

A CO-OPERATIVE PULPING STUDY OF YOUNG ASPEN:

DATA COLLECTION AND SUMMARIES

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by

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INTRODUCTION

World demand for wood is rising rapidly, and it is estimated that by the year 2000 the amount of fibre used in Canada for pulp and paper production will increase fivefold (Fowler 1966). Raw materials will be of short supply and species not commonly used at present will become economically important. Aspen will likely be one because of its abundance, widespread occurrence, ease of management and its favorable pulping properties. Because it regenerates quickly by suckering and has very rapid growth while young, shorter rotation management is feasible. This not only eliminates decay losses which occur in older aspen stands, but results in quick returns on investments, an important criterion at a time of high interest rates (Bella and Jarvis 1967). Before aspen can be extensively utilized, much information is needed on growth and yield, as well as on pulping characteristics of the species.

This co-operative study was initiated in the summer of 1968 by the Vancouver Forest Products Laboratory and the Winnipeg Forest Research Laboratory, to determine the pulping characteristics and yield by different pulping processes of young aspen. The stands sampled were 7, 13, and 22 years old. This report describes sampling procedures, green weight dry weight determination of various above ground tree components, as well as oven dry (green volume) and green specific gravity determination of stem wood. Data summaries are presented for each age group.

DESCRIPTION

The two younger stands (7 and 13 years old) sampled were located in the Riding Mountain National Park and the third (22 years old) at the southern boundary of the Porcupine Forest Reserve. All three stands were growing on fresh sites on soils developed from glacial tills.

¹This work relates to a larger study on short rotation aspen management (Project SIL-MS-079). The information present in this report along with its analysis and the results of pulping will be presented later in a journal article.

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Rowe (1959) classified the forest as Mixedwood (B.18a) of the Boreal Forest Region. Aspen and white spruce are predominant, and occur both in pure stands and in mixtures. Balsam poplar, white birch, and jack pine are usually present on upland sites, whereas, on poorly drained depressions, black spruce and larch are more common.

METHODS

Field work for this study was carried out in the latter part of August. It was assumed that leaf expansion had ceased and the current year's height and diameter growth had been completed.

Sample trees were located in pure even aged fully stocked trembling aspen stands. Only healthy trees were included in the sample, although some stain in the heartwood was allowed. In each area, a patch was clear cut and sufficient material collected to meet pulp testing requirements which amounted to 220 pounds green unbarked bole components for each age group (Keays, 1968). The sample included 57, 23 and 9 trees from stands 7, 13 and 22 years old, respectively.

Trees were cut at ground level. Dbh was measured to the nearest 1/10 inch and total height to the nearest 1/10 foot. All branches were cut and bundled. Above ground portions were separated into the following components:

- (a) leaves and twigs under 0.3 inches diameter
- (b) branches above 0.3 inches diameter
- (c) bole

Green weights of boles, branches and twigs plus leaves were obtained to the nearest gram within four hours after the tree was felled. The dry weights of each of these components and the amount of both leaves and twigs were determined as follows:

(a) Leaves and Twigs

Green and dry weights of leaves and twigs for each tree were estimated from a sub-sample of these components from each age group. Leaves were separated from twigs in the sub-sample, and green weights of each were determined. Separate green weights of leaves and twigs from the sub-sample were used to determine a ratio of leaves plus twigs to twigs. (All calculations were done on a computer, IBM 360-Model 65.) These ratios were used to estimate from total green weights of leaves and twigs of each tree, the separate green weights of these components. The sub-sample was oven dried at 105°C and separate oven-dried weights of leaves and twigs were determined. Green to oven-dry ratios were obtained for leaves and twigs in the sub-sample and the ratios used to estimate from the total green weights of leaves and twigs in each tree, the oven-dry weights of these components.

(b) Branches

Total dry weights of branches for each tree was estimated from a sub-sample of this component from each tree. Green and oven-dry weights of the sub-sample were determined and green to oven-dry ratios calculated. These ratios were used to estimate from total green weights of branches in each tree, the oven-dry weights of these components.

(c) Bole

The bole was cut into four equal length sections and each section was weighed. A 1-inch-thick disk was obtained from the butt end of each section (Figure 1). Each disk was measured for diameter and their green weights were obtained. The bark was peeled from each disk and green weights of both wood and bark were determined. Green wood to green bark ratios for bole disks were calculated and used to estimate from total green weights of the bole sections the amount of green wood and green bark in each section. Oven-dry weights of wood and bark from each disk were determined and green to dry ratios for both wood and bark were calculated. These ratios were used with appropriate green weights of bole sections to estimate the oven-dry wood and oven-dry bark content of the bole sections.

Green wood and oven-dry wood specific gravity (green wood volume) of each bole section was estimated from the specific gravity of the appropriate green and oven-dry disks. Disk volumes for specific gravity determination were obtained by submerging them in water and recording weight loss due to water displacement.

Ages at ground level of each tree were determined by annual ring counts from the lowest bole disk.

A pulping sample four feet long was obtained from the mid-portion of each bole section over four feet. The whole bole section was retained for pulping from trees whose bole sections were under four feet long. Green weight of each pluping section was determined and labelled to identify age group, tree number, and bole section number. These, along with a combined sample of branches and leaves were shipped to the Vancouver Forest Products Laboratory.

DATA SUMMARIES

Table 1 shows estimates of specific gravity of the green and oven-dry wood of the bole sections, and diameter outside bark at the butt end of the bole sections by age group. Averages, minimum and maximum values are given for each age group. Estimates of specific gravity for a bole section were obtained from two appropriate disks, e.g., for the lowest bole section (Figure 1) bole disk one (BD1) and bole disk two (BD2). To obtain realistic specific gravity estimates for these bole sections, the two disks' specific gravity values used were weighted by their diameter squared. Specific gravity was estimated using this method for the three lower bole sections. Specific gravity estimates for the top sections were obtained directly from the top disks.

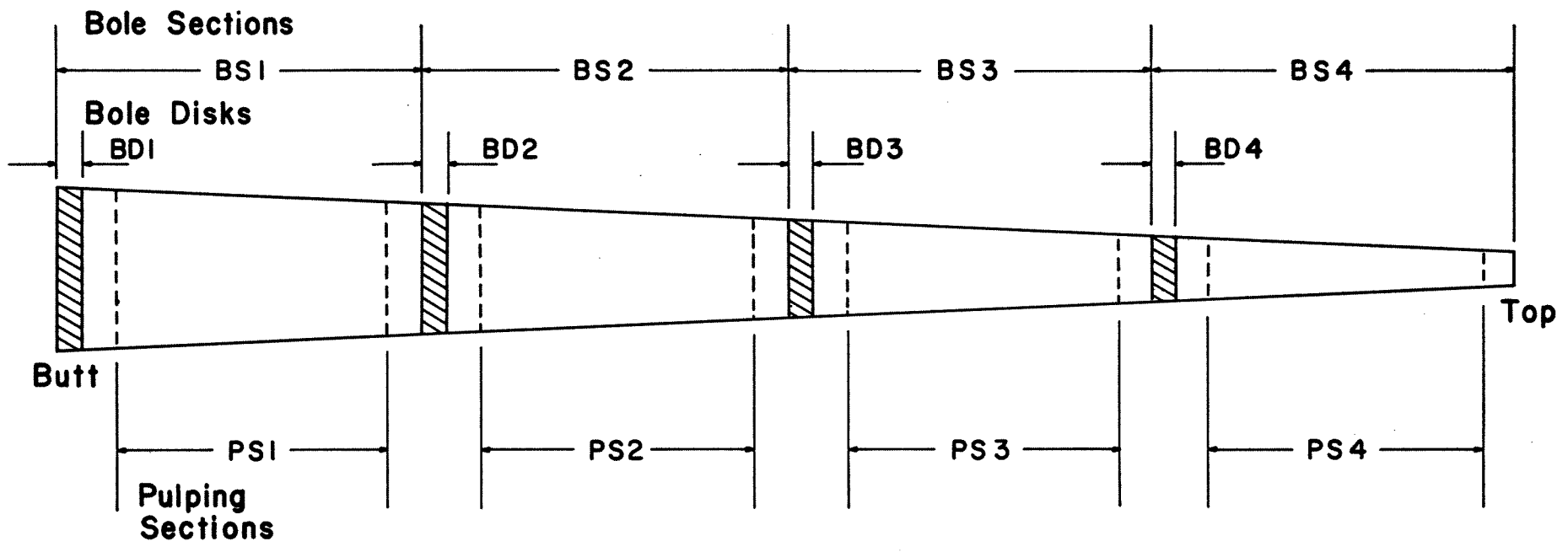


FIGURE I
Tree bole dissection diagram

Table 2 presents ratios of green wood to green bark, green wood to oven-dry wood and green bark to oven-dry bark of the bole sections for each age group. Averages, minimum and maximum values are given for each age group. These ratios for each bole section were calculated by the same method used to estimate specific gravity; i.e., the weighted average from two disks.

Table 3 presents estimated total green and oven-dry weights in kilograms of both wood and bark for bole sections and pulping sections for each age group. Weights shown in this table were calculated from total green weights (wood plus bark) of each bole section with the appropriate ratios estimated from the 1-inch-disks.

Table 4 shows green and oven-dry weights of branches, leaves and twigs for three age groups. Also shown are the ratios used to estimate the oven dry weights of branches, and the separate green and oven-dry weights of leaves and twigs.

TABLE 1

Specific gravity estimates of green and oven-dry wood of four bole sections by three age groups. Averages, minimum and maximum values are shown for bole sections by age group. Butt-end diameters of bole sections are also shown

Age Group	Bole Section	Specific Gravity of Bole Sections						Diameter outside bark of butt ends of bole sections (in.)		
		Green Wood			Oven-dry Wood			Average	Minimum	Maximum
		Average	Minimum	Maximum	Average	Minimum	Maximum			
7	Butt	0.70	0.58	0.83	0.40	0.36	0.45	1.24	0.5	2.3
	Lower Middle	0.68	0.57	0.83	0.38	0.34	0.43	1.04	0.4	1.8
	Upper Middle	0.70	0.58	0.84	0.39	0.34	0.46	0.77	0.3	1.3
	Top	0.77	0.64	0.90	0.40	0.28	0.48	0.40	0.1	0.8
13	Butt	0.70	0.66	0.77	0.38	0.36	0.42	1.82	0.8	3.1
	Lower Middle	0.63	0.57	0.73	0.35	0.32	0.40	1.52	0.6	2.5
	Upper Middle	0.62	0.54	0.68	0.35	0.32	0.45	1.20	0.5	2.0
	Top	0.66	0.55	0.74	0.36	0.30	0.48	0.70	0.4	1.1
22	Butt	0.68	0.65	0.74	0.40	0.38	0.42	2.98	2.0	3.9
	Lower Middle	0.63	0.60	0.68	0.36	0.35	0.39	2.57	1.7	3.3
	Upper Middle	0.66	0.62	0.72	0.37	0.36	0.40	2.01	1.3	2.7
	Top	0.73	0.66	0.82	0.38	0.37	0.42	1.19	0.7	1.5

TABLE 2

Green wood to green bark ratios and green to dry ratios of wood and bark
of four bole sections for three age groups

Age Group	Bole Section	Wood to Bark Ratios of Bole Sections								
		Green Wood to Green Bark			Green Wood to Oven-dry Wood			Green Wood to Oven-dry Bark		
		Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum
7	Butt	3.53	2.54	4.67	1.75	1.46	2.03	2.15	1.79	2.48
	Lower Middle	3.62	2.48	4.70	1.75	1.53	2.11	2.28	1.61	2.98
	Upper Middle	3.10	2.20	4.09	1.81	1.50	2.26	2.30	1.72	3.00
	Top	2.48	1.75	3.63	1.95	1.50	3.00	2.19	1.50	3.00
13	Butt	3.63	2.55	4.20	1.83	1.72	1.94	1.91	1.70	2.15
	Lower Middle	4.00	2.78	4.79	1.83	1.70	2.00	2.08	1.76	2.81
	Upper Middle	3.34	2.46	4.11	1.76	1.51	1.98	2.13	1.78	3.42
	Top	2.64	2.10	3.19	1.82	1.53	2.33	2.23	1.75	3.67
22	Butt	4.21	3.78	4.83	1.69	1.63	1.80	1.75	1.67	1.80
	Lower Middle	4.38	3.80	5.11	1.74	1.63	1.85	1.86	1.77	1.94
	Upper Middle	3.55	3.12	3.88	1.79	1.69	1.87	1.87	1.80	1.92
	Top	3.19	2.48	3.53	1.92	1.70	2.18	1.94	1.83	2.00

TABLE 3

Estimated green and oven-dry weights of wood and bark of bole sections and pulping sections for three age groups

Age Group	Bole Section	Bole Section Weights (kg.)						Pulping Section Weights (kg.)					
		Green			Oven-dry			Green			Oven-dry		
		Wood plus bark	Wood	Bark	Wood plus bark	Wood	Bark	Wood plus bark	Wood	Bark	Wood plus bark	Wood	Bark
7	Butt	51.43	37.95	13.48	27.48	21.16	6.32	49.98	36.89	13.09	26.70	20.56	6.14
	Lower Middle	34.51	25.72	8.79	17.96	14.04	3.92	33.63	25.07	8.56	17.51	13.69	3.82
	Upper Middle	17.79	12.47	5.32	9.11	6.79	2.32	17.25	12.10	5.15	8.83	6.58	2.25
	Top	4.35	2.69	1.66	2.11	1.37	0.74	4.02	2.49	1.53	1.95	1.27	0.68
	Total	108.08	78.83	29.25	56.66	43.36	13.30	104.88	76.55	28.33	54.99	42.10	12.89
13	Butt	53.43	39.43	14.00	28.92	21.50	7.42	51.62	38.09	13.53	27.95	20.78	7.17
	Lower Middle	36.27	27.73	8.54	19.20	15.00	4.20	35.49	27.14	8.35	18.78	14.67	4.11
	Upper Middle	19.42	13.95	5.47	10.43	7.77	2.66	19.07	13.70	5.37	10.25	7.64	2.61
	Top	4.42	2.83	1.59	2.28	1.54	0.74	4.22	2.71	1.51	2.18	1.47	0.71
	Total	113.54	83.94	29.60	60.83	45.81	15.02	110.40	81.64	28.76	59.16	44.56	14.60
22	Butt	78.50	59.93	18.57	46.10	35.48	10.62	48.71	37.17	11.54	28.60	22.00	6.60
	Lower Middle	57.03	44.09	12.94	32.36	25.42	6.94	34.91	26.98	7.93	19.80	15.54	4.26
	Upper Middle	32.07	23.10	8.97	17.67	12.85	4.82	19.63	14.13	5.50	10.81	7.86	2.95
	Top	8.52	5.91	2.61	4.39	3.04	1.35	7.06	4.89	2.17	3.64	2.52	1.12
	Total	176.12	133.03	43.09	100.52	76.79	23.73	110.31	83.17	27.14	62.85	47.92	14.93

TABLE 4

Green weights of branches and leaves plus twigs, and appropriate ratios used to estimate oven-dry weights of branches. Also, ratios for estimating green and oven-dry weights of leaves and twigs for the three age groups

Age Group	Branches			Green weight of leaves plus twigs (kg.)	Leaves plus twigs ratio	Leaves and Twigs					
	Green weight (kg.)	Green to dry ratio	Oven-dry weight (kg.)			Leaves			Twigs		
						Green weight (kg.)	Green to oven-dry ratio	Oven-dry weight (kg.)	Green weight (kg.)	Green to oven-dry ratio	Oven-dry weight (kg.)
7	9.75	2.07	4.72	30.99	2.69	19.46	2.23	8.73	11.53	1.95	5.91
13	10.05	1.94	5.18	27.35	2.42	16.07	2.76	5.82	11.28	1.97	5.73
22	14.04	2.01	6.10	17.17	2.41	10.04	2.52	3.98	7.14	2.17	3.30

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