LABORATORY PRODUCED CTMP FROM VARIOUS BLENDS OF ASPEN, SPRUCE AND PINE WOOD FURNISHES

by:

Econotech Services Limited[1]

This is a joint publication of the Canadian Forestry Service and the Alberta Forest Service pursuant to the Canada-Alberta Forest Resource Development Agreement

[1]New Westminster, B.C.
September 8, 1987

DISCLAIMER

The study on which this report is based was funded in part under the Canada/Alberta Forest Resource Development Agreement.

The views, conclusions and recommendations are those of the authors. The exclusion of certain manufactured products does not necessarily imply disapproval nor does the mention of other products necessarily imply endorsement by the Canadian Forestry Service or the Alberta Forest Service.

Catalogue No.: FO 42-91/58-1988E
ISBN: 0-662-16607-8

Additional copies for this publication are available at no charge from:

Regional Development
Canadian Forestry Service
5320 - 122nd Street
Edmonton, Alberta
T6H 3S5
Telephone: (403) 435-721

or

Forestry, Lands and Wildlife
Forest Industry Development Division
108th Street Building
#930, 9942 - 108th Street
Edmonton, Alberta
T5K 2J5
Telephone: (403) 422-7011

REPORT TO
GOVERNMENT OF ALBERTA, FORESTRY, LANDS & WILDLIFE
FOREST INDUSTRY DEVELOPMENT DIVISION
ON LABORATORY PRODUCED CTMP FROM VARIOUS BLENDS OF ASPEN, SPRUCE AND PINE WOOD FURNISHES

OBJECTIVES

1. To produce and evaluate CTMP from sound unfinished lumber bolts of aspen, spruce and pine.

2. To compare the properties of the laboratory produced CTMP to known newsprints produced from spruce and pine.

INTRODUCTION

The Government of Alberta, Forestry, Lands & Wildlife, Forest Industry Development Division provided Econotech with aspen, spruce and pine wood furnishes for these laboratory trials. Each specie was to be prepared separately and then blended prior to CTMP pretreatment, according to the matrix displayed in the Experimental section is this report. The Alberta Government's primary requirement was to define the suitability of pine (lodgepole) as an alternative to other softwoods in newsprint.

EXPERIMENTAL

Wood Furnish Preparation

The unfinished lumber samples consisted of:

Aspen:	4 pieces 4" x 4" x 48"
Pine:	4 pieces 4" x 6" x 48"
Spruce:	4 pieces 4" x 6" x 48"

Each sample was chipped separately in a 36" commercial chipper equipped with six blades. The wood chips were blended by species and % o.d. was determined. The chips were then screened in a Williams chip classifier. As the oven dry content of all the wood chips to be used in these trials was found to be high, the -7/8" +3/16" furnishes were soaked in room temperature distilled water for 60 hours, centrifuged and the o.d. content was again determined (see Table 1).

CTMP Production & Refining

Wood chips from the furnishes were blended according to the following matrix:

Species, %	Blend 1	Blend 2	Blend 3
Aspen	20	20	20
Pine	-	40	80
Spruce	80	40	-

The wood chips from each blend were processed using the conditions defined in Table 2. The chemically treated wood chips were refined to approximately 100 mLs latency removed CSF. The refiner employed was a modified 12" single rotating disc Sprout-Waldron laboratory refiner (model 105), fitted with a screw feeder, white water recirculation system and D2B505 refiner plates.

Evaluation

The resulting CTMPs were prepared and evaluated at 60 gsm. Standard latency removal techniques were applied, white water recirculation was utilized in the handsheet preparation and analyses were carried out in accordance with TAPPI standards or equivalent manufacturer's procedures. The results of the evaluation are shown in Table 3.

DISCUSSION

Blends (Table 1)

All three blends contained 20% aspen on an oven dry basis. Blend 1, with 80% spruce and blend 2, with 40% spruce and 40% pine, exhibited similar properties. Blend 3, with 80% pine, displayed the lowest overall strengths. This may be due in part to the marginally higher freeness. Yield, opacity and light coefficients tended to increase while brightness tended to decrease with the addition of pine.

Newsprint from Softwood TMP

Conventional TMP from softwoods at freeness levels of 75-150 mLs displays physical and optical properties satisfactory for use as a major furnish component of newsprint. Table 4 shows newsprint manufactured from 100% spruce TMP and 100% pine TMP at constant basis weights. The optical properties and tear for both species are similar. The spruce TMP newsprint exhibited superior burst, tensile and stretch compared to the pine TMP newsprint. The pine TMP newsprint had better bulk and roughness compared to the spruce TMP newsprint.

Blends vs Commercial Newsprint

Comparing the laboratory produced CTMPs to the commercially manufactured newsprint, the following observations can be made. The disadvantages of the CTMP blends are that they are bulkier and display less stretching ability. The advantages of the CTMP blends are that they are brighter, have better light scattering coefficients and a greater tearing strength. The opacities are similar for both the CTMP blends and the newsprints. Comparing the CTMP blends, further, to the pine newsprint the burst, tensile and roughness properties are better with the exception of blend 3 which contained 80% pine. Blend 3's burst, tensile and roughness were worse than the spruce newsprint. However, blend 1, with 80% spruce and blend 2, with 40% spruce and 40% pine, displayed better tensile and roughness properties and equal to or better burst properties compared to the spruce newsprint.

Table 5 displays some typical CTMP data generated from Englemann spruce and lodgepole pine. This data is included for information only. The pretreatment was at a higher sulphonation level (3.8%) than the work carried out in this report. The pulps were also bleached prior to evaluation.

CONCLUSIONS

Based on Econotech's analysis, the following conclusions are valid:

1. Lodgepole pine may be blended with 20% aspen and 40% spruce without adverse effects on the strength and optical properties of the CTMP produced.

2. Substituting 80% lodgepole pine for 80% spruce with 20% aspen saw a loss in overall strength with marginal changes in optical properties.

3. As a newsprint furnish, lodgepole pine CTMP should prove satisfactory to about 40% application.

RECOMMENDATIONS

It has been shown commercially that 100% pinus radiata TMP newsprint can be successfully manufactured. In this study, mixed furnishes were treated at a relatively low sulphonation level. To this end, CTMP conditions should be optimized for each species using conventional wood furnishes to yield the best possible properties with the designated end use as a constraint. The differences between separate and combined treatment might be small but a pure softwood CTMP offers improvement in opacity and scattering coefficient in a final pulp blend.

TABLE 1
WOOD FURNISH QUALITY DATA

	Spruce	Pine	Aspen
Furnish: Econotech chipped	Yes	Yes	Yes
O.D. content, as received, %	81.71	79.30	80.18
Williams chip classification, %			
+1 1/8"	22.7	14.9	20.5
+ 7/8"	23.3	27.4	31.0
+ 5/8"	34.0	40.5	31.5
+ 3/8"	13.3	13.3	11.9
+ 3/16"	5.3	3.0	3.8
- 3/16" (pan)	1.4	0.9	1.3
- 7/8 +3/16" fractions used	52.6	56.8	47.2
O.D. content, 60 hr soak, %	47.88	46.00	41.53

SRB:87:223

TABLE 2
CTMP PRODUCTION CONDITIONS

Laboratory:	Econotech Services Limited New Westminster, BC
Pretreatment:	1. Atmospheric presteam 15 minutes @ 100°C
	2. Impregnation 25 minutes @ 95°C, atmospheric
	Chemical application: Na_2SO_3, % 2.5 DTPA, % 0.25 pH 8.0
	3. Vapour phase 3 minutes @ 225 kPa (32.6 psig, 137°C)
Refining:	Refined to yield CSF levels of 80-100 mLs

SRB:87:223

TABLE 3
CTMP PRODUCTION AND EVALUATION DATA

Refiner run Done August 11, 1987	R264	R265	R266
Furnish: Spruce, %	80	40	-
Pine, %	-	40	80
Aspen, %	20	20	20
Impregnation, actual			
Chemical application, Na_2SO_3, %	2.55	2.55	2.55
pH, initial	11.22	11.22	11.22
pH, adjusted	8.0	8.0	8.0
Refining to 100 CSF			
1st pass yield, %	92.4	93.7	94.9
Refiner pass number	5	4	4
Bound sulphur, S, %	0.189	0.182	0.181
C.S. freeness, mLs	90	84	101
Handsheet properties			
Caliper, mm	0.14	0.14	0.16
Density, kg/m^3	443	447	398
Bulk, cc/g	2.26	2.24	2.51
Burst index, $kPa.m^2/g$	1.64	1.80	1.43
Tear index, $mN.m^2/g$	7.58	7.84	7.47
Tensile index, N.m/g	40.7	40.0	32.6
Stretch, %	1.47	1.50	1.38
Roughness, Sheffield, ml/min	118	110	147
Optical properties			
Opacity, T519, %	93.7	94.3	94.6
Scattering coefficient, m^2/kg	57.9	59.1	56.9
Absorption coefficient, m^2/kg	2.1	2.3	2.4
Brightness, ISO, %	65.1	63.9	63.1
Pulp properties			
Bauer McNett Fibre Classification, %			
retained on 14 mesh	0	0	0
28 mesh	8.2	10.0	10.1
48 mesh	25.0	25.8	26.3
100 mesh	25.7	24.5	23.7
200 mesh	14.6	14.6	12.1
total retained on 200	73.5	84.9	72.2
fines through 200 mesh	26.5	25.1	27.8

SRB:87:223

TABLE 4
NEWSPRINT PRODUCED FROM 100% TMP

	Newsprint from 100% Spruce	Pine
Physical properties		
Basis weight, gsm	47.9	47.5
Bulk, cc/g	1.88	1.83
Burst index, kPa, m^2/g	1.69	1.19
Tear index, $mN.m^2/g$*	5.67	5.51
Tensile index, N.m/g*	35.8	28.7
Stretch, %*	1.73	1.51
Roughness, mL/min	142	131
Optical properties		
Opacity, %	94.8	93.7
Scattering coefficient, m^2/kg	51.9	53.0
Brightness, %	56.3	56.7

* CD+MD/2

(see appendix for more detailed data)

SRB:87:223

TABLE 5
CTMP FROM PURE SPECIES

	-----Englemann Spruce------				Lodgepole Pine	
	Whole Log		Slabs		Whole Log	Slab
Furnish, spruce, %	100	100	100	100	-	-
pine	-	-	-	-	100	100
C.S. freeness, mLs	226	175	249	159	211	178
Bulk, cc/g	2.68	2.69	2.78	2.32	3.10	2.98
Burst index, kPa.m²/g	2.55	2.75	2.75	3.34	1.96	2.26
Tear index, mN.m²/g	10.6	10.2	11.1	8.93	10.7	10.5
Tensile index, N.m/g	44.7	48.3	48.2	53.0	39.4	42.3
Stretch, %	2.07	2.30	2.18	2.28	1.80	1.84
Opacity, T519, %	92.3	92.8	92.5	93.7	92.0	92.0
Scattering coeff, m²/kg	44.9	46.4	45.6	45.0	44.8	44.9
Absorption coeff, m²/kg	3.08	3.21	3.21	3.75	3.02	3.04
Brightness, T525, %						
unbleached	58.4	58.0	59.2	59.9	57.8	59.1
bleached	73.1	73.0	75.2	74.7	69.2	72.6

APPENDIX

MILL PRODUCTION DATA

FURNISH: Black Spruce, 100%

SAMPLE: Taken August 19, 1982
Newsprint from Newsprint Machine

PRODUCTION DATA:

Newsprint Machine Dominion Papriformer

Machine speed, mpm	915
Basis Weight, gsm	48.8
Machine furnish	TMP, 100%

SRB:82:131

TEST DATA SUMMARY

SAMPLE IDENTIFICATION	NEWSPRINT	
Analyzed for:		
Basis Weight, gsm	47.9	
Caliper, mils	3.6	
Density, g/cc	0.532	
Bulk, cc/g	1.88	
Mullen, points	11.8	
S.I. burst index, $kPa.m^2/g$	1.69	
TAPPI factor	17	
	MD	CD
Tear, g/single sheet	19.2	36.2
S.I. tear index, $mN.m^2/g$	3.93	7.41
TAPPI factor	40	76
Tensile, kg/15mm	3.96	1.29
lb/in.	14.8	4.80
S.I. tensile index, N.m/kg	54.0	17.5
Breaking length, meters	5505	1789
Internal Bond, Hinde & Dausch, psi	40.0	
Stretch, %	1.26	2.19
Freeness, C.S., mL	---	
Drainage, sec/60 g/m^2	---	
Brightness, TAPPI, Elrepho	56.3	
Opacity, TAPPI, Elrepho	94.8	
Scattering Coefficient, cm^2/g	519	
Densometer, cc/min	263	
Porosity, Gurley, sec/100 ml	22.8	
Pulmac rejects, % (+0.006)	---	
Smoothness, Sheffield, cc/min, w/f	142/136	
Bauer McNett Fiber Classification:		
Retained on 14 mesh, %	---	
28 mesh, %		
48 mesh, %		
100 mesh, %		
200 mesh, %		
Total retained on 200, %		
Fines through 200 mesh, %		
Apparent Density,		
+28 mesh fraction, g/cc	---	

MILL PRODUCTION DATA

FURNISH: Pinus radiata, 100% TMP

SAMPLE: Newsprint samples from Newsprint Machine at basis weights of:

40 g/m^2
45 g/m^2
48 g/m^2

PRODUCTION DATA:

Newsprint Machine Valmet Symformer	
Machine Speed, mpm	1070
Machine Furnish	TMP, 100%

SRB:83:168

TEST DATA SUMMARY

SAMPLE IDENTIFICATION	40 g/m^2		45 g/m^2		48 g/m^2	
Analyzed for:						
Basis Weight, gsm	40.6		45.3		47.5	
O.D. Content (as received), %						
Caliper, mils	3.3		3.5		3.4	
Density, g/cc	.492		.515		.546	
Bulk, cc/g	2.03		1.94		1.83	
Mullen, Points	5.8		6.9		8.2	
Burst Index, kPa·m^2/g	.98		1.05		1.19	
TAPPI Factor	10		11		12	
	MD	CD	MD	CD	MD	CD
Tear, g/single sheet	18.6	25.6	20.7	29.1	21.5	31.8
Tear Index, mN·m^2/g	4.49	6.19	4.48	6.29	4.44	6.57
TAPPI Factor	46	63	46	64	45	67
Tensile, kg/15mm	2.24	.88	2.11	.96	3.26	.91
lb/in	8.38	3.27	7.88	3.59	12.18	3.40
Tensile Index, N·m/g	36.1	14.1	30.5	13.9	44.8	12.5
Breaking Length, meters	3678	1438	3105	1414	4571	1278
Stretch, %	.93	1.83	.88	2.08	1.03	1.99
Internal Bond, Hinde & Dausch, psi	46.0		45.7		45.1	
Freeness, C.S., mL	-		-		-	
Drainage, sec/60 g/m^2	-		-		-	
Brightness, TAPPI, Elrepho	55.4		55.3		56.7	
Opacity, TAPPI, Elrepho	90.4		93.3		93.7	
Scattering Coefficient, cm^2/g	494		520		530	
Densometer, cc/min	272		270		244	
Porosity, Gurley, sec/100 ml	22.0		22.2		24.6	
Pulmac Rejects, % (+0.006")	-		-		-	
Smoothness, Sheffield, cc/min,w/f	165/164		161/160		131/121	

Bauer McNett Fiber Classification

Retained on 14 mesh, %	
28 mesh, %	
48 mesh, %	
100 mesh, %	
200 mesh, %	
Total retained on 200, %	
Fines through 200 mesh, %	
Apparent Density, g/cc	
+28 mesh fraction	

SRB: 63-168

LODGE POLE PINE & ENGLEMANN CONDITIONS

The CTMP was prepared using a 10 minute, 100`C presteaming followed by an impregnation with 3.8% sodium sulphite for 10 minutes at 80`C and pH 8.0. Cooking was carried out for 7 minutes at 130`C. The pulps were bleached using a single stage 2% peroxide treatment.

PINE CMP DATA - LODGEPOLE

Properties	WHOLE LOG					SLABS				
	Control R64	Green R67	Red R68	Grey No Bark R69	Grey With Bark R70	Control R71L	Green R72	Red R73	Grey No Bark R74	Grey With Bark R75
CS Freeness, Post Latency, mLs	211	183	187	195	194	178	180	169	204	211
Bulk, cc/g	3.10	2.87	3.08	3.07	2.89	2.98	2.88	2.77	3.20	3.16
Burst Factor	1.96 20	21	20	20	20	22623	24	27	20	20
Tear Factor	10.0 102	96	96	84	89	10.5 107	106	101	101	107
Breaking Length, m	3944014	4417	3946	3955	4154	4313 4223	4686	4774	3978	3996
Stretch, %	1.80	1.89	1.74	1.67	1.72	1.84	1.98	2.11	1.75	1.79
Porosity, Gurley, S-P-S, sec/100ml	6.8	12.1	8.2	9.0	11.4	9.6	12.6	16.1	6.7	6.8
Brightness, TAPPI, Elrepho, BaSO4, %	57.8	57.9	56.0	55.5	55.4	59.1	61.5	58.3	56.3	54.1
Bleached Brightness, %	69.2	67.0	65.8	65.5	64.7	72.6	71.6	68.7	68.3	65.5
Brightness Gain	11.4	9.1	9.8	10.0	9.3	13.5	10.1	10.4	12.0	11.4
Opacity, TAPPI, Elrepho, BaSO4, %	92.0	92.5	93.0	94.5	93.3	92.0	91.2	92.2	93.7	92.8
Scattering Coefficient, cm^2/g	448	448	457	486	446	449	446	466	460	439
Absorption Coefficient, cm^2/g	30.2	33.8	33.5	37.3	37.5	30.4	26.4	30.7	37.1	34.2
Pulmac Rejects (+0.006"), %	0.114	0.112	0.134	0.146	0.092	0.094	0.148	0.082	0.084	0.086
Bauer McNett Fibre Classification:										
Retained on 14 mesh, %	12.8	13.1	11.3	7.1	10.7	19.2	21.4	21.9	10.3	17.1
28 mesh, %	32.8	34.6	31.7	35.4	36.0	33.7	29.3	27.1	35.8	32.4
48 mesh, %	13.0	19.0	21.9	21.8	20.6	17.1	16.0	19.9	19.5	20.0
100 mesh, %	13.1	8.9	10.5	10.4	10.0	8.0	7.3	8.1	9.2	9.5
200 mesh, %	2.7	2.5	1.9	2.3	2.5	1.9	1.8	1.8	2.1	1.8
Total retained on 200, %	77.4	78.1	77.3	77.0	79.8	79.9	75.8	78.8	76.9	80.8
Fines through 200 mesh, %	25.6	21.9	22.7	23.0	20.2	20.1	24.2	21.2	23.1	19.2

SPRUCE CIMP DATA - ENGLEMANN

Properties	WHOLE LOG Control R83	WHOLE LOG Control R83	WHOLE LOG Red Top R84	WHOLE LOG Red Top R84	WHOLE LOG Grey R85	WHOLE LOG Grey R85	SLABS Control R86	SLABS Control R86	SLABS Red Top R87	SLABS Grey R88	SLABS Grey R88
CS Freeness, Post Latency, mLs	226	175	230	170	249	179	249	159	204	223	175
Drainage, sec/60 g/m²	5.8	6.5	5.6	6.7	5.6	6.4	5.6	7.3	6.3	6.4	7.0
Bulk, cc/g	2.68	2.69	2.73	2.51	2.69	2.55	2.78	2.32	2.40	2.47	2.38
Burst Factor	26	28	24	29	23	24	28	34	29	27	30
Tear Factor	108	104	104	92	97	89	113	91	87	86	84
Breaking Length, m	4554	4922	4614	5187	4505	5081	4910	5406	5113	5061	5401
Stretch, %	2.07	2.30	2.11	2.25	1.92	1.99	2.18	2.28	2.19	1.91	2.02
Porosity, Gurley, S-P-S, sec/100ml	12.0	25.7	12.9	30.2	12.9	26.6	13.1	35.9	28.0	27.9	42.6
Brightness, TAPPI, Elrepho, BaSO4, %	58.4	58.0	58.9	58.6	54.9	54.9	59.2	59.9	52.8	57.2	56.8
Bleached Brightness, %	73.1	73.0	73.0	73.0	69.9	69.2	75.2	74.7	70.6	71.1	71.0
Brightness Gain	14.7	15.0	14.1	14.4	15.0	14.3	16.0	14.8	17.8	13.9	14.2
Opacity, TAPPI, Elrepho, BaSO4, %	92.3	92.8	93.2	93.9	94.1	94.1	92.5	93.7	94.7	93.9	94.7
Scattering Coefficient, cm²/g	449	464	478	487	458	455	456	450	439	442	451
Absorption Coefficient, cm²/g	30.8	32.1	31.7	35.4	38.4	40.7	32.1	37.5	49.7	38.4	44.3
Pulmac Rejects (+0.006"), %	0.101	0.067	0.061	0.038	0.079	0.047	0.090	0.077	0.043	0.073	0.053
Bauer McNett Fibre Classification:											
Retained on 14 mesh, %	19.0	13.3	15.1	13.2	12.6	11.4	30.0	20.3	16.9	14.1	13.1
28 mesh, %	32.2	28.2	35.9	35.1	34.7	33.9	27.0	27.6	32.7	32.6	31.1
48 mesh, %	15.6	12.8	17.0	16.6	17.6	18.6	13.4	15.4	15.9	16.2	15.6
100 mesh, %	7.7	6.3	8.4	8.1	8.2	9.4	6.6	7.5	7.9	9.3	8.2
200 mesh, %	1.2	1.3	1.3	1.4	1.9	1.7	1.4	1.5	1.7	2.0	1.8
Total retained on 200, %	75.7	61.9	77.7	74.4	75.0	75.0	78.4	72.3	75.1	74.2	69.8
Fines through 200 mesh, %	24.3	38.1	22.3	25.6	25.0	25.0	21.6	27.7	24.9	25.8	30.2