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A.T.I 95714

Yale University

School of Forestry

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MOISTURE ABSORPTION IN CERTAIN TROPICAL AMERICAN WOODS

Technical Report No. 1

copy # 8

Project N6-ori-44, Task Order XV

Office of Naval Research

United States Navy

August, 1949

New Haven, Connecticut

MOISTURE ABSORPTION IN CERTAIN TROPICAL AMERICAN WOODS/1

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This study is one of a series undertaken as part of a continuing investigation of the properties of tropical woods. The investigation is being conducted at the Yale School of Forestry and is sponsored by the Office of Naval Research, Department of the Navy, under Contract N6 ori-44, Task Order XV (Project Designation NR-033-020). The scope of the complete research program is indicated in _Properties and Uses of Tropical Woods, I_ published in TROPICAL WOODS 95 (June 1, 1949).

Knowledge of the moisture absorption of wood is useful in a number of ways. Moisture absorption values may be employed in comparing a species with others of proved serviceability in determining suitability for use in boatbuilding and for many other applications in marine service. They may also be useful in evaluating a wood for use in tanks, wood pipe and conduit, tight cooperage, and other structures involving exposure to moisture or other liquids.

Woods that are characterized by a slow rate of moisture absorption are adapted to many of these uses not only because of the slow passage that they afford to water or other liquids, but also because of their relatively high dimensional stability when subjected to intermittent wetting and drying or to varying conditions of atmospheric humidity. In boat decking, for example, a low rate of moisture absorption may be equally as important as low shrinkage in contributing to the suitability of a particular timber. Woods that absorb moisture readily may, on the other hand, be preferable for uses that require preservative treatment.

/1 This paper is condensed from a thesis by Thomas E. Batey, Jr. submitted to the Yale School of Forestry in partial fulfillment of the requirements for the degree of Master of Forestry (1949).

Moisture absorption is related to the weathering characteristics of wood when exposed to intermittent wetting and drying, and data on absorption may aid in the evaluation of a particular wood for exterior use. Moisture distribution patterns, derived from absorption studies, are an essential part of the data on absorption and may be of additional interest from the standpoint of their contribution to knowledge of the seasoning characteristics of the wood of different species.

The purpose of this work was to determine the rate of moisture absorption and the distribution pattern of the moisture absorbed in 25 tropical American woods when submerged in salt water. This study is a part of a general evaluation of these woods. For each species, half of the total number of specimens were coated to eliminate, or at least minimize, the effects of end penetration and thus to afford a better estimate of the relative absorption characteristics of lumber in service in which side-grain penetration predominates. The remaining uncoated specimens permit a comparison of the additional effect of uninhibited end penetration in short blocks of the same woods.

Test Procedure

Tests were conducted on material from 30 logs representing 25 different tropical American species. In addition, tests were made on native White Oak and Burma Teak for purposes of comparison. Test material was carefully selected clear, check-free, straight-grained heartwood (except for the inclusion of typical interlocked grain) and consisted of 2 by 2 by 6-inch specimens uniformly planed to size on the sides and sawed squarely to length. Before test, the material was conditioned to constant weight in a humidity cabinet at 12 percent equilibrium moisture content and temperatures of 120-140° F.

From this material, five samples of each species were selected. These were cut to length and weighed to the nearest 0.1 gram. Two of these specimens were end-coated with a double application of hot paraffin and reweighed to determine the weight of the coating. Immediately after weighing, the two end-coated specimens, together with two uncoated blocks, were immersed in a 4 percent aqueous sodium chloride solution and subjected to a pressure of 8 lb. per sq. in. in an autoclave at room temperature for a period of 48 hours. Specimens were so placed on wire mesh racks that their surface area was in unobstructed contact with the salt water. Similar wire mesh racks were weighted and placed on top of the specimens to keep them submerged.

When the four specimens had been placed under pressure in the autoclave, the cross-sectional dimensions of the remaining block were measured to the nearest 0.01 inch. Then this block was cut and weighed to determine its moisture distribution. The first step in this operation consisted of cutting the block into two equal 3-inch pieces and wrapping one of these in aluminum foil to prevent any gain or loss of moisture in that piece.

The remaining 3-inch piece, previously marked at 1/2-inch intervals, was cut into six cross-sectional wafers. Immediately after cutting each wafer, the block was wrapped in metal foil while the loose edges of the wafer were removed with a disk sander and the wafer weighed to the nearest 0.01 gram. The wafers were numbered consecutively from 1 to 6, starting with No. 1 at the outer end and progressing to No. 6 which corresponded to the center portion of the original 6-inch block, as shown in Fig. 1.

After cutting and weighing the cross-sectional wafers, the other 3-inch piece was cut lengthwise in such a way as to remove four successive shells, the first three of which were each 1/8-inch thick, and the fourth

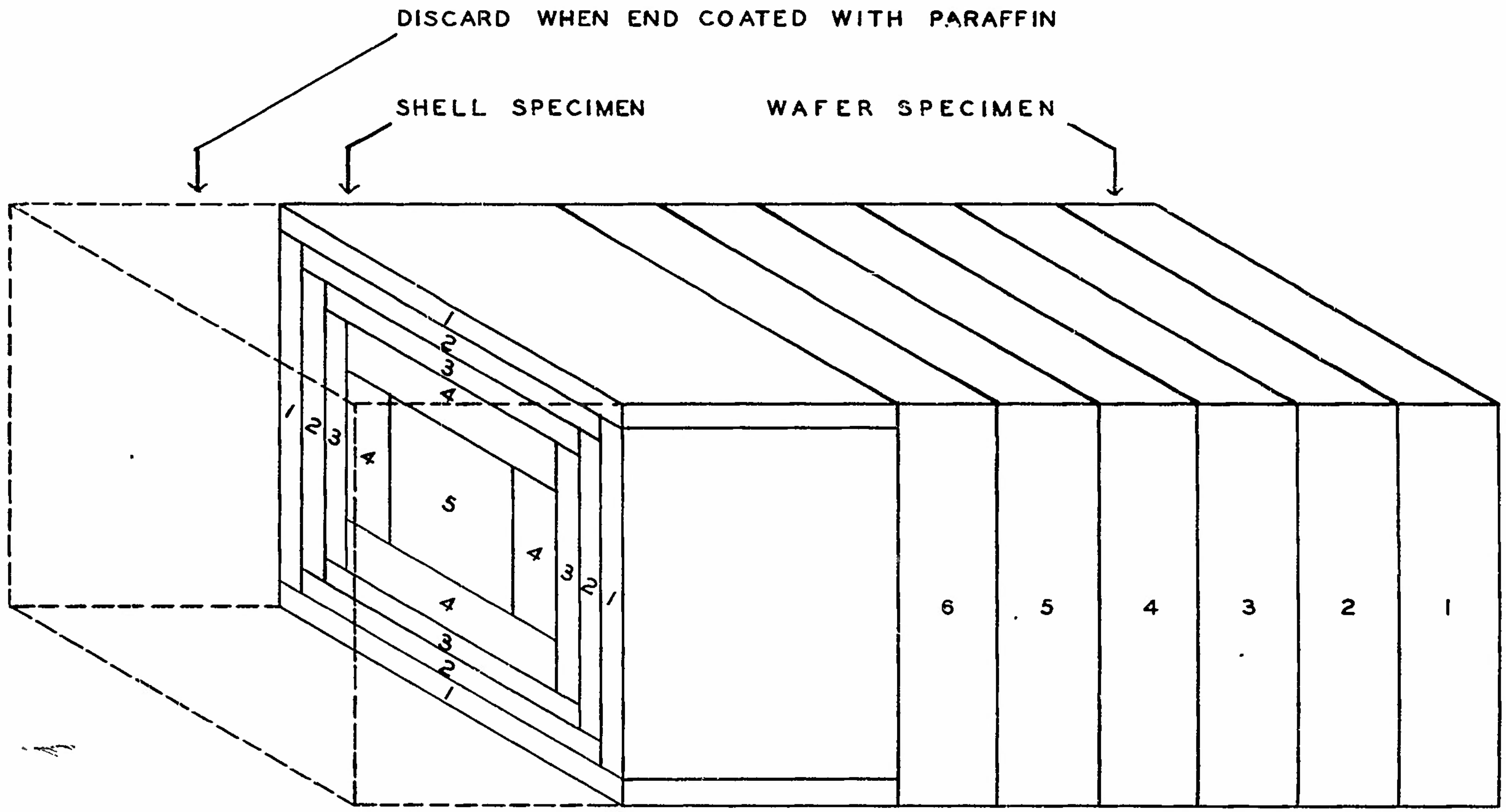


FIG. 1

METHOD OF CUTTING AND NUMBERING SECTIONS

1/4-inch thick, leaving a core approximately 1/2-inch square. Each shell consisted of one strip from each side of the block, or a total of four strips, and the core was a single piece. Immediately after one complete shell was cut, the remaining block was rewrapped in metal foil, and the strips were lightly sanded and weighed together. Shell and core specimens were numbered consecutively from 1 to 5 in the order of cutting and weighing. The general pattern of shell and core specimens is shown in Fig. 1, and differs in the case of the untreated block only in that these specimens were cut the full 3-inch length of the half block.

The wafers and shell and core specimens were next placed in a drying oven maintained at 212° F. until they had reached constant weight. The oven-dry weight of each was then obtained and moisture content based on oven-dry weight was calculated.

From these data the initial average moisture content of the whole block was obtained by weighted averages. Since all five specimens from a particular log had been subjected to the same conditioning treatment, it was assumed that the amount and distribution of moisture in the untreated block represented the initial condition of the four treated blocks.

At the end of the 48-hour soaking period, the four treated blocks were removed from the autoclave and weighed. The cross-sectional dimensions of each were measured, and the blocks wrapped separately in metal foil to prevent moisture loss. Each block was cut, sanded, and weighed as previously described for the untreated block and as shown in Fig. 1 with the following exceptions. Cross-sectional wafers only were cut from the uncoated blocks, the 3-inch piece corresponding to that cut into shells on the untreated block being discarded, since transverse distribution of moisture in these blocks with uninhibited end penetration has no significance. A thin layer was sliced from the wafer end of the coated blocks to remove the paraffin. As shown in Fig. 1, the exterior half of the 3-inch section of coated blocks to be cut into shells was discarded to eliminate or minimize the effects of end penetration of moisture through the paraffin. After drying to constant weight, in an oven at 212° F., oven-dry weights of the specimens were obtained and the moisture content of each wafer or shell and core specimen calculated as described previously for the untreated block.

Although the majority of the pieces weighed more than 10 grams, thus obtaining weights to an accuracy of 0.1 percent or better, the oven-dry weight of some of the smaller shells was less than 10 grams. Although the error resulting, was not as low as 0.1 percent, it did not exceed 1 percent.

Results

Results of the moisture absorption determinations are presented for the tropical American species tested as well as for White Oak and Teak in Table 1. In this table are shown the initial average moisture content of the control block and moisture content values for wafer and shell specimens of end-coated and uncoated blocks immediately following the 48-hour period of immersion. The value shown for each numbered shell or wafer represents the average for corresponding specimens of the two blocks tested.

The value shown in Table 1 for over-all absorption was calculated from the weights of complete uncoated blocks before and after treatment and represents the average increase in moisture content resulting from the treatment of each pair of uncoated blocks.

Side-grain absorption was computed from the average moisture content after treatment of the middle half of both end-coated blocks as determined from the data for all of the shells and for wafers 4, 5, and 6. From this figure, the initial moisture content was subtracted to obtain the increase in moisture content shown for side-grain absorption in Table 1.

Moisture distribution patterns for a number of representative species are presented as curves in Fig. 2. The transverse gradient after soaking is plotted from values shown in Table 1 for shells of end-coated specimens. The average initial moisture content of each pair of blocks is plotted as a reference. The curve showing longitudinal distribution for coated specimens (based on data in Table 1 for wafers of end-coated specimens) is presented to demonstrate the extent to which the effects of end penetration of moisture were eliminated in the zone 1-1/2 to 3 inches distant from the coated end. The effects of uninhibited longitudinal penetration are shown by the curve based on data of Table 1 for wafers of uncoated blocks.

Table 2 presents the results of over-all moisture absorption for each species tested. In this table the woods have been arranged and classified on the basis of the increase in moisture content over that initially present in the uncoated blocks. Five species were found to absorb considerably less moisture than Teak at 15.7 percent. White Oak appears in the last group with an increase in moisture content of 44.6 percent. Only five of the species tested show a greater absorption than White Oak on this basis of comparison.

A more significant classification of the woods tested is presented in Table 3 based on the increase in moisture content only in the middle half of end-coated specimens. In this classification, therefore, the woods are listed according to their rate of transverse absorption only with little or no effect of end penetration. Reference to the longitudinal moisture gradient as shown by moisture content data for cross-sectional wafers 4, 5, and 6 of end-coated specimens in Table 1 indicates how nearly complete was the elimination of end penetration effects.

In Table 3, Teak holds the same relative position as in Table 2 although the amount of moisture absorbed is much less than that indicated in the previous table. Similarly, the same five species again show lower increases in moisture content than does Teak. Many species occupy nearly the same relative position in both tables. White Oak, Vaco, and Masa, however, advanced considerably into classes of lower absorption.

Table 1. Moisture content of 2 by 2 by 6-inch specimens after immersion in 4 percent salt water at 8 pounds pressure for 48 hours.

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated specimens Wafers Moist. Cont. percent
Mylady (Aspidosperma cruentum)	British Honduras	0.82	9.8	1	37.0	1	46.6	1	48.9
				2	37.2	2	35.6	2	43.6
				3	37.6	3	30.7	3	38.2
				4	37.8	4	27.6	4	32.2
Average increase in moisture content (percent)				5	37.0	5	21.4	5	27.4
Over-all absorption 28.6				6	35.9			6	24.7
Side-grain absorption..... 25.2									
Goncalo Alves (Astronium graveolens)	Honduras	0.95	13.1	1	17.0	1	25.9	1	25.5
				2	18.4	2	16.4	2	20.0
				3	18.3	3	16.3	3	19.4
				4	18.4	4	16.3	4	19.1
Average increase in moisture content (percent)				5	18.8	5	16.8	5	18.7
Over-all absorption 5.6				6	18.7			6	18.5
Side-grain absorption 5.7									
Tatajuba (Bagassa guianensis)	Brazil	0.76	9.4	1	13.9	1	39.2	1	44.0
				2	17.0	2	14.9	2	32.8
				3	17.6	3	11.3	3	30.6
Average increase in moisture content (percent)				4	17.8	4	10.6	4	26.3
				5	17.9	5	10.3	5	24.1
Over-all absorption 20.5				6	17.9			6	22.7
Side-grain absorption 8.5									

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens Wafers No. /1	Moist. Cont. percent	Shells No. /1	Moist. Cont. percent	Uncoated specimens Wafers No. /1	Moist. Cont. percent
Castanha do Para (Bertholletia excelsa)	Brazil	0.66	10.8	1	16.7	1	28.1	1	37.8
				2	16.2	2	12.5	2	18.2
				3	15.9	3	11.6	3	16.5
Average increase in moisture content (percent)				4	15.8	4	11.8	4	15.9
Over-all absorption		9.9		5	15.8	5	12.3	5	15.5
Side-grain absorption		5.5		6	16.1			6	15.5
Cedro Espino/2 (Bombacopsis quinata)	Honduras	0.58	9.5	1	46.2	1	81.1	1	72.6
				2	46.9	2	53.4	2	60.8
				3	46.2	3	30.0	3	56.3
Average increase in moisture content (percent)				4	45.7	4	19.3	4	53.2
Over-all absorption		50.5		5	45.0	5	15.0	5	49.9
Side-grain absorption		33.9		6	43.6			6	43.0
Yellow-Sanders (Buchenavia capitata)	Puerto Rico	0.66	11.1	1	21.4	1	52.8	1	62.5
				2	21.5	2	21.9	2	37.8
				3	21.8	3	13.7	3	31.8
Average increase in moisture content (percent)				4	22.0	4	11.6	4	28.2
Over-all absorption		24.4		5	22.3	5	11.2	5	26.1
Side-grain absorption		12.0		6	22.6			6	24.9

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated specimens Wafers Moist. Cont. percent
Crabwood (Carapa guianensis)	Brazil	0.66	10.5	1	21.6	1	36.1	1	55.2
				2	19.9	2	18.3	2	37.1
				3	19.6	3	15.4	3	26.3
				4	19.4	4	14.0	4	26.8
Average increase in moisture content (percent)				5	19.1	5	13.1	5	25.6
				6	19.5			6	24.0
Over-all absorption 24.1									
Side-grain absorption 9.4									
Cedro Granadino (Cedrela Tonduzii)	Panama	0.46	10.1	1	51.5	1	55.4	1	67.8
				2	39.9	2	21.1	2	42.9
				3	36.2	3	15.8	3	33.8
				4	26.2	4	13.6	4	29.1
Average increase in moisture content (percent)				5	24.3	5	12.9	5	26.8
				6	23.2			6	25.4
Over-all absorption 30.5									
Side-grain absorption 14.7									
Laurel Blanco (Cordia alliodora)	Honduras	0.44	10.1	1	34.4	1	83.9	1	97.0
				2	35.9	2	27.7	2	35.6
				3	34.8	3	19.9	3	30.0
				4	33.7	4	16.4	4	27.7
				5	32.2	5	12.7	5	26.7
				6	33.9			6	26.8

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No./1	Wafers Moist.Cont. percent	No./1	Shells Moist.Cont. percent	Uncoated specimens No./1	Wafers Moist.Cont. percent
	British Honduras	0.53	9.4	1	30.0	1	53.3	1	56.2
				2	28.7	2	26.2	2	35.0
				3	28.1	3	21.0	3	30.5
				4	27.6	4	18.1	4	28.0
Average increase in moisture				5	27.8	5	12.1	5	27.1
content (percent)				6	28.1			6	26.5
		Honduras	Br.Honduras		Av.				
Over-all absorption		33.8	25.9		29.8				
Side-grain absorption		23.9	18.8		21.4				
Tauary (Couratari pulchra)	Brazil	0.60	8.9	1	37.2	1	88.5	1	104.8
				2	42.2	2	62.6	2	80.3
				3	44.5	3	40.2	3	78.1
				4	45.9	4	18.8	4	74.4
Average increase in moisture				5	46.9	5	13.5	5	72.6
content (percent)				6	48.3			6	71.2
Over-all absorption		77.0							
Side-grain absorption		38.5							
Angelique (Dicorynia paraensis)	Surinam	0.69	14.9	1	23.7	1	44.5	1	63.5
				2	25.0	2	24.8	2	48.2
				3	26.4	3	21.4	3	39.9
				4	27.2	4	19.7	4	33.7
Average increase in moisture				5	27.7	5	18.8	5	29.5
content (percent)				6	27.6			6	27.7
Over-all absorption		25.5							
Side-grain absorption		12.8							

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated Wafers Moist. Cont. percent	End-coated No. /1	End-coated Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated Wafers Moist. Cont. percent
Courbaril (Hymenaea courbaril)	Puerto Rico	0.84	10.0	1	25.4	1	51.6	1	54.2
				2	28.0	2	36.7	2	47.6
				3	30.2	3	24.0	3	37.9
				4	31.3	4	16.4	4	3[illegible].5
				5	31.6	5	12.9	5	29.1
				6	31.7			6	27.7
	Surinam	0.73	9.0	1	43.5	1	51.2	1	56.5
				2	40.1	2	35.3	2	43.7
				3	39.9	3	34.9	3	41.9
				4	40.6	4	37.3	4	40.8
				5	40.5	5	41.4	5	39.2
				6	40.4			6	38.5

Average increase in moisture content (percent)

	Puerto Rico	Surinam	Av.
Over-all absorption	29.5	36.0	32.8
Side-grain absorption	20.5	31.5	26.0

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated Wafers Moist. Cont. percent	End-coated No. /1	End-coated Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated Wafers Moist. Cont. percent
British Guiana ~~Cour~~ Courbaril (Hymenaea Davisii)	British Guiana	0.79	10.8	1	29.6	1	63.6	1	70.6
				2	32.4	2	37.5	2	53.5
				3	33.7	3	28.3	3	43.4
				4	34.9	4	22.8	4	41.8
				5	35.2	5	19.6	5	40.5
				6	35.3			6	39.3

Average increase in moisture content (percent)

Over-all absorption	40.8
Side-grain absorption	24.3

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated specimens Wafers Moist. Cont. percent
Angelim dos Amargosos (Hymenolobium excelsum)	Brazil	0.70	8.3	1	23.9	1	49.3	1	44.9
				2	26.8	2	32.4	2	41.3
				3	26.7	3	22.0	3	40.6
				4	27.1	4	13.0	4	40.7
				5	26.7	5	10.3	5	40.5
				6	27.0			6	40.3
Average increase in moisture content (percent)									
Over-all absorption 36.9									
Side-grain absorption 18.1									
Hububalli (Loxopterygium Sagotii)	Surinam	0.62	14.2	1	26.0	1	38.2	1	56.1
				2	24.0	2	18.9	2	35.1
				3	23.6	3	18.4	3	31.6
				4	23.6	4	18.4	4	29.8
				5	23.2	5	18.3	5	28.7
				6	22.8			6	28.2
Average increase in moisture content (percent)									
Over-all absorption 23.6									
Side-grain absorption 9.1									
Bulletwood (Manilkara bidentata)	Puerto Rico	0.98	12.8	1	16.3	1	23.8	1	23.1
				2	16.5	2	15.4	2	17.2
				3	16.5	3	14.1	3	16.4
				4	16.6	4	13.7	4	16.3
				5	16.6	5	13.4	5	16.2
				6	16.6			6	16.3

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated specimens Wafers Moist. Cont. percent
	British Guiana	1.04	11.0	1	12.7	1	21.7	1	21.4
				2	14.2	2	13.7	2	15.1
				3	14.5	3	12.5	3	14.8
				4	14.7	4	12.1	4	14.8
				5	14.7	5	12.1	5	14.9
				6	14.7			6	14.9

Average increase in moisture content (percent)	Puerto Rico	British Guiana	Av.
Over-all absorption	5.4	4.8	5.1
Side-grain absorption	3.8	3.7	3.8

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens: No. /1	End-coated specimens: Wafers Moist. Cont. percent	End-coated specimens: No. /1	End-coated specimens: Shells Moist. Cont. percent	Uncoated specimens: No. /1	Uncoated specimens: Wafers Moist. Cont. percent
Determa (Ocotea rubra)	Surinam	0.62	10.8	1	22.4	1	34.2	1	32.3
				2	16.6	2	12.1	2	16.4
				3	16.2	3	11.1	3	15.8
				4	16.1	4	10.9	4	15.4
Average increase in moisture content (percent)				5	15.9	5	11.7	5	15.4
				6	15.8			6	15.3
Over-all absorption 8.4									
Side-grain absorption 5.5									
White Oak (Quercus alba)	United States	0.71	10.2	1	19.0	1	54.3	1	67.1
				2	20.6	2	20.9	2	60.0
				3	21.4	3	11.0	3	54.6
				4	21.9	4	9.2	4	49.2
Average increase in moisture content (percent)				5	22.1	5	8.5	5	43.3
				6	22.1			6	39.2
Over-all absorption 44.6									
Side-grain absorption 11.9									
Mahogany (plantation-grown) (Swietenia macrophylla)	Honduras	0.46	9.7	1	34.2	1	53.4	1	81.2
				2	30.5	2	29.3	2	55.5
Average increase in moisture content (percent)				3	31.7	3	22.2	3	45.4
				4	32.5	4	17.1	4	39.0
				5	32.8	5	13.7	5	33.1
Over-all absorption 43.0				6	32.9			6	30.0
Side-grain absorption 22.9									

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated Wafers Moist. Cont. percent	End-coated No. /1	End-coated Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated Wafers Moist. Cont. percent
Primavera (Tabebuia Donnell-Smithii)	Honduras(1)	0.44	10.3	1	33.6	1	53.1	1	60.6
				2	28.2	2	18.4	2	35.1
				3	26.3	3	14.6	3	29.3
				4	25.4	4	13.5	4	27.4
				5	25.6	5	12.8	5	26.3
				6	24.6			6	25.5
	Honduras(2)	0.44	10.4	1	61.8	1	59.6	1	77.3
				2	41.8	2	22.4	2	39.1
				3	31.6	3	19.2	3	32.4
				4	28.2	4	16.7	4	28.9
				5	26.8	5	15.2	5	26.6
				6	27.0			6	25.9
Guayacan (Tabebuia guayacan)	Honduras	1.00	11.3	1	12.7	1	26.2	1	24.3
				2	14.3	2	18.7	2	18.0
				3	15.7	3	16.3	3	16.1
				4	15.8	4	14.0	4	15.0
				5	17.7	5	12.8	5	15.7
				6	18.3			6	14.5

Primavera — Average increase in moisture content (percent)

	Honduras(1)	Honduras(2)	Av.
Over-all absorption	25.4	31.7	28.6
Side-grain absorption	14.5	17.8	16.2

Guayacan — Average increase in moisture content (percent)

Over-all absorption	5.9
Side-grain absorption	6.5

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens Wafers No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens Shells No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens Wafers No. /1	Uncoated specimens Wafers Moist. Cont. percent
Roble Blanco (Tabebuia pentaphylla)	Honduras	0.56	10.2	1	69.2	1	80.7	1	79.6
				2	64.1	2	58.8	2	68.2
				3	61.3	3	52.9	3	63.5
				4	59.2	4	48.7	4	60.5
				5	58.5	5	50.9	5	58.2
				6	58.6			6	57.8
	British Honduras	0.59	9.6	1	50.7	1	81.9	1	90.0
				2	51.7	2	52.0	2	74.3
				3	51.9	3	35.9	3	67.0
				4	51.9	4	25.4	4	60.4
				5	51.7	5	26.7	5	53.7
				6	50.7			6	48.2

Average increase in moisture content (percent)	Honduras	Br. Honduras	Av.
Over-all absorption	61.9	59.5	60.7
Side-grain absorption	49.2	40.9	45.0

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens Wafers No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens Shells No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens Wafers No. /1	Uncoated specimens Wafers Moist. Cont. percent
Vaco (Magnolia sororum)	Panama	0.56	9.2	1	31.2	1	64.4	1	92.2
				2	26.0	2	18.1	2	54.7
				3	24.7	3	13.0	3	45.4
				4	24.4	4	11.3	4	42.4
				5	23.9	5	10.6	5	40.4
				6	23.8			6	39.1

Average increase in moisture content (percent)	
Over-all absorption	46.9
Side-grain absorption	16.0

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated specimens Wafers Moist. Cont. percent
Teak (Tectona grandis)	Burma	0.64	10.1	1	15.4	1	37.9	1	48.4
				2	15.7	2	12.2	2	23.7
				3	16.1	3	11.1	3	20.3
Average increase in moisture content (percent)				4	16.5	4	10.9	4	18.8
Over-all absorption 15.7				5	16.9	5	10.9	5	17.9
Side-grain absorption 7.4				6	16.7			6	17.5
Nargusta (Terminalia amazonia)	British Honduras	0.76	10.3	1	24.7	1	57.9	1	66.7
				2	25.6	2	23.7	2	52.9
				3	25.8	3	14.3	3	45.1
Average increase in moisture content (percent)				4	26.4	4	12.0	4	38.4
Over-all absorption 35.1				5	26.5	5	11.5	5	33.7
Side-grain absorption 16.1				6	26.6			6	31.1
Masa (Tetragastris balsamifera)	Puerto Rico	0.80	9.0	1	19.9	1	52.6	1	55.7
				2	22.6	2	28.3	2	47.7
				3	24.4	3	15.7	3	44.8
Average increase in moisture content (percent)				4	25.7	4	11.6	4	42.8
Over-all absorption 38.6				5	26.4	5	9.6	5	41.2
Side-grain absorption 16.6				6	26.3			6	40.4

Species	Source	Specific gravity oven-dry vol.	Initial moisture content percent	End-coated specimens No. /1	End-coated specimens Wafers Moist. Cont. percent	End-coated specimens No. /1	End-coated specimens Shells Moist. Cont. percent	Uncoated specimens No. /1	Uncoated specimens Wafers Moist. Cont. percent
Fiddlewood (Vitex Gaumeri)	British Honduras	0.68	10.0	1	58.0	1	61.6	1	70.4
				2	55.4	2	49.1	2	62.4
				3	53.3	3	43.8	3	57.9
				4	51.6	4	42.5	4	53.6
				5	50.1	5	44.7	5	49.6
				6	49.2			6	47.1

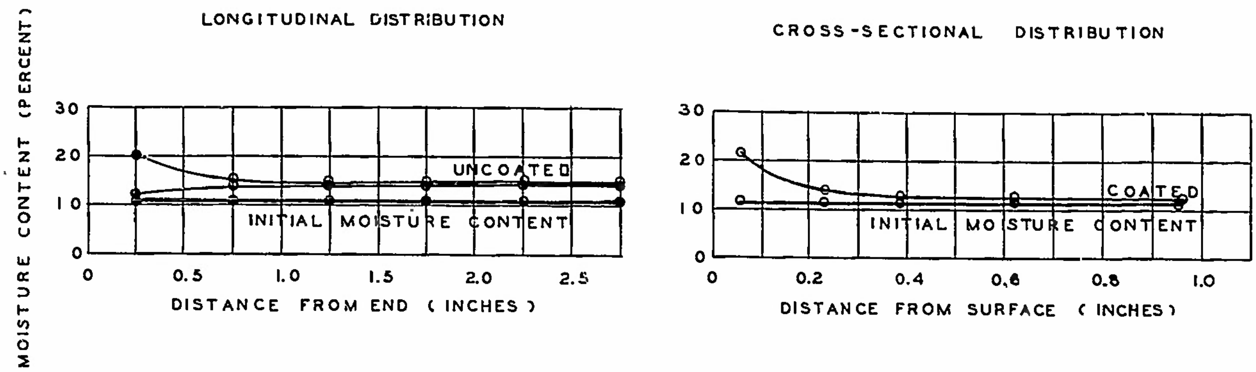
Average increase in moisture content (percent)

Over-all absorption 49.0

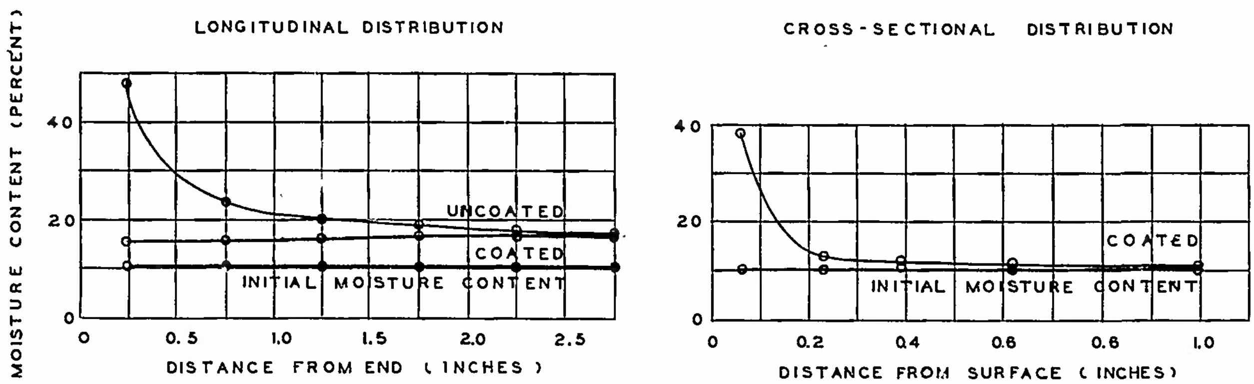
Side-grain absorption 40.0

/1 See Fig. 1 for diagram of test specimen showing designation of wafers and shells.

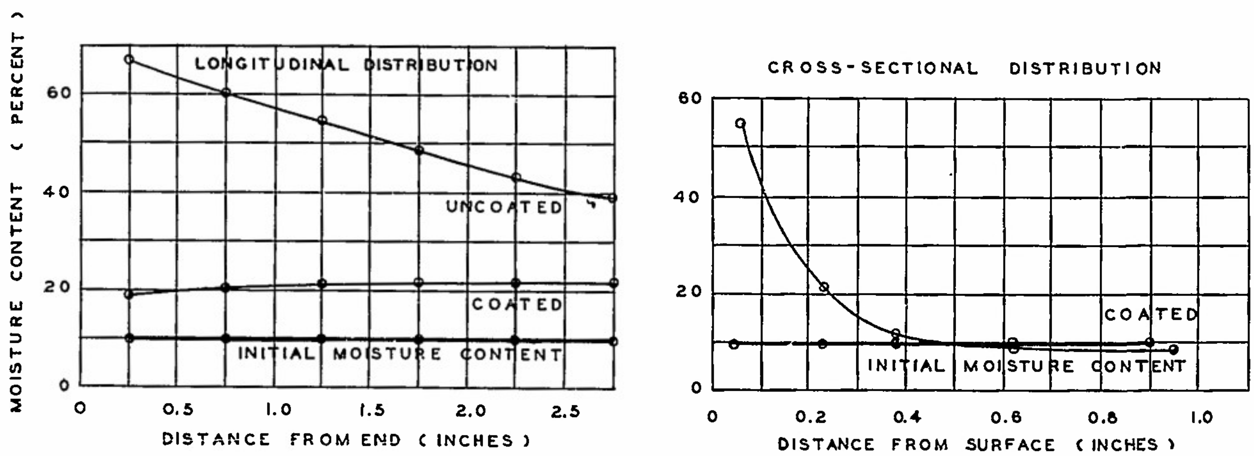
/2 Probably sapwood as the log contained very little heartwood.



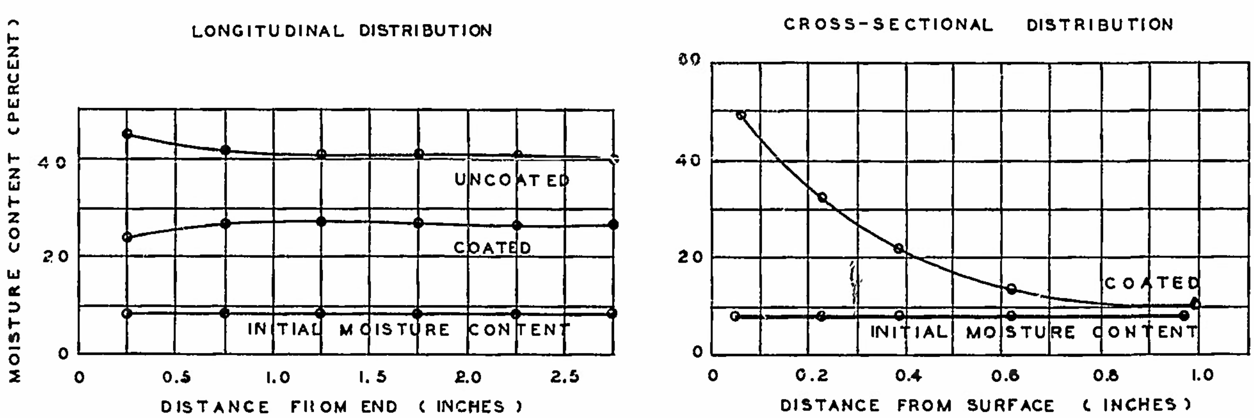
BULLETWOOD



TEAK

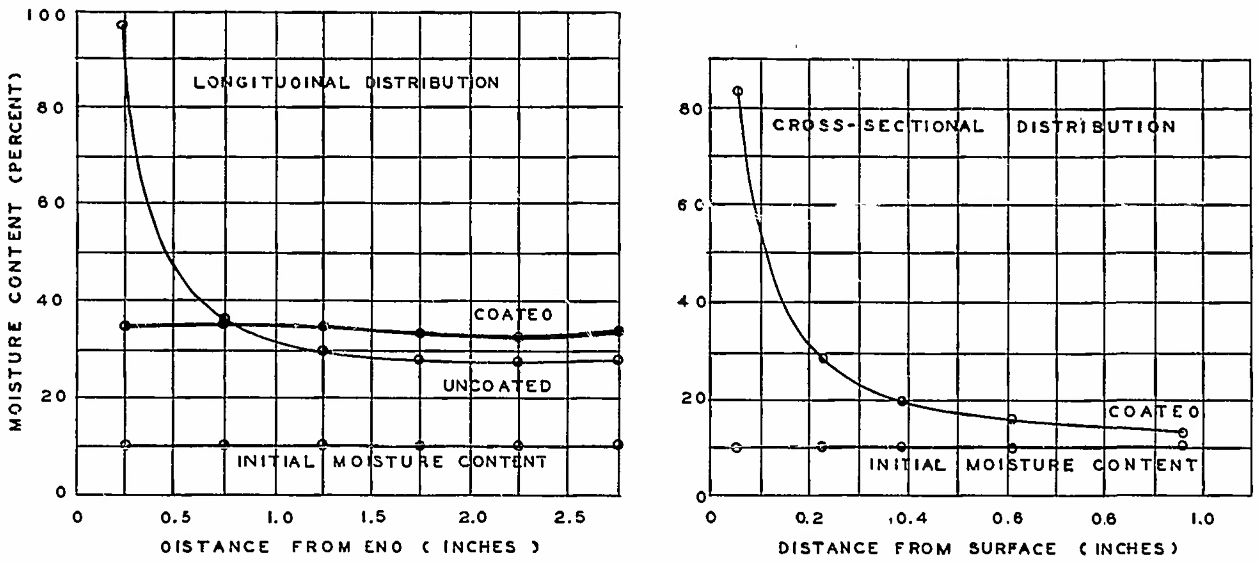


WHITE OAK

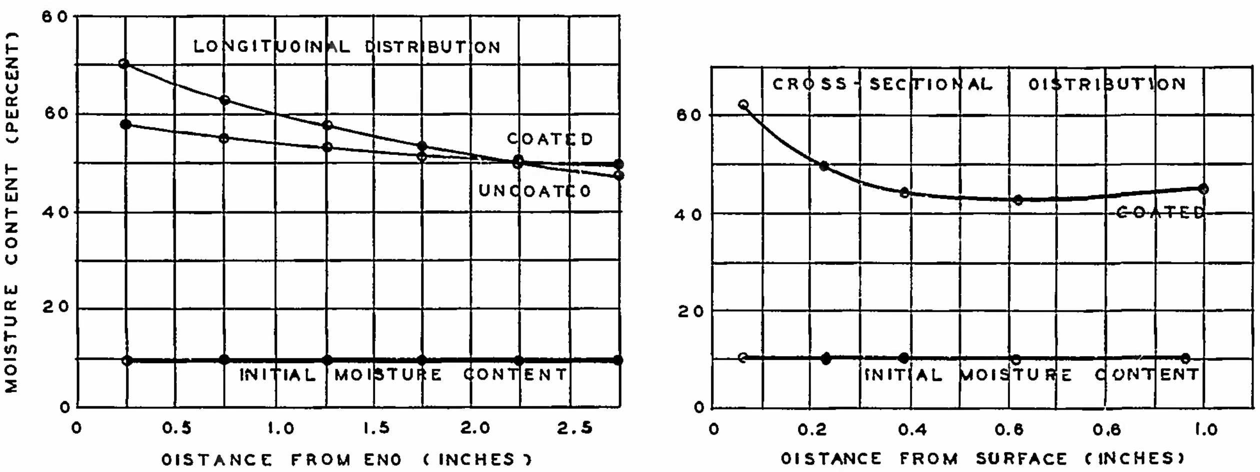


ANGELIM DOS AMARELOS

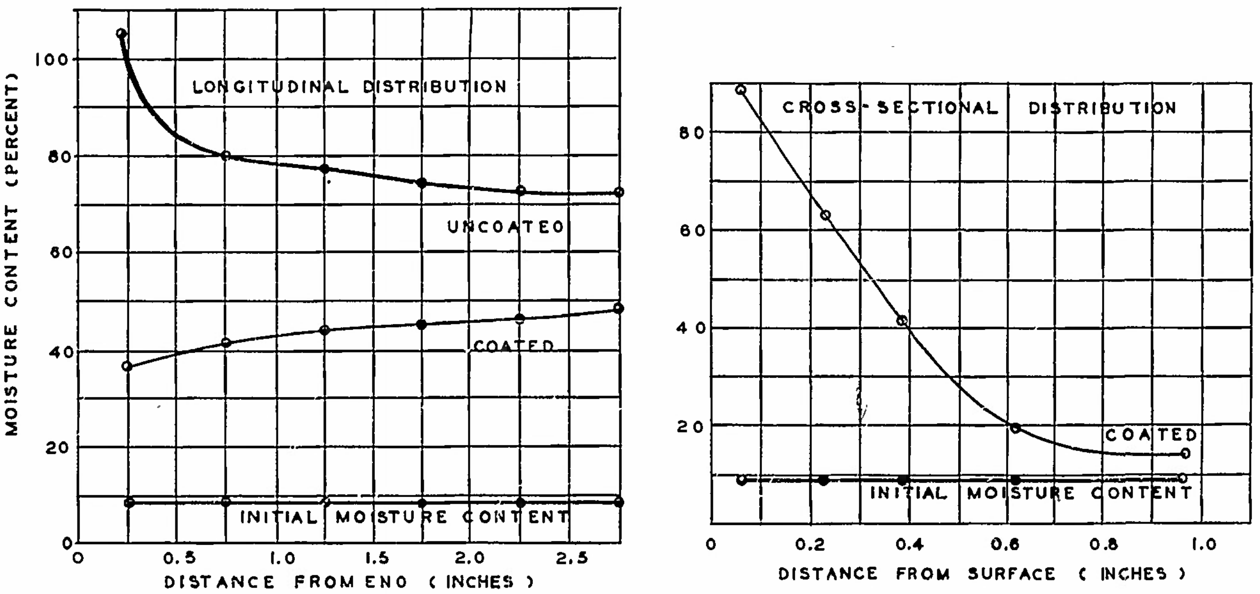
FIGURE 2
MOISTURE DISTRIBUTION CURVES FOR REPRESENTATIVE TROPICAL WOODS



LAUREL BLANCO

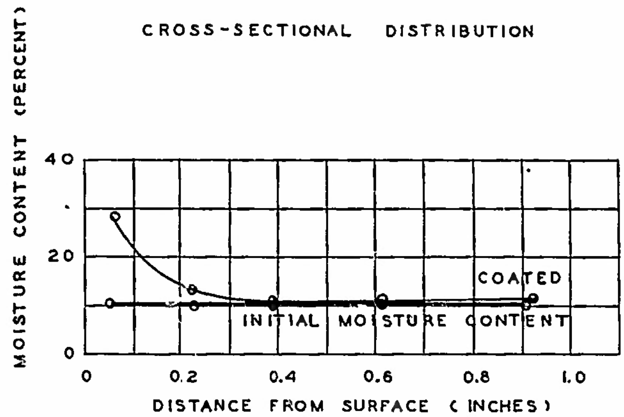


FIDDLEWOOD

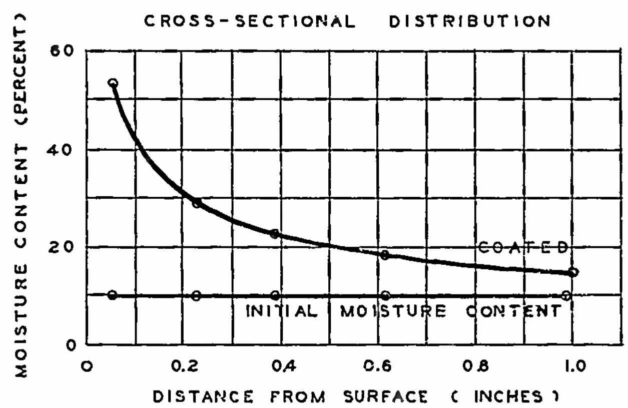


TAUARY

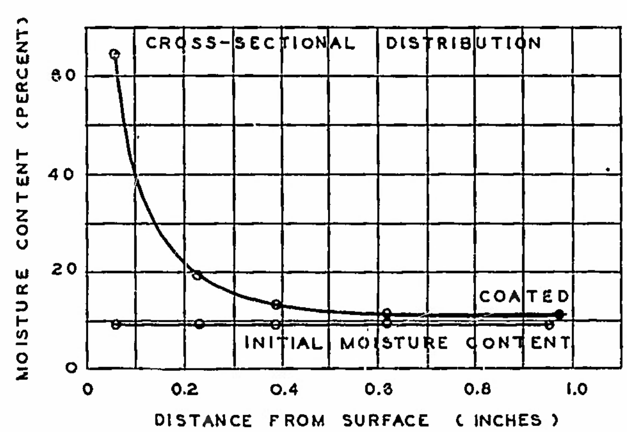
FIGURE 2 (CONTD.)



CASTANHA DO PARA



MAHOGANY (PLANTATION GROWN)



VACO

FIGURE 2 (CONTD.)

Table 2. Classification of Tropical American woods based on moisture absorption of heartwood./1

Species	Source	Increase in Moisture Content percent
Increase under 20 percent		
Bulletwood (*Manilkara bidentata*)	Puerto Rico, Br. Guiana	5.1
Gonçalo Alves (*Astronium graveolens*)	Honduras	5.6
Guayacán (*Tabebuia guayacan*)	Honduras	5.9
Determa (*Ocotea rubra*)	Surinam	8.4
Castanha do Para (*Bertholletia excelsa*)	Brazil	9.9
Teak (*Tectona grandis*)	Burma (control)	15.7
Increase 20 - 30 percent		
Tatajuba (*Bagassa guianensis*)	Brazil	20.5
Hububalli (*Loxopterygium Sagotii*)	Surinam	23.6
Crabwood (*Carapa guianensis*)	Brazil	24.1
Yellow Sanders (*Buchenavia capitata*)	Puerto Rico	24.4
Angélique (*Dicorynia paraensis*)	Surinam	25.5
Mylady (*Aspidosperma cruentum*)	Br. Honduras	28.6
Primavera (*Tabebuia Donnell-Smithii*)	Honduras	28.6
Laurel Blanco (*Cordia alliodora*)	Br. Honduras, Honduras	29.8
Increase 30 - 40 percent		
Cedro Granadino (*Cedrela Tonduzii*)	Panama	30.5
Courbaril (*Hymenaea courbaril*)	Puerto Rico, Surinam	32.8
Nargusta (*Terminalia amazonia*)	Br. Honduras	35.1
Angelim dos Amarelos (*Hymenolobium excelsum*)	Brazil	36.9
Masa (*Tetragastris balsamifera*)	Puerto Rico	38.6
Increase over 40 percent		
British Guiana Courbaril (*Hymenaea Davisii*)	Br. Guiana	40.8
Mahogany (plantation-grown) (*Swietenia macrophylla*)	Honduras	43.0
White Oak (*Quercus alba*)	United States (control)	44.6

/1 Total absorption by 2 x 2 x 6-inch uncoated specimens.

/2 Probably sapwood

Table 2 (Continued)

Species	Source	Increase in Moisture Content percent
	Increase over 40 percent	
Vaco (*Magnolia sororum*)	Panama	46.9
Fiddlewood (*Vitex Gaumeri*)	Br. Honduras	49.0
Cedro Espino (*Bombacopsis quinata*)/2	Honduras	50.5
Roble Blanco (*Tabebuia pentaphylla*)	Honduras, Br. Honduras	60.7
Tauary (*Couratari* sp.)	Brazil	77.0

Table 3. Classification of Tropical American woods based on moisture absorption of heartwood through side-grain penetration/1

Species	Source	Increase in Moisture Content percent
Increase under 10 percent		
Bulletwood (*Manilkara bidentata*)	Puerto Rico, Br. Guiana	3.8
Determa (*Ocotea rubra*)	Surinam	5.5
Castanha do Para (*Bertholletia excelsa*)	Brazil	5.5
Goncalo Alves (*Astronium graveolens*)	Honduras	5.7
Guayacán (*Tabebuia guayacan*)	Honduras	6.5
Teak (*Tectona grandis*)	Burma (control)	7.4
Tatajuba (*Bagassa guianensis*)	Brazil	8.5
Hububalli (*Loxopterygium Sagotii*)	Surinam	9.1
Crabwood (*Carapa guianensis*)	Brazil	9.4
Increase 10 - 20 percent		
White Oak (*Quercus alba*)	United States (control)	11.9
Yellow Sanders (*Buchenavia capitata*)	Puerto Rico	12.0
Angélique (*Dicorynia paraensis*)	Surinam	12.8
Cedro Granadino (*Cedrela Tonduzii*)	Panama	14.7
Vaco (*Magnolia sororum*)	Panama	16.0
Nargusta (*Terminalia amazonia*)	Br. Honduras	16.1
Primavera (*Tabebuia Donnell-Smithii*)	Honduras	16.2
Masa (*Tetragastris balsamifera*)	Puerto Rico	16.6
Angelim dos Amarelos (*Hymenolobium excelsum*)	Brazil	18.1
Increase 20 - 30 percent		
Laurel Blanco (*Cordia alliodora*)	Honduras, Br. Honduras	21.4
Mahogany (plantation-grown) (*Swietenia macrophylla*)	Honduras	22.9
British Guiana Courbaril (*Hymenaea Davisii*)	Br. Guiana	24.3
Mylady (*Aspidosperma cruentum*)	Br. Honduras	25.2
Courbaril (*Hymenaea courbaril*)	Puerto Rico, Surinam	26.0
Increase 30 - 40 percent		
Cedro Espino (*Bombacopsis quinata*)/2	Honduras	33.9
Tauary (*Couratari* sp.)	Brazil	38.5

/1 Effects of absorption through end grain are eliminated in the experimental design to show side grain absorption only.

/2 Probably sapwood

Table 3 (Continued)

Species	Source	Increase in Moisture Content percent
Increase over 40 percent		
Fiddlewood (*Vitex Gaumeri*)	Br. Honduras	40.0
Roble Blanco (*Tabebuia pentaphylla*)	Br. Honduras, Honduras	45.0