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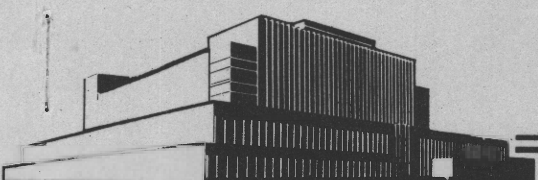

FOREST PRODUCTS LABORATORY
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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
In Cooperation with the University of Wisconsin

UTILIZATION OF WHITE-POCKET DOUGLAS-FIR IN CONTAINERS[1]

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Introduction

A defect termed "white pocket," caused by the fungus Fomes pini, has made serious inroads in the Douglas-fir forests of Oregon and Northern California. It is reported that a large volume of this material is left in the woods as cull or is culled in the manufacturing process. The U. S. Forest Products Laboratory, in cooperation with the Pacific Northwest and Pacific Southwest Forest and Range Experiment Stations, has undertaken a study of the possible uses of white-pocket Douglas-fir with the view to extending its market. This report summarizes three separate investigations dealing with the possible utilization of white-pocket Douglas-fir in shipping containers. The investigations were made with the material being utilized in the form of plywood or paper-overlaid veneer.

A Study of White-Pocket Douglas-Fir Panel Materials For Use in Domestic Cleated-Panel Boxes (1)[3]

Cleated-plywood and cleated paper-overlaid veneer boxes of two sizes, 24 by 16 by 16 inches and 44 by 24 by 16 inches, length, width, and depth, respectively, were constructed in accordance with the requirements of Federal Specification NN-B-601b, "Boxes, Wood; Cleated, Plywood, For Domestic Shipment," except that paper-overlaid veneer was substituted for plywood in the paper-overlaid veneer boxes and white pocket was permitted in the Douglas-fir plywood. All boxes were of Style A construction.

The plywood (fig. 1) was either sound (no white pocket), or it had light white pocket (10 to 20 percent of the surface area) or heavy white pocket (30 to 40 percent of the surface area). The 3/16-inch plywood was three-ply construction, each ply being 1/16-inch veneer. The paper-overlaid veneer was constructed of 1/10-inch Douglas-fir veneer with heavy white pocket. This veneer core had Fourdrinier kraft facings bonded to each side.

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[1] Original report issued November 1953.

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

[3] Numbers in parentheses refer to reports listed in appendix.

The veneer was cut, and the plywood panels and paper-overlaid veneer were fabricated at the Forest Products Laboratory. The degree of white pocket was determined by visual inspection of the veneer prior to fabrication. All veneers conformed to Grade C (exterior back) requirements of commercial Standard CS 45-58, except that white pocket was permitted in the panels. A flour-extended, urea-resin glue was used as an adhesive to fabricate the paper-overlaid veneer and plywood.

Box sizes, weight of contents, type of loads, and the box tests were set up so that the results could be compared with previous tests made on similar boxes constructed of sound materials. The smaller boxes were subjected to rough-handling tests in the 14-foot revolving hexagonal drum, and the larger boxes were tested on the incline-impact tester. In addition, specimens of each of the panel materials were subjected to puncture-resistance tests to obtain an index of their resistance to damage from puncture during handling or transportation.

The moisture content of the boxes and of the panel specimens at the time of testing was approximately 10 percent for the plywood and about 5 percent for the overlaid veneer.

In both of the box tests and in the puncture-resistance tests, the best performance was exhibited by the sound plywood (no white pocket) and the poorest performances were exhibited by the plywood with heavy white pocket and the paper-overlaid veneer.

Analysis and comparison of the results with previously obtained data seem to warrant the following conclusions:

(1) For style A domestic cleated-panel boxes, constructed in accordance with the requirements of Federal Specification NN-B-601b, the plywood with heavy white pocket and the paper-overlaid veneer may be satisfactory for weights of contents up to 150 pounds, and the plywood with light white pocket may be satisfactory for weights of contents up to 200 pounds. According to the specification, similar boxes using 3/16-inch Douglas-fir plywood without white pocket would be suitable for weights of contents up to 300 pounds.

(2) Boxes constructed of panel materials tested should be limited to sizes not greater than 44 by 24 by 16 inches, if they are intended for the maximum weight of contents. For boxes of larger sizes, auxiliary battens, cleats, or other variations in box design may be advisable.

Performance of Douglas-Fir Ply-Veneer Apple Boxes with Varying Degrees of White Pocket (2)

The paper-faced veneer boxes used in this study were constructed from a relatively new material (Ply-Veneer) which was developed by Elmendorf Research, Inc., Chicago, Ill., and the Weyerhaeuser Timber Company, Longview, Wash. It consisted of a single core of Douglas-fir veneer in which narrow knife-edge slits had been cut parallel to the grain.

The wedging action of the knife distended the cross-grain dimension of the veneer from 5 to 10 percent. The purpose of the distending process was to increase dimensional stability of the veneer by providing room for dimensional changes due to changes in moisture content. Kraft paperboard (16 point) was laminated with soya-silicate adhesive to each side of the veneer core while the veneer was in the distended position. The machine direction of the 0.016-inch kraft was perpendicular to the grain of the veneer, thus providing added rigidity across the grain of the panel.

In order to study the performance of this material in special purpose containers, comparative tests were made on standard Northwest apple boxes constructed of ponderosa pine and on boxes constructed of Ply-Veneer (fig. 2).

The Ply-Veneer apple boxes were constructed of paper-overlaid Douglas-fir veneer with three different degrees of white pocket: (a) no white pocket, (b) one-third or less of the surface area with white pocket, and (c) more than one-third of the surface area with white pocket. The area with white pocket was determined by visual inspection before the paper facing was applied to the veneer.

Tests were conducted on the Ply-Veneer and standard Northwest wooden apple boxes after they were conditioned at 75° F. and 65 percent relative humidity and after storage at 35° F. and 90 percent relative humidity. One series of boxes was subjected to tests in the 7-foot hexagonal drum to determine their resistance to rough handling. Another series was subjected to diagonal compression-on-edges tests to ascertain their rigidity. For the rough-handling tests, the boxes were loaded with simulated apples to a net weight of approximately 49 pounds. For the compression-on-edges tests, the boxes were closed but tested empty.

Results of these tests indicate that Ply-Veneer constructed of Douglas-fir veneer with white pocket on as much as one-third of its surface area may be satisfactorily used in the construction of apple boxes. Douglas-fir Ply-Veneer with white pocket on more than one-third of its surface area was not recommended for use in apple box construction because it did not furnish sufficient resistance to rough handling.

For the design used in these tests, Ply-Veneer apple boxes of all three intensities of white pocket were found to weigh, on the average, approximately 2 pounds less than the standard Northwest apple boxes. This amounts to a reduction in tare weight of about 29 percent over the nailed-wood apple boxes. The performance of the Ply-Veneer apple boxes appears to warrant additional investigations, such as trial shipments.

Use of Douglas-Fir Plywood Containing White Pocket as Material for Sheathing Shipping Crates

In this study, no actual tests were made of crates sheathed with Douglas-fir plywood containing white pocket. Based, however, on data and results obtained from previous studies of the strength properties and fastener-holding characteristics of Douglas-fir plywood containing white pocket, the following recommendations were made relative to its use as a crate sheathing material:

(1) Its use should be limited to fully sheathed crates of general design. It should not be used for crates employing the use of box beams.

(2) No white-pocket Douglas-fir plywood should be used for the sheathing of crates wherein the degree of white pocket in any one ply as evaluated by the grit analysis method[4] shows that the average percentage of voids is greater than 10 percent of the gross volume.

(3) When only the core or center ply contains white pocket, the thickness of the plywood shall be equal to the specified thickness for Douglas-fir plywood made from sound wood. If more than the core contains white pocket, the plywood should be one-eight inch thicker than that required for Douglas-fir plywood.

(4) When Douglas-fir plywood containing white pocket in any of the plies is used for sheathing a crate, the sheathing should be nailed to the struts, cleats, skids, and other framing members by the use of not less than 25 percent more nails than specified for Douglas-fir plywood. Usually the extra nails required should be placed by adding another row of nails accompanied by increasing the spacing between nails in a row, such as changing 2 rows at 4-inch spacing to 3 rows at 5-inch spacing. The width or depth of a framing member or skid may, in some instances, have to be increased to prevent its splitting when the extra nails are used.

(5) A grading system should be established to grade and positively identify all plywood made from white-pocket Douglas-fir veneer, and assurance that the system is operating should be obtained before any recommendation be made for the use of it.

It was further recommended that, should a serious interest in the use of white pocket Douglas-fir plywood for the sheathing of shipping crates arise, a more extensive study be undertaken to include the evaluation of a commercially made and graded white-pocket plywood. Such a study should consider:

(a) Possibilities of waterproofing the white-pocket plywood.
(b) Protection against fungus growths and insect infestation.
(c) Retention of strength properties and fastener-holding characteristics.
(d) Tests of actual crates using white-pocket Douglas-fir plywood as the sheathing material.

Results of such tests may reveal that the aforementioned recommendations are too rigid, and may also indicate that white-pocket Douglas-fir plywood may be suitable for use to a greater extent than that recommended.

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[4]Englerth, G. H., Bonser, W. E., and Wood, L. W., "Effect of *Fomes pini* on Strength and Grading of Douglas-Fir." Forest Products Laboratory report (not for publication), August 1950.

APPENDIX

1. WITTING, R. H.
A STUDY OF WHITE-POCKET DOUGLAS-FIR PANEL MATERIALS FOR USE IN DOMESTIC CLEATED-PANEL BOXES. Forest Products Laboratory Report, June 25, 1952 (Not for Publication).

2. BRIGGS, E. V. and SKIDMORE, K. E.
PERFORMANCE OF DOUGLAS-FIR PLY-VENEER APPLE BOXES WITH VARYING DEGREES OF WHITE POCKET. Forest Products Laboratory Report, March 20, 1953 (Not for Publication).

3. MATERIAL CONTAINERS STAFF
USE OF DOUGLAS-FIR PLYWOOD CONTAINING WHITE POCKET AS MATERIAL FOR SHEATHING SHIPPING CRATES. Forest Products Laboratory Report, November 6, 1952 (Not for Publication).

Figure 1. --From left to right is plywood with no white pocket, plywood with light white pocket, and plywood with heavy white pocket.

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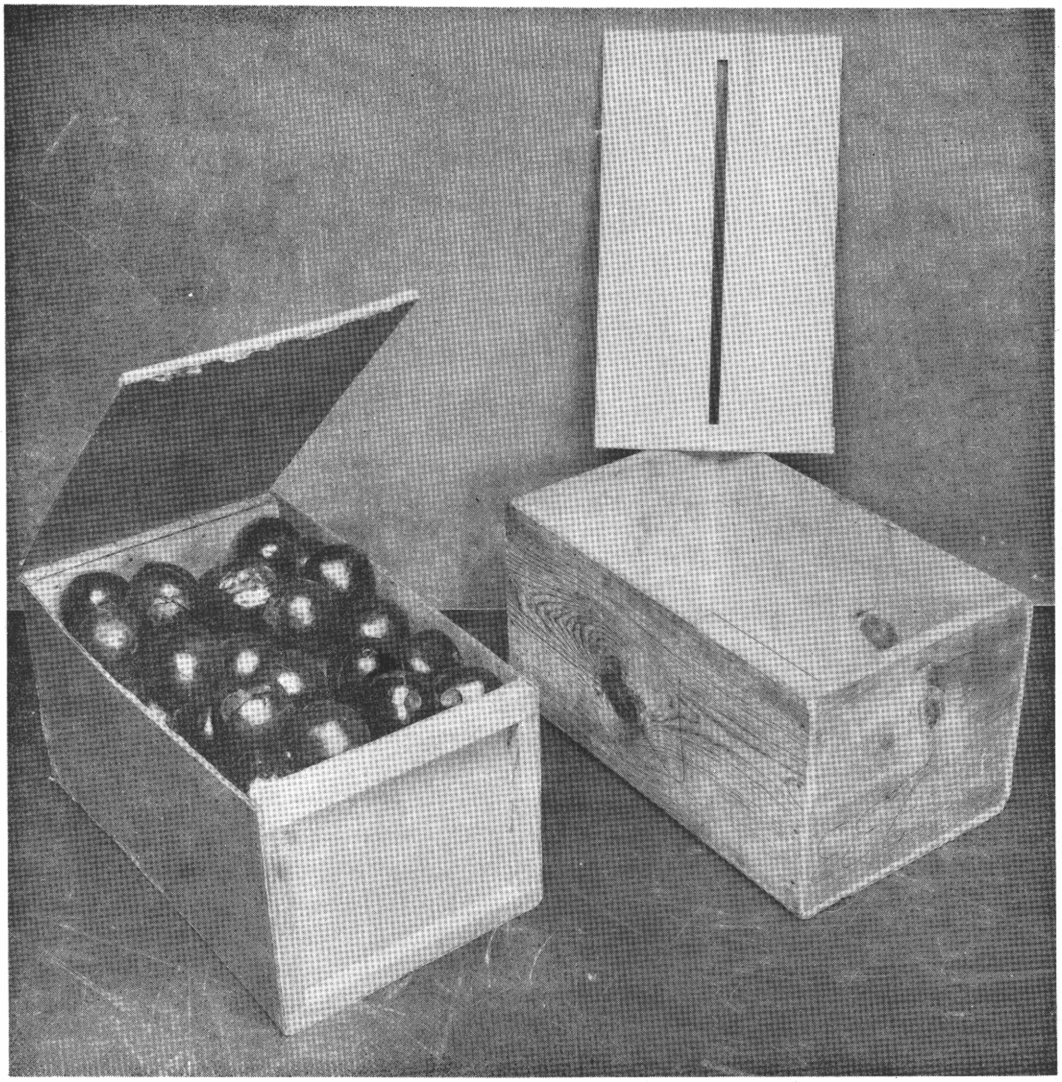

Figure 2. --A loaded ply-veneer apple box with simulated apples and a standard Northwest apple box ready for loading.

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SUBJECT LISTS OF PUBLICATIONS ISSUED BY THE FOREST PRODUCTS LABORATORY

The following are obtainable free on request from the Director, Forest Products Laboratory, Madison 5, Wisconsin:

List of publications on Box and Crate Construction and Packaging Data

List of publications on Chemistry of Wood and Derived Products

List of publications on Fungus Defects in Forest Products and Decay in Trees

List of publications on Glue, Glued Products and Veneer

List of publications on Growth, Structure, and Identification of Wood

List of publications on Mechanical Properties and Structural Uses of Wood and Wood Products

Partial list of publications for Architects, Builders, Engineers, and Retail Lumbermen

List of publications on Fire Protection

List of publications on Logging, Milling, and Utilization of Timber Products

List of publications on Pulp and Paper

List of publications on Seasoning of Wood

List of publications on Structural Sandwich, Plastic Laminates, and Wood-Base Aircraft Components

List of publications on Wood Finishing

List of publications on Wood Preservation

Partial list of publications for Furniture Manufacturers, Woodworkers and Teachers of Woodshop Practice

Note: Since Forest Products Laboratory publications are so varied in subject no single list is issued. Instead a list is made up for each Laboratory division. Twice a year, December 31 and June 30, a list is made up showing new reports for the previous six months. This is the only item sent regularly to the Laboratory's mailing list. Anyone who has asked for and received the proper subject lists and who has had his name placed on the mailing list can keep up to date on Forest Products Laboratory publications. Each subject list carries descriptions of all other subject lists.