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Yale University

School of Forestry

PROPERTIES OF TROPICAL WOODS

Report No. 28

Progress on the Investigation of the Properties of Tropical Woods for the Period July 1 to August 31, 1952

Project N6-ori-44, Task Order XV

Office of Naval Research

United States Navy

September 2, 1952

New Haven, Connecticut

PROPERTIES AND USES OF TROPICAL WOODS: REPORT NO. 28

Progress on the Investigation of the Properties of Tropical Woods for the Period July 1 to August 31, 1952

This report is one of a series of bi-monthly status reports covering progress on the investigation of properties of tropical woods that is being conducted at Yale University, School of Forestry, in cooperation with the Office of Naval Research, United States Navy, under Contract N6-ori-44, Task Order XV (Project designation number NR-330-001).

Work since June 15 has been accelerated under the customary summer schedule. The staff has been expanded to 9 men employed on a full-time basis including one member of the faculty. Schedule will continue until September 15. Since the last report, a considerable amount of time was diverted from this project to complete the cutting up, packaging, and shipping to cooperating laboratories of material from logs of Yellow Sanders, a species currently under development testing as a part of Project NR-335-001.

I. Mechanical Properties

During the period covered by this report, testing of material in the green condition has been completed for all logs available in water storage. This represents testing during the past two months of material from 28 logs representing 13 species. The status of testing of unseasoned material stands currently at 268 logs representing 93 species.

Computations for material tested in the green condition have since the last report been completed on 19 logs. This brings the status of completed computations for unseasoned material to 244 logs representing 84 species.

During this period toughness tests have been completed for air-dry material representing 28 logs and green material representing 6 logs. Subsequent computations bring available toughness results abreast of progress in the general mechanical testing of unseasoned material.

Table 1 presents all results currently available for green testing which were not published in Tropical Woods No. 98. The status of air-dry testing and computing remains at 195 logs representing 59 species.

II. Physical Properties

Shrinkage. Studies of shrinkage for 33 logs from Surinam and Brazil are being completed. It is anticipated that all available unpublished results will be presented in the next progress report.

Decay Resistance. All available results of decay resistance tests have been previously published in either Tropical Woods No. 98 or Progress Reports Nos. 21 and 27. No material has since been removed from exposure. Material representing 20 logs is presently under exposure.

In the retest program using the soil technique, testing has been completed on all series for the species included in the pilot test. The species Buchenavia capitata and Dicorynia paraensis are to be the next species exposed in this program.

III. Seasoning Properties

Observations of the seasoning properties of 48 logs piled for drying one year ago have been completed. Results are being tabulated for presentation in a subsequent progress report.

TABLE 1. MECHANICAL PROPERTIES OF TROPICAL WOODS IN THE GREEN CONDITION[1]

Species and Source	Log Nos.	Moisture Content	Specific Gravity		STATIC BENDING				
					Fiber Stress at Proportional Limit	Modulus of Rupture	Modulus of Elasticity	Work to Proportional Limit	Work to Maximum Load
		percent	Oven-dry vol.	Green vol.	lb.per sq.in.	lb.per sq.in.	1000 lb. per sq. in.	in.-lb. per cu.in.	in-lb. per cu.in.
Licaria cayennensis Surinam	243	25.6	1.19	1.03	22,320	24,970	4,260	5.72	13.8
Hymenaea parvifolia Brazil	128	33.3	1.15	1.03	15,390	22,960	3,340	4.37	20.0
Platymiscium Duckei Brazil	157	31.1	1.08	0.94	16,680	22,320	3,020	5.13	—
Tabebuia serratifolia Brazil	396	66.6	1.07	0.94	13,080	21,690	2,530	4.82	33.3
Manilkara Huberi Brazil	133	42.0	1.11	0.93	13,280	21,160	3,200	3.00	12.4
Ecclinusa sp. Brazil	142	42.5	1.06	0.91	13,770	17,420	3,130	3.46	12.7
Eschweilera subglandulosa Surinam	73	42.1	0.99	0.83	8,360	15,870	2,760	1.43	19.4
Tabebuia sp. Brazil	134	51.9	0.94	0.83	13,340	21,290	2,540	3.94	17.0

Table 1 (cont'd.)

Species and Source	Log Nos.	Moisture Content percent	Specific Gravity		STATIC BENDING				
			Oven-dry vol.	Green vol.	Fiber Stress at Proportional Limit lb. per sq. in.	Modulus of Rupture lb.per sq.in.	Modulus of Elasticity 1000 lb. per sq. in.	Work to Proportional Limit in.-lb. per cu. in.	Work to Maximum Load in.-lb. per cu.in.
Eschweilera odora Brazil	393,394, 395	52.7	0.96	0.81	8,940	14,380	2,420	2.04	9.8
Licania macrophylla Surinam	494	54.8	0.91	0.76	8,800	12,000	2,000	2.10	8.5
Vouacapoua americana Surinam	250,499	46.8	0.87	0.76	12,820	15,380	2,470	3.84	14.7
Licania macrophylla Brazil	390,391, 392	47.3	0.90	0.75	10,090	15,500	2,490	2.34	11.2
Mezilaurus itauba Brazil	127	51.1	0.84	0.75	8,310	13,150	1,870	2.06	9.2
Minquartia guianensis Costa Rica	183	65.4	0.88	0.75	8,560	12,660	2,080	1.96	6.5
Hymenaea oblongifolia Brazil	158	48.9	0.84	0.74	8,720	14,620	2,170	1.81	12.9
Aspidosperma desmanthum Brazil	160	58.2	0.84	0.72	9,790	14,410	2,570	2.23	7.7

Table 1. (cont'd.)

Species and Source	Log Nos.	Moisture Content	Specific Gravity		STATIC BENDING				
					Fiber Stress at Proportional Limit	Modulus of Rupture	Modulus of Elasticity	Work to Proportional Limit	Work to Maximum Load
		percent	Oven-dry vol.	Green vol.	lb. per sq. in.	lb. per sq. in.	1000 lb. per sq. in.	in.-lb. per cu. in.	in.-lb. per cu. in.
Glycydendron amazonicum Brazil	148	38.4	0.83	0.72	8,020	13,940	2,300	1.68	11.8
Parinarium Rodolphi Brazil	397,398, 399	60.3	0.83	0.71	9,060	14,760	2,660	1.77	11.7
Astronium Lecointei Brazil	152	41.1	0.79	0.69	8,890	13,140	2,290	1.93	7.5
Ormosia paraensis Brazil	125	74.1	0.77	0.68	9,710	13,510	2,060	2.75	10.4
Goupia glabra Surinam	495,496	63.8	0.78	0.67	7,560	10,510	1,800	1.80	6.9
Aspidosperma Duckei Brazil	140	74.6	0.74	0.66	9,170	14,470	2,100	2.28	10.0
Copaifera reticulata Brazil	146	51.9	0.75	0.64	9,180	12,980	2,270	2.07	9.9
Hymenolobium excelsum Brazil	121,388, 389	70.0	0.72	0.63	9,800	14,610	1,950	2.96	12.8

Table 1 (cont'd.)

Species and Source	Log Nos.	Moisture Content	Specific Gravity		STATIC BENDING				
					Fiber Stress at Proportional Limit	Modulus of Rupture	Modulus of Elasticity	Work to Proportional Limit	Work to Maximum Load
		percent	Oven-dry vol.	Green vol.	lb. per sq. in.	lb. per sq. in.	1000 lb. per sq. in.	in.-lb. per cu. in.	in.-lb. per cu. in.
Couratari pulchra Brazil	122, 379	60.1	0.62	0.56	6,340	10,240	1,970	1.11	8.5
Cordia Goeldiana Brazil	382, 383	47.6	0.61	0.53	7,660	11,010	1,840	1.60	11.7
Vitex orinocensis Venezuela	338	115.4	0.58	0.53	5,270	8,400	1,310	1.22	6.0
Cordia trichotoma Brazil	403	37.5	0.56	0.50	6,180	9,600	1,420	1.54	12.7
Sapium biglandulosum Venezuela	V106, V112, V147	81.6	0.51	0.45	4,800	7,700	1,480	0.88	5.5
Swietenia macrophylla Brazil	380, 401	56.8	0.49	0.45	6,070	8,960	1,280	1.70	9.0
Couratari pulchra Br. Guiana	214	77.7	0.49	0.44	4,520	8,230	1,480	0.78	8.0
Spondias mombin Venezuela	V108, V117, V121	131.4	0.44	0.40	3,460	6,400	1,160	0.60	3.8

Table 1. (cont'd.)

Species and Source	COMPRESSION PARALLEL TO GRAIN: Fiber Stress at Proportional Limit lb. per sq. in.	Maximum Crushing Strength lb. per sq. in.	Modulus of Elasticity 1000 lb. per sq. in.	Hardness End lb.	Hardness Side lb.	Compression Perpendicular to Grain: Stress at proportional limit lb.per sq. in.	Tension Perpendicular to Grain lb. per sq. in.	Shear lb.per sq. in.	Cleavage lb.per in. of width	Toughness in.-lb. per specimen
Licaria cayennensis Surinam	14,680	16,620	4,900	2520	2340	4290	1280	1380	460	350.2
Hymenaea parvifolia Brazil	8,330	11,590	3,260	1780 1/2	3580	4620	1930	2740	670	234.0
Platymiscium Duckei Brazil	7,760	10,540	3,480	2040 1/2	3320	2940	490	1840	350	—
Tabebuia serratifolia Brazil	7,430	9,420	2,580	2750	3350	2500	1480	2340	690	—
Manilkara Huberi Brazil	8,920	10,570	3,480	2680	2800	2850	1430	2220	600	271.1
Ecclinusa sp. Brazil	8,640	9,270	3,260	1880	2030	2830	1120	1720	400	210.3
Eschweilera subglandulosa Surinam	3,930	5,980	2,560	1950	2180	1380	960	1610	390	311.2
Tabebuia sp. Brazil	9,140	10,730	2,730	2410	2520	1780	1130	1970	500	316.4

Table 1. (cont'd.)

Species and Source	COMPRESSION PARALLEL TO GRAIN: Fiber Stress at Proportional Limit lb. per sq. in.	Maximum Crushing Strength lb. per sq. in.	Modulus of Elasticity 1000 lb. per sq. in.	Hardness End lb.	Hardness Side lb.	Compression Perpendicular to Grain Stress at proportional limit lb. per sq. in.	Tension Perpendicular to Grain lb. per sq. in.	Shear lb. per sq. in.	Cleavage lb. per in. of width	Toughness in.-lb per specimen
Eschweilera odora Brazil	5,140	6,760	2,670	1610	1740	1770	870	1410	390	--
Licania macrophylla Surinam	4,990	6,050	2,020	1730	1760	940	830	1340	320	263.7
Vouacapoua americana Surinam	7,110	9,000	2,580	1540	1550	1870	940	1460	370	181.6
Licania macrophylla Brazil	6,180	7,060	2,640	1740	1740	970	820	1370	410	—
Mezilaurus itauba Brazil	4,970	6,700	2,100	1270	1610	1520	1200	1550	560	135.9
Minquartia guianensis Costa Rica	4,570	5,400	2,210	1270	1510	1020	700	1510	430	181.2 [3]
Hymenaea oblongifolia Brazil	3,510	6,360	2,170	1660	1960	1630	1130	2070	500	143.4
Aspidosperma desmanthum Brazil	6,730	7,460	3,020	1530	1450	1100	980	1620	470	172.6

1-7 Table 1 (cont'd.)

Species and Source	COMPRESSION PARALLEL TO GRAIN: Fiber Stress at Proportional Limit lb. per sq. in.	Maximum Crushing Strength lb.per sq.in.	Modulus of Elasticity 1000 lb. per sq. in.	Hardness: End lb.	Hardness: Side lb.	Compression Perpendicular to Grain: Stress at proportional limit lb.per sq.in.	Tension Perpendicular to Grain lb. per sq. in.	Shear lb.per sq.in.	Cleavage lb.per in. of width	Toughness in.-lb. per specimen
Glycydendron amazonicum Brazil	4,890	6,140	2,510	1540	1710	1140	1040	1660	470	164.9
Peltogynarium Subsp. Brazil	3,670	6,780	3,090	1580	1380	910	900	1340	440	—
Astronium Lecointei Brazil	5,190	6,870	2,720	1110	1410	1040	1000	1510	470	157.0
Ormosia paraensis Brazil	5,200	6,520	2,310	1220	1350	1250	750	1430	340	141.7[4]
Goupia glabra Surinam	4,270	5,460	2,260	1260	1240	960	920	1310	340	118.8
Aspidosperma Duckei Brazil	5,340	7,000	2,280	1500	1310	1070	860	1660	460	161.2
Copaifera reticulata Brazil	4,970	6,070	2,600	1300	1390	900	860	1300	460	204.5
Hymenolobium excelsum Brazil	6,130	7,460	2,180	1640	1720	1360	860	1600	410	209.5

Table 1 (cont'd.)

Species and Source	COMPRESSION PARALLEL TO GRAIN: Fiber Stress at Proportional Limit lb. per sq. in.	Maximum Crushing Strength lb. per sq. in.	Modulus of Elasticity 1000 lb. per sq. in.	Hardness End lb.	Hardness Side lb.	Compression Perpendicular to Grain: Stress at proportional limit lb. per sq. in.	Tension Perpendicular to Grain lb. per sq. in.	Shear lb. per sq. in.	Cleavage lb. per in. of width	Toughness in.-lb per specimen
Couratari pulchra Brazil	4,280	4,890	2,160	940	820	590	580	1100	370	152.0
Cordia Goeldiana Brazil	4,600	5,280	1,980	1070	1110	500	710	1150	310	223.0
Vitex orinocensis Venezuela	3,320	4,490	1,430	860	920	1220	720	1260	320	74.0
Cordia trichotoma Brazil	3,370	4,110	1,350	930	880	610	830	1050	340	—
Sapium biglandulosum Venezuela	2,470	3,200	1,610	650	520	560	500	890	270	96.8
Swietenia macrophylla Brazil	3,830	4,340	1,370	770	790	670	630	1140	320	86.6
Couratari pulchra Br. Guiana	2,600	3,750	1,760	720	590	540	690	1040	250	103.2
Spondias mombin Venezuela	2,000	2,560	1,090	580	530	490	600	770	260	72.5

Table 1. (cont'd.)

NOTES: /1 Species arranged in order of decreasing specific gravity (green volume basis). Data represent all available results for green testing not previously published in Tropical Woods No. 98, June 1952. In many cases results include corrections of data presented conditionally in earlier Progress Reports.

/2 Hardness value limited by recurrent splitting under test.

/3 Air-dry results only available at present.

/4 Green results only available at present.

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