Studies on Alkaline Sulphite Pulping of Sesbania Sesban

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SUMMARY

Sesbania sesban is one of the most promising non-wohd fibrous plant (Packing density 230-245 kg/m³) having good fibre dimensions for pulp and paper makinб. S. sesban chips were cooked by alkaline sulphite process under condition of mild to high alkalinity with terminal pH 8 ta 13, using diffrent doses of sodium sulphite (6.8 to 12.8%, as Na_2O) and sodium hydroxide (0.78 to 8.52%, as Na_2O) for diffierent periods of time at temperature (90 to 240min) using a liquor to wood ratio of 3.5:1 at 175°C, in order to know the optimum doses of cooking chemicals and to know the effect of cooking time during the course of pulping. On increasing alkalinity of the alkaline sulphite process, the rate of delignification also increased and approached to that of kraft. The pulps were evaluated for yield, selectivity of cooking and strength properties. The selected pulps were also bleached using CEHH bleaching sequence (brightness 76% Elrepho). The unbleached and bleached pulps were beaten to different °SR and further examined for its strength properties. These results indicated that S. sesban alkaline sulphite pulp should not be beaten beyond a freeness level of 42±2 °SR for getting good strength properties.

The results of the present investigations showed that the alkaline sulphite process produced pulp superior to kraft process. It resulted in increased pulp yield combined with higher pulp strength, high pulp viscosity combined with easier bleachability and a higher brightness ceiling combined with less color reversion besides lower fuel and power consumptions. It provides a simplified and more economical pulping process with less environmental pollution load.

INTRODUCTION :

Cellulosic fibres are produced through permanent regrowth of not only trees but also of large number of non-woody plants and agricultural tissues. The non-woody plants represent one of the major sources of fibrous raw materials for many developing countries of the world. Increasing difficulties in the procurement of wood have resulted in increasing interest in the utilisation of non-woody fibrous plants. In some countries, especially where wood is scarce, non-woody fibres are consequently more common as a raw material to be used for pulp, paper and board manufacture.

One of the objectives of the present investigation is to find out some suitable non-woody fibrous raw materials to supplement and to overcome the problem of raw material shortage experienced by the Indian pulp and paper Industries, to an extent. Forest based raw materials are in tremedous short supply and hence cannot meet the projected paper demand. Thus, the industry has to look towards alternative fibrous raw materials other than wood and bamboo. There is a wide scope for identifying new potential non-woody fibrous plants.

Tne structure of the group of non-woody fibrous raw materials in India is significantly different from that of other countries and regions, since in India bamboo alongwith other non-woody fibres including agricultural residues is the most important pulping raw material. Considerable amount of work[1,2] has been done to study the effect of anatomical characteristics and chemical properties of wood fibres on the nature and quality of pulp.

Over the past few decades, high yield sulphite pulping of hardwoods has been investigated as a means of making a low cost pulp for the production of news-

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print, printing and tissue papers. Different combinations of pulping variables viz. per-steaming/liquor impregnation procedure, cooking liquor pH., sodium sulphite/sodium bisulphite content, cooking temperature, time and liquor to wood ratio etc., have been tried.

In the late 60s, the alkaline sulphite (AS) pulping process was developed as an alternative to kraft pulping By 1973, the AS pulping process had been tested in pilot plant[3] and mill[4] trials. Although its immediate advantage has been the elimination of the foul odour of kraft mill while maintaining pulp strength, excellent properties of fully cooked coniferous sulphite pulps prepared under mild alkaline conditions have been reported by many investigations[5-7]. Some how, the industrial acceptance did not come forth at that time. The main reasons include the doubts concerning the cost, reliability of existing sodium sulphite recovery system, yield lower than that of kraft pulping at a given kappa number and air quality regulations less severe than that of the present.

The emergence of sulphite process at moderate alkalinity with anthraquinone (AQ) as its essential additive offers the industry a pulp of kraft like strength at higher yield and better bleachability than conventional kraft, while substantially reducing the air pollution problem. Synchronizing with this development, three sulphite recovery systems have come into commercial use, thus, removing the major obstackle to the expansion of modern sulphite technology[4]. The comparison of the process economics of the moderately alkaline sulphite-AQ process with that of kraft process is reported[8,9]. The preliminary conclusion of these studies has been that this process is very interesting from the point of view of both economy and quality but it is still in the development stage. The most promising initial applications of the process seem to be in production of packaging grades of paper and news reinforcement. The present investigations relate to the evaluation of moderately alkaline sulphite pulps of Sesbania sesban-a non-woody fibrous plant of great promise.

MATERIAL :

Sesbania sesban[10] is a softwooded, quick growing, short lived shrub and found throughout the plains of India upto an altitude of 1,200m. As the plant is quick growing, it is valued as a temporary hedge in North India. The plant is especially rich in nitrogen (4%) and exceeds the minimum requirement of 2%, over which organic nitrogeneous materials render nitro gen available for plant growth. It nitrifies soil easily and used as green manure. S. sesban is propagated through seeds, when grown as a shade plant in orchards. It is sown parallel to the row of young orchard plants with a spacing of about a foot from their periphery on rich alluvial soil. It grows up to a height about 4 5 to 6m in one season. The bark of S. sesban is the source of a fiber used for making ropes. The wood yield of one year mature plants is about 55 tonnes of green matter per hectare. The bulk density of the chips (230-245 kg/m^3) is nearly same to the bulk density of bamboo chips (225-275 kg/m^3) and less than that from hardwood chips (275-325 kg/m^3). The plant is used as a nurse in forest plantations. Its leaves are a good source of protein, calcium and phosphorus and improve the productivity and physical condition of saline soils significantly.

EXPERIMENTAL METHODOLOGY

For the present investigations, Sesbania sesban was procured from nearby Meerut region and chopped by hand to chips of approximately 20mm. in length. It was thenscreened and material passing through 12.7mm. screen but retained on 6.4 mm. screen were collected. The accepted chips were air dried under atmospheric conditions, moisture content of the fresh (green) chips varing between 55 to 60% while that of air dry chips between 8 to 12%.

PROXIMATE CHEMICAL ANALYSIS :

Screened air dry material was disintegrated in the laboratory WEVERK disintegrator. The portion passing through 40 mesh but retained on 60 mesh sieves was utilized for proximate chemical analysis, which was carried out as per standard TAPPI procedures. The results are reported in Table—I.

MACERATION AND CELLULAR ELEMENTS MEASUREMENT

Transverse and longitudinal sections of 20 to 30μ thickness of S. sesban plants were cut on Lietz base sladge microtome 1300. For morphological study, the

TABEE—1

PROXIMATE CHEMICAL ANALYSIS OF S. sesban.

Sl. No.	Particulars	Percentage Values*
1.	Cold water solubility.	2.37
2.	Hot water solubility.	6.30
3.	Alcohol–benzene solubility (1:2 V/V)	4.45
4.	1% sodium hydroxide solubility.	24.70
5.	Lignin.	17.65
6.	Pentosan	19.00
7.	Holocellulose	73.23
8.	Hemicellulose	27.80
9.	Alpha cellulose	45.24
10.	Beta cellulose	11.12
11.	Gamma cellulose	16.42
12.	Ash	1.40
13.	Silica	0.38
14.	Acetyl content	2.61
15.	Methoxyl content	3.70

*% on o. d. wood.

samples were subjected to a chemical physical maceration to separate the individual cellular elements from each other without damage. It involved the use of a hot aqueous acetic acid and sodium chlorite solution to remove most of the lignin and other binding materials without appreciable degradation of the cellulosic tissues. The microscopic slides of cellular material prepared according to IS method 5285-1969. Microscope slides were projected at a magnification of 40X and the fibre length were measured. Fibre width and cell wall thickness were obtained by measuring the projected images at a magnification of 160X. The values of density, fibre length, fibre diameter, lumen diameter, cell wall thickness and different ratios of the above dimensions are reported in TABLE—II. The frequency percentage curves of fibre length, fibre diameter, lumen diameter and cell wall thickness are represented in figures 1 and 2.

PULPING STUDIES

For the optimization of pulping conditions, S.sesban chips were cooked in WEVERK rotary digester having bombs of 1 litre capacity, furnishing sufficient pulp for evaluation as well as for conducting bleaching experiments. During these studies, technical grade chemicals werc used excepting sodium sulphite which was of analytical grade. During the course of pulping, the liquor to wood ratio of 3.5:1 was maintained. Following time schedule for digester heating was adopted.

Room temperature to 105°C:45 min.
105°C to temperature of cooking : 30 min.

The pulping studies were made using different ratios of sodium sulphite to sodium hydroxide in order to know the optimum ratio of these cooking chemicals. The cookings were also carried out for different periods to know the effect of cooking time during the course of pulping. During cooking, the digester pressure was reduced by gas relief until the temperature reached 105°C. The charge was then blown from the digester and the chips were defibred through a Bader refiner with a plate clearance of 0.1 mm, followed by a second pass at 0.15 mm, plate clearnace. The pulp was screened through a laboratory vibratory flat WEVERK screen with 0.15mm. slits and the screened pulp was washed, pressed and crumbled. The yield and Kappa number were determined. The spent liquor was analysed for residual sulphur dioxide and its pH was also determined. The results are reported in Table—III and IV.

TABLE—II

MORPHOLOGICAL CHARACTERISTICS OF *S. sesban.*

Sl. No.	Particulars	Value
1.	Colour	Pale white
2.	Density g/cm³	0.498
3.	Fibre length, (L) mm, average	0.914
	variation	0.410 to 1.12
4.	Fibre width, (D) μ average	19.174
	variation	10.355 to 28.120
5.	Lumen width, (d) μ average	8.714
	variation	3.450 to 9.784
6.	Cell-wall thickness, (W) μ average	5.235
	variation	2.60 to 9.756
7.	Flexibility coeff-icient (d/D) x 100	45.44
8.	Ratio twice cell wall thickness to fibre width (2W/D)	0.546
9.	Runkel ratio, (2 W/D)	1.20
10.	Ratio of cell wall area to total cross sectional area %, (Muhlesteph ratio)	81.3
11.	Ratio of length to width, (L/D)	47.66
12.	Ratio of cell wall thickness to lumen width (W/d)	0.60

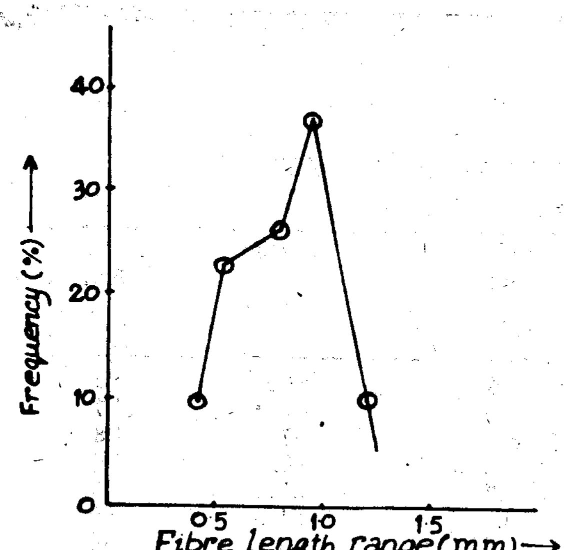

FIG.-1: Plots of fibre length range(mm) versus frequency(%) for S. sesban

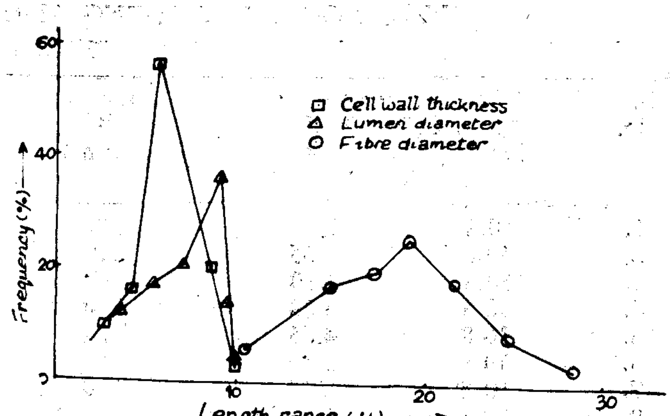

FIG.-2: Plots of length range (μ) of cellwall thickness, lumen diameter and Fibre diameter versus frequency(%) for S. sesban

TABLE—III

PULPING WITH VARYING AMOUNT OF SODIUM SULPHITE AND DIFFERENT COOKING TIME.

Sl. No.	Chemical charge % on O.D. Wood Na_2SO_3 (As Na_2O)	NaOH	Time at 175°C (min)	Spent Liquor SO_2 (gpl)	pH	Yield %	Kappa No.
1.	6.8	6.2	180	6.5	9.0	61.7	81
2.	7.8	6.2	180	7.0	9 2	57 6	70
3.	8.8	6.2	180	7.6	9 3	56.0	55
4.	9 8	6.2	180	7.7	9.6	:2 5	42
5.	10.8	6 2	180	8 1	10.2	49.8	34
6.	11.8	6.2	180	8.8	10.5	47.5	30
7.	12.8	6.2	180	9.2	10.6	46.7	28
8.	6.8	6.2	210	6.2	8.9	62.0	83
9.	7.8	6.2	210	7.2	9.2	57.0	69
10.	8.8	6.2	210	8 1	9.4	53.4	52
11.	9.8	6 2	210	8 0	10 1	50.5	38
12.	10 8	6.2	210	8.7	10.3	48.0	32
13.	11.8	6.2	210	8.9	10 2	46.2	27
14.	12.8	6.2	210	9.4	10 2	45 2	25
			EFFECT OF COOKING TIME				
15.	10.8	6 2	30	10.0	10.4	62 5	85
16.	10 8	6 2	60	9.7	10.1	53 4	72
17.	10.8	6.2	90	9.5	10 2	54.7	50
18.	10.8	6.2	120	9.3	10.0	53 2	46
19.	10 8	6.2	150	9.2	10.1	50 4	37

Liquor to wood ratio = 3.5:1
Time to raise from 30 to 105°C = 45 min.
Time to raise from 105 to 175°C = 33 min.

TABLE—IV

PULPING WITH VARYING AMOUNT OF SODIUM HYDROXIDE AND DIFFERENT COOKING TIME

Sl. No.	Chemical charge % on O.D. Wood Na_2SO_3 (As Na_2O)	NaOH	Time at 17°C (Min.)	Spent liquor SO_2 (gpl)	pH	Yield %	Kappa No.
1.	10.8	0.78	240	6.3	7 4	63 3	91
2.	10.8	1 55	240	6.7	8.0	60.0	82
3.	10 8	3.10	210	6.6	8.9	57.5	78
4.	10.8	3.88	210	7.5	9.4	56.0	70
5.	10.8	4.65	210	7.9	9.7	55.2	56
6.	10.8	5.42	180	8.0	10.0	51.0	39
7.	10 8	6 20	180	8.1	10.2	49 8	34
8.	10.8	6 98	165	8.6	11.2	46 4	28
9.	10.8	7.75	120	9.1	11.6	42.7	26
10.	10.8	8.52	90	9.3	12.0	39.5	22

Liquoa to wood ratio = 3.5:1
Time to raise from 30°C to 105°C = 45 min.
Time to raise from 105°C to 175°C = 30 min.

BLEACHING STUDIES

Since the alkaline sulphite process in its original form is found to be less selective than the kraft process with respect to delignification in the bleachable range, one would expect that the cost of bleach chemicals would be correspondingly higher. This, however, is not the case. The S. sesban alkaline sulphite pulps are somewhat easier to bleach, have a higher brightness ceiling and suffer considerably less brightness reversion. A three stage, chlorination, caustic extraction and hypochlorite (CEH) bleaching sequence was applied to selected pulp. The bleaching conditions and results are given in Table—V.

PULP EVALUATION

The unbleached and bleached alkaline sulphite pulps of S. sesban were beaten in a PFI mill with a beating pressure of 1.8 Kgs/cm. to different freeness levels and hand sheets of 60 g/m² were prepared on a standared British Sheet Forming machine. These handsheets were evaluated as per ISI standare for their physical strength properties at a relative humidity of 65 ± 2 % and a temperature of 27 ± 2°C. The pulp evaluation results are tabulated in Tables—VI and VII.

TABLE—V

CONDITIONS AND RESULTS OF BLEACHING

Sl. No.	Particulars					Values
1.	Unbleached pulp Kappa number.					32
2.	Chlorination stage (C)					
	Chlorine applied as available Cl_2 on pulp,			%		4.78
	Chlorine consumed as available Cl_2 on pulp,			%		4.76
	Final ph					1.90
3.	Extraction stage (E)					
	NaOH applied on pulp,			%		2.0
	Initial pH					11.30
	Final pH					9.90
4.	Hypochlorite stage 1st (H_1)					
	Hypo applied as available Cl_2 on pulp,			%		1.80
	Hypo consumed as available Cl_2 on pulp,			%		1.76
	Final pH					8.0
5.	Hypochlorite stage IInd (H_2)					
	Hypo applied as available Cl_2 on pulp,			%		0.74
	Hypo consumed as available Cl_2 on pulp,			%		0.70
	Final pH			%		7.80
6.	Total Cl_2 applied on pulp,			%		7 32
7.	Total Cl_2 consumed on pulp,			%		7 22
8.	Bleaching losses,			%		10.30
9.	Yield of bleached pulp,			%		43.90
10.	Brightness,			% (EL)		76.00
11.	Viscosity CED (0.5%)			CP		11.00
12.	Bleaching conditions	C	E	H_1	H_2	
	Consistency, %	3	10	9	10	
	Temperature, °C	27±2	58±2	45±2	42±2	
	Time (Minutes)	30	120	60	120	

TABLE—VI

PULPING CONDITIONS Vs PULP CHARACTERISTICS

Cood No.	Chemical charge % on O.D. Wood Na_2SO_3 (As Na_2O)	NaOH	Time at 175°C (Min)	Spent Liquor SO_2 (gpl)	pH	Pulp Yield %	Kappa Number	Freeness (°SR)	Burst Index (K.Pa m²/g)	Tear Index (mN.m² /g)	Tensile Index (Nm/g)	Folding endurance Kohler Molin
						Terminal pH 8 to 12						
S 1	7.8	6.2	210	7.2	9.1	56.2	66	40	2.96	3.54	42 40	82
S 2	8.8	6.2	210	7.6	9 3	53.6	52	41	3.12	3.95	45.16	95
S 3	9.8	6.2	180	8.0	9 6	50.0	40	40	3.85	4.16	47.82	102
S 4	10.8	6.2	180	8.2	10.1	49.0	42	42	4.20	4 50	51.40	138
S 5	11.8	6.2	150	8.1	9.8	47.7	31	39	4.25	4.66	52 00	140
S 6	10.8	6.2	210	9.2	10.0	50.0	31	40	4.10	4.60	51.75	135
S 7	11.8	6.2	210	8.1	10.3	47.2	30	42	3.90	4.28	50.20	130
						Terminal pH 12 to 13						
S 8	10.8	7.75	120	9.2	11.6	42.2	25	40	3.47	4.10	42.85	85
S 9	10.8	8.52	90	9.4	11.9	39.0	20	41	3.38	4.25	43.20	91
S 10	10.8	9.30	60	9.7	12.1	37.4	18	41	3.35	4.28	41.76	80

Liquor to wood ratio = 3.5:1
Time to raise from 30C to 105°C = 45 min.
Time to raise from 105°C to 175°C = 30 min.

TABLE—VII

STRENGTH PROPERTIES OF UNBLEACHED (COOK NO. S_4) PULPS AT DIFFERENT LEVELS OF FREENESS

Sl. No.	PFI Revolution (Nos)	Freeness (°SR)	Drainage time (seconds)	Apparent density (g/cm³)	Tear Index (mNm² /g)	Burst Index KPam² /g)	Tensile Index (Nm/g)	Folding endurance Kohler Molin	Poresity Bendtsen (ml/min)	Brightness (Elrepho) %	Opacity %
					Unbleached pulp						—
1.	0	14	3.8	0.64	2.56	0.92	14.41	10	1250	—	—
2.	1300	30	10 5	0.70	5.20	3.52	43.46	170	310	—	
3.	1600	35	13.5	0.72	5.80	4.04	48.85	220	195	—	—
4.	2400	47	19.0	0,75	4.37	4.74	56.37	242	95	—	—
					Bleached Pulp						
5.	0	16	4.3	0.65	1.92	0.98	15.65	10	1060	75.7	89.0
6.	1100	32	13.0	0.73	4.61	3.10	40.50	81	240	73.2	86 4
7.	1300	40	17.1	0.77	4.95	3.81	46.12	95	160	71.4	84 3
8.	1500	45	19.5	0.78	3.90	4.12	51.24	110	80	69.5	82.0

FIBRE CLASSIFICATION STUDIES :

The fibre classification studies of S. sesban alkaline sulphite pulps were made with the help of Bauer-McNett fibre classifier using screens of mesh numbers 20, 60, 80 and 120. The results are reported in Table—VIII.

RESULTS AND DISCUSSIONS

The results of proximate chemical analysis indicated that the plants of S. sesban have moderate quantities of solubles, thereby, creating lesser pitch trouble with improved homogenity in the paper sheet. It has low lignin and high alpha cellulose content, thereby, requiring lesser quantity of cooking chemicals with shorter cooking cycle and giving comparatively higher pulp yields.

The S. sesban non-woody fibrous plant consist, of polygonal sclerenchyma cells and the thickening of cells is due to the deposition of lignin. The microscopic studies of transverse as well as longitudinal sections of S. sesban revealed that the S. sesban has a large number of vessels arranged in a scattered manner and they form diffuse porous wood. The vessels of S.sesban are small having oblique septa. These vessels are short, barrel, shaped, having numerous pits. The longitudinal section of S. sesban are having unicerate medullary rays. The fibres of S. sesban are thick walled with gradually tapering pointed ends, smoot walls, narrow lumen and very spares slit like pits.

The amount of sodium sulphite charged had a considrable influence on the rate of cooking. The results of a series of S. sesban bomb scale digestions, cooked at constant temperature and time with the addition of sufficient sodium sulphite to give a spent liquor pH close to 10 (Table—III) are plotted in Figure—3. The amount of residual lignin decreased from 8% of the original wood to less than 2% as the sodium sulphite charge was increased from 6.8 to 12.8% (as Na_2O). The second series of cookings with increased time showed that the increase in time had little influence on the amount of lignin removed and it might have possibly caused redeposition where the digestions were made with small amounts of sulphite. From the cooking results, an optimum sulphite charge of about 10.8 % (as Na_2O) was indicated. Increasing the amount of sodium sulphite also improved the selectivity of cooking. Figure—4 providing a comparison of Kappa Number at same yield indicated that as Kappa number increased, the yield also increased. In Figure-5 the residual lignins (Kappa No. X 0.15) are plotted against cooking time. A high initial rate of delignification was indicated which decreased steadily with an appreciable amount of the lignin being quite resistant. The initial high rate of delignification, which is common in a varying degree, to nearly all delignification process, is undoubtedly partly due to high initial alkali concentration in the cooking liquor. It may also correspond to easily assessible and less condensed lignin where its high rate of dissolution coincides with that of wood polyoses. The interaction of lignin and hemicelluloses in the wood was probably one of the major factors affecting the rate and selectivity of the delignification during the later stages, whether this involves a primary or secondary valence bond or both.

TABLE—VIII

BAUER-MC-NETT FIBRE CLASSIFICATION OF UNBLEACHED AND BLEACHED PULPS

Sl. No.	Mesh size	Unbleached pulp, Freeness 14 °SR Kappa No. 32) (%)	Bleached pulp, (Freeness 16 °SR) (%)
1.	+ 20	17·0	13.4
2.	— 20 + 60	42.0	25.7
3.	— 60 + 80	20.5	26.5
4.	— 80 + 120	6.0	14.0
5.	— 120	14.5	20.4

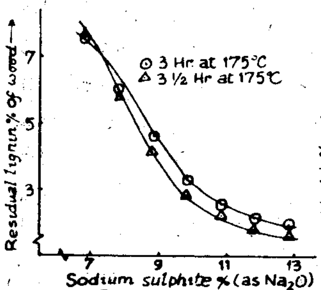

Fig-3: Relation between amount of sodium sulphite versus residual lignin removal during alkaline sulphite pulping of S. sesban

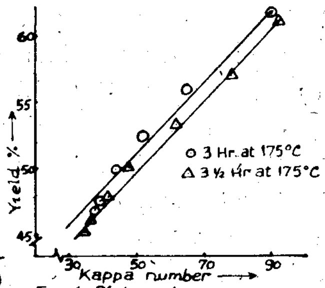

Fig-4: Plots of Kappa number versus pulp yield % of S. sesban alkaline sulphite pulping at different cooking time

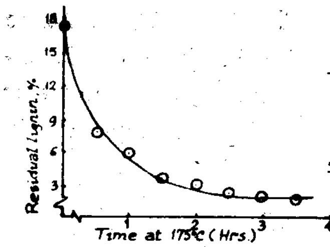

Fig-5: Relation between cooking time and degree of lignin removal during alkaline sulphite pulping of S. sesban

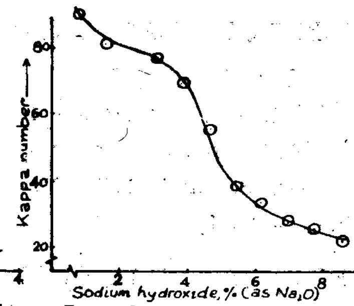

Fig-6: Plots of sodium hydroxide charge versus kappa number during alkaline sulphite pulping of S. sesban

The plote between Kappa number and caustic charged (Fig.—6) clearly indicated that the rate of cooking was faster at higher alkalinity. The pH of the cooking liquor increased with the addition of caustic, keeping the amount of sadium sulphite constant (Table—IV). As the caustic charge increaced from 0.78 to 8.52% (as Na_2O), the Kappa number decreased ftom 91 to 22, due to higher rate of delignification at higher alkalinity. The decrease in Kappa number was very sharp at lower doses of alkali (below 4.65 % as Na_2O) but the cooking rate was greatly influenced beyond a caustic dose of 4.65%. Time at maximum temperature continuously decreased as the amount of alkali increased. An increase in the terminal pH of spent liquor reduced the cooking time at maximum temperature by approximately 70%.

The pulps were evaluated at a freeness level of 41 ± 1 °SR. The burst, tear, and tensile indexes increased with decreasing Kappa number and reached their optimum values around a Kappa number of 31 and then decreased with decrease in Kappa number. The folding endurance also showed similar trend. The prolonged digestion with high doses of chemicals required for obtaining pulps with low Kappa number using caustic soda undoubtedly results in the loss of fibre strength.

S. sesban alkaline sulphite pulps showed good response towards optical properties and were having decidely superior values for both brightness and opacity. The pulp with a brightness level of about 76 % (Elrepho) was obained as a result of four stage (CEHH) bleaching sequence because the unbleached pulps also possessed a good level of brightness. Due to high initial brightness, the total chlorine consumption was low during bleaching.

The unbleached and bleached pulps of selected cooks were beaten to different °SR levels and their physical strength properties are reported in Table-VII. The initial freeness and drainage time of both unbeaten pulps were found to 14–16 °SR. The plots of unbleached and bleached pulps at different freeness levels versus various physical strength properties are shown in Figures 7 and 8, respectively. These plots clearly indicated that the apparent density is almost directly proportional to the freeness of pulp. The unbeaten bleached pulp had a higher initial apparent sheet density. These plots also indicated that both the tear index and porosity are indirect proportional to the freeness levels i.e., both decreased with an increase in freeness level. The apparent density, burst index, tensile index and folding endurance are in direct proportional with freeness. The strength properties increased upto a certain °SR, after, which it showed a declining trend as a result of over beating/or higher freeness values. It is obvious from these results that the pulp should not be beaten to a freeness range beyond 42 ± 2 °SR.

CONCLUSIONS :

The present investigation was undertaken to study whether S. sesban-could be a potential non-wood fibrous raw materal for pulp and paper making and to study the effect of fibre dimensions on the formation and structure of paper. S sesban is a soft wooded, fast growing but short lived shrub, cultivated throughout the plains of India upto an altitude of 1200 meters.

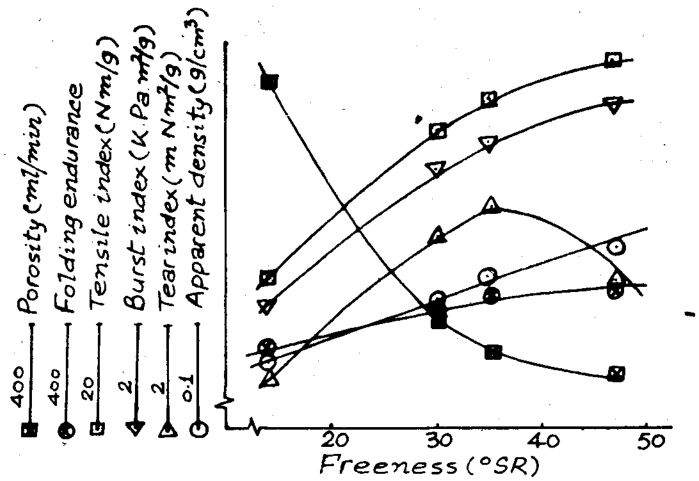

FIG.-7: Plots of pulp freeness (°SR) versus strength properties of S. sesban unbleached alkaline sulphite pulps.

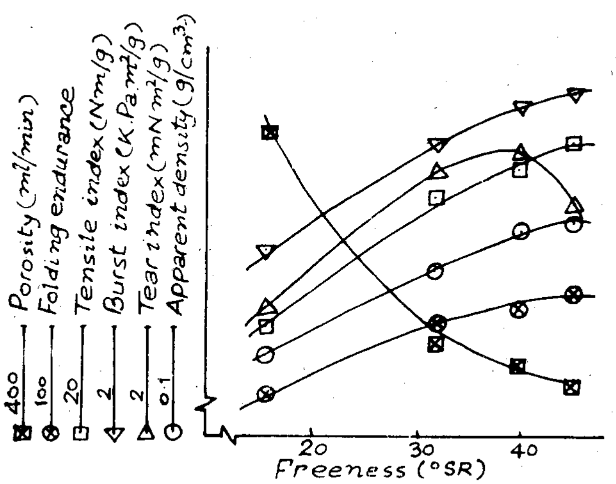

FIG.-8: Plots of pulp freeness (°SR) versus strength properties of S. sesban bleached alkaline sulphite pulps.

It can also be grown under water logged condition and in acidic soils. It it is propagated through seeds. It' nutrifies soils easily and is used as green manure. S. sesban bark is the source of a fibre used for making ropes. The plant yields about 56 tonnes of green matter per hectare. The packing density of chips is about 230–245 kgs/M³. The abundant availability and fibre dimensions indicated that it could be one of the most promising non-woody fibrous raw materials for pulp and paper making.

The long digestion time required for alkaline sulphite pulping of S. sesban can be reduced by increasing the alkalinity of cooking liquor to a pH level of 10 or above and still produce a pulp superior to kraft. With increased alkalinity, the rate of delignification also increases and approaches to that of kraft. The selectivity at moderate alkalinity is superior to and at high alkality equal to kraft. The proportion of sodium hydroxide greatly influerces the rate of delignification during alkaline sulphite pulping. The unbleached and bleached pulps show good strength properties, especially burst and tensile. The strength of the pulp, especially the tear, is largely governed by the alkalinity of the cooking liquor and it reaches maximum at a terminal pH of 9 to 11. Bleachable grade pulps delignity much readily than krakft pulps in a conventional bleaching sequence. Because of easy bleaching characteristics, it also has great potential for use in chlorine free bleach sequence.

The results of present investigation demonstrate advantages of alkaline sulphite process over the kraft process. It has increased pulp yield combined with higher pulp strength, high pulp viscosity combined with easier bleachability, a higher brightness ceiling combined with less brightness reversion besides lower fuel and power consumptions It provides a simplified and more economical pulping process with little odour as an alternative to kraft process.

REFERENCES

1. Barefoot, A.C., Hitchings, R G. and Ellwood, E L. TAPPI, 49 (4), 137-47 (1966).

2. Dadswell, H.E. & Watson, A J., Bolanm's Formation and structure of Paper. British Paper and Board Maker's Association London, 537–72 (1962).

3. Ingruber, O.V. and Allard, G.A. Pulp & Paper Mag. Can , 73 : T 354–369 (1973).

4. Peltonen, J.V.A. TAPPI/CPPA International Sulphite Pulping & Recovery Conference Boston 363–76 (1972).

5. Meller, A. TAPPI, 36 (8), 366–367 (1953).

6. Browning, B.L., TAPPI, 32 (3), 119–120 (1949).

7. Meier, H. Svensk Papperstid, 65, 589-594, Aug. 31 (1962).

8. Sebbas, E. and Mannisto, H., TAPPI Pulping Conference Page 437–443 November (1980)

9. Malinan, R.O., TAPPI Pulping Conference Page 471 November (1980).

10. Wealth of India, Raw Materials, CSIR Publication Vol. 9, 293–95, 298–301 (1972).