

POSSIBILITIES OF INCREASING THE USE
OF HARDWOODS TO MEET PULPWOOD
REQUIREMENTS

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POSSIBILITIES OF INCREASING THE USE OF HARDWOODS TO

MEET PULPWOOD REQUIREMENTS¹

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Abstract

Predictions of increased paper and board demands for the immediate future raise questions regarding possible sources of fibrous raw material to satisfy anticipated requirements. Because the cheapest source of paper-making fiber will probably continue to be wood and because readily available supplies of preferred long-fibered species are inadequate, new resources of pulpwood will need to be developed if domestic supplies are to be utilized. A promising pulpwood source lies in currently secondary species and low-grade wood. Hardwoods make up the bulk of secondary species and their use is necessary to realize a badly needed improvement in silviculture in the woods. Although hardwoods have been used to advantage in small amounts in the pulp and paper industry for many years, it is only within the last few years that advancements in technical knowledge have been made to overcome certain difficulties in hardwood harvesting and processing and in pulp- and paper-making procedures. Those advances have improved the possibilities of increased utilization of hardwoods.

Nearly 150 years ago the English economic world was introduced to the startling theory which predicted alarming poverty if population increases did not become commensurate with the more moderate increases in means of subsistence. However, advances in agricultural and other technologies and in transportation tended to disprove this famous theory of Malthus. Today, serious shortages again confront the United States and the world. Of particular interest to the Forest Products Laboratory is the shortage of paper and paperboard, since these are chiefly products of the forest. The demands for these products are not being met and the predicted demands in the near future exceed considerably the readily available supplies of the preferred long-fibered raw material. Although the situation is unlike that described by Malthus. It will be shown that technological developments can again help meet the present and prospective shortages, at least the paper and board shortages.

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As you know, the pulp and paper industry in the United States has had a rather amazing growth during this century. A large increase in paper consumption has been shown in each decade. In the period from 1899 to 1945 the consumption of paper and board has increased from slightly over 2 million tons to about 20 million tons. It has been predicted conservatively that paper and board consumption will be 24 million tons by 1950. During the period of 1899 to 1943 the per capita consumption of paper and board increased from 58 to 288 pounds, although it reached a high of 309 pounds in 1941; it is estimated that this value will be 330 pounds by 1950. It is of interest, incidentally, to recognize that a close correlation exists between consumers' expenditures for nondurable goods and services and paper consumption.

Accepting the predicted increase of 20 percent in paper and board consumption by 1950, the question then arises as to where this increase is to come from. It seems likely now that the added requirements will be met to a greater or lesser degree by the following alternatives, assuming that wood will continue to be the cheapest source of primary fibrous raw material:

- (a) Importing more pulpwood, pulp, and paper.
- (b) Using more waste paper.
- (c) Increasing domestic pulpwood production by going farther afield for preferred long-fibered species, by using new species, or by using more of the little-used species.

Part of the increased requirements will undoubtedly be met by increased imports, although there are increasing demands elsewhere for Scandinavian pulp and paper products and it will be a few years before those countries have recovered from the effects of World War II. In this connection it is interesting to note that before the war the amount of paper imported or made from imported pulpwood and pulp nearly equaled the amount of paper made from domestic pulpwood. Waste paper will continue to be used in large quantities in numerous grades of paper but it is doubtful if the war-time collection level can be maintained unless the situation becomes critical. Thus a large part of the increased requirements for the future will probably need to be met by domestic pulpwood.

During 1945 close to 86 percent of the pulpwood consumed in the United States was in the form of the preferred long-fibered species, the softwoods. The possibilities of cutting more preferred softwood pulpwood and maintaining this high percentage of long-fibered wood appear to be limited because additional supplies of the desired species are not readily available or cutting at an increased rate will impair the forests. In the Northeast, for example, the available supplies of softwoods have been inadequate for years and a considerable percentage, 31 percent in 1944, of the softwood pulpwood consumed has been imported. A similar situation exists in the Lake States. In the South there is a sufficient over-all supply of pine pulpwood for the future, but concentration of mills in certain areas has reduced the availability of the pine, or cutting at a higher rate is contrary to good forest practice. Finally, the supplies

of the preferred hemlock in the Northwest have become increasingly less available so that an increase under past conditions is improbable. In all regions, however, there is a tremendous supply of low-grade wood and little-used species whose utilization is imperative if badly needed improvements in the conditions and future productivity of the forest are to be realized. In the Northeast, Lake States, and the South these unused forest resources are largely in the form of the broad-leafed hardwoods. This source of wood appears to offer an attractive possibility for increasing the supply of pulpwood. Hemlock and Douglas-fir logging and mill wastes comprise the probable source of pulpwood in the Northwest. Thus, the most likely resources in three of the four major pulping regions exist in hardwoods.

Before discussing the possibilities of utilizing hardwoods to meet a substantial portion of present and future pulpwood requirements, it is advantageous to review the history of the use of wood as a fibrous raw material for paper in order to help determine possible future trends in pulpwood use. The first wood species used in the pulp and paper industry were poplar and basswood, both hardwood species although soft in texture. These woods were particularly suited for soda pulping, the first chemical pulping process. The invention of the sulfite pulping process and developments in groundwood pulping soon changed the preference to spruce. In 1899 spruce alone made up 76 percent of all the pulpwood consumed. Because the supplies of spruce did not prove inexhaustible and because paper demands were increasing rapidly, other species had to be used to meet these demands. In this way Eastern and Western hemlock, Southern yellow pine, balsam and white fir, and jack pine were added to the list of so-called pulping species. To the original hardwoods, poplar and basswood, were added small amounts of yellow-poplar, gum, chestnut, birch, maple, and cottonwood. These additions came about as a result of both economic pressure and advances in technical knowledge. The importance of spruce in the over-all picture has thus diminished and in 1941 spruce represented only 22 percent of the U. S. pulpwood consumption. It is inescapable, however, that the trend has been for now, long-fibered species like Western hemlock or southern pine to satisfy the increasing demands for pulpwood.

It is now natural to question why hardwoods have been passed over in spite of their availability in large quantities. Two reasons stand out for this rejection. These are: (1) Hardwoods are difficult to harvest and prepare for pulping (particularly bark removal), and (2) hardwood fibers are short (on the average 1/25 inch long in comparison with 1/8 inch long for softwood fibers) and have been used satisfactorily by conventional methods only in a few grades of paper where strength is not important. The question then arises as to whether those reasons still limit and will continue to handicap hardwoods. The answer to this second question is that hardwood harvesting will probably always be more difficult than softwood harvesting and that hardwood pulps will probably never find usage where the greatest strength is needed, but recent technical advances and developments having considerable future promise are showing the way for a much

wider use of short-fibered hardwoods than in the past. Discussion of a few of those advances and developments will illustrate the possibilities of increasing the use of hardwoods in the pulp and paper industry.

Hardwood harvesting and processing is generally more costly than that of softwoods because hardwoods are heavier and more difficult to saw, handle, and debark. Improvements in mechanization and integrated logging are expected to reduce costs and difficulties. The hardwood peeling season is shorter than for softwoods and hardwood bark is removed with considerable difficulty at the mill. However, improved methods of bark removal which may overcome this objection to hardwoods are being developed.

Before the war hardwood pulps were used chiefly as soda pulp in certain grades of book, writing, and printing papers, as sulfite pulp in printing, writing, and absorbent papers, papers, and as semichemical pulp in corrugating paper. The amounts of pulp made were not large and the use of semichemical pulp was the only substantial advance made since 1925. The hardwood soda pulp was used because of its soft and bulky nature and its short resilient fibers made papers with excellent printing characteristics. The sulfite pulp was used as a filler pulp to improve paper formation and surface properties, mainly because of its short fibers. The hardwood semichemical pulps imparted a desirable stiffness to the corrugating paper. All of these uses of the hardwood pulps depended on specific characteristics of the hardwood fiber. These specific properties at the same time limited the use of hardwood pulp to the narrow field where strength was not important. There have been recent developments, however, that indicate that pulps made from hardwoods can find broader use, and that the possibilities of increasing the utilization of hardwoods in the pulp and paper industry are definitely brighter now than at any time in the past.

One important development in hardwood pulping has been the demonstration that many hardwoods can be pulped by the conventional sulfate process to produce pulps having considerable strength and wide use possibilities. Heretofore, the sulfate process has been applied chiefly to northern and southern pines to produce the strong pine kraft pulps used in wrapping paper and container board. The hardwood sulfate pulps are much stronger than the soda pulps. One large northeastern mill has proven to its own satisfaction that bleached hardwood sulfate pulps can be used for a majority of the outlets now served by bleached softwood sulfite pulp and has started construction of a mill to produce bleached sulfate from birch, maple, and beech. At least two northeastern soda mills plan to convert to sulfate pulping to improve the strength and utility of their hardwood pulps. During the war a Wisconsin sulfate mill started using aspen to furnish part of its wood supply when pine and spruce resources failed. The benefits obtained exceeded expectations and the mill is continuing the pulping of aspen. One large southern sulfate mill has been pulping southern hardwoods for use in tissue papers; another is pulping hardwoods for book paper. It has been shown experimentally at the Forest Products Laboratory that certain proportions of hardwoods, say 10 percent, can be pulped in mixture with pine without sacrifice in pulp

quality. General use of even small proportions of hardwoods will provide a possible outlet of as much as a million cords annually in the pulp industry in the South. In a recent contest in Canada for the most practical method to use hardwoods in newsprint manufacture, the prize-winning suggestion entailed the use of semibleached sulfate pulp from birch, in addition to aspen groundwood pulp to provide a 40 percent portion of hardwoods in newsprint. Thus, the sulfate pulping process with little change in conventional operation offers several attractive possibilities for increasing hardwood utilization.

With slight modifications, the sulfite process also offers possibilities for increasing hardwood utilization over and above present use. During the war period it was recognized that hardwood sulfite pulps made according to the best practice had more use possibilities than previously realized. For example, the quality of birch sulfite pulp is not far from that of Eastern hemlock sulfite pulp. Hardwood sulfite pulp also has certain qualities which makes it a promising material for chemical conversion.

The conventional groundwood pulping process likewise offers possibilities for the additional use of hardwoods. During the war several Wisconsin groundwood pulp mills used aspen groundwood pulp to great advantage. The product made by one of the mills, a coated book paper, contained 50 percent aspen. While this usage was compelled by wartime demands, certain definite advantages have been recognized and at least a part of the wartime gains in the production of aspen pulps by the various methods is expected to be continued. Incidentally, the consumption of aspen has doubled during the last few years, and the information obtained by its forced use will increase the possibilities for its future utilization.

By modifying the relatively new neutral sulfite semichemical pulping of hardwoods through addition of a stage of bleaching, it is possible to partially overcome the low strength of hardwood pulps. Actually, hardwood pulps as strong as standard pulps from many long-fibered species have been made in mill-scale demonstrations. Developments in the semichemical pulping process itself are being pursued in several places. One large southern mill has started construction of pulping facilities to produce hardwood semichemical pulp for wider usage than heretofore on the basis of successful wartime operation in a smaller southern mill. Experiments at the Forest Products Laboratory have indicated the possibility of using hardwood semichemical and groundwood pulps in mixture with softwood pulps in the manufacture of newsprint. Other work at the Laboratory has shown that a large number of southern hardwoods are suitable for producing an excellent quality of corrugating board from semichemical pulp made with sulfate pulping liquor.

During the last few years the use of printing papers, particularly of the coated type for magazines, has increased astonishingly and huge quantities are expected to be used in the future. The hardwood pulps have an excellent possibility of fitting into this expansion because they

improve printing qualities. Development work recently started has as its purpose improving the strength of hardwood papers by use of resin bonding. If successful, this will increase the utilization of hardwood pulps.

Finally, some of the most attractive opportunities for utilizing wood waste and low-grade material, including certain hardwoods, exist in the field of coarse-fiber materials such as building board and paper, insulating board, and roofing felt. Use of these products has increased greatly during the past few years and this rapid expansion is expected to continue.

Thus it appears that the possibilities of increasing the use of hardwoods in the pulp and paper industry are more favorable now than at any previous time. The problems connected with hardwood utilization are far from solved, however, and considerable technical advancement is still needed before hardwoods may be used to the best advantage.