

THE GROUNDWOOD PULPING OF BALSAM FIR AND JACK PINE

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THE GROUNDWOOD PULPING OF BALSAM FIR AND JACK PINE

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Summary

Groundwood pulps made from balsam fir and jack pine were intermediate in strength between those of southern pine and those of spruce. Pulps with very good color can be made with the fresh wood, and energy consumption is about normal. Somewhat duller stone surfaces can and probably should be used for these species than for spruce if optimum strength and energy consumption are to be attained. Jack pine groundwood is probably more pitchy than spruce or balsam fir groundwoods, but the pitch very likely can be controlled by methods such as those in use commercially in making southern pine groundwood.

Introduction

In this report is discussed the experimental groundwood pulping of balsam fir (Abies balsamea) and jack pine (Pinus banksiana) at the U. S. Forest Products Laboratory. Some previous work by others is briefly reviewed. Though used for groundwood pulping to some extent, their available supply, particularly in the Lake States, justifies consideration for greater utilization. There is little information in the recent groundwood pulping literature on them. The experiments reported here were made to evaluate them by more modern standards.

Balsam fir has long been used for making groundwood and sulfite pulps. For groundwood, it is generally used with spruce, in proportions that vary according to several factors, which may include its cost compared to spruce and other softwoods or as compared with other available softwoods for particular uses.

¹Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Thickens (10)² reported making, from green balsam fir, groundwood of good quality that was as light or lighter in color than that made from spruce. The seasoned wood may, he pointed out, contain decay and insects and also be difficult to make into groundwood that will not contain many shives and be somewhat soft. The lower density of the balsam fir was said to result in proportionately lower yield per cord than spruce.

In recent years balsam fir has become more highly regarded for groundwood pulping. The pulp imparts softness to paper and improves its printing qualities (6).

TAPPI surveys (7) have shown that balsam fir is widely used for the production of groundwood pulp. In 1945 about two-thirds of the 49 reporting mills were using some balsam fir; with the proportions within mills ranging to as high as 75 percent of the wood used to make groundwood pulp. Of the total amount of wood used for groundwood pulp, however, spruce leads balsam fir by a wide margin.

The consensus appears to be that balsam fir produces groundwood of good quality and very good color but with strength properties somewhat lower than those of spruce. The yield per cord of balsam fir is less than for spruce because of its lower density and, unless the cost per cord is at least proportionately lower, it may not be economical to use.

Jack pine has been used for groundwood pulping in proportionately small amounts for many years, although the supplies in some areas would permit considerably greater use. Thickens (9, 10) found that jack pine groundwood had a somewhat softer texture than spruce groundwood and also that greater care and control of the process was necessary in grinding jack pine. He produced a good groundwood from jack pine by using a dull stone surface that resulted, however, in somewhat higher than normal consumption of energy. Newsprint made with the jack pine groundwood in the furnish had, under commercial conditions, the strength, finish, and appearance of standard newsprint. The color of jack pine groundwood was said to be slightly darker than that of spruce.

Paterson (4) reported that jack pine groundwood is coarser than spruce groundwood made under the same conditions, and that its strength is lower at the same freeness. To obtain groundwood of minimum coarseness and acceptable strength, a duller stone surface and lower grinding pressure should be used than for spruce. Higher energy consumption was believed necessary for grinding jack pine than for spruce.

Running (5) claimed that best results are obtained with green jack pine, although groundwood of satisfactory quality can be obtained from seasoned wood if ground at lower consistency and temperature than for spruce. The principal effect, in his opinion, of using jack pine groundwood in place of spruce groundwood appeared to be lower paper strength, and pitch trouble was said to develop on the paper machine if more than 15 percent of jack pine groundwood were used in the newsprint furnish.

There have been periodic efforts for years in eastern Canada to use jack pine for newsprint groundwood (6) without much success in increasing its use. The

²Underlined numbers in parentheses refer to literature cited at the end of this report.

papermaking properties of jack pine groundwood were considered to be less satisfactory than those of spruce, and its heartwood caused the pulp to be darker colored and gave pitch trouble.

In 1945, according to the TAPPI survey (7), one fourth of the 49 reporting mills were using some jack pine, the proportions in a given mill ranging up to about 33 percent of the wood used for groundwood.

Jack pine, therefore, has not found ready acceptance for groundwood pulping because, compared to spruce, it is claimed to produce a weaker and darker colored pulp and tends to give pitch trouble on the paper machine.

Wood Used in Experiments

The pulpwood used in these experiments was considered fairly representative of the material available in the Lake States region. The balsam fir was cut in Wisconsin and was well seasoned when received at the Laboratory, having a moisture content of about 14 percent. It had an average diameter of 5.3 inches, a growth rate of 12 rings per inch, and a density of 21 pounds per cubic foot, based on its weight when moisture free and volume when green.

The jack pine consisted of two lots, one well seasoned and the other green. They were quite comparable in physical properties, having an average diameter of 6.0 inches, a rate of growth of 8 rings per inch, heartwood content of 14 percent by volume, and a density of 25 pounds per cubic foot.

Equipment and Procedure

The experimental groundwood pulps were made on the Laboratory's 3-pocket grinder, which for these experiments, was equipped with a natural sandstone pulpstone 54 inches in diameter and 8 inches wide. The stone had been burred with a 10-cut, 1-1/2-inch-lead, spiral burr and then conditioned by grinding other wood before starting the experiments. The stone surface was between medium dull and dull and was considered suitable for grinding these species although too dull for grinding spruce.

All pulps for testing were screened on an 8-cut plate and then thickened on a suction filter.

Balsam Fir

A series of grinder runs was made on the air-dry balsam fir as received at 14 percent moisture content and also on the wood after it was remoistened by pressure impregnation to about the moisture content of green wood. In each series the grinding pressure was varied to produce pulps within a range of properties.

Jack Pine

Included in a total of 10 grinder runs on jack pine was a series of 3 using seasoned jack pine that had been remoistened. Also, 4 grinder runs were made using green wood on stone surfaces of 2 different degrees of sharpness. Finally, a series of 3 runs was made on wood after it had seasoned for a year, thus reducing its moisture content to about 25 percent.

Discussion of Results

Balsam Fir

Groundwood pulps of good strength properties were obtained from balsam fir. The wood of higher moisture content gave the better results. Compared with spruce groundwood pulps made experimentally, the balsam fir pulps were somewhat lower in tearing strength but only slightly lower in bursting and tensile strength. Energy consumption was comparable with that for spruce. The color of balsam fir groundwood is generally considered entirely satisfactory and comparable to that of spruce. The wood for these experiments was well seasoned and consequently had darkened slightly, but still produced pulps of acceptable although slightly lower than optimum brightness.

The wood of low moisture content when ground at low pressure (run No. 1,201, table 1) produced pulp of good strength at moderate consumption of energy (66 horsepower-days per ton) although with lower freeness (65 milliliter) than is desired for some purposes. Pulps of higher freeness were readily obtained by increasing the grinding pressure, which reduced energy consumption but also lowered the strength.

Pulps made from the remoistened wood were appreciably higher in freeness than those made from the drier wood, as was to be expected. Moreover, they were stronger when compared on the basis of the same freeness or energy consumption, and were also longer fibered.

The generally favorable strength properties obtained with balsam fir may be due to the use of stone surface conditions that were suitable for balsam fir but that would be too dull for grinding spruce. The sharper surfaces needed for spruce, on the other hand, would be too sharp to produce the best pulps from balsam fir. In grinding spruce and balsam fir, the best results would obviously be obtained by using separate stones for each species.

Jack Pine

Jack pine pulps of good strength were produced at moderate consumption of energy. The strength properties were generally slightly lower than those of balsam fir groundwood of comparable freeness, and energy consumption was slightly higher. Compared with spruce groundwood, their strength was of course somewhat lower. The brightness of pulps made from the fresh, green wood was good, being about 61 percent (runs Nos. 1,155 and 1,156, table 1). The brightness of pulps made

with wood that had been stored for varying intervals of time was lower than that of pulps made from green wood because of the presence of stain, which develops rapidly in the pines.

The quality of groundwood pulp depends upon grinding conditions and also on wood moisture content as the data show. The duller stone surface is preferred, as is also wood of high moisture content. The dry wood that had been re-moistened seemed to yield pulps as strong as those of the green wood, but appreciably lower in brightness. Remoistening of wood in 4-foot lengths, however, would require a long period of soaking or the use of pressure impregnation.

Pitch in Jack Pine

Pitch difficulties were not evident in the grinding experiments. However, pitch generally gives more trouble in papermaking than in grinding. Empirical tests give an indication of the amount of troublesome pitch that a pulp contains (1, 2). A test on groundwood made from fresh jack pine indicated the amount of pitch to be at about the level where difficulty in papermachine operation begins. Several methods of controlling pitch have been suggested and apparently successfully used. In the manufacture of newsprint from southern pine groundwood, alum and pH control is being used in one mill (3) while another proposes the use of alum and caustic soda to control pH in the grinder (2). Bentonite clay is claimed to be effective in controlling pitch in sulfite pulp during the papermaking (1) and might also be effective for controlling pitch in groundwood pulp. Seasoning of wood has often been used as an aid to reducing pitchiness; but, if the moisture content of the wood is reduced too much, the quality of the groundwood will also be reduced.

While it may be true, therefore, that jack pine gives more pitch trouble than spruce or balsam fir, this alone should not prevent wider use of jack pine, since effective means of pitch control are available.

Conclusions

The data in the Forest Products Laboratory experiments here reported indicate that groundwood pulps of good quality can be obtained from either balsam fir or jack pine at about normal consumption of energy.

The strength of pulps from these species is somewhat lower than that of spruce groundwood but is as high or higher than that of southern pine groundwood, and hence well within the usable range.

For optimum results, these species should be ground at a high moisture content and, preferably, separately from spruce, since they do not require stone surfaces as sharp as spruce does to produce pulps of equivalent freeness.

The color of pulps from fresh wood is excellent for balsam fir and also very good for jack pine, provided the proportion of heartwood is low.

Although jack pine is probably more pitchy than spruce or balsam fir, this factor alone should not limit its use for groundwood pulping, since apparently effective methods of controlling pitch are available.

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Table 1.-Groundwood pulping of balsam fir and jack pine

Grinder: run number	Wood: surface condition	Stone	Grinding data ¹		Properties of pulp suspension				Properties of pulp test sheets ²			
			Pressure: of wood	Grinding: rate ³	Energy: con- sumed ⁴	Freeness: (Canadian: Standard)	Screen analysis: Retained on: 200-mesh	Percent: 28-mesh	Bursting: length	Tearing: Density	Breaking: Brightness	
Percent		P.s.i.	Tons	Hrs. days	MI.	Percent	Percent	Pt. per lb. per ream	Gm. per lb. per ream	Meters	Gm. per cc.	Percent
Balsam fir												
Seasoned wood:												
1,201	14	Medium	15	0.74	66	65	39.5	0.26	0.54	2,565	0.47	57.4
1,202	14	Medium	27	1.29	56	90	42.0	.18	.42	2,140	.42	58.3
1,205	14	Medium	40	2.95	43	135	41.6	.17	.46	2,060	.42	57.6
Remoistened seasoned wood:												
1,195	50	Medium	15	1.01	56	113	28.6	.28	.65	3,100	.40	58.6
1,194	50	Medium	22	1.43	49	163	29.7	.21	.64	2,340	.37	58.9
1,192	50	Medium	30	2.06	46	173	28.3	.21	.60	2,460	.39	58.1
1,195	50	Medium	37	3.07	43	188	31.0	.18	.60	2,345	.38	58.1
Jack pine												
Remoistened seasoned wood:												
1,151	60	Dull	20	.78	95	45	38.2	.32	.67	3,360	.41	53.6
1,150	60	Dull	30	1.43	67	90	35.4	.24	.64	2,550	.36	54.9
1,149	60	Dull	40	1.85	65	85	32.5	.25	.69	2,660	.37	54.7
Green wood												
1,156	41	Dull	30	1.29	73	60	35.8	.23	.68	2,420	.37	61.7
1,155	41	Dull	40	2.25	55	130	34.5	.19	.55	2,065	.34	60.7
1,162	42	Medium	25	1.50	63	75	36.1	.20	.54	2,400	.37	57.5
1,161	42	Medium	35	2.99	42	160	40.8	.14	.43	1,870	.34	57.2
Wood seasoned for 1 year:												
1,196	25	Medium	20	1.30	56	100	37.6	.15	.45	1,677	.35	46.6
1,197	25	Medium	30	2.03	48	128	33.0	.13	.47	1,462	.42	45.9
1,198	25	Medium	40	2.35	43	163	31.6	.10	.40	1,312	.34	46.0
Experimental spruce groundwood pulps for comparison:²												
				1.10	73	90		.31	.78	3,100	.44	61
				1.80	55	155		.28	.76	2,800	.42	60

¹4 natural sandstone pulpstone was used that had been burred with a 10 by 1-1/2 burr then conditioned by grinding other wood 3 and 12 hours to produce respectively the medium and dull stone surface conditions. Conditions common to all runs: peripheral speed 3,120 feet per minute, pit temperature 150° to 160° F., and consistency 3 to 4 percent. Three pockets were in use simultaneously except in runs No. 1,195 and No. 1,198 in which 2 pockets were used.

²Asia weight of test sheets was 115 pounds per ream of 500 sheets, 25 by 40 inches.

³Moisture-free wood per 24 hours per square foot of wood-stone contact area.

⁴Net energy (corrected for motor efficiency and transmission losses) per ton of moisture-free wood ground.

⁵Each set of values represents the average of several experimental pulps.

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