

POSSIBILITIES OF IMPROVED WOOD UTILIZATION

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It is hardly necessary, in talking to members of a wood products association such as yours, to point out the need for better and more complete utilization of wood. It is perhaps the realization of this need that is responsible for your forming this association.

Improving wood utilization is an easy subject to talk about, but not such an easy field in which to make economically feasible accomplishments. Our seeming lack of progress in upgrading little-used species and the utilization of waste is not so much due to technical barriers as economic barriers. If it were just a matter of making products from inferior species and wood waste, regardless of price and demand, our problem would not be difficult. It is therefore important to consider the economic possibilities along with the technical possibilities.

Improved wood utilization can be attained either by improving processing methods so as to minimize waste or by introducing new or already known processes to use what is now wasted. The former is largely a matter of improving the operation of existing equipment and developing new equipment, including not only milling and cutting equipment, but also dry kilns. Some of the most preventable waste now occurring results from faulty operation of kilns. The Forest Products Laboratory is making an effort to correct this situation through special kiln-operation courses given either at the Laboratory or in different parts of the country. Such a course was arranged by the Forest Utilization Service of the Southern Forest Experiment Station and given at Fort Smith, Ark., just a year ago. Some of you men or other members of your firms may have taken this course. If so, I hope that the course proved helpful to you in establishing improved kiln-drying practices.

The second approach to improved wood utilization, involving the introduction of new processes to make profitable use of inferior species and waste, is less clear-cut than the first approach; and it requires more intensive

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analysis before the best approaches to each set of various conditions can be established. I shall hence confine the short time at my disposal to considerations of this phase of improved wood utilization.

The simplest approach to using mill waste is to utilize the short trim in making articles from dimension stock. The problem here is to find some item that is in appreciable demand and that sells at a price sufficient to make the extra cost of handling waste worth while. Often it is difficult to make cheap, small articles like pail handles or knobs from random wood waste. Small articles which theoretically can be made from waste often can be made cheaply only in highly automatic equipment that requires uniform-sized wood in appreciable lengths. It is frequently the case that objects of relatively high value must be sought so as to allow for the cost of increased handling of wood waste. One possible way of doing this is to make small modified-wood objects, such as compreg kitchen-knife handles that can be compressed onto the blade when the handle is formed. Such knife handles are not only attractive, but also highly durable, and would sell for a good price. They are so durable, however, that it is questionable if, after the first year's novelty sales, the sales would continue at more than 10 million kitchen knives per year. This would require only 200 cubic feet, or 3 tons per day, of dimension stock in 5- by 2- by 1-inch blanks, which would be compressed from 2 inches to about 5/8 inch in thickness. One moderately sized mill could thus make from its trimmings all the knife handles of this premium type needed in the whole country. One company is already making such knife handles, and several others have indicated a strong interest in going into their manufacture. I would ^{can} therefore not recommend that any of you go into this business. However, if you think of some other small item that would be short in the fiber direction (not over 1 foot to facilitate treating), and that could be carved or molded from compreg to sell in quantity for a good price, its manufacture by one of your member firms might prove profitable. Veneer clippings might be used to even better advantage than lumber trimmings in molding objects in which cross-banded construction is desired, such as small gear wheels. Making products from other forms of modified wood might also prove profitable to a few concerns.

Besides the foregoing mechanical approach to improved wood-waste utilization, there are two different promising chemical approaches, both of which might use large amounts of wood waste. The first of these consists in making some form of fibrous product such as paper, paperboard, or various other synthetic-board materials by combined chemical and mechanical processing methods. The second consists in deriving nonfibrous chemical products from the wood waste, such as various sugars, molasses, wood, grain, butyl, and complex cyclic alcohols, butylene glycol, glycerine, furfural, acetone, acetic, butyric, lactic and mucic acids, tannins, vanillin (the active ingredient of vanilla extract), yeast, various phenols, neutral oils, oleoresins, and charcoal.

Making fibrous products from waste wood has distinct advantages in that wood is the cheapest and most available raw material for producing fibers and that fibrous products are in increasing demand. Wood has few competitors in the paper and the synthetic-board fields. On the other hand the fibrous-products field is one that requires, in general, high technical skill, complicated and

expensive equipment, and generally large plants and investments to operate successfully. Such plants require such a large tonnage of wood that they cannot operate economically primarily on waste from small plants unless well-assured supplies are available within a reasonable shipping distance. Several of the present large fiberboard manufacturers started out using wood waste. However, they soon used up readily available supplies within reasonable shipping distances, and it became more economical to buy pulpwood.

Large companies in the West that operate both sawmills and pulp mills are utilizing their own mill waste in pulping operations. This use has been accentuated by removing the bark from the sawmill logs or slabs with hydraulic barkers, thus making all slabs and edgings available for pulping. Although this advance in waste utilization by large mills is of great significance to the wood-using industry as a whole, it does not help the small sawmill or wood-products operator. He is concerned with using his relatively small amount of waste. The important question to him, if ready markets are not available for his waste, is: Can wood waste be used for making fibrous products on a 5-to-20-ton-a-day basis?

According to our present technical knowledge, except for relatively high-cost specialties, paper and the more refined cellulose products cannot be profitably made on a small scale from waste. The only products that look at all promising for small-scale operations are either chips or mechanically processed coarse fiber prepared for sale to such companies as roofing-felt manufacturers, or for the manufacture of some form of fiberboard. Many efforts have been made recently in a number of laboratories and plants to develop a fiberboard that can be made economically on a small scale. Most of the efforts have been to make a dry- or semidry-formed board. This trend toward dry-formed boards is not surprising. Making up a slurry of pulp containing 2 percent or less of fiber in water, and then removing the water by filtration, suction, and evaporation, as is done in making conventional wet-felt-formed boards, does seem wasteful. Dry or semidry forming, however, has one or more of the following disadvantages: (a) too much expensive binder is needed; (b) a product with too high a density must be made to attain adequate properties; (c) too high a pressure is needed in forming the board; and (d) the product has inadequate water resistance and weathering properties and tends to recover from compression to too high a degree. The last of these is the most serious shortcoming. Such binders as starch, casein, soybean and hide glues, rosin and products of rosin refining, and even urea-formaldehyde resins, give poor water resistance. The water resistance of some of these binders can be improved by the addition of 10 to 20 percent of a bitumen, but this mixture gives a product so plastic that it tends to bend under its own weight in warm weather. Most of the dry-formed boards with a lignin binder lack in water resistance and have poorer strength properties than wet-felted boards of similar composition. Good water resistance has been obtained only with appreciable quantities of phenol, resorcinol, melamine, and furfural-alcohol resins, all of which are expensive. While it is not an impossibility, to date, dry- or semidry-formed boards comparable both in properties and cost to the conventional wet-felted boards have not, to my knowledge, been made.

The question thus arises: Can the superior wet-felted boards be profitably produced on a small scale? Under present economic conditions, I believe

that they can, but I do not care to predict how long this condition will last. The Chapman hardboard plant in Corvallis, Oreg., has demonstrated that, at the present time, a plant can profitably produce as little as 16,000 square feet of board per day (about 7 tons) from barked Douglas-fir slabs. Boards are formed one at a time in a semicontinuous automatically controlled deckel box. The boards are automatically handled and squeezed and dried in a multiple-opening press. A simple deckel box and air lift for handling the boards has been in successful experimental operation at the Forest Products Laboratory for several months. The Forest Products Laboratory experiments indicate that insulating boards that meet the Bureau of Standards weathering and strength tests, and high-quality medium-density boards and hardboards can be made in this way from various forms of wood waste from practically any species. Bark removal is unnecessary, but if the bark is left on, it does detract from the appearance of the board.

Not everyone who has a waste pile, can profitably make board materials from it. Those having excess plant space and steam capacity, together with good local marketing conditions, have the best chance of success. Plywood and furniture plants that could use the boards that they would produce from waste, as plywood cores or drawer bottoms and backs, would have an advantage over plants that would have to find outside markets for their fiberboards. Manufacture of molded products rather than flat boards would also improve the possibilities of success for the small manufacturer.

The subject of deriving chemicals from wood waste is too broad to cover adequately in a short summary paper such as this. The chemical-processing methods can, in general, be divided into (a) destructive-distillation methods, which produce methyl alcohol, acetone, acetic acid, turpentine, rosin oils, tars, and charcoal; (b) extraction methods, which produce tannins, galactans and other gums, turpentine, rosin, and various essential oils; (c) hydrolysis methods, which produce wood sugars and molasses; (d) fermentation of wood sugars, which produces grain and butyl alcohols, butylene glycol, acetic, butyric, and lactic acids, and yeast; (e) hydrogenation of lignin, which produces neutral oils, cyclic alcohols, and phenolic compounds; and (f) special chemical treatments of wood, cellulose, wood sugars, or lignin, which produce mucic and oxalic acid, furfural, vanillin, and a number of other products.

Here again, as in the case of the fibrous products, the field is highly technical. No sawmill or other producer of wood products should go into any form of chemical production without supervision by an adequate chemical or chemical-engineering staff. Most of the chemically derived products can be profitably produced only on a large scale. For example, it is questionable if grain alcohol could be profitably produced in a plant much smaller than the new Springfield, Oreg., alcohol plant, which was designed to process 200 to 300 tons of wood waste a day.

The production of molasses under present economic conditions, it appears, would be profitable on the basis of processing in the range of 30 to 50 tons a day. From pilot-plant experiments at the Forest Products Laboratory, it appears that practically any species of wood with or without bark in hogged

or chipped form, or in mixtures of these with sawdust, can be used. Experiments are just getting under way at the Forest Products Laboratory to simplify the molasses-production process so that it can be economically operated on the basis of processing only 5 to 10 tons of wood waste per day. Livestock feeding experiments are being carried on at several universities, preliminary results of which indicate that cattle and sheep eat the feed to which molasses is applied as though they liked it. Further experiments are needed to determine its nutrient value.

Yeast is another chemical product that shows promise of being economically produced from wood sugars. Wood-sugar yeast contains two important vitamins, riboflavin and thiamin, which, in addition to its high protein content, may be found by feeding experiments to give it a nutrient value as high as livestock feed and at a cost comparing favorably to the cost of other feeds. Yeast production procedures have been simplified at the Forest Products Laboratory and work well on a small scale. Larger-scale pilot-plant studies are being started. Enough yeast is to be produced to make good feeding tests on livestock. Promising results in feeding have already been obtained with yeast made from other sugars.

Although there are number of promising possibilities for making various chemicals from wood waste, there is not yet any process that can be recommended to the small sawmill or other small wood-products operators for utilizing their waste that can assure them of its economic success. We at the Forest Products Laboratory have the small producer's problem in mind, and we are making every possible effort to modify large-scale processes so that they can be operated economically on a smaller and smaller scale. To put wood waste to proper use, it is not enough to solve the problem for the big producer; it is the little fellow who needs the most help.