

**GRINDING AND NEWSPRINT PAPER EXPERIMENTS ON
SOUTHERN SUGARBERRY, ASH, COTTONWOOD,
WILLOW, AND ELM**

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(Report)



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GRINDING AND NEWSPRINT PAPER EXPERIMENTS ON .

SOUTHERN SUGARBERRY, ASH, COTTONWOOD, WILLOW, AND ELM

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Summary

Groundwood pulps of short fiber length and ^{low}tearing strength but of moderate bursting and tensile strengths were produced from sugarberry, ash, and elm pulpwood when ground under conditions resulting in about normal unit energy consumption. Ground under similar conditions, cottonwood and willow approached average commercial newsprint groundwood in strength and fiber length, failing to meet the standard principally in the 24-mesh screen fraction and in the tearing strength.

The willow and elm pulps were dark in color but the others were satisfactory in this respect. Newsprint paper having good color and strength comparable to commercial newsprint was obtained from furnishes consisting of approximately equal proportions of either cottonwood, green ash, or sugarberry groundwood and southern pine groundwood (80 percent in all) and 20 percent of semibleached pine sulfate pulp. Of the three hardwood species, cottonwood appeared first, green ash second, and sugarberry third in relative suitability for groundwood pulp to be used in newsprint paper.

Introduction

The Federal Forest Survey has shown that in the lower South 51 percent of the forest area is occupied by hardwood species, and of the total volume of usable wood 63 percent is hardwood. There is a distinct need for more effective utilization of this large amount of available raw material. An objective of investigations at the Forest Products Laboratory has been the determination of the suitability of certain of these hardwoods in pulp and paper manufacture. This report covers a study of the grinding characteristics of several hardwood species from the Arkansas Delta region and the making of newsprint paper from them.

Description of Material

The hardwoods were supplied by the Phillips County Chamber of Commerce, Helena, Arkansas, through the efforts of the Arkansas Forestry Commission. They were cut in late fall and ground in early spring, and were therefore in a substantially green condition. The botanical species of the several shipments were identified by a Laboratory xylotomist either from foliage supplied by the shipper, by examination of the wood structure, or by both methods, and were as follows:

Sugarberry [Celtis laevigata, Willdenow]

Green ash [Fraxinus pennsylvanica lanceolata
(Borkhausen) Sargent]

Southern cottonwood [Populus deltoides virginiana
(Foug) Sudworth]

Black willow [Salix nigra, Marshall]

American elm [Ulmus americana, Linnaeus]

The material has been described fully elsewhere.¹

Grinding Procedure

The wood was ground on a silicon carbide (Norton 3760/5, grade N-7) pulpstone. The stone had, in previous service, been burred with an 8-cut, 1-1/2 inch lead, spiral burr and sharpened once during the time with a 14-point diamond burr. At the time of starting the experiments the stone surface was dull. Due to the condition of the stone and the short operating periods the surface is considered to be practically constant throughout the series of runs. The grinder was brought up to operating temperature by means of hot water before commencing each run. Two of the three pockets were operated simultaneously. The stone was immersed in pulp in the pit to a depth of 9.5 inches.

The sugarberry and ash were ground at a low, an intermediate, and a high pressure while the other hardwoods were ground at the intermediate pressure only. Southern pine was also ground for comparison as well as for mixing with the hardwood groundwood pulps for the newsprint furnishes. This pine was obtained from the wood yard of a southern kraft mill and the species was not identified. It was ground under conditions previously found applicable to this wood.

¹ Physical and chemical properties of Arkansas Delta hardwood pulpwoods: sugarberry, ash, bitter pecan, cottonwood, willow, and elm. (Shipments 1545, 1546, 1547, 1548, 1549, 1550.) Project 1168-5, problem D-189, filed June 24, 1941.

Discussion of Grinding Experiments

The grinding data and physical properties of the pulps are given in table 1. Included in the table for comparison are data on northern paper birch² and average values for 29 commercial newsprint grade groundwood pulps.

Comparing pulps from the several species ground at a pressure of 30 pounds per square inch (384, 387, 389, 390, 391, 392, 375) it is seen that the unit energy consumptions are in the range of commercial newsprint pulps, with the sugarberry, elm, and southern pine values being somewhat on the high side. In fiber length the sugarberry, ash, and elm pulps are much shorter (as indicated by screen analysis data) than average commercial newsprint groundwoods and slightly shorter than the paper birch groundwood. The cottonwood and willow pulps, on the other hand, were low in the coarsest (24-mesh) screen fraction but otherwise approached commercial pulps in screen analysis.

The sugarberry, ash, and elm pulps had fair bursting and tensile strengths but poor tearing strength. They were much superior in strength to the birch pulp but not so good as the commercial pulps. The bursting and tensile strengths of the cottonwood and willow pulp equaled the average of the commercial news pulps but their tearing strengths were somewhat low. The willow and elm pulps were dark in color but the other pulps were equal or superior, in this respect, to the average of the commercial grade pulps.

Lowering the grinding pressure on the sugarberry from 30 pounds to 20 pounds per square inch (grinder run 383) raised the pulp strength a little. The power input was not decreased in proportion to the grinding rate, and consequently the unit energy consumption was increased considerably. Raising the pressure to 40 pounds (grinder run 385), on the other hand, produced very little lowering of strength, but increased the grinding rate out of proportion to the increase in power input, thus causing a marked decrease in the unit energy consumption. The ash responded similarly to the sugarberry except that the increase in pressure reduced the unit energy consumption only slightly.

Newsprint Paper Making Experiments

The cottonwood, ash, and sugarberry groundwood pulps were used in newsprint paper making experiments with various combinations of neutral sulfite semichemical pulp, southern pine groundwood pulp, and semibleached southern pine sulfate pulp. The data are given in table 2.

In the first four machine runs the principal chemical pulp component consisted of neutral sulfite semichemical pulp made from the same

²"The Grinding of Paper Birch and Use of the Pulp in Newsprint and Toweling Papers," by E. R. Schafer and J. C. Pew. Project 1168-6, problem D-187, filed January 21, 1942.

Table 1—The grading of the southern hardwoods: sugar-pine, spruce, fir, cedar, redwood, black alder, and American elm.

[illegible]

The actual thrust of the pressure foot (determined by calibration of the cylinder pressure) divided by the area represented by the product of the pocket width and the wood length.

Morton 3560/5-37 stone was used. In previous service it had been burved with an 8-cut, 1-1/2 inch lead spiral burr and after 58 1/2 hours of use lightly sharpened with a 14-point diamond burr. The hours given in this column were the service subsequent to this sharpening. The peripheral speed of the stone was 3150 feet per minute. The stones were the pockets of the grinder were in use at any one time, the time equivalent of wear of the stone surface is estimated on the basis of three-pocket operation at this peripheral speed.

Based on two pockets in simultaneous operation.

The tint is designated as follows: O, orange; Y, yellow; R, red.

Cylinder run made under Problem D187. Project L-168-6.

Eight percent retained between 42 and 60 mesh and 61 percent passing 60 mesh.

Table 2.--Newsprint papers from southern hardwoods and pine

| Machine run | Groundwood pulp | | | Chemical pulps | | | Jordan-ing | Properties of the paper ² | | | | | | | | | |
|--|-----------------------|---------|---------|----------------------------|--------|---------|------------|--------------------------------------|-------|----------------------------|------|---------------------------------------|---------|---------------------------|---------|-------------------|---------|
| | Hardwood ¹ | | | Southern pine ¹ | | | | Weight: Thick- per ream | | Burst-: Tear- ing : ing | | Tensile: White- per square inch | | Castor : Pen- etration | | Porosity: Opacity | |
| | Species | Amount | Percent | Species | Amount | Percent | | Pounds | Mills | Point | Gram | Pounds | Percent | Seconds | Percent | Seconds | Percent |
| No. | | Percent | Percent | | | | | | | | | | | | | | |
| 1750 | Cottonwood | 20 | 60 | Cottonwood | 20 | ..... | None | 38 | 4.48 | 0.20 | 0.55 | 1,535 | 64 | 43 | 25 | 91 | 29 |
| 1751 | Do..... | 18 | 54 | do..... | 18 | 10 | ..do... | 35 | 3.98 | .22 | .71 | 1,790 | 62 | 36 | 18 | 89 | 29 |
| 1753 | Do..... | 30 | 20 | do..... | 50 | ..... | Light | 39 | 3.80 | .19 | .67 | 2,080 | 61 | 39 | 24 | 90 | 33 |
| 1754 | Green ash | 30 | 20 | Green ash | 50 | ..... | ..do... | 44 | 4.21 | .17 | .38 | 1,630 | 62 | 12 | 25 | 94 | 35 |
| 1770 | Cottonwood | 20 | 60 | ..... | ..... | 20 | None | 42 | 4.18 | .22 | .69 | 2,186 | 65 | 46 | 25 | 92 | 34 |
| 1771 | Do..... | 20 | 60 | ..... | ..... | 20 | Light | 38 | 3.80 | .24 | .57 | 2,549 | 65 | 56 | 55 | 91 | 36 |
| 1772 | Do..... | 40 | 40 | ..... | ..... | 20 | ..do... | 37 | 4.45 | .23 | .66 | 2,020 | 65 | 43 | 29 | 91 | 33 |
| 1773 | Green ash | 40 | 40 | ..... | ..... | 20 | ..do... | 40 | 3.85 | .22 | .64 | 2,151 | 67 | 35 | 27 | 94 | 35 |
| 1774 | Do..... | 40 | 45 | ..... | ..... | 15 | None | 43 | 4.21 | .18 | .57 | 1,852 | 66 | 30 | 20 | 95 | 35 |
| 1775 | Sugarberry | 40 | 40 | ..... | ..... | 20 | ..do... | 41 | 4.06 | .19 | .61 | 1,801 | 67 | 33 | 19 | 93 | 34 |
| 1776 | Do..... | 40 | 45 | ..... | ..... | 15 | ..do... | 40 | 4.26 | .17 | .70 | 1,685 | 66 | 36 | 21 | 93 | 34 |
| 1777 | Cottonwood | 13 | 41 | ..... | ..... | 20 | ..do... | 39 | 4.07 | .18 | .70 | 1,805 | 65 | 32 | 21 | 93 | 34 |
| | Green ash | 13 |  | ..... | ..... | 20 | ..do... | 32 | 3.34 | .29 | .75 | 2,420 | 65 | 79 | 75 | 91 | 36 |
| | Sugarberry | 13 |  | ..... | ..... | 20 | ..do... | 36 | 3.30 | .25 | .54 | 2,537 | 59 | 50 | 49 | 92 | 41 |
| Southern pine newsprint ⁶ | | | | | | | | | | | | | | | | | |
| Average of 56 commercial newsprint papers..... | | | | | | | | | | | | | | | | | |

U. S. Forest Products Laboratory
Madison, Wisconsin
Problem D-191
Project L-168-5

| Species | Grinder | Neutral sulfite |
|---------------|---------|-----------------|
| | run No. | cook No. |
| Cottonwood | 389 | 3927-N |
| Green ash | 388 | 3928-N |
| Sugarberry | 395 | 3923-N |
| Southern pine | 392 | ..... |

¹In addition to the fiber furnish 0.25 percent of resin size, eye, and alum to a pH of 4.5 to 5.0 was added.

²All semichemical pulps were Bauer milled. The cottonwood pulp used in machine run No. 1751 was also beaten.

³With the exception of machine run No. 1751 the semibled pulp used was prepared from commercial southern pine kraft shipment 1493 bleached to a whiteness of 56 as measured by the Ives photometer. The semibled sulfite used in machine run No. 1751 was composed of 50 percent bitter pecan and 50 percent southern pine, digested together, cook Nos. 2550 and 2551 combined.

⁴The ream weight is based on the standard ream 25x40-500. To convert bursting and tearing strengths to the newsprint trade ream of 24x36-500 multiply by 1.157.

⁵Average of machine runs 1088-1092 inclusive, 1148, 1149, 1152-1154 inclusive.

hardwood as the hardwood groundwood pulp used. The papers were run on the machine with considerable difficulty, the chief trouble being caused by low wet strength and sticking to the first press. The bursting and tensile strengths were all lower than the average for commercial standard newsprint paper. The tearing strengths are all higher than the standard except in one instance. Subsequent experiments indicated that the poor running characteristics of these furnishes were due to the semichemical component. The opportunity did not afford itself to investigate this point further. It is therefore not concluded that neutral sulfite pulps satisfactory for the purpose could not be prepared from these species.

The furnishes for the machine runs which followed contained semi-bleached pine sulfate pulp as the chemical pulp constituent. Considering the three runs, 1770, 1771, and 1772, it is noted that a furnish of cottonwood groundwood of 20 percent, pine groundwood of 40 percent, and pine sulfate of 20 percent, lightly jordaned, gave a paper about equal to the average commercial newsprint. The color was very good, the whiteness being 65 percent. Increasing the cottonwood groundwood to 40 percent and maintaining the same total groundwood content caused a lowering of the tensile strength of about 20 percent. However, the bursting strength dropped only slightly and the tearing strength was higher than the standard average. The relative effect of the three species may be noted by comparing runs 1772, 1773, and 1775. The paper for the first run, containing cottonwood groundwood, is very slightly better than that of the second, containing an equal amount of ash groundwood, while the third, containing sugarberry groundwood, is the poorest. The papers containing ash and sugarberry groundwoods were lower than the commercial newsprint in bursting and tensile strengths but otherwise appeared to be satisfactory.

The furnish of the last machine run, No. 1777, contained equal amounts of the three hardwood groundwoods, 39 percent in all. The rest of the furnish was pine groundwood and semibleached sulfate in about the same proportions as in the three runs just discussed. With the exception of the tearing strength, the values for the strength properties are less than the average commercial standard.

These experiments indicate that groundwood pulps made from the three hardwoods, - cottonwood, green ash, and sugarberry - ^{which} may be used in the furnish of newsprint paper, may / ^{as high as} 40 percent, with the balance of the furnish consisting of southern pine groundwood and southern pine semibleached sulfate pulps. It appeared that at least 20 percent of semibleached sulfate was required to bring the bursting and tensile strengths up to values comparable with commercial newsprint. This amount of sulfate pulp caused the tearing strength to be higher than the commercial standard. Although none of the hardwood-containing sheets were quite as strong as the average for pine groundwood and sulfate alone, they are believed to be as satisfactory for use as newsprint paper.