

Resistance of Wood Wool Cement Board to the Attack of Philippine Termites

by

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Abstract

The study evaluated the resistance of yemane (*Gmelina arborea* Roxb.) -based wood wool cement board (WWCB) against Philippine termites under laboratory and field conditions. Tests were conducted following the standard procedures in determining the resistance of WWCB against subterranean termites and drywood termites.

Results of the laboratory tests showed that WWCB was resistant to both *Microcerotermes losbañosensis* Oshima and to *Cryptotermes dudleyi* Banks. Under field conditions, WWCB were highly resistant to subterranean termites. There was no remarkable termite damage except for the normal nibbling termite feeding activity on the board during the 8- year exposure period.

Keywords: Resistance, Wood wool cement board, *Microcerotermes*, *Nasutitermes*, *Gmelina*

Introduction

Wood wool cement board (WWCB) is a panel product basically made of wood strands and ordinary Portland cement. Small diameter logs and branches not suited for lumber manufacturing and agricultural wastes can be utilized as raw materials. At present, *G. arborea*, a hardwood and fast growing tree species is the main raw material in the production of WWCB in the Philippines.

The technology has made its greatest contribution in the reduction of the cost of housing components since it utilizes non-commercial wood species and agricultural wastes. WWCBs are recommended for structural components of ceiling, interior partitions and walling components of houses and buildings (Eusebio and Pablo 1990). In order to be competitive, the desirable construction qualities and certain standards on the physico-mechanical and mechanical properties should be maintained to keep this product saleable in the market. One of the properties of the board that has raised concerns is on its resistance to termite attack.

Reports showed that concrete houses are liable to the attack of destructive wood-boring insect (Garcia 1967). Wood destroying species of subterranean termites *Coptotermes vastator*, *M.vlosbañosensis*, *Macrotermes gilvus* and *N. luzonicus* can gain access to wooden structures or cracks in by constructing earthen tubes in more or less concealed manner along underground electrical cables, plumbing lines and inside cracks and crevices of wooden or concrete posts or foundations. On the other hand, drywood termites *C. dudleyi* directly attack wooden components of structures.

In 1993, Tsunoda and Kawai reported that phenolic resin-treated compresses Laminated Veneer Lumber were not immune from attacks of subterranean termites under field conditions. However, cement composites manufactured from sengon wood (*Paraserianthes falcataria*) and betung bamboo (*Dendrocalamus asper*) were found resistant to subterranean termites *Coptotermes gestroi* Wasmann under laboratory conditions (Sukartana et al. 2000). Both types of boards however, were not immune to termite attack as indicated by the evidence of termite feeding particularly on surfaces of the board. The performance of the cement composites in-situ was not evaluated.

This study therefore seeks to determine the resistance of FPRDI WWCB made of *G. arborea* to termite attack under laboratory and field conditions.

Materials and methods

Laboratory test.

Termite nest containing active members of *M. losbañosensis* was collected and the population was allowed to establish in a termite chamber. Fifty pieces of conditioned WWCB measuring 12 x 20 x 60 mm and solid wood blocks of *G. arborea* were randomly exposed over a concrete foundation provided into the termite chamber. The degree of damage of test wood blocks and board samples was evaluated at the end of exposure period.

Drywood termites, *C. dudleyi* were collected from infested lumber in culture chamber and were transferred by a smooth camel's brush into an aluminum tray provided with wood chips. The conditioned WWCB specimens or wood blocks were individually exposed inside a French-square bottle containing 100 workers plus 2 soldiers. The experimental set-up was incubated at room temperature and the rate of damage of board samples was observed and recorded after 6 months.

The degree of termite damage of each board sample was evaluated based on the volume of damage on the board.

Field test.

FPRDI WWCBs with dimensions of 10 mm x 30 cm x 60 cm were used in the field test. Fifteen (15) each of painted and unpainted boards were installed as siding, ceiling and paneling of a pre-constructed exposure shed. WWCBs were exposed in-service and the degree of termite damage was visually examined every 6 mos for 8 years.

The resistance of WWCB to termites was classified according to the following arbitrary rating:

% Termite Damage	Classification
0	Highly Resistant (No evidence of termite attack).
1 – 25	Resistant (WWCB slightly attacked by termites; from initial nibbling to almost ¼ of the board).
26 – 50	Moderately Resistant (WWCB moderately attacked; more than ¼ to more than ½ of the board)
51 – 75	Slightly Resistant (WWCB severely attacked by termites; > ½ to almost ¾ of the board).
76 – 100	Not Resistant (WWCB very severely attacked, more than ¾ of the board).

Results and discussion

Laboratory test

Initial construction of earthen tunnels by *M. losbañosensis* on WWCB samples originated from the soil in the termite chamber and extended towards the top of concrete foundation after 1 week of exposure. The formation of abundant earthen tubes was noted during the following week indicating the continuous host finding activity by the worker castes. Nibbling of termites on the surface the board was observed after 6 months of exposure. The average percent damage of WWCB was 13.5% and classified as resistant to subterranean termite *M. losbañosensis* (Table 1). On the other hand, wood blocks of *G. arborea* was moderately resistant which sustained 37.0% termite damage. Active termite population was still noted in termite chamber after board samples were retrieved.

The resistance WWCB to termite attack was due to inherent natural durability plus the additional protection enhanced by soaking wood wool particles in water and the binding cement that conceal the wood fibers. The *G. arborea* wood block is moderately durable to termites (FPRDI Technical Information) though some cases of termite attacks have been reported.

Table 1. Average termite damage of WWCB exposed to <i>M. losbañosensis</i> .		
Treatment	% Damage	Resistance Rating
WWCB	13.2	R
Wood Block	37	MR

There were no quantitative data that will show the comparison of chemical or starch content analysis of the soaked and unsoaked wood excelsior from *G. arborea* but soaking in water can reduce starch content of some materials. The study conducted by Garcia and co-workers (1997) showed that soaking of bamboo strips in water for 1 week downgraded the percent starch content of bamboo from 5.0 to 3% and prevented beetle attack. Further, the cement coated the wood excelsior thus providing protection against termite invasion.

Despite being considered as resistant composites, the boards can still be attacked by termite as indicated by the termite feeding activity. Initial damage on the interior portion of the board was noted and termites gained entry through the gaps between wood wool particles after the final trimming. On the other hand, termites can readily attack the surface of solid wood block of *G. arborea*.

For the accelerated test against drywood termites *C. dudleyi*, pellet-like materials were observed coming out from the board suggesting the active termite feeding activity. About 61.0% of WWCB samples and 100.0% of solid wood blocks showed manifestations of initial termite attack after 1 month of exposure. However, no new pellet materials were noted after 3 months suggesting the cessation of feeding activity of termites. After 6 months, WWCB and solid wood blocks of *G. arborea* had average percent damage of 2.1% and 4.8%, respectively (Table 2). Drywood termites initially invaded the WWCB but unable to establish in the substrate due to the insufficient nutrients from the food source. It was estimated that 50% of WWCB samples sustained initial damage and the rest with only 5% termite attack. Short term feeding activity in solid wood blocks was noted but their

attack did not persist due to inherent durability of *G. arborea*. Based on the degree of damage, WWCB and wood block of *G. arborea* were classified as resistant to drywood termites.

Field test

The initial occurrence of subterranean termites on the WWCB was observed after 5 ½ years of field exposure (Table 3). Earthen tunnels of *N. luzonicus* and *M. losbañosensis* were observed from the ground line and the base of painted and unpainted WWCB installed as exterior and interior walls. About 50.0% and 33.3% of painted and unpainted exterior wall, respectively and 8.3% of both painted and unpainted interior wall WWCB were initially invaded by subterranean termites. Sampling of termite tunnels showed only nibbling or zero termite damage in all boards.

Table 3. Percent of installed WWCB with termite occurrence during the -year of field exposure						
Year of Observation	% of Termite Occurrence Types & Locations of WWCB in the Exposure Shed					
	Painted			Unpainted		
	Exterior Wall	Interior Wall	Ceiling	Exterior Wall	Interior Wall	Ceiling
0.5	0	0	0	0	0	0
1.0	0	0	0	0	0	0
1.5	0	0	0	0	0	0
2.0	0	0	0	0	0	0
2.5	0	0	0	0	0	0
3.0	0	0	0	0	0	0
3.5	0	0	0	0	0	0
4.0	0	0	0	0	0	0
4.5	0	0	0	0	0	0
5.0	0	0	0	0	0	0
5.5	50.0	8.3	0	33.3	8.3	0
6.0	45.4	9.1	0	27.3	9.1	0
6.5	36.4	0	0	36.4	0	0
7.0	40.0	0	0	40.0	0	0
7.5	0	0	0	0	0	0
8.0	0	0	0	0	0	0

On the 6th year, the percent of WWCB with termite occurrence was slightly reduced from 50.0% to 45.4% and 33.3% to 27.3% of painted and unpainted exterior wall, respectively. The 9.1% of board samples of painted and unpainted interior wall had termite incidence. After 6 ½ years of field test, termite populations of *N. luzonicus* remained active at the base of painted and unpainted exterior wall. The previously active population of *M. losbañosensis* on painted and unpainted interior wall became inactive.

Only painted and unpainted exterior walls had termite incidence on the 7th year of test. There was no termite damage noted despite the active occurrence of *N. luzonicus* on 40.0% of each type of board. Termite abandoned all invaded WWCB after 7 ½ years and no termite population was observed until the 8.0 year of exposure. The painted and unpainted WWCB mounted as ceiling were not invaded by termites and the boards had no termite damage throughout the duration of the test.

The nibbling noted on WWCB was an indication of bite test by termites to determine whether the board is acceptable or not as a food source. The results showed that the board was not

acceptable as food thus termites abandoned the board without causing any remarkable damage. The inherent natural durability of *G. arborea* combined with the protective shield of the binding cement and soaking of excelsiors in water might have contributed to the resistance of the WWCB to subterranean termites.

Conclusions and recommendations

1. WWCB was resistant to both subterranean termites *M. losbañosensis* and drywood termites *C. dudleyi* under laboratory conditions.
2. WWCB had higher resistance to wood destroying subterranean termites compared with the solid wood blocks of *G. arborea* due to the added enhanced protection provided by the cement binder.
3. WWCB was highly resistant to subterranean termites under field conditions.
4. Treated lumber or metal should be used as nailing joists in the installation of WWCB to limit the chance of termite attack.

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