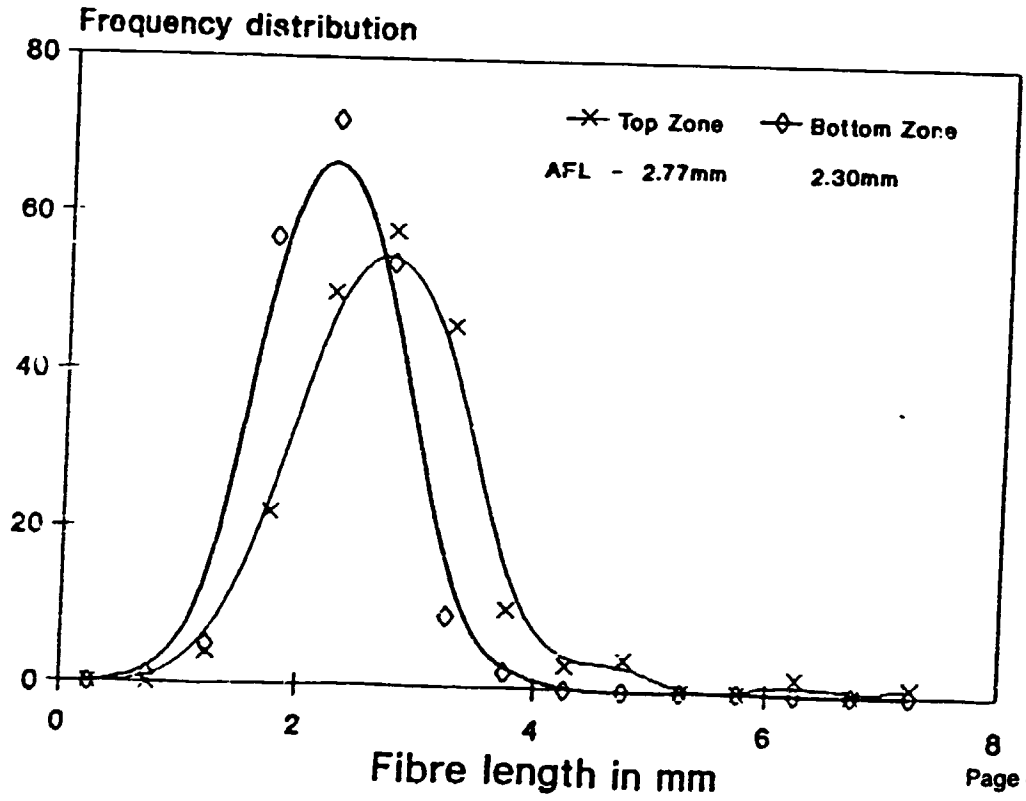
Proximate analysis of jute bast fibre

Se.No.	PROPERTY	UNIT	BAST FIBRE		
			LOWER	TOP	WHOLE
1.	Moisture	%	7.7	6.8	9,1
2.	Ash	%	1.7	0.6	0.3
3.	Water sol	%	0.5	0.5	0.6
4.	Alkali sol	%	15.5	10.7	14.5
5.	Lignin	%	13.8	-	11.8
6.	Holocellulose	%	88.0	90.2	90.0

Dimensions of jute bast fibre

Se.No.	PROPERTY		UNIT	BAST FIBRE		
				whole	top zone	bottom zone
1.	Fibre	length	mm			
		average			2.77	2.33
		maximum			7.44	3.59
		minimum			1.02	1.18
2.	Fibre	width	µm			
		average		11.9		
		maximum		20.0		
		minimum		3.9		
3.	Fibre	lumen	µm			
		average		4.9		
		maximum		11.2		
		minimum		1.0		
4.	Wall	thickness	µm			
		average		3.6		

Length distribution of jute bast fibre



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3. RAW MATERIAL PREPARATION

Bench scale pulping tests at Pulp & Paper Institute in Ljubliana, Slovenia:

The original size of the delivered jute cuts was approx. 250 mm.

We have tested in the pre test phase different size of jute material and we succeed with the original size of approx. 250 mm. Further pre-tests with produced pulp in different beating equipment has been done. The result was that Sprout Waldron Refiner is useful for beating jute pulp with Kappa < 30.

Bench scale pulping tests at CPPRI in Saharanpur, India:

The delivered jute was cute to approx. 75 mm size with the same quality as supplied to IVA.

Pilot plant trials at CPPRI in Saharanpur, India:

The first delivered jute was cute to approx. 75 mm size with the same quality as supplied to IVA.

The second delivered jute was from the same quality and size as supplied to IVA.

4. TESTING METHODS:

The following main testing methods have been used:

- Total active and effective alkali in white liquor	SCAN N 2 : 88
- Kappa number	ISO 302-1981 (E)
- Limiting viscosity number	ISO 5351/1-1981(E)
- Beating of pulp in PFI-mill	ISO 5264/2-1979
- Sheet forming (Rapid Köthen)	ISO 5269/2-1980
- Physical properties of sheets	ISO 5270-1979
- Fibre fractionation (Bauer McNett)	SCAN M6 :69
- Average fibre length and length distribution, Coarseness (Kajaani FS-200)	TAPPI T 271 PM-91
- Brightness	ISO 3688-1977 (5)
-Brightness reversion	ISO 5630/1
-Dirt in pulp	ISO 5350/2-1989 TAPPI 213
- COD (chemical oxygen demand)	DIN 38 409, Teil 41
- BOD (biochemical oxygen demand)	DIN 38 409, Teil 51
- AOX (Determination of adsorbable organic halogens)	DIN 38 409, Teil 14
- Analysis of black liquors	TAPPI T 625 CM-85
- Viscosity of black liquor	TAPPI T 666

5. PULPING EQUIPMENT:

Used at Pulp & Paper Institute in Ljubliana:

Digester: 10 l rotating Digester with electric heating.

Refiner: Sprout Wal ıron Disc Refiner:

Diam. of plates:	12"
Type of plates:	C-29-76
Space between plates:	0,14"
Speed of refiners:	1500 rpm

Washing: Screen Mesh 16

Screening: WFVERK membrane screen
with screenplate`s opening: 0,15 mm

6. BENCH SCALE PULPING TESTS:

The following laboratory programme was carried out at IVA' subcontractor Pulp & Paper Institute in Ljubliana, Slovenia to determinate the optimum pulping condition for jute bast fibre supplied by ITC Limited, TRIBENI TISSUE DIV, Calcutta, out of the selected processes.
Target for all tests was to reach a kappa number of 13+-2.
Cooking condition as well as Kappa number, yield, reject amount are presented for every cook.

6.1. Kraft Pu'ping (Sulphate) and Kraft AQ Pulping

In total 18 laboratory trails were carried out in a 10 l rotary digester with electric heating according to the Kraft process and Kraft AQ process with following parameter:

AA Charge as Na_2O	%	10	12	14
Heating up time	min	90		
Cooking time	min	60	120	240
Temperature	°C	150	160	165
AQ Charge	%	0,05		

After cooking and refining the pulp was washed over a Screen Mesh 16 and screened over a WFVERK membrane screen with screenplate's opening: 0,15 mm.

The Kraft pulping tests with 12% AA and 160°C with and without AQ were repeated to verify the cooking results.

Details of cooks see table 1 to table 6 as well as figure 1 to figure 4.

Summery of the laboratory trials:

All tests shows that the required AA-charge is about 12 % (as Na_2O) to get a Kappa about 13. In case of Kraft-AQ process the pulp yield was approx. 1% point higher than without AQ.
As high temperature would influence the mechanical properties of pulp and the low temperature would need a long cooking time the following parameter for the final pulping test was selected:

AA-charge	12 % as Na_2O
Sulfidity	20 %
Cooking temperature	160°C
Cooking time	2 hours
AQ-charge	0,05 % in case of Kraft-AQ Process

6.2. Soda and Soda AQ Pulping

In total 18 laboratory trails were carried out in a 10 l rotary digester with electric heating according to the Soda process and Soda AQ process with following parameter:

AA Charge as Na_2O	%	12	14	16
Heating up time	min	90		
Cooking time	min	60	120	240
Temperature	°C	150	160	165
AQ Charge	%	0,05		

After cooking and refining the pulp was washed over a Screen Mesh 16 and screened over a WFVERK membrane screen with screenplate`s opening: 0,15 mm.

Details of cooks see table 7 to table 12 as well as figure 5 to figure 8.

Summery of the laboratory trials:

All tests shows that the required AA-charge is about 14 % (as Na_2O)to get a Kappa about 13. In case of Soda-AQ process the pulp yield was approx. 1% point higher than without AQ and the AA-charge can be reduced by min. 0,5% point when using a cooking temperature of 160°C. As high temperature would influence the mechanical prcperties of pulp and the low temperature would need a long cooking time the following parameter for the final pulping test was selected:

	SODA	SODA-AQ
AA-charge	14 %	13,5 as Na_2O
Cooking temperature	160°C	
Cooking time	2 hours	
AQ-charge	-	0,05 %

6.3. Alkaline sulphite and Alkaline sulphite-AQ pulping

In total 8 laboratory trails were carried out in a 10 l rotary digester with electric heating according to the alkaline sulphite and alkaline sulphite-AQ process with following parameter:

NaOH Charge	%	2	2,5	4	8
SO_2 Equivalent	%	8	10	16	24
Na_2SO_3 Charge	%	15,75	19,69	31,50	47,25
Heating up time	min	90			
Cooking time	min	240			
Temperature	°C	165			
AQ Charge	%	0,05			

After cooking and refining the pulp was washed over a Screen Mesh 16 and screened over a WFVERK membrane screen with screenplate`s opening: 0,15 mm.

Details of cooks see table 13 to table 14 as well as figure 9 to figure 10.

Summery of the laboratory trials:

The tests shows that alkaline sulphite pulping process with an NaOH /SO_2 ratio of 1:3 - 1:4 , a relative high chemical charge, a high temperature of 165° and a long cooking time of 4 hours could not achieve the desired kappa number. the lowest kappa number was 51,3 at an Na_2SO_3 charge of 47,25 %. With an addition 0f 0,05 % AQ the kappa number could be reduced to approx. 19.
As the target kappa could not be reached with alkaline sulphite process and the results of AQ addition brought kappa down to approx. 19, it was decided that only Alkaline sulphite final cooks with AQ-addition will be used for the final pulping test with the following parameter:

Na2SO3-charge	47,25 %	(24 % SO_2)
Cooking temperature	165°C	
Cooking time	4 hours	
AQ-charge	0,05 %	

6.4. Final pulping tests for determination of physical properties and bleachability tests.

In total 10 laboratory trails were carried out in a 10 l rotary digester with electric heating according to following parameter:

Process	AA charge as Na_2O (Na_2SO_3) %	Heating up time min	Digesting time min	Temp. °C
Kraft	12	90	120	160
Kraft AQ	12	90	120	160
Soda	14	90	120	160
Soda AQ	13,5	90	120	160
Alkaline sulphite	no final pulping tests			
Alkaline sulphite AQ	47,25 (= 24 % as SO_2)	90	240	165

Sulfidity for Kraft and Kraft-AQ pulping process = 20 %

After cooking and refining the pulp was washed over a Screen Mesh 16 and screened over a WFVERK membrane screen with screenplate's opening: 0,15 mm.

Details of cooks see table 15a to table 19a

Physical properties of unbleached jute pulp see table 15b to table 19b

Fibre analysis see distribution analysis of unbleached jute pulp

Physical properties of each unbleached jute pulp see figure 11 to figure 15

Fibre length unbleached jute pulp see figure 16

Coarseness unbleached jute pulp see figure 17

Slenderness factor unbleached jute pulp see figure 18

Zero span tensile unbleached jute pulp see figure 19

Physical properties unbleached jute pulp at 50 SR see figure 20 to figure 27

Physical properties unbleached jute pulp at 30 SR see figure 29 to figure 33

Viscosity of unbleached jute pulp see figure 34

6.5. Summery of the laboratory trials:

All tests verify the selected pulping conditions.

For the selection of final process to be tested in the pilot plant of CPPRI the following matrix was prepared:

Process	Kraft	Kraft -AQ	Soda	Soda -AQ	Alkaline -AQ
Kappa number	3	2	4	1	5
Chemical consumption	2	1	4	3	5
Energy consumption	2	1	4	3	5
Chemical recovery	2	1	4	3	5
Yield unbleached	3	2	5	4	1
Viscosity unbleached	3	2	3	4	1
Bleaching chemical consumption *	4	2	3	1	5
Dirt content bleached *	3	2	1	5	4
Breaking length at 30 SR	2	1	4	5	3
fibre length	2	2	3	1	2
Fibre strength	3	2	2	4	1
Slenderness factor	3	2	4	1	5
Total	33	21	44	39	47

*) From the bleachability test results

Note:			
	1	=	Excellent
	2	=	Very gut
	3	=	Gut
	4	=	Sufficient
	5	=	Insufficient

From this matrix the pulping processes can be ranged as follow:
1. Kraft-AQ
2. Kraft
3. Soda-AQ
4. Soda
5. Alkaline sulphite

7. BLEACHABILITY TESTS

The following laboratory programme was carried out at IVA´ subcontractor Pulp & Paper Institute in Ljubliana, Slovenia to determinate the bleachability of the pulp produced under the prescribed conditions to support the selection of the final pulping process to be used in the pilot plant test at CPPRI in Saharanpur, India.
The bleachability tests were carried out with the sequence **C - E - H.**

For the Kraft and Kraft-AQ we used the following Parameter:
Chlorinating factor for C-Stage = approx. 0,25.
As this factor was high it was reduced to 0,2 for all other tests

Bleaching parameter:

		KRAFT	KRAFT -AQ	SODA	SODA -AQ	ALK.SULF .-AQ
C-Stage:						
Chlorine factor	-	0,25	0,25	0,2	0,2	0,2
Consistency	%	3,0	3,0	3,0	3,0	3,0
Retention time	min	30	30	30	30	30
Temperature	°C	20	20	20	20	20
E-Stage:						
NaOH charge	%	1,5	1,2	1,2	1,2	1,2
Consistency	%	10,0	10,0	10,0	10,0	10,0
Retention time	min	90	90	90	90	90
Temperature	°C	60	60	60	60	60
H-Stage:						
A.Chlor. charge	%-	1,5	1,5	1,5	1,5	1,5
Consistency	%	10,0	10,0	10,0	10,0	10,0
Retention time	min	150	150	150	150	150
Temperature	°C	40	40	40	40	40

Details of bleachability tests see table 20a to table 24a

Physical properties bleached jute pulp see table 20b to table 24b

Fibre analysis see Fibre distribution analysis of bleached jute pulp

Total active chlorine consumption see figure 36

Bleached jute pulp total yield see figure 37

Physical properties of each bleached pulp see figure 38 to figure 42

Fibre length of bleached jute pulp see figure 43

Coarseness of bleached jute pulp see figure 44

Slenderness factor of bleached jute pulp see figure 45

Zero span tensile of bleached jute pulp see figure 46

Physical properties of bleached jute pulp at 50 SR see figure 47 to figure 58

Physical properties of bleached jute pulp at 30 SR see figure 59 to figure 70

Viscosity of bleached jute pulp see figure 71

8. BENCH SCALE AND PILOT PLANT TRAILS AT CPPRI IN SAHARANPOUR

The following laboratory programs were carried out at CPPRI laboratory and pilot plant to check the results obtained at IVA´ subcontractor Pulp & Paper Institute in Ljubliana, Slovenia for jute bast fibre supplied by ITC Limited, TRIBENI TISSUE DIV, Calcutta.
Target for all tests was to reach a kappa number of 13+-2.
Cooking condition as well as Kappa number are presented for every cook.

8.1. Kraft Pulping (Sulphate) and Kraft AQ Pulping

The **laboratory trails** were carried out in a 2.5 l rotary digester with electric heating according to the Kraft process and Kraft AQ process with following parameter:

AA Charge as Na_2O	%	12	12
Sulfidity	%	20	20
Heating up time	min	90	90
Cooking time	min	120	120
Temperature	°C	160	160
AQ Charge	%	0,00	0,05

Details of cooks see table 25 to table 26

The **pilot plant trails** were carried out in a cylindrical rotary digester (Size = 11 m^3)with direct steam heating according to the Kraft process and Kraft AQ process with following parameter:

AA Charge as Na_2O	%	12	11.5	12	12	11.5
Sulfidity	%	20	20	20	20	20
Heating up time	min	90	90	90	90	90
Cooking time	min	120	120	180	240	120
Temperature	°C	160	160	160	150	160
AQ Charge	%	0,00	0,00	0,05	0,05	0,05

After cooking the pulp was blown in an blow tank and washed on an belt washer.

Details of cooks see table 27 to table 32

Summery of the laboratory and pilot plant trials:

All the tests at the laboratory and pilot plant of CPPRI as well as tests at Tribeni Tissue Laboratory confirm the cooking results of IVA.

AA-charge	12 % as Na_2O
Sulfidity	20 %
Cooking temperature	160°C
Cooking time	2 hours
AQ-charge	0,05 % in case of Kraft-AQ Process

See figures 81 to 92

Pulp produced during the Pilot plant tests at CPPRI was blown in a blow tank at different pressure without any problem.

Additional trial was carried out at SHAMLI Paper Mill (located near to Saharanpur) in a spherical digester with soda-AQ process to confirm the blow ability of jute pulp not only from a cylindrical digester with conical bottom but also out of a spherical digester.

The result of this trial is:

Jute pulp at the processed Kappa No. can be also blown from a spherical digester ! ! !

9. BENCH SCALE BLEACHING TRAILS

The following laboratory programme was carried out at IVA´ subcontractors Pulp & Paper Institute in Ljubliana, Slovenia and ÖHFI in Vienna to determinate the bleachability of the pulp produced in the pilot plant at CPPRI under the pre scribed conditions to support the selection of the final bleaching process to be used at Tribeni mill, India.
The bleaching tests were carried out with the sequences

C - E - H

C - Ep - H

O -C - EO - H

D - E - D

O -D - EO - D

O -A - EOP - P / O -Q - EOP - P

O -A - Z - P / O -Q - Z - P

During the execution of the bleaching tests it was founded that IVA-Laboratories used for the brightness measurement the absolute value and CPPRI and Tribeni mill the relative value so that all results of IVA have to be increased by approx. 2 % points to get comparable results to CPPRI and Tribeni mill.

A = Acidification stage

C = Chlorination stage

D = Chlorine dioxide stage

E = Extraction stage

EO = Extraction stage with addition of oxygen

EOP = Extraction stage with addition of oxygen and peroxide

EP = Extraction stage with addition of peroxide

H = Hypo stage

O = Oxygen delignification

P = Peroxide stage

Q = Chelation stage

Z = Ozone stage

9.1 C - E - H bleaching:

The target brightness for this sequence was 78-80 %.

In total 7 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

82,8 % ISO absolute
84,8 % ISO relative

Details of bleaching parameter and results see table 40

9.2 C - EP - H bleaching:

The target brightness for this sequence was 82-84 %.

In total 5 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

85,0 % ISO absolute
87,2 % ISO relative

Details of bleaching parameter and results see table 41

9.3 O - C - EO - H bleaching:

The target brightness for this sequence was 82-84 %.

In total 4 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

83,0 % ISO absolute
85,0 % ISO relative

Details of bleaching parameter and results see table 42

9.4 D - E - D bleaching:

The target brightness for this sequence was 88 %.

In total 7 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

85,8 % ISO	absolute
87,0 % ISO	relative

Details of bleaching parameter and results see table 43

9.5 O - D - EO - D bleaching:

The target brightness for this sequence was 88 %.

In total 3 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

82,4 % ISO	absolute
84,4 % ISO	relative

Details of bleaching parameter and results see table 44

9.6 O - A - EOP - P / O - Q - EOP - P bleaching:

The target brightness for this sequence was 84-85 %.

In total 3 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

82,7 % ISO	absolute
84,7 % ISO	relative

Details of bleaching parameter and results see table 45

9.7 O - A - Z - P / O - Q - Z - P bleaching:

The target brightness for this sequence was 84-85 %.

In total 3 laboratory bleaching trials were carried out.

The final results of brightness measurement was :

84,8-87,3 % ISO	absolute
86,8-89,3 % ISO	relative

Details of bleaching parameter and results see table 46

9.8 Quality of unbleached pulp:

During the bleaching trials it was founded that a part of the pulp send by air fright and submitted throw IVA to the Pulp and Paper Institute in Ljubliana was degraded and have to be separated from the good pulp to avoid further degradation.
This was one of the reasons whey this institute felt to achieve the target brightness in some of there tests.

Table 33 and 34 shows the physical properties of both kind of pulp.

9.9 Summery of bleaching trials:

Generally the bleaching results were in an acceptable ranges.

With the simplest bleaching sequence C E H a brightness of 84,8 % could be achieved.
When adding peroxide in the extraction stage the final brightness increased to 87,2 with a reduced total chlorine consumption.
Adding an oxygen delignification prior to the chlorination stage improve the total chlorine consumption.

Introducing chlorine dioxide instead of chlorine and hypo results in a brightness of 87 %. Adding an oxygen delignification prior to the first chlorine dioxide stage improve the total chlorine consumption.

In case of total chlorine bleaching with Oxygen and peroxide the final brightness was 84,7 %. Introducing ozone in an total chlorine free bleaching sequence increased the final brightness up to 89,3 %.

See table 47 and figures 101 to 129 and the following table !

The mill cooking trials and the bleaching tests planed in phase 1B will give more representative results for a mill operation.

10. TABLES

10.1 Bench scale pulping tests

TABLE 1 Kraft pulping at 165°C

TABLE 2 Kraft pulping at 160°C

TABLE 3 Kraft pulping at 150°C

TABLE 4 Kraft AQ pulping at 165°C

TABLE 5 Kraft AQ pulping at 160°C

TABLE 6 Kraft AQ pulping at 150°C

TABLE 7 Soda pulping at 165°C

TABLE 8 Soda pulping at 160°C

TABLE 9 Soda pulping at 150°C

TABLE 10 Soda AQ pulping at 165°C

TABLE 11 Soda AQ pulping at 160°C

TABLE 12 Soda AQ pulping at 150°C

TABLE 13 Alkaline sulphite pulping at 165°C

TABLE 14 Alkaline sulphite AQ pulping at 165°C

TABLE 15 Final kraft pulping at 160°C

TABLE 16 Final kraft-AQ pulping at 160°C

TABLE 17 Final soda pulping at 160°C

TABLE 18 Final soda-AQ pulping at 160°C

TABLE 19 Final alkaline sulphite-AQ pulping at 165°C

TABLE 1

Jute pulping **Kraft pulping at 165°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit			
Raw material		**Jute**	**Jute**	**Jute**
Quality of Fiber				
Size of fiber	mm	250	250	250
Puping data				
Pulping Process		Kraft	Kraft	Kraft
Cook No.		K01	K02	K03
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	341	341	341
	gBD	300	300	300
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	14,60	12,51	10,43
Na2S Charge	%	3,38	2,90	2,42
Sulfidity	%	19,20	19,20	19,20
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	14,00	12,00	10,00
Effective Alkali charge as Na2O	%	12,66	10,85	9,04
AQ charge	%	-	-	-
Heating up time	min	90	90	90
Cooking time	min	60	60	60
Cooking temp.	°C	165	165	165
H Factor	-	702,3	702,3	702,3
Yield unscreened	%	59,50	58,40	61,20
Screen reject	%	negl.	negl.	negl.
Yield screened	%	59,50	58,40	61,20
Kappa No.		11,20	12,50	27,20

TABLE 2

Jute pulping **Kraft pulping at 160°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit							
Raw material		Jute	Jute	Jute	Jute	Jute		Jute
Quality of Fiber								
Size of fiber	mm	250	250	250	250	250		250
Pulping data								
Pulping Process		Kraft	Kraft	Kraft	Kraft	Kraft		Kraft
Cook No.		K04	K05	K 05A	K 05B	K 05C	K05-K05c	K06
Type of digester		Rotary,elect. heated	Rotary,elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated		Rotary, elect. heated
Size	l	10	10	10	10	10		10
Hydromodul	1:??	3,00	3,00	3,00	3,00	3.00		3,00
Raw material charge	g	341	341	341	455	455		341
	gBD	300	300	300	400	400		300
Dry content	%	88,00	88,00	88,00	88,00	88.00		88,00
NaOH Charge	%	14,60	12,51	12,51	12,51	12.51		10,43
Na2S Charge	%	3,38	2,90	2,90	2,90	2.90		2,42
Sulfidity	%	19,20	19,20	19,20	19,20	19.20		19,20
SO2 Charge	%	-	-	-	-	-		-
Na2SO3 Charge	%	-	-	-	-	-		-
Active Alkali charge as Na2O	%	14,00	12,00	12,00	12,00	12.00		10,00
Effective Alkali charge as Na2O	%	12,66	10,85	10,85	10,85	10.85		9,04
AQ charge	%	-	-	-	-	-		-
Heating up time	min	90	90	90	90	90		90
Cooking time	min	120	120	120	120	120		120
Cooking temp.	°C	160	160	160	160	160		160
H Factor	-	859,6	859,6	859,6	859,6	859,6		859,6
Yield unscreened	%	56,40	61,00	60,20	57,80	61.00	60,73	60,60
Screen reject	%	negl.	negl.	negl.	negl.	negl.		negl.
Yield screened	%	56,40	61,00	60,20	57,80	61.00	60,73	60,60
Kappa No.		10,40	12,40	14,10	12,00	12.40	12,27	21,90

TABLE 3

Jute pulping — **Kraft pulping at 150°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Kraft	Kraft	Kraft
Cook No.		K07	K08	K09
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	341	341	341
	gBD	300	300	300
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	14,60	12,51	10,43
Na2S Charge	%	3,38	2,90	2,42
Sulfidity	%	19,20	19,20	19,20
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	14,00	12,00	10,00
Effective Alkali charge as Na2O	%	12,66	10,85	9,04
AQ charge	%	-	-	-
Heating up time	min	90	90	90
Cooking time	min	240	240	240
Cooking temp.	°C	150	150	150
H Factor	-	688,2	688,2	688,2
Yield unscreened	%	59,30	59,70	62,30
Screen reject	%	negl.	negl.	negl.
Yield screened	%	59,30	59,70	62,30
Kappa No.		11,20	13,50	27,30

TABLE 4

Jute pulping **Kraft AQ pulping at 165°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Kraft AQ	Kraft AQ	Kraft AQ
Cook No		KAQ01	KAQ02	KAQ03
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	341	341	341
	gBD	300	300	300
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	14,60	12,51	10,43
Na2S Charge	%	3,38	2,90	2,42
Sulfidity	%	19,20	19,20	19,20
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	14,00	12,00	10,00
Effective Alkali charge as Na2O	%	12,66	10,85	9,04
AQ charge	%	0,05	0,05	0,05
Heating up time	min	90	90	90
Cooking time	min	60	60	60
Cooking temp.	°C	165	165	165
H Factor	-	702,3	702,3	702,3
Yield unscreened	%	59,70	61,80	61,90
Screen reject	%	negl.	negl.	negl.
Yield screened	%	59,70	61,80	61,90
Kappa No.		10,60	11,80	16,00

TABLE 5

Jute pulping — **Kraft AQ pulping at 160°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit							
Raw material		Jute	Jute	Jute	Jute	Jute		Jute
Quality of Fiber								
Size of fiber	mm	250	250	250	250	250		250
Pulping data								
Pulping Process		Kraft AQ	Kraft AQ	Kraft AQ	Kraft AQ	Kraft AQ		Kraft AQ
Cook No.		KAQ04	KAQ05	KAQ05 A	KAQ05 B	KAQ05 C	KAQ5-KAQ5C	KAQ06
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated		Rotary, elect. heated
Size	l	10	10	10	10	10		10
Hydromodul	1:??	3,00	3,00	3,00	3,00	3,00		3,00
Raw material charge	g	341	341	341	455	455		341
	gBD	300	300	300	400	400		300
Dry content	%	88,00	88,00	88,00	88,00	88,00		88,00
NaOH Charge	%	14,60	12,51	12,51	12,51	12,51		10,43
Na2S Charge	%	3,38	2,90	2,90	2,90	2,90		2,42
Sulfidity	%	19,20	19,20	19,20	19,20	19,20		19,20
SO2 Charge	%	-	-	-	-	-		-
Na2SO3 Charge	%	-	-	-	-	-		-
Active Alkali charge as Na2O	%	14,00	12,00	12,00	12,00	12,00		10,00
Effective Alkali charge as Na2O	%	12,66	10,85	10,85	10,85	10,85		9,04
AQ charge	%	0,05	0,05	0,05	0,05	0,05		0,05
Heating up time	min	90	90	90	90	90		90
Cooking time	min	120	120	120	120	120		120
Cooking temp.	°C	160	160	160	160	160		160
H Factor	-	859,6	859,6	859,6	859,6	859,6		859,6
Yield unscreened	%	57,40	62,00	61,00	61,60	62,00	61,65	61,90
Screen reject	%	negl.	negl.	negl.	negl.	negl.		negl.
Yield screened	%	57,40	62,00	61,00	61,60	62,00	61,65	61,90
Kappa No.		9,70	12,20	12,30	11,50	12,00	12,00	14,40

TABLE 6

Jute pulping **Kraft AQ pulping at 150°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Kraft AQ	Kraft AQ	Kraft AQ
Cook No.		KAQ07	KAQ08	KAQ09
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	341	341	341
	gBD	300	300	300
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	14,60	12,51	10,43
Na2S Charge	%	3,38	2,90	2,42
Sulfidity	%	19,20	19,20	19,20
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	14,00	12,00	10,00
Effective Alkali charge as Na2O	%	12,66	10,85	9,04
AQ charge	%	0,05	0,05	0,05
Heating up time	min	90	90	90
Cooking time	min	240	240	240
Cooking temp.	°C	150	150	150
H Factor	-	688,2	688,2	688,2
Yield unscreened	%	60,60	62,30	61,90
Screen reject	%	negl.	negl.	negl.
Yield screened	%	60,60	62,30	61,90
Kappa No.		8,70	12,40	18,30

TABLE 7

Jute pulping **Soda pulping at 165°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Soda	Soda	Soda
Cook No.		S01	S02	S03
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	341	341	341
	gBD	300	300	300
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	20,65	18,06	15,48
Na2S Charge	%	0,00	0,00	0,00
Sulfidity	%	0,00	0,00	0,00
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	16,00	14,00	12,00
Effective Alkali charge as Na2O	%	16,00	14,00	12,00
AQ charge	%	-	-	-
Heating up time	min	90	90	90
Cooking time	min	60	60	60
Cooking temp.	°C	165	165	165
H Factor	-	702,3	702,3	702,3
Yield unscreened	%	56,90	56,10	57,80
Screen reject	%	negl.	negl.	negl.
Yield screened	%	56,90	56,10	57,80
Kappa No.		14,80	16,50	37,70

TABLE 8

Jute pulping — **Soda pulping at 160°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit						
Raw material		**Jute**	**Jute**	**Jute**	**Jute**		**Jute**
Quality of Fiber							
Size of fiber	mm	250	250	250	250		250
Pulping data							
Pulping Process		Soda	Soda	Soda	Soda		Soda
Cor k No.		S04	S05	S 05A	S 05B		S06
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated		Rotary, elect. heated
Size	l	10	10	10	10		10
Hydromodul	1:??	3,00	3,00	3,00	3,00		3,00
Raw material charge	g	341	341	454,55	454,55		341
	gBD	300	300	400,00	400,00		300
Dry content	%	88,00	88,00	88,00	88,00		88,00
NaOH Charge	%	20,65	18,06	18,06	18,06		15,48
Na2S Charge	%	0,00	0,00	0,00	0,00		0,00
Sulfidity	%	0,00	0,00	0,00	0,00		0,00
SO2 Charge	%	-	-	-	-		-
Na2SO3 Charge	%	-	-	-	-		-
Active Alkali charge as Na2O	%	16,00	14,00	14,00	14,00		12,00
Effective Alkali charge as Na2O	%	16,00	14,00	14,00	14,00		12,00
AQ charge	%	-	-	-	-		-
Heating up time	min	90	90	90	90		90
Cooking time	mir	120	120	120	120		120
Cooking temp.	°C	160	160	160	160		160
H Factor	-	859,6	859,6	859,6	859,6		859,6
Yield unscreened	%	58,70	58,30	57,80	58,30	58,13	61,70
Screen reject	%	negl.	negl.	negl.	negl.		negl.
Yield screened	%	58,70	58,30	57,80	58,30	58,13	61,70
Kappa No.		14,10	12,90	17,60	12,90	14,47	33,20

TABLE 9

Jute pulping — **Soda pulping at 150°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Soda	Soda	Soda
Cook No.		S07	S08	S09
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	340,91	340,91	340,91
	gBD	300,00	300,00	300,00
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	20,65	18,06	15,48
Na2S Charge	%	0,00	0,00	0,00
Sulfidity	%	0,00	0,00	0,00
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	16,00	14,00	12,00
Effective Alkali charge as Na2O	%	16,00	14,00	12,00
AQ charge	%	-	-	-
Heating up time	min	90	90	90
Cooking time	min	240	240	240
Cooking temp.	°C	150	150	150
H Factor	-	688,2	688,2	688,2
Yield unscreened	%	58,10	57,20	57,80
Screen reject	%	negl.	negl.	negl.
Yield screened	%	58,10	57,20	57,80
Kappa No.		17,20	20,30	42,80

TABLE 10

Jute pulping — **Soda AQ pulping at 165°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Soda AQ	Soda AQ	Soda AQ
Cook No.		SAQ01	SAQ02	SAQ03
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	340,91	340,91	340,91
	gBD	300,00	300,00	300,00
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	20,65	18,06	15,48
Na2S Charge	%	0,00	0,00	0,00
Sulfidity	%	0,00	0,00	0,00
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	16,00	14,00	12,00
Effective Alkali charge as Na2O	%	16,00	14,00	12,00
AQ charge	%	0,05	0,05	0,05
Heating up time	min	90	90	90
Cooking time	min	60	60	60
Cooking temp.	°C	165	165	165
H Factor	-	702,3	702,3	702,3
Yield unscreened	%	57,30	56,40	58,00
Screen reject	%	negl.	negl.	negl.
Yield screened	%	57,30	56,40	58,00
Kappa No.		10,30	10,60	28,10

TABLE 11

Jute pulping **Soda AQ pulping at 160°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducterl by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit						
Raw material		Jute	Jute	Jute	Jute		Jute
Quality of Fiber							
Size of fiber	mm	250	250	250	250		250
Pulping data							
Pulping Process		Soda AQ	Soda AQ	Soda AQ	Soda AQ		Soda AQ
Cook No.		SAQ04	SAQ05	SAQ10	SAQ10 A		SAQ06
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated		Rotary, elect. heated
Size	l	10	10	10	10		10
Hydromodul	1:??	3,00	3,00	3,00	3,00		3,00
Raw material charge	g	340,91	340,91	454,55	454,55		340,91
	gBD	300,00	300,00	400,00	400,00		300,00
Dry content	%	88,00	88,00	88,00	88,00		88,00
NaOH Charge	%	20,65	18,06	17,42	17,42		15,48
Na2S Charge	%	0,00	0,00	0,00	0,00		0,00
Sulfidity	%	0,00	0,00	0,00	0,00		0,00
SO2 Charge	%	-	-	-	-		-
Na2SO3 Charge	%	-	-	-	-		-
Active Alkali charge as Na2O	%	16,00	14,00	13,50	13,50		12,00
Effective Alkali charge as Na2O	%	16,00	14,00	13,50	13,50		12,00
AQ charge	%	0,05	0,05	0,05	0,05		0,05
Heating up time	min	90	90	90	90		90
Cooking time	min	120	120	120	120		120
Cooking temp.	°C	160	160	160	160		160
H Factor	-	859,6	859,6	859,6	859,6		859,6
Yield unscreened	%	59,40	58,60	60,10	60,10	60,10	60,90
Screen reject	%	negl.	negl.	negl.	negl.		negl.
Yield screened	%	59,40	58,60	60,10	60,10	60,10	60,90
Kappa No.		8,70	10,20	11,70	10,20	10,95	19,70

TABLE 12

Jute pulping **Soda AQ pulping at 150°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

	Unit			
Raw material		Jute	Jute	Jute
Quality of Fiber				
Size of fiber	mm	250	250	250
Pulping data				
Pulping Process		Soda AQ	Soda AQ	Soda AQ
Cook No.		SAQ07	SAQ08	SAQ09
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10
Hydromodul	1:??	3,00	3,00	3,00
Raw material charge	g	340,91	340,91	340,91
	gBD	300,00	300,00	300,00
Dry content	%	88,00	88,00	88,00
NaOH Charge	%	20,65	18,06	15,48
Na2S Charge	%	0,00	0,00	0,00
Sulfidity	%	0,00	0,00	0,00
SO2 Charge	%	-	-	-
Na2SO3 Charge	%	-	-	-
Active Alkali charge as Na2O	%	16,00	14,00	12,00
Effective Alkali charge as Na2O	%	16,00	14,00	12,00
AQ charge	%	0,05	0,05	0,05
Heating up time	min	90	90	90
Cooking time	min	240	240	240
Cooking temp.	°C	150	150	150
H Factor	-	688,2	688,2	688,2
Yield unscreened	%	57,70	58,90	58,40
Screen reject	%	negl.	negl.	negl.
Yield screened	%	57,70	58,90	58,40
Kappa No.		9,90	13,20	16,10

TABLE 13

Jute pulping — **Alkaline sulphite pulping at 165°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit				
Raw material		Jute	Jute	Jute	Jute
Quality of Fiber					
Size of fiber	mm	250	250	250	250
Pulping data					
Pulping Process		Alkal. Sulphite	Alkal. Sulphite	Alkal. Sulphite	Alkal. Sulphite
Cook No.		AS 01	AS 02	AS 03	AS 04
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	10	10	10	10
Hydromodul	1:??	3,00	3,00	3,00	3,00
Raw material charge	g	340,91	340,91	340,91	340,91
	gBD	300,00	300,00	300,00	300,00
Dry content	%	88,00	88,00	88,00	88,00
NaOH Charge	%	2,00	2,50	4,00	8,00
Na2S Charge	%	-	-	-	-
Sulfidity	%	-	-	-	-
SO2 Charge	%	8,00	10,00	16,00	24,00
Na2SO3 Charge	%	15,75	19,69	31,50	47,25
Active Alkali charge as Na2O	%	-	-	-	-
Effective Alkali charge as Na2O	%	-	-	-	-
AQ charge	%	-	-	-	-
Heating up time	min	90	90	90	90
Cooking time	min	240	240	240	240
Cooking temp.	°C	165	165	165	165
H Factor	-	2527,2	2527,2	2527,2	2527,2
Yield unscreened	%	74,20	70,30	67,90	63,60
Screen reject	%	negl.	negl.	negl.	negl.
Yield screened	%	74,20	70,30	67,90	63,60
Kappa No.		56,70	54,60	52,30	51,30

TABLE 14

Jute pulping — **Alkaline sulphite AQ pulping at 165°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

	Unit							
Raw material		Jute	Jute	Jute	Jute	Jute	Jute	
Quality of Fiber								
Size of fiber	mm	250	250	250	250	250	250	
Pulping data								
Pulping Process		Alkal. Sulphite AQ	Alkal. Sulphite AQ	Alkal. Sulphite AQ	Alkal. Sulphite AQ	Alkal. Sulph. AQ	Alkal. Sulph. AQ	
Cook No.		ASAQ 01	ASAQ 02	ASAQ 03	ASAQ 04	ASAQ 05	ASAQ 05A	
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	
Size	l	10	10	10	10	10	10	
Hydromodul	1:??	3,00	3,00	3,00	3,00	3,00	3,00	
Raw material charge	g	340,91	340,91	340,91	340,91	454,55	454,55	
	gBD	300,00	300,00	300,00	300,00	400,00	400,00	
Dry content	%	88,00	88,00	88,00	88,00	88,00	88,00	
NaOH Charge	%	2,00	2,50	4,00	8,00	6,00	6,00	
Na2S Charge	%	-	-	-	-	-	-	
Sulfidity	%	-	-	-	-	-	-	
SO2 Charge	%	8,00	10,00	16,00	24,00	24,00	24,00	
Na2SO3 Charge	%	15,75	19,69	31,50	47,25	47,25	47,25	
Active Alkali charge as Na2O	%	-	-	-	-	-	-	
Effective Alkali charge as Na2O	%	-	-	-	-	-	-	
AQ charge	%	0,05	0,05	0,05	0,05	0,05	0,05	
Heating up time	min	90	90	90	90	90	90	
Cooking time	min	240	240	240	240	240	240	
Cooking temp.	°C	165	165	165	165	165	165	
H Factor	-	2527,2	2527,2	2527,2	2527,2	2527,2	2527,2	
Yield unscreened	%	71,90	71,60	64,50	62,10	62,00	62,10	62,07
Screen reject	%	negl.	negl.	negl.	negl.	negl.	negl.	
Yield screened	%	71,90	71,60	64,50	62,10	62,00	62,10	62,07
Kappa No.		46,80	41,90	27,10	18,00	21,30	19,00	19,43

TABLE 15

Jute pulping **Kraft pulping at 160°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 15A

	Unit					
Raw material		Jute	Jute	Jute	Jute	
Quality of Fibre						
Size of fibre	mm	250	250	250	250	
Pulping data						
Pulping Process		Kraft	Kraft	Kraft	Kraft	
Cook No.		K 05	K 05A	K 05B	K 05C	
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	
Size	l	10	10	10	10	
Hydromodul		3,00	3,00	3,00	3,00	
Raw material charge	g	341	341	455	455	
	gBD	300	300	400	400	
Dry content	%	88,00	88,00	88,00	88,00	
NaOH Charge	%	12,51	12,51	12,51	12,51	
Na2S Charge	%	2,90	2,90	2,90	2,90	
Sulfidity	%	19,20	19,20	19,20	19,20	
SO2 Charge	%	-	-	-	-	
Na2SO3 Charge	%	-	-	-	-	
Active Alkali charge as Na2O	%	12,00	12,00	12,00	12,00	
Effective Alkali charge as Na2O	%	10,85	10,85	10,85	10,85	
AQ charge	%	-	-	-	-	
Heating up time	min	90	90	90	90	
Cooking time	min	120	120	120	120	
Cooking temp.	°C	160	160	160	160	
H Factor	-	860	860	860	860	
Yield unscreened	%	61,00	60,20	57,80	61,00	**Aver. 60,73**
Screen reject	%	negl.	negl.	negl.	negl.	
Yield screened	%	61,00	60,20	57,80	61,00	**Aver. 60,73**
Kappa No.		12,40	14,10	12,00	12,40	**Aver. 12,27**
Viscosity	ml/g			1029		
Brightness	% ISO				31,22	
Fibre fraction Bauer McNett:						
retained on mesh 14	%			88,40		
retained on mesh 30	%			7,50		
retained on mesh 50	%			2,00		
retained on mesh 100	%			0,50		
going through mesh 100	%			1,60		

NOTE: Cook no. K 05B used for physical propertie test, K 05C used for bleachability tests

TABLE 15B

Physical properties:		Sample: from Cook No. K05B				KAPPA= 12,00							
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		11600		5141		8741	
	min	0,00		3,00		5,00		8,00		3,55		6,03	
Freeness	SR	17		27		38				30		50	
	CSF	656		470		333				428		224	
Grammage	g/m²	76,96		73,46		74,41		73,25		73,72		74,01	
Thickness	mm	0,174		0,128		0,119		0,106		0,126		0,115	
Density	kg/m³	440		575		625		690		589		647	
Bulk	m³/kg	2,273		1,739		1,600		1,449		1,701		1,548	
Stretch	%	1,7		2,8		3,3		3,9		2,9		3,5	
Breaking length	m	3745		6715		7010		10175		6795		8095	
Burst strength	kPa	146		320		350		398		328		366	
Tearing resistance	mN	1138		1067		930		776		1030		877	
MID double fold		15		470		784		478		556		679	
Tensile index	Nm/g	36,74		65,87		68,77		99,82		66,66		79,41	
Burst index	kPam²/g	1,90		4,36		4,70		5,43		4,45		4,95	
Tear index	mNm²/g	14,79		14,52		12,50		10,59		13,97		11,85	
Bendtsen porosity A/B side	ml/min	-	-	-	-	752	750	57	56	-	-	514	512
Bendtsen smoothness A/B side	ml/min	962	984	564	554	412	460	350	420	523	528	391	446
Zero beaten pulp.													
Fibre length Arithmetic average	mm	1,27											
Fibre length weighted average	mm	1,69											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,104											
Slendemess factor		16,3											
Fibre zero span tensile	km	1,13											
fibre zero span stregth index	Nm/g	11,085											
Black liquor:													
pH		9,4											
Residual alkali as Na2O	g/l	5,27											
Viscosity at	RPM	20	50	100									
	mPa.S	12	14	19									
Dry solids content of org.liquor	%	17,0											
Organic content of dry solids	%	63,8											
Inorganic content of dry solids	%	36,2											
HHV of dry solids	kcal/kg	2889											
	kJ/kg	12097											
Specific gravity	g/cm³	1,10											

TABLE 16

Jute pulping **Kraft-AQ pulping at 160°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 16A

	Unit						
Raw material		Jute	Jute	Jute	Jute		
Quality of Fibre							
Size of fibre	mm	250	250	250	250		
Pulping data							
Pulping Process		Kraft AQ	Kraft AQ	Kraft AQ	Kraft AQ		
Cook No.		KAQ05	KAQ05 A	KAQ05 B	KAQ05 C		
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated		
Size	l	10	10	10	10		
Hydromodul		3,00	3,00	3,00	3,00		
Raw material charge	g	341	341	455	455		
	gBD	300	300	400	400		
Dry content	%	88,00	88,00	88,00	88,00		
NaOH Charge	%	12,51	12,51	12,51	12,51		
Na2S Charge	%	2,90	2,90	2,90	2,90		
Sulfidity	%	19,20	19,20	19,20	19,20		
SO2 Charge	%	-	-	-	-		
Na2SO3 Charge	%	-	-	-	-		
Active Alkali charge as Na2O	%	12,00	12,00	12,00	12,00		
Effective Alkali charge as Na2O	%	10,85	10,85	10,85	10,85		
AQ charge	%	0,05	0,05	0,05	0,05		
Heating up time	min	90	90	90	90		
Cooking time	min	120	120	120	120		
Cooking temp.	°C	160	160	160	160		
H Factor	-	860	860	860	860		
Yield unscreened	%	62,00	61,00	61,60	62,00	Aver.	61,65
Screen reject	%	negl.	negl.	negl.	negl.		
Yield screened	%	62,00	61,00	61,60	62,00	Aver.	61,65
Kappa No.		12,20	12,30	11,50	12,00	Aver.	12,00
Viscosity	ml/g			1045			
Brightness	% ISO				35,32		
Fibre fraction Bauer McNett:							
retained on mesh 14	%			84,30			
retained on mesh 30	%			18,20			
retained on mesh 50	%			2,40			
retained on mesh 100	%			0.70			
going through mesh 100	%			2,40			

NOTE: Cook no. KAQ 05B used for physical properie test, KAQ 05C used for bleachability tests

TABLE 16B

Physical properties:		Sample: from Cook No. KAQ05B					KAPPA= 11,50						
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		2900		4350		8700		4108		7411	
	min	0,00		2,00		3,00		6,00		2,83		5,11	
Freeness	SR	18		25		31		58		30		50	
	CSF	633		501		415		164		428		224	
Grammage	g/m²	74,84		74,30		76,00		74,41		75,72		74,88	
Thickness	mm	0,159		0,131		0,130		0,113		0,130		0,118	
Density	kg/m³	470		565		585		660		582		638	
Bulk	m³/kg	2,128		1,770		1,709		1,515		1,719		1,572	
Stretch	%	2,1		2,9		2,9		3,6		2,9		3,4	
Breaking length	m	5430		6900		7340		9070		7267		8557	
Burst strength	kPa	209		294		349		397		340		383	
Tearing resistance	mN	1303		1118		1098		596		1101		745	
MID double fold		112		469		749		496		702		571	
Tensile index	Nm/g	53,27		67,69		72,01		88,98		71,29		83,95	
Burst index	kPam²/g	2,79		3,96		4,59		5,34		4,49		5,11	
Tear index	mNm²/g	17,41		15,05		14,45		8,01		14,55		9,95	
Bendtsen porosity A/B side	ml/min	-	-	-	-	-	-	177	180	-	-	197	195
Bendtsen smoothness A/B side	ml/min	862	878	642	568	516	502	376	392	537	513	417	425
Zero beaten pulp:													
Fibre length Anthmetic average	mm	1,24											
Fibre length weighted average	mm	1,68											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,100											
Slenderness factor		16,8											
Fibre zero span tensile	km	2,61											
Fibre zero span stregth index	Nm/g	25,604											
Black liquor:													
pH		9,3											
Residual alkali as Na2O	g/l	4,68											
Viscosity at	RPM	20	50	100									
	mPa.S	15	16	20									
Dry solids content of org.liquor	%	16,3											
Organic content of dry solids	%	67,5											
Inorganic content of dry solids	%	32,5											
HHV of dry solids	kcal/kg	2997											
	kJ/kg	12547											
Specific gravity	g/cm³	1,10											

TABLE 17

Jute pulping **Soda pulping at 160°C**

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: January-March 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 17A

	Unit				
Raw material		Jute	Jute	Jute	
Quality of Fibre					
Size of fibre	mm	250	250	250	
Pulping data					
Pulping Process		Soda	Soda	Soda	
Cook No.		S 05	S 05A	S 05B	
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	
Size	l	10	10	10	
Hydromodul		3,00	3,00	3,00	
Raw material charge	g	341	455	455	
	gBD	300,00	400	400	
Dry content	%	88,00	88,00	88,00	
NaOH Charge	%	18,06	18,06	18,06	
Na2S Charge	%	0,00	0,00	0,00	
Sulfidity	%	0,00	0,00	0,00	
SO2 Charge	%	-	-	-	
Na2SO3 Charge	%	-	-	-	
Active Alkali charge as Na2O	%	14,00	14,00	14,00	
Effective Alkali charge as Na2O	%	14,00	14,00	14,00	
AQ charge	%	-	-	-	
Heating up time	min	90	90	90	
Cooking time	min	120	120	120	
Cooking temp.	°C	160	160	160	
H Factor	-	860	860	860	
Yield unscreened	%	58,30	57,80	58,30	Aver. 58,13
Screen reject	%	negl.	negl.	negl.	
Yield screened	%	58,30	57,80	58,30	Aver. 58,13
Kappa No.		12,90	17,60	12,90	Aver. 14,47
Viscosity	ml/g		1030		
Brightness	% ISO			37,31	
Fibre fraction Bauer McNett:					
retained on mesh 14	%		78,00		
retained on mesh 30	%		13,80		
retained on mesh 50	%		2,50		
retained on mesh 100	%		1,20		
going through mesh 100	%		4,50		

NOTE: Cook no. S 05A used for physical properties test, S 05B used for bleachability tests

TABLE 17B

Physical properties:		Sample: from Cook No. S05A				KAPPA= 17,60							
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		2900		4350		8700		4060		8483	
	min	0		2		3		6		2,80		5,85	
Freeness	SR	21		26		31		51		30		50	
	CSF	571		485		415		216		428		224	
Grammage	g/m²	77,60		75,69		75,90		75,37		75,86		75,40	
Thickness	mm	0,167		0,138		0,131		0,117		0,132		0,118	
Density	kg/m³	465		545		580		645		573		642	
Bulk	m³/kg	2,150		1,835		1,724		1,550		1,746		1,559	
Stretch	%	2,2		2,8		3,3		3,7		3,2		3,7	
Breaking length	m	3930		5590		5760		7020		5726		6957	
Burst strength	kPa	158		250		274		323		269		321	
Tearing resistance	mN	1267		1052		1032		914		1036		920	
MID double fold		35		416		871		1017		780		1010	
Tensile index	Nm/g	38,55		54,84		56,51		68,87		56,17		68,25	
Burst index	kPam²/g	2,04		3,30		3,61		4,29		3,55		4,25	
Tear index	mNm²/g	16,33		13,90		13,60		12,13		13,66		12,20	
Bendtsen porosity A/B side	ml/min	-	-	-	-	-	-	424	438	-	-	439	448
Bendtsen smoothness A/B side	ml/min	780	740	582	456	558	438	324	300	563	442	336	307
Zero beaten pulp:													
Fibre length Arithmetic average	mm	1,02											
Fibre length weighted average	mm	1,58											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,106											
Slenderness factor		14,9											
Fibre zero span tensile	km	2,60											
Fibre zero span stregth index	Nm/g	25,506											
Black liquor:													
pH		9,4											
Residual alkali as Na2O	g/l	8,76											
Viscosity at	RPM	20	50	100									
	mPa.S	10	13	19									
Dry solids content of org.liquor	%	14,7											
Organic content of dry solids	%	66,2											
Inorganic content of dry solids	%	33,8											
HHV of dry solids	kcal/kg	3296											
	kJ/kg	13799											
Specific gravity	g/cm³	1,09											

TABLE 18

Jute pulping **Soda-AQ pulping at 160°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl Ing. Mohamed NAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 18A

	Unit				
Raw material		Jute	Jute		
Quality of Fibre					
Size of fibre	mm	250	250		
Pulping data					
Pulping Process		Soda AQ	Soda AQ		
Cook No.		SAQ10	SAQ10 A		
Type of digester		Rotary, elect. heated	Rotary, elect. heated		
Size	l	10	10		
Hydromodul		3,00	3,00		
Raw material charge	g	455	455		
	gBD	400	400		
Dry content	%	88,00	88,00		
NaOH Charge	%	17,42	17,42		
Na2S Charge	%	0,00	0,00		
Sulfidity	%	0,00	0,00		
SO2 Charge	%	-	-		
Na2SO3 Charge	%	-	-		
Active Alkali charge as Na2O	%	13,50	13,50		
Effective Alkali charge as Na2O	%	13,50	13,50		
AQ charge	%	0,05	0,05		
Heating up time	min	90	90		
Cooking time	min	120	120		
Cooking temp.	°C	160	160		
H Factor	-	860	860		
Yield unscreened	%	60,10	60,10	Aver.	60,10
Screen reject	%	negl.	negl.		
Yield screened	%	60,10	60,10	Aver.	60,10
Kappa No.		11,70	10,20	Aver.	10,95
Viscosity	ml/g	1002			
Brightness	% ISO		40,87		
Fibre fraction Bauer McNett:					
retained on mesh 14	%	87,70			
retained on mesh 30	%	9,50			
retained on mesh 50	%	1,70			
retained on mesh 100	%	1,00			
going through mesh 100	%	0,10			

NOTE: Cook no. SAQ 10 used for physical propertie test, SAQ 10A used for bleachability tests

TABLE 18B

Physical properties:		Sample: from Cook No. SAQ 10				KAPPA= 11,70							
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		10150		4350		8378	
	min	0		3		5		7		3,00		5,78	
Freeness	SR	18		30		43		61		30		50	
	CSF	633		428		284		144		428		224	
Grammage	g/m²	76,11		76,11		74,52		75,47		76,11		74,89	
Thickness	mm	0,163		0,130		0,119		0,113		0,130		0,117	
Density	kg/m³	465		585		625		665		585		641	
Bulk	m³/kg	2,150		1,709		1,600		1,504		1,709		1,563	
Stretch	%	2,2		3,4		3,7		3,8		3,4		3,7	
Breaking length	m	3980		6070		6380		6720		6070		6512	
Burst strength	kPa	180		306		341		378		306		355	
Tearing resistance	mN	1177		1146		1059		1059		1146		1059	
MID double fold		31		366		1853		1893		366		1869	
Tensile index	Nm/g	39,04		59,55		62,59		65,92		59,55		63,88	
Burst index	kPam²/g	2,36		4,02		4,58		5,01		4,02		4,75	
Tear index	mNm²/g	15,46		15,06		14,21		14,03		15,06		14,14	
Bendtsen porosity A/B side	ml/min	-	-	-	-	710	708	216	206	-	-	518	513
Bendtsen smoothness A/B side	ml/min	886	842	512	438	442	318	302	292	512	438	388	308
Zero beaten pulp:													
Fibre length Arithmetic average	.nm	1,14											
Fibre length weighted average	mm	1,760											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,101											
Slenderness factor		17,4											
Fibre zero span tensile	km	2,17											
Fibre zero span stregth index	Nm/g	21,288											
Black liquor:													
pH		9,4											
Residual alkali as Na2O	g/l	6,44											
Viscosity at	RPM	20	50	100									
	mPa.S	10	13	19									
Dry solids content of org.liquor	%	14,2											
Organic content of dry solids	%	70,3											
Inorganic content of dry solids	%	29,7											
HHV of dry solids	kcal/kg	3388											
	kJ/kg	14185											
Specific gravity	g/cm³	1,08											

TABLE 19

Jute pulping **Alkaline sulphite-AQ pulping at 165°C**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , DipLIng. Mohamed KAGA**
Date: **January-March 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 19A

	Unit				
Raw material		Jute	Jute	Jute	
Quality of Fibre					
Size of fibre	mm	250	250	250	
Pulping data					
Pulping Process		Alkal. Sulph.AQ	Alkal. Sulph. AQ	Alkal. Sulph. AQ	
Cook No.		ASAQ04	ASAQ 05	ASAQ 05A	
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	
Size	l	10	10	10	
Hydromodul		3,00	3,00	3,00	
Raw material charge	g	341	455	455	
	gBD	300,00	400	400	
Dry content	%	88,00	88,00	88,00	
NaOH Charge	%	6,00	6,00	6,00	
Na2S Charge	%	-	-	-	
Sulfidity	%	-	-	-	
SO2 Charge	%	24,00	24,00	24,00	
Na2SO3 Charge	%	47,25	47,25	47,25	
Active Alkali charge as Na2O	%	-	-	-	
Effective Alkali charge as Na2O	%	-	-	-	
AQ charge	%	0,05	0,05	0,05	
Heating up time	min	90	90	90	
Cooking time	min	240	240	240	
Cooking temp.	°C	165	165	165	
H Factor	-	2527	2527	2527	
Yield unscreened	%	62,10	62,00	62,10	Aver. 62,07
Screen reject	%	negl.	negl.	negl.	
Yield screened	%	62,10	62,00	62,10	Aver. 62,07
Kappa No.		18,00	21,30	19,00	Aver. 19,43
Viscosity	ml/g	-	1302	-	
Brightness	% ISO			38,73	
Fibre fraction Bauer McNett:					
retained on mesh 14	%		78,90		
retained on mesh 30	%		13,00		
retained on mesh 50	%		2,50		
retained on mesh 100	%		1,10		
going through mesh 100	%		4,50		

Notes: Cook no. ASAQ 05 used for physical propertie test, ASAQ 05A used for bleachability test

TABLE 19B

Physical properties:		Sample: from Cook No. ASAQ 05 KAPPA= 21,30											
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		10150		4086		8700	
	min	0		5		5		7		2,82		6,00	
Freeness	SR	18		31		42		58		30		50	
	CSF	633		415		293		164		428		224	
Grammage	g/m²	80,89		74,94		75,47		78,55		74,89		77,01	
Thickness	mm	0,168		0,115		0,109		0,107		0,116		0,108	
Density	kg/m³	480		650		690		735		646		713	
Bulk	m³/kg	2,450		1,538		1,449		1,360		1,546		1,405	
Stretch	%	2,4		4,2		4,3		4,8		4,2		4,6	
Breaking length	m	3880		6650		6870		8740		6630		7805	
Burst strength	kPa	161		366		418		486		361		452	
Tearing resistance	mN	1393		1295		1165		1165		1307		1165	
MID double fold		40		3317		3172		2735		3330		2954	
Tensile index	Nm/g	38,06		65,24		67,39		85,74		65,04		76,57	
Burst index	kPam²/g	1,99		4,88		5,54		6,19		4,82		5,87	
Tear index	mNm²/g	17,22		17,28		15,44		14,83		17,45		15,13	
Bendtsen porosity A/B side	ml/min	-	-	1048	1016	310	308	102	102	-	-	206	205
Bendtsen smoothness A/B side	ml/min	912	824	422	426	406	302	404	264	423	437	405	283
Zero beaten pulp:													
Fibre length Arithmetic average	mm	1,200											
Fibre length weighted average	mm	1,660											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,130											
Slenderness factor		12,8											
Fibre zero span tensile	km	6,79											
Fibre zero span stregth index	Nm/g	66,610											
Black liquor:													
pH		8,8											
Residual alkali as Na2O	g/l	4,49											
Viscosity at	RPM	20	50	100									
	mPa.S	15	16	22									
Dry solids content of org.liquor	%	22,3											
Organic content of dry solids	%	59,2											
Inorganic content of dry solids	%	40,8											
HHV of dry solids	kcal/kg	1821											
	kJ/kg	7626											
Specific gravity	g/cm³	1,16											

10.2 Bleachability tests

TABLE 20

Bleachability test **of kraft-jute-puip**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **March-April 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 20A

	Unit	
Pulping process		Kraft
Kappa No. unbleached		12,40
Initial Brightness	% ISO	31,22
Viscosity	ml/g	1029
Bleaching Sequence:		C E H
First Stage		C
HCl Charge	%	0,00
Sulfamic acid	%	0,00
Active Chlorine applied	%	3,00
Residual Chlorine	%	0,80
Active Chlorine consumed	%	2,20
Temperature	°C	20
Retention time	min	30
Consistency	%	3,00
pH start		
pH end		2,40
Second Stage		E
NaOH	%	1,50
Peroxid applied	%	0,00
Oxygen pressure	kg/cm²	
Temperature	°C	60
Retention time	min	90
Consistency	%	10,00
pH start		12,00
pH end		11,80
Third Stage		H
Sulfamic acid	%	0,00
Active Chlorine applied	%	1,50
Residual Chlorine	%	0,85
Active Chlorine consumed	%	0,65
NaOH as Buffer	%	0,00
Temperature	°C	40
Retention time	min	150
Consistency	%	10,00
pH start		11,80
pH end		9,90
Total Active Chlorine applied	%	4,50
Total Active Chlorine consumed	%	2,85
Final Brightness absolute	% ISO	76,50
Brigtness revertion	%	2,21
Viscosity	ml/g	662

Ash content	%	1,02
Bleaching yield	%	93,40
Unbleached yield average	%	60,73
Total yield bleached pulp	%	56,72
Classification of speks		
>5 mm²	speks/kgBD	-
1,0-4,99 mm²	speks/kgBD	679
0,4-0,99 mm²	speks/kgBD	1903
0,15-0,39 mm²	speks/kgBD	3807
Fiber fraction Bauer McNett:		
retained on mesh 14	%	67,00
retained on mesh 30	%	21,90
retained on mesh 50	%	3,40
retained on mesh 100	%	1,50
going through mesh 100	%	6,20

TABLE 20B

Physical properties:	Unit												
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		11600		5141		11600	
	min	0,00		3,00		5,00		8,00		3,55		8,00	
Freeness	SR	19		27		38		50		30		50	
	CSF	611		470		333		224		428		224	
Grammage	g/m²	77,39		76,33		75,90		74,41		76,21		74,41	
Thickness	mm	0,163		0,134		0,123		0,118		0,131		0,118	
Density	kg/m³	475		570		615		630		582		630	
Bulk	m³/kg	2,105		1,754		1,626		1,587		1,719		1,587	
Stretch	%	2,4		2,9		3,6		3,7		3,1		3,7	
Breaking length	m	3425		5547		5854		6278		5631		6278	
Burst strength	kPa	146		283		288		307		284		307	
Tearing resistance	mN	1499		1353		1146		1118		1297		1118	
MID double fold		29		275		568		1114		355		1114	
Tensile index	Nm/g	33,60		54,42		57,43		61,59		55,24		61,59	
Burst index	kPam²/g	1,89		3,70		3,79		4,13		3,73		4,13	
Tear index	mNm²/g	19,37		17,73		15,10		15,02		17,01		15,02	
Bendtsen porosity A/B side	ml/min	-	-	-	-	912	902	582	560	3000	3000	582	560
Bendtsen smoothness A/B side	ml/min	935	788	656	556	466	404	422	354	604	515	422	354
Scattering coefficient	m²/kg	25,1	25,9	24,7	25,0	25,2	25,1	26,1	24,7	24,8	25,0	26,1	24,7
Opacity	%	82,5	82,2	80,9	81,1	81,5	81,3	81,7	81,3	81,1	81,2	81,7	81,3
Zero beaten pulp:													
Fibre length Arithmetic average	mm	1,100											
Fibre length weighted average	mm	1,60											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,102											
Slenderness factor		15,7											
Fibre zero span tensile	km	1,13											
fibre zero span stregth index	Nm/g	11,1											

TABLE 21

Bleachability test **of kraft-AQ-jute-pulp**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **March-April 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 21A

	Unit	
Pulping process		Kraft-AQ
Kappa No. unbleached		12,00
Initial Brightness	% ISO	35,32
Viscosity	ml/g	1045
Bleaching Sequence:		C E H
First Stage		C
HCl Charge	%	0,00
Sulfamic acid	%	0,00
Active Chlorine applied	%	3,00
Residual Chlorine	%	1,90
Active Chlorine consumed	%	1,10
Temperature	°C	20
Retention time	min	30
Consistency	%	3,00
pH start		
pH end		2,40
Second Stage		E
NaOH	%	1,20
Peroxid applied	%	0,00
Oxygen pressure	kg/cm²	
Temperature	°C	60
Retention time	min	90
Consistency	%	10,00
pH start		11,50
pH end		11,00
Third Stage		H
Sulfamic acid	%	0,00
Active Chlorine applied	%	1,50
Residual Chlorine	%	0,70
Active Chlorine consumed	%	0,80
NaOH as Buffer	%	0,00
Temperature	°C	40
Retention time	min	150
Consistency	%	10,00
pH start		11,40
pH end		9,90
Total Active Chlorine applied	%	4,50
Total Active Chlorine consumed	%	1,90
Final Brightness absolute	% ISO	76,30
Brigtness revertion	%	2,14
Viscosity	ml/g	743

Ash content	%	0,84
Bleaching yield	%	93,00
Unbleached yield average	%	61,65
Total yield bleached pulp	%	57,33
Classification of speks		
>5 mm²	speks/kgBD	-
1,0-4,99 mm²	speks/kgBD	384
0,4-0,99 mm²	speks/kgBD	1119
0,15-0,39 mm²	speks/kgBD	2175
Fiber fraction Bauer McNett:		
retained on mesh 14	%	81,80
retained on mesh 30	%	11,00
retained on mesh 50	%	2,40
retained on mesh 100	%	1,10
going through mesh 100	%	3,70

TABLE 21B

Physical properties:	Unit												
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		14500		7250		11927	
	min	0,00		3,00		5,00		10,00		5,00		8,23	
Freeness	SR	17		25		30		61		30		50	
	CSF	656		501		428		144		428		224	
Grammage	g/m²	74,30		75,05		76,85		74,63		76,85		75,42	
Thickness	mm	0,149		0,133		0,126		0,111		0,126		0,116	
Density	kg/m³	440		565		605		680		605		653	
Bulk	m³/kg	2,272		1,770		1,633		1,470		1,633		1,523	
Stretch	%	2,1		3,4		3,4		4,1		3,4		3,9	
Breaking length	m	2976		5283		5447		5984		5447		5793	
Burst strength	kPa	117		242		276		313		276		300	
Tearing resistance	mN	1126		1451		1538		969		1538		1171	
MID double fold		14		149		622		1427		622		1141	
Tensile index	Nm/g	29,19		51,83		53,44		58,70		53,44		56,83	
Burst index	kPam²/g	1,57		3,22		3,59		4,19		3,59		3,98	
Tear index	mNm²/g	15,15		19,33		20,01		12,98		20,01		15,53	
Bendtsen porosity A/B side	ml/min	-	-	-	-	-	-	171	168	3000	3000	171	168
Bendtsen smoothness A/B side	ml/min	916	825	570	442	486	360	334	268	486	360	388	301
Scattering coefficient	m²/kg	24,7	24,1	23,7	24,2	24,3	24,3	24,2	24,2	24,3	24,3	24,2	24,2
Opacity	%	81,3	81,6	80,1	80,7	80,9	81,2	80,9	81,0	80,9	81,2	80,9	81,1
Zero beaten pulp:													
Fibre length Arithmetic average	mm	1,21											
Fibre length weighted average	mm	1,71											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,129											
Slenderness factor		13,3											
Fibre zero span tensile	km	1,27											
fibre zero span stregth index	Nm/g	12,5											

TABLE 22

Bleachability test **of soda-jute-pulp**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **March-April 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 22

	Unit	
Pulping process		Soda
Kappa No. unbleached		12,50
Inital Brightness	% ISO	37,31
Viscosity	ml/g	1030
Bleaching Sequence:		**C E H**
First Stage		C
HCl Charge	%	0,00
Sulfamic acid	%	0,00
Active Chlorine applied	%	2,60
Residual Chlorine	%	1,31
Active Chlorine consumed	%	1,29
Temperature	°C	20
Retention time	min	30
Consistency	%	3,00
pH start		
pH end		2,30
Second Stage		E
NaOH	%	1,20
Peroxid applied	%	0,00
Oxygen pressure	kg/cm²	
Temperature	°C	60
Retention time	min	90
Consistency	%	10,00
pH start		11,70
pH end		11,30
Third Stage		H
Sulfamic acid	%	0,00
Active Chlorine applied	%	1,50
Residual Chlorine	%	0,58
Active Chlorine consumed	%	0,92
NaOH as Buffer	%	
Temperature	°C	40
Retention time	min	150
Consistency	%	10,00
pH start		11,23
pH end		10,05
Total Active Chlorine applied	%	4,10
Total Active Chlorine consumed	%	2,21
Final Brightness absolute	% ISO	76,90
Brigtness revertion	%	2,65
Viscosity	ml/g	660

Ash content	%	0,52
Bleaching yield	%	93,60
Unbleached yield average	%	58,13
Total yield bleached pulp	%	54,41
Classification of speks		
>5 mm²	speks/kgBD	-
1,0-4,99 mm²	speks/kgBD	335
0,4-0,99 mm²	speks/kgBD	832
0,15-0,39 mm²	speks/kgBD	1197
Fiber fraction Bauer McNett:		
retained on mesh 14	%	73,00
retained on mesh 30	%	16,20
retained on mesh 50	%	3,10
retained on mesh 100	%	5,40
going through mesh 100	%	

TABLE 22B

Physical properties:	Unit												
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		10150		5179		9321	
	min	0,00		3,00		5,00		7,00		3,57		6,43	
Freeness	SR	16		26		40		54		30		50	
	CSF	680		485		313		193		428		224	
Grammage	g/m²	74,52		74,73		76,11		75,05		75,12		75,35	
Thickness	mm	0,171		0,136		0,125		0,116		0,133		0,119	
Density	kg/m³	435		545		605		645		562		634	
Bulk	m³/kg	2,299		1,835		1,653		1,550		1,783		1,579	
Stretch	%	1,7		2,7		3,1		3,3		2,8		3,2	
Breaking length	m	2807		4126		4967		5135		4366		5087	
Burst strength	kPa	104		192		233		247		204		243	
Tearing resistance	mN	765		890		694		659		834		669	
MID double fold		5		26		33		100		28		81	
Tensile index	Nm/g	27,54		40,48		48,73		50,37		42,83		49,90	
Burst index	kPam²/g	1,40		2,57		3,06		3,29		2,71		3,22	
Tear index	mNm²/g	10,27		11,91		9,10		8,78		11,10		8,88	
Bendtsen porosity A/B side	ml/min	-	-	-	-	-	-	652	648	3000	3000	652	648
Bendtsen smoothness A/B side	ml/min	936	890	612	500	518	374	428	310	585	464	454	328
Scattering coefficient	m²/kg	26,0	26,1	24,8	25,3	25,6	25,7	25,9	25,3	25,0	25,4	25,8	25,4
Opacity	%	82,9	82,7	81,5	81,4	82,1	82,3	82,5	82,3	81,7	81,7	82,4	82,3
Zero beaten pulp:													
Fibre length Arithmetic average	mm	0,720											
Fibre length weighted average	mm	1,460											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,109											
Slenderness factor		13,4											
Fibre zero span tensile	km	1,83											
fibre zero span stregth index	Nm/g	18,0											

TABLE 23

Bleachability test **of soda-AQ-jute-pulp**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **March-April 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 23A

	Unit	
Pulping process		Soda-AQ
Kappa No. unbleached		10,20
Initial Brightness	% ISO	40,87
Viscosity	ml/g	1002
Bleaching Sequence:		**C E H**
First Stage		C
HCl Charge	%	0,00
Sulfamic acid	%	0,00
Active Chlorine applied	%	2,04
Residual Chlorine	%	1,60
Active Chlorine consumed	%	0,44
Temperature	°C	20
Retention time	min	30
Consistency	%	3,00
pH start		
pH end		2,45
Second Stage		E
NaOH	%	1,20
Peroxid applied	%	0,00
Oxygen pressure	kg/cm²	
Temperature	°C	60
Retention time	min	90
Consistency	%	10,00
pH start		12,00
pH end		10,80
Third Stage		H
Sulfamic acid	%	0,00
Active Chlorine applied	%	1,50
Residual Chlorine	%	0,73
Active Chlorine consumed	%	0,77
NaOH as Buffer	%	0,00
Temperature	°C	40
Retention time	min	150
Consistency	%	10,00
pH start		11,55
pH end		10,10
Total Active Chlorine applied	%	3,54
Total Active Chlorine consumed	%	1,21
Final Brightness absolute	% ISO	74,40
Brigtness revertion	%	2,37
Viscosity	ml/g	691

Ash content	%	0,62
Bleaching yield	%	93,70
Unbleached yield average	%	60,10
Total yield bleached pulp	%	56,31
Classification of speks		
>5 mm²	speks/kgBD	-
1,0-4,99 mm²	speks/kgBD	660
0,4-0,99 mm²	speks/kgBD	1814
0,15-0,39 mm²	speks/kgBD	6596
Fiber fraction Bauer McNett:		
retained on mesh 14	%	
retained on mesh 30	%	
retained on mesh 50	%	
retained on mesh 100	%	
going through mesh 100	%	

TABLE 23B

Physical properties:	Unit												
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		11600		5961		10730	
	min	0,00		3,00		5,00		8,00		4,11		7,40	
Freeness	SR	17		25		34		54		30		50	
	CSF	656		501		378		193		428		224	
Grammage	g/m²	74,20		75,69		75,80		74,52		75,75		74,78	
Thickness	mm	0,171		0,137		0,127		0,114		0.131		0,117	
Density	kg/m³	435		550		595		655		575		643	
Bulk	m³/kg	2,293		1,818		1,681		1,531		1,742		1,561	
Stretch	%	1,7		2,6		3,1		3,7		2,9		3,6	
Breaking length	m	2737		4703		5043		5789		4892		5640	
Burst strength	kPa	101		199		234		272		218		264	
Tearing resistance	mN	844		949		981		757		967		802	
MID double fold		5		52		91		183		74		165	
Tensile index	Nm/g	26,85		46,14		49,47		56,79		47,99		55,33	
Burst index	kPam²/g	1,36		2,63		3,09		3,65		2,88		3,54	
Tear index	mNm²/g	11,37		12,54		12,94		10,16		12,76		10,72	
Bendtsen porosity A/B side	ml/min	-	-	-	-	-	-	536	530	3000	3000	536	530
Bendtsen smoothness A/B side	ml/min	942	922	608	510	562	388	428	370	582	442	455	374
Scattering coefficient	m²/kg	25,4	26,2	24,6	24,6	25,0	25,4	25,3	25,2	24,8	25,0	25,2	25,2
Opacity	%	82,9	83,3	82,1	82,0	80,3	82,7	83,0	82,8	81,1	82,4	82,5	82,8
Zero beaten pulp:													
Fibre length Arithmetic average	mm	0,88											
Fibre length weighted average	mm	1,54											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,108											
Slenderness factor		14,3											
Fibre zero span tensile	km	1,95											
fibre zero span stregth index	Nm/g	19,1											

TABLE 24

Bleachability test **of alkali sulphite-AQ-jute-pulp**

Laboratory: **Pulp and Paper Institute**
City: **Ljubliana**
Country: **Slovenia**
Conducted by: **IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA**
Date: **March-April 1995**
Client: **UNIDO, Vienna for Tribeni Mill**

TABLE 24A

	Unit	
Pulping process		**Alkali Sulphite-AQ**
Kapp.. No. unbleached		19,00
Initial Brightness	% ISO	38,73
Viscosity	ml/g	1302
Bleaching Sequence:		**C E H**
First Stage		C
HCl Charge	%	0,00
Sulfamic acid	%	0,00
Active Chlorine applied	%	3,80
Residual Chlorine	%	1,26
Active Chlorine consumed	%	2,54
Temperature	°C	20
Retention time	min	30
Consistency	%	3,00
pH start		
pH end		2,10
Second Stage		E
NaOH	%	1,20
Peroxid applied	%	0,00
Oxygen pressure	kg/cm²	
Temperature	°C	60
Retention time	min	90
Consistency	%	10,00
pH start		11,90
pH end		11,40
Third Stage		H
Sulfamic acid	%	0,00
Active Chlorine applied	%	1,50
Residual Chlorine	%	0,84
Active Chlorine consumed	%	0,66
NaOH as Buffer	%	0,00
Temperature	°C	40
Retention time	min	150
Consistency	%	10,00
pH start		11,30
pH end		10,00
Total Active Chlorine applied	%	5,30
Total Active Chlorine consumed	%	3,20
Final Brightness absolute	% ISO	83,40
Brigtness revertion	%	1,81

Viscosity	ml/g	1051
Ash content	%	0,86
Bleaching yield	%	94,10
Unbleached yield average	%	62,07
Total yield bleached pulp	%	58,40
Classification of speks		
>5 mm²	speks/kgBD	-
1,0-4,99 mm²	speks/kgBD	691
0,4-0,99 mm²	speks/kgBD	1613
0,15-0,39 mm²	speks/kgBD	4839
Fiber fraction Bauer McNett:		
retained on mesh 14	%	73,00
retained on mesh 30	%	14,80
retained on mesh 50	%	2,60
retained on mesh 100	%	1,20
going through mesh 100	%	8,40

TABLE 24B

Physical properties:	Unit												
with PFI mill													
Beating point	-	0		1		2		3					
PFI revolution	rpm	1450		1450		1450		1450					
	rev.	0		4350		7250		13050		6888		12041	
	min	0,00		3,00		5,00		9,00		4,75		8,30	
Freeness	SR	18		23		31		54		30		50	
	CSF	633		535		415		193		428		224	
Grammage	g/m²	77,49		75,05		76,00		76,00		75,88		76,00	
Thickness	mm	0,166		0,125		0,118		0,110		0,119		0,111	
Density	kg/m³	465		600		645		690		639		682	
Bulk	m³/kg	2,151		1,666		1,550		1,449		1,565		1,467	
Stretch	%	2,3		3,4		4,1		4,2		4,0		4,2	
Breaking length	m	2713		5449		6955		7390		6767		7314	
Burst strength	kPa	128		288		324		386		320		375	
Tearing resistance	mN	969		1668		1460		1315		1486		1340	
MID double fold		14		2470		1981		2020		2042		2013	
Tensile index	Nm/g	26,61		53,45		68,23		72,50		66,38		71,75	
Burst index	kPam²/g	1,65		3,84		4,26		5,08		4,21		4,94	
Tear index	mNm²/g	12,50		22,23		19,21		17,30		19,58		17,63	
Bendtsen porosity A/B side	ml/min	-	-	-	-	-	-	224	211	3000	3000	224	211
Bendtsen smoothness A/B side	ml/min	860	838	604	451	464	394	456	322	482	401	457	335
Scattering coefficient	m²/kg	25,1	25,6	21,4	21,5	22,4	21,6	21,6	21,9	22,3	21,6	21,7	21,6
Opacity	%	80,5	80,6	76,5	76,0	77,6	76,8	77,2	77,5	77,5	76,7	77,3	77,4
Zero beaten pulp:													
Fibre length Arithmetic average	mm	1,15											
Fibre length weighted average	mm	1,65											
Fibre diameter	mm	0,030											
Coarseness	mg/m	0,118											
Slenderness factor		14,0											
Fibre zero span tensile	km	7,13											
fibre zero span stregth index	Nm/g	69,9											

10.3 Bench scale and pilot plant pulping tests at CPPRI

TABLE 25

Jute pulping **Kraft pulping at 160°C, 12 % AA, 2 h**

Laboratory: **Central Pulp and Paper Research Institute**
City: **Saharanpur**
Country: **India**
Conducted by:
Date: **18.4.1995**

TABLE 25A

	Unit				
Raw material		Jute	Jute	Jute	Jute
Quality of Fibre					
Size of fibre	mm	75	75	75	75
Pulping data					
Pulping Process		Kraft	Kraft	Kraft	Kraft
Cook No.		1	2	3	Avg.
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	2,5	2,5	2,5	2,5
Hydromodul		3,00	3,00	3,00	3,00
Raw material charge	g				
	gBD	200	200	200	200
Dry content	%				
NaOH Charge	%	12,39	12,39	12,39	12,39
Na2S Charge	%	3,02	3,02	3,02	3,02
Sulfidity	%	20,00	20,00	20,00	20,00
SO2 Charge	%	-	-	-	-
Na2SO3 Charge	%	-	-	-	-
Active Alkali charge as Na2O	%	12,00	12,00	12,00	12,00
Effective Alkali charge as Na2O	%	10,80	10,80	10,80	10,80
AQ charge	%	0,00	0,00	0,00	0,00
Heating up time	min	90	90	90	90
Cooking time	min	120	120	120	120
Cooking temp.	°C	160	160	160	160
H Factor	-	860	860	860	860
Yield unscreened	%	62,26	60,32	62,30	61,63
Kappa No.		14,30	14,90	15,00	14,73
Viscosity	ml/g				1080
	cp				56
Brightness	%				29,4

TABLE 25B

Physical properties:	Sample: from Cook No. 1-3				KAPPA= 14,73
with PFI mill					
Beating point	-	0	1		
PFI revolution	rpm	1450	1450		
	rev.	0	4000	1500	3500
	min	0,00	2,76	1,03	2,41
Freeness	SR	15	55	30	50
	CSF	706	656	656	656
Grammage	g/m²	64,40	63,50	64,06	63,61
Density	kg/m³	470	740	571	706
Stretch	%	3,7	3,8	3,7	3,8
Breaking length	m	5097	10398	7085	9735
Burst strength	kPa	135	435	248	398
Tearing resistance	mN	892	721	828	742
Tensile index	Nm/g	50,00	102,00	69,50	95,50
Burst index	kPam²/g	2,10	6,85	3,88	6,26
Tear index	mNm²/g	13,85	11,35	12,91	11,66
Bendtsen porosity	ml/min	3000	140	1928	498
Black liquor:					
pH		11,5			
Residual alkali as Na2O	g/l	8,99			
Dry solids content of org.liquor	%	9,9			

TABLE 26

Jute pulping — **Kraft-AQ pulping at 160°C, 12 % AA, 2 h**

Laboratory: Central Pulp and Paper Research Institute
City: Saharanpur
Country: India
Conducted by:
Date: 18.4.1995

TABLE 26A

	Unit				
Raw material		Jute	Jute	Jute	Jute
Quality of Fibre					
Size of fibre	mm	75	75	75	75
Pulping data					
Pulping Process		Kraft AQ	Kraft AQ	Kraft AQ	Kraft AQ
Cook No.		4	5	6	Avg.
Type of digester		Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated	Rotary, elect. heated
Size	l	2,5	2,5	2,5	2,5
Hydromodul		3,00	3,00	3,00	3,00
Raw material charge	g				
	gBD	200	200	200	200
Dry content	%				
NaOH Charge	%	12,39	12,39	12,39	12,39
Na2S Charge	%	3,02	3,02	3,02	3,02
Sulfidity	%	20,00	20,00	20,00	20,00
SO2 Charge	%	-	-	-	-
Na2SO3 Charge	%	-	-	-	-
Active Alkali charge as Na2O	%	12,00	12,00	12,00	12,00
Effective Alkali charge as Na2O	%	10,80	10,80	10,80	10,80
AQ charge	%	0,05	0,05	0,05	0,05
Heating up time	min	90	90	90	90
Cooking time	min	120	120	120	120
Cooking temp.	°C	160	160	160	160
H Factor	-	860	860	860	860
Yield unscreened	%	60,39	62,05	61,19	61,21
Kappa No.		13,60	13,50	13,60	13,57
Viscosity	ml/g				1050
Brightness	%				33,1

TABLE 26B

Physical properties:	Sample: from Cook No. 1-3				KAPPA= 13,57
with PFI mill					
Beating point	-	0	1		
PFI revolution	rpm	1450	1450		
	rev.	0	4000	1463	3415
	min	0,00	2,76	1,01	2,35
Freeness	SR	15	56	30	50
	CSF	706	178	428	224
Grammage	g/m²	66,60	62,20	64,99	62,84
Density	kg/m³	470	720	561	683
Stretch	%	1,8	3,9	2,6	3,6
Breaking length	m	4485	11111	6909	10141
Burst strength	kPa	120	476	250	424
Tearing resistance	mN	932	678	839	715
Tensile index	Nm/g	44,00	109,00	67,78	99,49
Burst index	kPam²/g	1,80	7,65	3,94	6,79
Tear index	mNm²/g	14,00	10,90	12,87	11,35
Bendtsen porosity	ml/min	3000	60	1924	490
Black liquor:					
pH		11,5			
Residual alkali as Na2O	g/l	8,99			
Dry solids content of org liquor	%	15,23			

TABLE 27

Jute pulping **Kraft pulping at 160°C,12% AA, 3h**

Pilot plant: **Central Pulp and Paper Research Institute**
City: **Saharanpur**
Country: **India**
Conducted by:
Date: **24.4.1995**

TABLE 27A

	Unit			
Raw material		**Jute**		
Quality of Fibre				
Size of fibre	mm	75		
Pulping data				
Pulping Process		Kraft		
Cook No.		PP01		
Type of digester		Pilot Plant		
Size	m^3	11		
Hydromodul		2,50		
Raw material charge	kg	560		
	kgBD	500		
Dry content	%	89,29		
NaOH Charge	%	12,39		
Na2S Charge	%	3,02		
Sulfidity	%	20,00		
SO2 Charge	%	-		
Na2SO3 Charge	%	-		
Active Alkali charge as Na2O	%	12,00		
Effective Alkali charge as Na2O	%	10,80		
AQ charge	%	0,00		
Heating up time	min	90		
Cooking time	min	180		
Cooking temp.	°C	160		
H Factor	-	1257		
Kappa No.		10,60	9,30	tested at TTD
Viscosity	ml/g	610		
	cps		33,00	
Brightness	%	29,6	38,10	

TABLE 27B

Physical properties:	Sample: from Cook No			PP01		KAPPA= 10,60		tested at TTD KAPPA= 9,30			
with PFI mill											
Beating point	-	0	1	2	3			0	1	2	
PFI revolution	rpm	1450	1450	1450	1450				1450	1450	
	rev.	0	2000	4000	6000	2400	4696		7000	11000	7444
	min	0,00	1,38	2,76	4,14	1,66	3,24		4,83	7,59	5,13
Freeness	SR	15	27	42	65	30	50	18	47	74	50
	CSF	706	470	293	119	428	224	633	248	67	224
Drainage time	s	4,5	5,0	6,5	13,5	5,30	8,93				
Grammage	g/m²	68,30	62,30	65,00	62,40	62,84	64,10		75,00	75,00	75,00
Thickness	mm										
Density	kg/m³	460	610	700	750	628	717		590	650	597
Bulk	m³/kg										
Stretch	%	2,2	2,6	3,1	3,7	2,7	3,3		2,86	2,67	2,86
Breaking length	m	3721	6830	7441	7085	6952	7317		6017	6777	6101
Burst strength	kPa	99	212	270	253	223	264		272	288	274
Tearing resistance	mN	826	455	400	346	444	381		644	602	639
MID double fold											
Tensile index	Nm/g	36,50	67,00	73,00	69,50	68,20	71,78		59,03	66,48	59,86
Burst index	kPam²/g	1,45	3,40	4,15	4,05	3,56	4,12		3,63	3,84	3,65
Tear index	mNm²/g	12,10	7,30	6,15	5,55	7,06	5,95		8,58	8,03	8,52
Bendtsen porosity	ml/min	3000	2810	720	130	2392	515		1127	271	1032
Bendtsen smoothness	ml/min										
Zero beaten pulp:											
Fibre length Anthmetic average	mm							1,10			
Fibre length weighted average	mm							1,61			
Fibre diameter	mm										
Coarseness	mg/m							0,105			
Slenderness factor								15,3			
Fibre zero span tensile	km										
fibre zero span stregth index	Nm/g										
Black liquor:											
pH		11,6									
Residual alkali as Na2O	g/l	8,20									
Viscosity at	RPM	20	50	100							
	mPa.S			2							
Dry solids content of org liquor	%	13,2									
Organic content of dry solids	%	35,4									
Inorganic content of dry solids	%	64,6									
HHV of dry solids	kcal/kg	2478									
	kJ/kg	10375									

TABLE 28

Jute pulping **Kraft pulping at 160°C,11,5% AA, 2h**

Pilot plant: **Central Pulp and Paper Research Institute**
City: **Saharanpur**
Country: **India**
Conducted by:
Date: **23.5.1995**

TABLE 28A

	Unit		
Raw material		Jute	
Quality of Fibre			
Size of fibre	mm	250	
Pulping data			
Pulping Process		Kraft	
Cook No.		PP05	
Type of digester		Pilot Plant	
Size	m^3	11	
Hydromodul		2,50	
Raw material charge	kg		
	kgBD	300	
Dry content	%		
NaOH Charge	%	11,87	
Na2S Charge	%	2,89	
Sulfidity	%	20,00	
SO2 Charge	%	-	
Na2SO3 Charge	%	-	
Active Alkali charge as Na2O	%	11,50	
Effective Alkali charge as Na2O	%	10,35	
AO charge	%	0,00	
Heating up time	min	90	
Cooking time	min	120	
Cooking temp.	°C	160	
H Factor	-	860	
Kappa No		13,60	13,00 tested at TTD
Viscosity	ml/g	1010	
	cps		62,70
Brightness	%		31,00

Tensile index	Nm/g				38,90	64,20	70,40	83,70	56,76	67,52	
Burst index	kPam²/g				2,16	4,76	5,25	5,76	4,00	5,02	
Tear index	mNm²/g				16,00	12,10	11,30	11,80	13,25	11,67	
Bendtsen porosity A/B side	ml/min				1443	711	181	53	926	427	
Bendtsen smoothness A/B side	ml/min										
Zero beaten pulp:											
Fibre length Arithmetic average	mm				1,20						
Fibre length weighted average	mm				1,61						
Fibre diameter	mm										
Coarseness	mg/m				0,148						
Slenderness factor					,0,9						
Fibre zero span tensile	km										
fibre zero span stregth index	Nm/g										
Dirt cont acc TAPPI	mm²/m²				235						
Black liquor:											
pH		11,6									
Residual alkali as Na2O	g/l	4,90									
Dry solids content of org liquor	%	12,04									
Organic content of dry solids	%	30,9									
Inorganic content of dry solids	%	69,1									
HHV of dry solids	kcal/kg	3200									
	kJ/kg	13398									

TABLE 40B

Sample: from test no. 6

Physical properties:	**Unit**						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	5500	8008	11500	5500	10694
	min	0,00	3,79	5,52	7,93	3,79	7,38
Freeness	SR	15	30	40	53	30	50
	CSF	706	428	313	200	428	224
Drainage time	s						
Grammage	g/m²	76,03	75,32	75,00	74,92	75,32	74,94
Thickness	mm	0,170	0,130	0,121	0,113	0 130	0,115
Density	kg/m³	447	579	620	663	579	653
Bulk	m³/kg	2,237	1,727	1,612	1,508	1,727	1,532
Stretch	%	1,8	3,5	3,9	4,2	3,5	4,1
Breaking length	m	2456	5355	5705	6726	5355	5490
Burst strength	kPa	106,9	279,5	299,1	329,5	279,5	322,5
Tearing resistance	mN	1114	1123	912	949	1123	940
MID double fold		9	1212	1203	1047	1212	1083
Tensile index	Nm/g	24,09	52,53	55,97	65,98	52,53	63,67
Burst index	kPam²/g	1,41	3,70	3,99	4,40	3,71	4,30
Tear index	mNm²/g	14,65	14 91	12,16	12,67	14,91	12,55
Bendtsen porosity	ml/min			595,9	284,4	-	356,5
Bendtsen smoothness	ml/min	925,1	465,7	362,5	380,7	465,7	376,5
Scattering coefficient	m²/kg	24,6	24,1	24,9	24,9	24,1	24,9
Opacity	%	80,85	81,76	82,99	83,39	81,76	83,30
Zero beaten pulp:		1	2	average			
Fibre length Arithmetic average	mm	1,220	1,230	1,225			
Fibre length weighted average	mm	1,66	1,67	1,67			
Fibre diameter	mm	0,030	0,030	0,030			
Coarseness	mg/m	0,100	0,105	0,103			
Slenderness factor		16,6	15,9	16,3			
Fibre zero span tensile	km	8,34					
Fibre zero span stregth index	Nm/g	81,8					

Pulping data		
Pulping Process		Kraft
Cook No		PP06
Type of digester		Pilot Plant
Size	m³	11
Hydromodul		2,50
Raw material charge	kg	
	kgBD	1,300
Dry content	%	
NaOH Charge	%	11,87
Na2S Charge	%	2,89
Sulfidity	%	20,00
SO2 Charge	%	-
Na2SO3 Charge	%	-
Active Alkali charge as Na2O	%	11,30
Effective Alkali charge as Na2O	%	10,35
AQ charge	%	0,00
Heating up time	min	90
Cooking time	min	120
Cooking temp	°C	160
H Factor	-	860
Kappa No		17,00
Viscosity	ml/g	1100
	cps	
Brightness	%	

14,70 tested at TTD

103,80

37,30

TABLE 40C

Sample: from test no. 7°

Physical properties:	Unit						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	0	1450	1450	1450		
	rev.	0	3500	7000	9000	3500	6300
	min	0,00	2,41	4,83	6,21	2,41	4,34
Freeness	SR	16	30	55	72	30	50
	CSF	680	428	185	78	428	224
Drainage time	s						
Grammage	g/m²	74,80	76,00	72,90	75,10	76,00	74,52
Thickness	mm	0,174	0,136	0,119	0,111	0,136	0,122
Density	kg/m³	430	560	610	680	560	600
Bulk	m³/kg	2,330	1,790	1,640	1,470	1,790	1,670
Stretch	%	1,69	3,05	3,37	3,45	3,05	3,31
Breaking length	m	2280	5240	6070	6240	5240	5904
Burst strength	kPa	86,2	255,7	293,7	298,2	255,7	286,1
Tearing resistance	mN	743	799	684	612	799	707
MID double fold		4	203	500	550	203	441
Tensile index	Nm/g	22,37	51,40	59,55	61,21	51,40	57,92
Burst index	kPam²/g	1,15	3,70	4,03	3,97	3,36	3,84
Tear index	mNm²/g	9,93	10,51	9,38	8,15	10,51	9,49
Bendtsen porosity	ml/min	3000	2950	400	230	2950	450
Bendtsen smoothness	ml/min	900	450	315	240	450	342
Scattering coefficient	m²/kg	26,22	29,14	29,38	30,01	29,14	29,33
Opacity	%	82,06	83,77	83,42	85,74	83,77	83,49
Zero beaten pulp:							
Fibre length Anthmetic average	mm	1,090					
Fibre length weighted average	mm	1,54					
Fibre diameter	mm						
Coarseness	mg/m	0,100					
Slenderness factor		15,4					
Fibre zero span tensile	km	16,00					
Fibre zero span stregth index	Nm/g	157,0					

MIT double fold											
Tensile index	Nm/g				32.98	65.07	72.25	79 20	65.07	71.60	
Burst index	kPam²/g				2.09	4.63	5.85	5.96	4.63	5.74	
Tear index	mNm²/g				15.16	14.65	13.61	13.46	14.65	13.70	
Bendtsen porosity	ml/min				3000	1425	441	121	1425	530	
Bendtsen smoothness	ml/min										
Zero beaten pulp:											
Fibre length Arithmetic average	mm				1.13						
Fibre length weighted average	mm				1.55						
Fibre diameter	mm										
Coarseness	mg/m				0.135						
Slenderness factor					11.5						
Dirt cont acc TAPPI	mm²/m²				149						

TABLE 41

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohammed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 41A

		TEST NUMBER				
	Unit	1	2	3	4	5*
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	10,2	10,2	10,2	9,6
Initial Brightness	% ISO					44,90
Viscosity	ml/g	1029	1029	1029	1029	1015
	cps					
Bleaching Sequence:		C Ep H	C Ep H	C Ep H	C Ep H	C Ep H
First Stage		C	C	C	C	C
HCl Charge	%					
Sulfamic acid	%	0,00	0,00	0,00	0,10	0,10
Chlorination factor		0,27	0,27	0,29	0,34	0,31
Active Chlorine applied	%	2,80	2,80	3,00	3,50	3,00
Residual Chlorine	%	0,99	0,29	0,52	0,68	0,66
Active Chlorine consumed	%	1,81	2,51	2,48	2,82	2,34
Temperature	°C	20	35	35	30	30
Retention time	min	30	30	45	45	45
Consistency	%	3,00	3,00	3,00	3,00	3,00
pH start		2,30	2,10	2,00	1,80	2,00
pH end		3,40	2,40	2,30	1,75	2,00
Kappa						1,20
Viscosity	ml/g					702

TABLE 30

Jute pulping **Kraft-AQ pulping at 160°C 12% AA, 3h**

Pilot plant: **Central Pulp and Paper Research Institute**
City: **Saharanpur**
Country: **India**
Conducted by:
Date: **25.4.1995**

TABLE 30A

	Unit		
Raw material		Jute	
Quality of Fibre			
Size of fibre	mm	75	
Pulping data			
Pulping Process		Kraft AQ	
Cook No.		PP02	
Type of digester		Pilot Plant	
Size	m³	11	
Hydromodul		2,50	
Raw material charge	kg	560	
	kgBD	500	
Dry content	%	89,29	
NaOH Charge	%	12,39	
Na2S Charge	%	3,02	
Sulfidity	%	20,00	
SO2 Charge	%	-	
Na2SO3 Charge	%	-	
Active Alkali charge as Na2O	%	12,00	
Effective Alkali charge as Na2O	%	10,80	
AQ charge	%	0,05	
Heating up time	min	90	
Cooking time	min	180	
Cooking temp.	°C	160	
H Factor	-	1257	
Kappa No.		10,40	9,30 tested at TTD
Viscosity	ml/g	690	
	cps		32,00
Brightness	%	29,6	38,47

TABLE 30B

Physical properties:	Sample: from Cook No			PP02		KAPPA= 10,40		tested at TTD			
with: PFI mill								KAPPA= 9,30			
Beating point	-	0	1	2	3			0	1	2	
PFI revolution	rpm	1450	1450	1450	1450				1450	1450	
	rev.								7000	11000	7462
	min								4,83	7,59	5.15
Freeness	SR							18	47	73	50
	CSF							633	248	72	224
Drainage time	s										
Grammage	g/m²								75.00	75.00	75.00
Thickness	mm										
Density	kg/m³								610	620	611
Bulk	m³/kg										
Stretch	%								2,81	2.67	2.79
Breaking length	m								6049	6185	6065
Burst strength	kPa								284	266	282
Tearing resistance	mN								575	570	575
MIT double fold											
Tensile index	Nm/g								59.34	60.68	59.48
Burst index	kPam²/g								3.79	3.54	3.76
Tear index	mNm²/g								7.67	7.60	7.66
Bendtsen porosity	ml/min								1016	236	926
Bendtsen smoothness	ml/min										
Zero beaten pulp:											
Fibre length Arithmetic average	mm							1.13			
Fibre length weighted average	mm							1.60			
Coarseness	mg/m							0.095			
Slenderness factor								16.8			
Black liquor:											
pH		11.67									
Residual alkali as Na2O	g/l	2.60									
Dry solids content of org liquor	%	13.7									
Organic content of dry solids	%	36.3									
Inorganic content of dry solids	%	63.7									
HHV of dry solids	kcal/kg	2469									
	kJ/kg	10337									
Specific gravity	g/cm³										

TABLE 31

Jute pulping **Kraft-AQ pulping at 150°C 12% AA, 4h**

Pilot plant: **Central Pulp and Paper Research Institute**
City: **Saharanpur**
Country: **India**
Conducted by:
Date: **26.4.1995**

TABLE 31A

	Unit		
Raw material		Jute	
Quality of Fibre			
Size of fibre	mm	75	
Pulping data			
Pulping Process		Kraft AQ	
Cook No		PP03	
Type of digester		Pilot Plant	
Size	m³	11	
Hydromodul		2,50	
Raw material charg	kg	672	
	kgBD	600	
Dry content	%	89,29	
NaOH Charge	%	12,39	
Na2S Charge	%	3,02	
Sulfidity	%	20,00	
SO2 Charge	%	-	
Na2SO3 Charge	%	-	
Active Alkali charge as Na2O	%	12,00	
Effective Alkali charge as Na2O	%	10,80	
AQ charge	%	0,05	
Heating up time	min	90	
Cooking time	min	240	
Cooking temp	°C	150	
H Factor	-	688	
Kappa No		11,60	9,30 tested at TTD
Viscosity	ml/g	880	
	cps		47,00
Brightness	%		43,20

TABLE 31B

Physical properties:	Sample: from Cook No			PP03		KAPPA= 11,60		tested at TTD KAPPA= 9,30			
with PFI mill											
Beating point	-	0	1	2	3			0	1	2	
PFI revolution:	rpm								1450	1450	
	rev.								7000	11000	8120
	min								4,83	7,59	5,60
Freeness	SR								43	68	50
	CSF								284	100	224
Drainage time	s										
Grammage	g/m²								75,00	75,00	75,00
Thickness	mm										
Density	kg/m³								570	610	581
Bulk	m³/kg										
Stretch	%								2,99	2,95	2,98
Breaking length	m								6537	6511	6530
Burst strength	kPa								290	396	320
Tearing resistance	mN								726	689	716
MIT double fold											
Tensile index	Nm/g								64,12	63,87	64,05
Burst index	kPam²/g								3,87	5,28	4,26
Tear index	mNm²/g								9,68	9,18	9,54
Bendtsen porosity	ml/min								1101	190	846
Bendtsen smoothness	ml/min										
Zero beaten pulp:											
Fibre length Arithmetic average	mm							1,19			
Fibre length weighted average	mm							1,63			
Fibre diameter	mm										
Coarseness	mg/m							0,104			
Slenderness factor								15,7			
Fibre zero span tensile	km										
fibre zero span stregth index	Nm/g										
Black liquor:											
pH											
Residual alkali as Na2O	g/l	2,6?									
Viscosity at	RPM										
	mPa S										
Dry solids content of org liquor	%	13,7?									
Organic content of dry solids	%										
Inorganic content of dry solids	%										
HHV of dry solids	kcal/kg										
	kJ/kg										
Specific gravity	g/cm³										

TABLE 32

Jute pulping **Kraft-AQ pulping at 160°C 11,5% AA, 2h**

Pilot plant: **Central Pulp and Paper Research Institute**
City: **Saharanpur**
Country: **India**
Conducted by:
Date: **27.4.1995**

TABLE 32A

	Unit		
Raw material		**Jute**	
Quality of Fibre			
Size of fibre	mm	75	
Pulping data			
Pulping Process		Kraft AQ	
Cook No.		PP04	
Type of digester		Pilot Plant	
Size	m^3	1	
Hydromodul		2.50	
Raw material charge	kg	448	
	kgBD	400	
Dry content	%	89.29	
NaOH Charge	%	11.87	
Na2S Charge	%	2.89	
Sulfidity	%	20.00	
SO2 Charge	%	-	
Na2SO3 Charge	%	-	
Active Alkali charge as Na2O	%	11.50	
Effective Alkali charge as Na2O	%	10.35	
AQ charge	%	0.05	
Heating up time	min	90	
Cooking time	min	120	
Cooking temp	°C	160	
H Factor	-	1257	
Kappa No.		14,10	12,80 tested at TTD
Viscosity	ml/g	1010	
	cps		78,00
Brightness	%		41,80

TABLE 32B

Physical properties:		Sample: from Cook No KAPPA= 14,10		PP04	tested at TTD KAPPA= 12,80					
with PFI mill										
Beating point	-	0			0	1	2	3		
PFI revolution	rpm				1450	1450	1450	1450		
	rev.		2769	5263	0	4000	8000	12000	4667	9053
	min				0,00	2,76	5,52	8,28	3,22	6,24
Freeness	SR		30	50	18	27	45	64	30	50
	CSF		428	224	633	470	266	125	428	224
Drainage time	s									
Grammage	g/m²		60,00	60,00	75,00	75,00	75,00	75,00	75,00	75,00
Thickness	mm									
Density	kg/m³		610	680	410	540	590	630	548	601
Bulk	m³/kg									
Stretch	%		2,6	2,9	1,35	2,88	3,42	3,87	2,97	3,54
Breaking length	m		6524	7238	2723	6244	7279	7916	6417	7447
Burst strength	kPa		408	330	95	290	347	407	300	363
Tearing resistance	mN		660	696	825	991	894	848	975	882
MID double fold										
Tensile index	Nm/g		64,00	71,00	26,71	61,26	71,40	77,66	62,95	73,05
Burst index	kPam²/g		6,80	5,50	1,26	3,87	4,63	5,43	4,00	4,84
Tear index	mNm²/g		11,00	11,60	11,00	13,21	11,92	11,30	13,00	11,76
Bendtsen porosity	ml/min				3000	3000	629	177	2605	510
Bendtsen smoothness	ml/min									
Zero beaten pulp:										
Fibre length Anthmetic average	mm				1,24					
Fibre length weighted average	mm				1,65					
Fibre diameter	mm									
Coarseness	mg/m				0,125					
Slenderness factor					13,2					
Dirt cont acc. TAPPI	mm²/m²				168					
Black liquor:										
pH		11,95								
Residual alkali as Na2O	g/l	6,24								
Dry solids content of org liquor	%	11,62								
Organic content of dry solids	%	33,7								
Inorganic content of dry solids	%	66,3								
HHV of dry solids	kcal/kg	2944								
	kJ/kg	12324								

TABLE 33

Physical properties of unbleached pulp produced in the pilot plant with Kraft-AQ pulping process prepared for bleaching tests

Measured at : **Pulp and Paper Institute, Ljubliana, Slowenia**

Sample from Pilot plant test No. PP04

		Gut pulp sample					
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	2120	6850	8880	3971	7720
	min	0,00	1,46	4,72	6,12	2,74	5,32
Freeness	SR	15	21	44	58	30	50
	CSF	706	571	275	164	428	224
Grammage	g/m²	79,30	75,95	74,84	74,20	75,52	74,57
Thickness	mm	0,174	0,142	0,124	0,118	0,135	0,121
Density	kg/m³	456	535	604	629	562	615
Bulk	m³/kg	2,193	1,869	1,656	1,590	1,786	1,628
Stretch	%	1,8	3,2	4,1	4,0	3,6	4,1
Breaking length	m	2752	6075	7818	7800	6757	7814
Burst strength	kPa	104	264	364	386	303	374
Tearing resistance	mN	1260	1233	919	922	1110	920
Tensile index	Nm/g	27,00	59,60	76,69	76,60	66,29	76,65
Burst index	kPam²/g	1,31	3,47	4,87	5,20	4,01	5,01
Tear index	mNm²/g	15,89	16,23	12,28	12,43	14,70	12,34
Zero beaten pulp:							
Fibre length Arithmetic average	mm	1,30					
Fibre length weighted average	mm	1,65					
Fibre diameter	mm						
Coarseness	mg/m	0,165					
Slenderness factor		10,0					
Fibre fraction Bauer McNett:							
retained on mesh 14	%	90,8					
retained on mesh 30	%	2,0					
retained on mesh 50	%	4,9					
retained on mesh 100	%	1,5					
going through mesh 100	%	0,8					
Viscosity	ml/g	988					

TABLE 34

Physical properties of unbleached pulp produced in the pilot plant with Kraft-AQ pulping process prepared for bleaching tests

Messured at : Pulp and Paper Institute, Ljubliana, Slowenia

Sample from Pilot plant test No. PP04

		Degraded pulp sample					
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	4350	7250	11600	6042	9860
	min	0,00	3,00	5,00	8,00	4,17	6,80
Freeness	SR	16	23	35	60	30	50
	CSF	680	535	366	151	428	224
Grammage	g/m²	73,45	75,45	71,97	73,56	73,42	72,02
Thickness	mm	0,183	0,137	0,119	0,158	0,127	0,142
Density	kg/m³	434	515	605	681	569	651
Bulk	m³/kg	2,304	1,810	1,530	1,468	1,647	1,493
Stretch	%	1,1	2,5	2,9	3,3	2,7	3,1
Breaking length	m	1497	3862	4525	4612	4249	4577
Burst strength	kPa	56	177	198	214	189	206
Tearing resistance	mN	838	871	643	562	738	594
Tensile index	Nm/g	14,69	37,89	44,39	45,24	41,68	44,90
Burst index	kPam²/g	0,76	2,35	2,75	2,91	2,58	2,85
Tear index	mNm²/g	11,41	11,54	8,93	7,64	10,05	8,15
Bendtsen porosity A/B side	ml/min				363	0	218
Bendtsen smoothness A/B side	ml/min		575	428	325	489	366
Scattering coefficient		237	216	217	214	217	215
Opacity	%	97,80	98,10	97,70	97,14	97,87	97,36
Zero beaten pulp:							
Fibre length Arithmetic average	mm	1,13					
Fibre length weighted average	mm	1,55					
Fibre diameter	mm						
Coarseness	mg/m	0,172					
Slendemess factor		9,0					
Fibre fraction Bauer McNett:							
retained on mesh 14	%	85,1					
retained on mesh 30	%	6,4					
retained on mesh 50	%	2,0					
retained on mesh 100	%	1,3					
going through mesh 100	%	5,4					
Viscosity	ml/g	669					

10.4 Bench scale bleaching tests

TABLE 40

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 40A

		TEST NUMBER						
	Unit	1	2	3	4	5	6	7*
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	10,2	10,2	10,2	10,2	10,2	9,6
Initial Brightness	% ISO							44,90
Viscosity	ml/g	1029	1029	1029	1029	1029	1029	1015
	cps							
Bleaching Sequence:		C E H	C E H	C E H	C E H	C E H	C E H	C E H
First Stage		C	C	C	C	C	C	C
HCl Charge	%							
Sulfamic acid	%	0,00	0,00	0,00	0,00	0,00	0,10	0,10
Chlorination factor		0,27	0,27	0,29	0,29	0,34	0,34	0,31
Active Chlorine applied	%	2,80	2,80	3,00	3,00	3,50	3,50	3,00
Residual Chlorine	%	1,05	0,24	0,43	0,06	0,14	0,49	0,83
Active Chlorine consumed	%	1,75	2,56	2,57	2,94	3,36	3,01	2,17
Temperature	°C	20	35	35	30	30	30	30
Retention time	min	30	30	45	45	45	45	45
Consistency	%	3,00	3,00	3,00	3,00	3,00	3,00	3,00
pH start			2,10	2,00	1,80	1,80	1,80	2,00
pH end		3,30	2,30	2,24	2,25	1,80	1,80	2,00
Kappa								1,20
Viscosity	ml/g							702
	cps							
Brightness	% ISO							60,70
Second Stage		E	E	E	E	E	E	E
NaOH	%	1,20	1,20	1,20	2,00	2,00	2,00	2,00
Temperature	°C	60	60	60	70	70	70	70
Retention time	min	90	90	90	90	120	120	120
Consistency	%	10,00	10,00	10,00	10,00	10,00	10,00	10,00
pH start		11,90	12,10	12,10	12,50	12,45	12,50	11,40
pH end		11,60	11,20	11,50	12,00	11,70	11,40	11,20
Kappa			1,60	1,70	1,10	1,00	< 1,0	0,90
Viscosity	ml/g		632	556	951	1008	998	646
	cps							
Brightness	% ISO		53,70	54,00	57,80	54,60	56,70	62,80
Third Stage		H	H	H	H	H	H	H
Sulfamic acid	%	0,00	0,00	0,00	0,10	0,10	0,10	0,10
Active Chlorine applied	%	1,00	1,00	1,50	1,00	1,30	1,30	1,30
Residual Chlorine	%	0,26	0,26	0,60	0,49	0,71	0,70	0,90
Active Chlorine consumed	%	0,74	0,74	0,90	0,51	0,59	0,60	0,40
NaOH as Buffer	%							

Temperature	°C	38	42	42	40	40	40	40
Retention time	min	180	180	210	120	180	180	150
Consistency	%	10,00	10,00	10,00	10,00	10,00	10,00	10,00
pH start			10,40	10,90	10,70	10,80	10,20	11,40
pH end		7,70	8,90	9,20	9,30	10,13	9,10	10,90
Total Active Chlorine applied	%	3,80	3,80	4,50	4,00	4,80	4,80	4,20
Total Active Chlorine consumed	%	2,49	3,30	3,47	3,45	3,95	3,61	2,57
Final Brightness	% ISO	77,90	75,80	75,50	76,40	77,40	79,70	82,80
Final Brightness corrected	% ISO	79,90	77,80	77,50	78,40	79,40	81,70	84,80
Brigtness revertion	%						8,30	
Viscosity	ml/g	499	539	448	916	817	811	540
Classification of speks								
>5 mm²	speks/m²						0,0	
1,0-4,99 mm²	speks/m²						57,8	
0,4-0,99 mm²	speks/m²						101,0	
0,15-0,39 mm²	speks/m²						231,0	
Dirt cont acc. TAPPI	mm²/m²						305,68	
Fiber fraction Bauer McNett:								
retained on mesh 14	%						83,10	
retained on mesh 30	%						7,90	
retained on mesh 50	%						2,00	
retained on mesh 100	%						0,30	
going through mesh 100	%						6,70	

* Bleaching tests at OHFI, Vienna

Residual Chlorine	%	0,67	0,00	0,40	0,73	1,03
Active Chlorine consumed	%	0,33	0,70	0,30	0,57	0,27
NaOH as Buffer	%					
Temperature	°C	38	42	42	40	40
Retention time	min	180	180	180	180	180
Consistency	%	10,00	10,00	10,00	10,00	10,00
pH start		11,50	10,30	10,60	10,00	11,30
pH end		11,30	8,60	9,20	9,15	10,80
Total Active Chlorine applied	%	3,80	3,50	3,70	4,80	4,30
Total Active Chlorine consumed	%	2,14	3,21	2,78	3,39	2,61
Final Brightness	% ISO	78,50	79,70	77,80	81,60	85,00
Final Brightness corrected	% ISO	80,50	81,70	79,80	83,60	87,20
Brigtness revertion	%				6,80	
Viscosity	ml/g	670	966	480	854	517
Classification of speks ISO						
>5 mm²	speks/m²				0,0	
1,0-4,99 mm²	speks/m²				43,0	
0,4-0,99 mm²	speks/m²				43,0	
0,15-0,39 mm²	speks/m²				535,0	
Dirt count acc. TAPPI	mm²/m²				303,1	
Fiber fraction Bauer McNett:						
retained on mesh 14	%				81,70	
retained on mesh 30	%				7,70	
retained on mesh 50	%				1,90	
retained on mesh 100	%				0,70	
going through mesh 100	%				8,00	

* Bleaching tests at OHFI, Vienna

TABLE 41B

Sample: from test no. 4

Physical properties:	**Unit**						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	4980	8015	11900	5694	9715
	min	0,00	3,43	5,53	8,21	3,93	6,70
Freeness	SR	15	26	43	59	30	50
	CSF	706	485	284	157	428	224
Grammage	g/m²	75,16	75,95	77,23	76,35	76,25	76,85
Thickness	mm	0,161	0,131	0,123	0,112	0,129	0,118
Density	kg/m³	467	580	628	682	591	652
Bulk	m³/kg	2,141	1,724	1,592	1,466	1,693	1,537
Stretch	%	1,7	3,1	3,5	4,3	3,2	3,9
Breaking length	m	2212	5158	6035	7004	5364	6459
Burst strength	kPa	102,0	254,0	305,0	323,6	266,0	313,1
Tearing resistance	mN	1138	1085	1050	926	1077	996
MID double fold		7	829	1438	1046	972	1267
Tensile index	Nm/g	21,70	50,60	59,20	68,71	52,62	63,36
Burst index	kPam²/g	1,36	3,70	3,95	4,24	3,49	4,07
Tear index	mNm²/g	15,14	14,29	13,60	12,13	14,12	12,96
Bendtsen porosity	ml/min			493,75	156,25	-	346,09
Bendtsen smoothness	ml/min	918,75	568,75	493,75	312,50	551,10	414,45
Scattering coefficient	m²/kg	25,06	24,47	25,37	25,37	24,68	25,37
Opacity	%	80,67	80,98	83,53	84,19	81,58	83,82
Zero beaten pulp:		1	2	average			
Fibre length Anthmetic average	mm	1,240	1,240	1,240			
Fibre length weighted average	mm	1,65	1,66	1,66			
Fibre diameter	mm	0,030	0,030	0,030			
Coarseness	mg/m	0,106	0,106	0,106			
Slenderness factor		15,6	15,7	15,6			
Fibre zero span tensile	km	8,16					
fibre zero span stregth index	Nm/g	80,0					

TABLE 41C

		Sample: from test no.			5°		
Physical properties:	**Unit**						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	0	1450	1450	1450		
	rev.	0	3500	7000	9000	3500	6192
	min	0,00	2,41	4,83	6,21	2,41	4,27
Freeness	SR	16	30	56	72	30	50
	CSF	680	428	178	78	428	224
Drainage time	s						
Grammage	g/m²	72,40	73,10	72,30	73,60	73,10	72,72
Thicknes.	mm	0,165	0,128	0,117	0,111	0,128	0,120
Density	kg/m³	440	570	620	660	570	608
Bulk	m³/kg	2,270	1,750	1,610	1,520	1,750	1,642
Stretch	%	1,64	3,04	3,49	3,15	3,04	3,39
Breaking length	m	2180	5090	5970	5800	5090	5767
Burst strength	kPa	79,5	245,2	278,1	292,3	245,2	270,5
Tearing resistance	mN	513	649	588	529	649	602
MID double fold		4	186	320	248	186	289
Tensile index	Nm/g	21,39	49,93	58,57	56,90	49,93	56,57
Burst index	kPam²/g	1,10	3,70	3,85	3,97	3,35	3,72
Tear index	mNm²/g	7,09	8,88	8,13	7,19	8,88	8,28
Bendtsen porosity	ml/min	3000	2730	400	220	2730	468
Bendtsen smoothness	ml/min	915	525	325	235	525	371
Scattering coefficient	m²/kg	22,4	27,4	29,6	29,0	27,4	29,11
Opacity	%	78,99	82,70	83,13	85,19	82,70	83,03
Zero beaten pulp:							
Fibre length Arithmetic average	mm	1,150					
Fibre length weighted average	mm	1,60					
Fibre diameter	mm						
Coarseness	mg/m	0,106					
Slenderness factor		15,1					
Fibre zero span tensile	km	16,20					
Fibre zero span stregth index	Nm/g	158,9					

TABLE 42

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 42A

		TEST NUMBER			
	Unit	1	2	3	4
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	10,2	10,2	10,2
Initial Brightness	% ISO				
Viscosity	ml/g	1029	1029	1029	1029
	cps				
Bleaching Sequence:		O C EO H	O C EO H	O C EO H	O C EO H
First Stage		O	O	O	O
NaOH	%	1,50	1,50	1,50	2,00
MgSO4	%	0,50	0,50	0,50	0,10
Oxygen pressure	kg/cm²	4,00	4,00	6,00	6,00
Temperature	°C	90	90	95	95
Retention time	min	60	60	60	60
Consistency	%	10,00	10,00	10,00	10,00
pH start		12,00	12,10	12,20	12,40
pH end		10,90	11,00	10,50	10,90
Kappa		7,80	7,80	7,80	7,80
Viscosity	ml/g				
	cps				
Brightness	% ISO				
Second Stage		C	C	C	C
HCl Charge	%				
Sulfamic acid	%	0,00	0,00	0.00	0,10
Chlorination factor		0,20	0,20	0,21	0,25
Active Chlorine applied	%	1,56	1,56	1,64	1,95
Residual Chlorine	%	0,14	0,14	0,30	0,39
Active Chlorine consumed	%	1,42	1,42	1,34	1,56
Temperature	°C	20	35	35	30
Retention time	min	30	30	45	45
Consistency	%	3,00	3,00	3,00	3,00
pH start		2,00	2,10	2,10	1,80
pH end		2,10	2,40	2,50	1,80
Kappa					
Viscosity	ml/g				
	cps				
Brightness	% ISO				
Third Stage		E/O	E/O	E/O	E/O
NaOH	%	1,00	1,00	1,00	1,50
Oxygen pressure	kg/cm²	2,50	2,50	2,50	2,50
Temperature	°C	90	70	60	70
Retention time	min	60	90	60	60

Consistency	%	10,00	10,00	10,00	10,00
pH start		12,10	12,00	12,10	12,20
pH end		10,30	11,00	10,70	11,20
Kappa			0,70		0,34
Viscosity	ml/g		591		903
	cps				
Brightness	% ISO		68,90	68,00	73,20
Forth Stage		**H**	**H**	**H**	**H**
Sulfamic acid	%				0,10
Active Chlorine applied	%	1,00	0,70	1,50	1,00
Residual Chlorine	%	0,73	0,28	0,81	0,51
Active Chlorine consumed	%	0,27	0,42	0,69	0,49
NaOH as Buffer	%				
Temperature	°C	40	42	42	40
Retention time	min	180	180	210	180
Consistency	%	10,00	10,00	10,00	10,00
pH start		10,10	10,40	10,70	9,90
pH end		8,90	8,90	9,50	8,90
Total Active Chlorine applied	%	2,56	2,26	3,14	2,95
Total Active Chlorine consumed	%	1,69	1,84	2,03	2,05
Final Brightness	% ISO	80,50	79,00	79,10	83,00
Final Brightness corrected	% ISO	82,50	81,00	81,10	85,00
Brigtness revertion	%				4,30
Viscosity	ml/g	756	583	473	792
Classification of speks ISO					
>5 mm²	speks/m²				0,0
1,0-4,99 mm²	speks/m²				72,0
0,4-0,99 mm²	speks/m²				43,0
0,15-0,39 mm²	speks/m²				376,0
Dirt cont acc. TAPPI	mm²/m²				347,0
Fiber fraction Bauer McNett:					
retained on mesh 14	%				92,40
retained on mesh 30	%				4,40
retained on mesh 50	%				1,40
retained on mesh 100	%				0,20
going through mesh 100	%				1,60

TABLE 42B

Sample: from test no. 4

Physical properties:	Unit						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	5000	7960	11470	6184	11470
	min	0,00	3,45	5,49	7,91	4,26	7,91
Freeness	SR	16	24	39	50	30	50
	CSF	680	517	323	224	428	224
Grammage	g/m²	77,62	76,75	76,19	76,19	76,53	76,19
Thickness	mm	0,176	0,136	0,122	0,117	0,130	0,117
Density	kg/m³	441	564	625	651	588	651
Bulk	m³/kg	2,267	1,773	1,600	1,536	1,704	1,536
Stretch	%	1,6	3,3	3,9	4,0	3,5	4,0
Breaking length	m	2028	5083	5613	5963	5295	5963
Burst strength	kPa	82,4	247,1	300,5	312,8	268,5	312,8
Tearing resistance	mN	960	1070	956	900	1024	900
MID double fold		4	447	1390	1392	824	1392
Tensile index	Nm/g	19,89	49,86	55,06	58,50	51,94	58,50
Burst index	kPam²/g	1,06	3,70	3,94	4,11	3,51	4,11
Tear index	mNm²/g	12,37	13,94	12,55	11,81	13,39	11,81
Bendtsen porosity	ml/min			715,65	281,30	3000	281,30
Bendtsen smoothness	ml/min	956,25	478,15	387,50	362,50	441,89	362,50
Scattering coefficient	m²/kg	26,10	24,74	25,20	25,41	24,92	25,41
Opacity	%	80,44	80,31	82,12	82,76	81,03	82,76
Zero beaten pulp:		1	2	3	average		
Fibre length Arithmetic average	mm	1,210	1,210	1,210	1,210		
Fibre length weighted average	mm	1,62	1,62	1,63	1,62		
Fibre diameter	mm	0,030	0,030	0,030	0,030		
Coarseness	mg/m	0,144	0,146	0,149	0,146		
Slenderness factor		11,3	11,1	10,9	11,1		
Fibre zero span tensile	km	5,21					
fibre zero span stregth index	Nm/g	51,1					

TABLE 43

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Triben: Mill

TABLE 43A

		TEST NUMBER						
	Unit	1	2**	3	4	5	6*	7*
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	10,2	10,2	10,2	10,2	9,6	9,6
Initial Brightness	% ISO						44,90	44,90
Viscosity	ml/g	1029	1029	1029	1029	1029	1015	1015
Bleaching Sequence:		D E D	D E D	D E D	D E D	D E D	D E D	D E D
First Stage		D0	D0	D0	D0	D0	D0	D0
HCl Charge	%							
Sulfamic acid	%	0,00	0,00	0,00	0,10	0,10	0,00	0,00
Chlorination factor		0,27	0,27	0,34	0,25	0,25	0,31	0,31
Active Chlorine applied	%	2,80	2,80	3,50	2,55	2,55	3,00	3,00
Residual Chlorine	%	0,22	0,27	1,74	0,70	0,93	0,01	0,01
Active Chlorine consumed	%	2,58	2,53	1,76	1,85	1,62	2,99	2,99
Temperature	°C	65	60	60	60	60	60	60
Retention time	min	35	35	60	60	60	60	60
Consistency	%	10,00	10,00	10,00	10,00	10,00	10,00	10,00
pH start				2,00	2,00	3,50	3,00	3,20
pH end		2,10	6,50	2,36	2,15	2,82	2,60	2,40
Kappa							3,40	3,20
Viscosity	ml/g						1013	1010
	cps							
Brightness	% ISO						68,80	70,70
Second Stage		E	E	E	E	E	E	E
NaOH	%	1,20	1,20	1,20	2,00	2,00	2,00	2,00
Temperature	°C	60	90	60	70	70	70	70
Retention time	min	90	60	90	120	120	120	120
Consistency	%	10,00	10,00	10,00	10,00	10,00	10,00	10,00
pH start		12,30	12,10	12,10	12,30	12,25	11,60	11,30
pH end		11,90	11,80	11,80	11,50	11,90	11,30	11,00
Kappa				4,80			3,20	2,90
Viscosity	ml/g			972	973	961	989	982
	cps							
Brightness	% ISO		59,80	63,50	69,00	70,30	70,80	71,80
Third Stage		D1	D1	D1	D1	D1	D1	D1
Sulfamic acid	%	0,00	0,00	0,00	0,10	0,10	0,00	0,00
Active Chlorine applied	%	1,00	1,00	1,50	2,00	2,00	5,30	2,50
Residual Chlorine	%	0,16	0,12	0,24	0,03	0,30	0,09	0,08
Active Chlorine consumed	%	0,84	0,88	1,26	1,97	1,70	5,21	2,42
NaOH as Buffer	%							

Temperature	°C	70	70	70	75	75	70	70
Retention time	min	150	180	210	210	210	180	180
Consistency	%	10,00	10,00	10,00	10,00	10,00	10,00	10,00
pH start		3,00		3,40	3,78	3,80	4,30	6,00
pH end		3,30	7,20	3,90	2,33	2,60	2,60	3,80
Total Active Chlorine applied	%	3,80	3,80	5,00	4,55	4,55	8,30	5,50
Total Active Chlorine consumed	%	3,42	3,41	3,02	3,82	3,32	8,20	5,41
Final Brightness	% ISO	77,60	73,30	77,20	78,80	78,00	83,50	85,80
Final Brightness corrected	% ISO	79,60	75,30	79,20	80,80	80,00	85,80	87,00
Brigtness revertion	%							
Viscosity	ml/g	962	642	973	941	936	935	937
Fourth Stage					D2			
Sulfamic acid	%				0,10			
Active Chlorine applied	%				1,00			
Residual Chlorine	%				0,53			
Active Chlorine consumed	%				0,47			
NaOH as Buffer	%							
Temperature	°C				75			
Retention time	min				150			
Consistency	%				10,00			
pH start					3,70			
pH end					3,56			
Total Active Chlorine applied	%				5,55			
Total Active Chlorine consumed	%				4,29			
Final Brightness	% ISO				81,70			
Final Brightness corrected	% ISO				83,70			
Brigtness revertion	%				3,30			
Viscosity	ml/g				925			
Classification of speks ISO								
>5 mm²	speks/m²				0,0			
1,0-4,99 mm²	speks/m²				32,0			
0,4-0,99 mm²	speks/m²				127,0			
0,15-0,39 mm²	speks/m²				382,0			
Dirt cont acc. TAPPI	mm²/m²				287,2			
Fiber fraction Bauer McNett*								
retained on mesh 14	%				87,50			
retained on mesh 30	%				4,40			
retained on mesh 50	%				2,40			
retained on mesh 100	%				0,10			
going through mesh 100	%				5,60			

* Bleaching tests at ÖHFI, Vienna

TABLE 43B

Sample: from test no. 4

Physical properties:	Unit						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	5400	8000	11300	6050	11300
	min	0,00	3,72	5,52	7,79	4,17	7,79
Freeness	SR	14	27	39	50	30	50
	CSF	733	470	323	224	428	224
Grammage	g/m²	73,96	73,96	74,52	73,88	74,10	73,88
Thickness	mm	0,165	0,125	0,118	0,114	0,123	0,114
Density	kg/m³	448,2	591,6	631,5	648,1	601,6	648,1
Bulk	m³/kg	2,231	1,690	1,583	1,543	1,663	1,543
Stretch	%	1,5	3,3	4,0	4,0	3,5	4.0
Breaking length	m	2100	5142	6523	6688	5487	6688
Burst strength	kPa	74,5	277,5	312,8	319,7	286,3	319,7
Tearing resistance	mN	790	1172	1066	990	1146	990
MID double fold		3	1223	1279	1463	1237	1463
Tensile index	Nm/g	20,60	50,44	63,99	65,61	53,83	65,61
Burst index	kPam²/g	1,01	3,70	4,20	4,33	3,86	4,33
Tear index	mNm²/g	10,68	15,85	14,30	13,40	15,46	13,40
Bendtsen porosity	ml/min			638	400	-	400
Bendtsen smoothness	ml/min	918,50	488,00	406,50	350,00	467,63	350,00
Scattering coefficient	m²/kg	23,26	23,86	24,28	24,45	23,96	24,45
Opacity	%	78,88	81,30	82,08	82,54	81,49	82,54

Zero beaten pulp:		1	2	average
Fibre length Arithmetic average	mm	1,190	1,200	1,195
Fibre length weighted average	mm	1,60	1,63	1,615
Fibre diameter	mm	0,030	0,030	0,030
Coarseness	mg/m	0,110	0,108	0,109
Slenderness factor		14,5	15,1	14,8
Fibre zero span tensile	km	6,36		
fibre zero span stregth index	Nm/g	62,4		

* Bleaching tests at ÖHFI, Vienna

TABLE 43C

		Sample: from test no.	7*					
Physical properties:	**Unit**							
with PFI mill								
Beating point	-	0	1	2	3	4		
PFI revolution	rpm	0	1450	1450	1450	1450		
	rev.	0	3500	7500	12000	14500	4731	9750
	min	0,00	2,41	5,17	8,28	10,00	3,26	6,72
Freeness	SR	16	26	39	61	71	30	50
	CSF	680	485	323	144	83	428	224
Drainage time	s							
Grammage	g/m²	71,80	72,00	72,00	71,70	72,30	72,00	71,85
Thickness	mm	0,163	0,129	0,118	0,112	0,108	0,126	0,115
Density	kg/m³	440	560	610	640	670	575	625
Bulk	m³/kg	2,270	1,790	1,640	1,560	1,490	1,744	1,600
Stretch	%	1,87	3,01	3,31	3,67	3,84	3,10	3,49
Breaking length	m	2130	4850	6320	6660	7000	5302	6490
Burst strength	kPa	81,05	244,96	326,40	343,61	356,30	270,02	335,01
Tearing resistance	mN	868	1071	883	864	795	1013	874
MID double fold		4	237	1317	1046	1502	569	1182
Tensile index	Nm/g	20,90	47,58	62,00	65,33	68,67	52,02	63,67
Burst index	kPam²/g	1,13	3,70	4,53	4,79	4,93	3,75	4,66
Tear index	mNm²/g	12,09	14,88	12,26	12,05	11,00	14,07	12,16
Bendtsen porosity	ml/min	3000	3000	1320	305	160	2483	465
Bendtsen smoothness	ml/min	920	475	390	300	270	449	345
Scattering coefficient	m²/kg	24,08	23,46	27,55	29,97	29,16	24,72	28,76
Opacity	%	80,57	79,18	81,78	83,87	85,35	79,98	82,83
Zero beaten pulp:								
Fibre length Arithmetic average	mm	1,100						
Fibre length weighted average	mm	1,56						
Fibre diameter	mm							
Coarseness	mg/m	0,106						
Slenderness factor		14,72						
Fibre zero span tensile	km	17,00						
Fibre zero span stregth index	Nm/g	166,8						

TABLE 44

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana
Country: Slovenia
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 44A

		TEST NUMBER		
	Unit	1	2	3
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	10,2	10,2
Initial Brightness	% ISO			
Viscosity	ml/g	1029	1029	1029
Bleaching Sequence:		O D EO D	O D EO D	O D EO D
First Stage		O	O	O
NaOH	%	1,50	1,50	2,00
MgSO4	%	0,50	0,50	0,10
Oxygen pressure	kg/cm²			6,00
Temperature	°C	90	90	95
Retention time	min	60	60	60
Consistency	%	10,00	10,00	10,00
pH start		12,00	11,90	12,40
pH end		10,60	10,60	11,00
Kappa		7,80	7,80	7,50
Viscosity	ml/g	953,00		
	cps			
Brightness	% ISO			
Second Stage		D0	D0	D0
HCl Charge	%			
Sulfamic acid	%	0,00	0,00	0,10
Chlorination factor		0,20	0,20	0,26
Active Chlorine applied	%	1,56	1,56	1,95
Residual Chlorine	%	0,48	0,38	0,73
Active Chlorine consumed	%	1,08	1,18	1,22
Temperature	°C	65	60	60
Retention time	min	60	60	60
Consistency	%	10,00	10,00	10,00
pH start		2,00	2,00	2,00
pH end		3,20	3,10	2,18
Kappa				
Viscosity	ml/g			
	cps			
Brightness	% ISO			
Third Stage		E/O	E/O	E/O
NaOH	%	1,00	1,00	1,50
Oxygen pressure	kg/cm²	2,50	2,50	2,50
Temperature	°C	90	70	70
Retention time	min	60	90	60
Consistency	%	10,00	10,00	10,00

pH start		12,00	11,90	12,30
pH end		10,60	10,70	11,40
Kappa			3,30	5,20
Viscosity	ml/g		616,00	915,00
	cps			
Brightness	% ISO	66,00	68,00	74,30
Forth Stage		**D1**	**D1**	**D1**
Sulfamic acid	%			0,10
Active Chlorine applied	%	1,00	2,00	2,00
Residual Chlorine	%	0,10	0,13	0,00
Active Chlorine consumed	%	0,90	1,87	2,00
NaOH as Buffer	%			
Temperature	°C	70		75
Retention time	min	150		210
Consistency	%	10,00		10,00
pH start		4,00		4,03
pH end		4,10		2,40
Total Active Chlorine applied	%	2,56	3,56	3,95
Total Active Chlorine consumed	%	1,98	3,05	3,22
Final Brightness	% ISO	78,30	77,50	82,40
Final Brightness corrected	% ISO	80,30	79,50	84,40
Brigtness revertion	%			
Viscosity	ml/g	924		821
	cps			
Fourth Stage				**D2**
Sulfamic acid	%			0,10
Active Chlorine applied	%			1,00
Residual Chlorine	%			0,50
Active Chlorine consumed	%			0,50
NaOH as Buffer	%			
Temperature	°C			75
Retention time	min			150
Consistency	%			10,00
pH start				3,80
pH end				3,70
Total Active Chlorine applied	%			4,95
Total Active Chlorine consumed				3,72
Final Brightness	% ISO			82,70
Final Brightness corrected	% ISO			84,70
Brigtness revertion	%			6,50
Viscosity	ml/g			811
Classification of speks ISO				
>5 mm²	speks/m²			0,0
1,0-4,99 mm²	speks/m²			48,0
0,4-0,99 mm²	speks/m²			96,0
0,15-0,39 mm²	speks/m²			303,0
Dirt cont acc. TAPPI	mm²/m²			292,3
Fiber fraction Bauer McNett:				
retained on mesh 14	%			91,70
retained on mesh 30	%			5,20
retained on mesh 50	%			0,80
retained on mesh 100	%			0,20
going through mesh 100	%			2,10

TABLE 44B

		Sample: from test no.			3		
Physical properties:	**Unit**						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	4900	6680	9500	5968	9688
	min	0,00	3,38	4,61	6,55	4,12	6,68
Freeness	SR	15	24	34	49	30	50
	CSF	706	517	378	232	428	224
Grammage	g/m²	74,60	76,11	76,03	68,79	76,06	68,31
Thickness	mm	0,166	0,132	0,123	0,106	0,127	0,105
Density	kg/m³	449	577	618	649	602	651
Bulk	m³/kg	2,227	1,733	1,618	1,541	1,664	1,536
Stretch	%	1,5	3,4	3,7	3,9	3,6	3,9
Breaking length	m	1917	5300	5994	6597	5716	6637
Burst strength	kPa	81,4	253,7	305,2	319,5	284,6	320,5
Tearing resistance	mN	776	1267	1051	825	1137	810
MID double fold		3	933	1053	1093	1005	1096
Tensile index	Nm/g	18,81	51,99	58,80	64,72	56,08	65,11
Burst index	kPam²/g	1,09	3,70	4,01	4,64	3,74	4,69
Tear index	mNm²/g	10,40	16,65	13,82	11,99	14,95	11,86
Bendtsen porosity	ml/min			944	338	3000	298
Bendtsen smoothness	ml/min	866,00	600,50	431,50	313,00	499,10	305,10
Scattering coefficient	m²/kg	24,03	24,54	25,01	22,11	24,82	21,91
Opacity	%	78,56	80,43	81,74	80,23	81,21	80,12

Zero beaten pulp:		1	2	average
Fibre length Arithmetic average	mm	1,200	1,200	1,200
Fibre length weighted average	mm	1,62	1,60	1,610
Fibre diameter	mm			
Coarseness	mg/m	0,121	0,125	0,123
Slenderness factor		13,4	12,8	13,1
Fibre zero span tensile	km	5,97		
fibre zero span stregth index	Nm/g	58,6		

TABLE 45

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana / Vienna*
Country: Slovenia / AUSTRIA*
Conducted by: IVA, Linz AUSTRIA , Dipl.Ing. Mohamed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 45A

		TEST NUMBER		
	Unit	1	2*	3
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	9,6	10,2
Initial Brightness	% ISO		44,90	
Viscosity	ml/g	1029	1015	1029
	cps			
Bleaching Sequence:		O A EOP P	O A EOP P	O Q EOP P
First Stage		O	O	O
NaOH	%	1,50	1,50	1,50
MgSO4	%	0,50	0,50	0,10
Oxygen pressure	kg/cm²	6,00	6,00	6,00
Temperature	°C	95	95	95
Retention time	min	60	60	60
Consistency	%	10,00	10,00	10,00
pH start		11,90	11,10	12,40
pH end		10,80	11,40	11,60
Kappa		7,80	6,60	7,50
Viscosity	ml/g	953	944	
	cps			
Brightness	% ISO		56,60	
Second Stage		A	A	Q
HCl Charge	%			
DTPA	%	0,00		0,20
H2SO4	%			
Temperature	°C	70	70	70
Retention time	min	60	60	60
Consistency	%	10,00	10,00	10,00
pH start		2,00	2,00	5-5,5
pH end		2,20	2,20	5,32
Kappa				
Viscosity	ml/g			
	cps			
Brightness	% ISO		58,70	
Third Stage		EOP	EOP	EOP
NaOH	%	2,00	1,50	1,00
Peroxid applied	%	3,00	3,00	2,00
Residual peroxid	%	0,00	0,01	0,21
Peroxid consumed	%	3,00	2,99	1,79
DTPA	%		0,20	0,20
EDTA	%	0,03		
MgSO4	%	0,05	0,20	0,20

H2SO4	%			
Oxygen pressure	kg/cm²	4,00	4,00	4,00
Temperature	°C	95	85	85
Retention time	min	15/150	15/150	15/120
Consistency	%	10,00	10,00	10,00
pH start		11,30	10,90	11,04
pH end		11,10	10,80	10,99
Kappa		3,00	5,10	6,60
Viscosity	ml/g	389	562	875
	cps			
Brightness	% ISO	69,10	79,20	72,30
Forth Stage		**P**	**P**	**P**
NaOH	%	1,00	0,50	1,00
Peroxid applied	%	1,00	1,00	2,00
Residual peroxid	%	0,65	0,02	1,04
Peroxid consumed	%	0,35	0,98	0,96
DTPA	%		0,20	0,20
EDTA	%	0,03		
MgSO4	%	0,05	0,20	0,20
H2SO4	%			
Oxygen pressure	kg/cm²			
Temperature	°C	90	90	90
Retention time	min	180	180	180
Consistency	%	10 00	10,00	10,00
pH start		11,60	9,80	11,50
pH end		11,20	10,10	11,40
Final Brightness	% ISO	78,20	82,70	75,90
Final Brightness corrected	% ISO	80,20	84,70	77,90
Brigtness revertion	%			7,40
Viscosity	ml/g	386	550	869
Classification of speks ISO				
>5 mm²	speks/m²			0,0
1,0-4,99 mm²	speks/m²			0,0
0,4-0,99 mm²	speks/m²			87,0
0,15-0,39 mm²	speks/m²			361,0
Dirt cont acc. TAPPI	mm²/m²			157,9
Fiber fraction Bauer McNett:				
retained on mesh 14	%			90,80
retained on mesh 30	%			4,10
retained on mesh 50	%			1,10
retained on mesh 100	%			0,90
going through mesh 100	%			3,10

* Bleaching tests at ÖHF:, Vienna

TABLE 45B

		Sample: from test no.			3		
Physical properties:	**Unit**						
with PFI mill							
Beating point	-	0	1	2	3		
PFI revolution	rpm	1450	1450	1450	1450		
	rev.	0	5440	8080	12060	5440	9141
	min	0,00	3,75	5,57	8,32	3,75	6,30
Freeness	SR	15	30	46	61	30	50
	CSF	706	428	257	144	428	224
Grammage	g/m²	72,21	75,24	75,48	76,27	75,24	75,69
Thickness	mm	0,159	0,122	0,117	0,111	0,122	0,115
Density	kg/m³	454	616	645	687	616	656
Bulk	m³/kg	2,202	1,623	1,550	1,455	1,623	1,525
Stretch	%	1,6	3,7	4,0	4,4	3,7	4,1
Breaking length	m	1929	6428	6687	7584	6428	6926
Burst strength	kPa	69,60	322,60	326,50	356,00	322,60	334,37
Tearing resistance	mN	692	994	886	880	994	884
MID double fold		3	1801	1834	1655	1801	1786
Tensile index	Nm/g	18,92	63,06	65,60	74,40	63,06	67,95
Burst index	kPam²/g	0,96	4,29	4,33	4,67	4,29	4,42
Tear index	mNm²/g	9,58	13,21	11,74	11,54	13,21	11,68
Bendtsen porosity	ml/min			368,8	118,8	3000	302,1
Bendtsen smoothness	ml/min	956,30	409,41	396,90	281,30	409,41	366,07
Scattering coefficient	m²/kg	23,01	22,92	23,12	22,61	22,92	22,99
Opacity	%	81,54	81,91	82,66	82,82	81,91	82,70
Zero beaten pulp:		1	2	3	average		
Fibre length Arithmetic average	mm	1,210	1,220	1,230	1,220		
Fibre length weighted average	mm	1,63	1,65	1,66	1,647		
Fibre diameter	mm						
Coarseness	mg/m	0,120	0,113	0,116	0,116		
Slenderness factor		13,6	14,6	14,3	14,2		
Fibre zero span tensile	km	6,50					
fibre zero span stregth index	Nm/g	63,8					

TABLE 46

Bleaching of kraft-AQ Jute pulp

Laboratory: Pulp and Paper Institute
City: Ljubliana / Vienna*
Country: Slovenia / AUSTRIA*
Conducted by: IVA, Linz AUSTRIA , DipLIng. Mohamed NAGA
Date: Mai-Jul 1995
Client: UNIDO, Vienna for Tribeni Mill

TABLE 46A

		TEST NUMBER		
	Unit	1	2*	3*
Pulping process		Kraft-AQ	Kraft-AQ	Kraft-AQ
Kappa No. unbleached		10,2	9,6	9,6
Initial Brightness	% ISO		44,90	44,90
Viscosity	ml/g	1029	1015	1015
	cps			
Bleaching Sequence:		**O A Z P**	**O A Z P**	**O Q Z P**
First Stage		**O**	**O**	**O**
NaOH	%	1,50	1,50	1,50
MgSO4	%	0,50	0,50	0,50
Oxygen pressure	kg/cm²	6,00	6,00	6,00
Temperature	°C	95	95	95
Retention time	min	60	60	60
Consistency	%	10,00	10,00	10,00
pH start		12,00	11,20	11,20
pH end		10,50	11,00	11,00
Kappa		7,40	7,30	7,20
Viscosity	ml/g	953	936	932
	cps			
Brightness	% ISO		58,10	58,10
Second Stage		**A**	**A**	**Q**
HCl Charge	%			
NaOH	%			
EDTA	%			0,50
MgSO4	%			
H2SO4	%			
Temperature	°C	70	70	70
Retention time	min	60	60	60
Consistency	%	10,00	10,00	10,00
pH start		2,00	2,00	5,20
pH end		2,20	2,00	5,40
Kappa		6,80		6,50
Viscosity	ml/g	929		968
	cps			
Brightness	% ISO	55,80	60,80	61,60
Third Stage		**Z**	**Z**	**Z**
HCl Charge	%			
NaOH	%			
O3 applied	%	0,50	0,61	0,88
O3 Residual	%		0,23	0,33

O3 consumed	%		0,38	0,55
DTPA	%			
MgSO4	%			
H2SO4	%			
Temperature	°C	40	50	50
Retention time	min	5	5	
Consistency	%	20,00	10,00	10,00
pH start			2,00	2,00
pH end			2,00	2,00
Kappa		5,30	0,70	0,50
Viscosity	ml/g	883,00	683,00	658,00
	cps			
Brightness	% ISO	59,20	75,50	76,50
Forth Stage		**P**	**P**	**P**
NaOH	%	1,50	1,50	1,50
Peroxid applied	%	2,50	3,00	3,00
Residual peroxid	%	1,36	1,36	0,01
Peroxid consumed	%	1,14	1,64	2,99
DTPA	%	0,03	0,20	0,20
MgSO4	%	0,05	0,20	0,20
H2SO4	%			
Temperature	°C	90	90	90
Retention time	min	180	180	180
Consistency	%	10,00	10,00	10,00
pH start		10,90	10,10	10,60
pH end		10,40	10,60	10,70
Final Brightness	% ISO	76,10	84,80	87,30
Final Brightness corrected	% ISO	78,10	86,80	89,30
Brigtness revertion	%			
Viscosity	ml/g	800	584	525
Classification of speks ISO				
>5 mm²	speks/m²			
1,0-4,99 mm²	speks/m²			
0,4-0,99 mm²	speks/m²			
0,15-0,39 mm²	speks/m²			
Dirt cont acc. TAPPI	mm²/m²			
Fiber fraction Bauer McNett:				
retained on mesh 14	%			
retained on mesh 30	%			
retained on mesh 50	%			
retained on mesh 100	%			
going through mesh 100	%			

* Bleaching tests at ÖHFI, Vienna

TABLE 46B

Sample: from test no. 3*

Physical properties:	Unit							
with PFI mill								
Beating point	-	0	1	2	3	4		
PFI revolution	rpm	1450	1450	1450	1450	1450		
	rev.	0	4000	6000	8000	12000	2750	6235
	min	0,00	2,76	4,14	5,52	8,28	1,90	4,30
Freeness	SR	19	3[illegible]	48	65	81	30	50
	CSF	611	366	240	119	30	428	224
Grammage	g/m²	73,60	75,10	73,20	74,90	73,50	74,63	73,40
Thickness	mm	0,171	0,136	0,128	0,123	0,122	0,147	0,127
Density	kg/m³	430	550	570	610	600	513	575
Bulk	m³/kg	2,320	1,810	1,750	1,640	1,660	1,969	1,737
Stretch	%	2,91	3,85	3,57	3,65	3,88	3,56	3,58
Breaking length	m	1543	4753	5405	5923	6153	3750	5466
Burst strength	kPa	74,96	256,48	302,57	329,24	329,76	199,76	305,71
Tearing resistance	mN	549	1052	811	784	647	895	808
MID double fold		52	268	440	792	477	201	481
Tensile index	Nm/g	15,14	46,63	53,02	58,10	60,36	36,79	53,62
Burst index	kPam²/g	1,02	3,42	4,13	4,40	4,49	2,68	4,16
Tear index	mNm²/g	7,46	14,01	11,08	10,47	8,80	11,99	11,01
Bendtsen porosity	ml/min	3581	2954	1391	333	116	3149,9	429
Bendtsen smoothness	ml/min	1158	453	423	439	422	453	425
Scattering coefficient	m²/kg	22,5	26,8	28,4	29,7	31,7	26,2	28,6
Opacity	%	77,4	82,0	82,7	83,7	85,6	81,7	82,8
Zero beaten pulp:								
Fibre length Arithmetic average	mm	1,020						
Fibre length weighted average	mm	1,41						
Fibre diameter	mm							
Coarseness	mg/m	0,109						
Slenderness factor		12,9						
Fibre zero span tensile	km							
fibre zero span stregth index	Nm/g	0,0						

TABLE 47

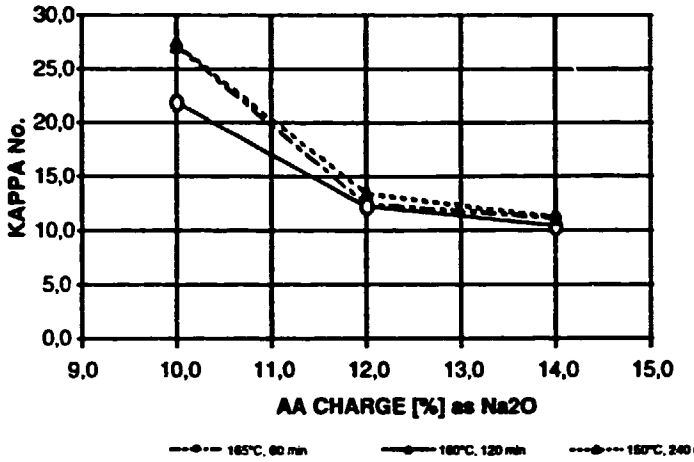
Summery of Bleaching tests for kraft-AQ Jute pulp

SEQUNCE	Lab	No. of TEST	Bright-ness absolute	Bright-ness relative	Limited Viscosity	Break. length at 50 SR	Fibre length weight. average	Coarse-ness	Slender-ness factor
			ISO	ISO	ml/g	m	mm	mg/m	
Brown stock			44,9	44,9	1029	7814	1,65	0,125	13,20
C-E-H	ICP	1	77,90	79,90	499				
	ICP	2	75,80	77,80	539				
	ICP	3	75,50	77,50	448				
	ICP	4	76,40	78,40	916				
	ICP	5	77,40	79,40	817				
	ICP	6	79,70	81,70	811	6490	1,67	0,103	16,25
	ÖHFI	7	82,80	84,80	540	5904	1,54	0,100	15,40
C-EP-H	ICP	1	78,50	80,50	670				
	ICP	2	79,70	81,70	966				
	ICP	3	77,80	79,80	480				
	ICP	4	81,60	83,60	854	6459	1,66	0,106	15,61
	ÖHFI	5	85,00	87,20	517	5767	1,60	0,106	15,09
O-C-EO-H	ICP	1	80,50	82,50	756				
	ICP	2	79,00	81,00	583				
	ICP	3	79,10	81,10	473				
	ICP	4	83,00	85,00	792	5963	1,62	0,146	11,10
D-E-D	ICP	1	77,60	79,60	962				
	ICP	2	73,30	75,30	642				
	ICP	3	77,20	79,20	973				
	ICP	4	78,80	80,80	941				
	ICP	5	78,00	80,00	936				
D-E-D-D	ICP	4	81,70	83,70	925	6688	1,62	0,109	14,82
D-E-D	ÖHFI	6	83,50	85,80	935				
D-E-D	ÖHFI	7	85,80	87,00	937	6490	1,56	0,106	14,72
O-D-EO-D	ICP	1	78,30	80,30	924				
	ICP	2	77,50	79,50					
	ICP	3	82,40	84,40	821				
O-D-EO-D-D	ICP	3	82,70	84,70	811	6637	1,61	0,123	13,09
O-A-EOP-P	ICP	1	78,20	80,20	386				
	ÖHFI	2	82,70	82,70	550				
O-Q-EOP-P	ICP	3	75,90	77,90	869	6926	1,65	0,116	14,17
O-A-Z-P	ICP	1	76,10	78,10	800				
	ÖHFI	2	84,80	84,80	584				
O-Q-Z-P	ÖHFI	3	87,30	87,30	525	5466	1,41	0,109	12,94
Total		32							

11. DIAGRAMS

11.1 Bench scale pulping tests

CORRELATION BETWEEN KAPPA AND AA CHARGE - KRAFT



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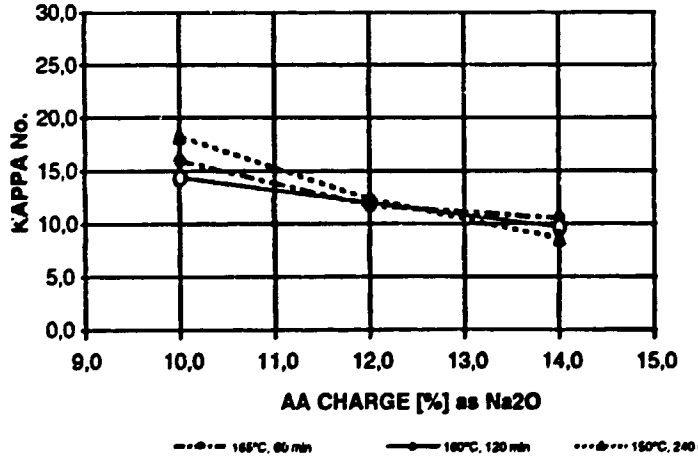
JUTE PULPING

CORRELATION BETWEEN KAPPA AND AA CHARGE - KRAFT AQ



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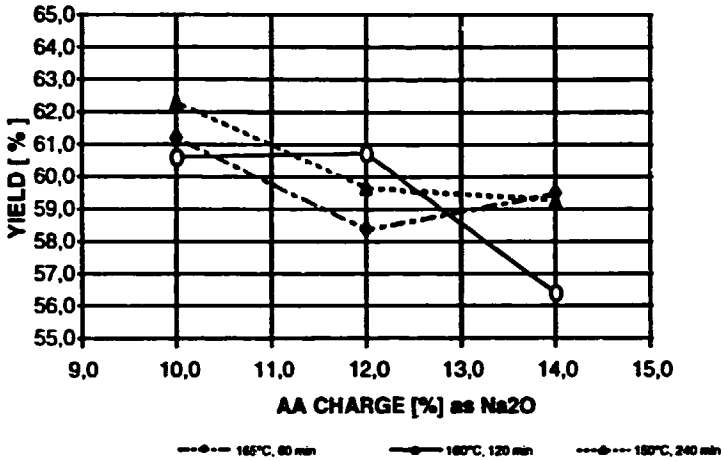
JUTE PULPING

CORRELATION BETWEEN YIELD AND AA CHARGE - KRAFT



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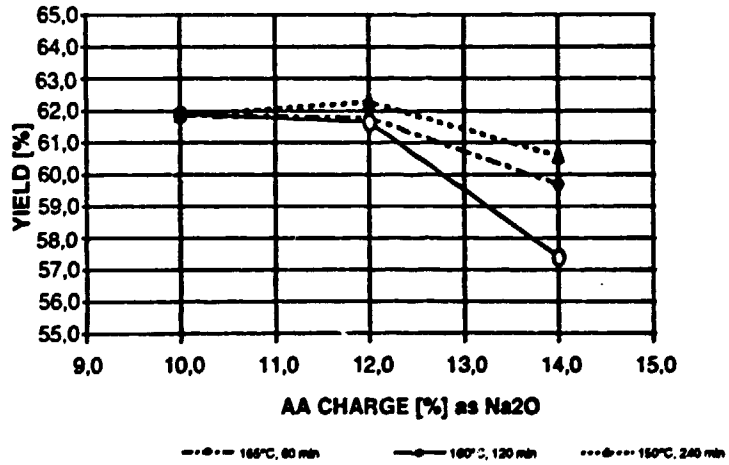
JUTE PULPING

CORRELATION BETWEEN YIELD AND AA CHARGE - KRAFT AQ



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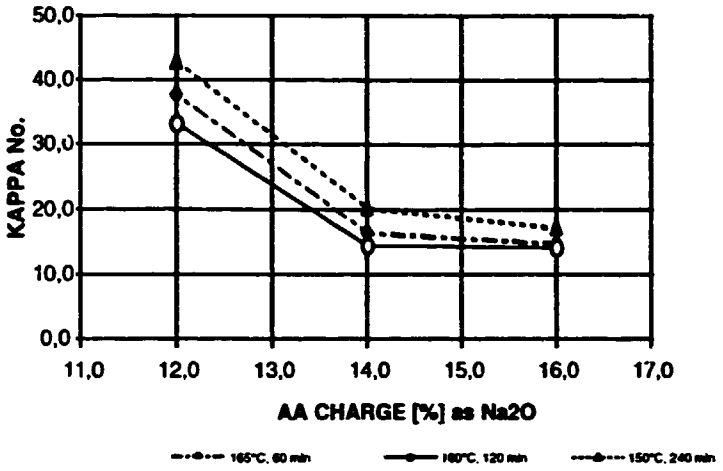
JUTE PULPING

CORRELATION BETWEEN KAPPA AND AA CHARGE - CAUSTIC SODA



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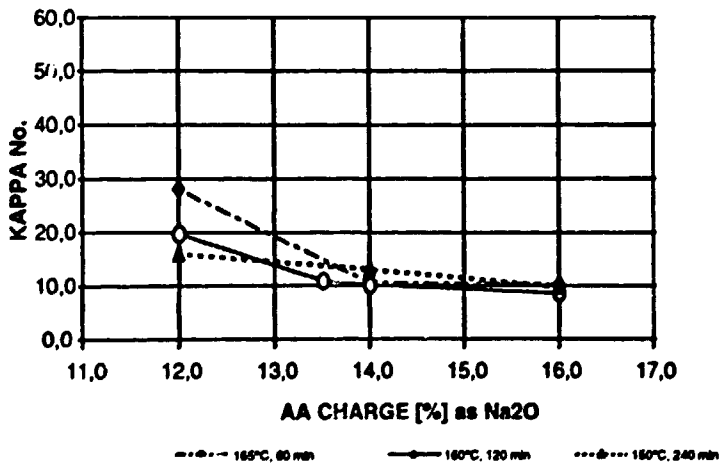
JUTE PULPING

CORRELATION BETWEEN KAPPA AND AA CHARGE - SODA AQ



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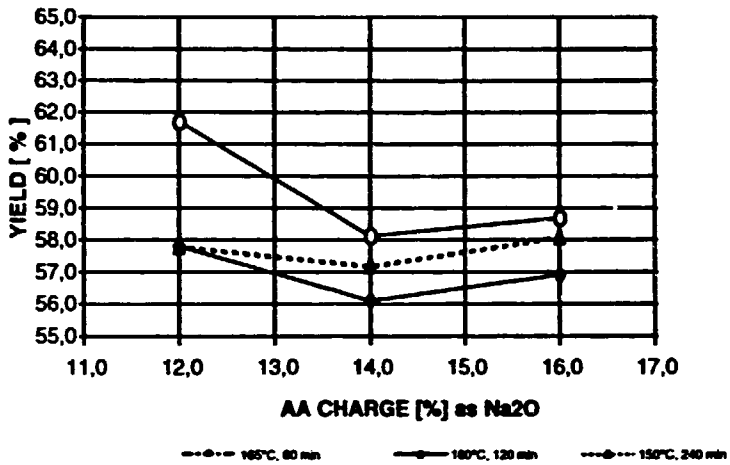
JUTE PULPING

CORRELATION BETWEEN YIELD AND AA CHARGE - CAUSTIC SODA



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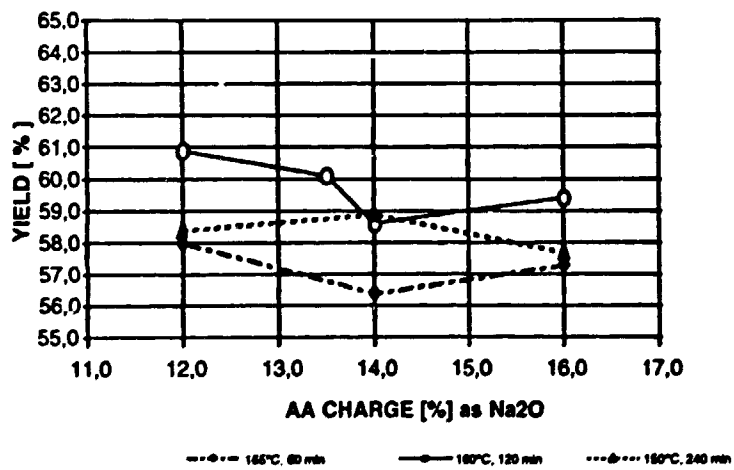
CORRELATION BETWEEN YIELD AND AA CHARGE - SODA AQ



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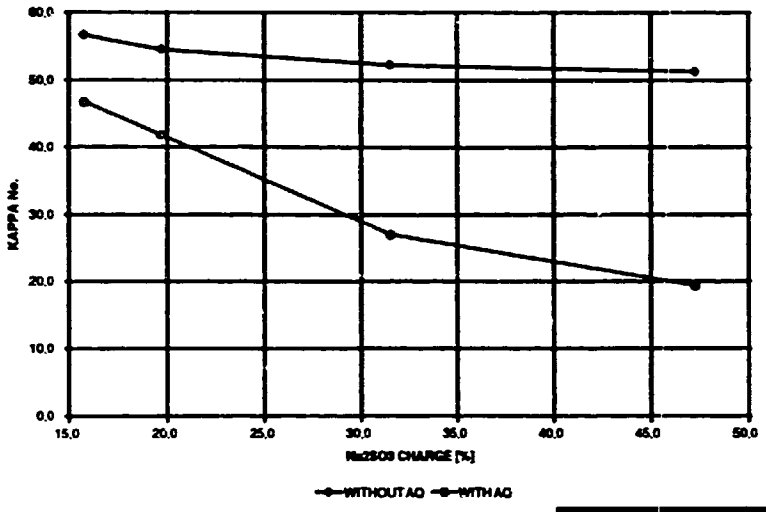
CORRELATION BETWEEN KAPPA AND Na2SO3 CHARGE



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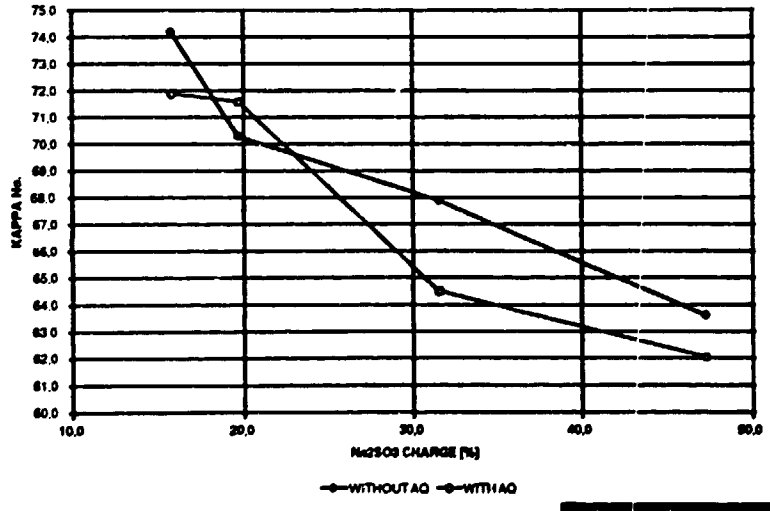
JUTE PULPING

CORRELATION BETWEEN YIELD AND Na2SO3 CHARGE



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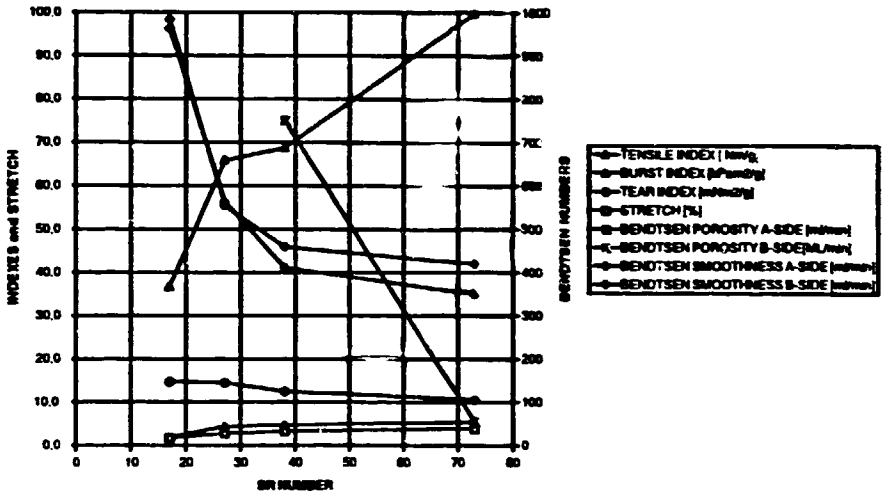
JUTE PULPING

PHYSICAL PROPERTIES OF UNBLEACHED JUTE PULP [KRAFT PULPINING]



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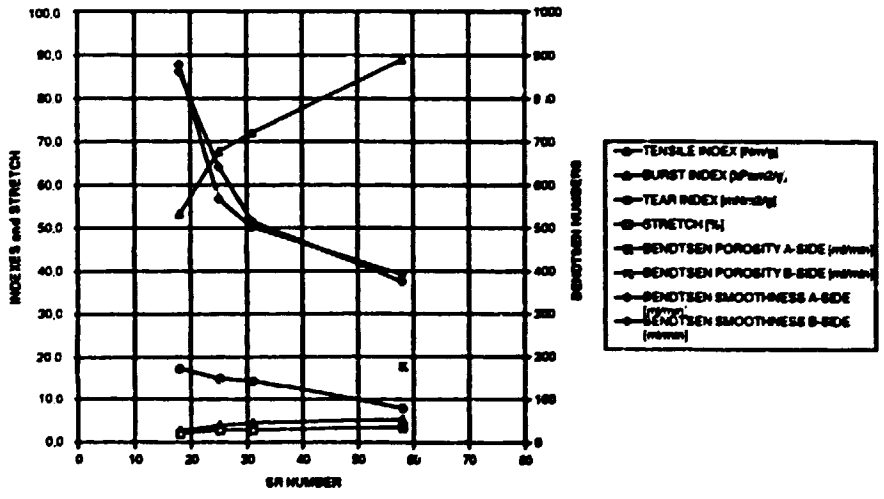
JUTE PULPING

PHYSICAL PROPETIES OF UNBLEACHED JUTE PULP [KRAFT- AQ PULPING]



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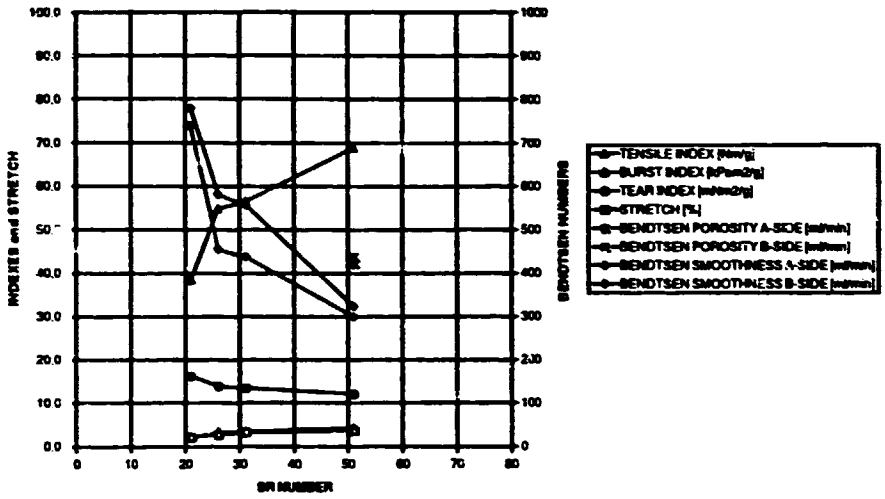
JUTE PULPING

PHYSICAL PROPERTIES OF UNBLEACHED JUTE PULP [SODA PULPING]



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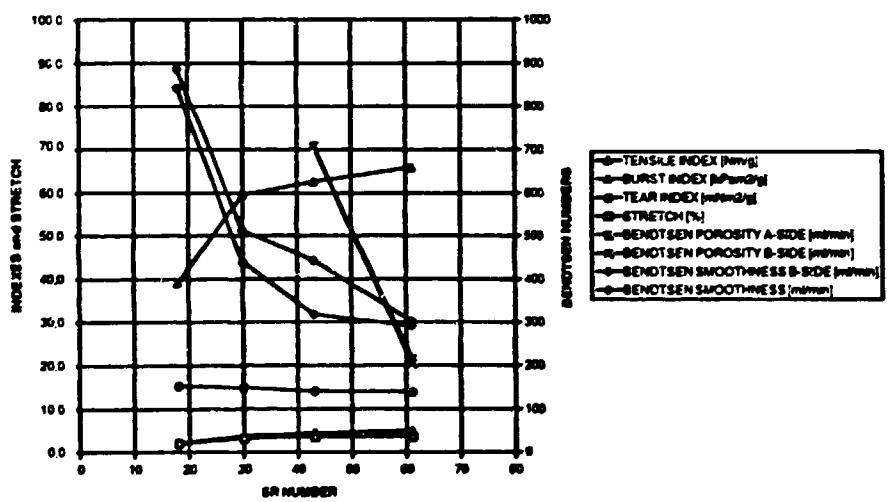
JUTE PULPING

PHYSICAL PROPERTIES OF UNBLEACHED JUTE PULP [SODA-AQ PULPING]



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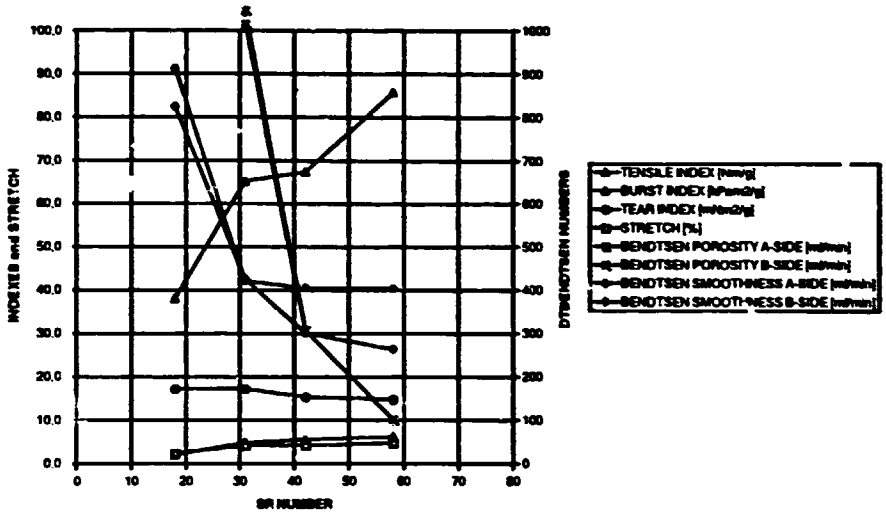
JUTE PULPING

PHYSICAL PROPERTIES OF UNBLEACHED JUTE PULP [ALKALINE SULPHITE-AQ PULPING]



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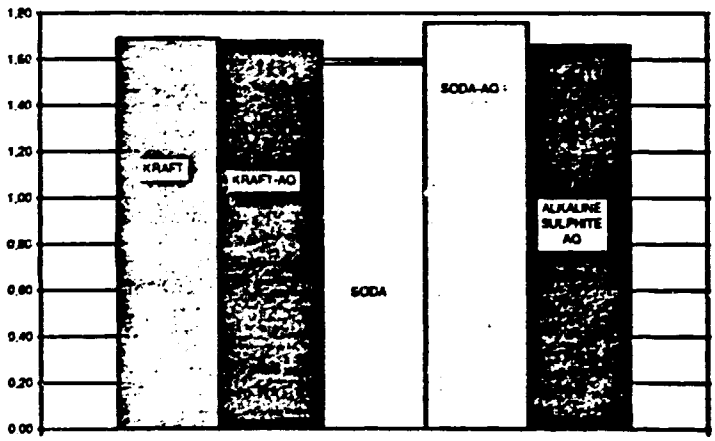
JUTE PULPING

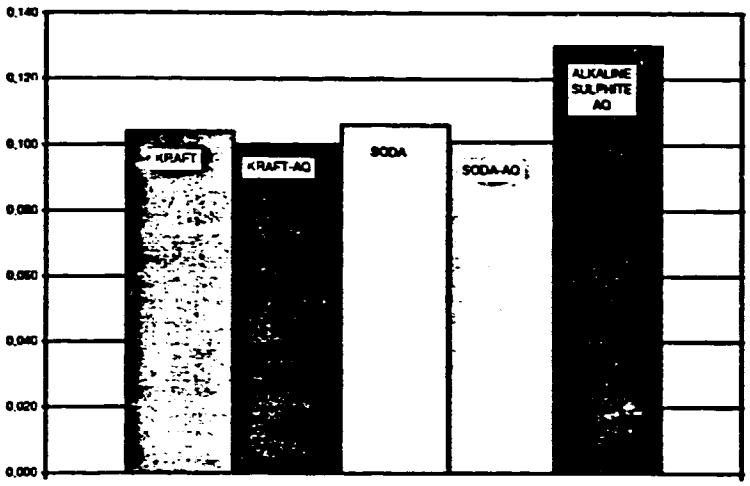
FIBER LENGTH [mm] weighted average OF UNBLEACHED JUTE PULP



ppt\Projekte\Tribeni\Final Report 1a\Figure 16

JUTE PULPING

COARSENESS [mg/m] OF UNBLEACHED JUTE PULP



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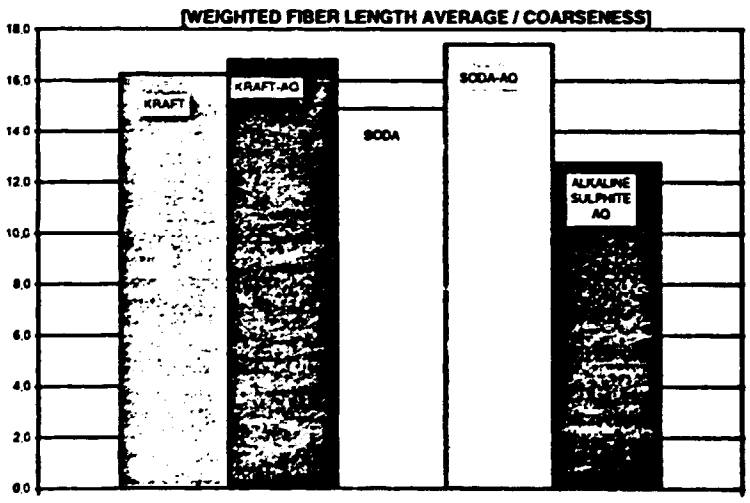
JUTE PULPING

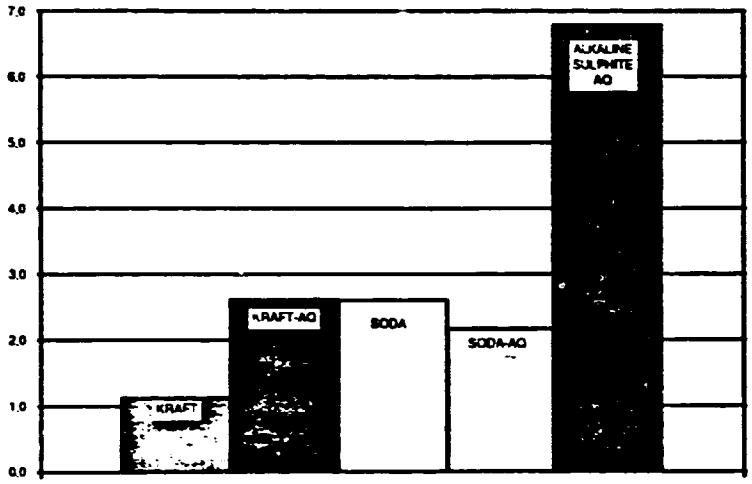
SLENDERNESS FACTOR OF UNBLEACHED JUTE PULP



ppt\Projekte\Tribeni\Final Report 1a\ Figure 18

JUTE PULPING

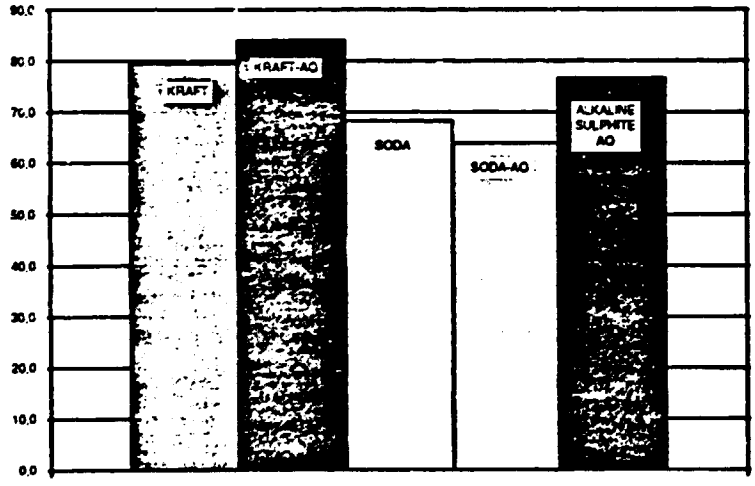
ZERO SPAN TENSILE [km] OF UNBLEACHED JUTE PULP



ppr\Projekte\Tribeni\Final Report 1a\ Figure 19

JUTE PULPING

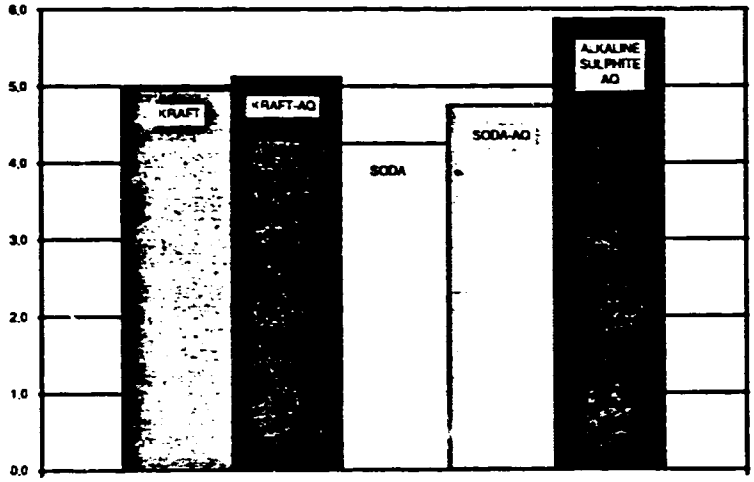
TENSILE INDEX [Nm/g] OF UNBLEACHED JUTE PULP AT 50 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 20

JUTE PULPING

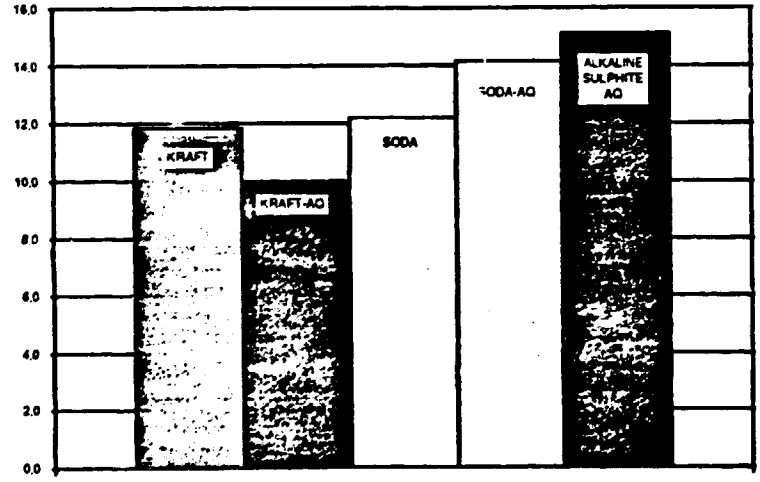
BURST INDEX [kPam2/g] OF UNBLEACHED JUTE PULP AT 50 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 21

JUTE PULPING

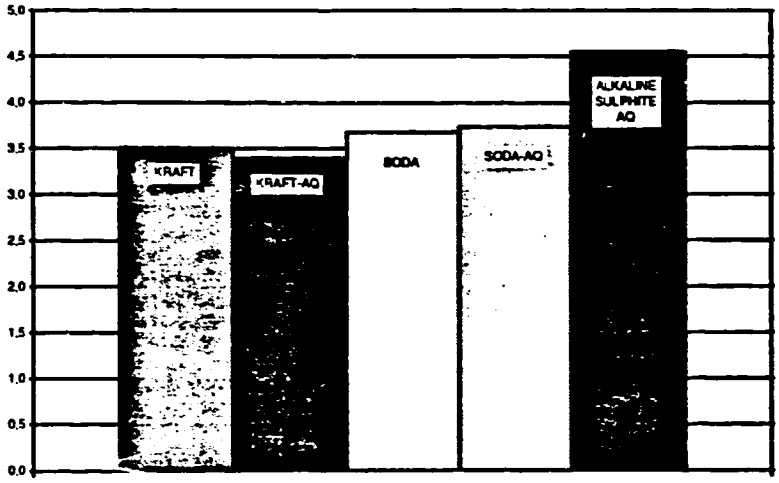
TEAR INDEX [mNm2/g] OF UNBLEACHED JUTE PULP AT 50 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 22

JUTE PULPING

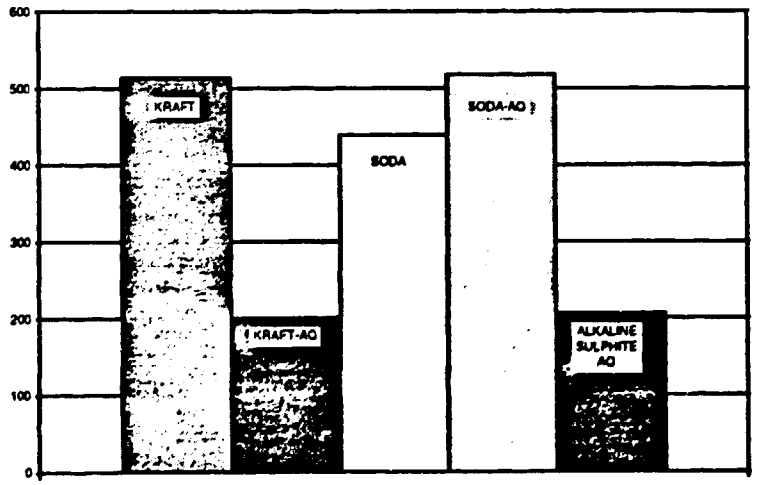
STRETCH [%] OF UNBLEACHED JUTE PULP AT 50 SR



ppt\Projekte\Tribeni\Final Report 1a\Figure 23

JUTE PULPING

BENDTSEN POROSITY A-SIDE [ml/min] OF UNBLEACHED JUTE PULP AT 50 SR



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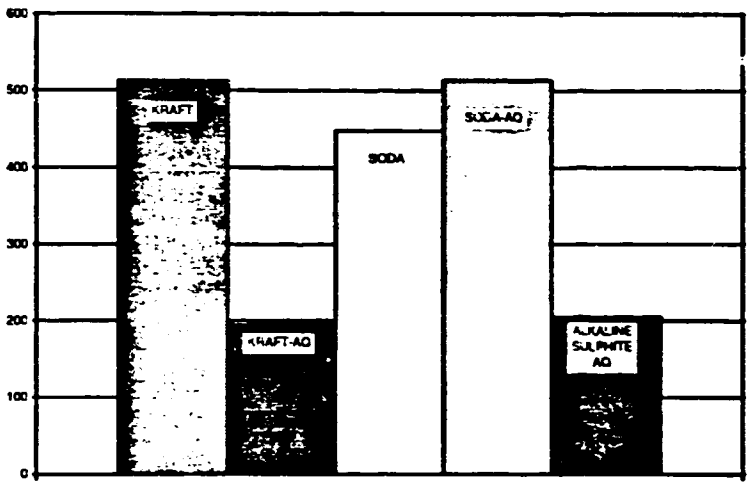
JUTE PULPING

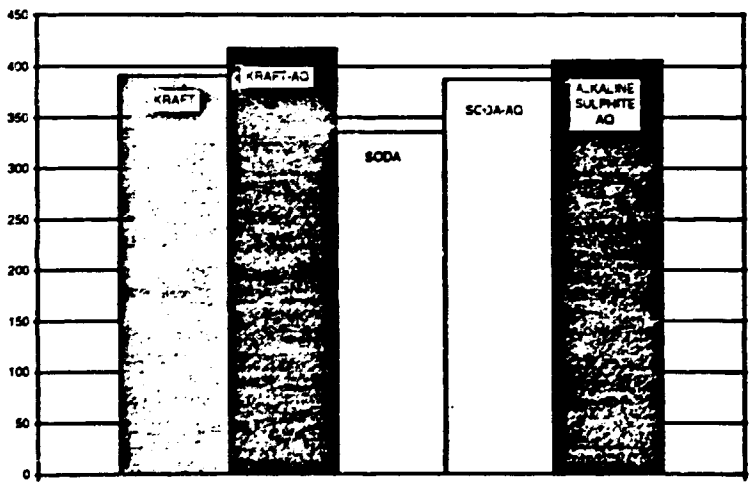
BENDTSEN POROSITY B-SIDE [ml/min] OF UNBLEACHED JUTE PULP AT 50 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 25

JUTE PULPING

BENDTSEN SMOOTHNESS A-SIDE[ml/min] OF UNBLEACHED JUTE PULP AT 50 SR



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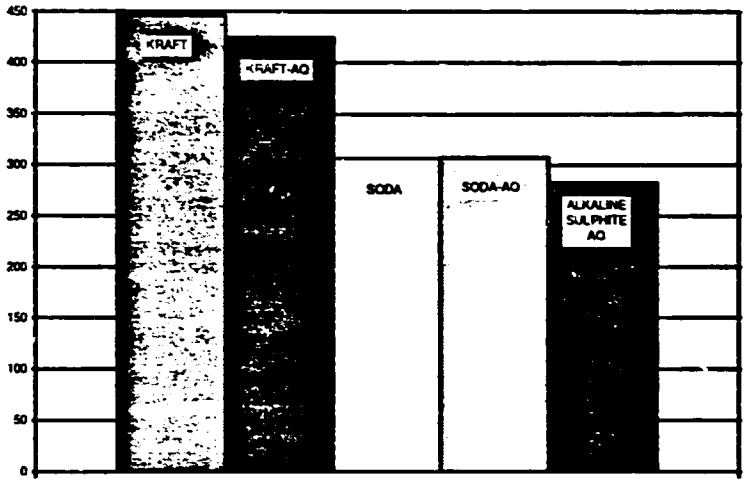
JUTE PULPING

BENDTSEN SMOOTHNESS B-SIDE[ml/min] OF UNBLEACHED JUTE PULP AT 50 SR



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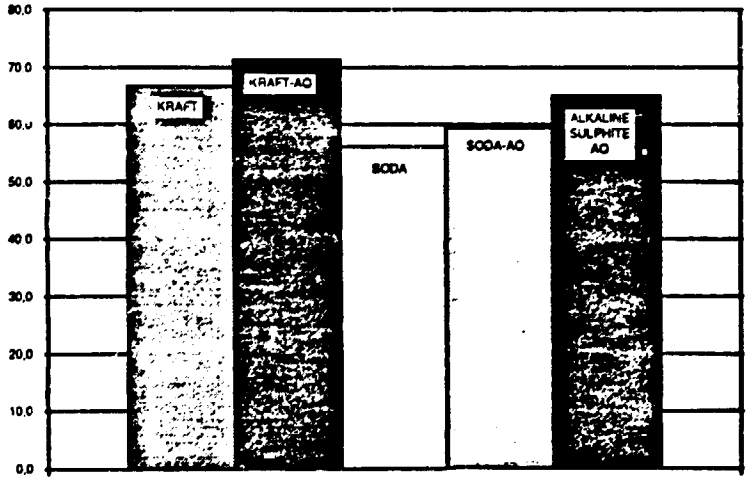
JUTE PULPING

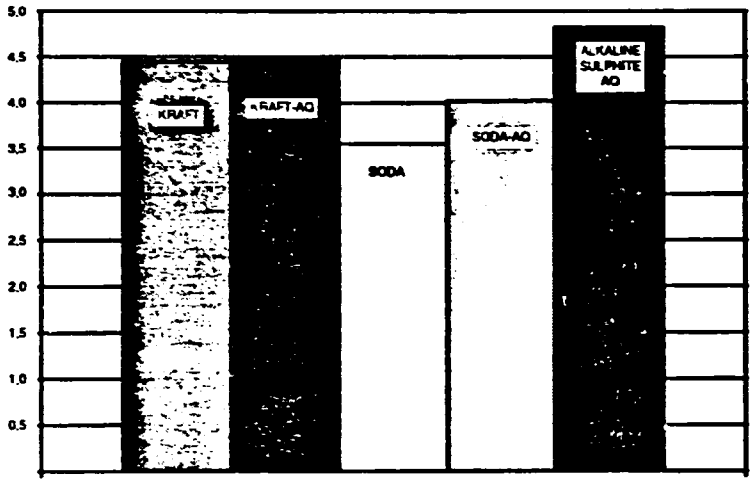
TENSILE INDEX [Nm/g] OF UNBLEACHED JUTE PULP AT 30 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 28

JUTE PULPING

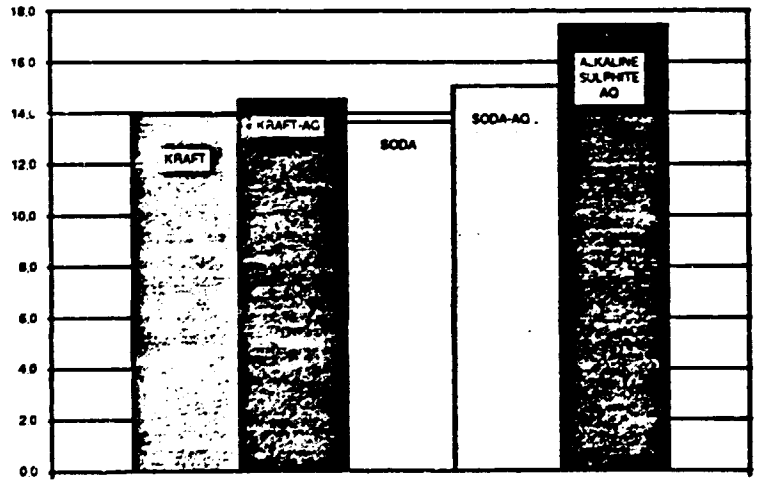
BURST INDEX [kPam2/g] OF UNBLEACHED JUTE PULP AT 30 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 29

JUTE PULPING

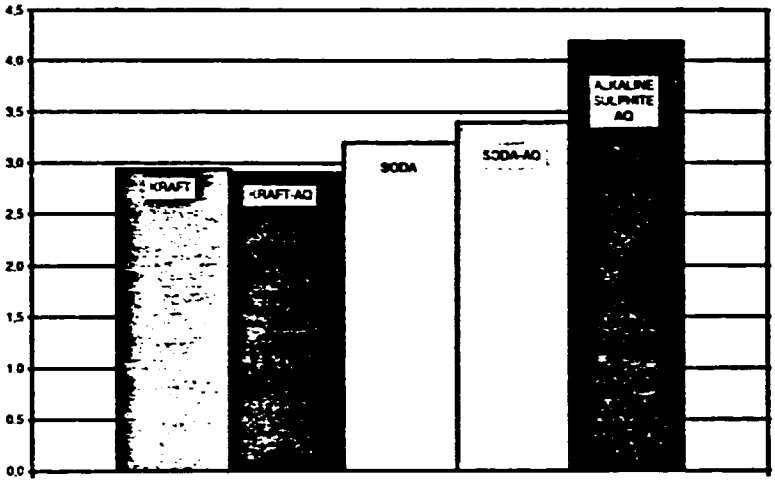
TEAR INDEX [mNm2/g] OF UNBLEACHED JUTE PULP AT 30 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 30

JUTE PULPING

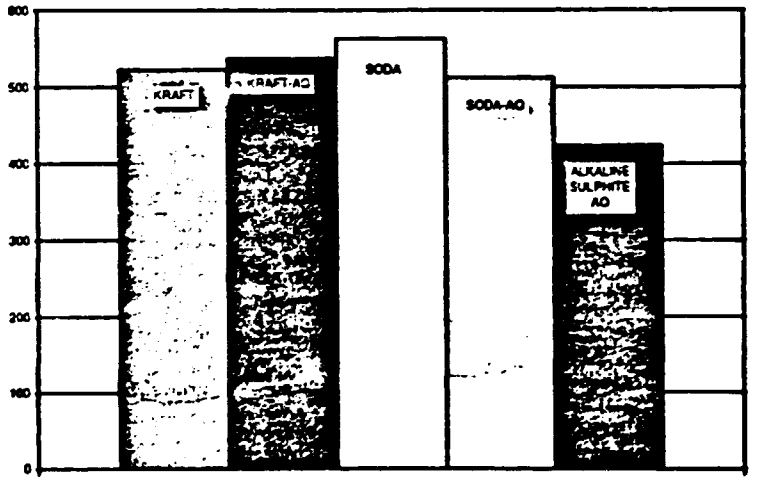
STRETCH [%] OF UNBLEACHED JUTE PULP AT 30 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 31

JUTE PULPING

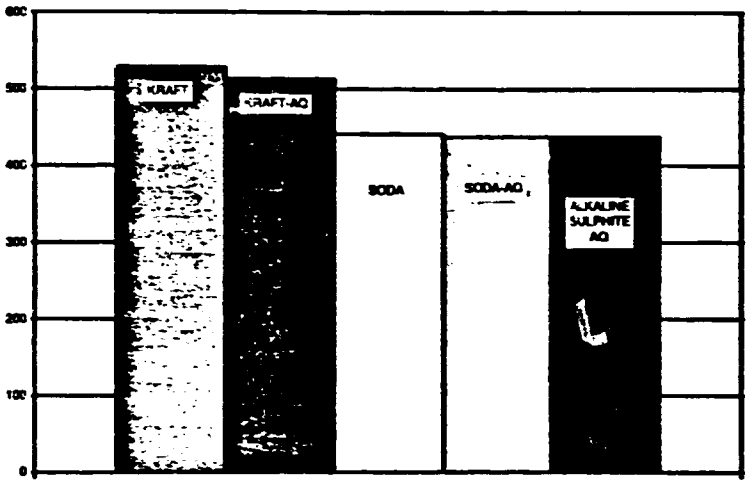
BENDTSEN SMOOTHNESS A-SIDE[ml/min] OF UNBLEACHED JUTE PULP AT 30 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 32

JUTE PULPING

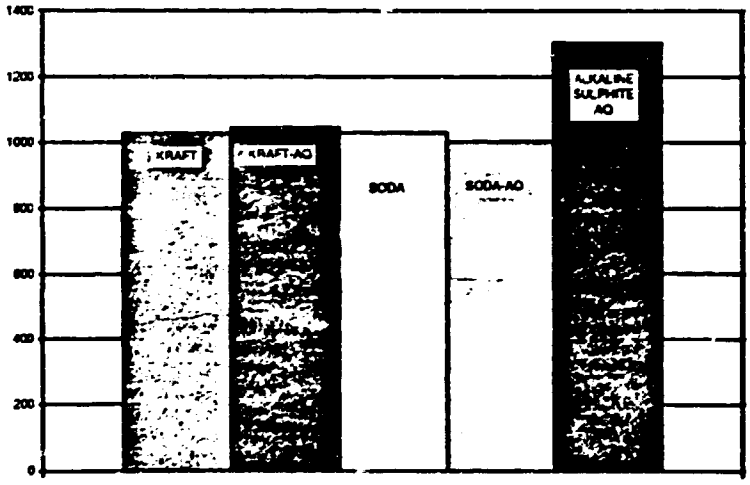
BENDTSEN SMOOTHNESS B-SIDE[ml/min] OF UNBLEACHED JUTE PULP AT 30 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 33

JUTE PULPING

VISCOSITY [ml/g] OF UNBLEACHED JUTE PULP



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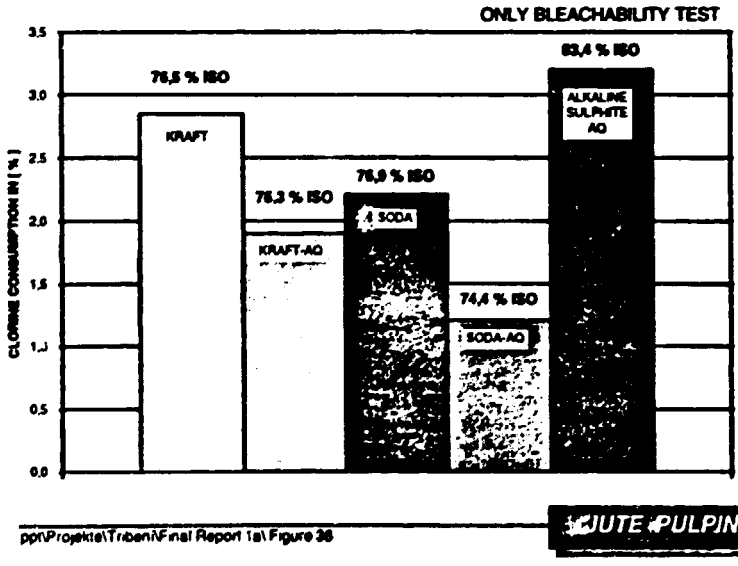
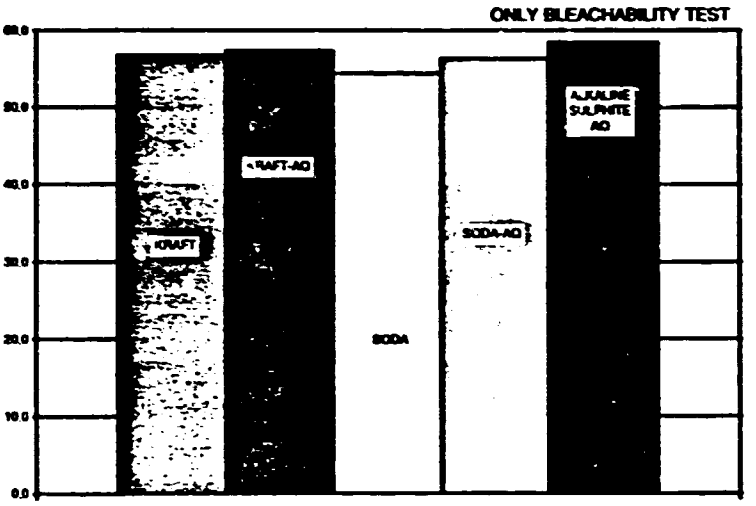
JUTE PULPING

11.2 Bleachability tests

TOTAL ACTIVE CHLORINE CONSUMPTION



BLEACHED PULP TOTAL YIELD [%]



ppt\Projekte\Triben\Final Report 1a\ Figure 37

JUTE PULPING

PHYSICAL PROPERTIES OF BLEACHED JUTE PULP [KRAFT PULPINING]

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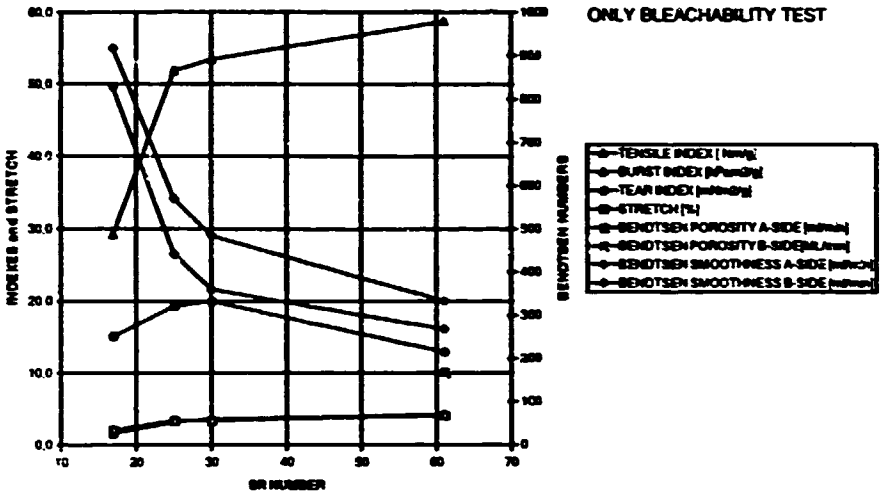
JUTE PULPING

PHYSICAL PROPERTIES OF BLEACHED JUTE PULP [KRAFT-AQ PULPINING]



ppr:Projekte\Tribeni\Final Report 1a\ Figure 39

JUTE PULPING

PHYSICAL PROPERTIES OF BLEACHED JUTE PULP [SODA PULPINING]

ppr:Projekte\Tribeni\Final Report 1a\ Figure 40

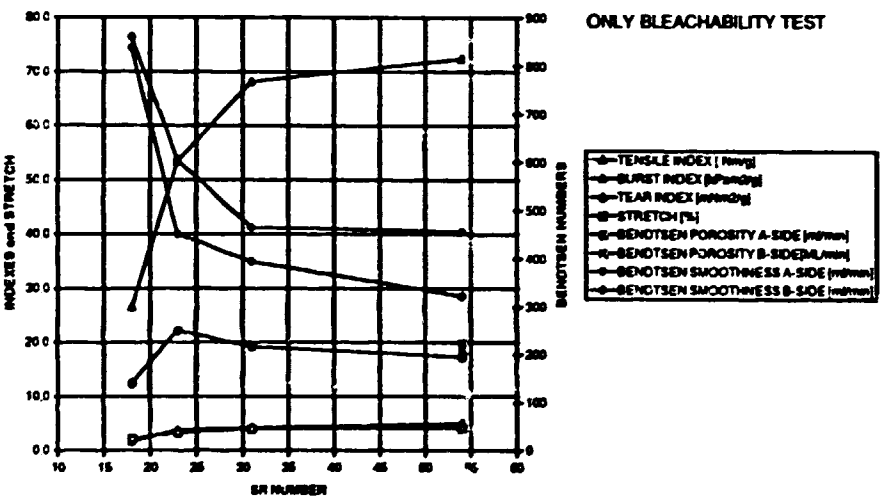
JUTE PULPING

PHYSICAL PROPERTIES OF BLEACHED JUTE PULP [SODA-AQ PULPINING]

ppr:Projekte:Tribeni:Final Report 1a:Figure 41

JUTE PULPING

PHYSICAL PROPERTIES OF BLEACHED JUTE PULP [ALKALINE SULPHATE-AQ PULPINING]



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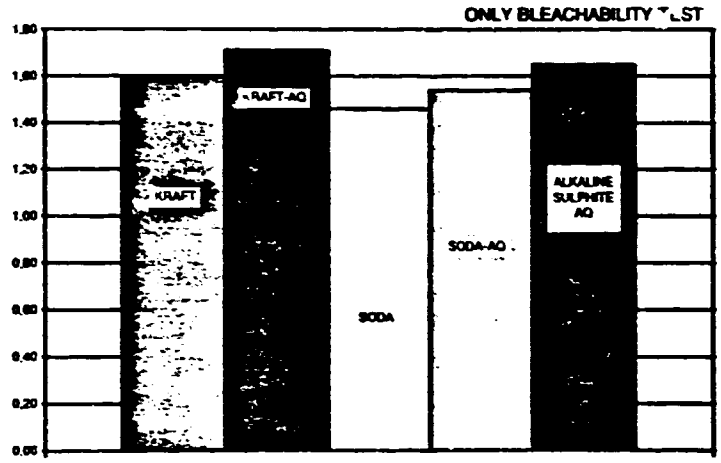
JUTE PULPING

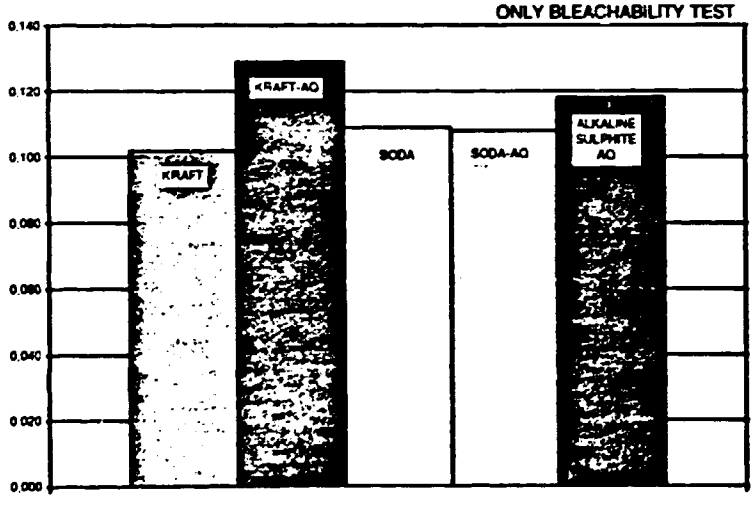
FIBER LENGTH [mm] weigthed average OF BLEACHED JUTE PULP



ppr\Projekte\Tribeni\Final Report 1a\ Figure 43

JUTE PULPING

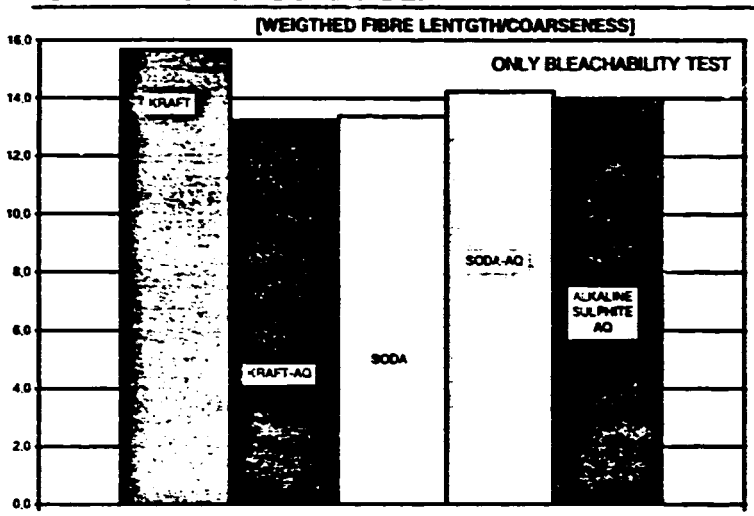
COARSENESS Img/m] OF BLEACHED JUTE PULP



ppr\Projekte\Tribeni\Final Report 1a\ Figure 44

JUTE PULPING

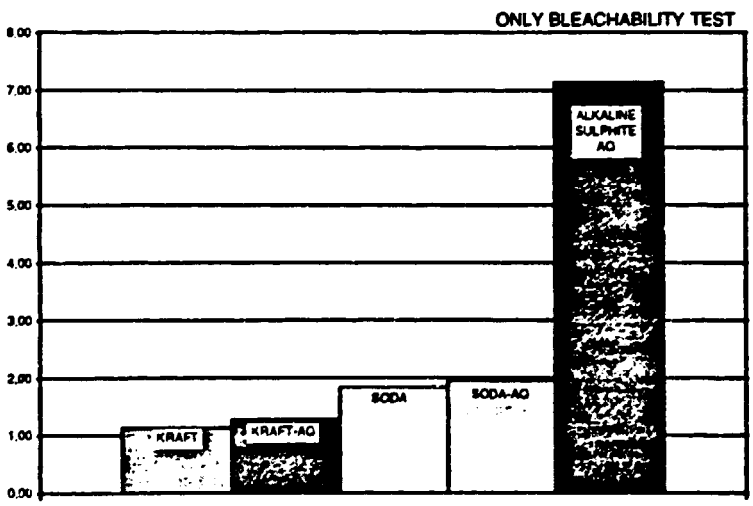
SLENDERNESS FACTOR OF BLEACHED JUTE PULP



ppt\Projekte\Tribeni\Final Report 1a\ Figure 45

JUTE PULPING

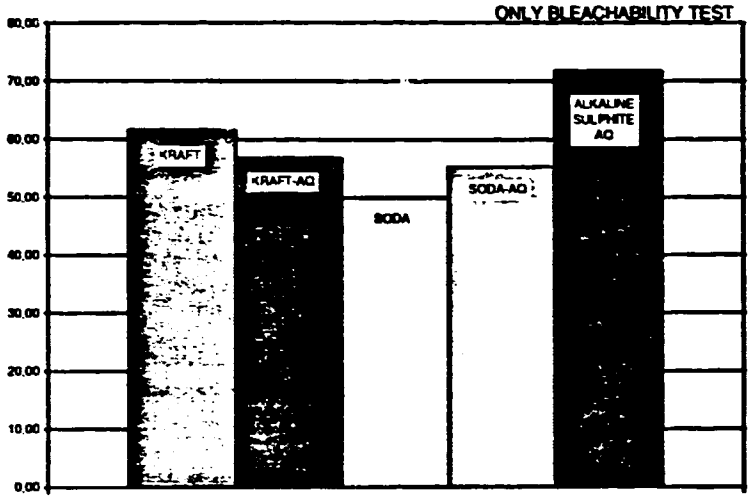
ZERO SPAN TENSILE [km] OF BLEACHED JUTE PULP



ppt\Projekte\Tribeni\Final Report 1a\ Figure 46

JUTE PULPING

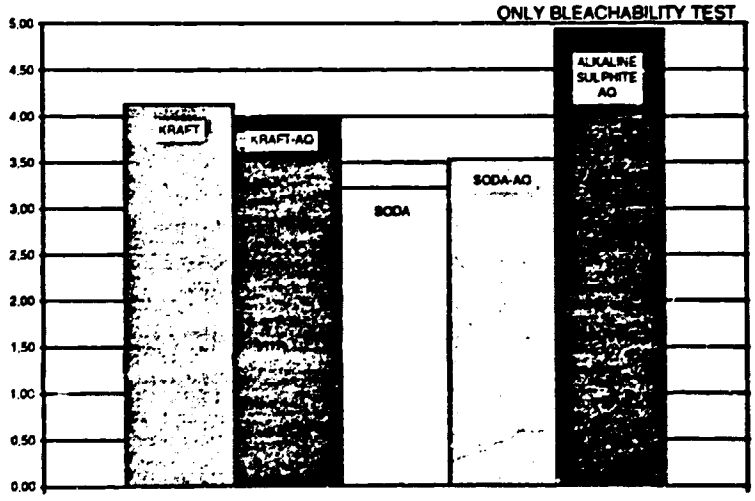
TENSILE INDEX [Nm/g] OF BLEACHED JUTE PULP AT 50 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 47

JUTE PULPING

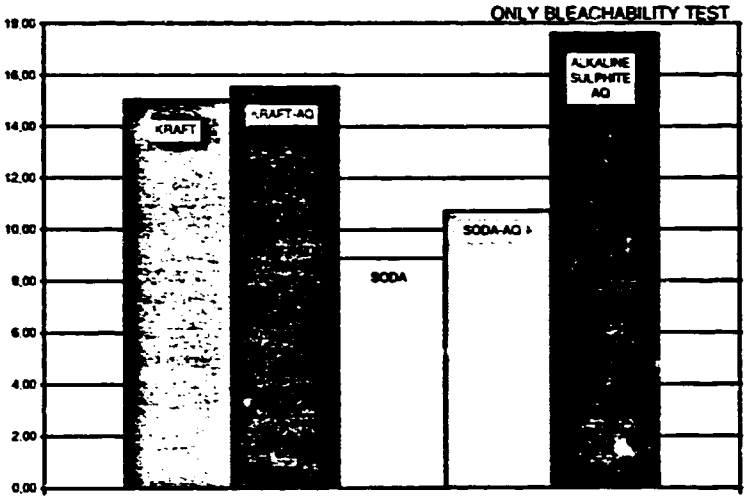
BURST INDEX [kPam2/g] OF BLEACHED JUTE PULP AT 50 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 48

JUTE PULPING

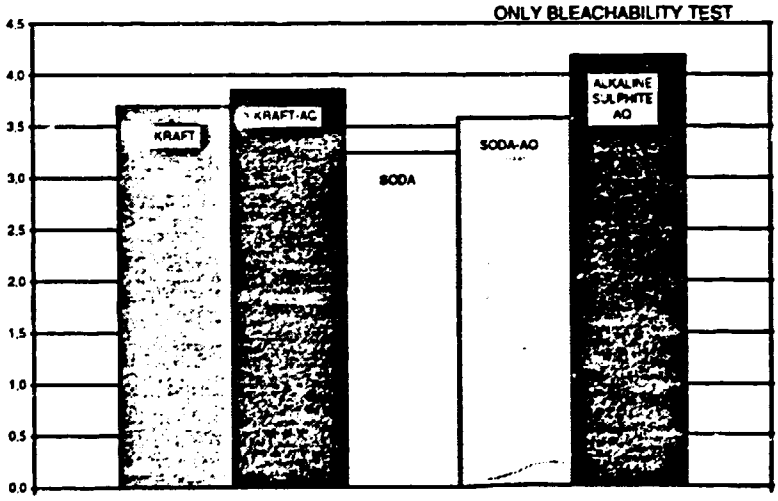
TEAR INDEX [mNm2/g]
OF BLEACHED JUTE PULP AT 50 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 49

JUTE PULPING

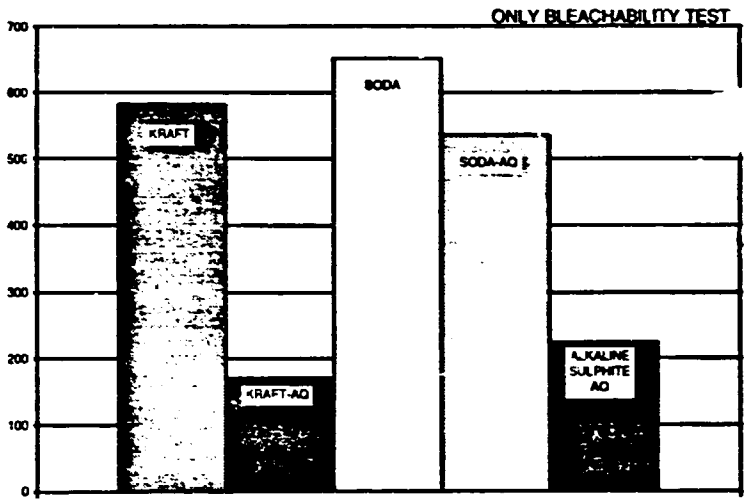
STRETCH [%]
OF BLEACHED JUTE PULP AT 50 SR



ppr\Projekte\Tribeni\Final Report 1a\ Figure 50

JUTE PULPING

BENDTSEN POROSITY A-SIDE [ml/min] OF BLEACHED JUTE PULP AT 50 SR



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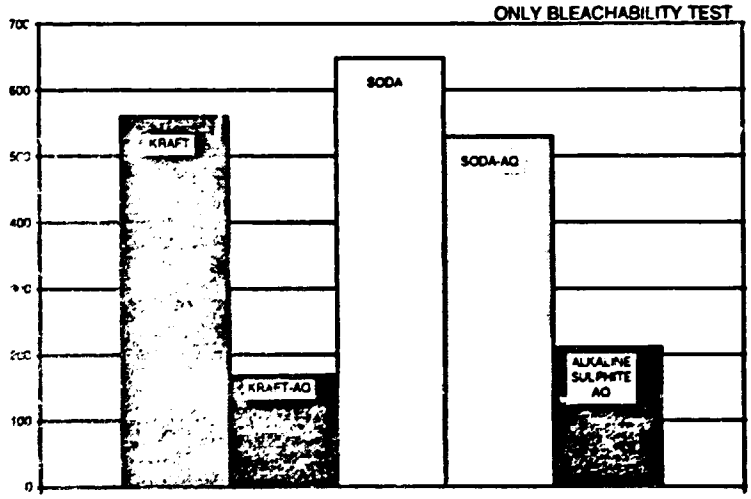
JUTE PULPING

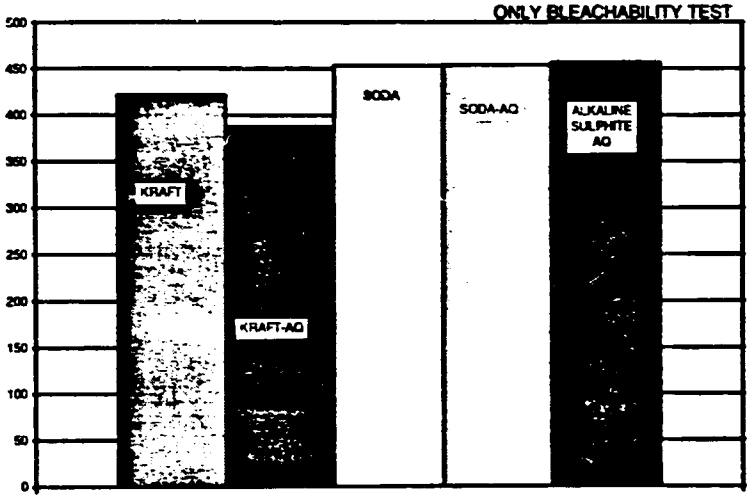
BENDTSEN POROSITY B-SIDE [ml/min] OF BLEACHED JUTE PULP AT 50 SR



ppt Jekte\Tribeni\Final Report 1a\ Figure 52

JUTE PULPING

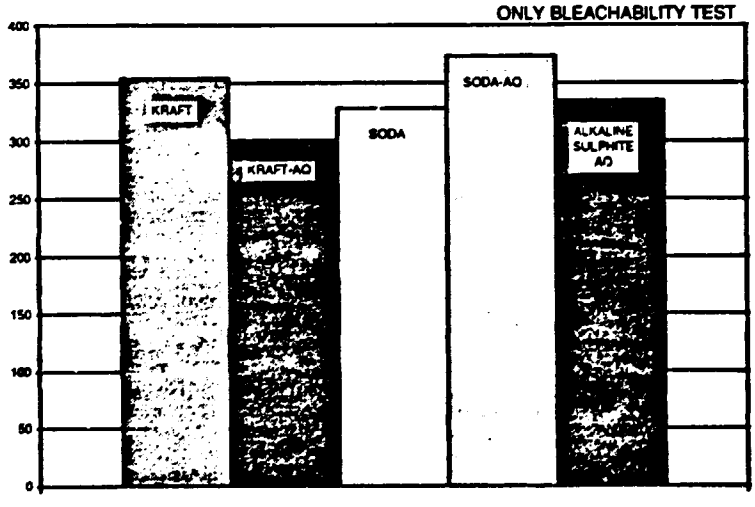
BENDTSEN SMOOTHNESS A-SIDE [ml/min] OF BLEACHED JUTE PULP AT 50 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 53

JUTE PULPING

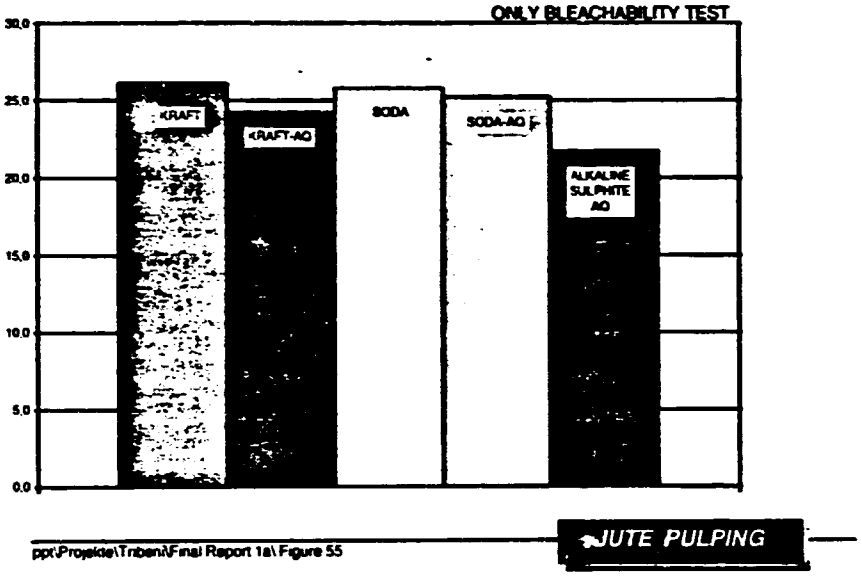
BENDTSEN SMOOTHNESS B-SIDE [ml/min] OF BLEACHED JUTE PULP AT 50 SR



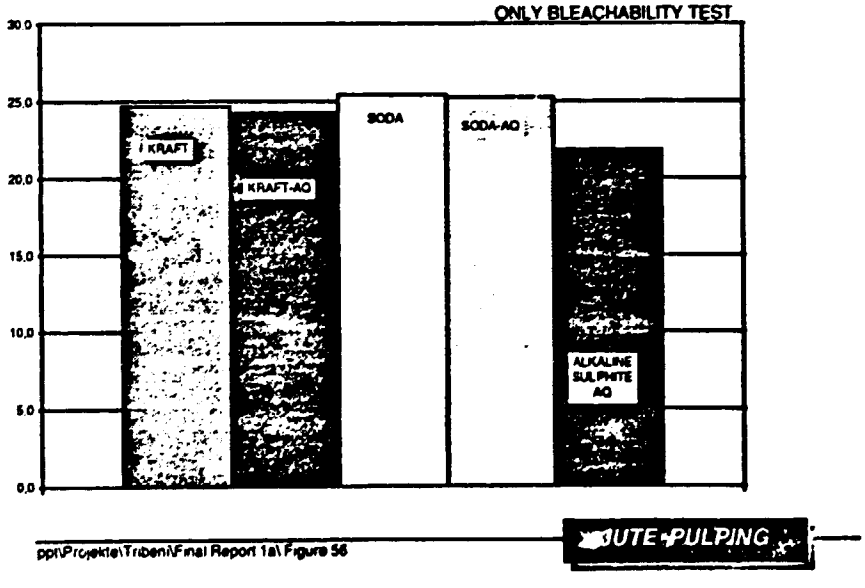
ppt\Projekte\Tribeni\Final Report 1a\ Figure 54

JUTE PULPING

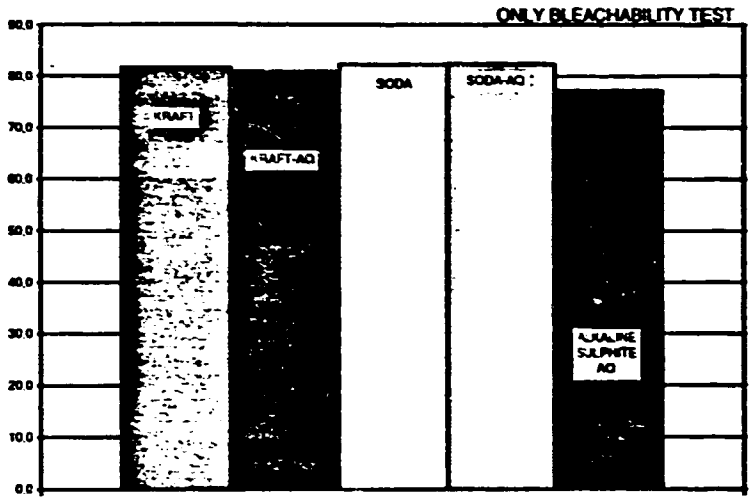
SCATTERING COEFFICIENT A-SIDE [m²/kg] OF BLEACHED JUTE PULP AT 50 SR



SCATTERING COEFFICIENT B-SIDE [m²/kg] OF BLEACHED JUTE PULP AT 50 SR



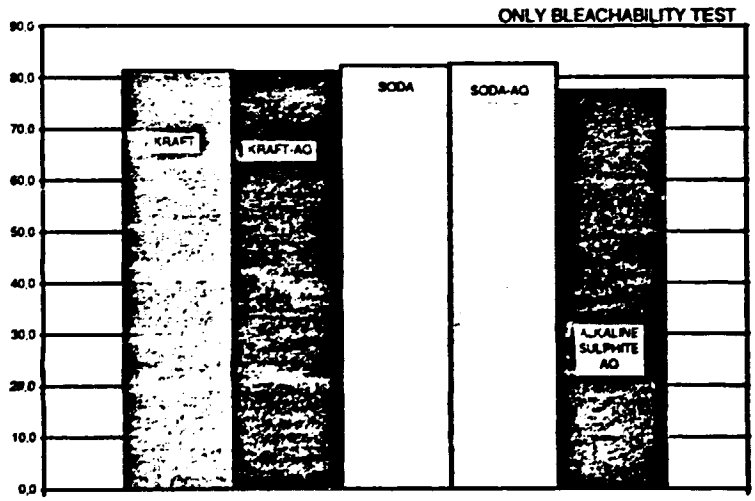
OPACITY A-SIDE [%]
OF BLEACHED JUTE PULP AT 50 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 57

JUTE PULPING

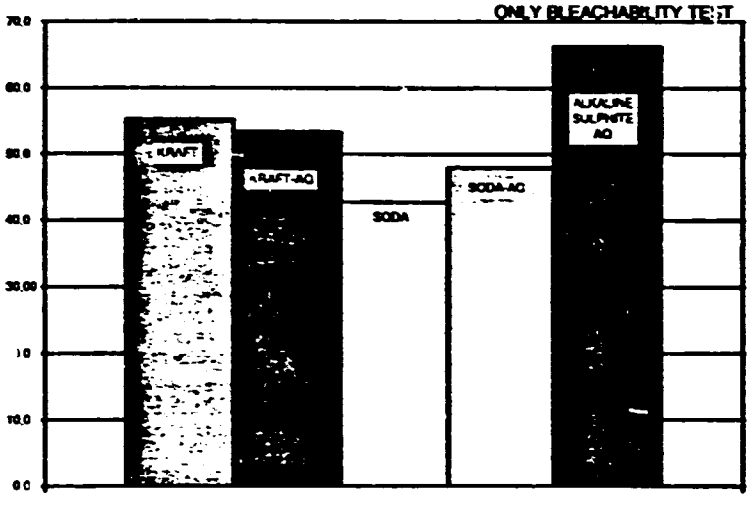
OPACITY B-SIDE [%]
OF BLEACHED JUTE PULP AT 50 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 58

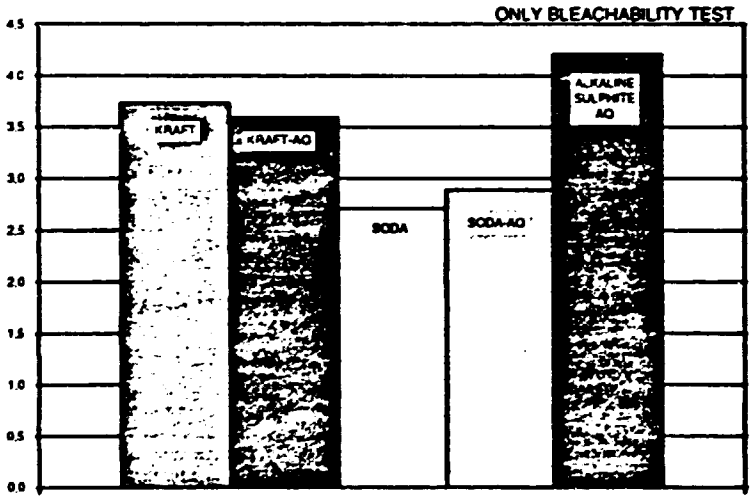
JUTE PULPING

TENSILE INDEX [Nm/g] OF BLEACHED JUTE PULP AT 30 SR



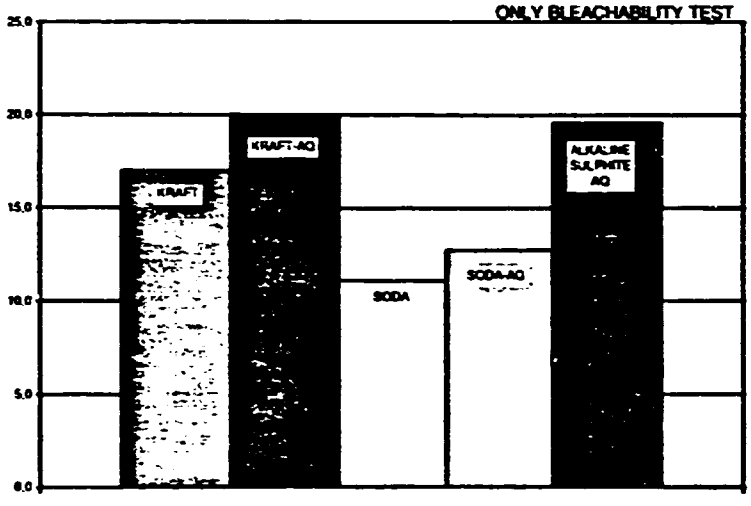
ppt\Projekte\Tribeni\Final Report 1a\ Figure 59

BURST INDEX [kPam2/g] OF BLEACHED JUTE PULP AT 30 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 60

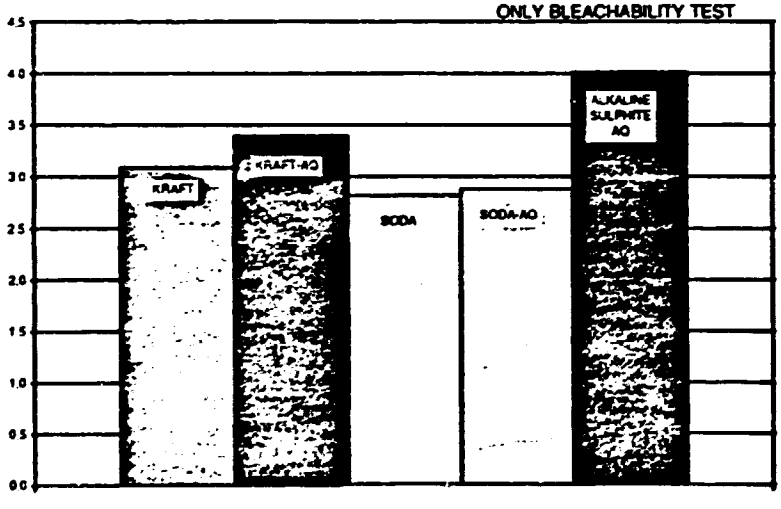
TEAR INDEX [mNm2/g] OF BLEACHED JUTE PULP AT 30 SR



ppr:Projekte:Triben\Final Report 1a\ Figure 61

JUTE PULPING

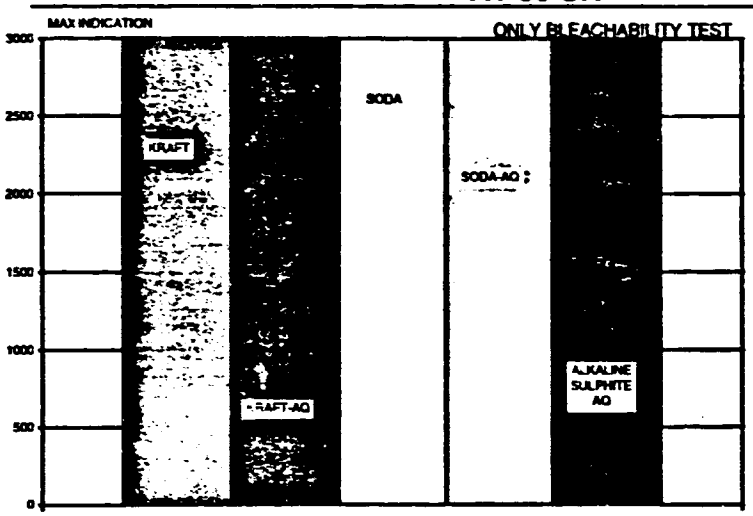
STRETCH [%] OF BLEACHED JUTE PULP AT 30 SR



ppr:Projekte:Triben\Final Report 1a\ Figure 62

JUTE PULPING

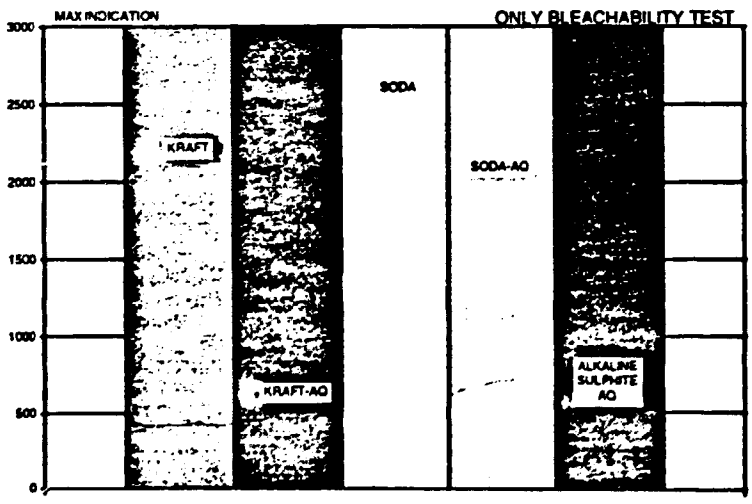
BENDTSEN POROSITY A-SIDE [ml/min] OF BLEACHED JUTE PULP AT 30 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 63

JUTE PULPING

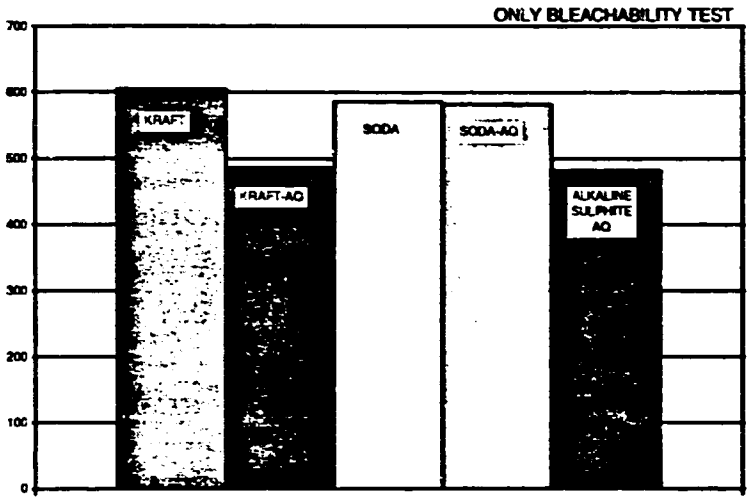
BENDTSEN POROSITY B-SIDE [ml/min] OF BLEACHED JUTE PULP AT 30 SR



ppt\Projekte\Tribeni\Final Report 1a\ Figure 64

JUTE PULPING

BENDTSEN SMOOTHNESS A-SIDE [ml/min] OF BLEACHED JUTE PULP AT 30 SR



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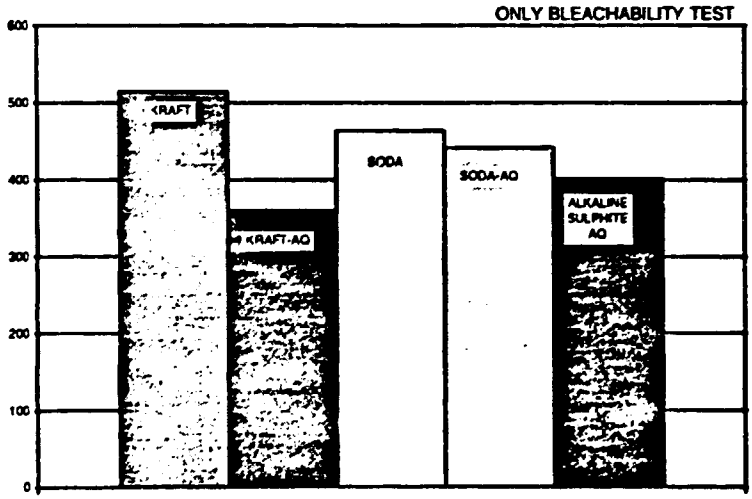
JUTE PULPING

BENDTSEN SMOOTHNESS B-SIDE [ml/min] OF BLEACHED JUTE PULP AT 30 SR



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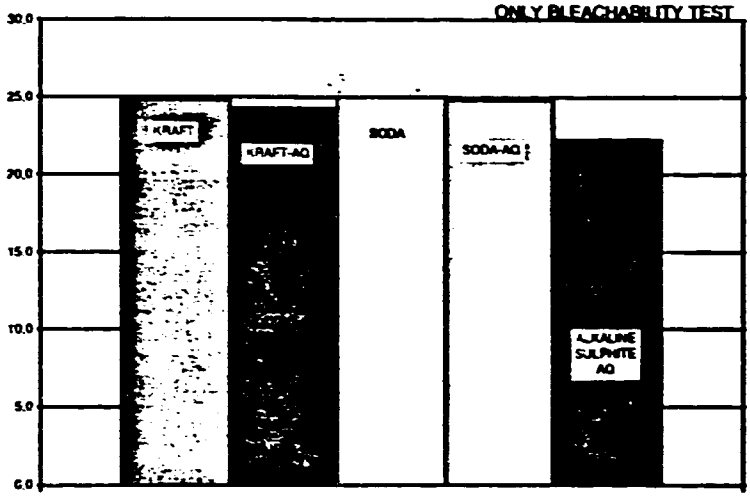
JUTE PULPING

SCATTERING COEFFICIENT A-SIDE [m²/kg] OF BLEACHED PULP AT 30 SR



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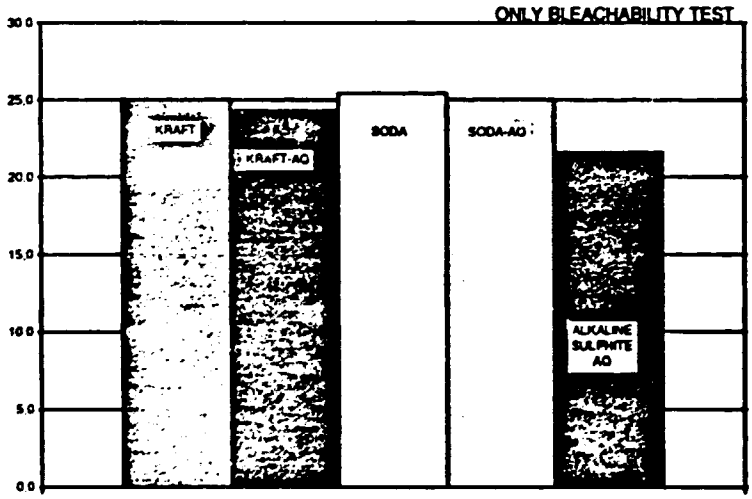
JUTE PULPING

SCATTERING COEFFICIENT B-SIDE [m²/kg] OF BLEACHED PULP AT 30 SR



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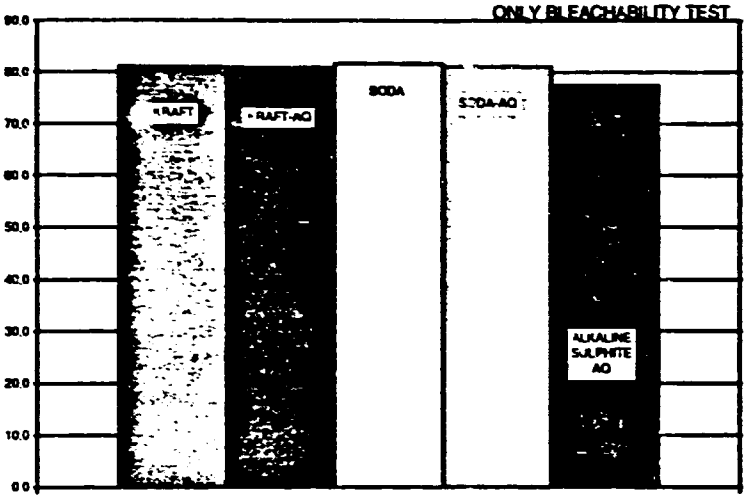
JUTE PULPING

OPACITY A-SIDE [%] OF BLEACHED PULP AT 30 SR



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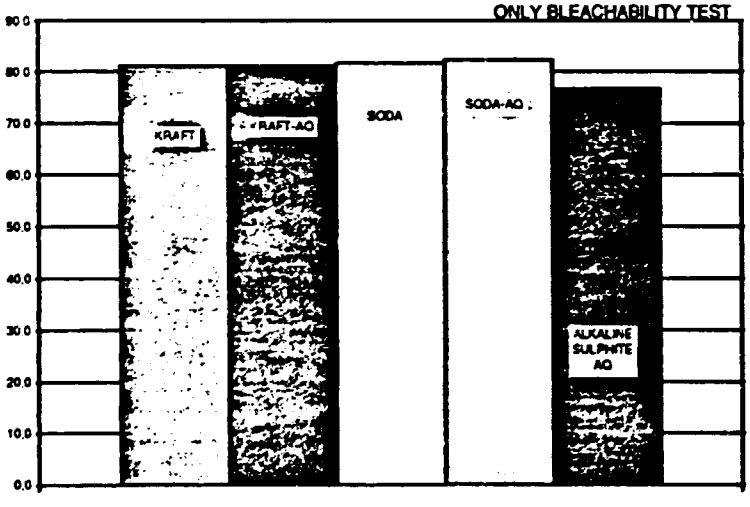
JUTE PULPING

OPACITY B-SIDE [%] OF BLEACHED PULP AT 30 SR



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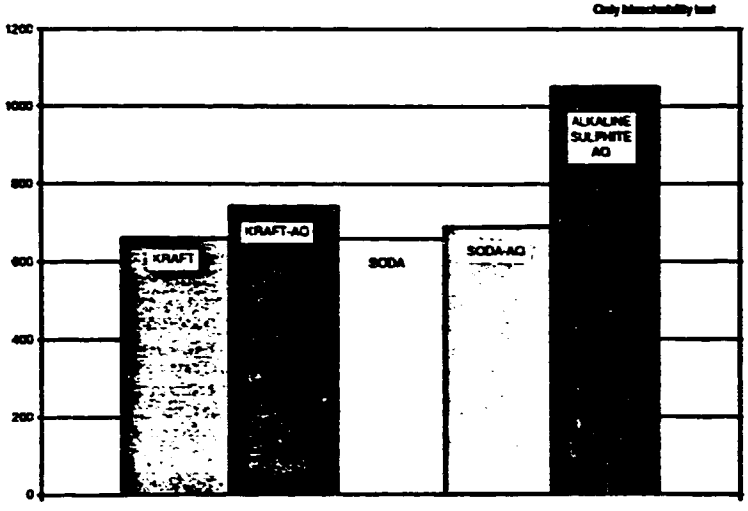
JUTE PULPING

VISCOSITY [ml/g] OF BLEACHED PULP



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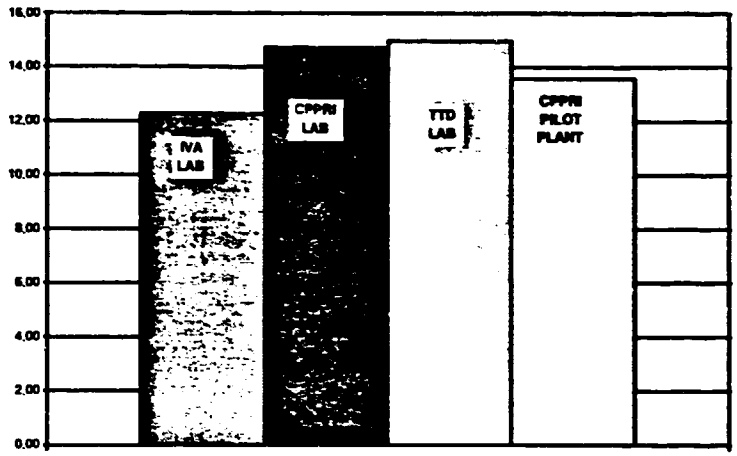
JUTE PULPING

11.3 Bench scale and pilot plant pulping tests at CPPRI

KAPPA NR. OF UNBLEACHED KRAFT JUTE PULP



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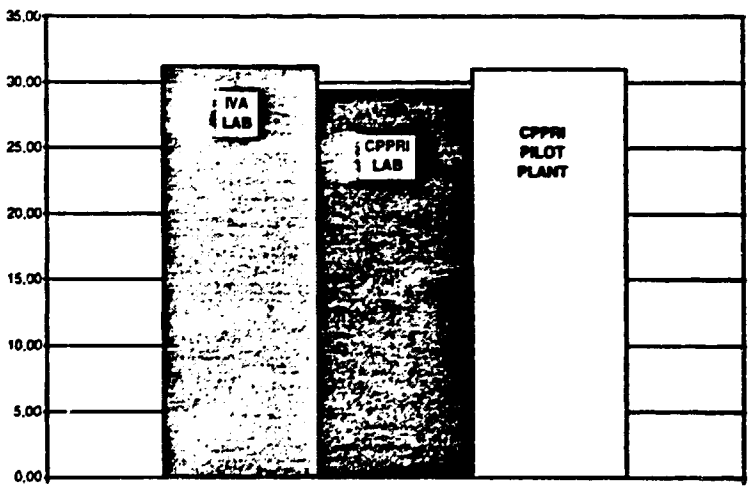
JUTE PULPING

BRIGHTNESS [%]OF UNBLEACHED KRAFT JUTE PULP



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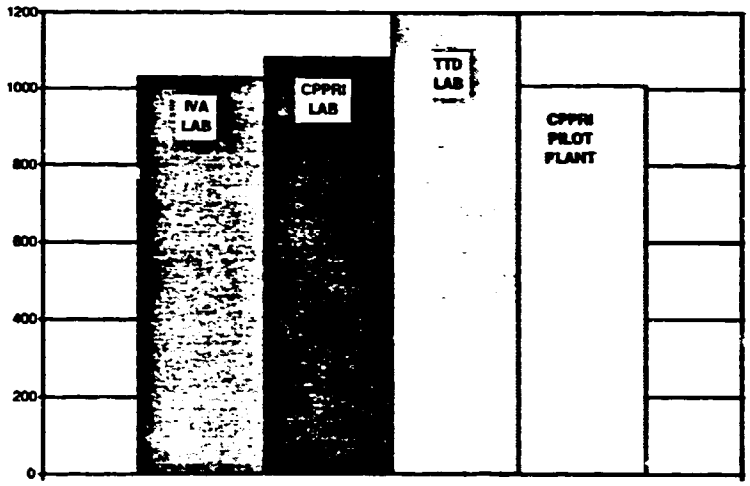
JUTE PULPING

VISCOSITY[ml/g]OF UNBLEACHED KRAFT JUTE PULP



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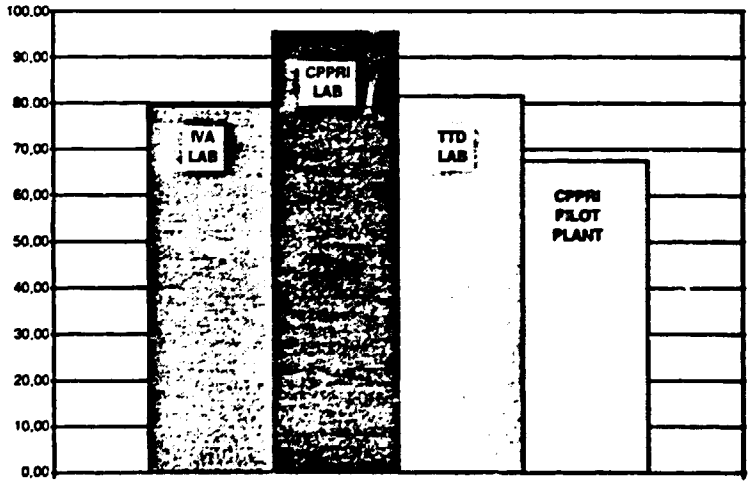
JUTE PULPING

TENSILE INDEX [Nm/g] OF UNBLEACHED KRAFT JUTE PULP AT 50 SR



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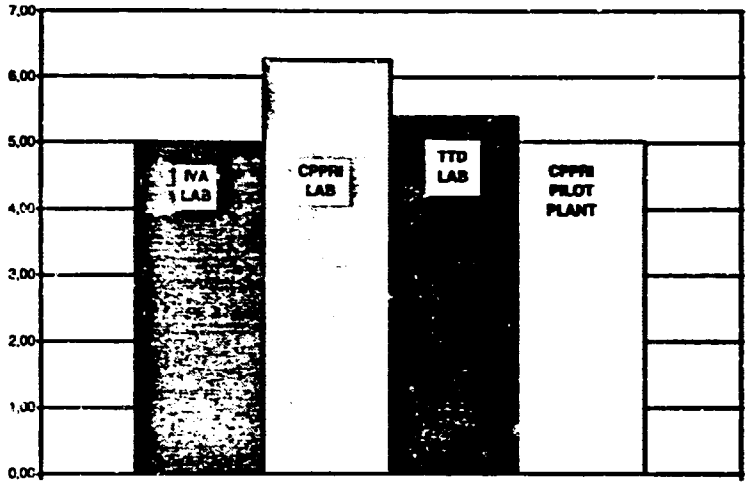
JUTE PULPING

BURST INDEX [kPam2/g]OF UNBLEACHED KRAFT JUTE PULP AT 50 SR



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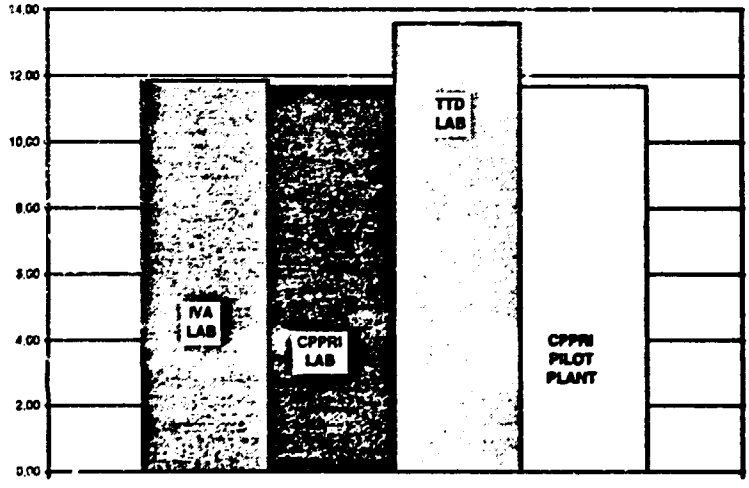
JUTE PULPING

TEAR INDEX [mNm2/g]OF UNBLEACHED KRAFT JUTE PULP AT 50 SR



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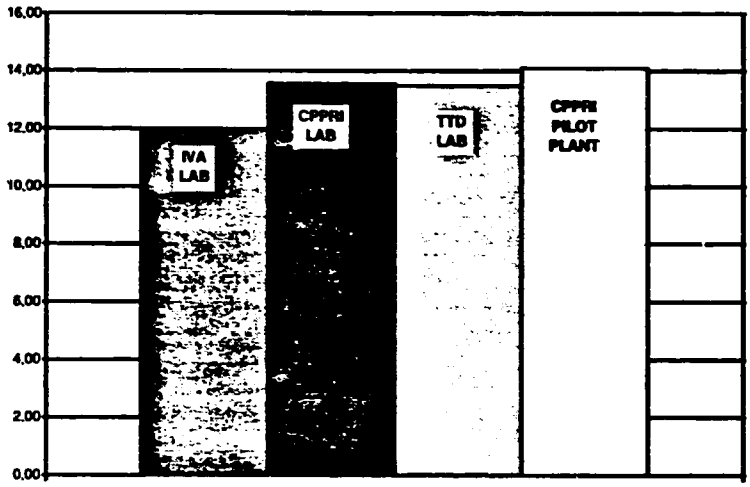
JUTE PULPING

KAPPA NR. OF UNBLEACHED KRAFT-AQ JUTE PULP



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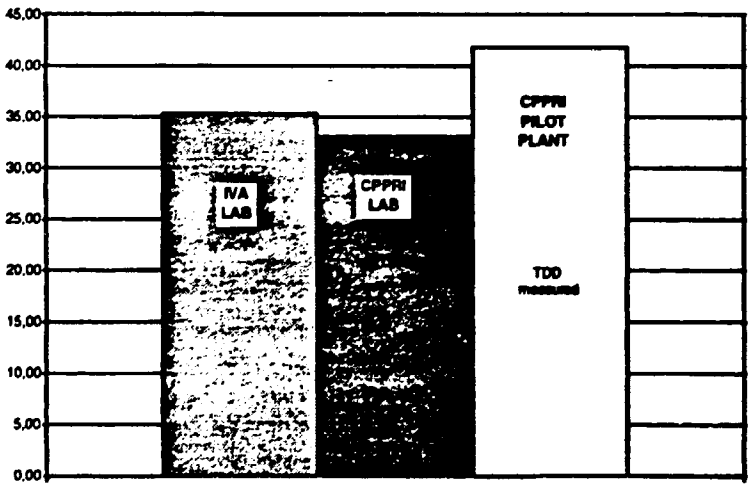
JUTE PULPING

BRIGHTNESS [%]OF UNBLEACHED KRAFT-AQ JUTE PULP



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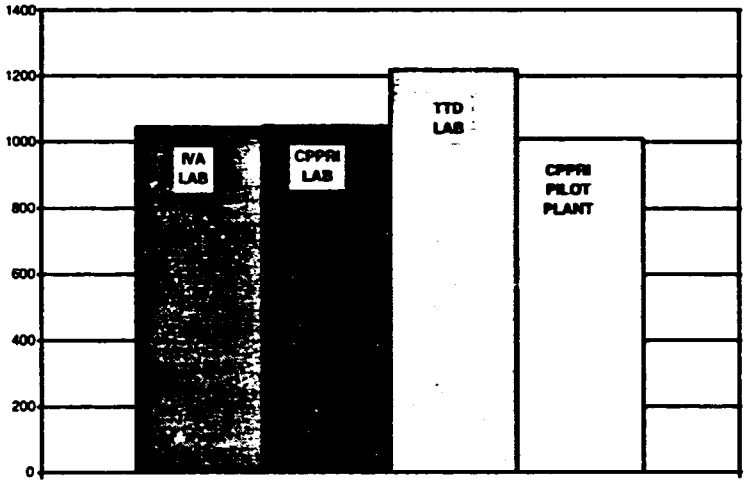
JUTE PULPING

VISCOSITY[ml/g]OF UNBLEACHED KRAFT-AQ JUTE PULP



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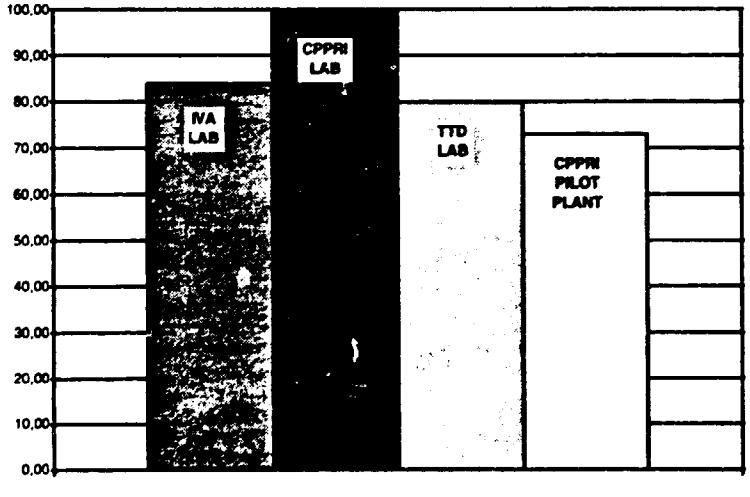
JUTE PULPING

TENSILE INDEX [Nm/g] OF UNBLEACHED KRAFT-AQ JUTE PULP AT 50 SR



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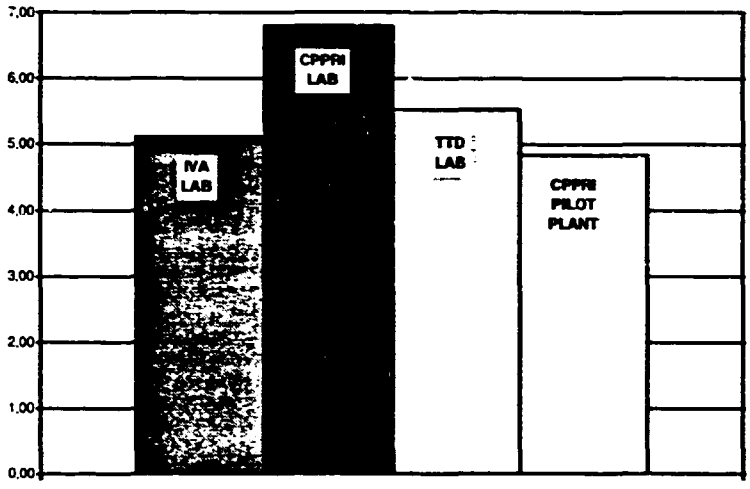
JUTE PULPING

BURST INDEX [kPam2/g]OF UNBLEACHED KRAFT-AQ JUTE PULP AT 50 SR



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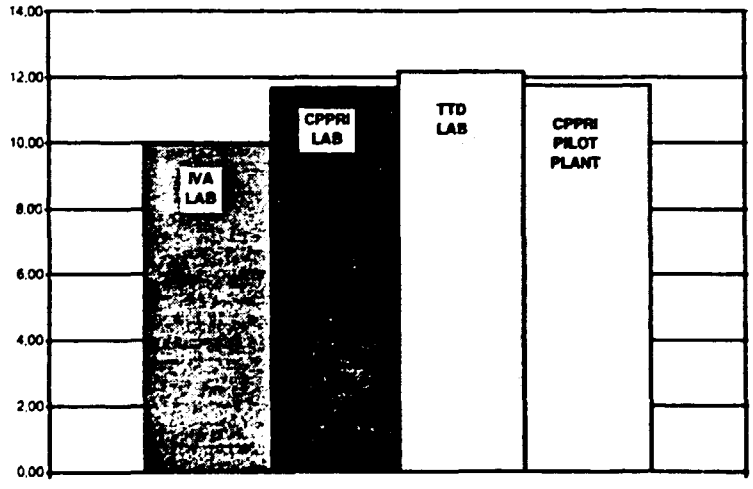
JUTE PULPING

TEAR INDEX [mNm2/g]OF UNBLEACHED KRAFT-AQ JUTE PULP AT 50 SR



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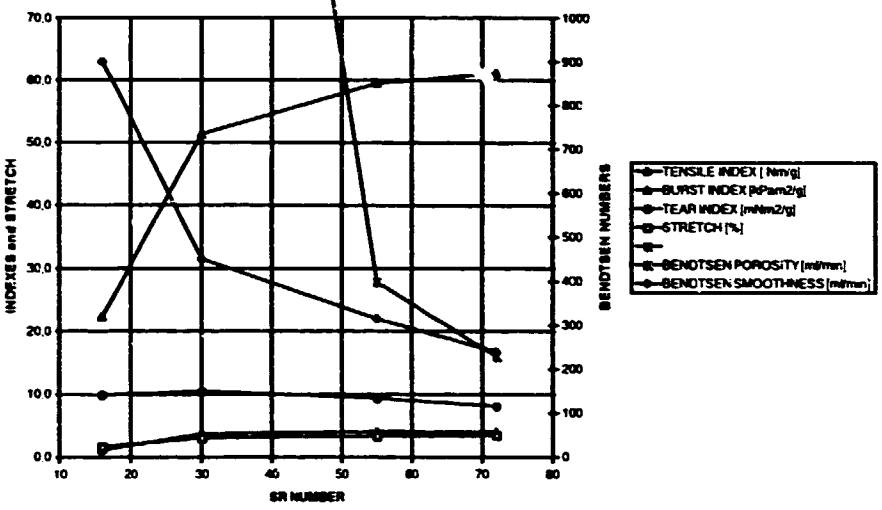
JUTE PULPING

11.4 Bench scale bleaching tests

PHYSICAL PROPERTIES OF C-E-H BLEACHED JUTE PULP



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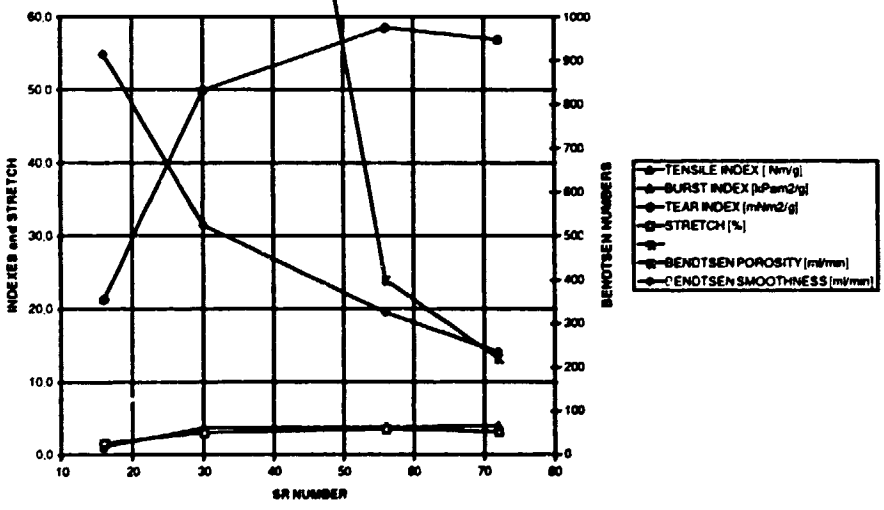
JUTE PULPING

PHYSICAL PROPERTIES OF C-EP-H BLEACHED JUTE PULP



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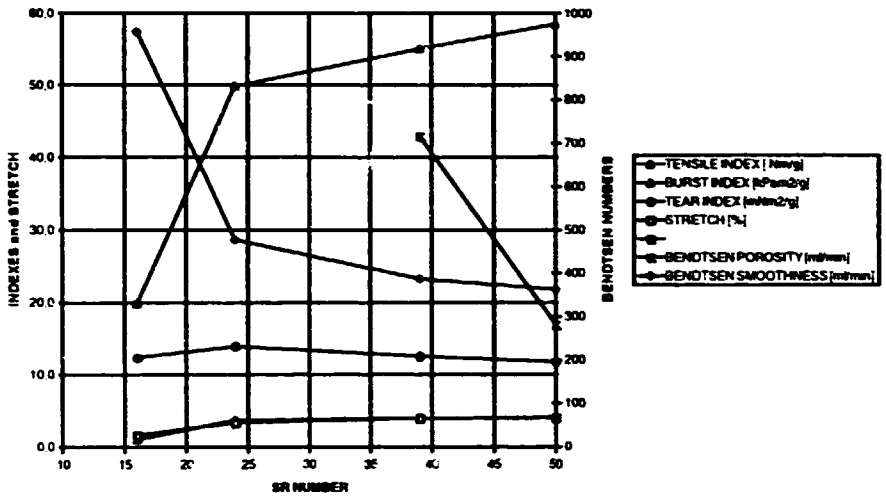
JUTE PULPING

PHYSICAL PROPERTIES OF O-C-EO-H BLEACHED JUTE PULP



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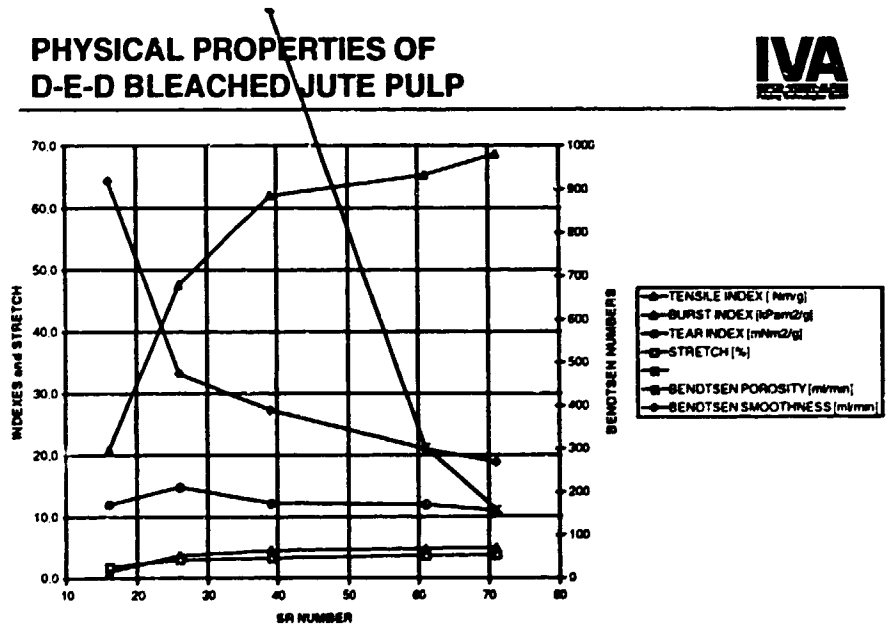
JUTE PULPING

PHYSICAL PROPERTIES OF D-E-D BLEACHED JUTE PULP



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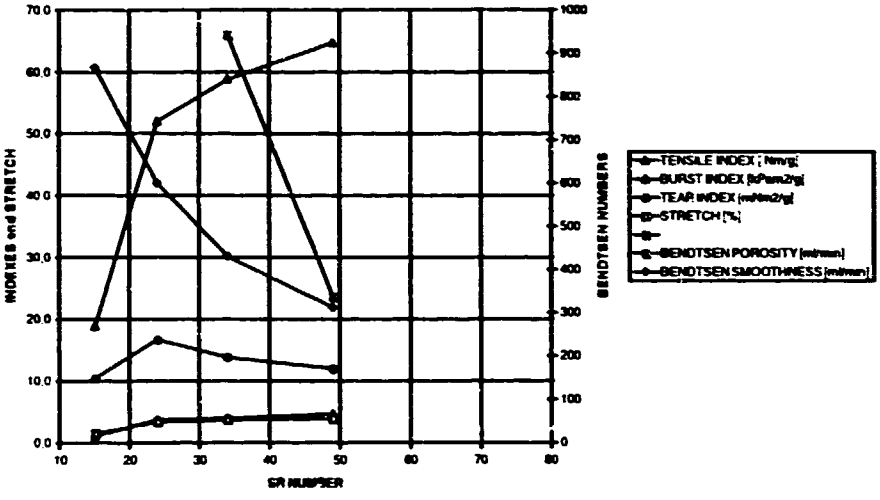
JUTE PULPING

PHYSICAL PROPERTIES OF O-D-EO-D BLEACHED JUTE PULP



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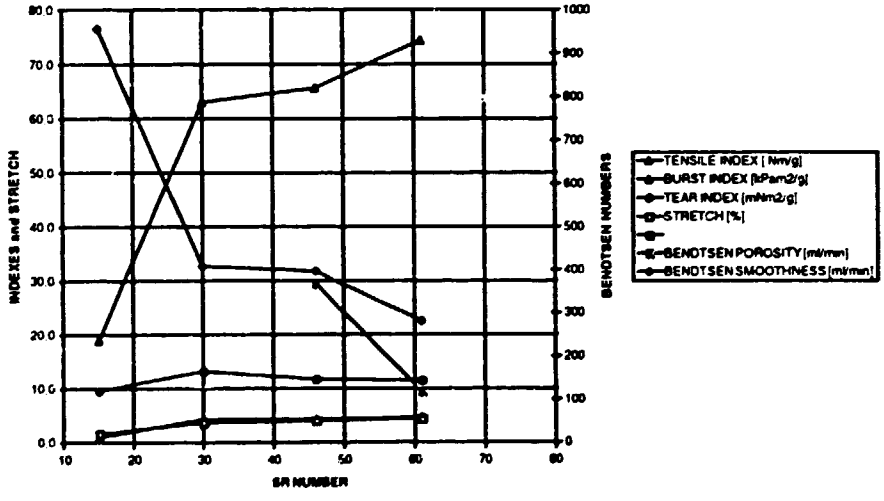
JUTE PULPING

PHYSICAL PROPERTIES OF O-Q-EOP-P BLEACHED JUTE PULP



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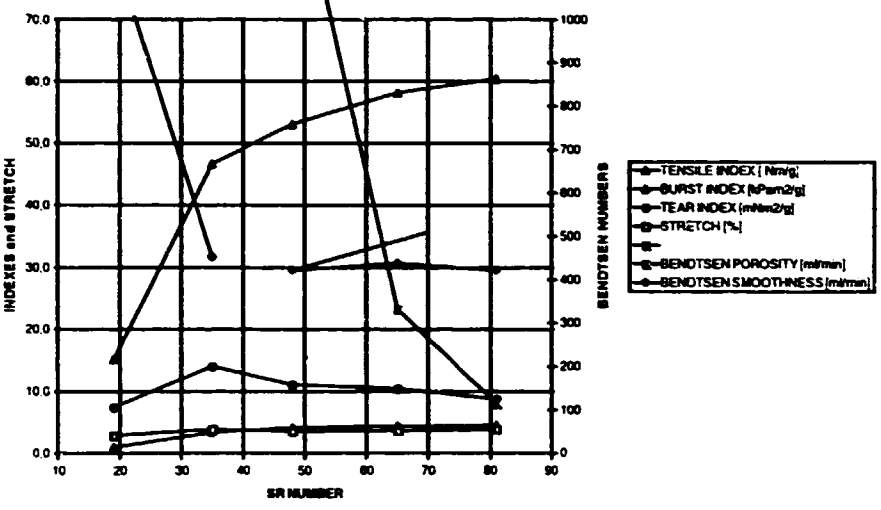
JUTE PULPING

PHYSICAL PROPERTIES OF O-Q-Z-P BLEACHED JUTE PULP



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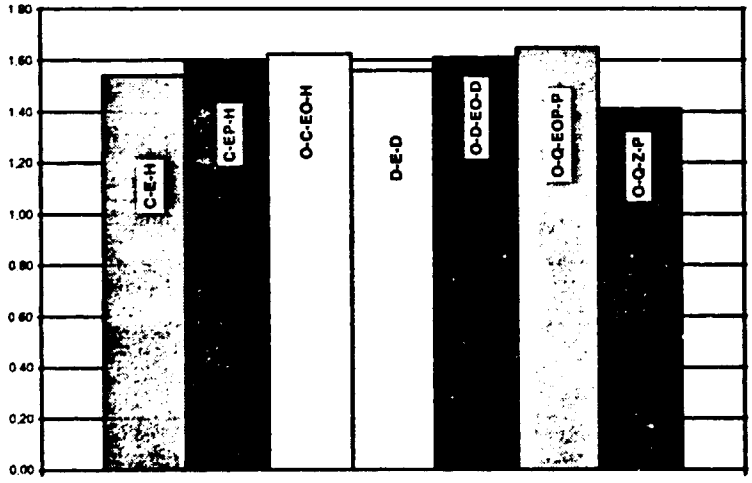
JUTE PULPING

FIBRE LENGTH [MM] weighted average OF BLEACHED JUTE PULP



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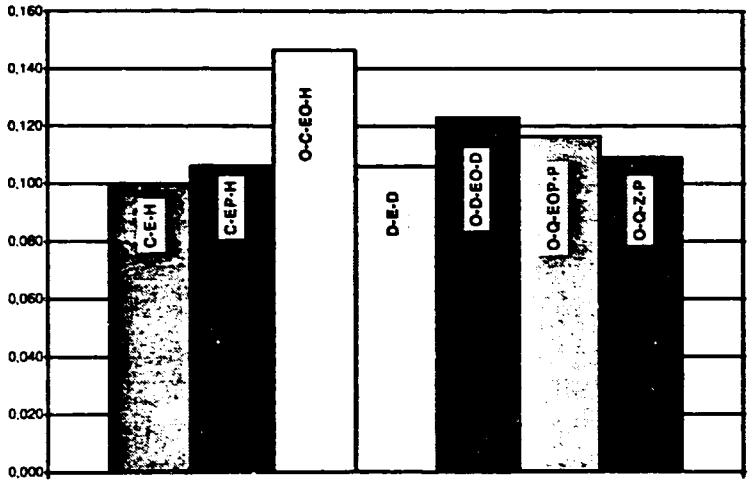
JUTE PULPING

COARSENESS [mg/m] OF BLEACHED JUTE PULP



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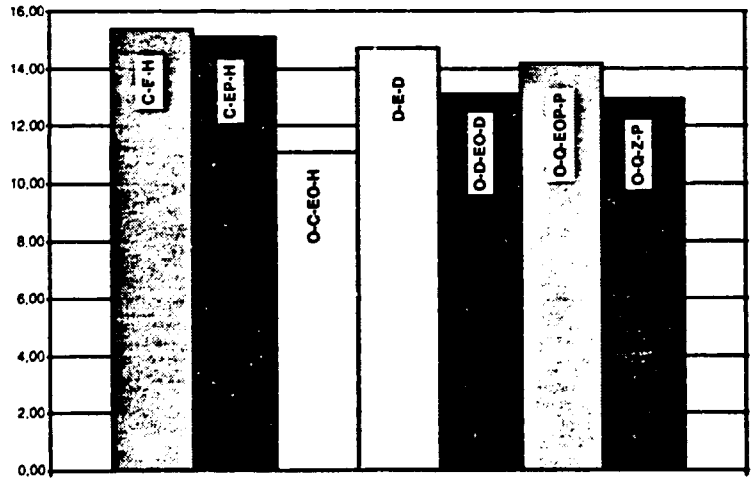
JUTE PULPING

SLENDERNESS FACTOR OF BLEACHED JUTE PULP



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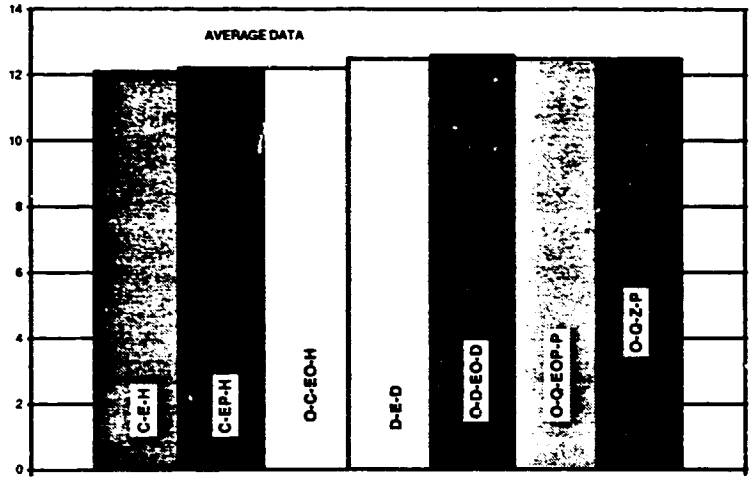
JUTE PULPING

ZERO SPAN TENSILE [km] OF BLEACHED JUTE PULP



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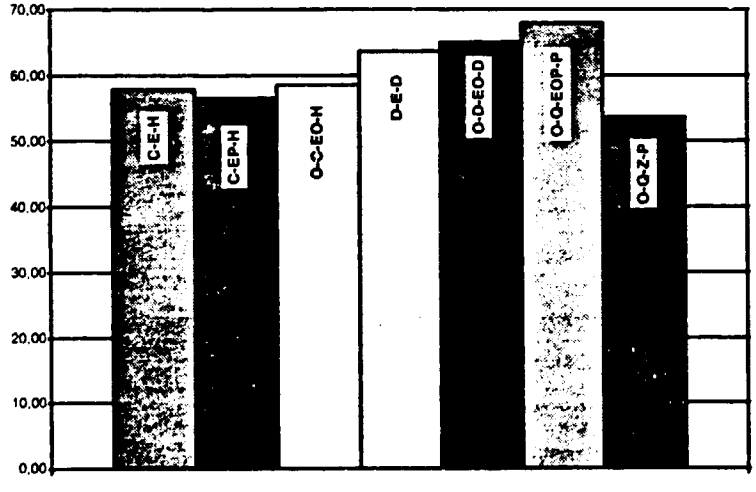
JUTE PULPING

TENSILE INDEX [Nm/g] OF BLEACHED JUTE PULP AT 50 SR



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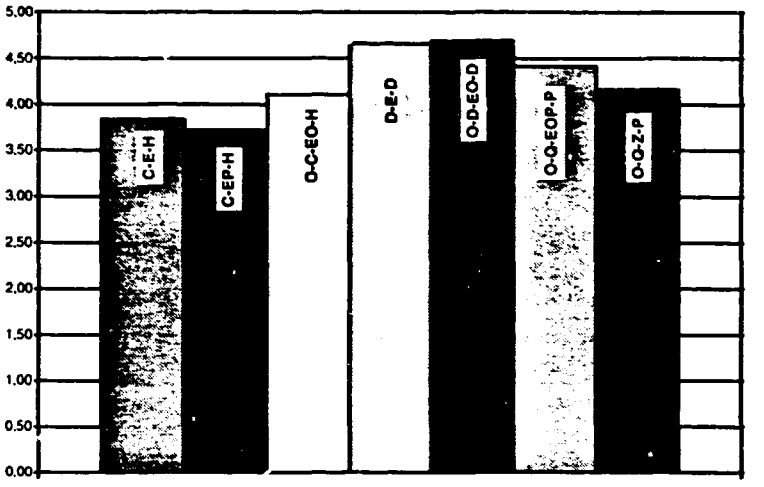
JUTE PULPING

BURST INDEX [kPam2/g] OF BLEACHED JUTE PULP AT 50 SR



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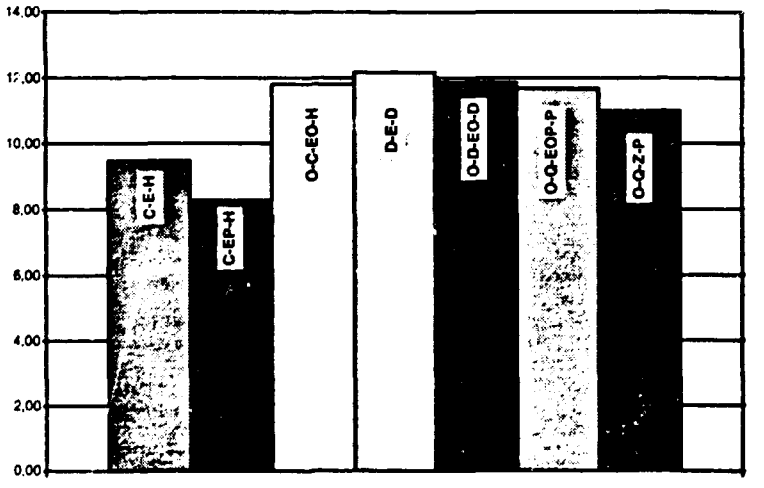
JUTE PULPING

TEAR INDEX [mNm2/g] OF BLEACHED JUTE PULP AT 50 SR



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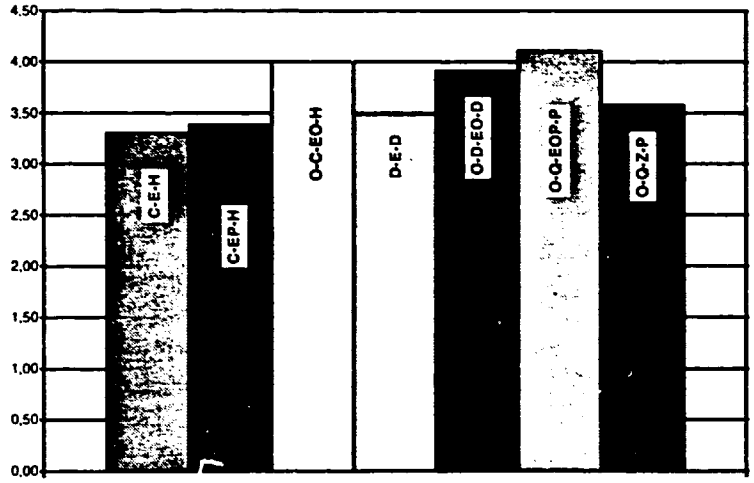
JUTE PULPING

STRETCH [%] OF BLEACHED JUTE PULP AT 50 SR



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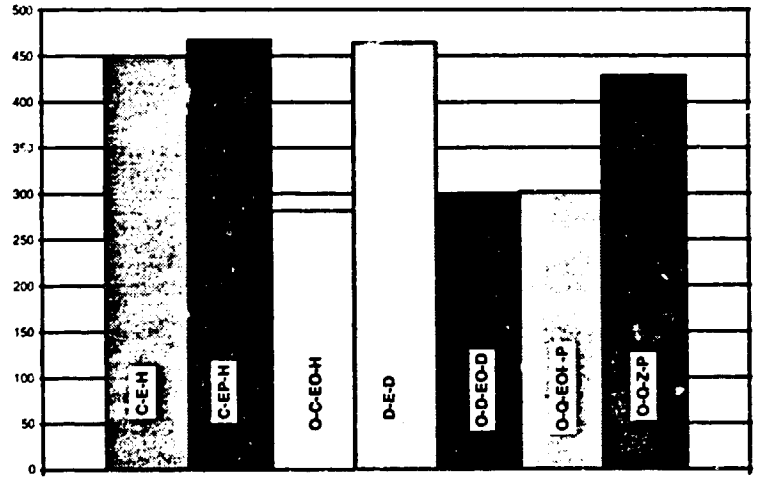
JUTE PULPING

BENDTSEN POROSITY [ml/min] OF BLEACHED JUTE PULP AT 50 SR



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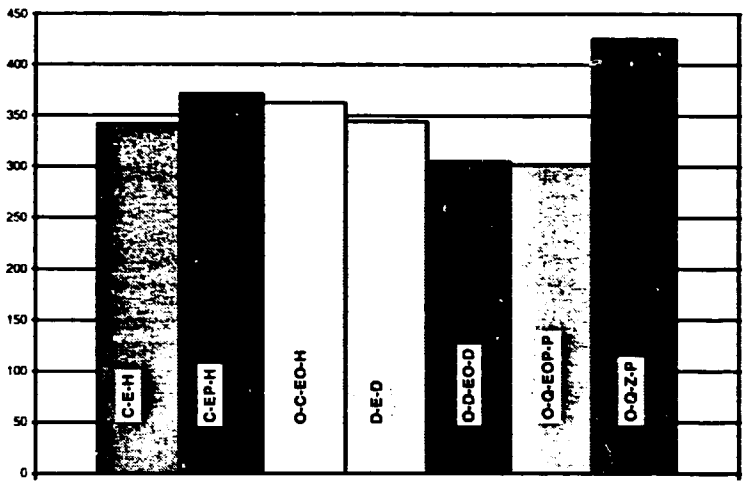
JUTE PULPING

BENDTSEN SMOOTHNESS [ml/min] OF BLEACHED JUTE PULP AT 50 SR



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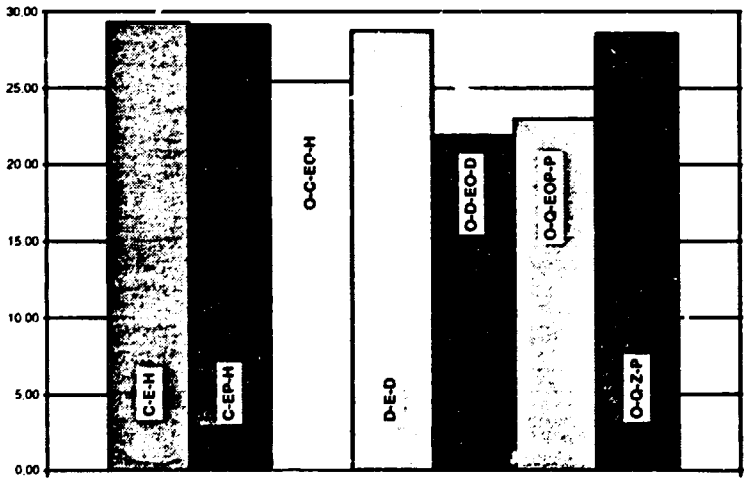
JUTE PULPING

SCATTERING COEFFICIENT [m²/kg] OF BLEACHED JUTE PULP AT 50 SR



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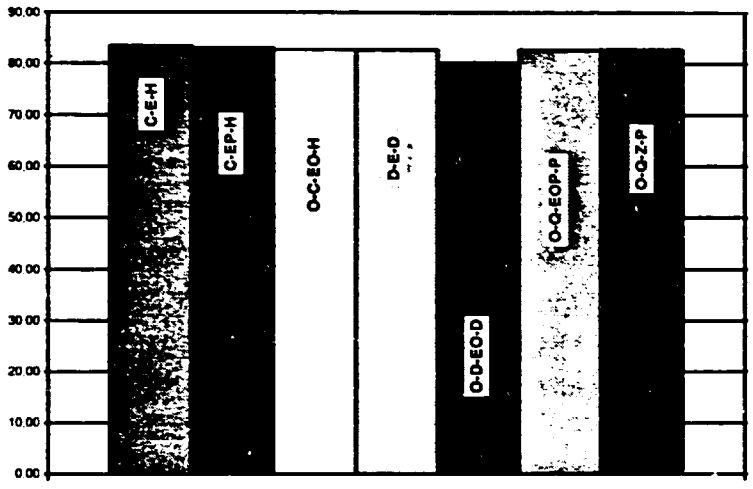
JUTE PULPING

OPACITY [%] OF BLEACHED JUTE PULP AT 50 SR



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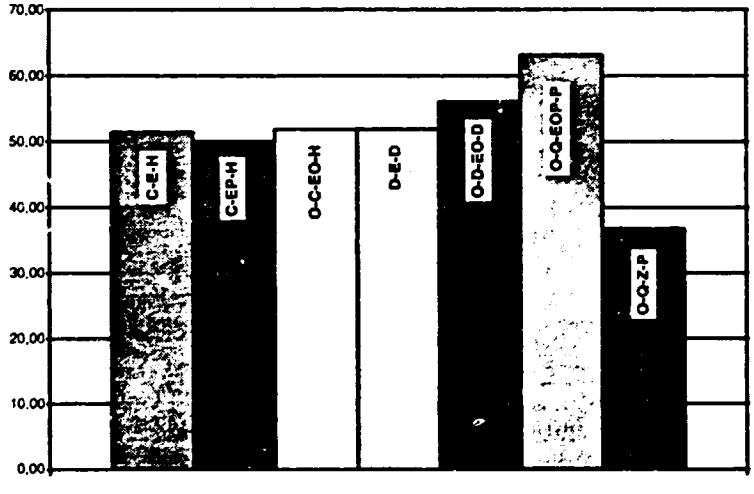
JUTE PULPING

TENSILE INDEX [Nm/g] OF BLEACHED JUTE PULP AT 30 SR



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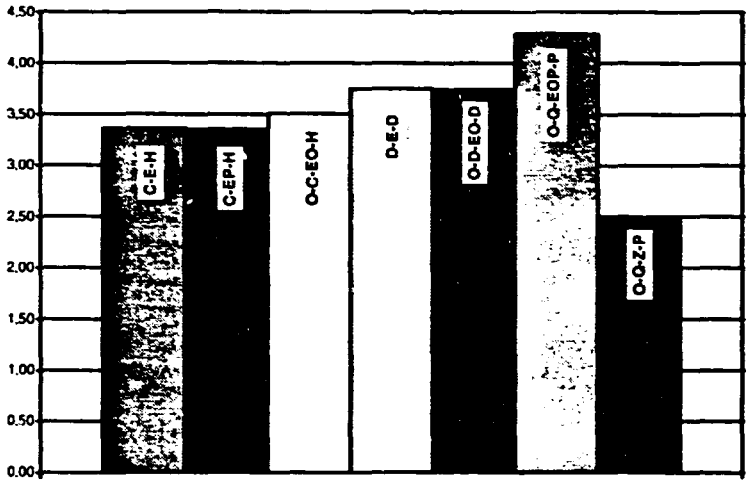
JUTE PULPING

BURST INDEX [kPam2/g] OF BLEACHED JUTE PULP AT 30 SR



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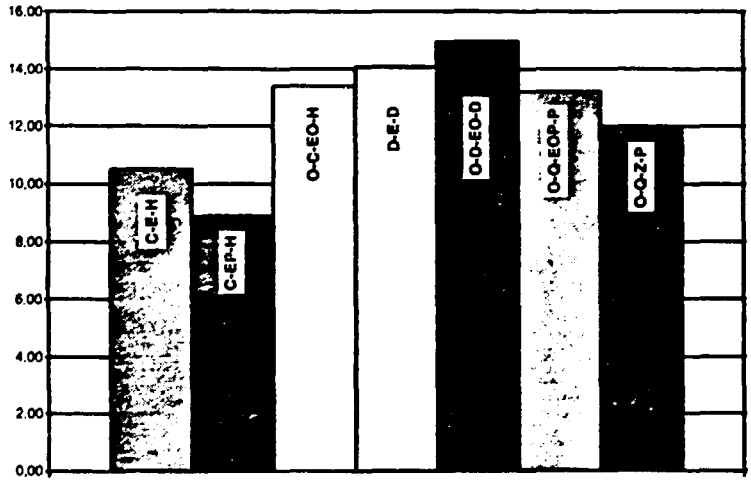
JUTE PULPING

TEAR INDEX [mNm2/g] OF BLEACHED JUTE PULP AT 30 SR



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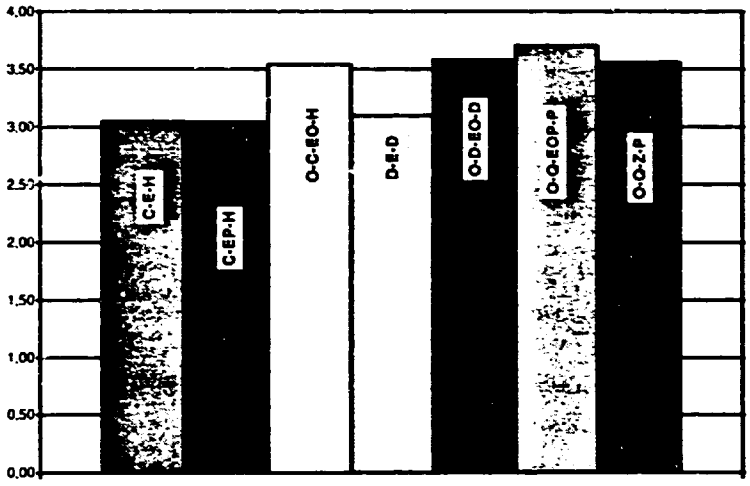
JUTE PULPING

STRETCH [%] OF BLEACHED JUTE PULP AT 30 SR



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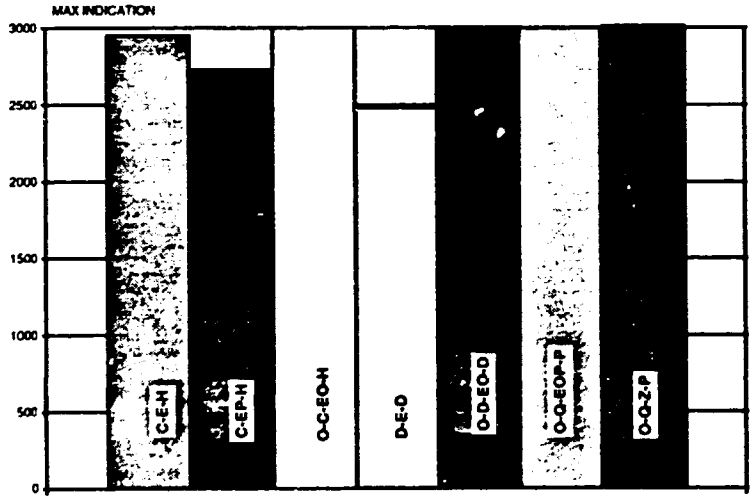
JUTE PULPING

BENDTSEN POROSITY [ml/min] OF BLEACHED JUTE PULP AT 30 SR



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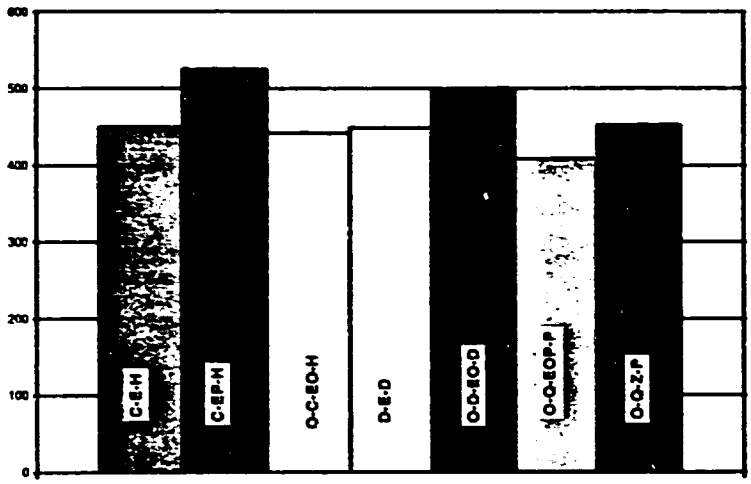
JUTE PULPING

BENDTSEN SMOOTHNESS [ml/min] OF BLEACHED JUTE PULP AT 30 SR



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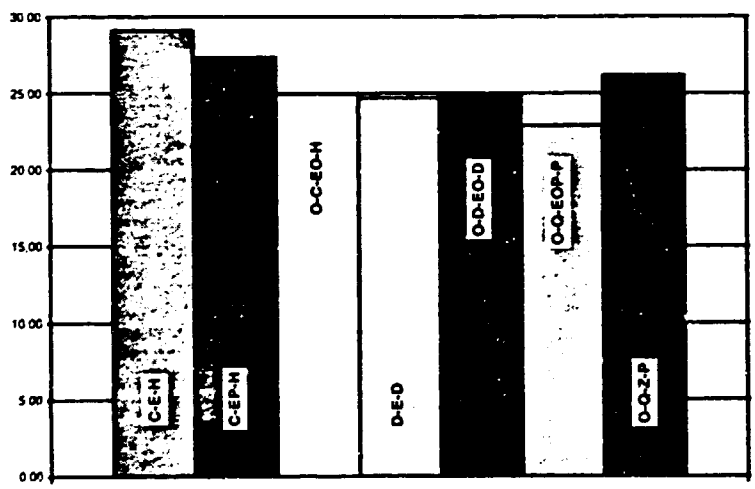
JUTE PULPING

SCATTERING COEFFICIENT [ ] OF BLEACHED JUTE PULP AT 30 SR



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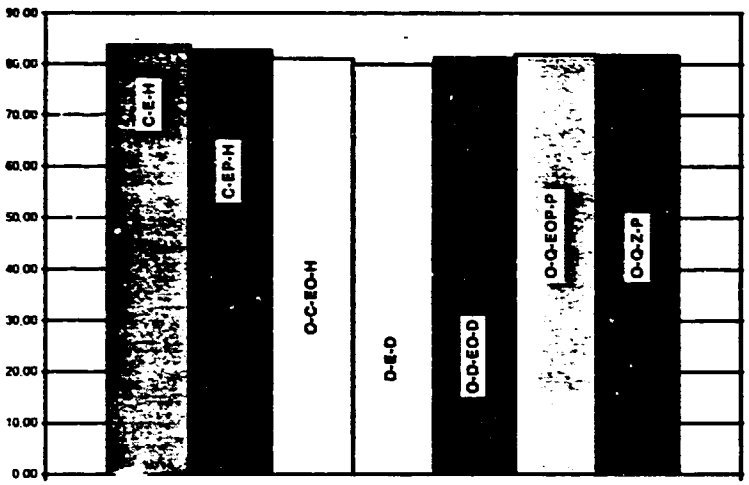
JUTE PULPING

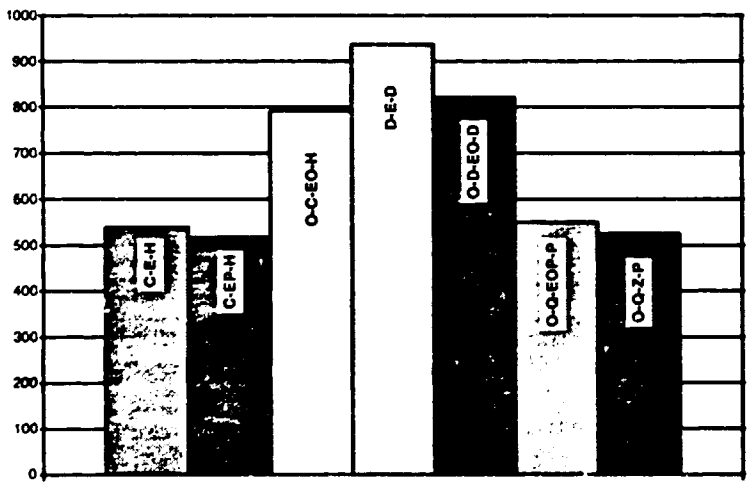
OPACITY [%] OF BLEACHED JUTE PULP AT 30 SR



pptx Projekte\Tribeni\Final Report 1a\Figure 127

JUTE PULPING

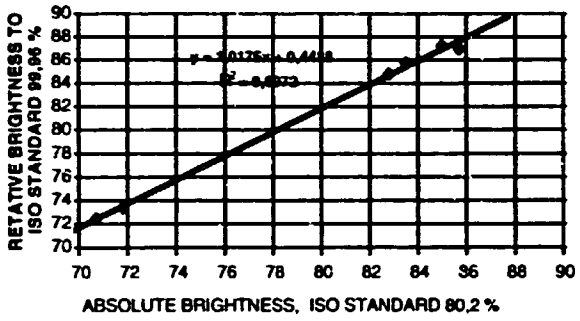
VISCOSITY [ml/g] OF BLEACHED JUTE PULP AT 30 SR



pptx\Projekte\Tribeni\Final Report 1a\Figure 128

JUTE PULPING

CORELATION BETWEEN ABSOLUTE AND RELATIVE ISO BRIGHTNESS



Messured at ÖHFI, Vienna sept. 1995

ppt\Projekte\Tribeni\Final Report 1a\ Figure 129

JUTE PULPING

FIBRE DISTRIBUTION AND ANALYSIS OF UNBLEACHED JUTE PULP

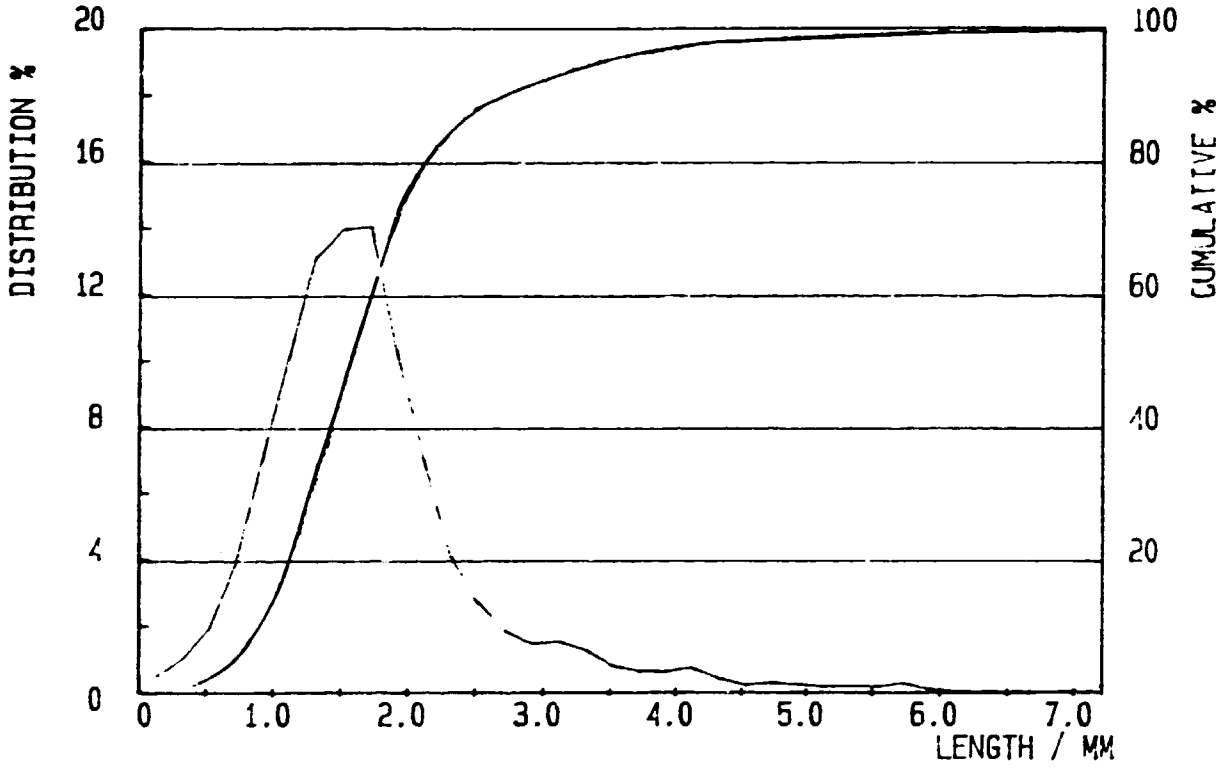
WITH

KAJAANI FS-200

KAJAANI FS-200 KRAFT 02-03-95 12:01

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 P 3B JUTA	SAMPLE FILE NO	006
SAMPLED	01-03-95	UPPER LIMIT	6.00
ANALYSED	02-03-95 11:57	LOWER LIMIT	0.00
TOTAL FIBERS	24908	WEIGHT	9.07 mg



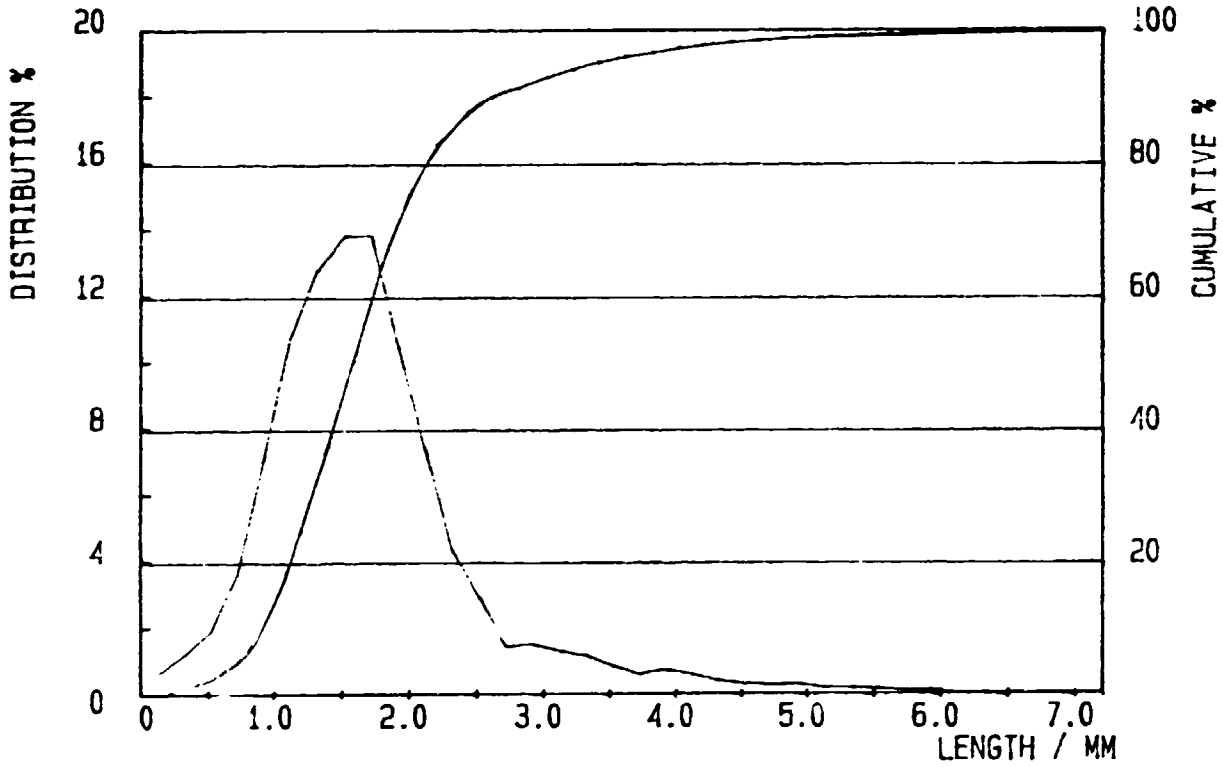
ARITHMETIC AV	1.27 mm	COARSENESS	0.104 mg/m
L WEIGHTED AV	1.69 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.09 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 7.02 % W= 0.45 %

KAJAANI FS-200 KRAFT-AQ 02-03-95 12:14

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 P 48 JUTA	SAMPLE FILE NO	007
SAMPLED	01-03-95	UPPER LIMIT	6.00
ANALYSED	02-03-95 12:12	LOWER LIMIT	0.00
TOTAL FIBERS	27041	WEIGHT	9.80 mg



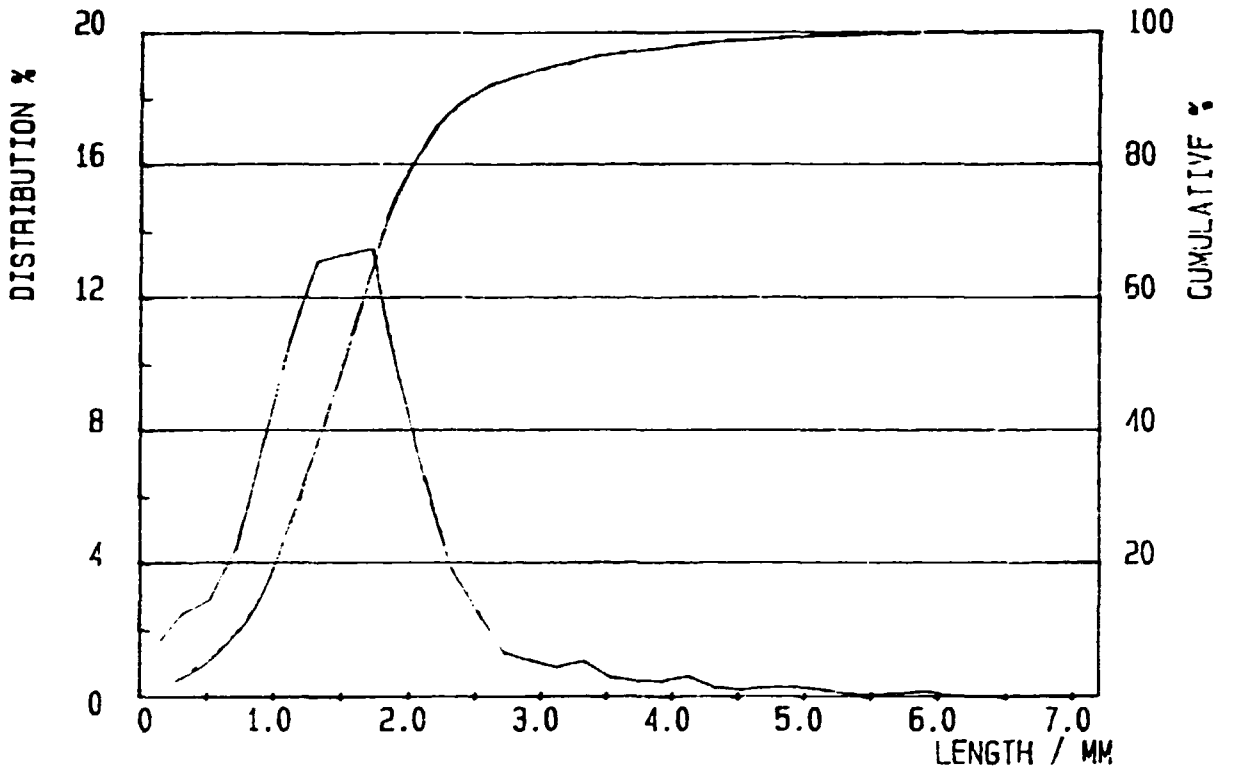
ARITHMETIC AV	1.24 mm	COARSENESS	0.100 mg/m
L WEIGHTED AV	1.68 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.07 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 8.90 % W= 0.57 %

KAJAANI FS-200 SODA 02-03-95 09:16

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 P21B JUTA	SAMPLE FILE NO	008
SAMPLED	01-03-95	UPPER LIMIT	6.00
ANALYSED	02-03-95 09:10	LOWER LIMIT	0.00
TOTAL FIBERS	32792	WEIGHT	9.12 mg



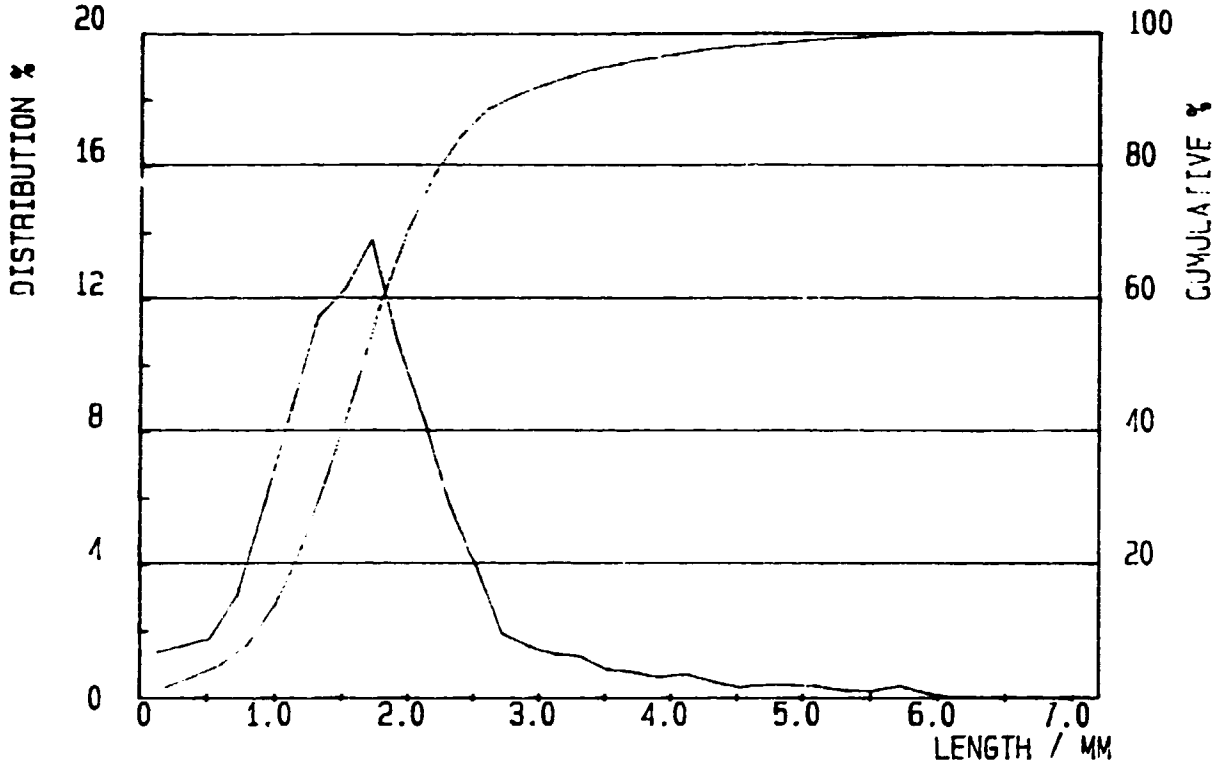
ARITHMETIC AV	1.02 mm	COARSENESS	0.106 mg/m
L WEIGHTED AV	1.58 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	1.99 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 18.36 % W= 1.54 %

KAJAANI FS-200 SODA-AQ 02-03-95 10:58

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 P228 JUTA	SAMPLE FILE NO	010
SAMPLED	01-03-95	UPPER LIMIT	6.00
ANALYSED	02-03-95 10:33	LOWER LIMIT	0.00
TOTAL FIBERS	30236	WEIGHT	9.11 mg



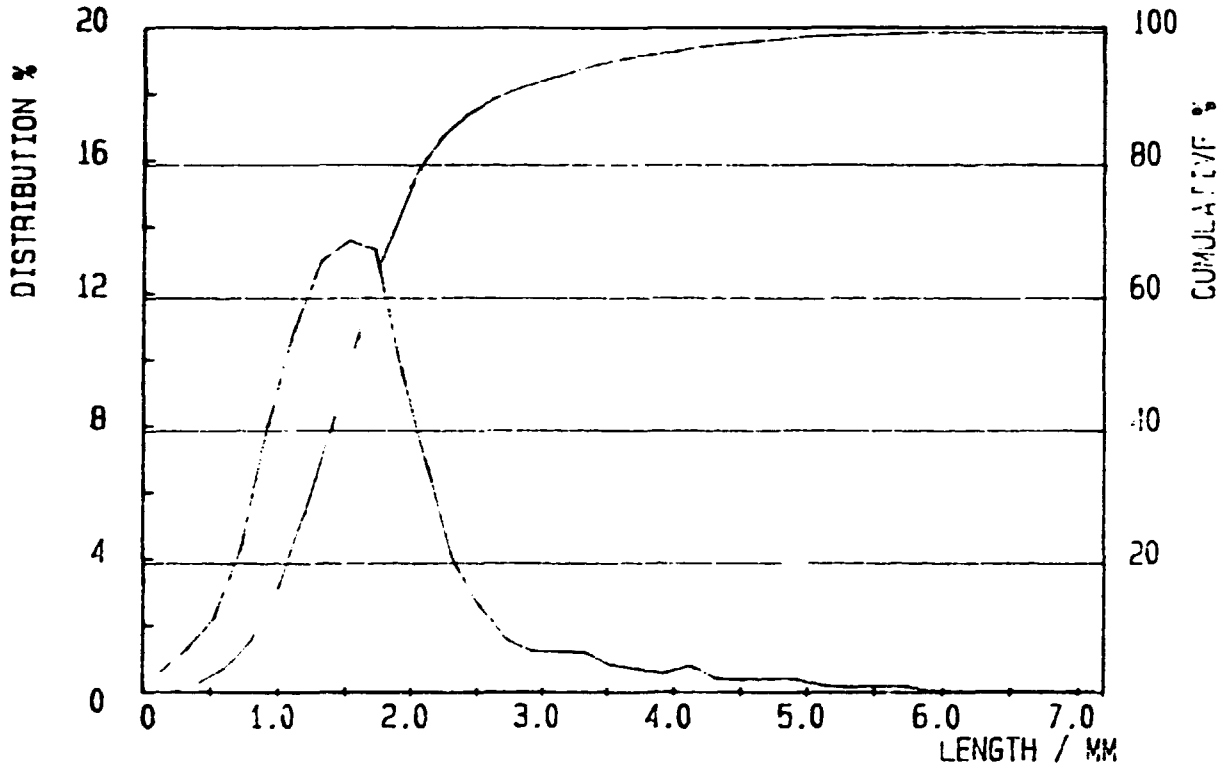
ARITHMETIC AV	1.14 mm	COARSENESS	0.101 mg/m
L WEIGHTED AV	1.76 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.20 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 19.42 % W= 1.34 %

KAJAANI FS-200 **ALKALINE SULPHITE-AQ** 06-03-95 08:31

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 P 40 B JUTA	SAMPLE FILE NO	092
SAMPLED	06-03-95	UPPER LIMIT	6.00
ANALYSED	06-03-95 08:25	LOWER LIMIT	0.00
TOTAL FIBERS	22355	WEIGHT	9.00 mg



ARITHMETIC AV	1.20 mm	COARSENESS	0.130 mg/m
L WEIGHTED AV	1.66 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.07 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 9.09 % W= 0.60 %

FIBRE DISTRIBUTION AND ANALYSIS OF BLEACHED JUTE PULP

WITH

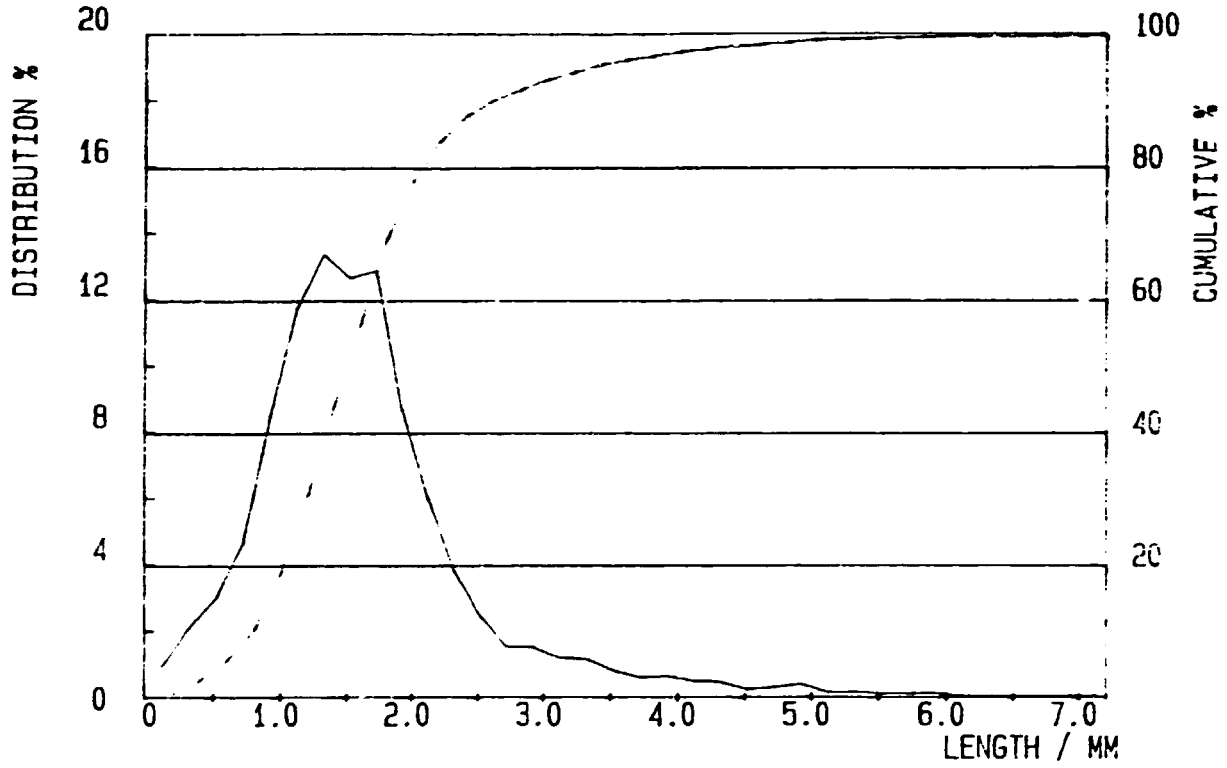
KAJAANI FS-200

BLEACHABILITY TEST ONLY

KAJAANI FS-200 17-03-95 11:16

WEIGHTED DISTRIBUTION **KRAFT, BLEACHED**

SAMPLE TITLE	N14/95 P3 BELJ	SAMPLE FILE NO	005
SAMPLED	17-03-95	UPPER LIMIT	6.00
ANALYSED	17-03-95 11:12	LOWER LIMIT	0.00
TOTAL FIBERS	30575	WEIGHT	9.06 mg



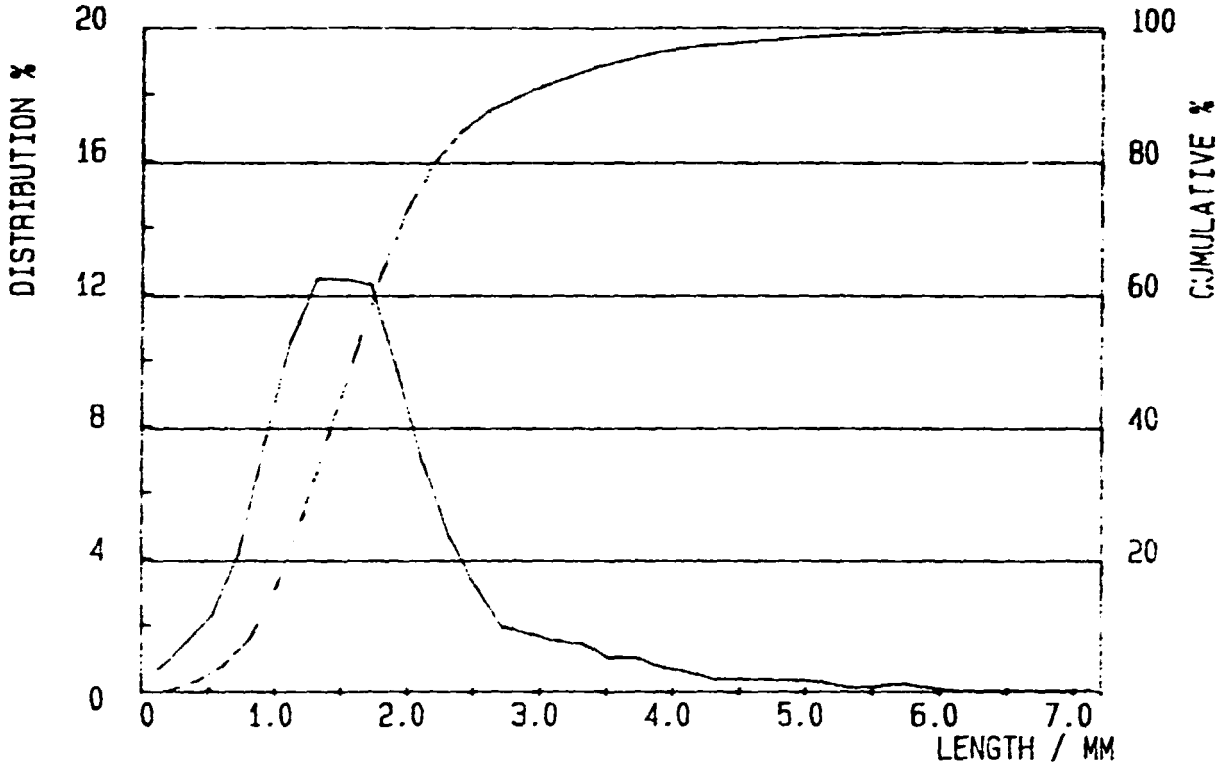
ARITHMETIC AV	1.10 mm	COARSENESS	0.102 mg/m
L WEIGHTED AV	1.60 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.03 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 11.61 % W= 0.91 %

KAJAANI FS-200 17-03-95 11:32

WEIGHTED DISTRIBUTION KRAFT-AQ, BLEACHED

SAMPLE TITLE	N14/95 P4 BELJ	SAMPLE FILE NO	012
SAMPLED	17-03-95	UPPER LIMIT	6.00
ANALYSED	17-03-95 11:30	LOWER LIMIT	0.00
TOTAL FIBERS	21993	WEIGHT	8.90 mg



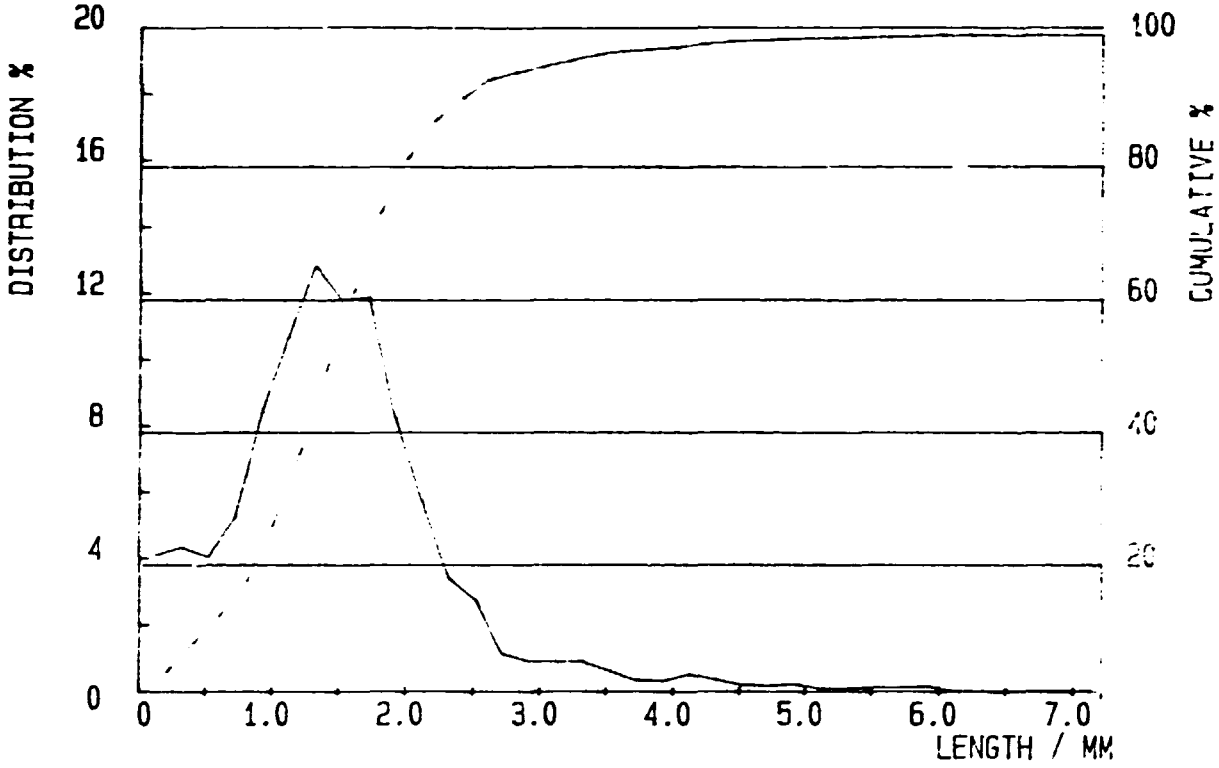
ARITHMETIC AV	1.21 mm	COARSENESS	0.129 mg/m
L WEIGHTED AV	1.71 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.15 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 9.47 % W= 0.64 %

KAJAANI FS-200 17-03-95 12:52

WEIGHTED DISTRIBUTION SODA, BLEACHED

SAMPLE TITLE	N14/95 P21 BELJ	SAMPLE FILE NO	014
SAMPLED	17-03-95	UPPER LIMIT	6.00
ANALYSED	17-03-95 12:04	LOWER LIMIT	0.00
TOTAL FIBERS	41422	WEIGHT	8.80 mg



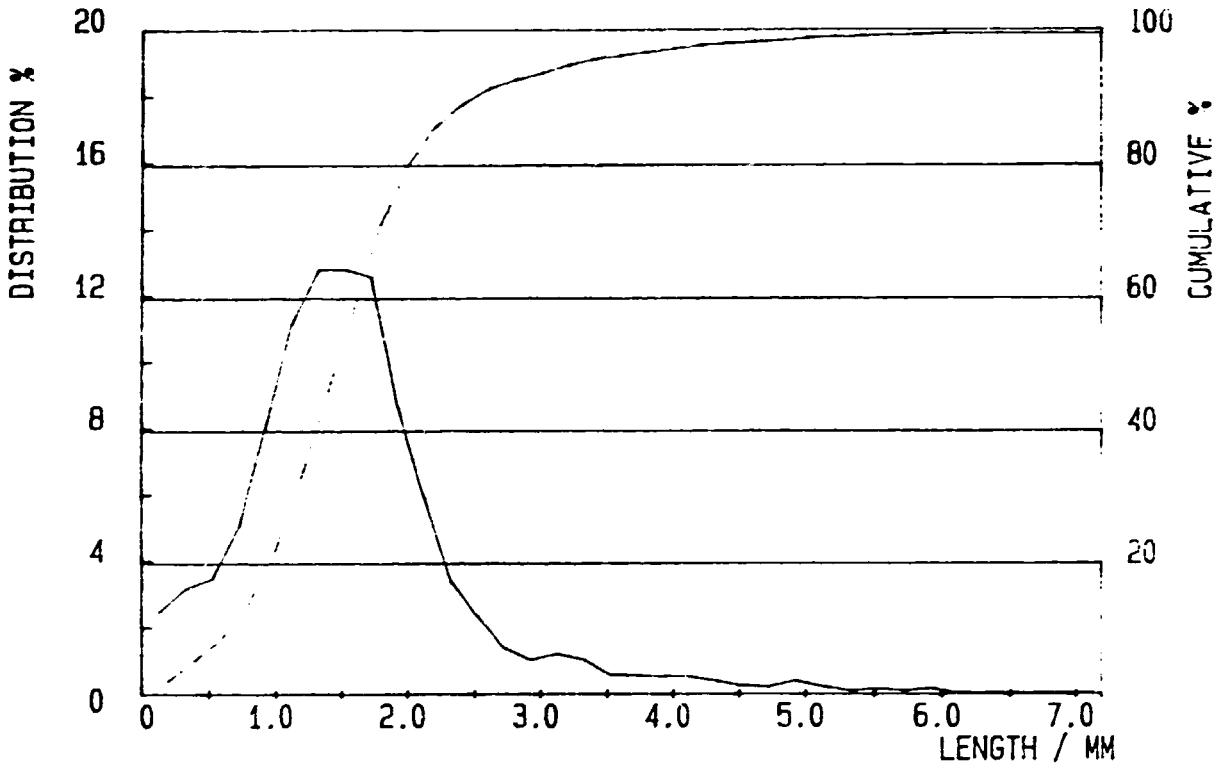
ARITHMETIC AV	0.72 mm	COARSENESS	0.109 mg/m
L WEIGHTED AV	1.46 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	1.93 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 36.16 % W= 4.08 %

KAJAANI FS-200 17-03-95 12:32

WEIGHTED DISTRIBUTION SODA-AQ, BLEACHED

SAMPLE TITLE	N14/95 P 22 BELJ	SAMPLE FILE NO	016
SAMPLED	16-03-95	UPPER LIMIT	6.00
ANALYSED	17-03-95 12:26	LOWER LIMIT	0.00
TOTAL FIBERS	36072	WEIGHT	8.72 mg



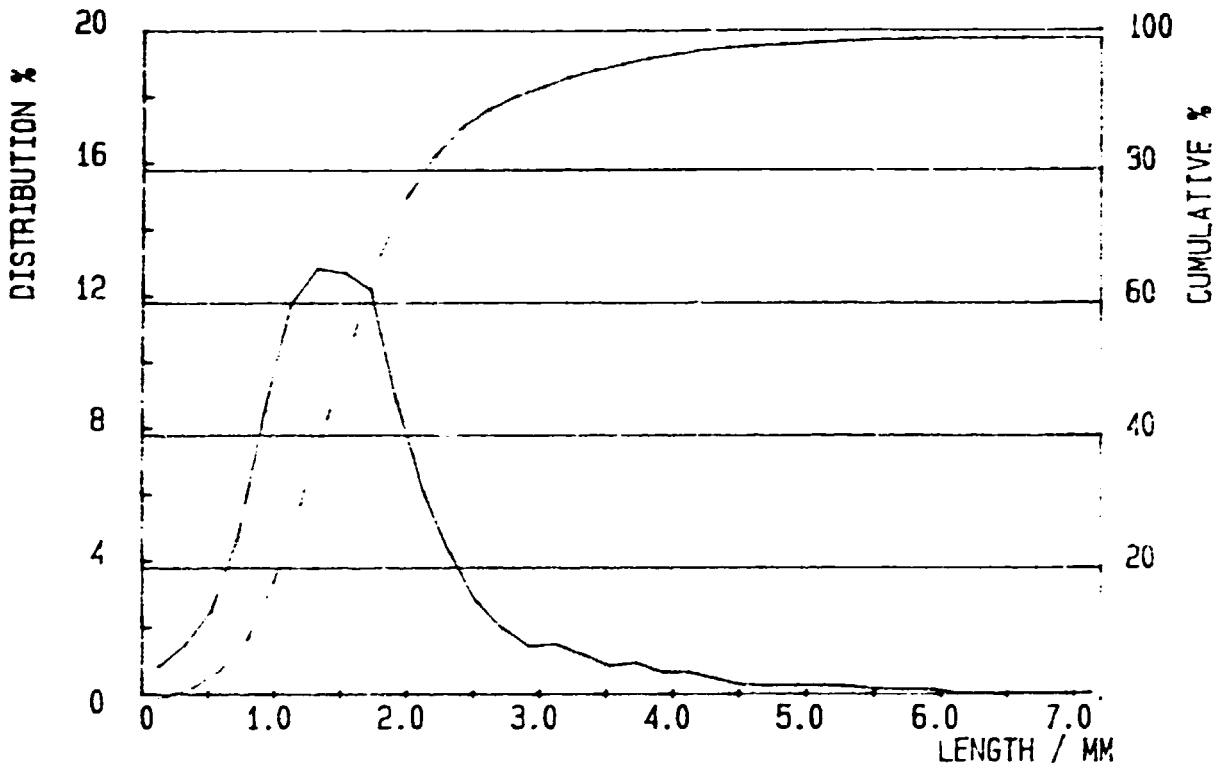
ARITHMETIC AV	0.88 mm	COARSENESS	0.108 mg/m
L WEIGHTED AV	1.54 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.00 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 25.93 % W= 2.45 %

KAJAANI FS-200 17-03-95 12:47

WEIGHTED DISTRIBUTION **ALKALINE SULPHITE-AQ, BLEACHED**

SAMPLE TITLE	N14/95 P 40 BELJ	SAMPLE FILE NO	017
SAMPLED	16-03-95	UPPER LIMIT	5.00
ANALYSED	17-03-95 12:46	LOWER LIMIT	0.00
TOTAL FIBERS	24070	WEIGHT	8.50 mg



ARITHMETIC AV	1.15 mm	COARSENESS	0.118 mg/m
L WEIGHTED AV	1.65 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.08 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 10.96 % W= 0.80 %

FIBRE DISTRIBUTION AND ANALYSIS OF BLEACHED JUTE PULP

WITH

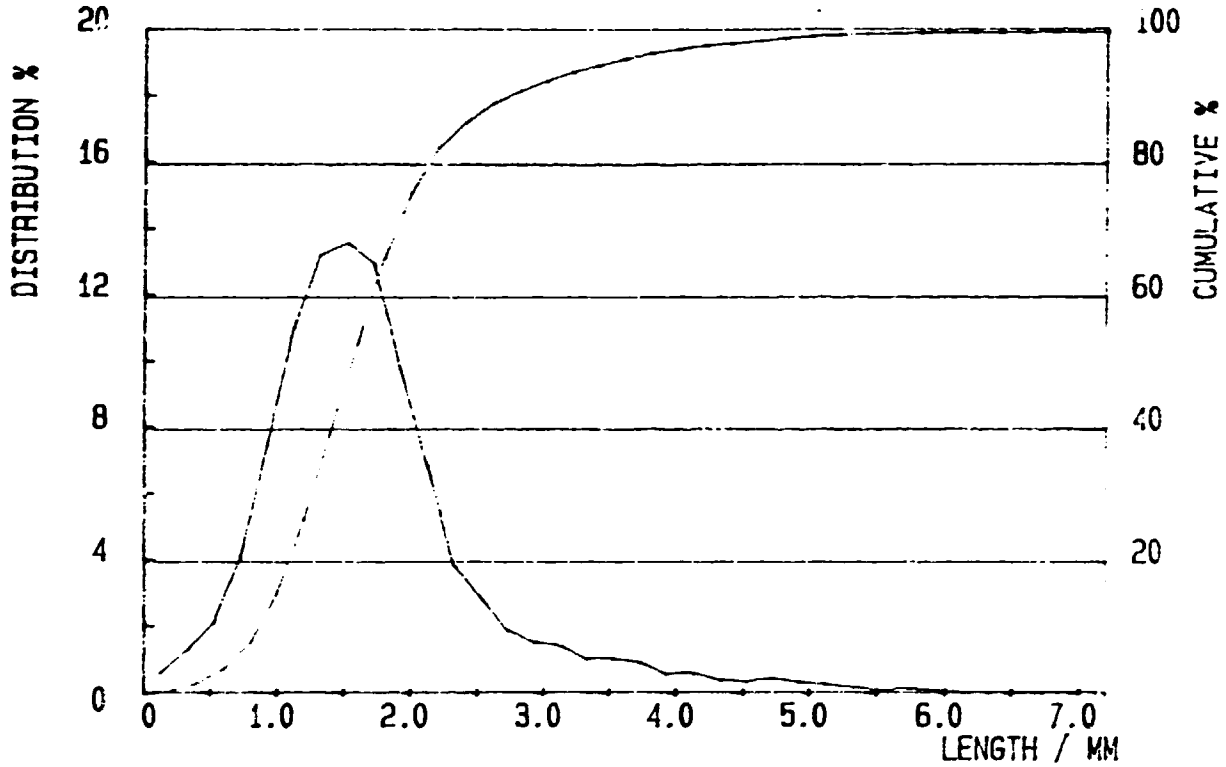
KAJAANI FS-200

BLEACHING TRIALS

KAJAANI FS-200 13-07-95 08:14

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 1E C-E-H	SAMPLE FILE NO	045
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 08:10	LOWER LIMIT	0.00
TOTAL FIBERS	21817	WEIGHT	7.83 mg

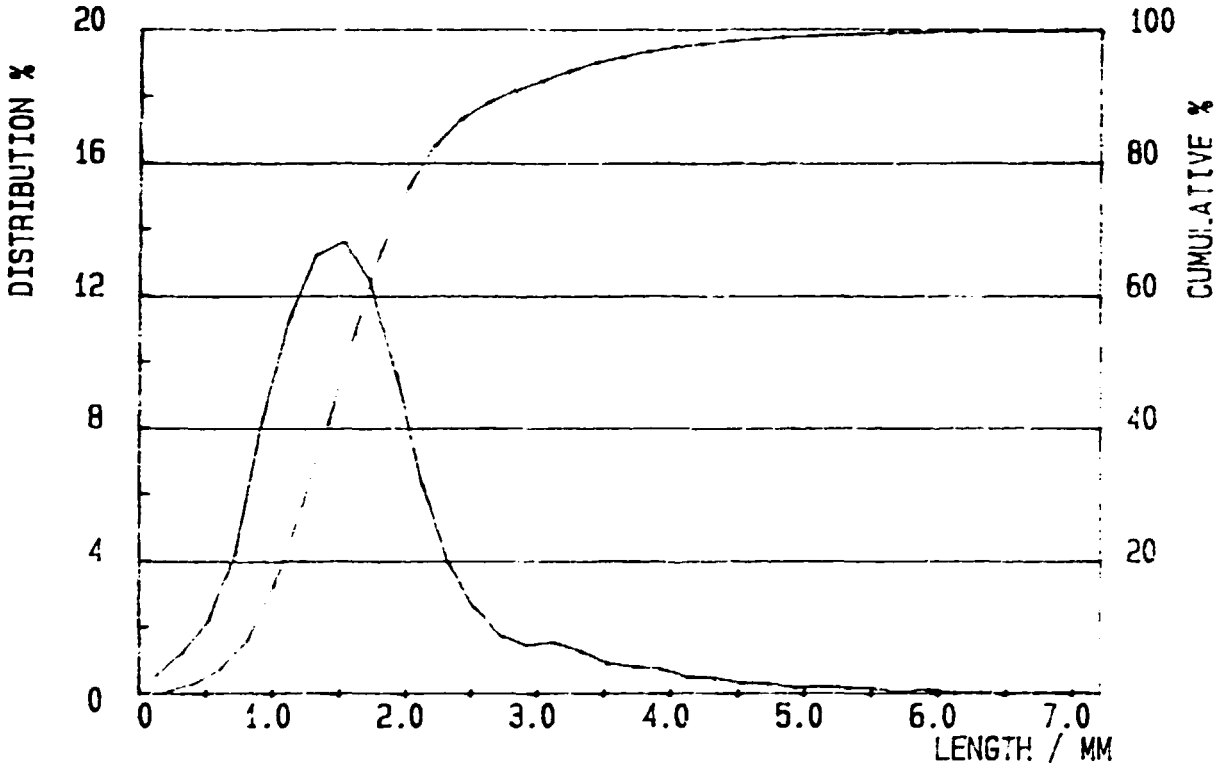


ARITHMETIC AV	1.23 mm	COARSENESS	0.105 ng/m
L WEIGHTED AV	1.67 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.08 mm	CUSTOM /L VALUE OUT OF TABLE	
LENGTH 0.20 mm	P= 8.15 %	W= 0.57 %	

KAJAANI FS-200 13-07-95 08:29

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 1E C-E-H	SAMPLE FILE NO	046
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 08:24	LOWER LIMIT	0.00
TOTAL FIBERS	23270	WEIGHT	7.83 mg



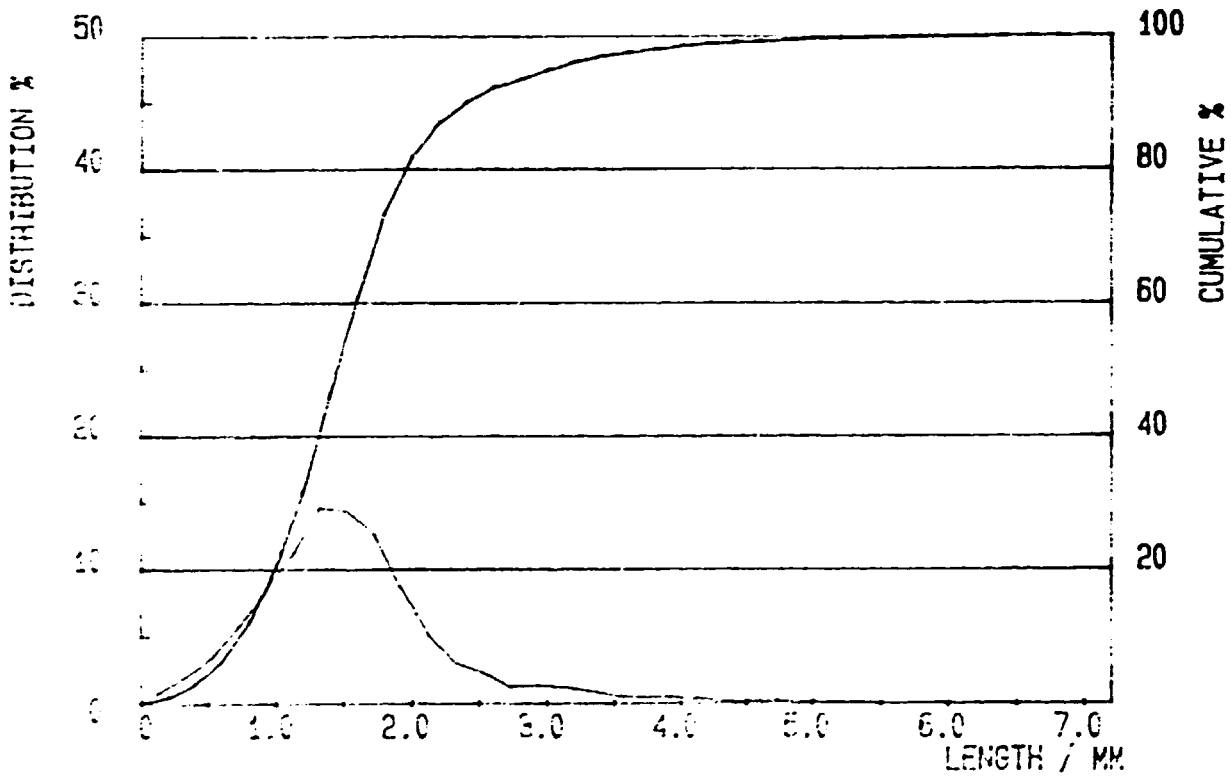
ARITHMETIC AV	1.22 mm	COARSENESS	0.100 mg/m
L WEIGHTED AV	1.66 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.06 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 7.9: % W= 0.52 %

KAJAANI FS-200 21-09-95 15:20

WEIGHTED DISTRIBUTION

SAMPLE TITLE	C-E-H	SAMPLE FILE NO	026
SAMPLED	21-09-95	UPPER LIMIT	7.20
ANALYSED	21-09-95 15:18	LOWER LIMIT	0.00
TOTAL FIBERS	21569	WEIGHT	5.67 mg

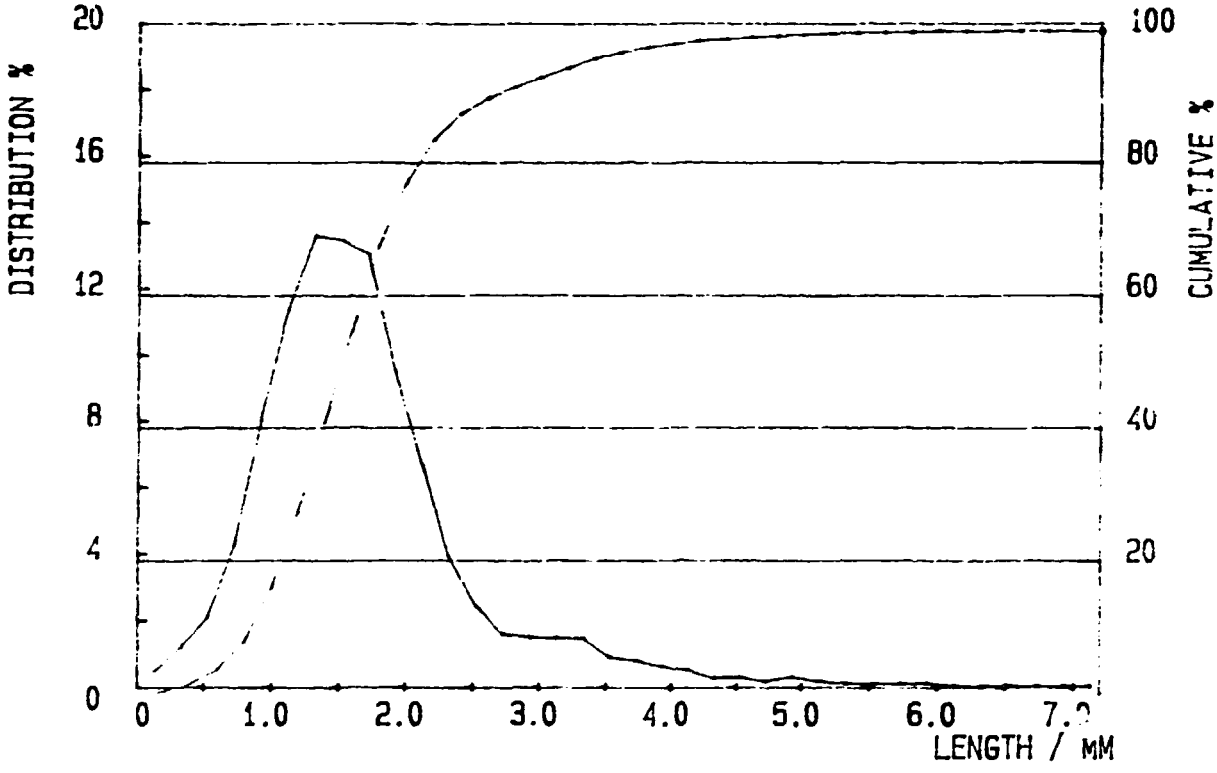


ARITHMETIC AV 1.09 mm COARSENESS 0.100 mg/m
L WEIGHTED AV 1.54 mm
W WEIGHTED AV 1.93 mm
LENGTH 0.20 mm P= 9.95 % W= 0.81 %

KAJAANI FS-200 13-07-95 09: 13

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 2C C-EP-H	SAMPLE FILE NO	048
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 08: 53	LOWER LIMIT	0.00
TOTAL FIBERS	19255	WEIGHT	7.64 mg



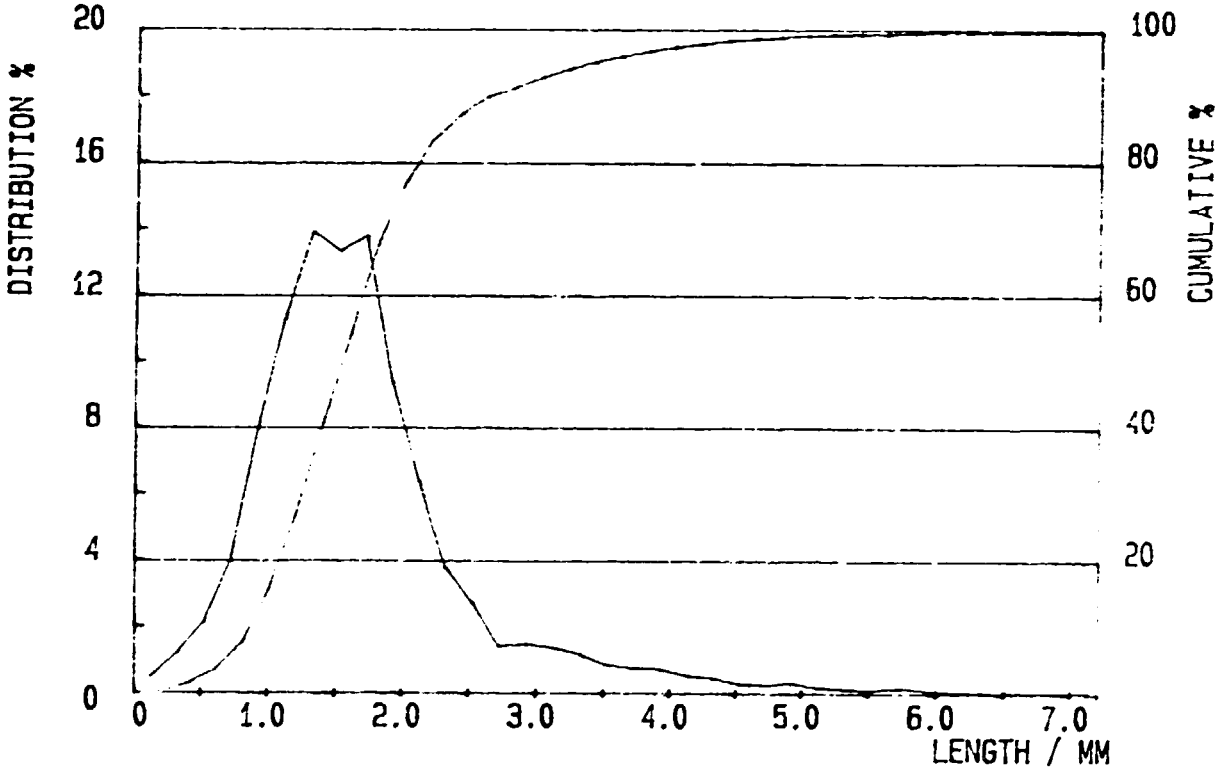
ARITHMETIC AV	1.23 mm	COARSENESS	0.117 mg/m
L WEIGHTED AV	1.65 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.03 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.90 % W= 0.47 %

KAJAANI FS-200 13-07-95 08:44

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 2C C-EP-H	SAMPLE FILE NO	047
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 08:41	LOWER LIMIT	0.00
TOTAL FIBERS	20819	WEIGHT	7.64 mg



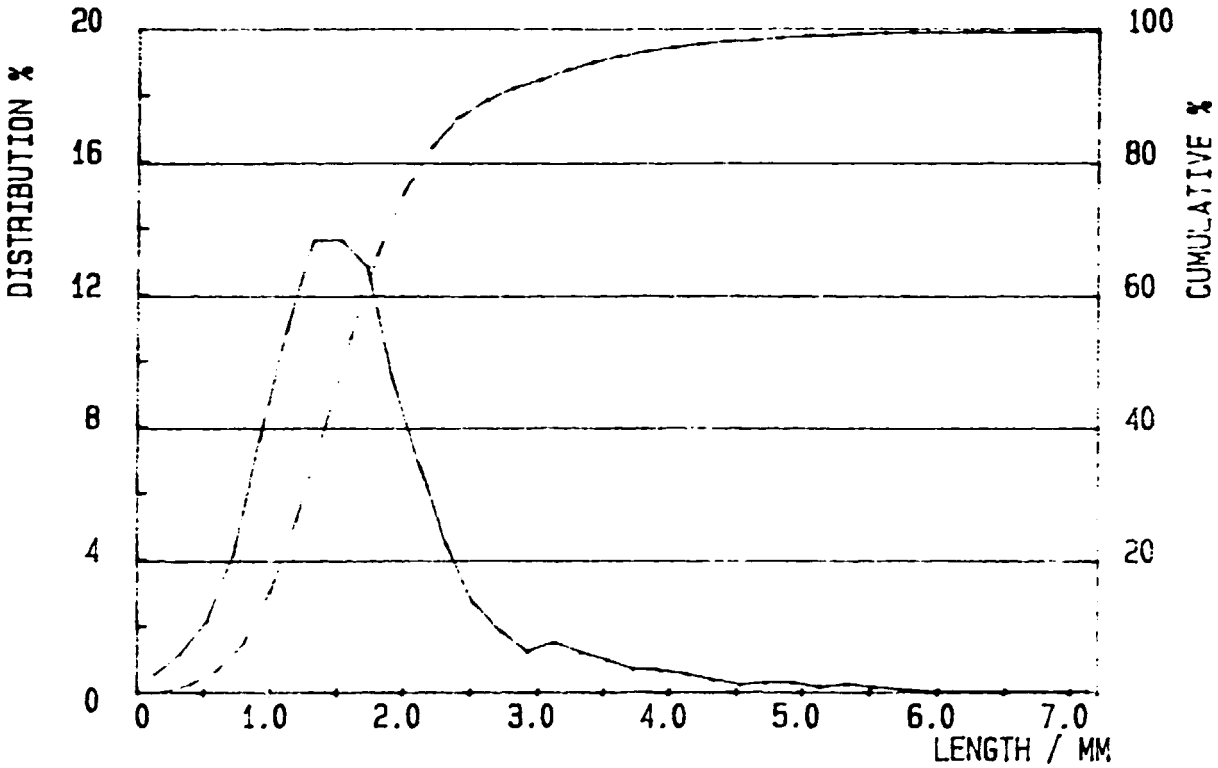
ARITHMETIC AV	1.24 mm	COARSENESS	0.106 mg/m
L WEIGHTED AV	1.65 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.04 mm	CUSTOM /L	VALUE OUT OF TABLE

LENGTH 0.20 mm P= 6.79 % W= 0.46 %

KAJAANI FS-200 13-07-95 09:26

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 2C C-EP-H	SAMPLE FILE NO	049
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 09:23	LOWER LIMIT	0.00
TOTAL FIBERS	21163	WEIGHT	7.64 mg



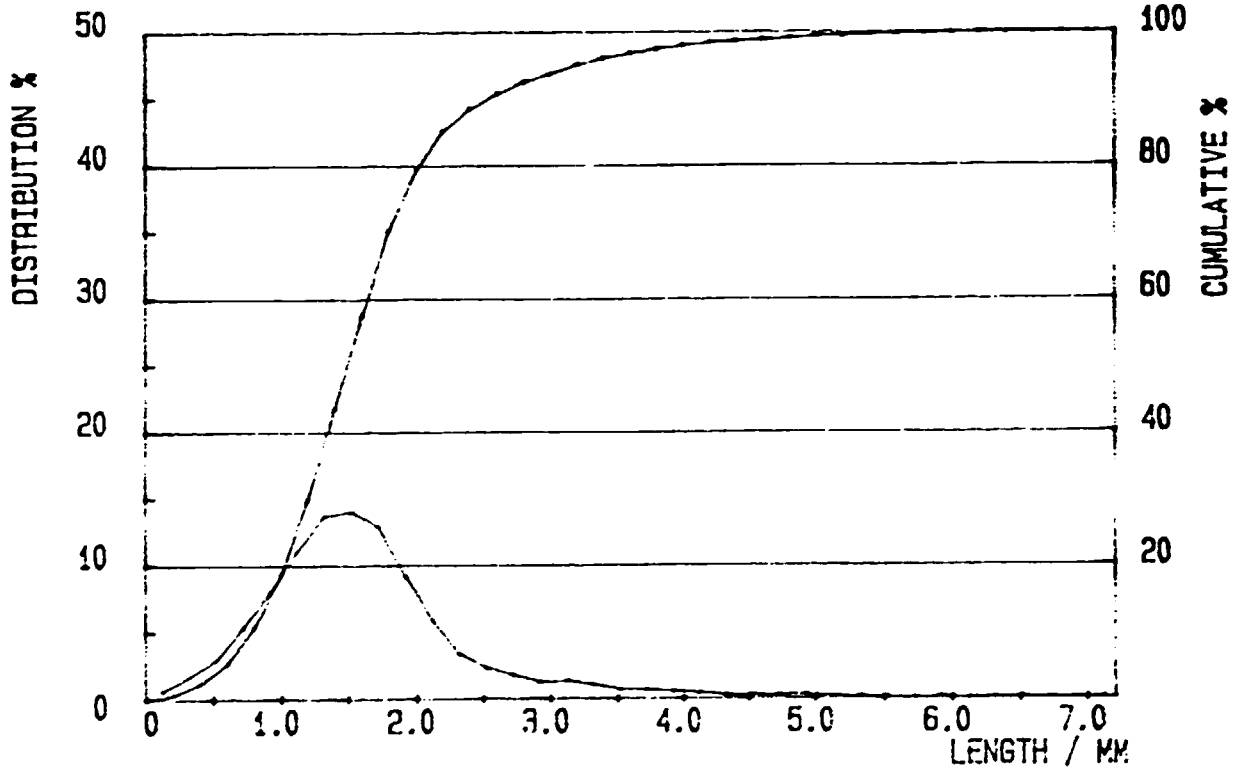
ARITHMETIC AV	1.24 mm	COARSENESS	0.105 mg/m
L WEIGHTED AV	1.66 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.06 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 7.29 % W= 0.50 %

KAJAANI FS-200 22-09-95 09:59

WEIGHTED DISTRIBUTION

SAMPLE TITLE	C-EP-H	SAMPLE FILE NO	027
SAMPLED	22-09-95	UPPER LIMIT	7.20
ANALYSED	22-09-95 09:54	LOWER LIMIT	0.00
TOTAL FIBERS	21295	WEIGHT	6.30 mg



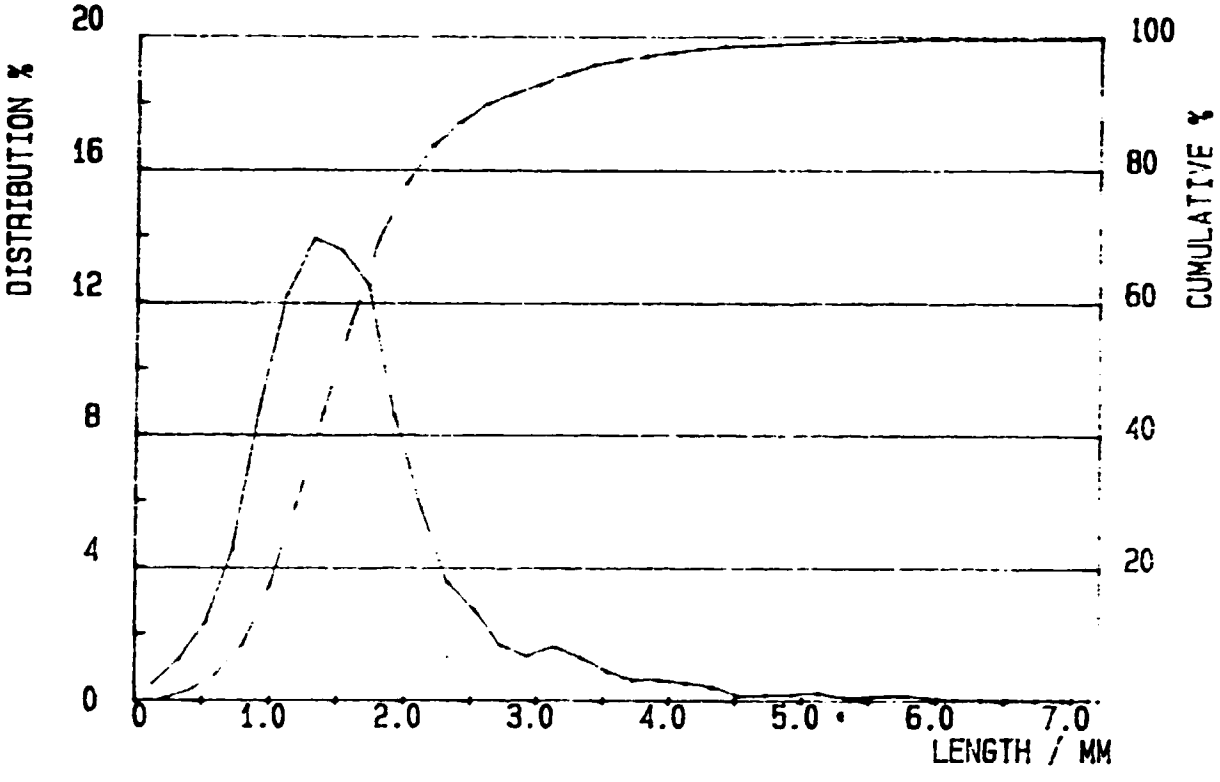
ARITHMETIC AV 1.15 mm
L WEIGHTED AV 1.60 mm
W WEIGHTED AV 2.01 mm
LENGTH 0.20 mm P= 8.32 % W= 0.64 %

COARSENESS 0.106 mg/m

KAJAANI FS-200 13-07-95 10:01

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 3C 0-C-E0-H	SAMPLE FILE NO	052
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 09:59	LOWER LIMIT	0.00
TOTAL FIBERS	15411	WEIGHT	7.43 mg



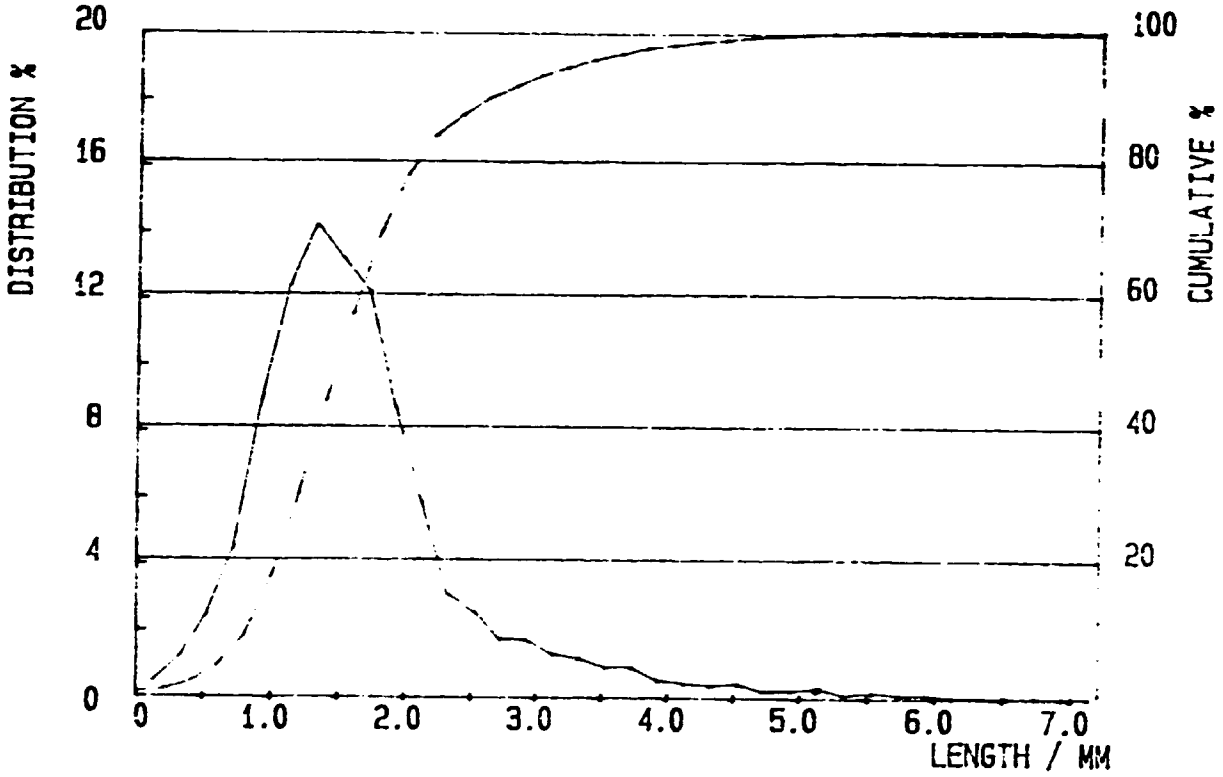
ARITHMETIC AV	1.21 mm	COARSENESS	0.144 mg/m
L WEIGHTED AV	1.62 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.01 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.50 % W= 0.45 %

KAJAANI FS-200 13-07-95 09:50

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 3C 0-C-E0-H	SAMPLE FILE NO	051
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 09:48	LOWER LIMIT	0.00
TOTAL FIBERS	15233	WEIGHT	7.43 mg



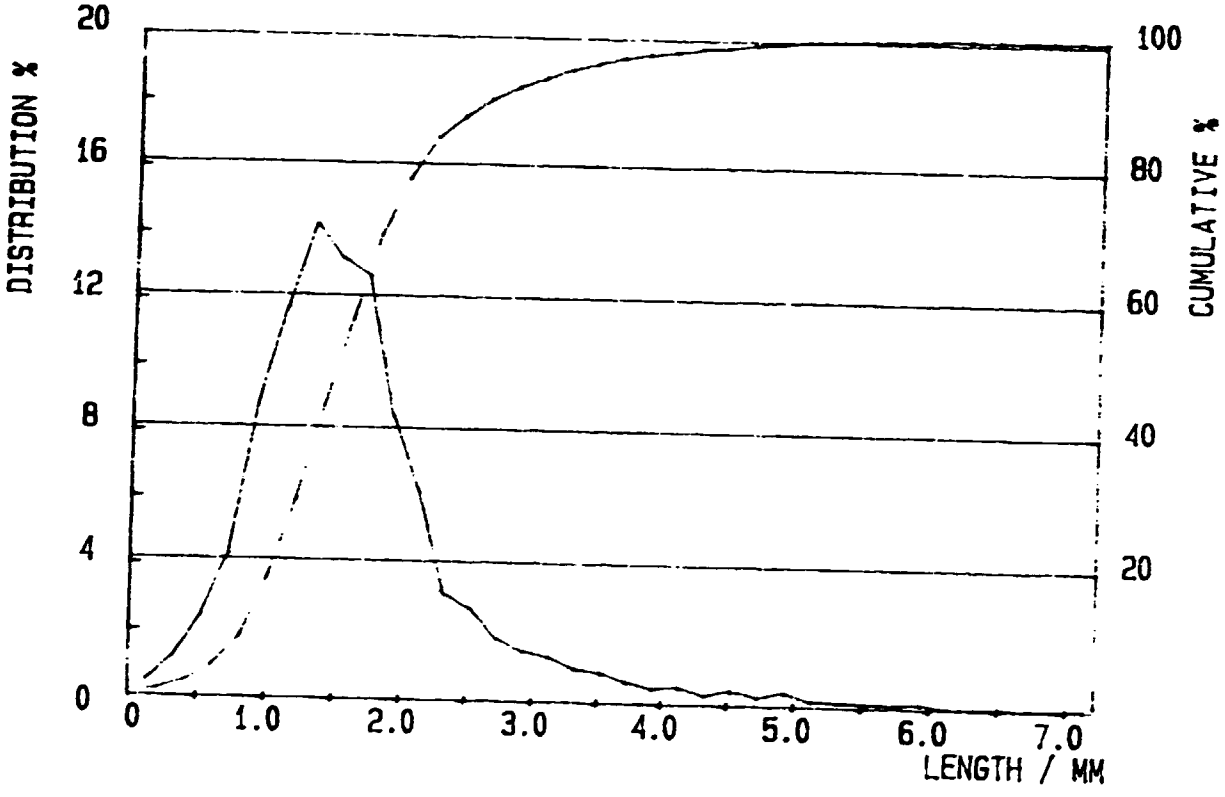
ARITHMETIC AV	1.21 mm	COARSENESS	0.146 mg/m
L WEIGHTED AV	1.62 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.03 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.20 % W= 0.44 %

KAJAANI FS-200 13-07-95 09:38

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 3C 0-C-E0-H	SAMPLE FILE NO	050
SAMPLED	13-07-95	UPPER LIMIT	6.00
ANALYSED	13-07-95 09:36	LOWER LIMIT	0.00
TOTAL FIBERS	14990	WEIGHT	7.43 mg

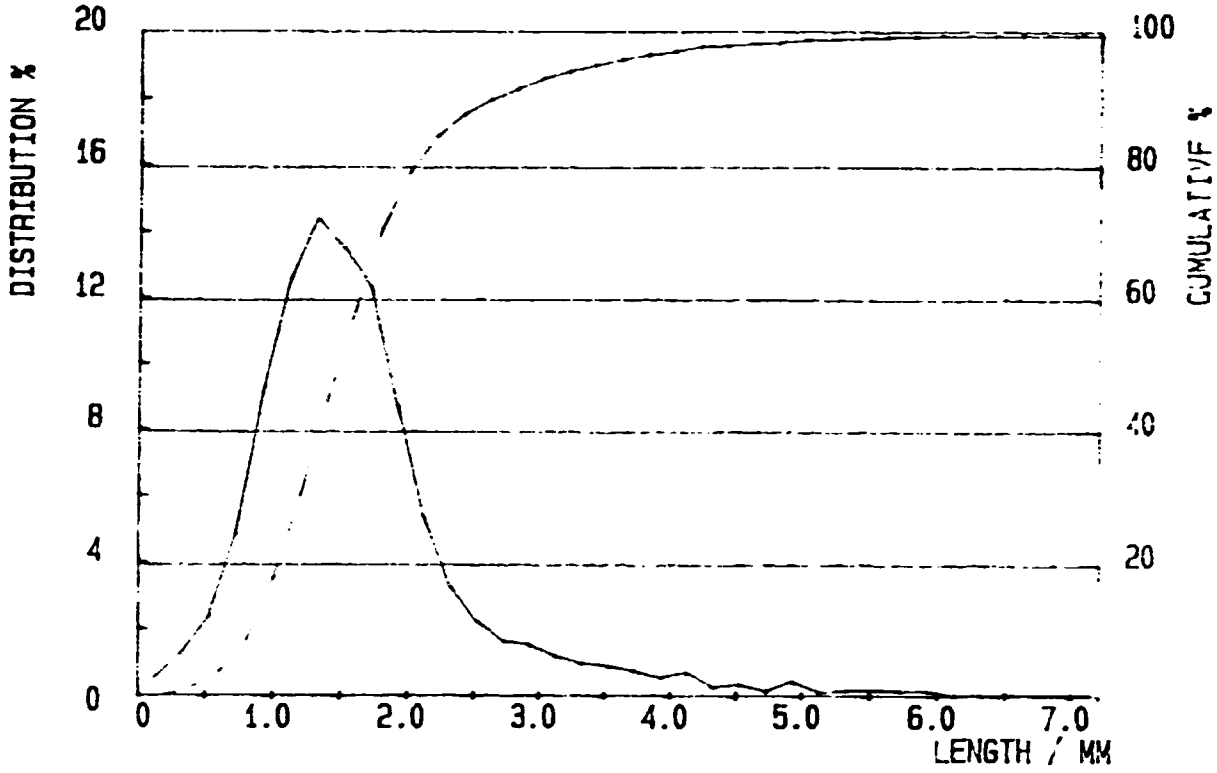


ARITHMETIC AV	1.21 mm	COARSENESS	0.149 mg/m
L WEIGHTED AV	1.63 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.04 mm	CUSTOM /L VALUE OUT OF TABLE	
LENGTH 0.20 mm	P= 6.65 % W= 0.46 %		

KAJAANI FS-200 14-07-95 08:32

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 4C D-E-D-D2	SAMPLE FILE NO	054
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 08:29	LOWER LIMIT	0.00
TOTAL FIBERS	21634	WEIGHT	7.88 mg



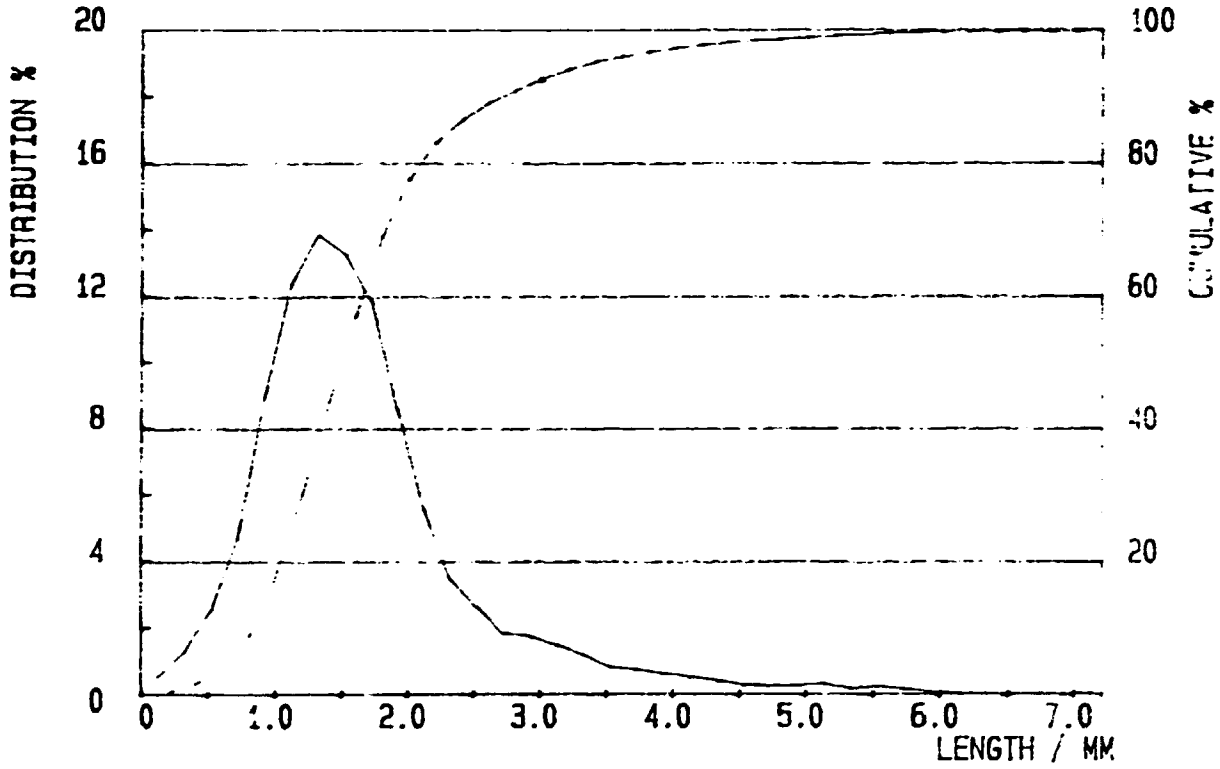
ARITHMETIC AV	1.19 mm	COARSENESS	0.110 mg/m
L WEIGHTED AV	1.60 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.02 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.84 % W= 0.50 %

KAJAANI FS-200 14-07-95 08:19

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95 4C D-E-D-D2	SAMPLE FILE NO	053
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 08:17	LOWER LIMIT	0.00
TOTAL FIBERS	21967	WEIGHT	7.88 mg



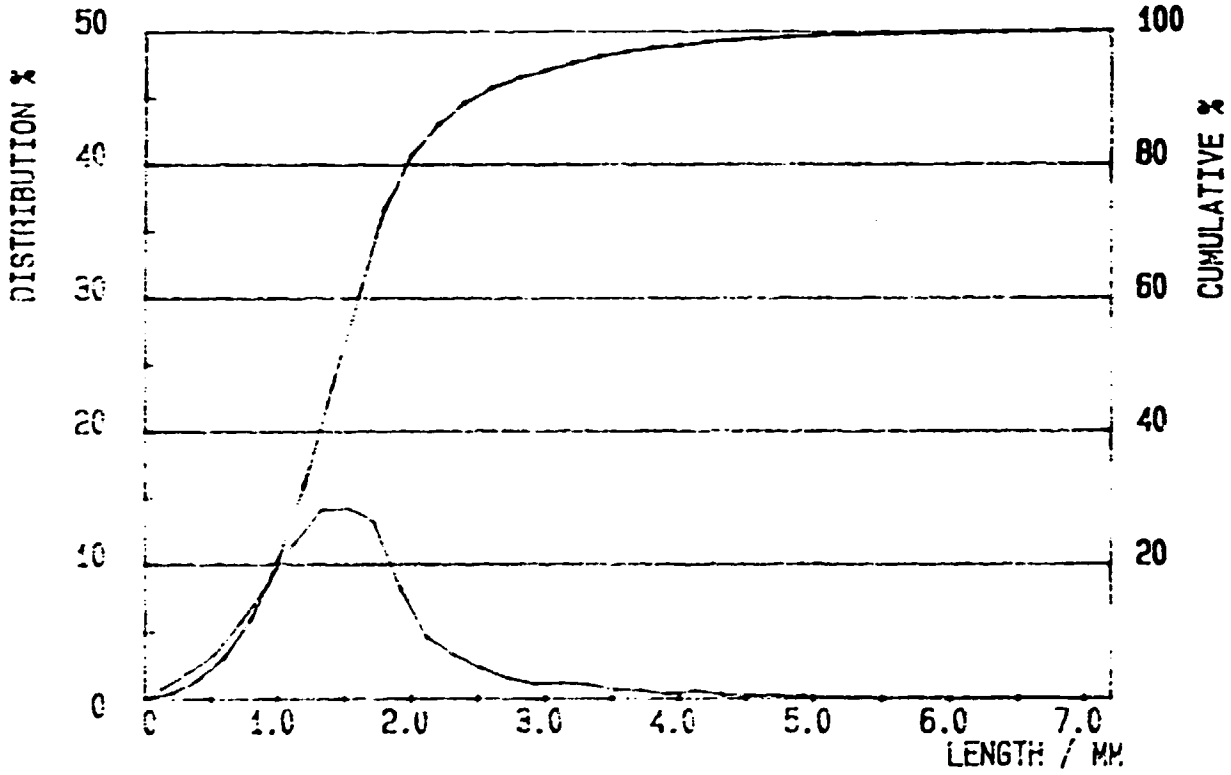
ARITHMETIC AV	1.20 mm	COARSENESS	0.108 mg/m
L WEIGHTED AV	1.63 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.06 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.67 % W= 0.50 %

KAJAANI FS-200 21-09-95 15:06

WEIGHTED DISTRIBUTION

SAMPLE TITLE	D-E-D	SAMPLE FILE NO	025
SAMPLED	21-09-95	UPPER LIMIT	7.20
ANALYSED	21-09-95 15:04	LOWER LIMIT	0.00
TOTAL FIBERS	22921	WEIGHT	6.39 mg



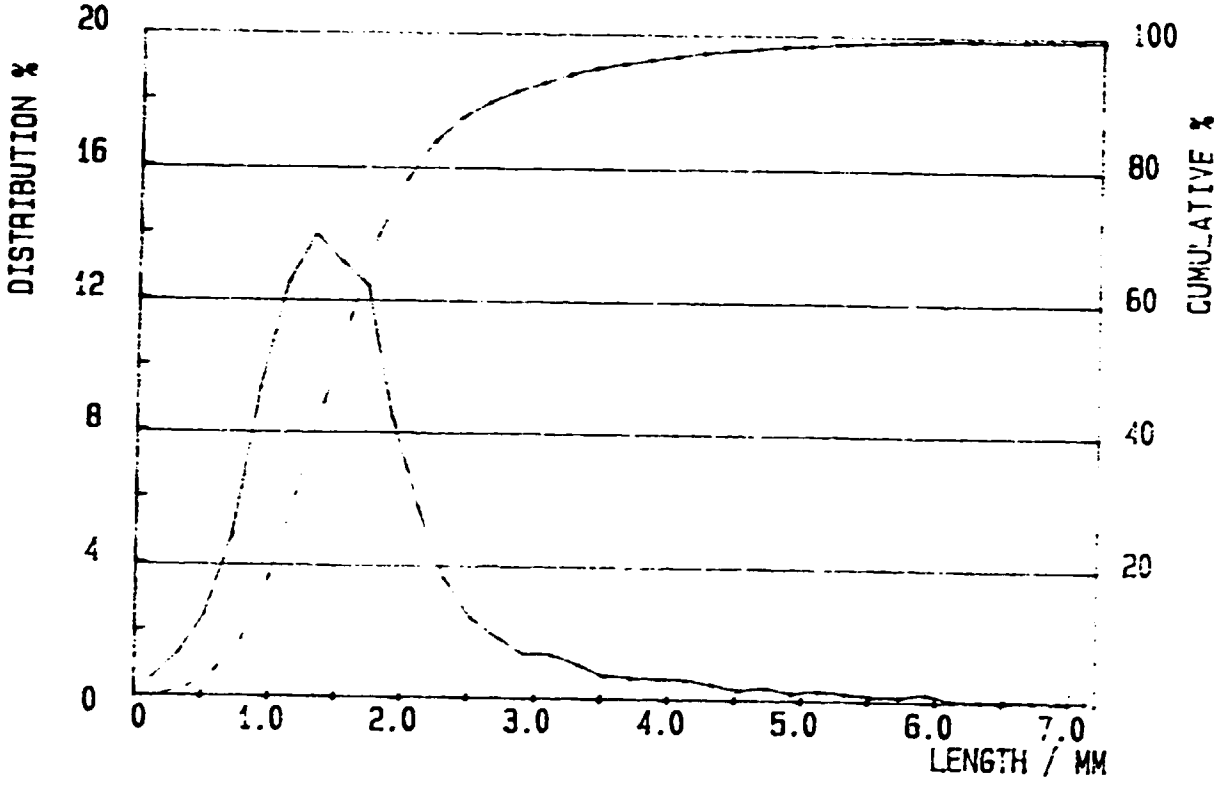
ARITHMETIC AV 1.10 mm
L WEIGHTED AV 1.56 mm
W WEIGHTED AV 1.99 mm
LENGTH 0.20 mm P= 9.69 % W= 0.78 %

COARSENESS 0.106 mg/m

KAJAANI FS-200 14-07-95 09:23

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95-5B-0-0-E0-DD	SAMPLE FILE NO	056
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 08:54	LOWER LIMIT	0.00
TOTAL FIBERS	18945	WEIGHT	7.67 mg



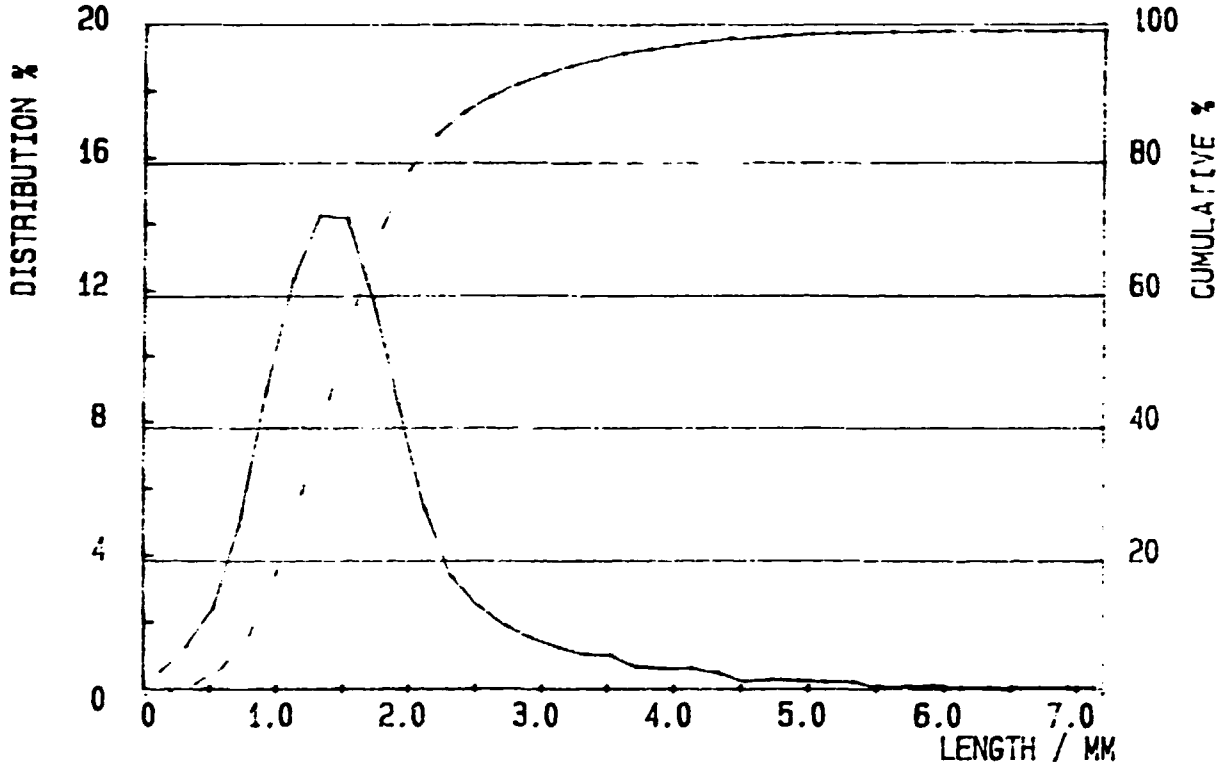
ARITHMETIC AV	1.20 mm	COARSENESS	0.121 mg/m
L WEIGHTED AV	1.62 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.06 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.78 % W= 0.49 %

KAJAANI FS-200 14-07-95 08:57

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95-58-0-0-E0-00	SAMPLE FILE NO	055
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 08:43	LOWER LIMIT	0.00
TOTAL FIBERS	18498	WEIGHT	7.67 mg



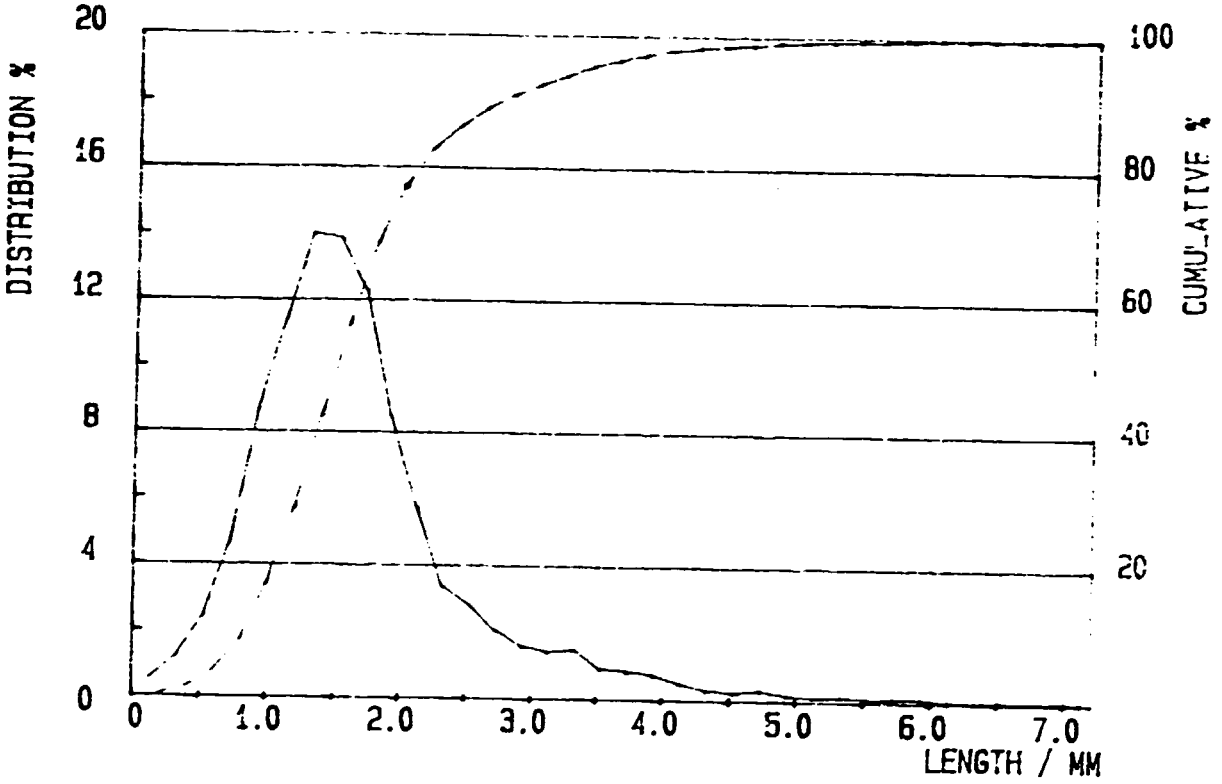
ARITHMETIC AV	1.20 mm	COARSENESS	0.125 mg/m
L WEIGHTED AV	1.60 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.00 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.48 % W= 0.49 %

KAJAANI FS-200 14-07-95 09:38

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95-6C-0-0-EOP-P	SAMPLE FILE NO	057
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 09:35	LOWER LIMIT	0.00
TOTAL FIBERS	18535	WEIGHT	7.49 mg

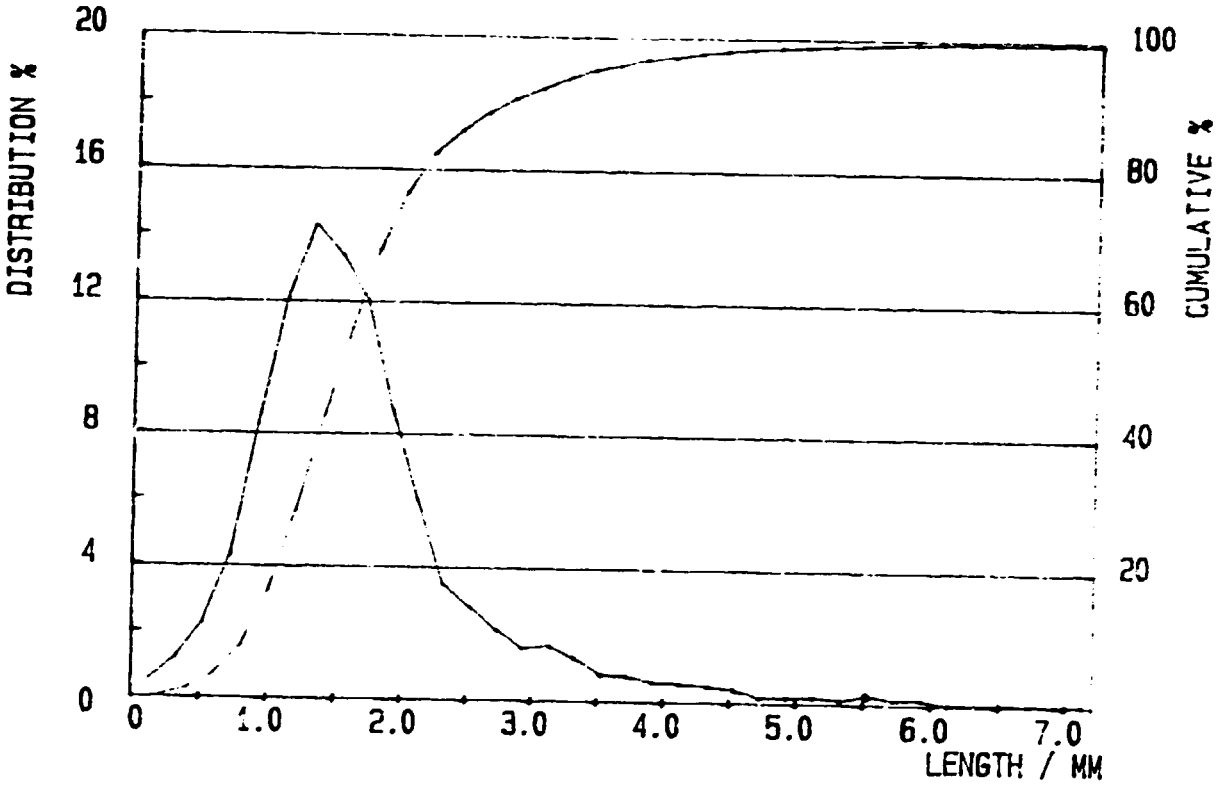


ARITHMETIC AV	1.21 mm	COARSENESS	0.120 mg/m
L WEIGHTED AV	1.63 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.04 mm	CUSTOM /L VALUE OUT OF TABLE	
LENGTH 0.20 mm P=	7.00 % W= 0.50 %		

KAJAANI FS-200 14-07-95 09:50

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95-6C-0-0-EOP-P	SAMPLE FILE NO	058
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 09:47	LOWER LIMIT	0.00
TOTAL FIBERS	19486	WEIGHT	7.49 mg



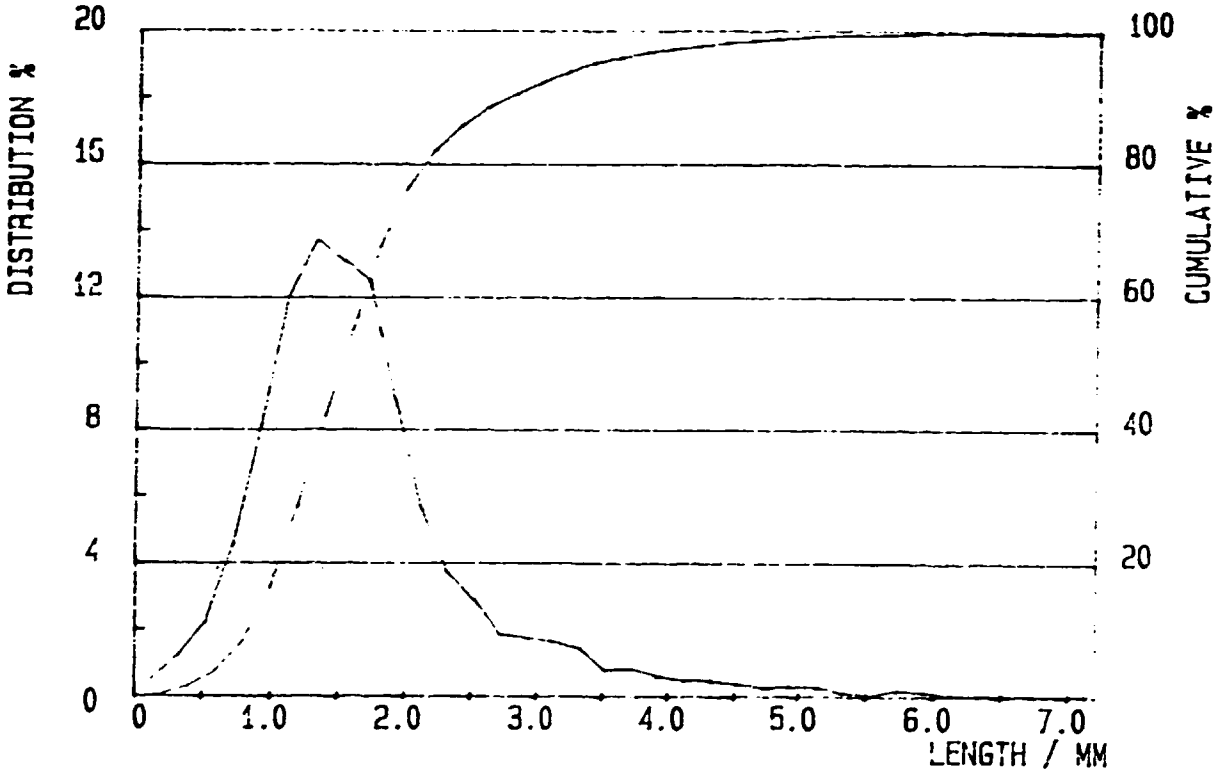
ARITHMETIC AV	1.22 mm	COARSENESS	0.113 mg/m
L WEIGHTED AV	1.65 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.07 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 7.15 % X= 0.50 %

KAJAANI FS-200 14-07-95 10:01

WEIGHTED DISTRIBUTION

SAMPLE TITLE	N/14/95-6C-0-Q-EOP-P	SAMPLE FILE NO	059
SAMPLED	14-07-95	UPPER LIMIT	6.00
ANALYSED	14-07-95 10:00	LOWER LIMIT	0.00
TOTAL FIBERS	19195	WEIGHT	7.49 mg



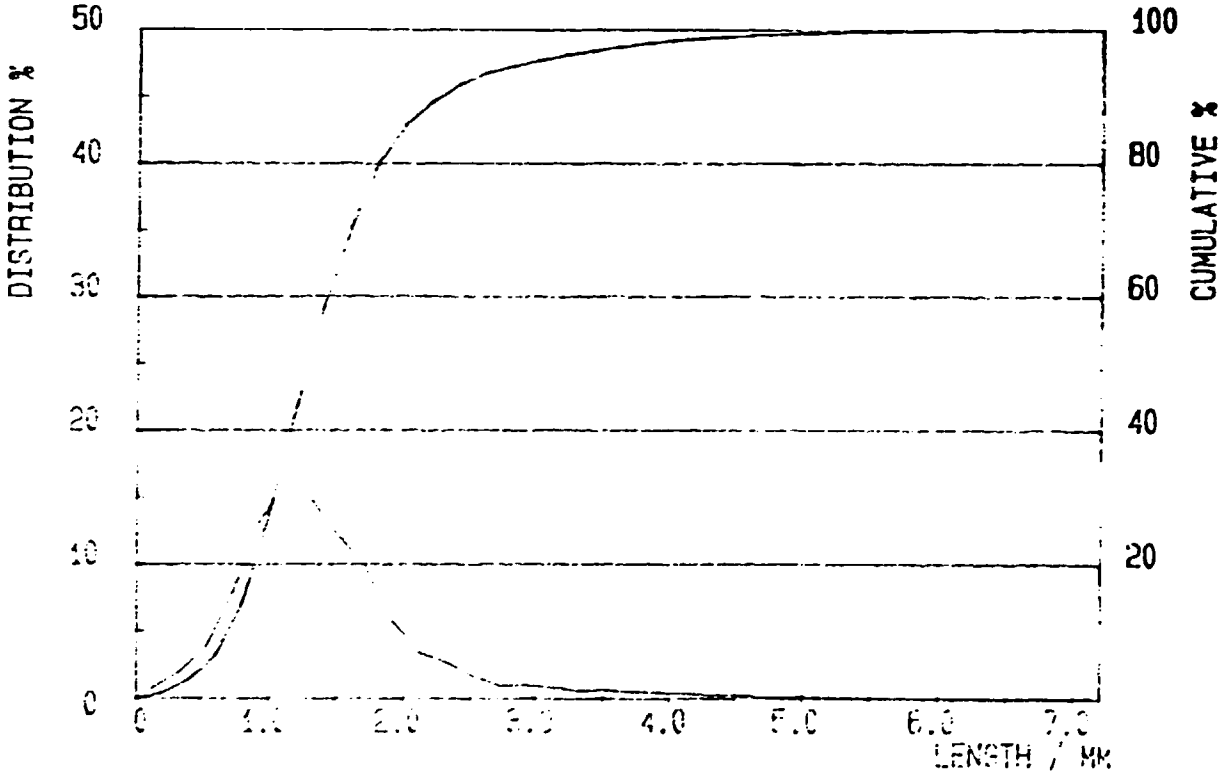
ARITHMETIC AV	1.23 mm	COARSENESS	0.116 mg/m
L WEIGHTED AV	1.66 mm	WOOD SPEC	0.0 %
W WEIGHTED AV	2.08 mm	CUSTOM /L VALUE OUT OF TABLE	

LENGTH 0.20 mm P= 6.78 % W= 0.48 %

KAJAANI FS-200 09-08-95 16:15

WEIGHTED DISTRIBUTION

SAMPLE TITLE	IVA (OGZP) 3	SAMPLE FILE NO	016
SAMPLED	07-08-95	UPPER LIMIT	7.20
ANALYSED	09-08-95 16:13	LOWER LIMIT	0.00
TOTAL FIBERS	23162	WEIGHT	6.28 mg



ARITHMETIC AV 1.02 mm
L WEIGHTED AV 1.41 mm
W WEIGHTED AV 1.94 mm
LENGTH 0.20 mm F= 8.9% W= 0.76 %

COARSENESS 0.109 mg/m