GLUING CHARACTERISTICS OF CHINQUAPIN TANOAK, CALIFORNIA LAUREL, MADRONE

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GLUING CHARACTERISTICS OF CHINQUAPIN, TANOAK, CALIFORNIA LAUREL, MADRONE

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Introduction

While most Pacific Coast softwoods have been extensively utilized, the hardwoods of the region have been neglected in favor of species from the eastern States. To promote closer utilization of hardwood species native to the area, the California Forest and Range Experiment Station of the Forest Service cooperated with this Laboratory to investigate the properties of California laurel (Umbellularia Californica, best known to the novelty trade as Oregon myrtle), chinquapin (Castanopsis chrysophylla), tanoak (Lithocarpus densiflorus), and madrone (Arbutus menziesii), in order to determine whether they are satisfactory for commercial use. This report presents results of tests to determine whether the four species can be satisfactorily glued with casein, starch, animal, urea, and resorcinol glues. The tests involved initial dry shear strength only. Because of the limited amount of material available for the tests, the results are regarded as only indicative of the quality of glued joints that may be expected with these species under good gluing conditions.

The data in this report apply directly to laminating and edge gluing, in which the tangential or radial surfaces of lumber are glued and the grain of adjacent pieces is in the same direction.

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

Procedures

All species were at about 8 percent moisture content. Samples to be used for gluing tests were cut into 11/16- by 2-1/2- by 12-inch pieces. Four joints, each consisting of two pieces, were made with each glue and each species except the laurel, for which only enough material was available to make three joints with each glue.

The glue was applied to only one surface of each joint. Gluing conditions were as given in table 1. After being taken from the press, the joints were kept in an atmosphere at 80° F. and 30 percent relative humidity for 1 week before block-shear test specimens were cut. Five shear specimens were cut from each joint and were tested dry in a universal testing machine with the shearing head moving at a rate of about 0.015 inch per minute as described in American Society for Testing Materials Method D905-49.

Results

The average results of the initial dry shear tests of the joints are given in table 2. The data in table 2 indicate that California laurel offered some resistance to gluing with casein and vegetable glues, and that joints of inferior quality resulted in all four species when animal glue was used under conditions favorable to starved joints. However, joints of good quality were obtained with all four species when animal glue was used under good gluing conditions.

Joints made in laurel with casein, vegetable, and animal glue under good conditions were adequate for many purposes, although percentages of wood failure were lower than with most other hardwood species listed in U. S. Department of Agriculture Bulletin 1500, "The Gluing of Wood." The other three West Coast hardwood species generally produced joints with higher wood-failure values than did California laurel. Except with vegetable glue, chinquapin appeared to be the easiest of the four species to glue.

The gluing characteristics of these four hardwoods were compared with data in U. S. Department of Agriculture Bulletin 1500, "The Gluing of Wood," and in Forest Products Laboratory Report No. 1342, "The Gluing Characteristics of 15 Species of Wood with Cold-setting, Urea-resin Glues." In table 3, the species of the present study are grouped, for

each glue, with other species that gave similar wood-failure values. No comparison could be made for resorcinol-resin glue because this glue has not been investigated extensively for gluing a large number of species.

When reasonable care is used in selection of gluing conditions, a species can be expected to produce joints of about the same quality as do the species grouped with it in table 3 for a particular kind of glue. For example, tanoak may be glued with vegetable (starch) glue under normal or average conditions to produce joints of about the same quality that would be produced by this glue in sycamore, black tupelo, or water tupelo. The hardwood species used for comparison in table 3 are not native to the West Coast. Compared with one of the more commonly used western hardwoods - red alder - the gluability of chinquapin resembled closely that of red alder when animal or casein glue was used. When vegetable glue was used, madrone compared more closely with red alder in gluability. These comparisons are not, however, so close as those given in table 3.

In table 4 another means of comparing the gluability of the four western hardwoods is presented. In this table the species are described as easy, moderately easy, or difficult to glue with the several glues, depending upon the amount of wood failure developed in the joint in the block-shear tests (table 2). In table 4 a species is classified as easy to glue if the wood-failure values were between 90 and 100 percent, moderately easy to glue if between 50 and 90 percent, and difficult to glue if between 0 and 50 percent.

In addition to the gluing of these species in lumber form with room-temperature-setting glues, a few tests were made of joints in plywood made with tanoak veneers. The tanoak plywood was made with casein, and hot press extended urea-resin, and phenol-resin glues. Good dry strength values were obtained with all three glues. Plywood made with the resin glues showed good resistance to water in delamination tests and in shear strength after 48 hours' soaking in water.

Considering all the glues used, chinquapin could be glued most easily, followed by madrone, tanoak, and California laurel, in that order. In summary, the four species do not appear to present unusual gluing problems, although good joints cannot be expected without moderate control of gluing conditions.

Table 1.--Conditions used in preparing block-shear test joints with California laurel, chinquapin, tanoak, and madrone

Glue	Glue formula	Average glue spread	Assembly time (closed)	Pressure	Temperature of wood during pressure period	Period under pressure
	Parts by weight	Grams per sq. ft.	Minutes	Lb. per sq. in.	° F.	Hours
Casein	FPL 4B formula	72	12	200	75	24
Vegetable (starch)	100 parts starch, 225 parts water, 3 parts NaOH	79	12	200	75	24
Animal (J-2 grade)	100 parts glue, 225 parts water	44	3	200	80	24
Animal[1] (J-2 grade)	100 parts glue, 300 parts water	29	0.5	200	90	24
Urea-resin	100 parts resin,[2] 10 parts walnut-shell flour, 60 parts water, 1.0 part ammonium chloride, 1.2 parts tricalcium phosphate	41	20	200	75	24
Resorcinol-resin	A commercial glue mixed according to the manufacturer's directions	33	50	200	75	24

[1]The formula and gluing conditions used favored the formation of starved joints.

[2]Urea-formaldehyde resin received from manufacturer with filler or catalysts not incorporated.

Table 2.--Average shear-test results of glued joints in four West Coast hardwoods

Species	Average specific gravity[1]	Average shear-test results[2]					
		Casein glue	Vegetable (starch glue)	Animal glue	Animal glue[3]	Urea-resin glue	Resorcinol-resin glue
California Laurel	0.67	2574-28	2726-17	2929-50	1234- 2	3044-83	2942-77
Chinquapin	.52	2044-88	1740-68	1952-92	1763-27	2199-98	2130-88
Tanoak	.69	2714-49	2712-64	3042-74	1880- 8	3020-90	3132-65
Madrone	.67	2855-78	2630-87	2675-84	1447- 0	2714-86	2976-86

[1] Based on oven-dry weight and volume at 12 percent moisture content. These determinations were made on specimens from the same lot used in the gluing experiments.

[2] The value before the dash is the average shear strength in pounds per square inch; the value after the dash is the average estimated wood failure in percent. Each value is the average for 15 tests for the laurel and 20 tests for each of the other species.

[3] Conditions used in making the test specimens with this glue favored the formation of starved joints.

Table 3.--Species with which California laurel, chinquapin, tanoak, and madrone compared most closely when glued with several glues[1]

Glue	California laurel	Chinquapin	Tanoak	Madrone
Casein	Sugar maple Persimmon	Magnolia (sp.) American elm Ponderosa pine[2]	Beech White oak Black walnut	Rock elm Butternut Black tupelo[3]
Vegetable (starch)	Yellow birch Osage-orange	Black cherry Soft maple Red oak	Sycamore Black tupelo[3] Water tupelo[4]	Southern yellow pine Pecan Sweetgum[5]
Animal	Persimmon Hickory	Sycamore Rock elm Mahogany	Beech Water tupelo[4] Red oak	Soft maple Ponderosa pine[2] Sassafras
Animal[6]	Osage-orange Sugar maple	Hickory Red oak Magnolia (sp.)	Maple Sweetgum[5]	Osage-orange
Urea-resin	Pecan Sugar maple	Black walnut Noble fir Mahogany	Sweetgum[5] Sitka spruce White oak	Yellow birch White ash

[1]Comparisons are based on wood-failure values as given in USDA Bull. 1500, Forest Products Laboratory Rept. 1342, and in table 2 of this report. Resorcinol-resin glue was omitted because of lack of data on various species.

[2]Shown as western yellow pine in Bull. 1500.

[3]Shown as black gum in Bull. 1500.

[4]Shown as tupelo gum in Bull. 1500.

[5]Shown as red gum in Bull. 1500.

[6]When used under conditions favoring starved joints.

Table 4.--Ease of gluing[1] of California laurel, chinquapin, tanoak, and madrone with several glues

Glue	California laurel	Chinquapin	Tanoak	Madrone
Casein	Difficult	Moderately easy	Difficult	Moderately easy
Vegetable (starch)	Difficult	Moderately easy	Moderately easy	Moderately easy
Animal	Moderately easy	Easy	Moderately easy	Moderately easy
Animal[2]	Difficult	Difficult	Difficult	Difficult
Urea resin	Moderately easy	Easy	Easy	Easy
Resorcinol resin	Moderately easy	Moderately easy	Moderately easy	Moderately easy

[1]Based entirely on percentage of wood failure developed in the block-shear test (table 2).

[2]When used under conditions favoring starved joints.