DIMENSIONAL STABILITY AND DECAY RESISTANCE OF COMPOSITE FIBERBOARD MADE FROM PLANTATION-GROWN SOUTHERN YELLOW PINE

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[ABSTRACT] The objective of this study was to investigate the influence of the phenol-formaldehyde resin content level (3 percent and 7 percent), and three fungi species (Poria Placenta, Gleophyllum trabeum, and Polyporus versicolor) on the dimensional stability and decay resistance of high density composition boards made from plantation-grown southern pine chips. A standard ASTM method was used to evaluate weight loss and thickness change. The linear shrinkage and expansion of each species were also determined. All specimens were exposed to decay chambers for 16 weeks. Test results indicated that the main factors significantly influence the thickness and length changes and the decay resistance of the high density southern pine composition boards.

1. INTRODUCTION

When composition board becomes wet, it swells mostly in thickness and in length, and considerable bonding degradation occurs. Phenolic resin bonded boards are preferred in building construction for protection against water and high humidify. However, fungal attack in the phenolic bonded board was as severe as that in the urea bonded board [2 and 4].

Weight loss during the mycological testing of particleboard and fiberboards was reported as a good measure of decay resistance [3]. However, in the United States, little information concerning the dimensional stability of wood-base composites such as dry-process hardboard made from plantation-grown southern pine is available in spite of the rapidly expanding use of these materials often in areas of potentially high decay hazard. There is a need to provide the public with general information in the areas of the effects of resin content and fungal species on the dimensional stability and decay resistance of the composition boards.

2. MATERIALS AND PROCEDURE

Wood fiber composition boards approximately 279-by 279-mm were made from steam-pressure refined fibers. The wood chips were obtained from the juvenile plantation-grown southern pine. All fibers were Produced from chips, steamed for 2 to 5 minutes at about 7.5 MPa, disk refined, and dried at 150 to 160°C in a rotation drier. Two levels of phenol-formaldehyde adhesive content were used: 3 and 7 percent (based on resin solids content and ovendry fiber weight).

Table 1. Design for the experiment.

No.	Fungus Type	Resin (%)	Replication
1	Poria	3	8
2	Poria	7	8
3	Gleophyllum	3	8
4	Gleophyllum	7	8
5	Polyporus	3	8
6	Polyporus	7	8

Composition boards with a specific gravity of 1.0 and a thickness of 3.2 mm were produced for two resin contents. All boards were pressed on a steam-heated press at about 190°C for 8 minutes at a maximum pressure of 7.24 MPa for all hoards.

Forty-eight board specimens approximately 25 mm square by 3.2 mm thick were cut from the experimental boards made from plantation-grown southern pine fibers. After conditioning at a temperature of 26.7°C and 70% relative humidity for 4 weeks, all specimens were weighed and calipered.

All specimens were tested according to ASTM Method D2017 [1] using cultures of three common rot fungi (two brown rots and one white rot); *Poria placenta* (Fr.) Cook (ATCC 11538), *Gleophyllum trabeum* (ATCC 11539), and *Polyporus versicolor* (L. ex. Fr.) (ATCC 12679). The second brown cubical rot often causes decay in millworks and wood situated aboveground. A replicate of eight specimens of each fungus and resin content condition were used. Each cylinderical 225 cm^3 culture bottle contained one specimen of the board. After 16 weeks exposure to fungus specimens were removed from the test bottles, reconditioned, reweighed, and recalipered to measure the weight loss and dimensional changes.

3. RESULTS

Statistical analysis indicates that the average dimensional stability and decay resistance values for all specimens were significantly (5% level) influenced by major factors of resin content and the decay species. The effect of resin content on the thickness change of the board specimens was found not to be significant as shown in Table 2.

Table 2. Factorial analysis

Factor	SGR[a]	TC[b]	WL[c]	LC[d]
Fungus (3)	S[e]	S	S	S
Resin Content (2)	S	N[f]	S	S

[a]SGR = Specific gravity reduction
[b]TC = Thickness change
[c]WL = Weight loss
[d]LC = Linear expansion or shrinkage
[e]S = Significant at 5% level
[f]N = Not significant at 5% level

Table 3. Average specific gravity reduction, thickness change, and weight loss of plantation-grown southern pine composition boards.

Fungus Type	3 Percent Resin Content[a]	7 Percent Resin Content
	SPECIFIC GRAVITY REDUCTION	
GT[b]	**-31.6**	-29.4
Pp	**-28.3**	**-21.7**
PV	**-23.4**	**-24.0**
	THICKNESS CHANGE (%)	
GT	+8.2	+8.9
PP	-7.1	+7.6
PV	+24.7	+16.7
	WEIGHT LOSS (%)	
GT	-44.6	-36.9
PP	-50.0	-34.3
PV	-18.1	-21.3

[a]Phenol - formaldehyde resin
[b]PP = *Poria placenta,* GT = *Gleophyllum trabeum.*
PV = *Polyporus versicolor*

Table 3 shows the average specific gravity reduction (SGR). thickness change (TC), and weight loss (WL) of specimens exposed to three wood decay fungi for 16 weeks. Table 4 shows the effects of resin content and fungi species on the linear change (LC) of specimens. It indicates that a moisture content incrfease did occur to the majority of the specimens after they were exposed to three common rot fungi.

Table 4. Average Linear expansion

Fungus Type	3 Percent resin content[a]	7 Percent resin content
	LINEAR CHANGE (%)	
GT[b]	-0.255	+0.223
PP	-0.354	-0.161
PV	+0.453	+0.334

[a]Phenol-formaldehyde
[b]PP = *Poria placenta,* GT = *Gleophyllum trabeum,*
PV = *Polyporus versicolor*

4. SUMMARY

The following conclusions can be made from this study.
1. The effects of differences in adhesive content and type of decay fungi on dimensional change and decay resistance of hardboards made from plantation-grown southern pine were statistically significant at 5 percent level. The phenolic resin content level did not play an important role in influencing the thickness change of the specimens.
2. As increased resin content from 3 to 7 percent caused a significant reduction in SGR, WL, and LC values in specimens.
3. Specimens appeared to have more resistance to *Polyporus versicolor* (a white rot fungus) than two other brown-rot fungi.
4. Most of the specimens swelled in dimension except that the thickness and length shrinkage occurred in many specimens after the decay exposure.

5. REFERENCES

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