USE OF HARDWOODS IN THE MANUFACTURE OF NEWSPRINT

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Summary

Technical information is now available on the possibilities of using hardwood pulps as part or all of the composition of newsprint. They may be used in the form of conventional groundwood and chemical pulps and also in the form of the newer semichemical or chemigroundwood pulps.

Hardwood pulps might be used in mixtures with softwood pulps to extend supplies of softwoods for existing mills, expansion of these mills, or for new mills. It may also be possible to make a satisfactory newsprint entirely from low-density, light-colored hardwoods, such as aspen and cottonwood, and, with some change in quality, from the heavier hardwoods. However, blends of hardwood pulps with softwood pulps would ordinarily be preferred.

Cost factors and the technical problems of large-scale operation must be investigated to determine the maximum quantities of hardwoods that can be used profitably. Present processes must be modified and new, low-cost processes must be developed to realize the full potentialities of hardwood usage. In general, however, there is little indication that costs would be reduced substantially as a result of developments now in prospect. The principal effect of these developments would be to broaden the base of raw material supplies.

The processes now used for manufacturing newsprint are highly efficient in the utilization of wood, labor, and power; they are undoubtedly as economical as processes now in prospect. By improving the yield of pulp and paper-machine performance, some increase in production is possible with the processes and woods now used.

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1 Report originally dated March 1955.
2 Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Report No. 2027
Introduction

Most newsprint used in the United States today contains at least 70 percent groundwood pulp; the rest is unbleached sulfite or semibleached sulfate pulp.

The high tonnage production of newsprint has become possible because of the availability of low-cost fibrous raw materials and cheap methods for converting them into paper having a light color, adequate strength, and satisfactory printing characteristics. The newsprint to which we are accustomed was not available until low-cost wood pulps were developed for this purpose. Though newsprint paper is considered one of the lower grades of printing papers, it is actually a specialized product. It is manufactured on the largest of paper machines at a high operating speed and at the highest production rates of any of the printing papers. Because of demands of the users, newsprint has been greatly improved in quality over the years. To compete, new materials and new processes will have to meet these quality and manufacturing standards.

Pulping of Hardwoods for Newsprint

Conventional Pulping Processes

The three main processes used in making pulp for newsprint are the groundwood process, the sulfite process, and the sulfate process. Nearly all newsprint is now made of a mixture of groundwood pulp and either sulfite or sulfate pulp. These pulps are made almost entirely from softwoods, largely white and black spruce, balsam and other true firs, western hemlock, and southern pine. Small quantities of hardwoods are used.

Groundwood process.—The groundwood process consists of pressing wood against a grindstone running in water showers and partly submerged in a mass of pulp. Since the process is entirely mechanical, it gives close to the maximum efficiency in wood conversion that can be expected of any process for making pulp. The yield of pulp obtained is 90 percent or more of the weight of the wood ground. Groundwood pulp has low strength, but it imparts to printing papers a bulkiness, softness, opacity, finish, and other desirable qualities. Groundwood pulps made from most hardwoods, however, are much lower in strength than those made from softwoods, so that only relatively small amounts of hardwood groundwood pulps can be used in blends with other pulps. To produce groundwood of equal strength, hardwoods require a much higher energy consumption than the softwoods.

Groundwood pulp of fair quality can be made from light-colored, low-density hardwoods like poplar and cottonwood. Poplar groundwood pulps are used to some extent in magazine book paper and in newsprint. The heavier hardwoods
like birch and beech produce groundwood pulps having much lower strength than the lower density hardwoods. They can be used only in small amounts as a filler in combination with stronger pulps.

Eucalyptus groundwood pulp is used in large proportions in the newsprint manufactured in Australia. Appreciable amounts of poplar are used in making newsprint in Italy; in India a low-density hardwood, Salai (Boswellia Serrata), is used for the groundwood component of a newsprint paper.

Sulfite process.--The sulfite process employs an acid chemical solution consisting of calcium bisulfite and sulfurous acid. The softwoods used in this process are relatively low in resin content and light in color. The yield of pulp is less than half the weight of the wood used. For making newsprint the pulp is not bleached. Softwood sulfite pulp of newsprint grade contains longer fibers and is stronger than groundwood pulp. This pulp imparts strength to the newsprint paper, provides a network of fibers to hold the groundwood pulp, and helps the drainage of water from the sheet as it is formed.

Hardwoods are pulped by the sulfite process for use in book papers and other white papers. Hardwood sulfite pulps are generally bleached because they are usually too dirty and shivey to be used unbleached. Hardwood sulfite pulps are not so strong as softwood sulfite pulps and, of course, could not be substituted weight for weight in making newsprint paper. A small amount of poplar sulfite pulp is used in newsprint paper in Italy and a little eucalyptus sulfite pulp is used similarly in Brazil.

Sulfate process.--An alkaline solution of sodium hydroxide and sodium sulfide is used in the sulfate process. This process can be used to pulp practically all woods, including resinous species. It is used for making the chemical pulp component of southern pine newsprint. The yield of pulp, like that from the sulfite process, is less than half the weight of wood used. Sulfate pulp has a brown color and therefore must be bleached to a satisfactory whiteness. The sulfate process also produces pulp having good strength from many hardwoods that should be suitable for use in newsprint.

New Pulping Processes

Three processes, the neutral sulfite semichemical process, the cold soda process, and the chemigroundwood process are now being studied and developed. They are of considerable interest because of their possible application in the manufacture of newsprint pulp from new or little-used woods. These processes employ both chemical and mechanical treatments. The yields of pulp are high, and the pulps are stronger than conventional hardwood pulps.
Neutral sulfite semichemical pulping.--The neutral sulfite semichemical process was developed at the Forest Products Laboratory. It consists of a mild chemical treatment to soften the wood, followed by mechanical refining to complete the fiber separation. The treating solution contains three or four parts of sodium sulfite to one of sodium carbonate. Pulp suitable for use in newsprint can be obtained in yields of 70 to 85 percent from most woods. For newsprint the pulp obtained from light-colored woods does not need to be bleached. Bleaching, if necessary, can be done by treatment with small amounts of either calcium hypochlorite or sodium peroxide.

The neutral sulfite semichemical process is especially suitable for hardwoods. The strength of semichemical hardwood pulp is appreciably higher than that of the sulfite pulp and approaches that of the sulfate pulp made from the same wood. Hardwood neutral sulfite semichemical pulp is a potential substitute for softwood chemical pulp now used for newsprint. In fact, small quantities are now being used for this purpose.

Cold soda pulping.--In the cold soda pulping process, a process now being developed at the Forest Products Laboratory, the chips are steeped at room temperature in a relatively strong solution of caustic soda for about 2 hours. The treated chips are then fiberized in an attrition mill. Experimental work in progress indicates that the process can be made continuous. The yield of pulp is about 90 percent of the weight of the wood used. Aspen cold soda pulp was found to contain more fibers of intermediate length and less fines than aspen and spruce groundwood pulps of equal freeness. It was also stronger than the groundwood pulps, and the test sheet had higher density. It may be possible to blend this pulp with hardwood groundwoods to produce mixtures approaching the properties of softwood groundwoods.

Chemigroundwood pulping.--Hardwood groundwood pulp can be improved in strength by treating the wood blocks with chemical solutions before they are ground in the conventional manner. The term "chemigroundwood" is now used for this kind of pulping. The pretreatment of wood for groundwood pulping has been practiced to a limited extent for special purposes for many years. During the past few years there has been a renewed interest in this kind of pulping, and a 400 ton per day mill for producing chemigroundwood was recently built by a large newsprint company. The process has particular interest in areas where an established groundwood pulping industry is confronted with a diminishing supply of the preferred softwoods. The hardwoods usually available to these mills might be utilized if satisfactory and economical pretreating procedures are developed.

Recent research on pretreating wood for grinding with a neutral sodium sulfite solution has greatly improved the technology of the process.\(^2\)


Rept. No. 2027
The logs, cut to length for grinding, are treated in a cylinder with alternate vacuum and pressure cycles, in the presence of the liquor, at relatively low temperature. Different degrees of penetration and treatment can be obtained by regulating the process variables. With some hardwoods complete penetration and softening of the piece has been obtained; the pulp resembles in some respects that made by the neutral sulfite semichemical process. Chemigroundwood, like cold soda pulp, is useful for blending with hardwood groundwood to give mixtures comparable with softwood groundwood pulp.

Bleaching semichemical and groundwood pulps.—Most newsprint is made from unbleached pulp. Only the sulfate pulp used in southern pine newsprint is now bleached, using a conventional chlorine-hypochlorite treatment. For use in newsprint, pulps made from some hardwoods, or by some processes, may require bleaching.

The neutral sulfite semichemical, chemigroundwood, and groundwood pulps made from light-colored woods like aspen, cottonwood, paper birch, yellow-poplar, and tupelo probably would not ordinarily need to be bleached. Pulps made from the darker woods like maple, ash, elm, hickory, and oak, if used in any appreciable proportion, no doubt would require some bleaching.

One-stage processes using relatively small amounts of calcium hypochlorite or sodium peroxide have been developed for bleaching semichemical and chemigroundwood pulps. The peroxide process is also satisfactory for bleaching softwood groundwood when necessary; for most hardwood groundwood pulps the hypochlorite process is suitable. The strength of the hardwood pulps is nearly always improved by bleaching.

Production of Newsprint from Hardwood Pulps

The availability of hardwood species has led to a great deal of speculation and research on the possibilities of using them to a greater extent for making all kinds of pulp and paper. About 4.8 million cords of hardwoods, amounting to about 16 percent of the total pulpwood consumed, were used for pulp and paper in 1954. This quantity is more than twice the amount of hardwood pulpwood used before the last war and four to five times the amount used in 1930.

Significant progress has been made in the production of hardwood pulps of better quality by the conventional processes—groundwood, sulfate, and sulfite—and particularly by the newer semichemical processes just described. The greatest difficulty encountered in processing hardwoods for papermaking is that of developing bonding strength in the shorter fibered pulps comparable to that of longer fibered softwood pulps.
Various combinations of the different kinds of hardwood pulps might be considered as possibilities for making newsprint. Small quantities of hardwood pulp in the form of conventional-type groundwood and sulfite pulps can be used with the longer fibered softwood pulps. Larger quantities of hardwoods might be used as semibleached sulfate pulp and also as part of the groundwood. For example, a mixture containing 71 percent spruce groundwood, 10 percent aspen groundwood, and 19 percent semibleached birch sulfate has been proposed. Such a mixture, having a total hardwood pulp content of 29 percent with no increase in the more expensive chemical pulp, probably could be simulated with other kinds of hardwoods.

Experiments at the Forest Products Laboratory have shown that a paper with strength and other physical characteristics comparable to commercial newsprint can be made from a variety of hardwood and softwood pulp mixtures. The composition and properties of representative papers are given in table 1. In some of the mixtures the softwood sulfite pulp was replaced entirely by hardwood semichemical pulp or cold soda pulp. In others parts of both the softwood sulfite and groundwood pulps were replaced by these kinds of pulps. As much as 40 percent of hardwood groundwood was used in some mixtures. Several mixtures contained a total of 75 to 80 percent of hardwood semichemical and groundwood pulps.

Although experiments indicate that high percentages of hardwood pulps can be used in making newsprint, it might be difficult or impracticable to use such quantities in commercial operations. However, it appears that at least 50 percent of the total furnish could consist of hardwood pulps, particularly of such low-density species as aspen, cottonwood, basswood, yellow-poplar, willow, and red alder, and the lighter colored denser species like the birches, tupelos, sweetgum, and sugarberry. Dark, heavy woods like the oaks, hickory, and elm might be used up to 15 percent of the total furnish as unbleached sulfate, semichemical, cold soda, or chemigroundwood pulps, and possibly up to 40 percent if semi-bleached.

Whether hardwood pulps can profitably be used for newsprint in competition with present sources, however, remains to be determined. Certain factors in the use of hardwoods tend to increase costs. For example, as mentioned above, some of the pulps need to be bleached. hardwoods are often crooked and knotty, and it is generally more difficult to remove bark from them than from softwoods. Factors that would tend to offset possible higher costs are the higher yield of pulp obtained from hardwoods, particularly when made into semichemical pulps and in some instances, lower wood cost.

The maximum quantities of hardwoods that can be used profitably can only be determined by larger scale trials. Where hardwoods are available to

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established mills, they might be used to extend existing supplies of soft-woods. They could also be considered when planning expansion of mill facilities or the construction of new plants.

**Paper Manufacturing Problems**

The use of new fiber blends will undoubtedly present new problems in paper manufacture, such as low drainage rates of water from fiber and low strength of the wet web of paper. Longer wire screens for increased drainage time, greater suction box capacity, and devices to assist in handling low wet-strength sheets may solve the problems in some instances. One device provides for carrying the wet web from the machine wire through the wet presses without depending on the web to carry its own weight from the wire to the presses. This should not only minimize breaks but permit the running of weaker wet webs or running at higher speeds. The addition of chemicals or binders may be necessary for improving web strength.
SUBJECT LISTS OF PUBLICATIONS ISSUED BY THE
FOREST PRODUCTS LABORATORY

The following are obtainable free on request from the Director, Forest Products Laboratory, Madison 5, Wisconsin:

List of publications on Box and Crate Construction and Packaging Data
List of publications on Chemistry of Wood and Derived Products
List of publications on Fungus Defects in Forest Products and Decay in Trees
List of publications on Glue, Glued Products and Veneer
List of publications on Growth, Structure, and Identification of Wood
List of publications on Mechanical Properties and Structural Uses of Wood and Wood Products

Partial list of publications for Architects, Builders, Engineers, and Retail Lumbermen

List of publications on Fire Protection
List of publications on Logging, Milling, and Utilization of Timber Products
List of publications on Pulp and Paper
List of publications on Seasoning of Wood
List of publications on Structural Sandwich, Plastic Laminates, and Wood-Base Aircraft Components
List of publications on Wood Finishing
List of publications on Wood Preservation

Partial list of publications for Furniture Manufacturers, Woodworkers and Teachers of Woodshop Practice

Note: Since Forest Products Laboratory publications are so varied in subject no single list is issued. Instead a list is made up for each Laboratory division. Twice a year, December 31 and June 30, a list is made up showing new reports for the previous six months. This is the only item sent regularly to the Laboratory's mailing list. Anyone who has asked for and received the proper subject lists and who has had his name placed on the mailing list can keep up to date on Forest Products Laboratory publications. Each subject list carries descriptions of all other subject lists.