Techniques and Practices of Forest Products Laboratories and Industries in the U.S.*

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(*Continued from last issue*)

DIVISION OF WOOD PRESERVATION

Fire Protection Section

This is the reason that the Laboratory's work in this direction is being concentrated along three lines:

1. Developing fire method tests which could be standardized to be able to forecast as closely as possible fire behaviors under certain conditions.

2. Studying methods of protecting wood against fire:
   a. By impregnating the wood with a fire-retarding chemical.
   b. By the use of coatings of fire-retardant paints.

3. Testing wood structures for their fire resistance. This is mainly in cooperation with manufacturers: like in the case of door manufacturers wanting to find out how long a standard door keep fire away from penetrating.

There are several fire retardants in use at present:

Ammonium phosphate is expensive, but ammonium sulfate is cheaper. The following are being used by the U.S. Navy:

(1) 80% ammonium sulphate + 20% ammonium phosphate.

(2) 60% ammonium sulphate + 10% ammonium phosphate + 20% boric acid + 10% borax. This is very satisfactory.

(3) 60% borax + 40% boric acid. This is rather weak on fire-retardant properties but toxic to fungus. It takes 4 to 6 lbs. per cubic foot to make wood resistant to fire.

The principle of coating is to protect the surface from immediately catching fire. When the ammonium phosphate is heated it is converted into phosphoric acid and absorbed in the wood and make it difficult to burn. The big problem on hand is to make fire-proof paints weather resistant. But the trouble with many of the salts used for fire proofing is that they are subject to leaching when exposed to the weather.

Painting and Finishing Section

Fundamental and applied researches have been conducted to prolong the life of wood through the use of paints. But there are so many kinds of paints and paint making is still an art rather than an applied science. While paint has been in use in all types of buildings or structures for a long time, it was only in 1920 when work along this field was started in the Forest Products Laboratory. At first the work was confined in testing paints found in the market for durability. Right along with these studies, each kind of paint has to be analyzed to find its composition and quality so as to tie in the results being obtained in the different durability tests involving the use of each of these paints found in the market. It is quite a common practice by manufacturers to use ambiguous terms describing the composition and quality of their respective types of paint.

* Third of a series on the report of Prof. E. de la Cruz.

While a great deal of information have been obtained about paints on these tests, it has not yet been possible to establish general laws of paint behavior to correlate the facts. Besides, the durability of a paint depends on many factors besides its composition, and there is no generally accepted technique of measuring such durability. It was found that there are five factors which significantly affected the serviceableness of exterior paints on woods: (1) the kind and quality of wood painted, (2) the design and use of the building or structure to insure that the wood will remain dry enough to hold paint, (3) the composition and quality of the paint, (4) the technique of application and the program of maintenance, and (5) the severity of the climatic and local conditions of exposure.

With the pin-pointing of these factors it became necessary to develop in the Laboratory certain types of paints which is believed suitable to fit different conditions and uses as a means of solving problems that were encountered with test experiments of manufactured paints.

In the studies of paint durability two types were used: (1) the exposure tests which involve not only a great number of specimens but scattered over wide range of climatic conditions to secure useful comparison and must extend over a period of several years before conclusion may be drawn. This being quite slow it has been considered to accelerate these tests by using (2) artificial weathering tests. But this type of tests has been used only as an auxiliary with a view to rejecting from a large number of previously untried paint compositions those mixtures so seriously faulty that they merit no further consideration, thus reducing the number of paints that need be tested by natural weathering.

From the results gathered it was found that wood properties affect paint performance. For this purpose the commercially important native woods, when purchased in lumber of higher grades, are classified for painting characteristics into five groups. (USDA Misc. Pub. No. 629, pp. 6-7).

For the benefit of paint users, the Laboratory made a classification of house and barn paints into Group, Type, and Grade but this received very little attention and was immediately opposed by manufacturers. Fortunately, there are now seven small manufacturers who are following this classification. Considering that many people are not in a position to secure the standard paint recommended, effort is made to show them how to buy house and barn paint by buying only paints that show the formula on the label, and learn to read paint formulas by consulting publications on the matter published by the U. S. Department of Agriculture.

Glued Products and Veneer Section.

Curved members of wood are produced by band sawing or by banding. The former is not only wasteful but it produces curved members that are relatively weak because of cross grain, while the latter is generally stronger and less wasteful of material. It comes in two forms—solid or laminated. The laminated may be individually bent and then glued together in the curved shape, or glued together and then bent.

During the war the Laboratory was kept busy producing molded plywood due to lack of aluminum. With the availability of metals again this work is abandoned in the Laboratory. But much is being done in the manufacture of small boats and to a certain extent in furniture manufacture and to a limited degree in the manufacture of store fixtures where bent or curved laminated wood is used for streamlining. For this purpose, urea or phenolic or melamine glues are used.

Sandwich gluing are of two general types: one for use in house buildings and the other for very light but strong materials for aircraft-constructions. In the former, coat is considered very essential so as to make a material cheap but very satisfactory for

house construction; in the latter, however, strength and lightness of weight is the paramount consideration, the cost of production is not of much importance.

Veneer.—There is an unmistakable evidence that veneer was used thousands of years ago but it was not so clear first how it was made in those early times. In more modern times prior to about 1805, when a power-driven circular saw for the purpose was patented and put into operation in England, veneer was cut by simply ripping thin sheets from a block with a hand saw. Shortly after the first power veneer saw was put into operation, a machine for slicing veneers was patented. This was not quite satisfactory but served as the first step to the development of the present-day slicer and rotary lathes. It took about three-quarters of a century, however, to develop a rotary lathe that would now be considered a success.

Veneer may be defined as thin layer or sheet of wood. It is produced on a lathe, a slicer, or a saw, and is commonly known as "rotary", "sliced", or "sawed" veneer, according to the manner of cutting. It may be used as a single ply or as a combination of plies bonded together to form plywood; or it may be glued to lumber or other core materials to form veneered products. They are cut into many thicknesses ranging from 1/40 to 5/16 inch. For special purposes, it is cut as thick as 3/8 and as thin as 1/110 inch, or even less. The standard for softwood are 3/16, 1/8, and 1/10 inch; for hardwoods—1/12, 1/10, 1/8, 3/16, and 1/4 inch depending upon the density of the wood and the type of plywood to be made. Common thickness for rotary cut hardwood face veneers are 1/20, 1/24, and 1/28 inch. But for container veneer, rotary cut hardwood and soft wood are 1/10, 1/8, 1/7, 1/6, 3/16, 7/32, 1/4 and 5/16 inch.

During the war the Laboratory developed technique in the manufacture of molded plywood for aircraft on account of the shortage of aluminum. At present, they are back to metals. But this method was picked by the industries like in boat building, molded furnitures and in streamlined store-fixtures using laminated materials. In all cases they use water-proof glues such as urea, phenolic or melemine.

Another phase of veneer use presently developed is the two kinds of sandwiches in an effort to produce very light materials but exceedingly strong for its weight. The first is now being used for building construction using wood and the other is with metal facings for aircraft and this is produced without regard to what it will cost. The Air Force is now concerned in getting very light materials but strong too to increase the carrying capacity of their planes.

Veneer making is now an art. It is not simply putting thin slices of wood for facing but these face sheets must be prepared so as to take advantage, as much as possible, of the high quality of grain figures which command a good price for any kind of products of the industry. In general the following points are to be taken into consideration:

(1) The fundamental problem of making a veneer is the preparation of the log, the condition of the veneer to be produced, and the sharpening of knives.

(2) The heating of log is of great importance, yet I am afraid this phase is not given much attention in the Philippines. They found that different species are given different heating ranges—birch, 160°F; oak 200°F and they are still experimenting what is the best temperature range for other species. At Roddis Veneer Company the red oak is heated in steam compartment at 4 lbs. per square inch for 4 hours. Although Dr. H. O. Fleischer, a veneer specialist who was with me in my visit to this plant, considers that the treatment is insufficient to raise the temperature of log to over 100°F.

Currently, it is being studied how to heat logs effectively within a shorter time than it is being done at present by the application of electrical heat into big-sized logs to

produce better veneers by placing the log between high frequency fields placed on both sides of the logs as in diagram (Fig. 1). It was tried to place copper plates at both ends of the log but the heating result is not quite satisfactory.

The next to be considered is the cutting angle of the knife with reference to the veneer sheet and the pressure applied opposite the knife so as to produce a high grade veneer free from ruptures. Studies along this field has been conducted in the Laboratory so as to increase the production of high grade veneer by reducing the number of defective sheets obtained from each log.

Then comes the problem of drying the veneer. The Laboratory also had made different temperature tests so as to produce better grades of veneer. Different thicknesses in each species or log must have separate drying treatment. Generally, sapwood is easier to dry than heartwood everything being equal.

In my visit of the Roddis Veneer Company at Marshfield, Wisconsin, I noticed that red oak logs are not cut into veneer in the usual manner as we do in the Philippines. They use what is known as bastard cuts, by placing the clips at the opposite edge of each log's end. And instead of having the log rotate firmly pressed against the knife, it simply swings and pieces of veneer is sliced every swing, growing wider and wider as the slice is made more and more toward the heart of the log. This is known technically as half-round cut (Fig. 2). If the slicing continues beyond the center of the log then it is called—back cut (Fig. 3).

The Roddis people are making all their veneers into doors of all kinds for interior or for exterior use. They use the core by sawing this into 1" x 2" as short as 6" and these are glued side by side and end to end to form the core of panel doors with beautiful grained veneer for facings. They use also framing and fill the space with accordion latch or short blocks arranged like a jig-saw puzzle.

The poor grade veneer are cut into narrow strips to get the best grain pattern out of each sheet and matched by skilled workers, usually women. The poorer grades of veneer are either used as cross banding sheets in multi-ply plywood or inner facings of panel-plywood used for walls. As much as possible veneer of all sorts are scrutinized by trained laborers and cut into some patterns and utilized for various purposes where each will be of distinct value. Nevertheless, there was still a tremendous volume of wastes which are chopped into fuel wood to develop steam for the use of the mill.

DIVISION OF INDUSTRIAL INVESTIGATIONS

Functions

1. "Plans, directs, coordinates, and conducts fundamental and applied research programs on methods of forest harvesting and the mechanical conversion of forest raw material including logging methods and equipment, sawmilling, development of log and lumber grades, machining characteristics of wood and wood working equipment, utilization of low-grade timber, and utilization of wood as a fuel.

2. "Analyzes and interprets research data and prepares and reviews reports and publications incorporating the results of research on forest harvesting and the mechanical conversion of forest raw material."

3. "Consults with technicians and other officials, both public and private, on research policies and plans and on the application of the results of research on forest harvesting and the mechanical conversion of forest raw material."

4. "Develops and maintains cooperative relations with public and private agencies to further research on timber harvesting and conversion and to improve the harvesting and mechanical conversion of forest and forest raw material."

This is the youngest and one of the smallest divisions of the Laboratory. Most of its experiments are conducted in the field.

There is not much equipment in the Laboratory to work with. This Division was originally organized as a connecting link between the industries and the Laboratory.

Many of the studies made in the field were on *time and costs* in the different mill operations, the main object has been to determine the small-size of the tree that could be logged and sawn into lumber economically. To arrive at a definite result, trees of different sizes and located under different conditions have to be followed from the time they are cut, transported, milled, graded, and the lumber produced from each tree is sold. Work of this nature may take a crew of 6 men to gather the data needed as much as six months, then go back to the Laboratory to analyze the figures and prepare their report. This is done to cover the representative parts of the different forests of the country.

In recent years the Forest Experiment Stations have expanded their activities and they are now doing about 80% of these costs studies.

The development of a system of grading hardwood logs for sawing into standard factory lumber through extensive work at sawmills in each of the important hardwood regions of the United States is another accomplishment of this Division. This system is designed to meet a need, on the part of buyers and sellers of logs, timber, appraisers, and those concerned in managing timber properties for a method of determining the money values realizable when a given lot of logs is sawed into standard lumber. Visible surface characteristics of logs are correlated with the proportions of high, medium, and low grade lumber that the logs will yield.

Heretofore, in the appraisal of logs, quantity rather than quality has been the principal criterion of value, and the quality factor has been left largely to individual judgment with little definite means of measuring it in the log or standing tree. This is now solved with the proper application of log grading rules that the quality of lumber contained in a group of logs can be fairly accurately estimated. In other words; the use of log grades puts milling, logging, and the management of forest properties on a predictable dollars and cents basis and results in more profitable operation for all concerned. Anyone can arrive at a fair valuation of the timber for both the buyer and the seller by applying current lumber prices, and making proper adjustment for logging and milling costs.

At present, the division is developing a system of grading Douglas Fir veneer logs. For every log out of a given tree a diagram is made showing every visible defect, knots, shake, checks, pith seams, etc., and follow each of these logs in the veneer mill. Every grade of veneer produced out of each is recorded so that one can tell exactly how much is produced under different defects or conditions found in each section of the log. This work is still in progress.

Another study is aimed to benefit small mill operators of the circular saw type cutting hardwoods or softwoods by increasing their efficiency and minimizing wastes. From time to time someone puts up new types of equipment, either in logging and milling, at once, someone in the Division who is keeping tract of all these, studies these equipment and if they are worthwhile, photographs them, and writes leaflets about their virtues or performances and broadcast these freely for the information and benefits of the operators. There is much work done along this line under a general caption, "Improved Harvesting Methods."

One of the things which has received much attention is the barking and chipping of logs. Many of the mills in the West bark their logs before milling. They claimed that they could produce better grades of lumber and reduce wastes as they could see the defects of the logs when barked than otherwise, and the slabs, edgings and trimmings could be chipped and sold to nearby pulp and paper mills as they are free from

bark and dirt. Another reason perhaps is that the barks are also utilized.

The Weyerhouser Company developed several marketable products from the bark of fir, such as:

1. Conditioning materials for the soil.
2. A filler for plastic.
3. A wax for cleaning floors.

Barking is not so much a problem to big mills who are better equipped and are capable of using hydraulic barker. This is quite expensive as it needs plenty of power.

It is the Division's concern to direct its efforts to find a barker that would fit the needs of small mill. They don't try to develop one but are constantly watching for new developments and publicized these for the benefits of the small mills. Swedish barker is found very satisfactory in southern pine regions.

Barker and chippers are so important that a paper mill developed a portable chipper and brought this to the woods and used to chip twigs as small as one inch in diameter. It gets 25% more pulp per acre in so doing, and use this for producing paper board boxes with corrugated in-lay using bark and all.

A new device for separating pulp from bark and other dirt elements has been devised. I saw one of these used in the Mead paper mills at Escanaba. It is a jet adjusted at angle which throws pulp with the bark at the side of funnel shape container and the bark and dirt being heavier drops by gravity to the bottom and ejected while the pulp floats and pushed up and drained away.

Another work is the machining and related characteristics of southern hardwoods which include about 65 of the native hardwoods. In machining properties the work done are—planing, shaping, turning, boring, mortising, and sanding; on related properties—steam bending, nail splitting, screw splitting, a variation in specific gravity, number of annual rings per inch, cross-grain, shrinkage warp, minor imperfections of hardwoods, and change of color in hardwoods. Along with this work experiments were made on cutting angles, moisture contents, depth of cut, speed of cutter heads, and speed rates. In the Laboratory a type of saw-teeth was designed for circular saw although it could also be applied to the band saw. There is still much work to be done in this field.

In woodworking factories one of the biggest problem is to know which grade of lumber is profitable to use. Years ago, a time study was undertaken by crews from this Division numbering from 2 to 3 men and assigned to these factories. They followed the use of different grades of lumber from the time these entered the mill, in the cutting, processing, etc., step by step and noted how each grade affected man-hours time until the finished stage of the product. But it is hard to make a conclusion on industry-wide basis because of lots of factors involved due to machineries, how good and efficient are these. There is no doubt that the use of high grade lumber is profitable in high class type of furniture but due to lack of these the industry has to fall back on poorer grades of lumber. Fifteen years ago No. 2 and No. 1 common is rarely used in woodworking industries, more so during the war because of lack of labor; the industry cares for nothing but first and second grade lumber. But at present they are beginning to use No. 2 and No. 1 common.

(To be continued)