WOOD WASTE: A CHALLENGE TO INDUSTRY AND SCIENCE

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In the first postwar year low-quality timber and waste utilization have been important sources of material for all the forest industries. Much technical study and research have been directed at the problems they involve. People close to the woods know that the major problems in forest utilization for many years to come will center around the use of timber which, prior to the war, was considered too poor for operating industries to take very seriously. Ill-favored species, cull timber, and wood waste are almost synonomous. From all angles wood waste is thrown into bolder and sharper relief as every year passes.

Thousands of tons of wood are wasted every day. No one knows the exact amount, but we all have seen enough to know that the economic loss is enormous. When we think of all the material, jobs, profits, and taxes these great quantities of wasted wood could furnish, we are tempted to shout loudly about what someone else should do about it. Getting emotional about the matter will not help. Neither will it do any good to point the finger of scorn at anyone for being a waster. Directly or indirectly we have a part to play in improving the situation.

A basic reason for the waste, of course, is that no commercial enterprise in the business of growing, harvesting, or processing wood can afford to operate very long at a loss. The wood wasted by any such enterprise constitutes the portion that apparently cannot be used without financial loss under prevailing conditions. The word "apparently" is used advisedly, for individuals and companies differ widely in their interest and skill in avoiding waste or finding profitable uses for their otherwise waste material. Locality and current economic conditions also have an important influence on what can be done. What is needed, is constant effort on the part of all concerned to devise new or improved products

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and methods for using what is now wasted. This means taking advantage of every opportunity offered by changing economic conditions to increase the percentage of the wood crop that finds profitable utilization.

The responsibility for improvement does not fall on any one group. It is a joint obligation of the many groups, including those engaged in research and education, timberland management, harvesting or processing of wood, and the sale of wood products. Even the lawmakers and the administrators of the laws, have an important influence. Each of these groups can make some progress without the help of the others. The combined effect of all their efforts in the same direction can be very great.

The staff of the Forest Products Laboratory at Madison feels keenly its special obligation to give substantial service in improving the efficiency of wood utilization. Congress has provided us with funds for the purpose and the public has a right to expect results. I feel that the contributions we have made to date have justified, many times over, all the money and effort we have invested. They do not give us grounds for complacency, but they stimulate our belief that greater things can be accomplished and spur us on to more intensive effort.

In carrying out this obligation, we are working along many lines. Our program of work includes studies on methods of harvesting, transporting, manufacturing, and grading primary forest products; development of new and improved pulping methods to make more woods acceptable for the manufacture of pulp and paper products; development of new chemical products and processes; studies of mechanical and physical properties of all woods; development of improved gluing, finishing, treating, and other processing methods; and fundamental studies to increase our basic knowledge of the chemistry, physics, and mechanics of wood, lignin, cellulose, and wood derivatives. Throughout all fields of work, a constant watch is kept for opportunities to increase wood waste utilization.

Broad Classification of Wastes

In considering what can be done about waste, it is useful first to take a look at what and where the wastes are. This is desirable whether we are viewing the problem from a national, state, local, or individual viewpoint. Considering the country as a whole, the broad classes of waste by the logging and manufacturing industries consist of:

1. Material left in the woods in the form of unwanted or little-used species, tops, high stumps, cull logs or bolts, undersized but damaged trees, broken material, and the like.

2. Wastes in processing wood mechanically, such as sawdust, shavings, bark, slabs, edgings, trimmings, defective pieces, veneer log cores, and many others.

3. Wastes in processing wood chemically, such as the extractives, lignin sugars, hemicelluloses, and cellulose, that are not recovered in manufacturing pulp, the chemicals and gases that are not recovered in making charcoal, and the bark that is removed from wood before pulping.

4. Deterioration in storage and use. There is, of course, another type of waste in a somewhat different category than the three previous classes, but none the less important, namely, the enormous waste through the destruction of wood by fire, insects, and decay in the forest, in storage, and in use, and by mechanical wear and breakage in service or storage.

Numerous additional examples of each type of waste might be listed. Wood waste occurs in literally hundreds of forms and variations, but, with few if any exceptions, they fall in one of the foregoing classes.

Examples of Improved Utilization

What is needed to reduce these different forms of logging and manufacturing waste and convert them into products of higher value? Everyone should realize that there is no panacea. We cannot hope that any revolutionary process is going to change the picture completely so that from then on there will be no waste problem. I think we should all recognize that progress will consist of thousands of individual forward steps, many of which may not even be noticed, but which in the aggregate will undoubtedly bring about substantial forward progress year by year.

One example of this progress under the first broad classification is the past work of the Forest Products Laboratory on little-used species. With the entrance of a little-known wood into lumber markets, a number of questions immediately arise. The consumer quite naturally wants to know how the new wood compares with woods with which he is familiar. As a result, there is a demand for information on the properties and suitability of the wood for various uses. Anticipating this demand, the Laboratory has through the years tested and compiled information on various so-called little-used species, so that today, when economic conditions are making many of these woods marketable, their general properties and usefulness are known. Western hemlock, Western larch, sweetgum, white fir, aspen, jack pine, and lodgepole pine are examples of woods now widely used whose properties and usefulness were studied long before the public was willing to buy them.

An important example of increasing the utilization of unwanted species is the Laboratory's development since 1924 of the semichemical process for pulping, which makes possible high yields of excellent pulp from hardwoods. This process has steadily gained in favor and today forms a sound basis for expanding the use of hardwoods for pulp and paper, thus making it possible for pulp mills to make use of practically all the woods that grow in their vicinity. The fact that semichemical pulping gives

yields of 70 to 80 percent of the dry wood in comparison with yields of 45 to 50 percent from the older standard chemical processes is of high importance as a means of avoiding waste in chemical processing.

The Laboratory's current work in small sawmill improvement may be cited as a means of reducing waste in mechanical processing. Methods of operation which eliminate miscut lumber obviously result in producing more usable lumber per thousand board feet of logs and less waste in shavings and trimmings. Certain items of small sawmill efficiency have indirect bearing. In a study of the efficient use of power on the headsaw it was found that the force used in the actual cutting action of the sawtooth is practically the same for a shallow cut or bite, as for a deep one. This fact has led the Laboratory to advise thousands of small sawmill operators to decrease the speed of the saw and increase the rate of feed, thereby obtaining greater production with a given amount of power. The utilization of much woods waste and little-used species depends largely on the improved efficiency of small sawmills.

The Laboratory's recent work on the production of wood sugars, alcohol, and yeast from sawdust is a good example of the utilization of wood wastes by chemical processing. During World War II the great demand for ethyl alcohol revived interest in converting wood into sugar and fermenting the sugar for which several rather inefficient processes were known. As a result of the Laboratory's research on wood hydrolysis, in cooperation with industry and the War Production Board, an improved process was developed which formed the basis for the design of a plant recently constructed at Springfield, Oregon, and now beginning operation. From Douglas-fir sawmill waste, this plant has the capacity to produce 5 to 6 million gallons of alcohol per year as well as other products. It is hoped that experience at this plant, together with further research at the Laboratory and elsewhere, will make possible the successful operation of additional wood-sugar plants in different parts of the country and on a smaller scale. We have much to learn, however, before the erection of additional plants can be recommended.

For many years the technicians at the Forest Products Laboratory, as well as countless other investigators, have attempted to make practical the utilization of sawdust in building boards, but with very limited success. Recent tests at the Laboratory have indicated that it may be practical now to revive an old idea that makes use of the well known binding property of highly hydrated or gelatinized pulp to permit the use of large amounts of sawdust in a low-cost board. Experimental boards have been made, using 85 percent sawdust with 15 percent hydrated or highly processed wood pulp. Rosin or asphalt size can be added to increase the water resistance of these materials, producing sample boards with excellent resistance to high humidities, steaming, or freezing, and having properties similar to those of commercial wallboards. Whether or not such a board can be produced commercially at a profit remains to be determined. The question is receiving further study. It may be that the cost of collecting the waste, plant investment, hydrating the pulp, and the like, will defeat it at this time. Nevertheless, establishing the fact that

a satisfactory building board can be made chiefly from sawdust in this manner is a forward step in waste utilization.

In recent years important advances have been made by many private and public agencies in the attack upon wastes in the chemical processing of wood. For example, lignin in sulfite waste liquor is being used as a base for the production of tannins, as a dispersing agent for Portland cement, in the negative plates of storage batteries, and for the production of vanillin. The evaporated waste liquor itself finds considerable usage as a binder in foundry cores, in linoleum cement, and as a road binder. Most lignin from wood processing, however, still remains unused.

The carbohydrates in waste sulfite liquor have been partially converted to sugars that may be fermented by yeast to ethyl alcohol or used for the growing of yeast. The production of alcohol from waste sulfite liquor has been practiced in Sweden for many years. The process was also used in Germany to produce alcohol for motor fuel and as a propellent for robot bombs. One plant in Canada and one in the United States are producing alcohol from waste sulfite liquor. Yields as high as 21 gallons of alcohol per ton of pulp have been produced. The process of producing food yeast was well-developed in Germany during the war period and is being examined for use in the United States.

The Laboratory's work on seasoning and preservation is concerned with overcoming waste from deterioration in storage and use. For example, the chlorinated phenols, suggested by the Laboratory to manufacturers in 1930, have proved especially valuable in the control of blue stain in forest products and now are important substitutes for coal-tar creosote. By means of preservative treatment, the inroads of decay fungi, insects, and other hazards are now markedly curbed in houses, posts, poles, railroad ties, and a long list of wood products. By improved piling and handling methods, less lumber is ruined by checking, splitting, and warping.

Steps Toward Better Utilization

Encouraging better utilization involves varied fields of effort, of which technical research is but one. The range of needed effort includes improved equipment, better selling, development of new processes and products, and greater publicity and education.

Improved Equipment

One of the most important contributions to better utilization can be made through the development of improved harvesting, handling, and hauling equipment and methods. Any such development that will permit bringing in more of the wood at a profit will help reduce the amount that is left on the ground to rot or burn. As you know, such developments are now taking place at a rapid rate all over the country. They are

stimulated by shortage of labor, and the belief that there are many opportunities to effect substantial reductions in costs as compared to the cost of harvesting and handling with old equipment and methods that were designed for prime, virgin timber instead of low-grade and waste. The members of your organization, as witnessed by this Congress, are taking an active part in this quiet revolution. The Forest Products Laboratory is doing what it can to stimulate progress in this field by sending technicians into the woods and mills throughout the country to observe what is going on, to pick out the interesting and promising new ideas and equipment, and to tell about them in other parts of the country.

One prominent example of improved harvesting is the relogging that is now going on with considerable success in the Pacific Northwest. The old methods and equipment were designed for handling big timber and large volumes. They could not handle small logs or small quantities cheaply enough to permit their profitable removal from the woods. By using lighter and faster equipment, the loggers are now able to go back over the ground that has been logged and take out large quantities of material at a profit. Their ability to do this, of course, has been influenced in part by the reduction in stands of virgin timber, by the increased marketability of medium-grade products, by the development of new equipment, and by the growing belief that something must be done to reduce waste and bring about sustained-yield management.

Relogging probably promises very little outside of the western forests, where the wastes have been notoriously high in the past. The reduction in easily available supplies of preferred pulpwood species, the improvements in pulping processes, and the increasing prices paid for pulpwoods east of the Mississippi River, however, do provide opportunities to bring in species and sizes of pulpwood that formerly could find no profitable market. These facts may not permit relogging of a cut-over area, but they should permit in many places more complete utilization of the timber available on the area.

One development that deserves much greater application and that can greatly reduce waste is what is called "integrated utilization." In simple words, this means putting each part of the tree to its highest use. It can be accomplished by grouping industries. It should be possible, in many localities where large wastes are available from woods or mill operations, to establish additional industries that can make use of the waste or that can make higher use of some of the material than the primary manufacturing operation.

For example, a common situation is to have just a sawmill. Everything that can be made into boards at a profit is run through the mill and all that is not made into boards is waste. Obviously, more complete utilization and more local jobs will result when there is some other plant within reach to use logs too small for the sawmill, as, for example, a pulp mill, chipping plant, fiberizing mill, or chemical plant. A further increase in efficiency or in money return might be obtained by sending the best of the logs to a veneer mill where they command a higher price. The various individual plants can be under the same management or

different management and the variety of possible combinations is very great. Perfection is too much to expect, but great improvement over present practices is easily possible in many places by better grouping of manufacturing operations.

Tree-length logging, which is being practiced more and more, contributes not only to lower logging costs but to the better grouping of manufacturing plants as well. By this method the whole tree can be brought to a central point where it can be cut, under expert supervision, into logs, pulpwood, poles, posts, or other products according to quality, grade, and what will bring the best price. In this way much waste can be avoided by more accurate cutting to required length as well as by putting each part of the tree to its highest use.

Salesmanship

Another factor of great importance in bringing about more complete utilization that seldom receives the attention it deserves is the need for more and better salesmanship or market analysis. By this I mean that more people must spend their time trying to find more or better markets for the specific items that can be produced from the material available to them. In normal times wood must meet the competition of other materials. To be sure, lumber and a few other forest products, because of acute shortages, practically sell themselves at the present time and may continue to do so for some years, but this is not a normal condition. The lumber industry has been accused for many years of adopting the "come-and-get-it" attitude. Wherever that attitude exists with regard to waste, either in the woods or at the mill, not much progress can be expected. On the other hand, when a good salesman undertakes the task of searching out the market for wood products of all kinds and determining which of these products can be produced from waste and distributed profitably by his own company, and then goes out and sells them, progress will be made.

Long lists of minor forest products that can be made from waste can be prepared, but the mere preparation of the lists accomplishes little. There must be action on the part of someone, first to find a buyer for some of these products and then to see that the products are made and delivered at a cost that is mutually agreeable to producer and user.

New Products and Processes

A third type of progress upon which the need for continuous effort is obvious is the development of new processes and products. This is going on all the time and all wood research institutions, as well as all forward-looking manufacturers and many individual inventors, are constantly striving to develop something new or improved that will be useful. New products and processes will not of themselves solve the waste problem. They merely provide more and better possibilities for using waste or avoiding it. They put more tools into the hands of the operator who is endaavoring to reduce waste or change it into saleable articles.

Many new products have been developed during the past few years that have value and will probably continue to find use on a large or small scale. The public, however, has been induced by sensational accounts of what science has done during the war and what scientists are going to do to believe that all of these products can be made profitably from waste and that all of them have unlimited markets. The announcement of a new and interesting wood product or process results in hundreds and sometimes thousands of inquiries from people with little money and no experience, but who may know where there is a pile of sawdust or a hundred acres of woods waste. They immediately want to go into the business of producing the new product, even though they have little capital, no experience, and no idea where it can be sold or what it costs. The Forest Products Laboratory in the last few years has developed or improved a substantial number of useful, practical products, which can be produced at a profit within certain limitations. Not one of these products, however, has unlimited markets or can be made by inexperienced people without substantial equipment and capital.

Despite the extreme difficulty in developing new products and processes to be put in use by the small producer, the Laboratory in its postwar program is increasing its efforts on behalf of the small operator in order that the results of our work may be more widely applied and may have direct benefit to the maximum number of people.

Publicity and Education

A fourth factor of importance in bringing about better utilization is more publicity and stimulation of the right sort by public and private agencies. I do not mean publicity of the sensational type. There has been far too much glamorization of new products and processes.

Sensational reports are harmful, but there is need to exert all possible effort to stimulate the desire to reduce waste and to make available to everyone all the practical ideas that can be collected from all sources as to how it can be done. Whenever a manufacturer in one part of the country finds a new product or a new method that can and should be applied in other parts of the country, the fact should receive wide publicity and everyone interested in better utilization should do what he can to see that additional manufacturers know about it and make use of the idea if it applies to their conditions. There are many good ideas developing in a small way throughout the country and no one individual or company can hope to develop them all or to exhaust all the possibilities of using his own material. If everyone can be told about the progress being made by everyone else, however, there should be many improvements brought about locally that otherwise would be missed.

The Forest Products Laboratory's instructional courses in improved seasoning practices now being given throughout the nation to dry kiln operators constitute one example of education in better utilization. Similar efforts are being made in a variety of ways by schools, research organizations, manufacturers, and others.

An important development by the Forest Service that helps in this direction is the establishment of Forest Utilization Service units at various forest experiment stations. The men of these units circulate among the industries in their regions seeking out their wood utilization problems, helping to apply the available technical knowledge to the solution of these problems, stimulating research to develop new information where needed, and helping in every practical way to bring about more efficient utilization. They work in close coordination with the Forest Products Laboratory and cooperate with all agencies in their respective regions interested in promoting better wood-using practices, in order to multiply their effectiveness through united action. The Forest Utilization Service units have already accomplished much of value and we count on them for greater accomplishments in the future. Each of the units needs to be expanded and we need more units.

Similarly, the efforts of state and private agencies should be greatly increased. The need for education and extension in the promotion of better wood utilization is very great because the wastes are so large and the potential values that can be obtained from them are so enormous. The Federal agencies should not and cannot carry the entire burden of stimulating better practices. The more the state and private agencies increase their activities in this field the better.

General

In presenting these comments I have purposely refrained from making specific suggestions as to what can be done in this north country, and have dealt largely in generalities. I believe that what is done in any locality depends very largely upon the people in that locality and their interest and skill in determining what can be done under their conditions. The Michigan Planning Commission, the Michigan College of Mining and Technology, and the forest schools at Lansing and Ann Arbor are doing everything they possibly can to make general ideas more specific in this region. The hope for substantial improvement in wood utilization in this territory depends in considerable degree upon the extent to which you, as representatives of industry, cooperate with them and make use of their services in developing improvements in your own operations.