Variation in Eta Reed Pulp Properties

T.C. Mantri, U.K. Deb, Y.K. Sharma, D. Ghosh

Hindustan Paper Corporation Limited (U.N.D.P. Project)

The major species of reeds of Kerala namely **Ochlandra travancorica** *and* **Ochlandra reedii** *were subjected to chemical pulping in the Project laboratories. The variation in chemical composition and the variation in pulp properties of the above mentioned reed species due to different sites and different growing conditions were investigated. For these experiments, six samples of Ochlandra reedii and sixteen samples of Ochlandra travancorica from different ranges were collected at random. Composite samples were prepared depending upon terrain and height of the culms. Proximate analysis of chips as well as pulps was carried out. No significant difference in chemical composition due to growth conditions of the culms was observed. Eta reeds could be easily bleached by CEH sequences to 70% brightness applying about 8% of chlorine on O.D. pulp. It was further observed that both bleached and unbleached eta reed pulps have a high tear factor; much higher than bamboo pulps, even higher than kraft softwood pulps. Breaking length and burst factor are higher than of bamboo pulps and only slightly lower than those of softwood pulps. Tasman semibleached pine kraft pulp was used for comparison of optical and strength properties. The wet web strength of eta reed pulps was only slightly lower than that of Tasman pulp.*

Introduction

Eta reeds (Ochlandra species) are evergreen bamboos occuring in Kerala and other tropical areas with rainfall not less than 1500 mm. Within seven species identified in India, Ochlandra travancorica and Ochlandra reedii are the major ones in Kerala, the first prevailing. Whereas O. travancorica grows on both hill slopes and flat terrain, O. reedii is commonly found only in low elevation areas between approximately 150 to 300 metres elevation in river banks and besides water courses.

The growth behaviour indicates that new culms are produced in the rainy season and the fresh shoots elongate rapidly attaining full height within 18 months. O. travancorica reaches a height of 8 to 15 metres and a diameter of 5 to 12 cm. After attaining full height there is no (secondary) growth and only the thickening of cell wall continues for 4-5 years. Reeds exhibit gregarious flowering like bamboos.

Object of the Study

Semibleached eta reed pulp will be used as the long fibre component in the Kerala Newsprint Mill together with Eucalypt cold soda pulp. The utilisation of eta reed pulp in a furnish with bleached bagasse pulp is under consideration of Mandya National Paper Mills Limited.

In this context, it was considered of interest to study the variation in chemical composition and pulp properties from the two major reed species of Kerala and also the variations due to different sites and different heights of reeds. A literature survey revealed the paucity of published information on this subject.

Description of Reeds

Reeds belong to the family Gramineac and form one of the most important plant material of economic importance in the State of Kerala of South India. Reeds serve mankind in various ways, the important of them being the manufacture of paper. It also serves as a raw material for other cottage industries like mat weaving, basket making, handicraft etc. Out of the various reed species found in Kerala, the most important is Ochlandra travancorica. There are several other species of less economic importance. However, Ochlandra reedii also is another important reed species found in the Kerala region.

Ochlandra travancorica is an associate of the evergreen forest requiring a high rainfall for a better growth. The best reed forest types are found in areas where the rainfall is minimum of 3000 mm. In general, it is very difficult to find reeds in a area having rainfall less than 1500 mm.

Ochlandra reedii is commonly found in low elevation areas ranging from 1(0 to 300 metres. The river banks and the banks of the water ways are the most preferred regions for this species and in the higher altitudes the existence of the same is totally absent. Ochlandra reedii is never found outside its habitat which is restricted to a maximum of 100 metres length along the stream banks and water course.

In a nutshell the growth characteristics of reeds are as follows :

> The new culms are produced in the rainy season. The sprouts appear in the form of tender pointed cones covered with imbricate sheaths at the nodes, The culms elongate rapidly and as a rule attain full height within 10 months. After attainment of full height there is no secondary growth, only thickening of cell wall continues for 4-5 years. In the process of thickening ; cellulose, lignin, pentosans and other chemicals are added to the tissues.

Raw Material Sampling Plan

As mentioned above, the two major reed species, viz. O. travancorica and O. reedii, were selected for investigation. The following factors were considered important :

a. Flat ground vs. hill slope (growth terrain). However, O. reedii grows in flat terrain only.

b. Height of culms: more than 5 metres vs. shorter than 3 metres.

For sampling purpose, all reed-bearing forest ranges of Kerala were numbered and 4 ranges were selected for sampling by random numbers. Samples were collected in an area 100 m. away from the forest-non forest border. While collecting samples in each class, number of culms in 5 clumps were numbered and 5 culms were collected at random numbers. Only the mature culms of more than 2 years of age were collected. The culms were cut at a height of 60 cm above the ground. It should be mentioned that O. reedii grows only on flat terrain. Samples of O. travancorica from hilly region were collected from mid-slope.

From the samples collected, 4 composite samples of O. travancorica and 2 composite samples of O. reedii were prepared taking the terrain (flat and hilly) and height (longer than 5 m. U.S. shorter than 3 m.) as variables. The sampling plan is given in Table 1 and the composition and code numbers of composite samples are recorded in Table 2. These code numbers have been used throughout this report.

Experimental

1. Chip Preparation and Density Determination :

The reeds were chipped in the pilot plant chaff cutter and the chips passing through 1" mesh and retained on 1/4" mesh were used for detailed pulping studies.

The basic density of chip samples was determined by measurement of volume of chips washed thoroughly in water essentially according to procedure specified in APPITA Standard.

2. Chemical Analysis of Reed Samples :

The chips were disintegrated to prepare the meal passing through 60 mesh. This meal was used for proximate analysis. The analysis was carried out according to TAPPI Standard methods except for Silica and holocellulose determination, which were determined by SCAN-C-62 method and the chlorite method of Wise and co-workers[1] respectively. Ash content, silica content, organic solvent solubles (AB extractives), acid insoluble lignin (Klason) and acid soluble lignin were determined. Chip density and chemical analysis data are recorded in Table 3.

3. Pulping, Bleaching and Pulp Evaluation :

Pulping and bleaching conditions were based on previous laboratory studies[2].

The sulphate cooking was done in 2.5 litre pressure vessels, rotating in an oil bath, keeping following conditions as constant :

1. Active alkali Charge — 15% as Na_2O
2. Material to liquor ratio (including moisture in chips) — 1:3:5
3. Sulphidity — 25%
4. Max. cooking temperature — 170°C
5. Time to reach 100°C — 20 minutes
6. Time from 100°C to 170°C — 105 minutes
7. Time at max. temperature — 45 minutes
8. H. Factor — 903

TABLE 1

Sampling Plan of Eta Reeds

Species	*Range*	*A Goodericàl*		*B Vazhachal*		*C Sedlayar*		*D Thuedathil*	
	Terrain Height	*Flat*	*Hilly*	*Flat*	*Hilly*	*Flat*	*Hilly*	*Flat*	*Hilly*
	5m	A. 1.1.1 Nilackal	—	B. 1.1.1 Vazhachal	—	—	—	D. 1.1.1 Vadatt-upara	—
O. reedii	3m	A. 1.1.2 Nilackal	—	B. 1.1.2 Vazha-chal	—	—	—	D. 1.1.2 Vadatt-upara	—
	5m	A. 2.1.1. Angaum-ushi	A. 2.2.1 Moozhiar	B. 2.1.1 Pokala-pera	B. 2.2.1 Kollath-irumedu	C. 2.1.1 Sholayar	C. 2,2.1 Kamatty	D. 2.1.1 Thaluka-ndom	D. 2.2.1 Thaluka-ndom
O. travancorica	3m	A. 2.1.2 Volu-thodu	A. 2.2.2 Moozhiar	B. 2.1.2 Pokala	B. 2.2.2 Kollath-irumedu	C. 2.1.2 Kamatty	C. 2.2.2 Sholayar	D. 2.1.2 Thaluka-ndom	D. 2.2.2 Thaluka-ndom

TABLE 2

Numbering of Composite Samples

Species	*Height*	*Terrain*			
		Flat		*Hilly*	
		Sample No.	*Code No.*	*Sample No.*	*Code No.*
O. reedii	Taller than 5 metres	A. 1.1.1 B. 1.1.1 D. 1.1.1	OR-1	—	—
	Shorter than 3 metres	A. 1.1.2 B. 1.1.2 D. 1.1.2	OR-2	—	—
O. travanco-rica	Taller than 5 metres	A. 2.1.1 B. 2.1.1 C. 2.1.1 D. 2.1.1	OT-3	A. 2.2.1 B. 2.2.1 C. 2.2.1 D. 2.2.1	OT-5
	Shorter than 3 metres	A. 2.1.2 B. 2.1.2 C. 2.1.2 D. 2.1.2	OT-4	A. 2.2.2 B. 2.2.2 C. 2.2.2 D. 2.2.2	OT-6

Note : Sample nos. are from Sampling Plan (Table 1).

TABLE 3

Analysis of Various Eta Reed Samples

Code No.	*Basic Density g/cm³*	*Alcohol Benzene Extractives %*	*Lignin % Klason Lignin*	*Acid Sol. Lignin*	*Total Lignin %*	*Ash %*	*Silica %*
OR-1	0.661	7.47	20.7	2.1	22.8	4.72	3.38
OR-2	0.653	6.16	21.3	1.9	23.3	4.00	2.80
OT-3	0.655	6.68	18.7	2.1	20.9	4.90	3.60
OT-4	0.645	5.37	19.0	1.9	20.9	6.80	4.67
OT-5	0.657	6 91	20.0	1.8	21.8	6.04	4.73
OT-6	0.656	4.52	19.2	1.8	21.0	5.65	4.05

After the cooking schedule was completed, the vessels were removed from the series digester and quenched in water. After 5 minutes of quenching they were removed, opened and emptied on terylene cloth to remove black liquor (about one litre). The pulp was washed and disintegrated at 3,000 rpm for 5 minutes in a disintegrator fitted with an impeller. The disintegrated pulp was washed thoroughly free of black liquor on a Buchner funnel fitted with a terylene cloth. The washed pulp was stored at +5°C in polyethylene bags for yield determination and further analysis.

Pulp Analysis

The pulp was screened and the yield of the pulp was determined by weighing the pulp lot and taking two representative samples of 50 g from the lot to be dried in an oven at 105 ± 30°C for 6 hours. The dried samples were weighed and the yield was determined by simple calculations of percentage moisture in 50 g of the representative samples and conversion to the total weight of wet lot of pulp. The amount of rejects were also determined by weighing after drying at 105±30°C in an oven for 6 hours. The Kappa No. was determined according to APPITA Standard (P 201 m-68).

The pulp was bleached by CEH sequence keeping the following conditions constant :

C (Chlorination) — 3.0% consistency, 1 hour 25±1°C temperature, active chlorine input in % on pulp according to the Kappa number of unbleached pulp (see Annexure).

E (Alkaline Extraction) — 10% consistency, 1 hour 60±1°C temperature, 1.8% input on pulp.

H (Hypochlorite) — 10% consistency, 2 hours 50± 1°C temperature, 1.2% active chlorine charge.

Between the different bleaching stages effective water washing was done and after having finished a bleaching sequence, bleached pulp was acidified with H_2SO_4 solution in water to remove traces of active chlorine.

The physical properties of unbleached and bleached pulps were evaluated according to APPITA Standard methods. The pulps were beaten in the PFI Mill to various degrees of freeness, according to APPITA Standard :

Stock consistency	10%
Charge	25 g.o.d.
Relative speed	6.0 m/sec
Beating load	3.4 kg/cm

Handsheets of 60± 2 gm/m² were prepared. Physical testing of handsheets for breaking length, tear factor, burst factor, stretch etc. was done after conditioning the sheets of 65± 2% RH and 27 ± 1°C. These were performed according to APPITA Standard P 209 ts-75 and P 208 m-75 respectively. Brightness, scattering coefficient and opacity were determined according to SCAN methods, using ELREPHO relectometer.

The black liquor was analysed for residual alkali, total solids and sulphated ash according to Tappi Standard T 625 ts-63 and silica according to SCAN C-9 : 62.

Data on pulping and bleaching are presented in Tables 4 & 5 and on pulp evaluation in Tables 6 to 9.

TABLE 4

Data on Kraft Pulping and Bleaching of Various Eta Reed Samples

Code No.	*RO-1*	*RO-2*	*OT-3*	*OT-4*	*OT-5*	*OT-6*
Unbleached Pulp :						
Pulp yield :						
Total yield %	47.93	47.96	49.48	48.00	49.54	49.08
Screen yield %	47.57	47.81	48.99	47.63	49.09	48.73
Reject %	0.36	0.15	0.49	0.37	0.45	0.35
Kappa number	24.6	24.0	22.3	23.0	23.3	24.2
Unbleached pulp brightness %	23.1	24.0	22.6	23.6	22.2	22.2
Residual A.A. in W.B.L. as Na_2O	7.83	7.11	7.15	5.93	6.51	5.27
pH	10.85	11.3	10.05	11.05	10.95	11.0
Total Solids W/W %	16.3	16.7	16.1	16.4	15.7	16.1
Silica as dry solids W/W %	4.18	3.39	4.13	3.14	4.15	4.06
Bleached Pulp :						
Pulp Yield :						
Uubleached Pulp basis %	90.39	90.47	90.65	89.98	90.89	91.16
O.D. wood basis %	43.32	43.39	44.85	43.19	45.03	44.74
Bleached Pulp brightness %	69.8	68.8	68.3	70.4	71.1	68.50

TABLE 5

Code No.	*OR-1*	*OR-2*	*OT-3*	*OT-4*	*OT-5*	*OT-6*
Kappa Numbers	24.6	24.0	22.3	23.0	23.3	24.2
C-Stage						
Cl_2 applied %	7.0	7.0	6.5	6.5	6.5	7.0
Cl_2 consumed %	6.6	6.73	6.4	6.11	6.26	6.63
Final pH	2.0	2.0	2.0	1.9	1.95	2.05
E-Stage						
NaOH applied %	1.8	1.8	1.8	1.8	1.8	1.8
Final pH	10.2	10.3	10.4	10.5	10.0	10.2
H-Stage						
Cal. hypochlorite applied as av. % Cl_2	1.20	1.20	1.20	1.20	1.20	1.20
Cal. hypochlorite consumed as av. % Cl_2	1.15	1.15	1.16	1.0	1.15	1.11
NaOH as buffer %	0.6	0.6	0.6	0.6	0.6	0.6
Final pH	8.9	9.1	9.5	9.6	9.2	9.3
Total Cl_2 applied %	8.2	8.2	7.7	7.7	7.7	8.2
Total Cl_2 consumed %	7.73	7.86	7.3	7.1	7.4	7.74

Note : All percentages are on o.d. pulp.

TABLE 6

Pulp Evaluation of O. Reedii Sulphate Pulp in the P.F.I. Mill

Sample	*Beating rev (PFI)*	*Freeness CSF (ml)*	*Std. Drainage time (sec.)*	*Density (g/cm^3)*	*Burst Factor*	*Breaking length (km)*	*Stretch (%)*	*Tear factor*	*Double fold (km)*	*Air resistance Gurley (s/100 ml)*	*Bright-ness % (ISO)*	*Opacity (%)*	*Scatt. coeff (cm^2/g)*
OR-1 Unbleached	Unbeaten	690	3.4	0.42	13.9	3.47	1.4	212	12	—	—	—	—
	1000	669	3.5	0.48	26.5	4.51	2.6	266	86	—	—	—	—
	2000	610	3.9	0.50	34.5	5.22	3.0	285	266	1	—	—	—
	4000	490	4.9	0.53	42.0	6.00	3.7	237	722	2.6	—	—	—
	8000	285	8.3	0.59	56.6	7.06	4.9	203	2277	52.5	—	—	—
OR-1 Bleached	Unbeaten	680	3.6	0.47	12.0	3.17	1.8	219	13	—	70.7	74.2	284
	1000	640	3.9	0.52	27.0	4.50	2.7	253	82	—	70.1	72.1	262
	2000	600	4.1	0.55	29.9	4.92	3.1	247	140	1.2	69.3	71.9	253
	4000	470	5.0	0.58	43.6	6.46	4.2	210	746	5.8	68.6	70.2	238
	8000	260	9.7	0.64	54.2	6.83	4.7	187	2031	87.1	68.1	70.5	231
OR-2 Unbleached	Unbeaten	690	3.3	0.43	14.9	3.61	1.5	184	15	—	—	—	—
	1000	650	3.4	0.51	27.1	4.70	2.6	233	62	—	—	—	—
	2000	620	3.8	0.53	32.8	5.63	3.0	229	188	1	—	—	—
	4000	500	4.7	0.58	47.4	6.33	4.0	204	718	3	—	—	—
	8000	252	8.5	0.62	52.2	7.38	4.5	178	1835	—	—	—	—
OR-2 Bleached	Unbeaten	695	3.4	0.48	14.1	3.32	2.0	227	14	—	70.5	76.2	297
	1000	640	3.8	0.55	26.8	4.32	2.5	255	62	1	69.9	74.1	276
	2000	585	4.0	0.56	36.5	5.08	3.4	210	241	1.6	68.9	72.6	256
	4000	475	5.1	0.60	40.3	6.19	4.0	183	510	7.6	68.5	71.8	249
	8000	255	10.8	0.66	55.1	7.77	4.7	165	1148	100.9	67.03	70.1	233

TABLE 7

Pulp Evaluation of O. Travancorica Unbleached Sulphate Pulps

Sample	*Beating Rev. (PFI)*	*Freeness CSF (ml)*	*Std. Drainage time (sec.)*	*Density (g/cm^3)*	*Burst factor*	*Breaking length (km)*	*Stretch (%)*	*Tear factor*	*Double fold (km)*	*Air resistance Gurley (s/100 ml)*
	Unbeaten	705	3.6	0.40	10.9	3.19	1.2	201	9	—
	1000	670	3.6	0.45	23.3	4.09	2.2	295	45	—
OT-3	2000	625	3.8	0.50	23.8	4.64	2.8	292	235	—
	4000	505	5.5	0.55	41.5	6.00	4.0	266	1083	—
	8000	275	7.7	0.61	44.0	6.39	4.2	225	2024	—
	Unbeaten	695	3.3	0.43	15.4	3.56	1.4	209	15	—
	1000	660	3.8	0.48	27.7	5.17	2.5	257	86	—
OT-4	2000	605	3.9	0.51	32.8	5.20	3.0	241	229	—
	4000	470	5.1	0.56	46.0	6.56	3.7	213	858	6.1
	8000	265	9.4	0.62	53.2	6.85	4.7	173	1590	74.9
	Unbeaten	705	3.5	0.41	14.0	3.21	1.3	223	13	—
	1000	665	3.9	0.48	25.3	4.57	2.4	288	86	—
OT-5	2000	595	4.	0.151	32.6	5.39	2.9	285	284	—
	4000	495	4.6	0.54	42.6	6.24	3.7	263	1251	3.8
	8000	250	10.0	0.59	53.7	7.01	4.4	214	2308	79.3
	Unbeaten	690	3.6	0.41	12.6	3.58	1.3	203	12	—
	1000	655	—	0.49	25.8	4.81	2.8	255	113	—
OT-6	2000	605	4.0	0.51	35.2	5.34	3.2	257	255	1
	4000	500	5.0	0.55	45.9	5.91	3.7	253	1235	4.8
	8000	246	10.2	0.59	54.9	7.05	4.6	204	1883	79.6

Results and Discussion :

The chip density and chemical analysis data are recorded in Table 3. There is no difference in basic density of various samples of chips. There is hardly any important difference between various samples of eta reeds, except in silica content. O. travancorica has a higher silica content in comparison with O. reedii. The extractives content seems to be higher in culms longer than 5 m. as compared with culms shorter than 3 m. The lignin content seems to be slightly higher in O. reedii.

The results of pulping and bleaching are recorded in Table 4. All eta reed samples were well cooked by the sulphate process with the given process parameters. Practically no yield variation was observed. The screen rejects were less than 0.5% in all cases. There was practically no difference in Kappa number in all samples. Further, it appears that the alkali consumption is higher in case of O. travancorica. However, this is not reflected in the total solids and silica per cent in the black liquor which are practically constant. The black liquor silica content is high.

From Table 4 it can be concluded that an unbleached pulp of 49% yield and 23 Kappa number can be produced from eta reeds using 15% active alkali as Na_2O.

Detailed bleaching conditions have been given in Table 5 and properties of bleached pulp are shown in Table 4. From Table 4 it can be seen that the pulps produced are in desired brightness range. Thus, it can be concluded that bleached pulp of about 68 to 70% Elrepho (ISO) brightness can be produced from eta reeds with the sequence CEH under the given conditions.

The strength properties of unbleached and bleached O. reedii beaten to various degrees of freeness in the PFI Mill are recorded in Table 6. Those of unbleached O. travancorica pulps are given in Table 7 and results of bleached O. travancorica pulps in Table 8. The strength properties are also presented in Figs. 1 and 2 and the freeness scattering coefficient relationship for bleached eta reed pulp in Fig. 3. For comparison, the strength and optical properties of Tasman semi-bleached pine pulp are presented in Fig. 4. This pulp was selected for comparison as it is used in Australia as long fibre pulp for newsprint and magazine paper manufacture from eucalypt cold soda pulp. It is evident from the above mentioned tables and figures that eta reed pulps are more easily beaten than pine pulp and have higher tear factor values, but slightly lower breaking length and burst factor.

The tear factor of bleached pulps is slightly lower than that of unbleached pulps, but there is hardly any difference in breaking length and burst factor (Fig. 1) The perusal of Fig. 1 shows that there is no difference in breaking length and burst factor values of various samples of O. travancorica and O. reedii at same freeness levels. However, there are differences in tear factor. O. travancorica samples have a higher tear factor than O. reedii samples. For both species tear factor is higher in pulps prepared from culms longer than 5 m. as compared with pulps from culms shorter than 3 m. both for unbleached and bleached pulps. However,

TABLE 8

Pulp Evaluation of O. Travancorica Bleached Sulphate Pulps

Sample	*Beating rev. (PFI)*	*Freeness CSF (ml)*	*Std. Drainage time (sec.)*	*Density (g/cm³)*	*Burst factor*	*Breaking length (km)*	*Stretch (%)*	*Tear factor*	*Double fold (km)*	*Brightness (%) (ISO)*	*Opacity (%)*	*Scatt. coeff. (cm²/gm)*
	Unbeaten	690	3.6	0.44	13.1	2.65	1.5	197	10	70.8	71.9	238
	1000	650	3.9	0.50	22.9	4.27	2.7	267	65	68.4	70.7	239
OT-3	2000	610	4.0	0.52	35.2	4.90	3.4	275	190	70.6	69.6	236
	4000	465	4.8	0.58	42.9	5.39	4.1	224	690	70.0	69.6	226
	8000	235	10.5	0.63	48.1	6.38	4.4	198	973	68.6	71.3	226
	Unbeaten	690	3.4	0.47	13.8	3.18	1.7	197	11	71.0	74.7	284
	1000	650	3.6	0.50	26.5	4.26	2.7	227	58	70.1	72.0	257
OT-4	2000	580	4.0	0.56	33.5	5.24	3.1	219	171	69.4	70.0	231
	4000	445	5.5	0.60	40.8	5.96	3.9	179	539	68.4	71.2	235
	8000	205	12.7	0.66	52.5	7.23	4.7	153	977	67.4	69.1	220
	Unbeaten	690	3.5	0.46	10.9	2.82	1.7	196	8	73.3	71.4	259
	1000	650	3.8	0.50	22.2	4.32	2.5	255	53	72.2	70.9	244
OT-5	2000	600	4.1	0.52	30.4	4.74	3.2	238	182	72.1	69.2	237
	4000	450	5.1	0.58	42.2	5.61	4.0	210	630	71.8	67.2	219
	8000	235	11.8	0.61	57.0	6.92	5.0	198	1533	70.9	68.1	228
	Unbeaten	695	3.6	0.45	13.5	2.93	1.6	202	13	71.2	72.4	264
	1000	640	3.8	0.50	28.1	4.34	2.7	246	76	70.5	69.5	246
OT-6	2000	590	4.0	0.54	31.7	4.88	3.1	250	247	68.5	70.1	231
	4000	460	5.3	0.58	43.4	5.83	4.0	214	727	68.7	68.8	226
	8000	250	11.4	0.64	54.7	7.07	4.7	186	1743	67.9	68.4	212

all samples have a higher tear factor than Tasman semi-bleached pine kraft pulp. This is confirmed by the tear factor-breaking length and tear factor-burst factor relatonships (Fig. 2). Only at very low freeness levels (high breaking length and burst factor values) Tasman pine pulp has higher tear factor value.

The scattering coefficient of O. reedii pulps is higher as compared with O. travancorica pulps at same freeness level (Fig. 3). At higher scattering coefficient levels, O. reedii has a higher tear factor (Fig. 3). The scattering coefficient of eta reed pulps is higher as compared with Tasman semi-bleached pine pulp (Fig. 4).

The initial wet tensile strength index of eta reed pulps and semibleached pine pulps, unbeaten and at approximately 250 c.s.f., are recorded. O. travancorica seems to have slightly higher wet web strength as compared with O. reedii pulps, but lower as compared with Tasman semibleached pine pulp. However, only few tests were performed and more experiments are required to confirm these findings.

Conclusions

1. The basic density of the chips was between 0,645 and 0,661 g/cm^3, alcohol benzene extractives 4.5-7.4% acid insoluble (Klason) lignin content 19.2-21.3%, Silica content 2.8-4.7%. The lignin content was slightly higher in O. reedii whereas the silica content was higher in O. travancorica. There are no significant differences in chemical composition due to growth conditions or height of culms.

2. Eta reeds were pulped in laboratory digesters. Kraft pulp could be prepared using 15% active alkali on o. d. chips by cooking for 45 minutes at 170°C (H. factor 903) at a sulphidity of 25%. The yield of unbleached pulp was 48-49% at a Kappa number of 22-25. The rejects were 0.15-0.49%. There was no difference in pulping of different samples.

3. Eta reed pulps could be easily bleached by the C-E-H sequence to 68-70%. ELREPHO-ISO brightness applying 7.7-8.2% Cl_2 on o. d. pulp. The bleached yield was 43.2-45% on o. d. chips.

4. The silica content of the black liquor was 3.14-4.18% on dry solids.

5. Both unbleached and bleached eta reed pulps have an unusually high tear factor, much higher than bamboo pulps, even higher than the reference pine kraft.

6. There is no difference in breaking length and burst factor of different samples. The tear factor of O. travancorica samples is higher than that of O. reedii. For both species, pulps from culms longer than

TABLE 9

Wet Web Strength of Eta Reed Pulps at 25% Dryness

Sample No.	*Bleached Pulps*		*Uubleached Pulps*	
	CSF (ml)	*Initial Wet Web tensile index Nm/gm*	*CSF (ml)*	*Initial Wet Web tensile index Nm/gm*
OR-1	680	0.49	690	0.44
	260	1.17	285	1.23
OR-2	695	0.47	690	0.39
	255	0.97	252	1.21
OT-3	690	0.45	705	0.41
	235	1.25	275	1.11
OT-4	690	0.49	695	0.38
	205	1.28	265	1.06
OT-5	690	0.41	705	0.40
	255	1.19	250	1.04
OT-6	695	0.47	690	0.40
	250	1.27	296	1.11
Tasman Semi-bleached	730	0.44	—	—
Pine	250	1.50	—	—

FIG. I STRENGTH PROPERTIES OF DIFFERENT ETA REED SAMPLES BEATEN IN PFI MILL.

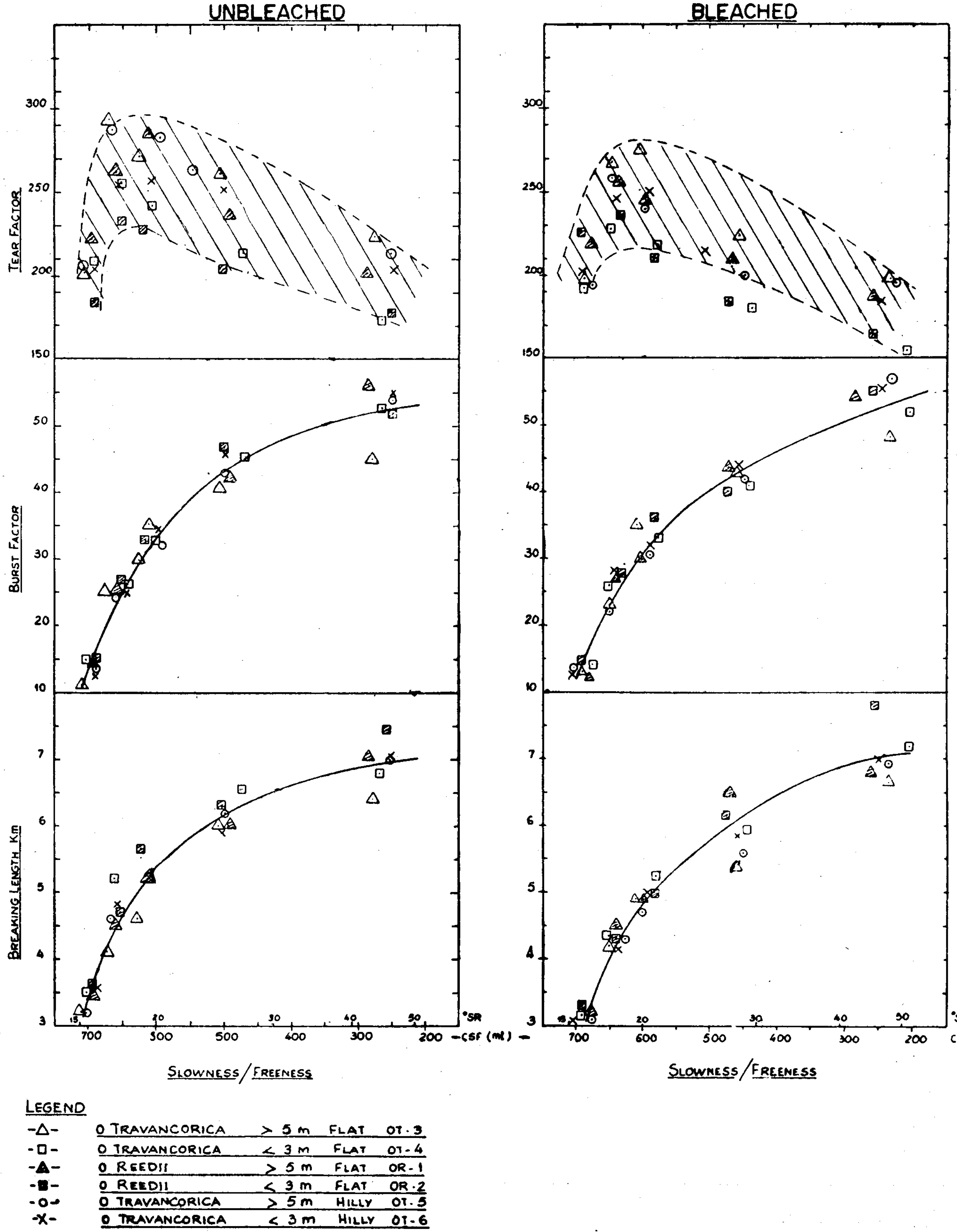


FIG. 2. TEAR FACTOR - BURST FACTOR - BREAKING LENGTH RELATIONSHIP OF DIFFERENT ETA REED PULPS.

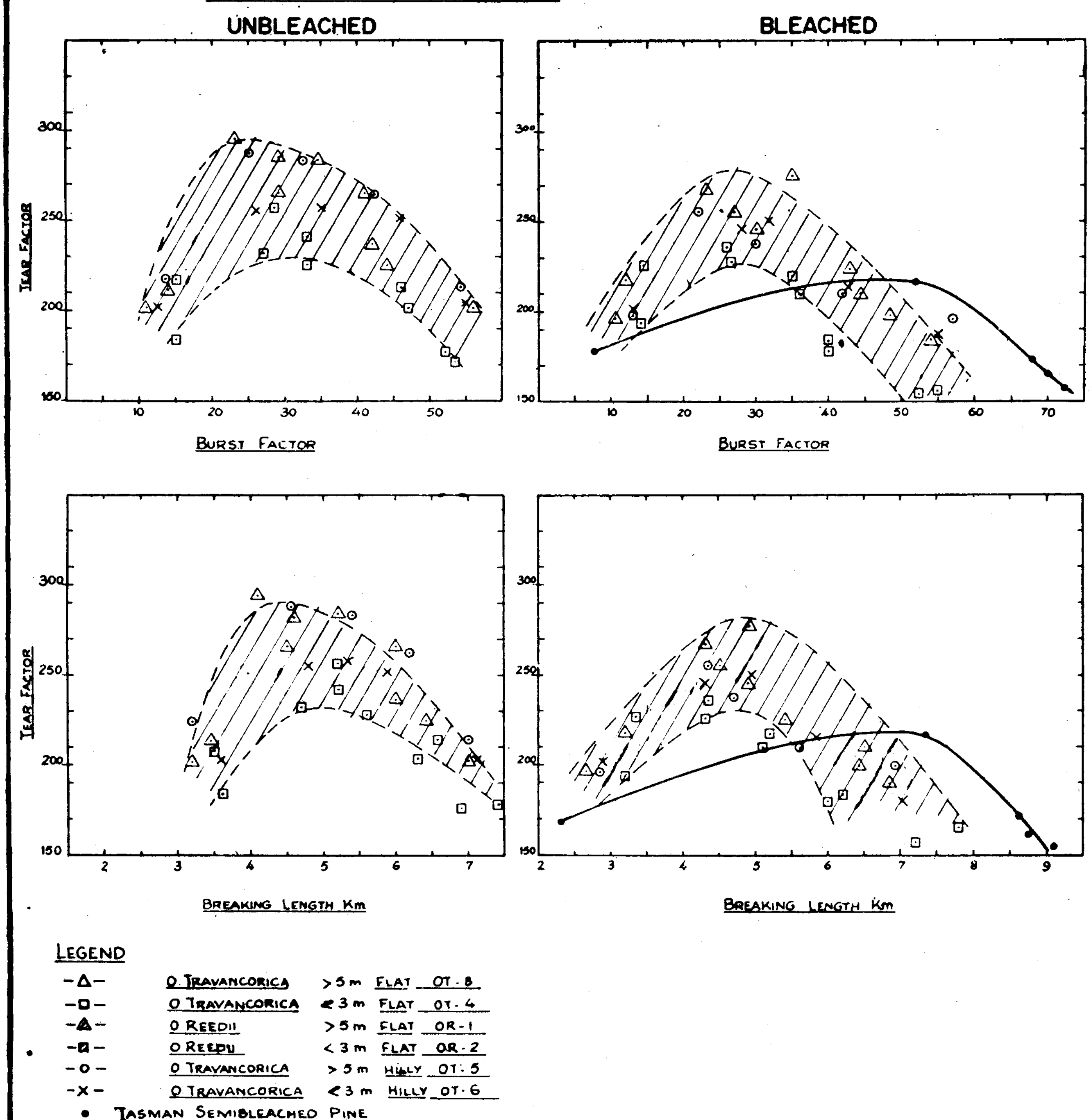


FIG. 3 SCATTERING COEFFICIENT OF ETA REED PULPS.

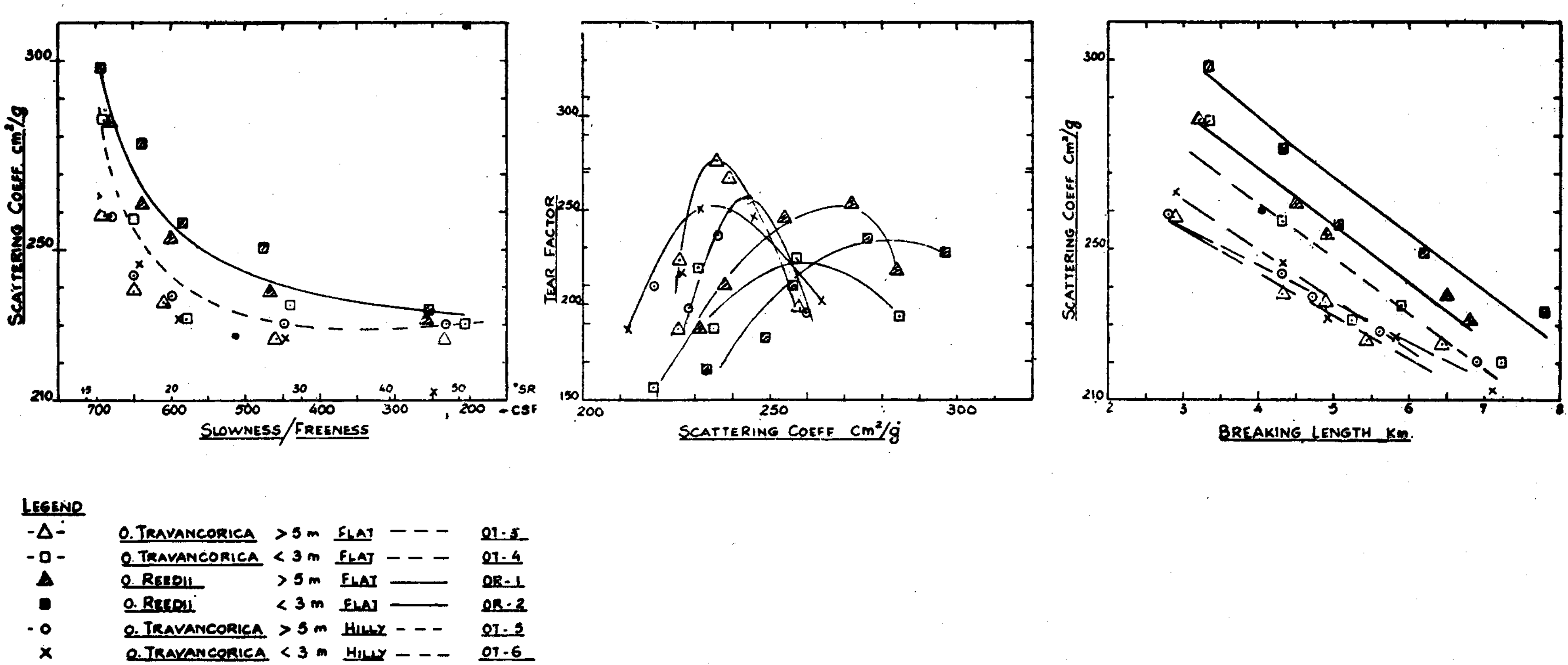


FIG. 4 STRENGTH PROPERTIES OF TASMAN SEMI-BLEACHED PINE PULP

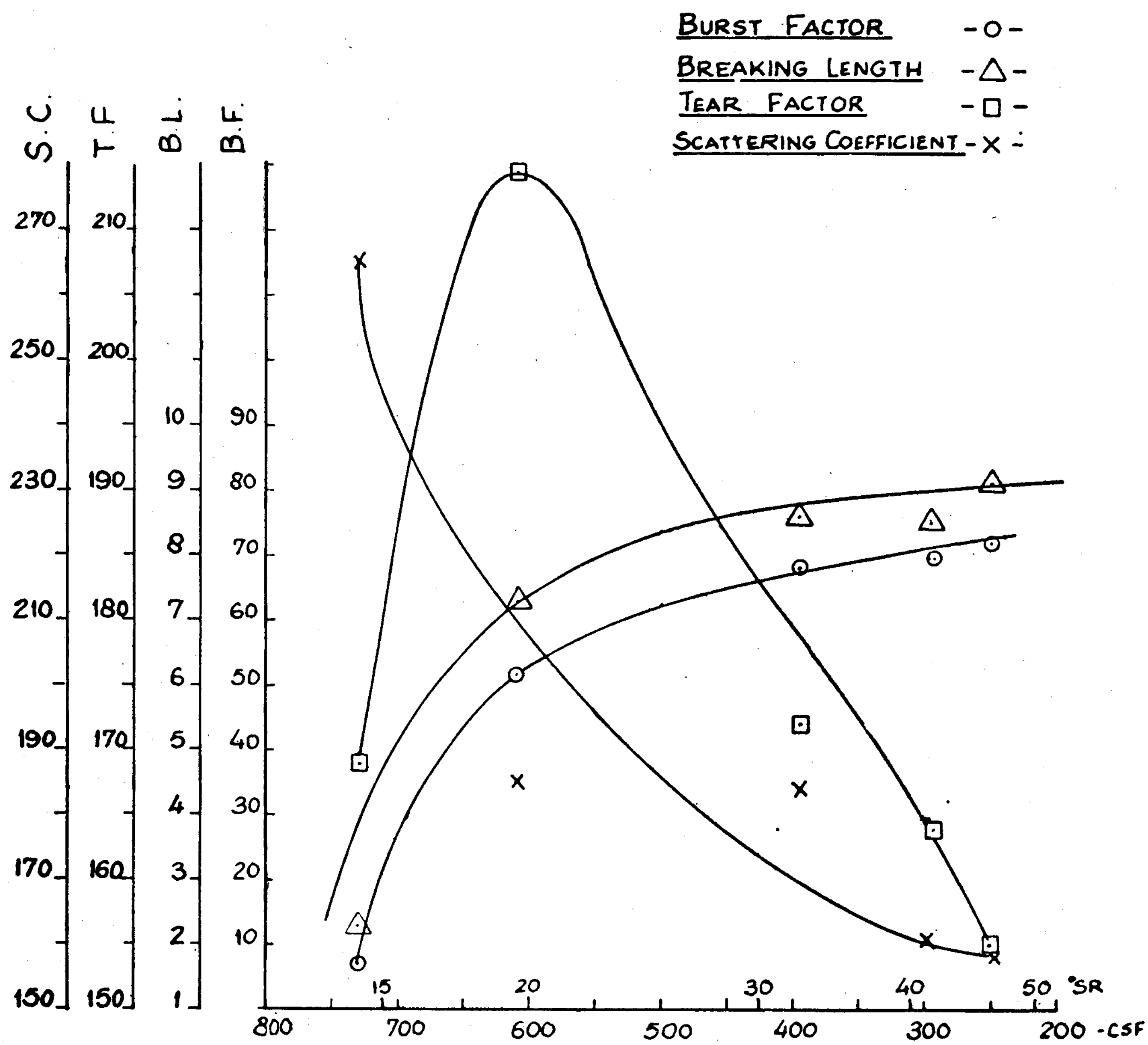
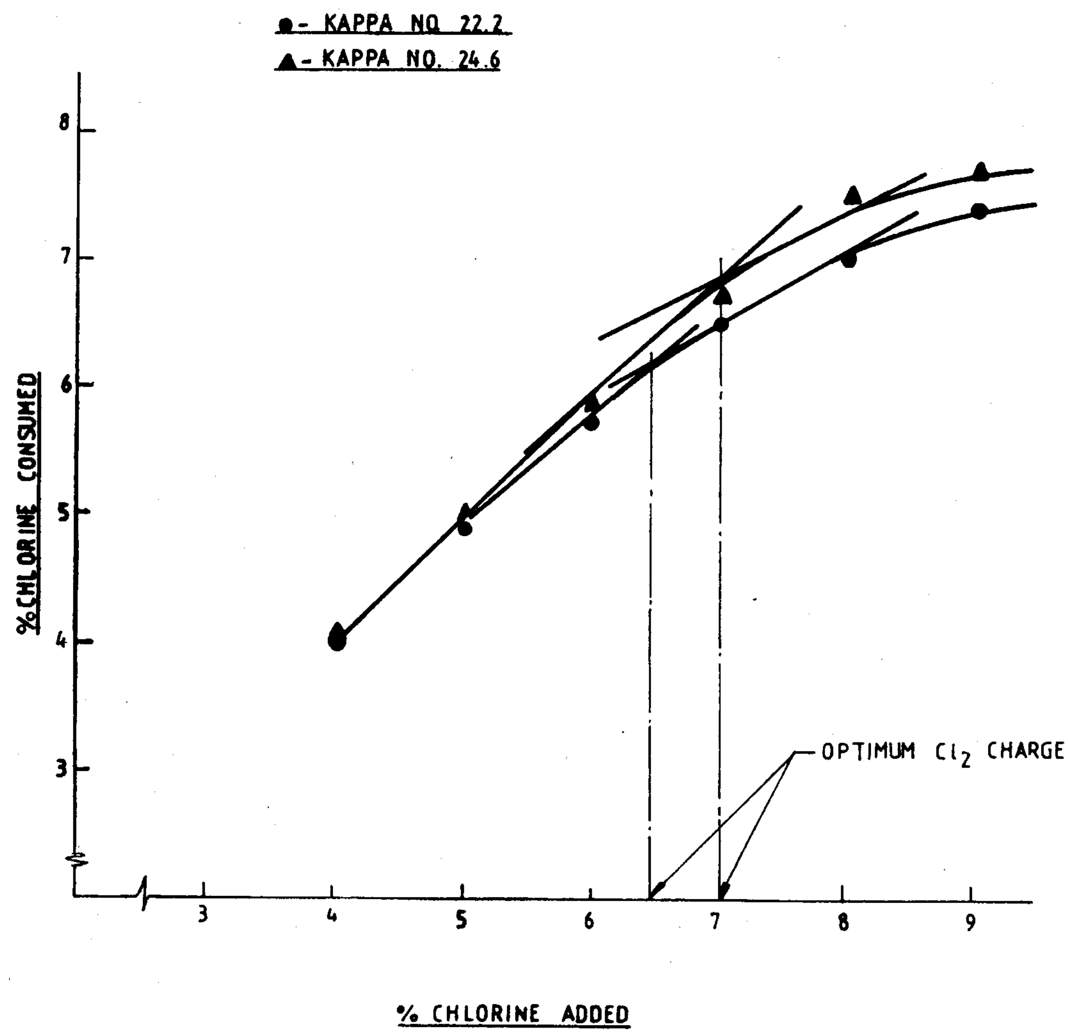


FIG -5

DETERMINATION OF OPTIMUM CHLORINE CHARGE FOR THE CHLORINATION STAGE (CEH SEQUENCE) WITH PULP OF KAPPA NO. 22.2 & 24.6



5 m. have a higher tear factor than pulps from culms shorter than 3 m.

7. The scattering coefficient of eta reed pulps is slightly higher than that of the reference Tasman pine semi-bleached kraft pulp. The scattering coefficient of O. reedii pulps are slightly higher than that of O. travancorica pulps (see Fig. 3).

8. The initial wet web strength of eta reed pulps is only slightly lower than that of the reference Tasman pine pulp.

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Annexure

For accurate determination of the chlorine charge in the chlorination stage, independent small-scale chlorinations were carried out with 25 gm. o.d. pulp and graphs prepared between applied and consumed chlorine. This was done with pulps of minimum and maximum Kappa number (22.3 and 24.6 respectively). The curves are shown in Fig. 5. It can be seen that the curves have a rising portion and a relatively flat portion. The tangents to these two parts intersect at a point which gives the optimum chlorine charge for that Kappa number. Since the Kappa number range was small, the chlorine charge for Kappa numbers between 22.3 and 24.6 was taken proportionately.