The Chemithermomechanical Pulping of Mixed Hardwoods For Newsprint

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ABSTRACT

The potential of Diospyros melanoxylan, Spondias magnifera and Myristica spp. as a raw material for productron of chemithermomechanical pulp for newsprint was investigated by laboratoay pulping. CTMP were prepared from each species for studies as well as from mixtures of these species. The chips were pretreated by mlxture of Sodium hydroxide (3%) and Sodium sulphite (2%). The unbleached pulps of mixed woods were bleached with hydrogen peroxide. The resulting CTMP could be employed to partially or totally replace the chemical pulp in newsprint furnish.

INTRODUCTION

The world is facing a serious shortage of cellulosic raw materials for paper making. The gap between the demand and supply of wood is expected to widen in the closing years of the century. Indigenous production of newsprint is not sufficient and large quantities of newsprint are imported. In the year 1985–86, indigenous production was 265,000 tons against a demand of 480,000 tons. The demand for newsprint is likely to increase to about 500,000 tpy by 1989-90 in view of the recent and rapid growth in the country's newspaper and periodicals. Hence the import of newsprint continue to be around 200,000 tonnes per year. The utilisation of hardwood resources of the world for pulp manufacture has assumed vital importance. The hardwoods are the predominant species of tropical and subtropical natural forests and plantations. During the recent years, in India, significant progress has been made towards self-reliance in the manufacture of newsprint.

It is in this optique that we attempt to investigate the pulping characteristics of some Indian hardwood species, D. melanoxylon, S magnifera, and Myristica spp. in an effort to promote hardwoods utilisation.

Diospyros melenoxylan[1]

It is a moderate sized large tree, attaining a height of 18.29 to 24.38 m. and girth upto 2.13 m. The sapwood is light rosate grey ageing to light rosate brown. The heartwood is sharply delimited from the sapwood and is black, often with purple or brown bands. It is somewhat lustrous with a smoothfeel heavy (820 kg/m^3).

Myristica spp.[2]

A tall evergreen tree, 12-35 m high and 1.5-3 m in girth, with greyish brown, somewhat flaky bark. The tree is common in Andaman Islands. The wood is light (592 kg/m^3), coarse textured, lustrous, light red to reddish brown in colour.

Spondias mangifera[3]

An erect, spreading tree, 18m high, introduced into India and cultivated for the edible fruit. The fresh heartwood is cream to buff coloured, straight or slightly interlocked grained, coarse-textured and light (465 kg/m^3).

EXPERIMENTAL

Raw Material : The logs of above mentioned hardwoods were debarked manually and chipped at pilot plant (KMW) chipper. The chips were screened and the size of accepted chips varied from 25mm to 35 mm.

Characteristics of Wood : All these hardwoods were analysed for their proximate chemical analysis, fibre length, fibre diameter and cellwall thickness using TAPPI standard methods. The results are reported in Table 1.

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TABLE—I

CHARACTERISTICS OF DIOSPYROS MELANOXYLON, SPONDIAS MAGNPERAS AND MYRISTICS SPP.

S. No.	Particulars	D. melan-oxylon	S. Magni-fera	Myris-tica spp.
1.	Fibre length, mm (L)	1.062	1.041	1.061
2.	Fibre diameter, μm (D)	19.120	18.340	18.145
3.	Fibre slenderness ratio (L/D)	55.54	56.76	55.99
4.	Cellwall thickness μm	3.4	4.3	4.5
5.	Wood rays %	8.6	9.8	10.2
6.	Vessel volume %	23.7	28.2	26.4
7.	Fibre volume %	67.7	62.0	63.4
8.	Ash %	2.12	0.42	0.16
9.	Hot water solubles %	3.40	4.10	8.67
10.	Extractives %	5.26	6 32	3.80
11.	Lignin %	26.4	25.80	23.50
12.	Holocellulose %	68.4	68.74	67.65
13.	Alpha cellulose %	48.5	47.80	46 20

Refining: CTMP of each species used as well as from mixture of species were prepared by a 12″ Sprout Waldron disc refiner equipped with C-2976 discs. Chemical treatment was carried out using 3% NaOH and 2% Na_2SO_3 (based on O.D. wood) in a impregnator built in the preheater. In the first stage the chips were presteamed at 140KPa for 5 minutes after which they were refined at 170 KPa pressure (disc clearance 0 40 mm). Subsequent refining to lower freeness was done at atmospheric pressure at 20% consistency (disc clearance 0.25 mm).

Pulp Evaluation: The refined pulp was properly washed in a laboratory centrifuge. Laboratory handsheets were prepared and their properties were evaluated according to TAPPI standard methods. The results at different CSF are reported in Table 2.

Bleaching: Pulp from mixed cooks was bleached by 0.5 to 2.0 percent hydrogen peroxide as H_2O_2 on O.D. pulp. The bleached pulp was washed with SO_2 water. The bleaching conditions and results are given in Table 4 and 5.

RESULTS AND DISCUSSIONS

Table 1 presents some physical and ohemical properties of these hardwoods. D. melanoxylon wood is more porous in comparison to S. magnifera and Myristica spp. The D. melanoxylon fibres have thin cellwall and slightly longer fibre than S. magnifera and Myristica Spp. These properties of D. melanoxylon would favour the good formation of the paper prepared from these fibres. S. magnifera have greater slenderness ratio than D. melanoxylan and Myristica spp- S magnifera possesses the largest vessel volume among these three raw materials indicating a low fibre volume and consequently a low density. D. melanoxylon have more alpha cellulose and lignin, among the three. Rest of the chemical constituents of these woods are nearly the same. The CTMP were prepared from D. melanoxylon, S. magnifera and Myristica spp. by employing 3% Na_2SO_3 and 2% NaOH under similar conditions. D. melanoxylon CTMP showed higher strength values except apparent density and opacity in comparison to S. magnifera and Myristica spp. Myristica spp. produced darker pulp than those of D. melanoxylan and S. magnifera pulps. The results of Bauer McNett classification showed that CTMP of both S. magnifera and Myristica Spp. have higher fine content. CTMP were also made from mixture containing equal propration of the three hardwood studied. The physical strength properties of mixed woods pulp are reported in Table 1. The mixed CTMP of these woods showed good strength

TABLE—2

CHARACTERISTICS OF HARDWOODS CHEMIOTHERMOMECHANICAL PULPS

Particulars	D. melan-oxylon	S. Magni-fera	Myrist-ica spp.	Mixed hard-woods	SBK	SGW
C. S. F.	100	120	130	110	450	110
Apparent density g/cm³	0.61	0.69	0 66	0.65	0.78	0.53
Tear index, mN.m²/g	3.80	3.10	2.80	3.30	6.52	1.53
Burst index, KPa.m²/g	1.80	1.50	0 92	1,52	4.84	0.32
Tensile index, Nm/g	24.46	21.50	18.56	22 80	61.70	6.48
Stretch %	0.85	0.78	0.74	0.79	1.60	0.30
Brightness (Elrepho) %	42 0	41.0	38.0	41 6	64.2	39.0
Opacity %	90	93	96	94	82.0	97
Spocific energy MJ/kg	5.31	5.52	5.54	5.40	—	—
Bauer McNett %						
+ 20	1.6	1.3	1.2			
+ 40	21.2	18.4	16.4			
+ 80	36.5	32.3	30.1			
+ 150	10.8	12.2	14.0			
— 150	29.9	35.8	38.3			

SBK : Semibleached Kraft Pulp of Eucalyptus hybrid

SGW : Stoneground wood pulp of Salai (Boswellia serrata)

TABLE—3

PHYSICL PROPERTIES OF EXPERIMENTAL NEWSPRINT PRODUCED FROM D. MELANOXYLAN/S. MAGNIFERA/MYRISRICA SPP. MIXTURE

COMPOSITION %			Apparent Density	Tear Index	Burst Index	Tensile Index	Stretch	Brightness (Elrepho)	Opacity
CTMP	SGW	SBK	g/cm³	m.N.m²/g	KPa.m²/g	N.m/g	%	%	%
10	90	0	0.76	2.22	0.83	10.50	0.46	51.2	99.3
20	80	0	0.77	2.46	1 02	13.58	0.62	51.8	98 4
30	70	0	0.74	2.76	1.15	15.60	0.71	50 1	98.5
40	60	0	0,72	3.08	1.24	18.40	0.76	49 2	98.1
50	50	0	0.71	3.24	1.37	20.92	0,82	48.4	96.7
5	90	5	0.72	2.80	1 10	16 10	0.80	51.7	98.2
15	80	5	0.72	2 84	1.21	17.10	0.81	51.2	98.0
25	70	5	0.71	3.00	1,30	19.80	0 83	50 6	97.7
35	60	5	0.69	3.20	1.44	20,52	0.87	49.9	96.4
45	50	5	0.68	3.45	1.48	22 40	0,91	49.2	95 6
5	85	10	0.71	3.30	1 34	16.54	0.80	50.1	98.4
10	80	10	0.70	3.27	1.28	17.80	0.85	50.7	98.2
20	70	10	0.69	3 40	1 42	19.91	0.91	50.0	98.1
30	60	10	0 67	3 52	1 49	21.20	0 94	49 4	98.0
40	50	10	0.63	3.65	1.58	25.90	0.98	49.0	97.4
0	80	20	0.72	3 36	1.40	21.50	0.94	52.4	96.9
5	75	20	0.70	3.60	1.44	22.00	0.82	52.8	97.7
15	65	20	0.69	3.80	1.52	24.21	0.86	51.4	96.7
25	55	20	0.67	4 05	1 59	30.72	1.05	50.2	96 0
35	45	20	0 65	4.20	1.66	33.20	1.13	49.2	94.8

TABLE—4

BLEACHING CONDITIONS AND BRIGHTNESS OF CTMP
(MIXED WOODS)

H_2O_2 on pulp %	pH		H_2O_2 Consumption %	Brightness (Elrepho) %	Pulp Yeld (O.D. wood) %
	Initial	Final			
0	—	—	—	41.6	—
0.5	11.4	9.9	41.5	46.2	91.2
1.0	11.0	9.6	45.0	55.2	89.7
1.5	10.8	9.3	51.2	60.5	89.0
2.0	10.6	9.0	54.8	64.7	86.2

TABLE—5

PROPERTIES OF HANDSHEET BLENDS OF BLEACHED MIXED WOODS
CTMP (60%) AND SGW (40%)

Constant Bleaching Conditions :	
Unbleached pulp	50 g o.d.
Temperature	80°C
Magnesium sulphate ($MgSO_4 . 7H_2O$)	0.1%
Sodium hydroxide	0.5%
Concentration	10%
Sodium silicate	3%
Duration	2 hrs

Particulars	Bl. CTMP	Bl. CTMP + SGW	Indigenous[4] newsprint
Apparent density g/cm³	0.66	0.68	0.52
Tear index mN.m²/g	5.04	3.80	3.20/3.85 (MD/CD)
Burst index, KPa.m²/g	1.92	1.48	—
Tensile index, N m/g	29.46	21.25	19.0/11.5 (MD/CD)
Stretch %	1.20	1.06	0.7/1-3 (MD/CD
Brightness (Elrepho) %	60.5	54.60	52.7
Opacity %	86.7	92.7	96.1

properties. This unbleachcd pulp has low 4 1.6% brightness (Elrepho). Experimental newsprint were prepared using mixed hardwood CTMP together with low commercial pulps that is semibleached kraft (SBK) pulp of eucalyptus and stoneground wood (SGW) pulp of salai. The characteristics of the sample pulps are presented in Table 1. In comparing the properties of experimental newsprint, we used a standard formulation (which is mostly employed in India) composing of 20% SBK and 80% SGW pulp as a refercnce point. The properties of the bleached CTMP and indigeneous newsprint are given in Table 5. Table 3 and 5 indicated that the SBK in the newsprint furnish my be completely replaced by the bleachcd or unbleached CTMP made from mixed hardwoods, while maintaining accceptable sheet properties. It can be concluded that a large proportions of CTMP has to be added to the newsprint furnish say 50-60% giving a replacement ratio of about 2.

CONCLUSION

From the present study it can be concluded that D. melanoxylon S. magnifera and Myristica spp. wood responded well to the chemithermomechanical pulping. The D. melanoxylon produced better CTMP than S. magnifera and Myristica spp. The pulp was produced with an unbleached brightness of 38-42% (Elrepho). The pulp of mixed hardwood can easily be bleached to a brightness of 60% (Elrepho) is one stage peroxide bleaching using 1.5% H_2O_2. Good quality CTMP could be produced from mixture composing of equal amount of each species studied by employing a similar chemical treatment of the chips. In newsprint manufacture, CTMP from mixed hardwoods could be used as a replacement for chemical pulp. It may even be possible to reduce the proportion of semibleached kraft pulp in a newsprint furnish by the inclusion of bleached CTMP of these hardwoods.

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