COMPOSITE PLYWOOD WITH SOUTHERN PINE VENEER FACES AND ORIENTED STRAND CORE FROM SWEETGUM AND SOUTHERN PINE

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ABSTRACT

Certain mechanical properties and dimensional changes of ½ in. composite plywood, fabricated from ⅛ in. southern pine veneer faces and ¼ in. unidirectionally oriented strand cores were evaluated. Three types of cores were included: (a) 100% southern yellow pine, (b) 100% sweetgum, and (c) a mixture of 50% southern pine and 50% sweetgum. The cores were blended with a liquid phenol-formaldehyde resin (6½% solids) and bonded to veneer faces with an extended phenolic glue.

Experimental results indicate that the physical and mechanical properties of the composite panels were equal to and, in certain cases, superior to ½ in. southern pine CDX plywood and to commercial composite plywood from western species.

After comparing the experimental results of the composite panels with similar properties of commercial CDX southern pine plywood, the following conclusion can be drawn: Composite panels similar to those tested are expected to perform satisfactorily all structural functions required by sheathing panels for walls, roofs, and subfloors.

Keywords: Composite plywood, southern pine, sweetgum, veneer, strand, core.

INTRODUCTION

Approximately 40% of the softwood plywood produced in the United States is manufactured from southern yellow pine. Although the growth of southern yellow pine is able to satisfy present demands for pulp and paper, lumber, and plywood, the average diameter of harvested southern pine trees is decreasing (Am. Plywood 1981). When economic conditions improve and house construction reaches levels to satisfy needs, demand for plywood sheathing will surpass current production levels by 3 to 4 billion sq ft (⅜ in. basis) per year (Am. Plywood 1981). Part of this additional plywood for sheathing may be manufactured as composite plywood with southern pine veneer faces and sweetgum (*Liquidambar styraciflua*) or southern pine oriented board as core. Fabrication of composite plywood provides the opportunity for utilization of lower quality and smaller diameter logs as core material. In addition, composite plywood provides the opportunity for utilizing the large supply of southern hardwood for which there is little demand presently (Koch 1982). In a previous paper (Biblis and Mangalousis 1982) the author presented properties of experimental composite plywood with southern oaks strand core.

The growing stock (9 in. and above in diameter) of all hardwoods in the South (104.3 billion cu ft) represents 52% of the total southern forests (USDA 1978). Sweetgum represents 12% of all growing hardwood stock in the South (USDA 1978). Density, gluability, strength, and physical properties of sweetgum are com-

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TABLE 1. *Construction of experimental composite panel groups.*

Composite plywood group	Veneer grade		Core
	Face	Back	
1	C	C	100% southern pine
2	C	D	100% southern pine
3	C	C	100% sweetgum
4	C	D	100% sweetgum
5	C	C	50% southern pine 50% sweetgum
6	C	D	50% southern pine 50% sweetgum

parable to Loblolly pine (*Pinus taeda*) (USDA 1974). Sweetgum flakes easily into good quality, long flakes with smooth surfaces.

This study evaluates certain mechanical properties and dimensional changes of ½ in. composite plywood, fabricated from ⅛ in. thick southern pine veneer faces and ¼ in. unidirectionally oriented strand cores of sweetgum and southern pine.

MATERIALS AND METHODS

Core fabrication

Core panels ¼ in. thick were manufactured in a pilot plant at Lewiston, Idaho, using strand-type wood particles unidirectionally oriented along the 4-ft width. One group of core panels was made from 100% southern yellow pine, another group of panels was made from 100% sweetgum, and a third group was made from 50% southern pine and 50% sweetgum. Following are the production variables used for manufacture of these cores:

Raw material: debarked logs, 8 ft long, less than 9 in. diameter
Flaker: (PRZ-28 Hombak) drum-type machine
Particle size: approximately 0.025 in. thick, 2.75 in. long
Particle moisture (MC): 9% (out of blender) and 7% at the press
Resin: (Reichhold No. 22-743) phenol-formaldehyde, 6½% solids; emulsion form of wax 1% solids
Mat formation: oriented strands (along 50 in. width)
Hot pressed: at 410 F for 5½ min
Board thickness: 0.280 in.–0.300 in.
Board size: 53 in. by 102 in. trimmed to 50 in. by 100 in.
Desired board density: 48 lb/ft^3.

Composite fabrication

Experimental composite plywood panels ½ in. thick, 4 by 8 ft, were fabricated in a southern pine plywood mill. The same resin and process used by the mill to produce southern yellow pine CDX plywood were used to fabricate the experimental panels. Six panels from each of the six composite plywood groups listed in Table 1 were fabricated. Specifications of the fabrication process were:

Veneer faces and backs: southern yellow pine veneer (⅛ in.) C-grade for faces and C- or D-grade for backs.
Core thickness (sanded): 0.250 in.
Resin: extended phenolic, applied with resin curtain, 90 lb/1,000 sq ft of double glue line
Pre-pressed: 175 psi, 3½ min
Hot pressed: 200 psi, 325 F, 4½ min.

Core testing

Three sheets of each core type (one 100% southern pine, another 100% sweetgum, and the third 50% mixture each of southern pine and sweetgum) were used to obtain specimens for evaluation of the following properties at three MC conditions:

1) Flexure parallel and perpendicular to particle orientation. A total of 108 core specimens was tested in flexure to failure (six replications at each of three MC conditions for each of three core types and two particle orientations). MC conditions at test were the following: original (65% RH, 72 F), soaked (48 h), cycled (soaked and reconditioned at 65% RH, 72 F). Specimen dimensions were: 6 in. by 16 in. (12 in. span for parallel orientation) and 6 in. by 10 in. (6 in. span for perpendicular orientation). Specimens were tested to failure with central loading. Testing speeds were according to ASTM D-1037 (1974).
2) Internal bond (IB). Twenty-four specimens from each core type were tested. Twelve of these specimens were tested at the original condition and twelve tested after 48 h soaking and reconditioned to original condition, according to ASTM D-1037 (1974).
3) Dimensional changes with change in moisture. Six specimens, 6 in. by 6 in., from each core type were tested for dimensional changes in thickness, and linear expansion both parallel to and perpendicular to strand orientation. The same specimens were tested for water absorption. The dimensional change in thickness and percentage of water absorption correspond to changes in MC from the original to soaked and back to the original condition. Dimensional changes in length and width correspond to MC changes from original to soaked conditions.

Composite testing

Three panels of each of the six composite groups (Table 1) were used to obtain specimens to evaluate the following properties:

1) Flexure. Twelve specimens with the grain of face veneers parallel to the span and twelve specimens with the veneer face grain perpendicular to the span, from each of the six composite groups, were tested to destruction under each MC condition. A total of 432 specimens (twelve replications for each of six groups under three conditions with two veneer orientations) was tested. The three test conditions were the same as in the core test, namely: original (65% RH, 72 F), soaked (48 h), and cycled (soaked and reconditioned at 65% RH, 72 F). Specimen dimensions were 6 in. by 26 in. (24 in. span for specimens with the face veneer grain parallel to span) and 6 in. by 14 in. (12 in. span for

specimens with the face veneer grain perpendicular to span).[1] Matching of specimens in the three conditions was obtained by consecutively assigning each cut specimen to one of the three conditions in sequence and repeating. Specimens were tested to failure with central loading at speeds according to ASTM D-3043 (1974).

2) Edgewise shear strength (rail shear). Twelve specimens, 3.5 in. by 10 in., from each of the four composite groups were tested under each MC condition. A total of 216 specimens (twelve replications for each of six groups under three conditions) was tested according to ASTM D-1037 (1974).
3) Plate shear modulus. Six specimens, 16 in. by 16 in., from each of the six composite groups were tested under each MC condition. Testing was performed according to ASTM D-3044 (1974).
4) Interlaminar shear strength (similar to rolling shear in plywood). Six specimens, 6 in. by 18 in., from each of the three composite groups with C-C surface veneers were tested in the original condition according to ASTM D-2718 (1974). The long dimension of each specimen was parallel to the grain direction of the surface veneers.
5) Internal bond. Twelve specimens from each group with C-C surface veneers were tested in the original and cycled conditions according to ASTM D-1037 (1974).
6) Dimensional changes with changes in MC. Six specimens, 16 in. by 16 in., from each of the six composite groups were measured for dimensional change and water absorption. Changes in width (perpendicular to veneer) and in length (parallel to veneer) were measured from the original condition (65% RH, 72 F) to the 48-h soaked condition. Changes in thickness and the percent of water absorption were measured from the original condition to the soaked condition and again when the specimens reached equilibrium back at the original condition.

RESULTS AND DISCUSSION

Cores

Flexural properties of core specimens are presented in Table 2. In flexure parallel to strand orientation, the moduli of elasticity (MOE) and rupture (MOR) values of all three core types (pine, sweetgum and mixture) were higher than values reported (Snodgrass and Saunders 1974) for core sheets made from western softwood species. The moisture-cycled core specimens of all core types retained between 78 and 90% of their original MOE and MOR values.

Cycled specimens in flexure perpendicular to particle orientation retained between 59 and 75% of their stiffness and between 69 and 87% of their strength compared to the uncycled specimens. Flexural property ratios of parallel to perpendicular strand orientation are from 6.1 to 8.8 for MOE and from 3.2 to 4.6 for MOR for all three groups.

Values of internal bond (IB) strength of core specimens are shown in Table 3.

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[1] Specimen widths of 6 in. were used rather than 2 in. widths recommended by ASTM D-3043, because 6 in. widths include larger areas with defects, thus specimens are more representative of 4 × 8 ft panels.

Table 2. *Flexural properties of unidirectionally oriented strand core, ¼ in. thick.*

Species	Moisture conditions[a]	Density (pcf)	MC %	Flexure parallel[b] MOE (1,000) (psi)	Flexure parallel[b] FSPL (psi)	Flexure parallel[b] MOR (psi)	Flexural perpendicular[c] MOE (1,000) (psi)	Flexural perpendicular[c] FSPL (psi)	Flexural perpendicular[c] MOR (psi)	Ratios: parallel/perpendicular MOE	Ratios: parallel/perpendicular FSPL	Ratios: parallel/perpendicular MOR
Southern	Original	46.8	8.3	1,234	4,930	7,540	203	1,130	2,120	6.1	4.4	3.6
yellow pine,	Soaked		55.7	672	2,510	4,850	90	540	1,195	7.5	4.7	4.1
100%	Cycled		9.3	1,044	3,970	6,780	119	765	1,470	8.8	5.2	4.6
Sweetgum,	Original	44.9	8.8	1,091	4,460	6,980	174	935	1,820	6.3	4.8	3.8
100%	Soaked		78.2	587	1,260	3,370	78	420	950	7.5	3.0	3.5
	Cycled		10.1	933	2,200	6,200	108	627	1,450	8.7	3.5	4.3
Mixture,	Original	48.0	8.4	1,283	4,940	8,590	196	1,030	2,020	6.6	4.8	4.3
50% southern pine,	Soaked		54.4	668	1,480	4,000	85	535	1,240	7.9	2.8	3.2
50% sweetgum	Cycled		9.9	995	1,930	6,820	147	735	1,750	6.8	2.6	3.9

[a] Original = Conditioned to 65% RH, 72 F; Soaked = 48 h; Cycled = soaked and reconditioned to original.
[b] Specimens were 6 in. wide, tested over 12 in. span, with strands oriented along the span. FSPL = fiber stress at the proportional limit.
[c] Specimens were 6 in. wide, tested over 6 in. span, with strands oriented perpendicular to span.

TABLE 3. *Internal bond strength of unidirectionally oriented strand core, ¼ in. thick.*

Species	Density (pcf)	MC (%)	Moisture conditions	Internal bond strength Mean[a] (psi)	S
100% southern pine core	46.8	8.3	Original	151	43
		8.7	Cycled[b]	134	42
100% sweetgum core	44.9	8.8	Original	92	26
		9.4	Cycled	76	24
Mixture, core 50% southern pine, 50% sweetgum	48.0	8.4	Original	149	34
		9.1	Cycled	92	35

[a] Each value represents the mean of twelve specimens; S = standard deviation.
[b] Specimens were first water soaked for 48 h, then conditioned to equilibrium at 65% RH, 72 F and then tested.

TABLE 4. *Dimensional changes of ½ in. composite plywood with ⅛ in. southern pine veneer faces and ¼ in. unidirectionally oriented strand core.*

Face and core species	Density MC in original (pcf)	(%)	Swelling from 65% RH to 48 h soaked Length (%)	Width (%)	Thickness swelling from 65% RH Soaked (%)	Cycled[a] (%)	Water absorption from 65% RH Soaked (%)	Cycled (%)	MC soaked (%)
Faces: southern pine veneers C	41.0	9.4	0.07	0.21[b]	7.18	2.61	34.26	2.73	46.9
Core: OSB, 100% southern pine			0.04	0.04	0.44	0.40	4.36	0.26	4.7
Faces: southern pine veneers C-D	41.2	9.0	0.09	0.25	7.41	3.21	29.95	3.09	41.6
Core: OSB, 100% southern pine			0.06	0.02	0.61	0.44	2.18	0.18	2.6
Faces: southern pine veneers C	43.3	9.5	0.07	0.39	9.55	3.63	29.81	2.48	42.1
Core: OSB, 100% sweetgum			0.03	0.07	0.68	0.54	1.58	0.54	1.9
Faces: southern pine veneers C-D	43.4	9.0	0.13	0.26	10.97	4.60	40.83	3.99	53.5
Core: OSB, 100% sweetgum			0.07	0.05	0.81	0.99	3.36	0.27	3.7
Faces: southern pine veneers C	41.5	9.1	0.08	0.19	8.20	4.02	33.97	3.60	46.2
Core: 50% southern pine, 50% gum			0.05	0.07	2.78	2.08	6.12	0.30	7.3
Faces: southern pine veneers C-D	44.8	9.2	0.12	0.33	9.67	4.17	33.48	3.51	45.3
Core: 50% southern pine, 50% gum			0.02	0.06	0.49	0.43	3.30	0.19	3.5
OSB core: 100% southern pine	46.8	8.2	0.02	0.23	8.05	3.21	25.40	0.95	55.7
				0.06	0.84	0.97	1.65	0.08	2.9
OSB core: 100% sweetgum	44.9	8.8	0.01	0.39	13.23	6.37	63.83	1.27	78.2
				0.09	1.71	1.74	2.89	0.15	3.1
OSB, 50% southern pine, 50% gum	48.0	8.4	0.01	0.37	10.00	9.96	42.40	1.48	54.4
				0.05	0.95	1.45	4.72	0.11	5.1

[a] Specimens were first soaked for 48 h, then reconditioned to 65% RH, 72 F and measured.
[b] Each upper value represents the average of six specimens; lower values represent one standard deviation.

Internal bond strength of all core types in the original condition ranged from 92 to 151 psi. Moisture-cycled specimens retained between 62 and 89% of their original IB strength.

Dimensional changes of core specimens are presented in Table 4. Linear swelling parallel to the direction of strands and thickness swelling of both core types were approximately equal to those reported for western species (McKean et al. 1975; Snodgrass and Saunders 1974), although moisture change limits in this study were larger than moisture limits reported for the western species.

Composites

Flexural properties of composite plywood specimens are presented in Table 5. In flexure parallel to the grain of surface veneers, MOE and MOR in the original condition of all groups with C-D veneers were approximately equal to the reported values for commercial composite plywood (McKean et al. 1975) and for CDX southern pine plywood (Biblis and Lee 1982). As expected for the same type of core, specimens with C-C-grade veneer faces were stiffer and stronger than specimens with C-D-grade veneers. Significant is the fact that the moisture-cycled specimens of all groups retained between 87 and 95% of their original MOE and between 71 and 100% of their original MOR. These values were equal to or greater than those reported for southern pine plywood (Biblis and Lee 1982).

In flexure perpendicular to the face veneer grain, MOE and MOR in the original condition were significantly higher than those reported for a commercial composite plywood (McKean et al. 1975). Moisture-cycled specimens retained approximately 72% and 88% of their original MOE and MOR values, respectively. Property ratios of parallel to perpendicular face veneer grain direction in flexure were between 6.8 to 9.2 for MOE and 2.5 to 3.6 for MOR.

Shear properties of the composites are presented in Table 6. Plate shear modulus (modulus of rigidity, G) of composite specimens with C-D face veneers in the original condition (249,940 psi) was about three times greater than that of southern pine ½ in. CDX plywood in the same condition (Biblis and Lee 1982). Moisture-cycled composite specimens retained 69% of their original plate shear modulus value. Edgewise (rail) shear strength of composites in the original condition (1,195 psi) was approximately 24% greater than that of southern pine ½ in. CDX plywood (Biblis and Lee 1982). Moisture-cycled specimens retained 90% of their original strength value. In flatwise shear modulus and strength (a property similar to rolling shear of plywood), composite specimens with 100% sweetgum cores developed 79,927 psi in rolling shear modulus, which is approximately 54% higher than the value reported for southern pine ½ in. plywood (Biblis et al. 1982). The same composites developed 355 psi in rolling shear strength as compared to 310 psi for southern pine CDX plywood.

Dimensional changes are presented in Table 4. Linear swelling along the face veneer grain for all groups was between 0.07 and 0.21%, while swelling perpendicular to the face veneer grain was between 0.08 and 0.39% for an MC change from 65% RH to 48 h soaking. Corresponding dimensional changes of 4-ply ½ in. southern pine CDX plywood are 0.25% in parallel to the face veneer grain, and 0.27% in perpendicular to the face veneer grain (Biblis and Lee 1982). Thick-

TABLE 5. *Flexural properties of ½ in. composite plywood with southern y. pine veneer faces and ¼ in. unidirectionally oriented strand core.*

Face and core species	Tested	Specific gravity (o.d.b.)	MC (%)	Flexural parallel[a] MOE (psi)	Flexural parallel[a] FSPL (psi)	Flexural parallel[a] MOR (psi)	Flexure perpendicular[b] MOE (psi)	Flexure perpendicular[b] FSPL (psi)	Flexure perpendicular[b] MOR (psi)
Faces: C-grade	Original[c]	0.67	8.5	1,641,980[d]	6,850	9,710	230,070	960	2,730
southern pine veneer				260,310	1,086	1,800	39,455	250	640
Core: oriented board,	Soaked			1,117,160	2,760	5,400	129,220	780	1,720
100% southern pine				202,080	445	534	21,580	160	360
	Cycled[c]		12.5	1,499,820	6,000	8,400	183,610	840	2,150
				253,640	710	1,020	38,200	130	460
Faces: C-D-grade	Original	0.65	8.5	1,562,790	6,070	8,390	227,070	850	2,600
southern pine veneer				217,370	1,840	3,115	21,330	160	300
Core: Oriented board,	Soaked			1,078,060	2,740	4,540	128,990	740	1,640
100% southern pine				218,000	743	1,465	15,710	175	300
	Cycled		12.6	1,388,020	4,815	5,940	165,030	940	2,010
				298,050	1,780	2,125	20,800	130	340
Faces: C-grade	Original	0.68	8.8	1,967,620	8,110	9,990	213,250	1,000	2,830
southern pine veneer				215,710	1,180	1,950	25,050	200	320
Core: oriented board,	Soaked			1,404,500	3,050	5,480	138,000	810	1,730
100% sweetgum				174,560	430	580	14,860	90	180
	Cycled		12.4	1,805,220	7,010	8,440	148,790	820	1,900
				272,805	1,432	1,750	9,420	95	200

TABLE 5. *Continued.*

Face and core species	Tested	Specific gravity (o.d.b.)	MC (%)	Flexural parallel[a] MOE (psi)	Flexural parallel[a] FSPL (psi)	Flexural parallel[a] MOR (psi)	Flexure perpendicular[b] MOE (psi)	Flexure perpendicular[b] FSPL (psi)	Flexure perpendicular[b] MOR (psi)
Faces: C-D-grade	Original	0.68	8.4	1,787,360	5,630	7,170	228,380	1,090	2,750
southern pine veneer				272,140	1,980	2,950	39,170	270	570
Core: oriented board,	Soaked			1,095,890	2,270	3,920	142,740	760	1,560
100% sweetgum				164,530	820	1,080	49,455	190	340
	Cycled		12.9	1,701,390	4,630	7,140	149,780	765	1,880
				268,640	2,160	2,480	52,640	150	280
Faces: C-grade	Original	0.66	8.4	1,897,940	7,340	8,850	215,340	910	2,820
southern pine veneer				291,850	2,050	2,400	45,420	250	810
Core: oriented board,	Soaked			1,251,160	3,150	5,130	130,930	750	1,700
50% southern pine,				152,960	710	1,240	25,390	230	620
50% sweetgum	Cycled		12.8	1,646,280	6,160	7,700	160,330	910	2,120
				197,220	1,140	1,500	35,320	170	520
Faces: C-D-grade	Original	0.70	8.8	1,822,280	5,880	7,790	246,480	1,100	3,100
southern pine veneer				183,040	2,050	2,030	26,300	250	490
Core: oriented board,	Soaked			1,171,610	2,410	4,960	141,460	885	1,980
50% southern pine				191,340	660	1,340	14,770	170	325
50% sweetgum	Cycled		13.1	1,694,330	5,440	7,890	183,200	1,010	2,420
				272,710	1,830	2,420	11,150	170	240

[a] Specimens were 6 in. wide, tested over 24 in. span, with veneer grain oriented along the span.
[b] Specimens were 6 in. wide, tested over 12 in. span, with veneer grain oriented perpendicular to span.
[c] Original = conditioned to 65% RH, 72 F; Soaked = 48 h; Cycled = soaked and reconditioned to original.
[d] Each upper value represents the average of twelve specimens; lower values represent one standard deviation.

TABLE 6. *Shear properties of ½ in. composite plywood with southern pine veneer faces and ¼ in. unidirectionally oriented strand core.*

Face and core species	Tested	Density (pcf)	MC %	Rail shear strength (psi)	Flatwise modulus (psi)	Shear strength (psi)	Plate shear modulus (psi)
Faces: C-grade	Original[a]	41.0	9.4	1,190[b]	121,920[c]	365[c]	238,740[c]
southern pine veneer				143	30,880	28	17,890
Core: oriented board,	Soaked		46.9	715			143,895
100% southern pine				132			5,100
	Cycled		12.4	1,210			170,735
				153			6,250
Faces: C-D-grade	Original	41.2	9.0	1,105			261,470
southern pine veneer				110			25,060
Core: oriented board,	Soaked		41.6	670			144,095
100% southern pine				108			10,035
	Cycled		12.4	1,060			184,360
				127			16,460
Faces: C-grade	Original	43.3	9.5	1,165	79,927	325	224,950
southern pine veneer				125	15,640	28	41,145
Core: oriented board,	Soaked		42.1	660			150,075
100% sweetgum				54			9,995
	Cycled		12.2	990			154,090
				107			21,960
Faces: C-D-grade	Original	43.4	9.0	1,195			249,940
southern pine veneer				182			17,870
Core: oriented board,	Soaked		53.5	630			146,690
100% sweetgum				98			10,110
	Cycled		13.4	985			160,410
				117			13,010
Faces: C-grade	Original	41.5	9.1	1,190	43,320	340	213,035
southern pine veneer				318	11,524	130	39,565
Core: oriented board,	Soaked		46.2	630			140,550
50% southern pine,				140			19,410
50% sweetgum	Cycled		13.1	1,000			154,015
				325			23,030
Faces: C-D-grade	Original	44.8	9.2	1,350			255,415
southern pine veneer				140			33,280
Core: oriented board,	Soaked		45.3	700			149,348
50% southern pine,				157			10,000
50% sweetgum	Cycled		12.7	1,215			173,237
				180			15,540

[a] Original = conditioned to 65% RH, 72 F; Soaked = 48 h; Cycled = soaked and reconditioned to original.
[b] Each upper value represents the average of twelve specimens; lower values represent one standard deviation.
[c] Each upper value represents the average of six specimens; lower values represent one standard deviation.

ness swelling of composite from 65% RH to 48 h soaked was from 7.2 to 10.9%. When reconditioned to the original 65% RH, specimens retained an increase in thickness between 2.6 and 4.6%. Corresponding thickness swelling of southern pine ½ in. CDX plywood is 9.2% with a residual swelling of 4.7% (Biblis and Lee 1982). Water absorption of composites after 48 h soaking was between 29.8 and 40.8%. In comparison, water absorption after 48-h soaking of southern CDX plywood was reported between 40.0 and 43.5% (Biblis and Lee 1982).

SUMMARY

Experimental test results are presented for composite structural panels fabricated with southern yellow pine veneer faces and backs, and with unidirectionally oriented strand cores, made from (a) 100% southern yellow pine, (b) 100% sweetgum, and (c) a mixture of 50% southern pine and 50% sweetgum. The cores were blended with a liquid phenol-formaldehyde resin (6½% solids) and bonded to veneer faces with an extended phenolic glue.

Experimental results indicate that the physical and mechanical properties of the composite panels were equal to and, in certain cases, superior to ½ in. southern pine CDX plywood and to commercial composite plywood from western species.

After comparing the experimental results of the composite panels with similar properties of commercial CDX southern pine plywood, the following conclusion can be drawn: Composite panels similar to those tested are expected to perform satisfactorily all structural functions required by sheathing panels for walls, roofs, and subfloors.

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