Wood-Based Composites Exposed to Fungal Degradation: Laboratory Results

Vina W. Yang, Barbara L. Illman, Leslie A. Ferge, and Robert J. Ross

Abstract

Oriented strandboard (OSB) and laminated veneer lumber (LVL) are widely used as residential construction materials. The durability of OSB and LVL against biological degradation has not been studied comprehensively. The objective of this research was to investigate the durability of OSB and LVL when exposed to wood decay fungi. Fourteen brown-rot and eight white-rot wood decay fungi were screened for their capacity to degrade OSB and LVL. Samples were evaluated for decay by weight loss measurements using the American Society for Testing and Materials D1413-76 soil block test method. Results revealed that the brown-rot fungus *Gloeophyllum trabeum* (Mad-617) and the white-rot fungus *Trametes versicolor* (Mad-697) degraded OSB to a greater extent than solid southern yellow pine wood. Both fungi degraded LVL to a much lesser extent than OSB. Our findings provide valuable information on the durability of OSB and LVL, to predict serviceability and protection requirements of these construction materials.

Key Words: OSB, LVL, fungal degradation

Introduction

The production and use of oriented strandboard (OSB) and laminated veneer lumber (LVL) in North America as a replacement for larger solid structural lumber is increasing. This is primarily the result of the shortage of quality timber such as large-diameter trees and the drive for using small-diameter trees. In recent years, wood composite I-joists have provided another promising market for OSB (Fig.1), the use of which is predicted to double in the next 5 to 7 years (1). The markets for LVL appear to be growing quickly for trusses, I-beams, bridges, door and window headers (Fig.2), and furniture parts. The strength of LVL makes it a viable alternative to structural lumber.

Products made from OSB and LVL are used both indoors and outdoors, and thus they are susceptible to biological attack by wood-decay fungi such as brown- and white-rot fungi. Little information is available regarding fungal degradation on composites (3,5,7,13–15).As more applications are found for wood composites, a clearer picture of fungal degradation is needed to guide service conditions of these materials.

The objective of this study is to evaluate the durability of OSB and LVL when exposed to wood decay fungi. The degradation rates of OSB and LVL by the brown rot fungus *Gloeophyllum trabeum,* Mad 617 and the white rot fungus *Trametes versicolor,* Mad 697 were compared to that of solid wood.

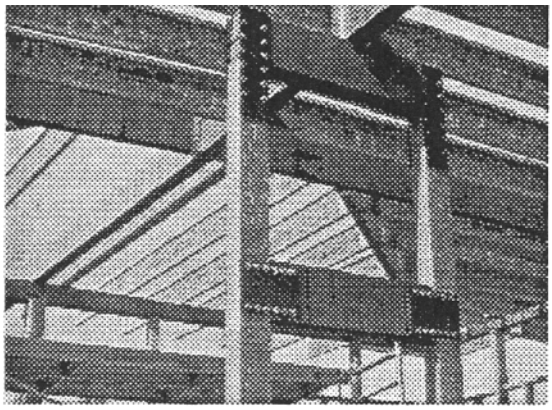

Figure 1. Use of OSB as I-joist for residential construction.

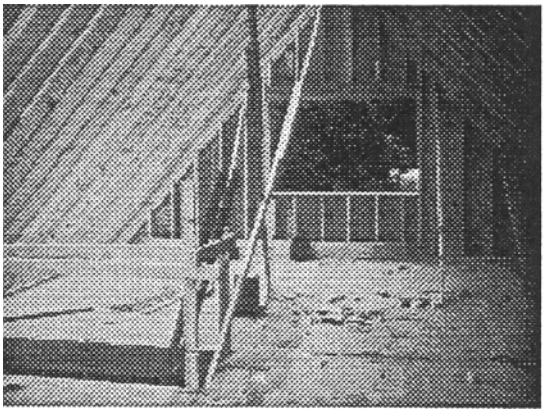

Figure 2. Use of LVL as interior application for door/window headers.

Materials and Methods

Wood samples

Two different wood composite materials, OSB and LVL, and one solid wood sample were obtained from the commercial market. The OSB and LVL samples were 11.1 mm and 35 mm thick, respectively. Small specimens (25.4 by 25.4 by 12.7 mm) were cut from each type of wood according to American Society for Testing and Materials (ASTM) D-1413-76 standard soil block method (2).

Decay fungi

Fourteen brown-rot and eight white-rot wood decay fungi were screened for their capacity to degrade OSB and LVL. Samples were evaluated for decay using the ASTM standard soil block method (2). The percentage of weight loss was calculated at the end of a 12-week incubation period. Five replications were used for each fungus.

The brown-rot fungus Gloeophyllum trabeum (Mad-617) and white-rot fungus Trametes versicolor (Mad-697) were selected for determining the rates of OSB and LVL degradation. Southern yellow pine controls were used for comparison. Specimen weight was measured at 0, 2, 4, 6, 8, 10, and 12 weeks of fungal exposure, with five replications for each fungus.

Results and Discussion

The capacity of brown and white-rot fungi to degrade OSB and LVL, as measured by specimen weight loss, is shown in Table 1. Weight loss was measured after 12 weeks of fungal exposure. In general, the brown-rot fungi caused more degradation and greater weight loss than did the white-rot fungi in both OSB and LVL. Both types of fungi degraded OSB much more extensively than LVL. The structure and design of OSB lead to large voids, which provide abundant paths for fungal hyphae to penetrate and degrade the wood (4). Therefore, faster and heavier degradation of OSB was expected.

Table 1. Fungal degradation of oriented strandboard and laminated veneer lumber[a]

Fungus	Weight loss (%)	
	OSB	LVL
Brown-rot fungi		
Antrodia serialis (FP-104443)	15.8±10.1	2.1±2.4
Antrodia vaillantii (FP-90877-R)	20.1±2.0	9.7±0.9
Antrodia xantha (Mad-5096-35)	36.4±5.1	13.0±2.4
Antrodia carbonica (HHB-5104)	45.3±6.1	21.2±5.9
Coniophora puteana (Mad-515)	34.2±5.2	-0.5±2.2
Fomitopsis meliae (FP-105065-sp)	58.4±1.4	32.0±3.7
Gloeophyllum trabeum (Mad-617)	49.0±2.7	13.4±5.1
Laetiporus sulphureus (SH-27-R)	20.3±3.2	10.8±3.3
Leucogyrophana arizonica (RLG-9902-sp)	36.7±4.9	4.3±3.3
Leucogyrophana olivascens (FP-104339-sp)	50.6±4.8	24.0±16.6
Meruliporia incrassata (Mad-563)	19.8±4.2	8.7±2.0
Neolentinus lepideus (Mad-534)	52.7±2.1	20.8±6.0
Postia placenta (Mad-698)	42.9±5.4	14.7±3.1
Serpula himantoides (FP-97367)	42.8±3.4	24.012.9
White-rot fungi		
Trametes versicolor (Mad-697)	53.3±1.8	26.0±6.3
Ganoderma applanatum (HHB-7823-s)	37.3±3.7	3.3±3.5
Irpex lacteus (HHB-7328-sp)	25.8±4.9	5.3±1.5
Phanerochaete chrysosporium (ME-461)	0.2±0.4	-020±0.4
Phellinus ferrigineofuscus (MJL-1357-sp)	16.7±1.4	5.8±2.4
Phellinus pini (L-14602-sp)	30.2±3.1	9.0±5.2
Phlebia brevispora (HHB-7030)	16.7±1.2	4.4±1.2
Pycnosporus sanguineus (FP- 103380-sp)	1.8±1.5	−1.7±0.3

[a]Standard Method of Testing Wood Preservatives by Laboratory Soil-Block Cultures, ASTMD-1413-76.

The rate of degradation of OSB, LVL, and solid wood (Southern yellow pine) by the brown-rot fungus *G. trabeum* and the white-rot fungus *T. versicolor* is shown in Figure 3. After 12 weeks of exposure, degradation of OSB, by both fungi, was more extensive than degradation of the solid wood. The brown-rot fungus degraded the solid wood to a greater extent than LVL, whereas the white-rot fungus degraded the solid wood and LVL to the same extent. Brown- and white-rot fungi are known to preferentially attack softwood and hardwood species, respectively (6,8−12). Both OSB and LVL are primarily made from softwood. The low degradation of LVL leads us to assume that the structure and design of composite wood have a greater influence on the susceptibility of the wood to fungal attack than do the constituent materials.

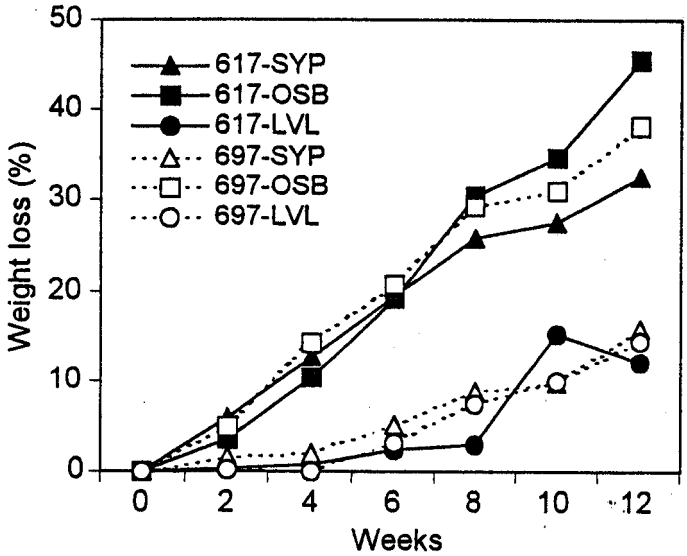

Figure 3. Degradation rate of OSB, LVL, and southern yellow pine by brown-rot fungus *G. trabeum* Mad-617 and white-rot fungus *T. versicolor* Mad-697.

This study provides valuable information toward understanding the durability of OSB and LVL and thus to predict their serviceability. This information should also facilitate research on ways to protect these materials from fungal degradation.

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Section 4 Processes and Properties

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