Hardboard from Extracted Juniper Chips[1]

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Chips from western juniper that had been steam-distilled for recovery of volatile oil were ground in an attrition mill and then made into hardboard—some without additives, some with resin, and some with resin plus wax. The boards possessed exceptional bending strength and water resistance but inferior toughness properties compared with boards made from other species. Additives and higher pressing temperatures increased specific gravity values. Surfaces were uniformly colored and semiglossy without use of a water spray.

IN LARGE AREAS of central and eastern Oregon, the principal tree species is western juniper (*Juniperus occidentalis,* Hook), which is now practically unused. In an effort to find economic uses for this tree, the volatile oil content has been studied.[2]

The present report is on a study of hardboard production from juniper chips extracted by steam distillation. Harvesting the tree solely for hardboard manufacture might be uneconomic, but the practicality would be increased if the raw material could be obtained as a byproduct from another manufacturing process, such as extraction of the wood for its volatile oils.

Principal uses for the wood are restricted at present to fence posts, novelties, and fuel. Most large trees are decayed internally, thus making difficult the recovery of lumber for pencil stock.

Experimental Procedure

The work was divided into two parts, each part being analyzed separately. Part I was a short study designed to determine which of three grinding runs and chip cooks produced the best fiber for board making. The additive combinations were the same for all grinds, and two pressing temperatures (320° F. and 400° F.) were used. The plan of action followed during Part I is shown in Fig. 2.

Part II was an attempt to determine the influence of three additive treatments (no additives, resin only, and resin and wax) and temperatures on boards made with fiber from cook and grind number three. The plan of action for Part II is shown in Fig. 3.

Equipment: The chips were fiberized in a 24-inch, double-rotating-disc Bauer attrition mill. The mixing was done in a propeller-type mixer equipped with two spray heads for additive distribution. The mat felter was laboratory-designed, as was the pre-pressing equipment. All boards were pressed with mats at 40 per cent volatile content in a steam-heated hydraulic press.

Preparation of Fiber: Chips were supplied as a by-product from volatile oil extraction. All chips used had been screened to ⅝-inch size and cooked under one of the following conditions:

1. Steam pressure, 25 psi for 6 hours.
2. Steam pressure, 25 psi for 5 hours.
3. Steam pressure, 45 psi for 8 hours.

The chips were fiberized hot. Cook number one was ground using a plate setting of 23 mils, which was the same setting used on previous studies of lodgepole pine and Douglas-fir.[3] Be-

[3] Nixon, G. D. 1953. Suitability of Lodgepole Pine for Dry-formed Hardboard. Report No. L-3, Oregon Forest Products Laboratory.

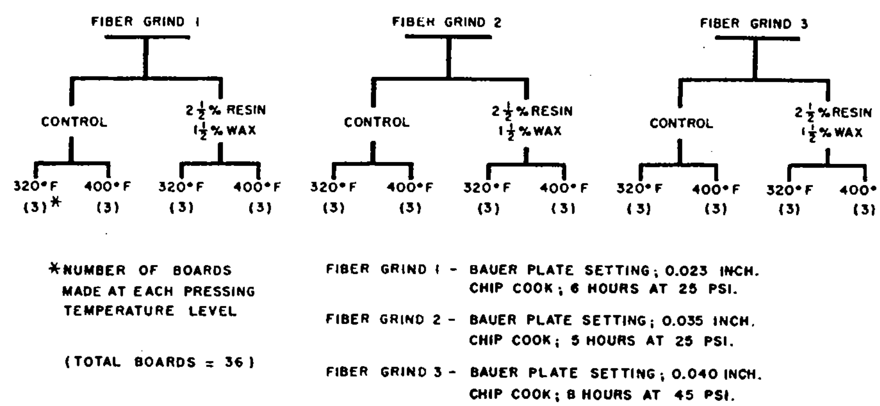

Fig. 2.—Plan of action used in Part I.

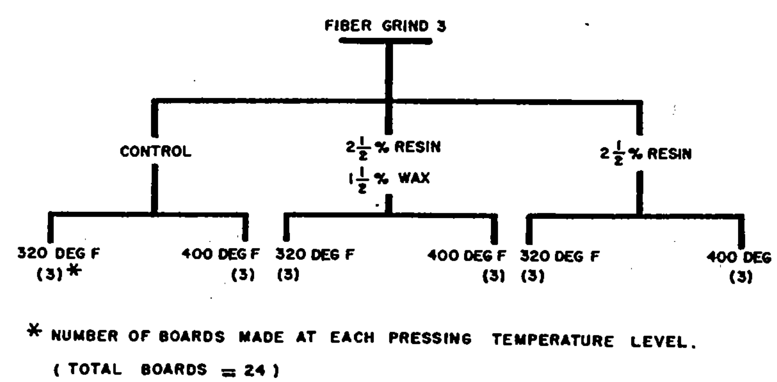

Fig. 3.—Plan of action used in Part II.

[1] A contributed paper.
[2] Kurth, E. F., and Ross, J. D. Volatile Oil from Western Juniper. Report No. C-3, Oregon Forest Products Laboratory. April, 1954.

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the chips were soft and pliable, yielding short fiber with a high percentage of fines.

The second cook was ground at a faster feed rate and with a plate setting of 35 mils. The objective in increasing the plate setting was to produce a coarser fiber. This grind gave fiber which appeared to approximate the fiber-size distribution obtained from lodgepole pine and Douglas-fir.

The third cook, which was steamed at 45 psi, was ground at a plate setting of 40 mils to give a fiber with distribution comparable to that of cook number two. In order to maintain a full load on the Bauer mill, it was necessary to further increase the feed rate. The extracted juniper chips required less power for grinding than did lodgepole pine or Douglas-fir.

All grinds were analyzed for fiber distribution in a Bauer-McNett fiber classifier, and the results of the analysis are shown in Table 2.

Preparation of Boards: The wet fiber from all grinds was dried to below 15 per cent moisture content (on a dry-weight basis) before further processing. The dried fiber was mixed with the necessary amounts of resin, wax, and water. The mixed fiber was felted into a loose mat by means of a shaker box and pre-pressed by an air-operated ram. Following the pre-pressing, the mats were pressed into screen-backed boards in a steam-heated press at 1000 psi for 45 seconds, then released to 100 psi for 9 minutes, 15 seconds. This was the same pressing cycle used on previous studies of lodgepole pine, Douglas-fir, and West Coast hemlock. The volatile content of the fiber at time of pressing was about 40 per cent (oven-dry weight basis).

Forty-two boards were made, 12 by 12 by $1/4$ inches, and smooth one side. No pH control was used with these boards because of the low pH of the raw material. A phenolic resin binder was used throughout the study and a wax emulsion was used to reduce water absorption. The combination of resin and wax was used because it had given satisfactory results in hardboard using lodgepole pine, West Coast hemlock, and Douglas-fir fibers. The amounts of additives were kept constant throughout the work at either $2\frac{1}{2}$ per cent resin, or $2\frac{1}{2}$ per cent resin plus $1\frac{1}{2}$ per cent wax emulsion.

Testing of Boards: Test values for modulus of rupture, water absorption, specific gravity, and moisture content at time of testing were obtained for all boards. Test specimens were cut from the 12- by 12-inch boards in accordance with the pattern shown in Fig. 1. All boards to be tested were conditioned for one week at 65 per cent relative humidity and 70° F.

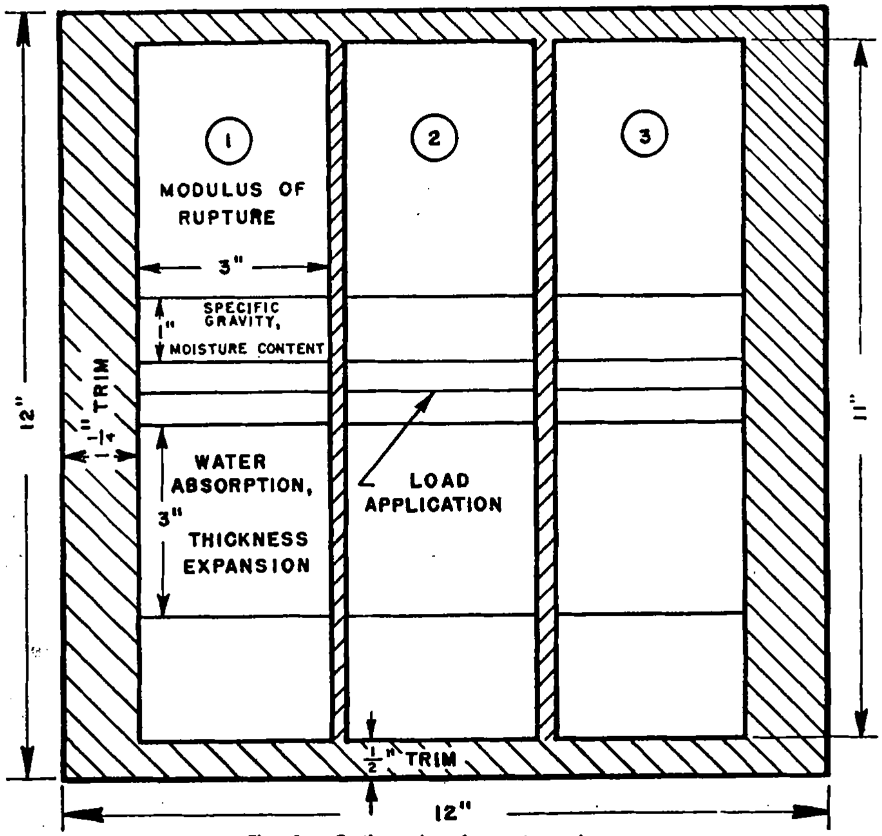

Fig. 1.—Cutting plan for test specimens.

Modulus of rupture values were obtained from 3-inch by 11-inch test specimens, broken on an 8-inch span with a head speed of 4 inches per minute (Federal Specification LLL–F–311).

Water absorption test specimens were cut as 3- by 3-inch pieces, taken from the broken bending specimens. After initial weight and thickness measurements were taken, the pieces were immersed for 24 hours under 1 inch of water at 70° F. Upon removal from the water the pieces were set on edge and allowed to drain for 10 minutes. Final weights and thicknesses were recorded and values for water absorption and thickness swelling calculated as percentages of the original weight and thickness. The standard size for a 24-hour water absorption test specimen is 12 by 12 inches; therefore the values obtained from these smaller pieces should be somewhat higher than would be expected from full-size test pieces.

Specific gravity values were determined from 1- by 3-inch sections that were taken also from the bending specimens. The pieces first were weighed, then oven-dried and weighed a second time. Volume measurements were made by immersion of the piece in mercury, and the weights and volumes were used to calculate moisture content at test, and specific gravity. Specific gravity values were based on oven-dry weight and oven-dry volume.

Results and Discussion

Part I

Data pertinent to the steaming, grinding, and fiber-size distribution from the four digester loads are shown in Tables 1 and 2. The fourth digester load was run as a continuation of load 3 and the resultant fibers were considered the same.

The data in Table 2 show that the juniper chips produced a shorter fiber with more fines than in fiber from any of the previous anlayzed species. Where a comparable plate setting was used (grind 1) an extremely fine fiber resulted, but when coarser plate settings were used the fiber-size distribution more closely approached that of previous species studied.

All the juniper boards were characterized by a glossy, uniformly colored surface on the smooth side, regardless of the pressing temperature used. Boards made from the extremely fine fiber of grind 1 produced superior surface characteristics, although the boards from grinds 2 and 3 were comparable to commercial products. It was unnecessary to water-spray the mat for uniform surface color of boards.

Because of the extended cooking times (5–8 hours), somewhat more water solubles than previously experienced with other species were deposited on the screen back. The deposits did not cause serious sticking of the fiber to the screen, but in a commercial operation it would seem desirable to