Light microscopic studies of Saccharum Munja (Sarkanda) for papermaking

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Introduction

There seems to be no doubt that non wood plant fibers will play an increasingly important role in world's pulp and paper industry especially in developing and other wood short countries.

Bagasse, rice straw, wheat straw and other annual and seasonal grasses are emerging as nonwood sources for small scale Indian paper industry too.

The important aspect for a paper mill to use a particular raw material, and to meet the social obligation is ample supply of the raw material in all seasons, minimum deterioration on storage, economical separation of fibers and above all this, is the quality of fibers. It thus becomes imperative to have an understanding of anatomical, morphological and chemical characteristics of raw material and its fibers. This paper mainly presents results of microscopic studies after laboratory pulping, bleaching and refining of the grass, sarkanda.

Saccharum munja commonly known as sarkanda is a seasonal grass found largely in Punjab, Haryana and west Uttar Pradesh. It grows to a height of 2-3 m and the stem has a diameter of about 1 cm or even less. Sarkanda is monocot belonging to the grass family.

Results and Discussion

Proximate chemical analysis

The proximate chemical analysis show that S. munja has got high Hollocellulose content and low lignin content. Its ash content is comparable to bamboo (1) but higher than bagasse (2).

Pulping

Sachharum–munja was procured from BILT, Yamunanagar, a mill that has been pulping this raw material effectively. The raw material was pulped in an electrically heated rotary autoclave digester. The conditions maintained are given below.

Cooking Conditions

Type of pulping	:	soda
Percent of NaOH charged on o.d basis	:	12%
Bath Ratio	:	1 : 3
Maximum Temperature	:	150° C
Time at maximum temperature	:	120 min
Screen Yield of Pulp	:	35%
Resultant Kappa No.	:	18 5

Samples were taken out of this pulp for fiber classification, coarseness and photomicography.

The results of Bauer Mc. nett classification and on measuring the fiber length by projection method, it became evident that Saccaharum munja gives more uniform fiber length distribution than bagasse. Approximately 90% of sarkanda pulp has an average fiber length of 1.39 mm whereas about 78% of bagasse pulp has an average fiber length of 1.25 mm (3). Fig. 1 & 2.

Bleaching

Bleaching of pulp was done by two stage hypo chlorite. Conditions maintained are given in table 3.

Refining

Bleached sarkanda pulp has a °SR of 15. This pulp was refined in PFI mill as per SCAN standard. with following conditions :

Initial °SR	15
Final °SR	40
Consistency	10%
No. of revolutions required	1750

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Table—1

Proximate chemical analysis of different raw materials

Property		S. munja (Sarkanda)	D. Strictus (Bamboo) (1)	S. officinarum (Bagasse) (2)
Solubility in				
Hot water	%	10.43	5.3	6.3
Alc Benzene	%	3.92	4.3	2.7
1% NaOH	%	41.82	24.0	18.7
Cold water	%	7.62	—	—
Lignin Klason	%	22.03	20–31	19–24
Holocellulose	%	79.13	67.3	69 90
Pentosans	%	26.5	15–26	19–24
Ash	%	4.67	1.5–4.5	1.5–5 0

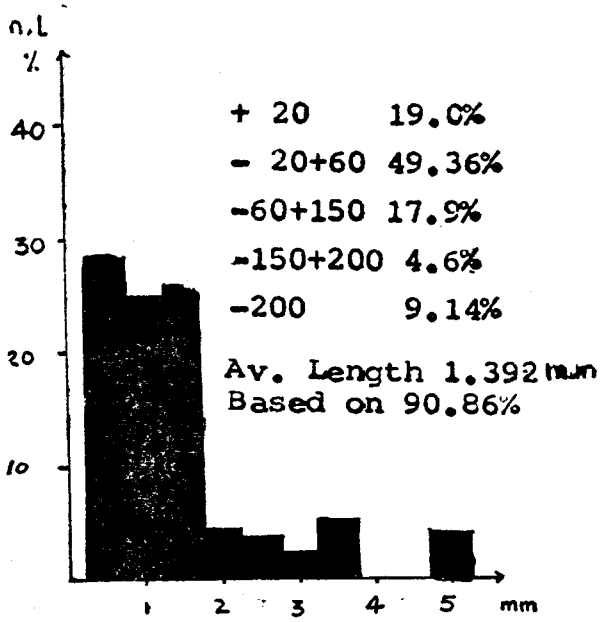


FIG.1 FIBER LENGTH & FIBER LENGTH DISTRIBUTION OF UNBLEACHED SARKANDA PULP

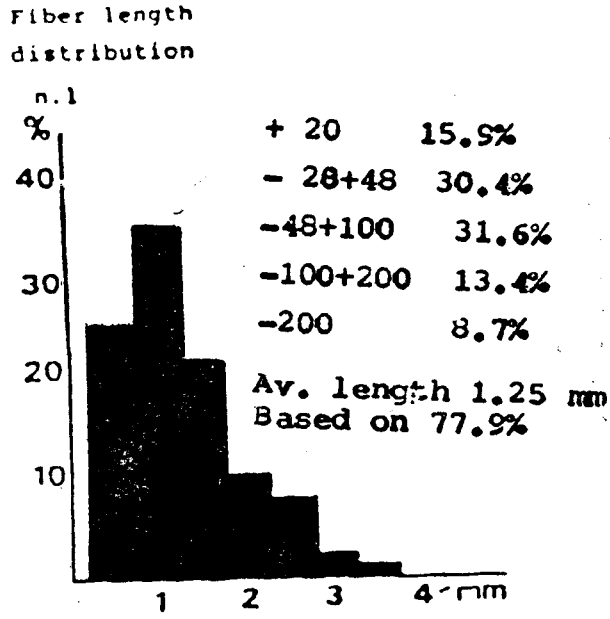


FIG.2 FIBER LENGTH & FIBER LENGTH DISTRIBUTION OF BAGASSE PULP (3)

Table—2

Bauer Mc. Nett Classification of unbleached unbeaten pulp

+20	19%
—20/+60	49.36%
—60/+150	17.9%
—150/+200	4.6%
—200	9.14%

Fiber length and fiber length distribution of bleached and refined pulp was determined by projection method. Results are shown in Fig 3 and 4.

Coarseness number of unbleached, bleached and refined pulp was determined and is tabulated in table 5.

Table—3
Bleaching conditions

Stage	Charged Av. Cl_2	Cy. %	Retention Time, Hrs	pH	Brightness % Elrepho
H_1	4 0	7.0	3	11	61.6
H_2	1 5	7.0	1.5	11	71.0

Table—4
Bauer Mcnett Classification of bleached and refined pulp

Sample	Bleached pulp	Refined pulp
Schopper Reigler	15	40
+20	10.72%	7 4%
—20/+60	51.36%	51.67%
—60/+150	20 1%	20.1%
—150/+200	5.3%	7.4%
—200	12 52%	13.43%

Table—5
Coarseness number of pulp

	Unbleached	Bleached	refined
Fiber length mm	1.392	1.302	1.013
coarseness number mg/100 m	5.29	4 626	4.193

Photomicography

Classified samples from each pulp was stained with Chlorazol black E and slides were prepared. Photomicrographs were taken using Leitz Laborlux Microscope having facility of polarised light and phase contrast. Cross section of raw material were made using Reichert Jung sliding microtome at wood anatomy branch, FRI, Dehradun.

The microscopic study of saccharum munja showed a typical monocotyledone cross section. It contains a hard and dense epidermis with ground tissue of vascular bundles, embedded in parenchyma cells, Fig. 5. At the periphery the vascular bundles are very close together and contain higher quantity of fibers than in the center of stalk.

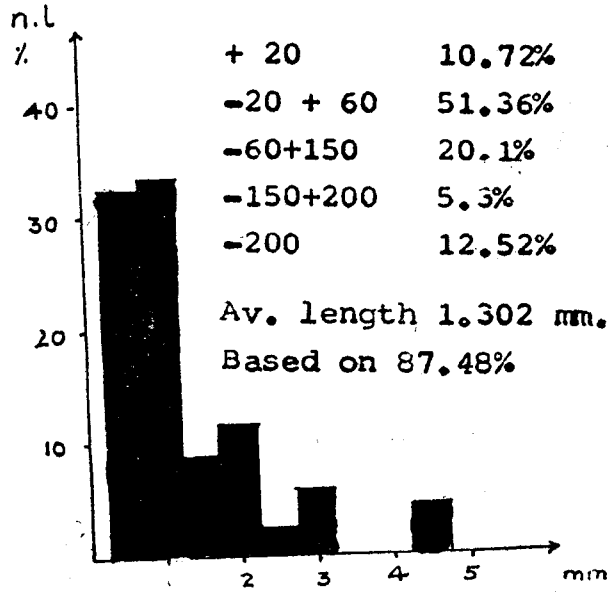


FIG.3 FIBER LENGTH & FIBER LENGTH DISTRIBUTION OF BLEACHED SARKANDA PULP

The vascular bundle consists of several types of Fig. 6. In addition to fibers, a pair of large pitted vessels and protoxylem elements with annular and spiral thickenings are present.

Fig. 7, that is photomicrograph of unbleached whole pulp shows all the cell types in the pulp samples. Fibers, vessel elements, epidermal cells are clearly visible. Fig. 8 of —200 fraction snaps all the fine creating cells. This fraction is mainly composed of parenchyma and debris.

When comparing the +60 fraction of unbleached and bleached pulp Fig. 9 & 10 under the microscope, it was observed that bleached pulp samples contains relatively lesser number of cells other than fiber which may be the reason of high amount of shrinkage during bleaching of sarkanda pulp.

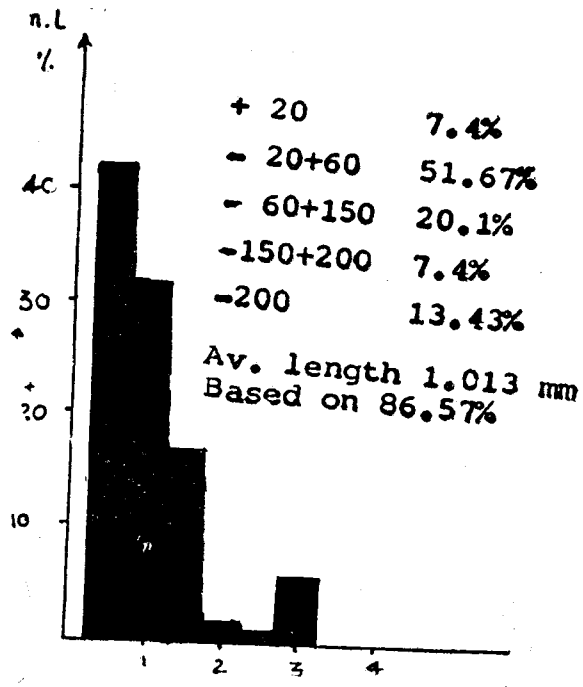


FIG.4 FIBER LENGTH & FIBER LENGTH DISTRIBUTION OF REFINED SARKANDA PULP

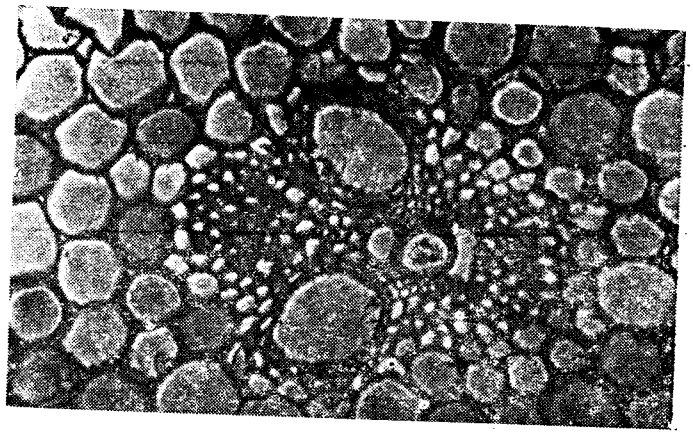


Fig. 6 Detailed Structure of vascular Bundle (500x)

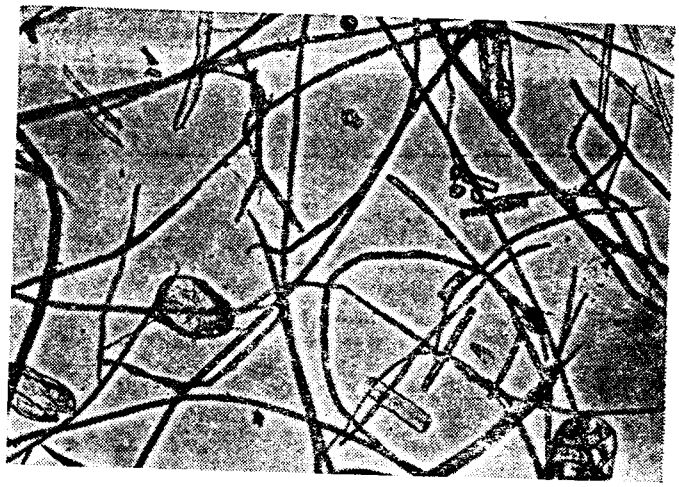


Fig. 7 Unbleached Whole Pulp of Sarkanda (125x)

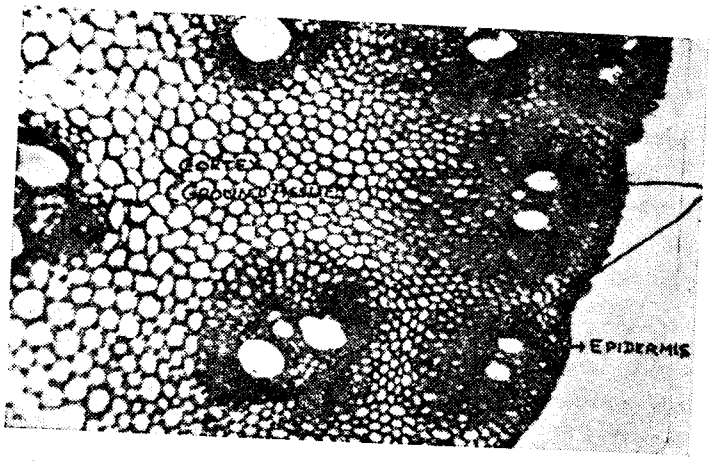


Fig. 5 Transverse Section of Sarkanda STM (125x)

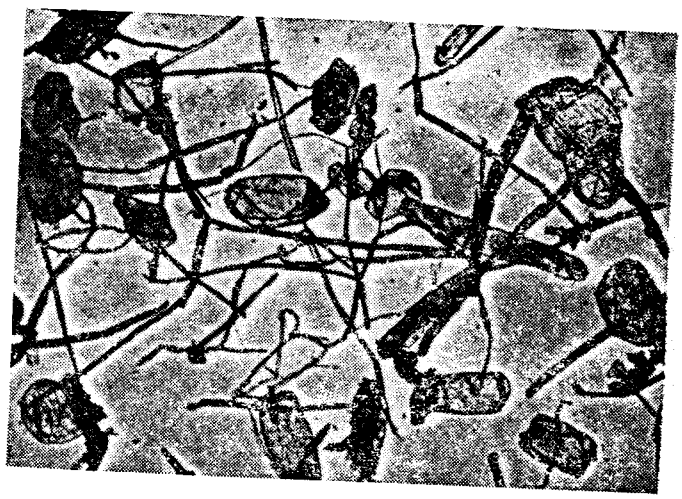


Fig. 8 200 Fraction of Sarkanda Pulp (125x)

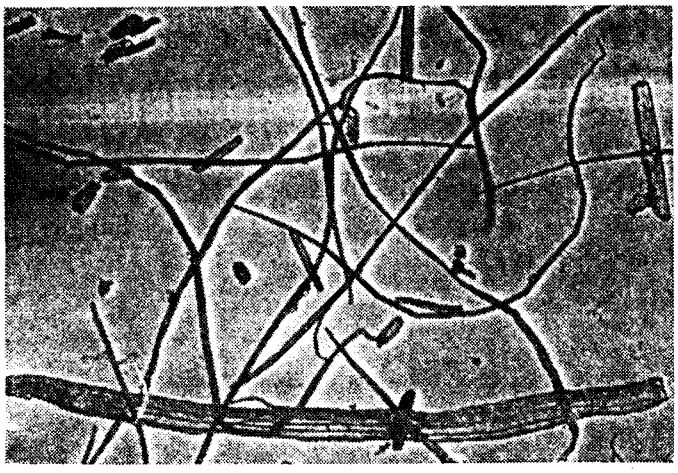


Fig. 9 +60 Fraction of Unbleached Sarkanda Pulp (125x)

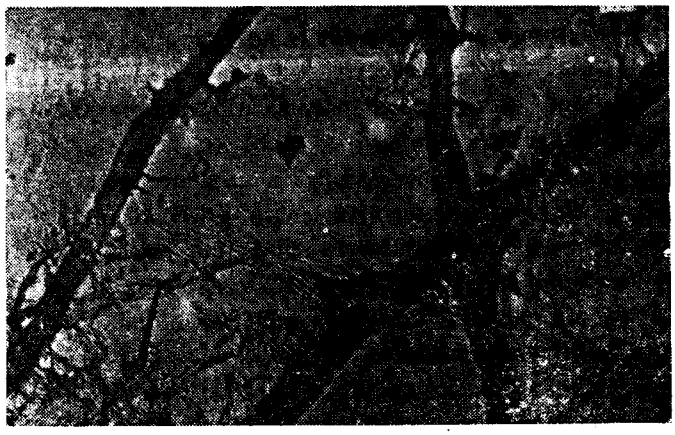


Fig. 11 Refined Sarkanda Pulp (125x)

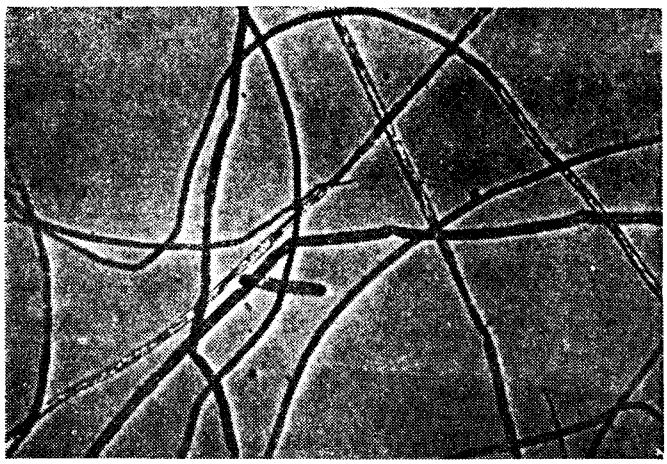
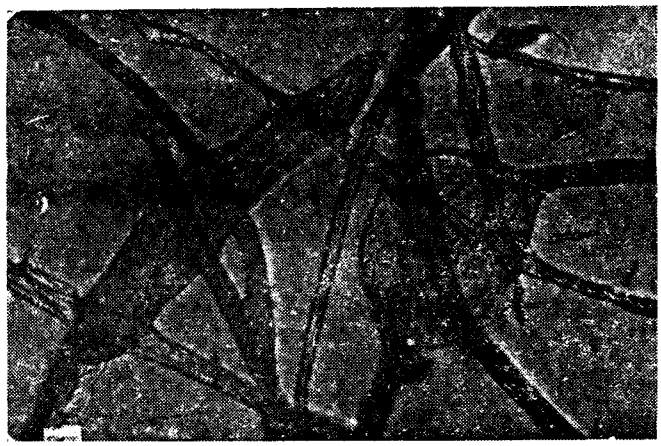


Fig. 10 +60 Fraction of Bleached Sarkanda Pulp (125x)



Fg. 12 Refined Sarkanda Pulp Fibers Showing Ballooning (500x)

Photomicrograph Fig. 11 of refined pulp shows fibrillated fiber and ruptured fine cells. Ballooning effect is clearly visible in the refined pulp fibers Fig. 12, as commonly found in refined bamboo fibers (4).

Since the fibers of sarkanda are comparatively very fine as compared to bagasse (5) they are very easily comformable to other fibers during consolidation and thus could give higher tensile and bursting strength than bagasse at same slowness level, as shown in table 7.

Table–7
Properties of Sarkanda and Bagasse pulp

Property	Saacharum munja (sarkanda)	Saccharum Officinarum (bagasse)
°SR	40	40.5
Coarseness number	4.16	8.14
Tensile Index	83.93	66.3
Burst Index KPa/g/m²	5.06	4.33
Folding Endurance	1.48	1.72

Conclusions :

Saccharum munja, sarkanda, a noonwood seasonal grass, which grows widely throughout Punjab, Haryana and Uttar Pradesh anatomically and marphologically has all the similarities to bagasse. Its holocellulose content is higher and lignin content lower to bagasse. It gives a better fiber length distribution and fibers are more finer than bagasse and thus are capable of giving good strength to paper. If available, sarkanda is a promising nonwood raw material to be used in paper industry as a blend.

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