LUMBER WASTE AND FURNITURE MANUFACTURE

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Lumber waste in the production of furniture is but one segment or part of the overall waste problem in the conversion of timber stands into useful products. In its major aspects wood waste may be broken down into four broad classes as follows: (1) material left in the woods in the form of cull logs and bolts, broken stems, tops, stumps, little-used species, and damaged or small trees that are later lost; (2) wastes in processing wood mechanically, such as slabs, edgings, trimmings, sawdust, shavings, defective pieces, and veneer bolt cores and bark; (3) wastes in the chemical processing of wood, such as extractives, lignin, sugars, hemicelluloses, and cellulose in the production of pulp, and chemicals and gases that are not recovered in the making of charcoal and the like; and (4) wastes that result from deterioration of wood in storage and use through decay, insects, and fire, which in the aggregate are very large.

You, as manufacturers of furniture, are directly and primarily concerned with the second of these four broad classes or categories of waste. However, I would like to point out that your industries have an interest in and are vitally affected by the other forms of waste, especially the wastes incident to logging and to lumber and veneer manufacture, because of their relation to an adequate supply of raw materials both now and the future. Waste in the woods means less material delivered at your plants and endangers your future supplies. It is in your present and future interest to encourage the more complete salvage of good materials in the woods and sawmill operations, the use of little-used species, insofar as they can be made to meet your needs; also to stimulate more accurate manufacture of lumber, veneer, and dimension stock and thereby reduce wastes in manufacture in your own plants.

Another type of uneconomical use not included in the above four principal classes of waste and not so generally and well recognized is the utilization of species and classes of material for purposes for which it is not well suited and on the other hand the utilization of high-grade and valuable species and material for purposes where little-used species and lower-grade material are satisfactory. Numerous examples can be cited of both classes that result in waste and a failure to utilize our timber resources to their

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[2] Maintained at Madison 5, Wisconsin, in cooperation with the University of Wisconsin.

fullest extent. To fully utilize our timber supplies and to develop their values to best advantage requires a close correlation of properties and requirements for specific uses and a balancing of supplies and demands. For example, in the manufacture of furniture it means correlating grades and species of lumber to different classes of cuttings. In other words it means determining waste factors for different grades of lumber for specific types and kinds of cuttings in your operations.

Likewise, you should be fully aware of the possibilities of substituting little-used species for the scarcer and more valuable woods where they can be made to meet your needs. A wider range of species is being used for furniture. Some of them are imported species concerning which technical information is scanty. Some of them are little-used species from our own forests. Determining the utility of little-used species and finding satisfactory ways of processing them is in itself a big factor in reducing wood waste.

Those who are close to the timber conversion industries know that the major problems in the utilization of waste will center in the future, as it has in the past, around the use of timber that is considered too poor in quality for operating industries to utilize economically. The wood wasted by any operating enterprise constitutes the portion that is thought cannot be used without financial loss. However, individuals and companies vary widely in their interest and skill in avoiding waste or in finding profitable uses for it and what may be classified as waste by one may be utilized profitably by another. Locality and current economic conditions are also important factors in determining the degree of utilization. During the latter part of the war period and subsequently, low-quality timber and wastes have become important sources of material for all the wood using industries. Relogging of previously logged areas and the removal of much previously considered woods waste is now in progress in the Pacific Northwest on an extensive scale, the salvage of dead timber, more extensive use of little-used species, closer utilization of slabs, edgings, and trimmings are all encouraging signs, but we must remember that they are in large part a result of present economic conditions and current price structure. Developments in logging, transportation, and milling equipment, and much other technical study and research have had a significant part, but, if we are to continue to make progress, there must be a constant effort on the part of all concerned to devise new and improved products and methods for using the large quantities of material that is still wasted. Continued progress will most likely consist of many small forward steps, which may even seem insignificant and unimportant, but which in the aggregate will undoubtedly bring substantial forward progress.

Waste Prevention

I wish now to direct my remarks more specifically to the waste problem that you as manufacturers are concerned with in the conversion of lumber and veneer into furniture. To this problem there are two approaches, namely, (1) waste prevention and (2) waste utilization. It is generally admitted that the most practical solution to the problem of waste in furniture manufacture is in reducing or preventing the occurrence of waste as far as possible. After

the waste is accumulated there are distinct limitations to what can be done with it under present conditions other than to use it as fuel.

Wastes Affected by Inaccurately Manufactured Lumber

The amount and character of your waste is, of course, closely related to the quality of the lumber, veneer, and dimension stock that you process. Inaccurately manufactured lumber with its large variations in thickness results in much more waste in the remanufacture into the many items and parts required in your products. Here the problem becomes complex since your sources of supply are doubtless many small mills operating in large part with inefficient and poorly maintained equipment and in many cases a lack of ability or desire on the part of the operators to produce well-manufactured lumber.

Furniture manufacture and sawmilling are separate industries, but in preventing waste they can hardly be divorced and considered independently. Excess waste in the form of shavings from miscut lumber can be reduced, to the advantage of all concerned, by joint effort, preferably initiated by the furniture manufacturers themselves. Furniture factories as consumers can become an active force in inducing the sawmill men to do a better job of millwrighting so that their machines are kept in such mechanical repair that more accurately sawed lumber can be produced.

Excessive waste in manufacture is also the result of other subnormal qualities in the raw material. Warped, checked, blue-stained, and decayed material are all contributing causes to excessive waste, and can be largely controlled by proper manufacture, handling, drying, and storage.

In any organized, concerted move to bring about better manufactured lumber, the U. S. Forest Service has a vital interest and through the Forest Products Laboratory and the Forest Utilization Service Units of Forest Experiment Stations is willing and anxious to cooperate insofar as possible.

Seasoning of Wood for Use

Properly dried wood is a prerequisite in the manufacture of fine furniture. There is nothing mysterious about the drying of wood, yet significant losses in footage are being experienced at many of your plants because the process is not completely understood. Much of the waste caused by improper drying and the poor performance of the product resulting from inadequate seasoning can be avoided and it is not necessary to assume that a revolutionary drying process is needed to attain this accomplishment. Good air seasoning practices, proper piling for kiln drying, modern dry kiln equipment supervised by operators familiar with the fundamentals of wood drying, and the moisture requirements of your product combine to increase the number of units you can produce from a given quantity of lumber.

During the war the tremendous demands for lumber in the face of production shortages resulted in a relaxation of seasoning standards. The continued shortage of lumber resulted in the procurement of partially air dried or green stocks and in kiln drying this material your seasoning degrade mounted. Your dry kiln operators were unfamiliar with the new drying problems and only through costly trial and error methods were some able to cope with the situation. Others are either air drying their stock prior to kiln drying or suffering excessive degrade, or are making a poor product from the standpoint of controlling the moisture content of the wood.

The remedy, and in most instances a profitable one, is two-fold; first, the modernization of dry kiln equipment and lumber handling methods for kiln drying -- essential to an increase in drying efficiency; and second, the training of the supervisor of the drying operation -- a necessity if maximum production of properly dried lumber with a minimum of seasoning loss is to be obtained. The Forest Products Laboratory has assisted your industry with the latter. Your association has sponsored four courses in the kiln drying of wood, which were given in the fall of 1946 -- one at Lenoir, N. C., one at Martinsville, Va., one at Winston-Salem, N. C., and the fourth at Fort Smith, Ark. The two-weeks training course in the kiln drying of wood does not make an experienced dry kiln operator; it can only introduce the man to the subject. Therefore, these asscciation sponsored short courses must be followed up with action by management, if the gains are to be made permanent.

Action by management along two lines are suggested; first, that the request by the dry kiln supervisor for repair and modification of the dry kiln equipment be given serious consideration. We have advised these men how to sharpen the tool they are working with. If management wants these men to keep up their interest in good drying results, then investments in improvements and better dry kiln equipment will pay dividends. The first essential of maximum production of properly dried lumber with a minimum of seasoning degrade is good drying equipment.

The second activity that management can engage in with respect to the seasoning problem is the encouragement of the dry kiln supervisor to broaden his knowledge and experiences in the drying of wood and the control of moisture content. There are several possible ways of accomplishing this objective. One would be for the association to provide an expert, experienced drying engineer or technician to consult and counsel with kiln operators at the various manufacturers plants and to conduct clinics on drying and conditioning problems. A primary purpose of such a clinic would be to provide an opportunity to your dry kiln supervisors to keep abreast of the fundamentals of air seasoning, kiln drying, and storage, to discuss the practical application of these fundamentals to seasoning and storage problems, and to exchange experiences in the solution of such problems.

I have deliberately referred to the dry kiln operator as the supervisor of drying and conditioning processes. We believe that the job that you have in your plants is a broader one than just operating dry kilns. The control of the moisture content of the wood going into production involves more than operating dry kilns. It is concerned with air seasoning practices, the piling of lumber for kiln drying, and the storage and handling of the lumber

after kiln drying. We have recommended that the responsibility for moisture control in the processing of lumber prior to fabrication be centralized, believing that the broader position will attract better qualified and trained technicians to your industry.

Machining Wood

In the time available I cannot go into details about machining wood parts for use in furniture to reduce waste. The subject is too big and complicated. Suffice to say the standards for smooth surfaces, accurately dimensioned parts, and freedom from warp and distortion are necessarily high in the furniture industry. To obtain these results necessitates a number of machining operations, which in turn result in the production of substantial quantities of waste in the form of sawdust and shavings, a major part of which is unavoidable. Well-designed machines, efficiently maintained and operated are necessary to give the minimum of waste in such operations.

I have already pointed out the importance of quality of lumber, especially uniformity in thickness, to the occurrence of waste in machining finished parts to standard sizes. Factors in the machining operations themselves that affect the quality of surfaces and the occurrence of waste are moisture content of stock, machine speeds, rate of feed, and bevel and angle of knives. Machining characteristics of different species, especially the little-used woods, and the working out of optimum machining conditions of each are important items of direct waste saving to furniture manufacturers. The Forest Products Laboratory has a program of work under way in this field that the furniture industry can make use of or help to direct along most beneficial lines.

Gluing in Relation to Waste

Improvements in glues and gluing methods afford an opportunity to accomplish both waste reduction and waste utilization. I venture to assert that there is not a furniture manufacturer using glue in the fabrication of his product, that has not had difficulty at one time or another with defective pieces of furniture or parts thereof as a result of improper gluing procedures or inferior glues and an accompanying waste of materials. Furthermore, losses from such wastes represent not alone the value of the wood, but frequently involve substantial labor costs.

I am sure you have all seen open glue joints, twisted and bowed panels, loose veneer, blistered plywood, and other defects associated with improper gluing conditions or occasionally with inferior glue or the use of the wrong glue for a particular job. Their occurrence in the manufacturer's plants or in the hands of the distributor or ultimate consumer means a loss to all concerned and a waste of materials. It is the manufacturer's responsibility and in his own interests to see that such defects are eliminated or reduced to a minimum through the proper selection of glues and the adoption of good gluing practices.

There have been tremendous strides made in the past 10 to 15 years in the development of glues and perhaps only slightly less significant developments in gluing techniques and processes. We have seen the development of and introduction into the woodworking field of a large group of new adhesives, broadly designated as synthetic resins, the properties and use characteristics of which are very different from the glues that were available two decades ago. We have seen a marked increase in the use of hot press equipment in plywood, furniture, and other plants; new and improved methods in laminating and in the production of curved and molded parts and assemblies, sandwich type structures, and the like; and improvements in equipment -- glue spreaders, presses, and heating devices, including radio or high-frequency equipment. These developments have very greatly extended the use of glues in woodworking and have broadened our conception of the possible use of wood alone and in combination with other materials, such as metals and plastics.

The significance of all these developments to the furniture manufacturer cannot be categorically and fully evaluated for an industry as a whole and even less can their significance in waste reduction and waste utilization be evaluated. Furthermore, the extent to which the various developments are applicable to individual plants varies with the type of plant, its layout, and the products produced. Consequently, management has the ever-present and difficult problem of evaluating and applying current developments and improvements in glues and gluing to his particular operation. To do this effectively the plant manager needs the services of a technician with a thorough knowledge of glues -- their properties, use characteristics, preparation for use, and adaptability to specific jobs; suitable test methods and requirements; gluing methods, procedures, and techniques; gluing characteristics of different species and surfaces, and the facilities and equipment involved. I am sure that you, as manufacturers of a product in which glue joints are so vitally important, recognize the need and value of personnel within your organization competent to handle the complex problems involved in your gluing operations.

Utilization of Wastes by Chemical Processes

Much has been said and written in recent years about the utilization of wood waste by chemical processes, but we should all realize there is no panacea for our waste problem. Significant progress has been made in many fields as in the pulping of little-used species and woods- and mill-waste of other species; in the production of wood sugars, alcohol, and food yeast from sawdust, in the utilization of sulphite waste liquor (from pulping mills) for the production of a tanning material, a dispersing agent for Portland cement, in the plates of storage batteries, and for the production of vanillin and ethyl alcohol; in converting wastes, including sawdust and shavings into building boards.

In general, chemical processing plants have involved a rather large investment of capital and required a low-cost raw material in rather large volume for successful operation. Salvage and transportation costs, therefore,

become important limitations to chemical utilization. Situations where substantial volumes of wastes of uniform character are easily available offer the best opportunities for success. Until chemical processes are available for economical operation on small quantities of material, there will continue to be large quantities of waste unutilized or used for fuel.

The making of a composition board from sawdust and shavings, suitable for a core material, is not beyond the realm of possibility. Work is currently in progress at the Forest Products Laboratory and elsewhere on this problem. Two approaches are being followed: (1) combining dry wood waste in the forms of sawdust, hogged wood, or mechanically refined fiber with various types of binders, such as inorganic cements, bitumens, starch and protein glues, and various synthetic resins; and (2) forming wet mats from various unprocessed or slightly processed wood fibers. The first approach is not very promising because of the use of substantial amounts of relatively expensive binding materials. Low-density insulating boards cannot be obtained by this means, but building boards for indoor use might be made.

Boards with less expensive binder, better formation at low specific gravity, and with generally better weathering resistance than can be obtained by the dry processing method are obtainable by wet forming. This work differs from the conventional process for making insulating boards in that only part of the stock need be beaten or hydrated and the material coats and acts as the binder between the unprocessed or partially processed fibers. For example, sample boards that seem to have some promise as a core material have been successfully made on a small scale, using 70 to 85 percent sawdust, 13 to 28 percent hydrated pulp, and 2 percent of either asphalt emulsion or 2 percent of resin-alum size. A water slurry of this material is formed into a mat on a hand-operated suction box. This mat is pressed and dried with a wire screen on one side in a hot press at about 15 pounds per square inch. The wire makes it possible for moisture to escape readily from the board without building up internal steam pressure that might disrupt the board. Higher quality boards can be made, using better quality, more refined fiber and preliminary tests indicate that boards of variable density can be made merely by pressing at different pressures. While offering some promise as a core material, I wish to point out that its suitability for this purpose has not yet been determined.

A second chemical process that has attracted considerable attention is the conversion of wood waste to sugars, alcohol, and food yeast. Any type of wood waste in a hogged form with bark contents up to 50 percent can be treated with dilute acid in a steam-pressure digester by methods developed at the Forest Products Laboratory to convert the major portion of the cellulose to sugars. After neutralization and filtering these sugar solutions can be concentrated to make a molasses, or they may be fermented to alcohol. The nonfermented sugars, or all the sugar, can be utilized for the growing of yeast.

A plant to produce alcohol from 300 tons of woods waste per day is now starting operation at Springfield, Oregon, using the Laboratory process. It is estimated that alcohol could be profitably made on only a slightly smaller scale. Molasses production by several plants processing 50 tons of wood

waste per day that furnish their molasses output to a central alcohol plant might be profitable. Single plants making only yeast might operate on a slightly smaller scale. In all cases the investment to utilize the waste of a sawmill, veneer mill, or furniture plant would, in general, exceed the investment in the parent plant. Specialized technical personnel would be required that would substantially increase operating costs. For these reasons we do not feel that the time is ripe to resort to chemical processing of waste in the average wood-processing mill.

In conclusion may I say that the waste problem in the fabrication of wood products is one that we can expect to have with us for a long time and that, while some progress is being made, it requires the concerted effort of lumber producers, lumber processors, lumber users, and the various Federal and State agencies in its solution. Again, may I suggest that in my judgment you as furniture manufacturers can make the most progress in reducing waste in your operations by making a more concentrated effort to work out technical problems, to keep abreast of current developments and improvements, and to be constantly on the alert to apply new materials, methods, and techniques. May I further suggest that we at the Forest Products Laboratory and the Forest Utilization Service of the Forest Experiment Stations are anxious and willing to assist you in the solution of your problems and to cooperate with you, insofar as possible, in a reduction of wood waste and an improvement of wood products.