The Chapman Fiberboard Process

By

T. M. Waarvick

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This paper presents information and facts regarding a process which utilizes a waste product of primary lumber manufacture — slabwood. The Chapman process makes fiberboard manufacture possible on a small scale and with a relatively low capital investment. It is being improved upon constantly through experimentation and research. At present the only plant in operation using the Chapman process is located in Corvallis. However, other plants in the United States and Canada are under construction or in the promotion stages.

The author has broken down the text into the following divisions: (1) The Introduction, (2) The raw material and steps in the process, (3) Sales and markets, and (4) Productive capacity. Discussion of the preform and cold press was limited upon the request of Chapman Forest Utilization, Incorporated, due to incomplete patent coverage. Photographs of portions of the process are included in the Appendix.

Acknowledgment is made to Gene Tower, Director of Research and Development, at Chapman Forest Utilization, Incorporated, for his generous assistance.
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THE CHAPMAN FIBERBOARD PROCESS

INTRODUCTION

Chapman Forest Utilization, Inc. is located in the southeast section of Corvallis on Fisher Lane. The total land ownership exceeds ten acres, including canal rights from the Mary's River Dam. The plant is built upon the same foundation that once was a part of the Fisher Flour Mill. The canal plays a vital part in the operation of the plant because during the winter months when the canal water supply is adequate, power developed from the two water-turbine generators supplies two-thirds of the plant's power requirements. Mountain States Power Company buys electrical power from them when the plant is not operating.

The company is incorporated with R. Chapman, L. Chapman, R. Yates, and E. Elliot holding the majority of stock.

Fiberboard and deep-freeze food lockers were the two products the company was set up to manufacture. However, deep freezer production has been suspended due to the scarcity of raw material and a desire to concentrate on certain other production items.
THE RAW MATERIAL AND STEPS IN THE PROCESS

The Christenson Fuel Company supplies the four-foot slabwood used for board production, also the sawdust for steam generation. The slabwood and sawdust are obtained from the Philomath area. The slabs should have a high moisture content because dry slab is hard to debark, and adds considerably to the labor cost. In addition, the board produced from dry slab is less uniform in strength and color properties. Approximately twelve cords of slabwood are needed to produce 18,000 square feet of fiberboard in three shifts. Nine units of sawdust are used each day for steam generation.

SLAB PREPARATION

The slab is piled in the storage yard alongside a small access road from which the slabs are easily thrown on the pile (see Appendix). Steel baskets, six feet ten inches in diameter, are then filled by stacking the slabs on end. An overhead crane is used to transport the loaded baskets in and out of the steam-cooker. This process softens the wood and loosens the bark. The steam-cooker, which is set up vertically, is fourteen feet high and has an outside diameter of seven feet. Three baskets of slab constitute a charge that is cooked for an average of two hours. The cooked wood is transferred to the debarking platform where all the bark is removed by hand and large slabs split in two.

THE DEFIBERIZER

The debarked slabs are stacked near the defiberizer machine where they are cut into two-foot lengths. Large knots are cut out and protuberances planed off on a routing machine. The Allis-Chalmers defiberizing machine cuts and tears the wood fibers from the slab.
(see Appendix). The rotary cutting head used in this machine is fastened to the base of the machine below the cutting line. The hopper, in which the slabs are piled crosswise to the cutter, is mounted on wheels and is moved across the cutter by a piston connected to an eccentric on the drive shaft. The cutter head is equipped with hundreds of free-swing bits which, with centrifugal force swing out to come in contact with the lower layer of slabwood in the hopper. The weight of the slabwood piled in the hopper maintains a steady cutting action.

THE OUTSIDE MIXING TANKS

The fibers are drawn from the base of the machine by a blower system transferring the fiber to a large cyclone separator which acts as a splinter trap (see Appendix). Acceptable fiber is blown into two smaller separators where the fiber is separated from the air stream. The fiber then drops from the small separators into one of four mixing tanks. The wood fiber in the tanks is mixed with water to a consistency of roughly 1.7 percent. These tanks have a capacity of 5,000 gallons each. The mixture is transferred from the mixing tanks to the factory proper through a trough into a consistency regulator which removes approximately three-quarters of the water.

THE ATRITION MILL

The fiber passes through the regulator and empties into the first of three consecutively placed attrition mills. The fiber, having passed through the attrition mills, is pumped into a Birkshire Machine driven by a 150 horsepower electric motor which further refines the fiber.

THE MIXING TANKS

The refined fiber from the Birkshire Machine is pumped to one
of three mixing tanks. Water is first added to bring the consistency down to $2\frac{1}{2}$ percent. Then the resin and control elements are added preparatory to the performing operation. Each of these vats has a capacity of 5,000 gallons of mixture which is sufficient for the preparation of 45 minutes to one hour of operation, or 21 to 28 boards.

The materials added to the wood fiber in the mixing tanks are a synthetic phenol resin, Paracol Goo, alum, and kerosene. The resin sets the board under high heat. The Paracol Goo is used to size the fiber. The alum changes the pH of the mixture to an acid condition and the kerosene reduces foaming in the preparation of the wet sheet. The water-soluble resin and chemicals are said to permeate every fiber, resulting in a uniform and strong board.

THE PREFORM

The preforming equipment used in the Chapman process is the most vital and distinctly new step in the whole process of fiberboard manufacture. The intermediate steps of preforming, preform transfer, and preform pickup are the most novel and ingenious stages in the process. The equipment used in these steps of production was invented, fabricated and put into use by Ralph Chapman. Many other innovations were, and are, being incorporated into the process, but these are the most important. The preform equipment is gravity fed, used air and electrical power for its motivation, has a water spray to control foaming, uses vacuum pressure for water removal, and is automatic batch forming.

At the Company's request, this is the sum of what I am permitted to divulge about this equipment.

At this point it might be well to point out the main difference between this particular process and the more common Fourdinier process.
The latter, when begun, must be run continuously until the entire batch of fiber is run through. If a breakdown should occur at any time during the process, the remainder of the batch would be a complete loss due to the nature of the materials used and the type of forming equipment. The resultant loss in material and the labor expense could possibly run into thousands of dollars. The Chapman process, however, does not have this problem to contend with, and production may be stopped at any time, except when there are boards in the press or preform, without loss.

The mixture may be left overnight in the mixing tanks without any effect upon the quality of the board produced. This is due to the character of the water-soluble resin which does not polymerize until exposed to high temperatures.

**PREFORM TRANSFER**

The wet sheet transfer operation is automatically operated by vacuum and pressure switches so that no operator is needed to control the operation. When a vacuum pressure of fifteen pounds per square inch is reached under the preform sheet the vacuum is released, for by this time there is no water above the pulp mat. The preform shell is raised and the wet pulp sheet is transferred beneath a small hydraulic cold press that builds up a pressure of 1,500 pounds per square inch upon the wet sheet, squeezing most of the excess water from the sheet. At 1,500 pounds per square inch the pressure is automatically released. When the preform shell and the hydraulic plate have both raised, an operator sets the continuous screen in motion; thus moving the sheet from the press to the pick-up point and the next wet sheet from the preform shell to the hydraulic cold press. The pressed sheet is then
transferred to a loading rack in front of the hot press; the transfer equipment operating by air and vacuum. A vacuum applied from the overhead pickup rigidly holds the wet sheet from falling while the air operated cylinders move the pickup device through a 90° arc to the loading racks (see Appendix). An air-operated cylinder is used to raise and lower the pickup device. A lever located on top of the pickup box controls the vacuum so that the wet sheet may be released on the loading rack. The pattern seen on the back of the fiberboard is made by the wire screen placed beneath the wet sheet prior to press loading. The function of this screen is two-fold: (1) to provide a means of pulling the wet sheet into the press, and (2) to facilitate water and steam removal while under pressure and heat.

THE PRESS

The press used is a seven-plate hydraulically operated steam press. The wet sheets are pulled onto the platens by hand. The present cycle, time expired from start to finish of the pressing operation, is fourteen minutes for seven boards. The pressure is supplied by three electrically powered hydraulic pumps. Two gear pumps supply large amounts of oil under comparatively low pressures to speed the closing of the press and cut out when the pressure against the boards reaches 250 pounds per square inch. The piston type pump maintains the high press pressures needed to press the wet sheets to the desired thickness. The actual pressures used in the pressing operation are not available for publication.

The pressing operation having been completed, the boards are pulled off the platens two at a time and placed on a table from which the boards and screens are separated (see Appendix). The screens are
placed over an inclined sawhorse arrangement which permits easy access to the press operator for placement beneath the wet sheets on the loading racks. The fiberboards are then placed in rolling racks on edge and measured by a micrometer for maximum and minimum limits of thickness and thinness.

THE HUMIDIFIER

When the boards are removed from the press they are nearly bone dry. They must be placed in a controlled humidity chamber to prevent warping from unequal moisture absorption. For this reason the boards are placed in a humidifying room which is maintained at a constant humidity and temperature. The humidifier used at Chapman's is steam-heated and humidity is controlled by a Foxboro automatic wet-dry recorder-controller (see Appendix). The boards remain in the humidifying chamber for four hours which is considered sufficient to control warping. The chamber has two full length swinging doors opening into two lanes, each capable of accommodating three racks; a total of 210 boards in one charge.

THE TRIMMER

The trimmer is the next stage of production. The stabilized boards are fed into the trimming machine one at a time (see Appendix). It is manually fed and care must be exercised that there is no crowding of the capacity of the machine or boards will be damaged. The boards are fed into the machine lengthwise, two pressure rolls hold the board rigidly while two circular saws placed exactly four feet apart trim and square the edges. Two more sets of rolls carry the board beyond the first two saws and cause the board to depress a switch at the end of the trimmer which activates a transfer chain. This chain transfers the board at right angles to its former line of travel and two saws
at a distance of eight feet trim the ends. The board is then received by the grader at the side of the trimmer who grades and stacks the boards according to grade. A number one board has full size and thickness, no warp or twist, is clean and uniform in color with no cracks, incomplete cure or rough spots. A number two board may have discoloration and foam spots, but must be full size and have no cracks or blisters. The boards which are too thick or too thin, or have a slight warp but with no other serious defects are designated number two. A number three board may have small uncured spots, sticking, warping, small blisters, be undersize and have torn or cracked corners, but no serious combination of defects which would render a large portion of the board incapable of being utilized. A cull board is one which is torn, blistered, or cracked too badly for sale. Cull boards are used in plant construction or given to employees.

WRAPPING

The number one boards are the only grade wrapped. The bundles contain five boards placed with the reverse side outward to prevent damage to the smooth face. All rail and most of the truck shipments are wrapped in heavy paper and taped. The paper used is 100 inches wide and cut from the roll into nine-foot lengths for sufficient overlap to permit taping. The wrapping table and stand for the paper are movable and upon completion of a row of stacks are moved to begin a new row (see Appendix). At present there are no provisions for mechanical transfer so that all the following operations are manual: wrapping, stacking, transfer, and car loading.
SALES AND MARKETS

RAIL AND TRUCK SHIPMENTS

The rail shipments are generally sent to destination in three sizes: 250 bundles, a weight of 43,750 pounds; 315 bundles, a weight of 55,125 pounds; and 380 bundles, a weight of 66,500 pounds. The freight cars are spotted on the spur beside the loading doors through which a roll case is placed into the car door and bundles are rolled into the car where they are taken from the roll-case and stacked. The load is braced by bulk-heading upon completion of loading and is ready to be moved away within a period of three hours. The truck shipments are usually small, less than 100 bundles, and are shorter hauls.

LOCAL AND PRESENT MARKETS

The bulk of the truck shipments are local, involving unwrapped number two and number three boards. The principal customers for these boards are: Corvallis Sand and Gravel Company, Independent Lumber Company, Scharpf Brothers of Albany, and Albany Cabinet Shop. The first two companies retail these number two and three boards exclusively, while the latter use much of it in furniture backs, drawer bottoms, etc. The sales department does no retailing whatever. Its outlets are primarily the retailers or furniture manufacturers, however, large construction firms have placed orders and received shipments by rail. Eastern shipments are infrequent. The bulk of the rail shipments are west of the Rocky Mountains, including Salt Lake City, Utah, Pocatello and Boisé, Idaho, and Spokane, Washington. Markets to the north and south are bounded by Seattle, Washington, and San Diego, California.
Small shipments have been sent to Hawaii.

**POTENTIAL MARKETS AND COMPARISON WITH PLYWOOD**

The potential market for fiberboard is tremendous. It has been said that the future market will consume a production of 500 million to one billion square feet per year. Further, it is believed that fiberboard will price one quarter-inch plywood out of the market because of the high percentage of face stock needed and the increasing cost and decreasing supply of high-grade peeler logs. If a general price decline occurs, plywood may have to maintain the present price level. It is for this reason the manufacturers of fiberboard are so confident of their future. Many of the uses which were primarily filled by plywood are now being taken over by fiberboard. A few of these uses are: Wallboard, table tops, backing for paper and plastic overlays, wainscoating, shower stalls, decorative paneling, furniture backs and drawer bottoms, signboards, and linoleum base.

At present the price of fiberboard is slightly below that of one-quarter inch plywood. The price of fiberboard is $80.00 per thousand in the current market. However, the price could be reduced to $50.00 per thousand and still enable the manufacturer to realize a good margin of profit. Within a year or two a fiberboard product will be developed which will be suitable for exterior use at a price of $20.00 to $25.00 per thousand above the price of the interior grade.

Fiberboard compares favorably with plywood in many ways where strength is not a primary factor. The most serious handicap to increased use of fiberboard is the fact that it does not resist puncture as well as plywood.

Fiberboard, however, has several distinct advantages over plywood.
One advantage is that fiberboard, when painted or stained, keeps its mirrorlike surface with no grain raising or surface checking. Another advantage is fiberboard's excellent lateral stability. Any swelling is even in all planes at about two times the longitudinal swelling characteristic of solid wood. The last advantage is the price differential in favor of fiberboard. These advantages prevail whenever strength is not a factor and one smooth surface will fulfill the use requirements.

The problem of placing two panels together to form an imperceptible joint is one which is common to both fiberboard and plywood manufacturers. Great care must be exercised in workmanship and the materials used to satisfactorily join panels to be used for a painted or natural finish. One method which has met with moderate success is that of placing the panels in such a manner that the edge of the adjacent panel is one-eighth inch distant. This space is filled with a plastic wood filler which is sanded smooth after drying. The plastic wood filler absorbs paints, varnishes, and stains in about the same manner that fiberboard panels do.

If fiberboard is to be used as a base for wallpaper a cloth tape over the joints serves satisfactorily. The inventive person who discovers a foolproof way to satisfactorily join the edges of any product manufactured in sheet or panel form will undoubtedly be rewarded.
PRODUCTIVE CAPACITY

CONVERSION FACTORS

The conversion factors of man-days per thousand square feet, power per ton of output, and the like, at this plant do not represent fairly the advantages of the Chapman Process. The plant in Corvallis is a pilot plant. It is wasteful of labor, materials and money. The results of unfruitful experimentation lie in the junk heap behind the plant. The dollar value of materials and labor lying there almost equal the average workman's lifetime earnings.

The new plants springing up in Canada and in other sections of the United States have equipment that incorporates the best design and highest production with the Chapman Process. Within the near future the use of slabwood as a source of raw material will be discontinued and wood chips substituted. Future development plans are in the blueprint stage for increased fiber-making capacity, press capacity, and board production. The steam generation equipment will be moved to a boiler-house set apart from the factory proper. The whole process will be re-arranged for highly efficient, straightline production. This process is the only one to date which makes it possible for the manufacturer with relatively little capital to enter a highly competitive market and make a good margin of profit. At the Corvallis plant three shifts employ a total of 23 men to produce an average of 18,000 square feet per day. The man-days per square foot produced compares closely to the volume in board feet produced in primary lumber production -- 800. For this volume of production the
power required is 500 kilowatt hours per ton of output (roughly 54 boards). The new plant in Vancouver, Washington will produce 40,000 to 50,000 square feet of boards per day with a man-day factor of 2,500 to 3,000 square feet.

INVESTMENT

The cost of building and equipping a fiberboard manufacturing plant like the one under construction in Vancouver, B.C., would be $300,000. This plant will exceed by three times the production of the pilot plant in Corvallis, Oregon. Incorporated into it will be entirely new features. Some of these new features are: Using wood chips for raw material, Asplund chip defiberizers, faster preforming, automatic press loading and unloading, automatic, continuous humidifying equipment, faster trimming, machine board wrapping, and the use of lift-trucks for package transfer and car loading.

Gene Tower, Chief of Research and Development at Chapman Forest Utilization, Incorporated, states, "Our process is the best of its type and size to date for economy, quantity, and quality of board produced. It is but one method of doing the job. Someone in the future may come along with a better idea".
APPENDIX

Figure 1 Slab Storage and Preparation
2 Allis-Chalmers Defiberizer
3 Outside Mixing Tanks
4 Attrition Mill
5 Wet-Sheet Pickup Device
6 Hot Press
7 Humidifier
8 Trimmer
9 Wrapping
10 Flow Diagram After Proposed Improvements To The Process
Figure 1

North view showing piled slabs, slab baskets, vertical steamcooker, overhead crane and in the background the debarking platform.
Figure 2

View of the defiberizer machine. The operator is placing a two-foot slab in the hopper. The hook and chain in the foreground are attached to an electric hoist used to change the cutterheads.
Figure 3

View of the outside mixing tanks and separator equipment. The extreme top right, above the catwalk, shows the trough which transfers the mixture from the outdoor tanks to the factory proper.
The left background shows the three consecutively placed attrition mills. At the extreme left the mixture from the Birkshire machine is emptying into Number 2 tank. The foreground shows the Birkshire machine and the 150 horsepower motor. The top right shows the preforming machine and water spray.
Figure 5

View of the pickup box with a wet sheet held rigidly to it prior to transfer to the loading racks on the left. The operator is holding the control which raises the pickup box.
Figure 6

View of the press showing the off-bearer removing the boards from the press. The largest of two steam boilers is in the background.
Gene Tower, Director of Research and Development, examining boards to be rolled into the humidifier. The blower switches and Foxboro recorder-controller are shown on the right wall of the humidifier.
Figure 8

View of Trimming Machine
Figure 9

View of Wrapping Table in the background and a dolly of trimmed boards in the foreground.
Flow Diagram after proposed improvements to the process.
Sample #1
raw fiber

Chapco Board
Paste Wood Filler
1 coat Flat White
2 coats semi-gloss enamel

Sample #7
1/4 in.
Philippine Mahogany

Sample #8
1/4 in.
painted D.P.

Physical sample available at library. Contact Special Collections to view.