Resistance of Cement-Fibre and Resin Composites to Termite Attack

Report for UAC Berhad

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Materials and Methods

Three product samples were supplied by UAC Berhad for tests of termite resistance. These were two cement-fibre composites, namely Ardex Plus (a corrugated sheet coated on one side with a copper-based fungicide) and Superflex (a flat sheet), and a resin-bonded wood composite. The material samples were cut into 50 × 15 mm strips, with a thickness of about 6 mm for the cement-fibre composites and 8 mm for the resin bonded composite. They were compared for termite resistance against five-ply plywood of 12 mm thickness cut to similar dimensions.

Prior to exposure to termites, all sample strips were dried in an oven at 105°C and then weighed. Ten sample strips were compared for each type of material. The test carried out was based on the method described by Kirton et al. (1998). The strips were placed in a foil-lined, rectangular plastic receptacle (approximate dimensions 32.0 × 24.0 × 12.5 cm), containing sheets of corrugated cardboard. Five strips of each type of material were placed randomly between separate layers of cardboard sheets. Termites were led into the receptacle from a field colony of Coptotermes travians (Rhinotermitidae) (sensu Tho 1992), which is an important pest affecting wood in houses. The receptacle was exposed to termites in the field, which were led into the receptacle with the aid of cardboard leaders (Kirton et al. 1998). The termites were allowed to feed on the cardboard and sample strips for 30 days, after which the sample strips were retrieved, washed, oven-dried and weighed. The percentage weight loss was determined for each material. A visual score of material loss was also used to assess damage to the strips.

Results and Discussion

There was no visible damage to the cement-fibre composites after exposure to termites. Negligible to very slight damage occurred to the resin-bonded composite. Superficial feeding marks on the surface appeared matte against the otherwise glossy outer coating. In a few sample strips, there were small holes, indicating the termites had attempted to burrow deeper into the material. In the plywood, however, which was used as a control, damage by the termites was moderate (Table 1). The termites almost invariably consumed one outer ply, and the opposite side of the plywood was
also partially eaten in many of the sample strips. The termites had also burrowed into all the plywood strips.

Table 1: Visual scores of material loss from sample strips after exposure to termites. Definition of damage scores: 0 = none, 1 = trace (negligible), 2 = very slight (< 5%), 3 = slight (5-10%), 4 = moderate (10-20%).

<table>
<thead>
<tr>
<th>Material</th>
<th>Median</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plywood</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ardex Plus cement-fibre composite</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Superflex cement-fibre composite</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Resin composite strip</td>
<td>1</td>
<td>1.4</td>
<td>1-2</td>
</tr>
</tbody>
</table>

Both the plywood and resin composite strips decreased in weight after exposure to termites, but the cement-fibre composites gained weight by about 8%. This weight gain may be attributed to physical and chemical processes that may have taken place during the course of the experiment. The weight changes have, therefore, been subjected to compensation by subtraction of the largest weight gain among the individual samples. Figure 1 shows the weight changes after compensation. It should be noted that actual losses due to termites are likely to be slightly lower than portrayed in the figure, since small weight losses are expected due to the cleaning process to remove soil and carton after the samples are exposed to termites. However the results are consistent with the visual scores, which indicated very high resistance in the cement-fibre composites, high resistance in resin-bonded composite and little resistance in plywood. The resin-bonded composite is at least five times more resistant than plywood.

![Figure 1: Mean weight loss (± standard error) in the different materials after exposure to termites. Materials labeled with different alphabets differed significantly (ANOVA on arcsin, square root transformed data, with Tukey's comparisons, α = 0.05)](image-url)
Conclusions

Both the cement-fibre composites, Ardex Plus and Superflex, are highly resistant to attack by the termite *Coptotermes travians*, while the resin composite strip is at least five times more resistant than plywood. However, it should be cautioned that results might vary depending on the termite species and environmental conditions to which the materials are exposed.

References


The difficulty of obtaining infestations of *Coptotermes* at randomly placed baits has been noted in Australia by French *et al.* (1981) and Abensperg-Traun (1993). French and Robinson (1981) increased the chances of obtaining non mound-building species by placing large steel drums filled with wet toilet rolls close to existing infestations. The termites colonised the baits through holes in the base of the drums, but it took five months to obtain infestations. Short lengths of PVC pipes have been used to lead Australian *Coptotermes* from mounds (French and Robinson 1985) and *C. formosanus* from heartwood infestations of living trees (Waller and La Fage 1987), to wood samples placed in the pipes. Corrugated cardboard was placed in the PVC pipes used by French and Robinson, to lead the termites to the wood samples, and has also been used as a bait in receptacles placed over infestations of *Coptotermes* to trap the termites (La Fage *et al.* 1983). Grace *et al.* (1995) used rolls of corrugated cardboard to lead subterranean termites into above-ground traps placed directly over below-ground monitoring stations. In what may have been the earliest attempt to use a system of attracting termites to test wood samples, Kalshoven (1962) connected rolls of newspapers from an existing indoor infestation of *Coptotermes* to insecticide treated and untreated wood samples wrapped in cardboard.

The technique described here, of using long cardboard strips to function as a conduit for subterranean termites, combines versatility and ease of use. It enables termites to be tapped from infestations that would not be accessible to the other techniques, and eliminates the problem of chance encounter associated with placing baits close to termite sources.

**MATERIALS AND METHODS**

Infestations of *Coptotermes* were located in areas where the termites were known to be reasonably abundant. Two species were trapped, the identities of which are based on Tho (1992), namely *Coptotermes travians* and *C. curvignathus*. Emphasis was placed on the former species as it is a pest of domestic timber, while the latter, which generally attacks living trees, was tested fewer times for comparability. Logs, stumps or living trees were checked, with the aid of a heavy knife, for the presence of termites. Most often, only soldiers were seen. If there was even a small number of soldiers, one end of a five-ply corrugated cardboard strip recently moistened with water was fastened over the area where the termites were present. In some cases, moist cardboard pieces were first used to fill large holes or depressions in the wood where the termites were found, particularly if the termites were deep in the
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REFERENCES


wood. The cardboard strip was generally fastened over the infestation on stumps or trees by string and on logs by nailing. The strips of cardboard were cut such that the internal grooves ran parallel to the long edge of the strip, providing channels through which the termites could readily move (Fig. 1). The other end of the cardboard strip was placed on top or between dry pieces of cardboard cut to fit within a receptacle placed on the ground (Fig. 2A). The opening of the receptacle was then covered and sealed over with aluminum foil. The foil served both as a barrier to keep termites in and a seal to minimise light entering the receptacle. A plastic sheet was pegged over the receptacle to keep rain water out (Figs. 2B & 2C), and the entire receptacle and its cardboard leader were hidden, if necessary, by covering with sand, leaf litter or other available debris. In situations where added concealment was deemed necessary, the receptacle was first placed flush with the ground by excavating a depression in the soil.

Two types of receptacles were used. For simply trapping termites for use in the laboratory, aluminum-foil-lined rectangular plastic receptacles with internal dimensions of 32 x 24 cm and 12 cm deep were used (Fig. 2). These were covered and sealed with aluminum foil. For field experiments, such as testing the response of the termites to test wood samples, cylindrical aluminum receptacles with an internal diameter of 16-17 cm and internal depth of 7.5-8.0 cm were used (Fig 3). Wood samples were placed between the layers of cardboard in the receptacles (Fig. 3A). Cylindrical receptacles were used to enable wood samples to be arranged radially in random order. A stainless steel pin with an
The debris and plastic covers were removed from the receptacles when the termites or wood samples were collected. With the rectangular receptacles used to trap termites, the cardboard connection was cut near the opening of the receptacle and the aluminum foil cover used to seal the entire receptacle, which was then transported back to the laboratory with the termites in it.

A total of 15 sets of three cylindrical receptacles (that is, 45 individual receptacles) and more than 8 rectangular receptacles were tested on infestations of *C. travians* in two different habitats. One rectangular receptacle was used to test the response of *C. curvignathus*.

**RESULTS AND DISCUSSION**

The technique proved to be consistently effective in initiating infestations within the receptacles. The termites rapidly entered the receptacles through the cardboard strips. *Coptotermes travians* entered within one to three days and the rectangular traps could be collected with large numbers of termites after about five days. After one week, the number of termites in the traps was observed to decline. In the cylindrical receptacles, the cardboard was completely consumed within two weeks, when test wood samples were collected for analysis (Fig. 3C). *Coptotermes curvignathus* entered the trap more slowly, after about one week, with numbers building up over about 10 days.

Apart from being a highly attractive food material to the termites, the five-ply corrugated cardboard strips also provided sheltered grooves within which the termites could move freely, forming interconnections between parallel grooves. Cardboard strips as long as one meter were used effectively. The strips were able to withstand rain throughout the required period. The method could also be used to make simultaneous multiple tests (or multiple collections) from the same infestation source. It was observed that the termites consistently entered virtually simultaneously all three receptacles attached to the same infestation. Lining the plastic receptacles with aluminum foil enabled them to be used without any damage. It was also found to make cleaning of the receptacles much easier, since the foil could be disposed of after use. When aluminum receptacles were used without a lining, there was no damage to the receptacle by termite feeding, but the fecal deposits of the termites proved very difficult to remove. Lining even metal receptacles with aluminum foil would facilitate cleaning and reuse of the receptacles. In a single test with *Coptotermes travians* and several tests with *C. curvignathus*, the termites consumed aluminum-foil-wrapped layers of corrugated cardboard placed without a receptacle in the field. The layers of cardboard were stacked or tied together before being