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Preliminary Accelerated Field Simulators (AFC) test report

SUBMITTED

TO

Ekologix Australia Pty Ltd

On

Preliminary durability assessment of Ekologix wood plastic composite against decay fungi and subterranean termite, *Coptotermes acinaciformis* (Froggatt) (Isoptera: Rhinotermitidae) after twelve and eight weeks exposure in Accelerated field simulated condition respectively

Prepared by

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ABSTRACT

The results of this preliminary Accelerated Field Simulator test of Wood Plastic composite was conducted for twelve weeks against decay fungi and eight weeks against subterranean termites' *Coptotermes acinaciformis* (Froggatt) and the result indicated that Wood Plastic composite has a potential as durable wood products against both decay fungi and subterranean termites in preventing attack and damage of wood plastic in service.

INTRODUCTION

In Australia the protection of building timbers from termites has relied for many years upon the application of persistent organochlorines, as well as the organophosphate compound Chlorpyrifos, and the synthetic pyrethroid bifenthrin, as soil chemical barriers (Lenz *et al.* 1988; 1990; Watson 1990). The organochlorine insecticides have been banned since 1987 in the USA and from June 1995 in all Australian states except the Northern Territory until 1997. Around 70% of total timber produced in Australia is used for building and construction purposes. Preservative treatment of timber according to Australian Standard AS 1604.1-2010 prevents attack and damage of wood and wood products from biodeteriogens (wood decay fungi and insects). Above-ground interior timber framing is not liable to decay but is prone to damage by wood-destroying insects (borers and termites). In-ground exterior timbers are liable to damage by wood decay fungi and termites.

Most termites' damage is attributable to subterranean termites (hence forth referred to as 'termites'). The economic loss to timber in service by termites constitutes the greatest problem in both urban and rural environments. Termite damage was estimated by the Archicentre which includes the costs of termite damage, treatment and replacement costs are approximately of $915 million annually (Caulfield 2007).(now more likely to be more than 1 billion!).

Termites can attack and damage sound and decayed timber of native hardwoods, and native and exotic softwoods. The Northern giant termite *Mastotermes darwiniensis* Froggatt is by far the most destructive termite in Australia. It occurs in the region north of the Tropic of Capricorn, with Rockhampton being the southernmost area of its natural distribution. *Coptotermes acinaciformis* (Froggatt), however, is responsible for greater economic losses than all the other Australian species of termites combined. This is due to its extensive geographical range, the severe nature of its attack, and its success in adapting to urban areas.

This report describes the preliminary Accelerated field simulator (AFS) test assessment and evaluation on the durability of wood plastic as a durable and resistant against foraging workers and soldier castes of the Australian subterranean termite, *Coptotermes acinaciformis* (Froggatt) and decay fungi from freshly collected field soil exposed in AFS.

MATERIAL AND METHODS

Accelerated Field Simulator (AFS)

Preparation of test termite and decay fungi

The AFS test was designed to evaluate the ability of the test termite and decay fungi (Basidiomycetes) to attack and damage Ekologix wood plastic material and *Pinus radiata* D. Don wood samples as controls included in the test and exposed directly to the termite colonies on the feeding tanks and to fresh field soil for decay fungi respectively. The wood plastic material was supplied by Ekologix Pty Ltd., Victoria and the *P. radiata* samples were collected from "plantation tree of 23 years old" from the Creswick timber training centre.

Termite source

Two active termite colonies of *C. acinaciformis* were used in this test and the test specimens were directly placed in the termite tank against foraging termites from the termite colonies. All termites used in the AFS test were from two discrete above-ground colonies of *C. acinaciformis* in Victoria (Fig. 1).

Figure 1: Two termite nests in conditioned rooms with actively foraging and feeding workers/soldiers of the subterranean termite *Coptotermes acinaciformis.* The left tanks are two half of 44lt gallon drums and the right tank is 1162 X 1162 X 780 ml.

Decay fungi source

Fresh field soil collected from East Gippsland forest for the decay test and placed in a tank in the AFS condition room (27^{O}C & 80% RH) for the decay test as shown in the photo below (see Fig. 2).

Figure 2: Decay test tank (1200 L X 750 W X 750 D mm) with freshly collected soil and test stakes installed in-ground and above ground on the soil surface exposure.

Timber test specimens

(i) **Wood Plastic composite timber:** Termite test timber specimens were 250 x 250 x 25 mm with the artificial grooving along the 250 mm direction (Fig.3) and the decay test specimens were 300 x 40 x 25 mm. Control timber test specimens were used from *P radiata* trees from a pruned and thinned forest which had been harvested from the Mount Gambier region (Victorian plantation co-operation) as mentioned above and cut to similar sizes as the wood plastic specimens.

(ii) **Randomisation:** Both timber specimens were pooled and randomly allocated into groups. Prior to installing the timber specimens to test, they were oven dried for initial mass loss and were set to mean moisture content (m.c.) of about 11 %. Mean density of the specimens at 11 % m.c. was calculated to be 470 kg/m^3 (*P. radiata*) (Fig. 3).

Figure 3: Wood plastic termite test specimens (left) and oven drying of test specimens of both plastic wood and *P. radiata* for decay test (right).

Termite and decay test set up:

Five replicates of the four different colour of Wood plastic were prepared for the termite test (250 mm x 250 mm x 25 mm) and decay test specimens were 300 x 40 x 25 mm and relatively similar size of *P. radiata* wood were prepared. Each test unit consisted of wood plastic specimens and *P. radiata* wood samples in active colony of termite and decay test tank in a standard condition of 27ºC and 75% Relative Humidity (R.H.) (Fig 4)**.**

Figure 4: Wood plastic and *P. radiata* test blocks exposed to termite colony (left) and decay fungi (right).

Results and Discussion

Untreated controls

Termites were able to attack and damage the *P. radiata* control test blocks' significantly while decay fungi has slightly damaged the *P. radiata* wood blocks controls. Plastic wood samples were only nibbled on the surface by termites and no visible effect by decay fungi (Fig. 5). The visual assessment of termites feeding on the wood plastic blocks over the eight week test period is shown in the graph above. While the above data on the test blocks is quantitative, it is not easy to record termite behaviour when they are presented with such artificial wood plastic, which may or may not affect their behaviour and mortality rate. Normally, it is only after the bioassays have been completed that the termite surface nibble is discovered when compared against the *P. radiata* stakes, which was obvious at the test period. However, it is important taking a more 'holistic' view of the evaluation of both test specimens, when comparing damage (see Fig 4). So, when a visual assessment of termite feeding behaviour on the wood plastic blocks is made and compared to the *P. radiata* (Fig 4), it is seen that there are indeed, important differences of feeding pattern and damage between the two test blocks. Despite the test specimens were exposed together, there was an initial attractancy to the *P. Radiata* (Fig 4). Termites were actively attacking the *P. radiata* blocks compared to the wood plastic composite. Termites became actively feeding and hardly moved off the *P. radiata* blocks even when the light was turned on in the AFS. This trend continued until the end of the test period.

Unlike termite, decay fungi attack and damage was not obvious and the mass loss was very small. This is normal for the period of the exposure and the result has indicated decay has not affected the wood plastic composite when compared to the *P. radiata* blocks.

Termite and decay fungi were unable to attack and damage the *P. radiata* wood blocks control as shown in Figure 5 and as described in the graphs below (fig 6 & 7):

Figure 5: Wood plastic and radiata pine samples after eight weeks exposure to termites (left) and twelve weeks exposure to decay fungi (right).

According to this preliminary bioassay wood plastic seems to have an anti feedant reaction to foraging *C. acinaciformis* in this test, compared to *P. radiata* wood blocks (Fig. 5). The anti feedant effect of wood plastic was characterised by the termite mudding on the surface of the wood blocks, while, continually feeding on *P. radiata* wood blocks. These choice preferences indicate wood plastic has either repellent or the physical structure of the composite was hard for the foraging termites to continue feeding on the test blocks or even both properties may be attributed to the wood plastic!

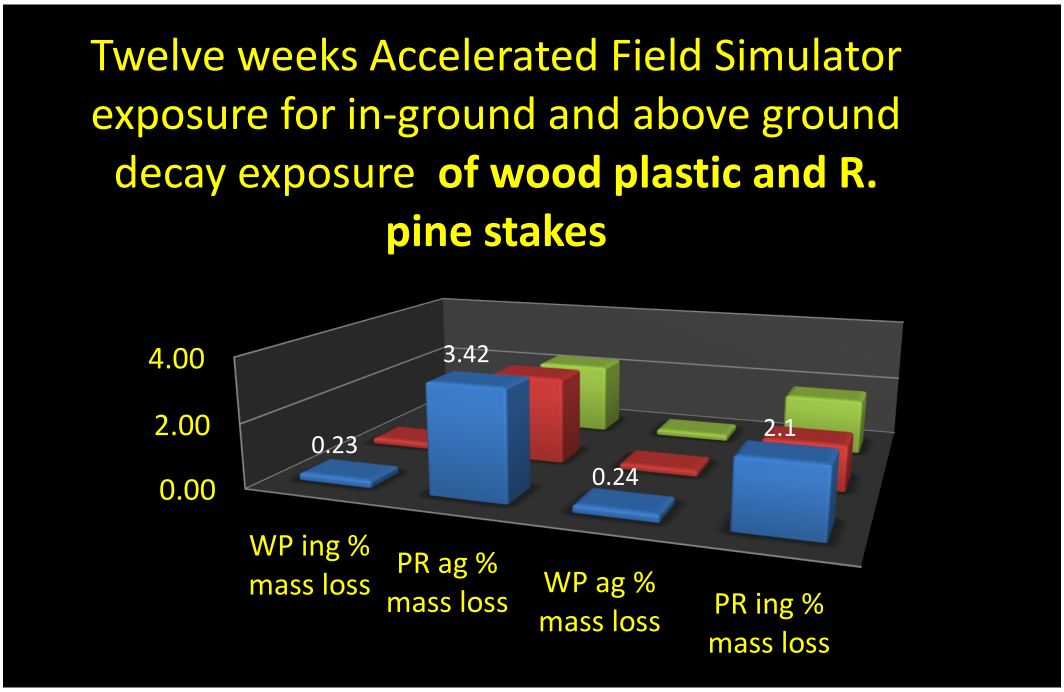

Figure 6: Mass loss of wood plastic and *P. radiata* blocks after twelve weeks of exposure to decay fungi in AFS.

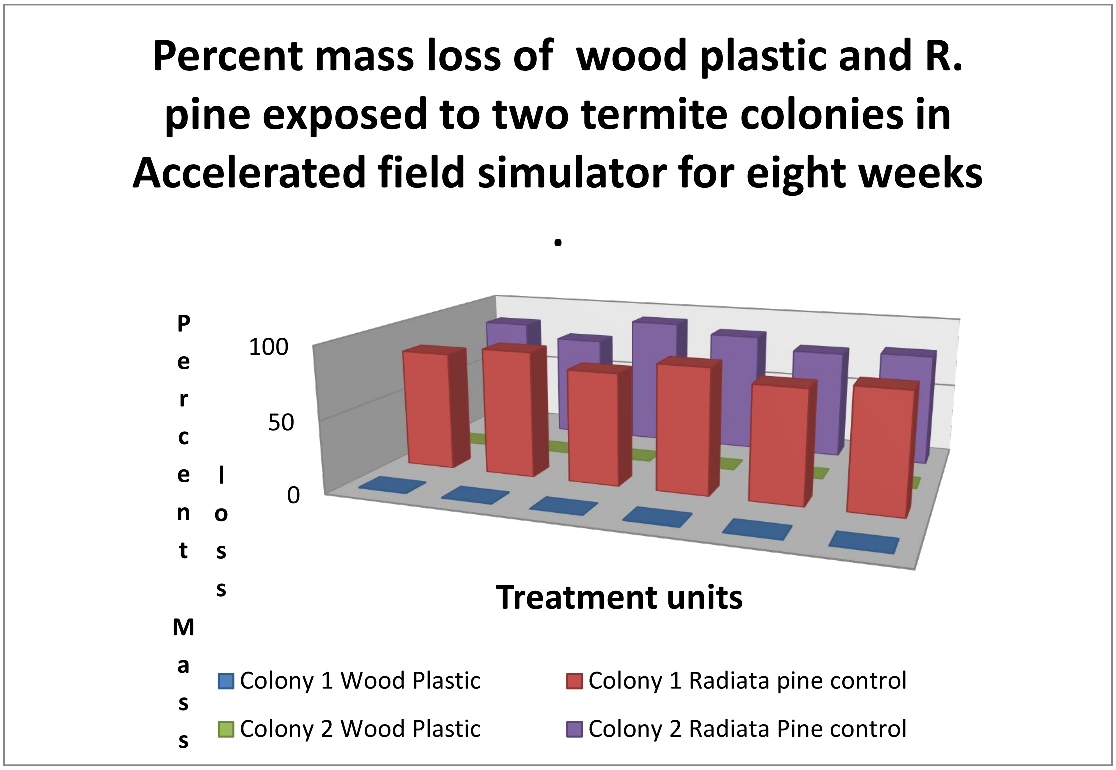

Figure 7: Mass loss of wood plastic and *P. radiata* wood blocks after eight weeks of exposure to two colonies of termites in AFS.

CONCLUSION

The evidence gathered in this preliminary AFS test indicates that termites and decay fungi were not able to attack and damage wood plastic. The wood plastic colour and grooving has not affected termite feeding and damage to the test blocks. Therefore, the results of the AFS indicate that wood plastic composite has not been attacked or damaged despite been subjected to high termite nest pressure comparable to that normally encountered within a building environment from natural foraging populations of termites. Termites forage and explore around materials that pose a chemical/physical barrier to them. When they have ascertained that it is not potential source of food, they will change direction and randomly forage elsewhere.

However, it is important to understand that termite feeding and foraging depends on both the availability of food and moisture, plus the environment surrounding the food. Thus, wood plastic composite demonstrated durability against the foraging termite, *C. acinaciformis* and decay fungi for the period exposed in AFS. Meanwhile, further laboratory and field trials would be important to understand and determine the main reason for the durability of the wood plastic to foraging termite and decay fungi. The high feeding preference to the *P. radiata* blocks is significantly higher than that of the wood plastic. There may be some effect to the foraging termites in AFS, which may require more exposure to such termites under natural conditions and in laboratory conditions.

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