TERMIFILM® : A unique, effective product for preventing termite infestation of building construction

by

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Abstract

TERMIFILM® is a physico-chemical barrier that acts with lethal effect against many species of subterranean and tree-nesting termites. TERMIFILM® is a low-density waterproof polyethylene film 150 µm thick that contains the active ingredient permethrin. Grafting the encapsulated insecticide into the polyethylene plastic insures a barrier to termites and exempts the product of any toxicological and ecotoxicological classifications. TERMIFILM® is a patented invention that insures, years of termite protection for all types of construction (individual houses, collective housing, offices, industrial, commercial, agricultural, school buildings) for regions like Europe (Metropolitan France, Spain, Portugal), the South Pacific Ocean (Antilles: Guadeloupe, Martinique, French Guyana), the Indian Ocean (Reunion Island, Mauritius, Mayotte), South-East Asia (Thailand), the Caribbeans and Australia. Several field tests have proven the termite resistance of the TERMIFILM® barrier when exposed to different termites (*Reticulitermes*, *Coptotermes*, Mastotermes, *Microtermes*, *Microcerotermes*, *Allodontermes*, *Odontotermes*, *Nasutitermes*, *Cryptotermes*, *Heterotermes)* in different countries.

Key words: Termite resistance, Plastic material, Preventive treatment of buildings, Physical-chemical barrier, Subterranean termite

Introduction

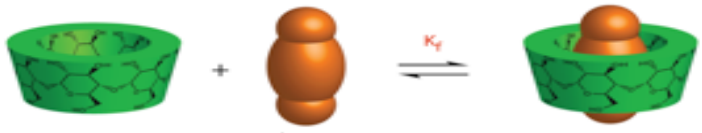
Plastic materials for termite prevention are a real alternative to spraying liquid termiticides and generally do not represent any risk of pollution to the ground or water tables. All plastic materials are not termite resistant during the service life of a building due to chemical structure, composition, hardness and surface finish. The number of termite species all over the globe makes it difficult to propose a unique plastic material solution against termite damage that can work in every region. The incorporation of an insecticidal active ingredient in the plastic material is almost mandatory. The laboratory of the BERKEM Group has formulated one original physical-chemical barrier called TERMIFILM® with the aim to provide an efficient and, above all, non-hazardous product for humans and the environment. A brief summary of the key results from six field tests in six regions in the world is provided in this document. The aim of those field tests was to evaluate the termite resistance of the permethrin-treated TERMIFILM® against several species of termites.

Materials and Methods

Materials

TERMIFILM® plastic sheeting film is treated with 1.0% permethrin trapped by LDPE (Low Density Polyethylene) molecules thus it is not sensitive to leaching, but still bioavailable (Figure 1). Permethrin has a high affinity for lipids and therefore migrates from the plastic onto the insect cuticle and through their body wall following simple contact. TERMIFILM® is considered a repellent. The mortality rate is dependent on the contact time between the insect and the film.

Figure 1: Dispersion of permethrin encapsulated in the LDPE matrix



TERMIFILM® has proved to be efficient for waterproofing according to EN13967 (2012).

TERMIFILM® is not classified dangerous for humans and the environment because of its physico-chemical properties. This non-classification for hazards allows the use of TERMIFILM® as confirmed by the OECD standards (for environmental effects: OECD 202, OECD 203, and OECD 201, for human effects: OECD 402, OECD 404, and OECD 406).

Methods

Six field tests were conducted in six different regions to evaluate the field performance of TERMIFILM® as a barrier to penetration by termites. TERMIFILM® plastic sheets that contained no insecticide were used for the control units.

1- Australia

Two trials were undertaken by Termite Research, CSIRO Entomology for the BERKEM Group.
The first trial was installed in August 1999 against *Mastotermes darwiniensis* and *Coptotermes acinaciformis* (mound building form) in wet-dry tropical northern Australia near Coolalinga, approx. 30km southeast of Darwin, Northern Territory. The second trial against *Coptotermes acinaciformis* (tree-nesting form) was installed in October 1999 in substropical eastern Australia within the Greenbank military training area approx. 23km south of Brisbane, Queensland. At both sites, subterranean termite species other than the targeted species are also abundant.

For each experimental unit, two sheets of TERMIFILM® measuring 700x600mm and 700x450mm were joined with clear 3M Tape (50mm wide) with a 200mm overlap. The largest sheets had a 50mm diameter hole which was fitted over a 55mm PVC pipe sealed at one end with stainless steel wire mesh. (Figures 2 and 3) TERMIFILM was fitted and secured onto the service pipe with a stainless steel pipe clamp. A piece of *Eucalyptus regnans* veneer bait wood was placed between the TERMIFILM® sheet and the concrete slab. Therefore only way the termites could reach the bait wood placed in the service penetration pipe was to penetrate the TERMIFILM. The top end of the pipe was closed with a PVC cap. Termites are able to sense the block of wood through the wire mesh providing a further stimulus for the termites to explore the barrier and attempt to reach the wood.

The experimental units at each colony site (six for each species) were installed at least a meter away from each other. Ten control units and ten treated experimental units were each distributed.
In total, forty experimental units (twenty for each target species) were installed at the Darwin site and twenty experimental units at the Brisbane site.

Figure 2: Diagrammatic representation of the TERMIFILM® experimental unit, TERMIFILM® installed as per the installation procedure for TERMIFILMTERMIFILM® with the overlap taped (with 3M Tape) on the inside, facing the concrete slab (Brisbane site)

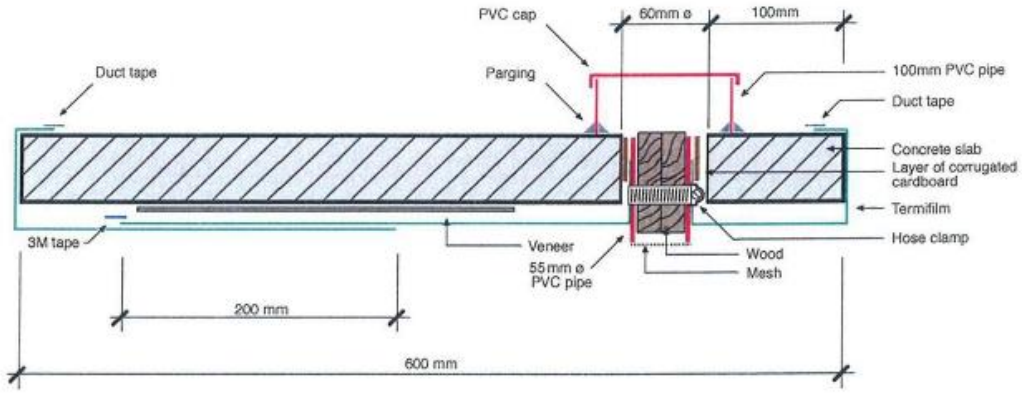
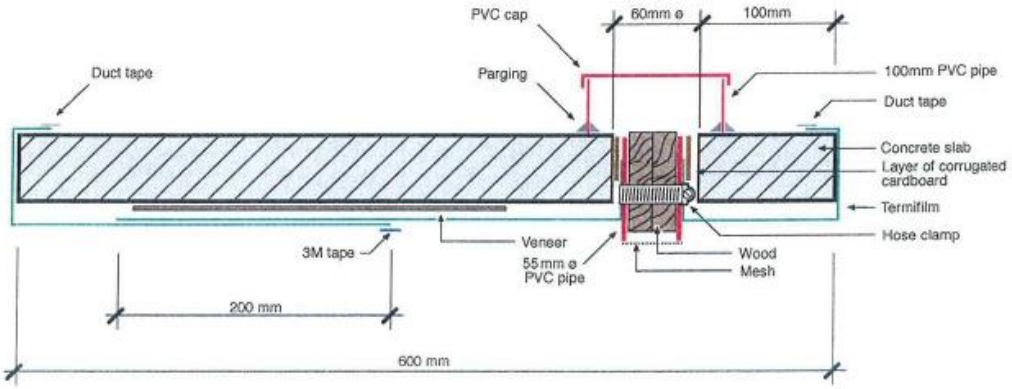


Figure 3: Diagrammatic representation of the TERMIFILM® experimental unit, the overlap taped (with 3M Tape) on the outside, facing the soil (Darwin site)



2- United States

This study was installed in the United States nationwide test sites (Arizona, Florida, Mississippi, South Carolina) in 1998 and was undertaken by the Wood Products Insect Research Forestry Sciences Laboratory of the Forest Service of the United States Department of Agriculture in cooperation with the BERKEM Group. The concrete-slab and concrete-block test methods were used to install the barrier. In the concrete-slab test, the barrier was placed between the soil and the concrete slab. In the concrete block method, the barrier was applied to the block of wood.

3- South Africa

This trial was undertaken by the South African Bureau of Standards using the test method SABS Method 859 except that:

- Four holes each measuring 350x300x150mm deep were dug. The holes were lined with TERMIFILM® and the ends protruding over the side of the hole were covered with soil.
  Six Saligna wood bait specimens coded A-F were placed out on the TERMIFILMTERMIFILM® as indicated below:

A	B	C
D	E	F

  The hole was then covered with a fibre cement sheet and the sides covered with soil.
- Another four holes except with no TERMIFILM® were used. These served as untreated controls.

The treatment was carried out on the 8th of July 1997. The termite species identified at the research station were *Microtermes sp.*, *Microcerotermes sp.*, *Allodontermes sp.* and *Odontotermes transvaalensis.*

4- Thailand

The trial was carried out by the Section of Development on the Prevention and Control of Forest Pest Insects of the Forestry Research and Development Office of the Royal Forest Department located in Bangkok, Thailand. The trial was located at the Extension & Development Utilization of Small Timber and Non-Wood Forest Products Station, Royal Forest Department, Ratchaburi Province, Thailand. The RFD standard methods on efficacy testing of chemicals used as soil treatment for prevention of subterranean termites were used with four replicates. The duration of the trial was three years (February 2011-March 2014). Tested organisms were subterranean termites.

5- French Guyana

The field tests in French Guyana were conducted in two areas:

- an urban area (PARIACABO + Campus) infested by *Nasutitermes spp*, *Cryptotermes sp* and *Coptotermes testaceus*,
- a forested area (PARACOU) mainly infested with *Nasutitermes spp* and *Heterotermes tenuis.*

The posts were put in the soil to a depth of 10-cm in July 1998 observations made once a month for one year. The inspection visits were made with the cooperation of the experts of CIRAD, France.

<u>Installation of the traps with TERMIFILM® in the urban area</u>

Traps with TERMIFILM® were installed at three sites. At each site, there were: two control samples of Poplar, two control samples of Kobe, one post of Kobe with TERMIFILM®. The two wood species Kobe (*Sterculia pruriens*) and Poplar (*Populous spp*) are sensitive to termite attack.

<u>Installation of the traps with TERMIFILM in the forested area</u>

Traps with TERMIFILM® were installed in three sites. At each site, there were: two control samples of Poplar, two control samples of Kobe, one post of Kobe with TERMIFILM®. All posts were randomly placed.

The site of the SIMKO in the village SARAMACA at Kourou also was treated with TERMIFILM® in 1996. It is located in an area known for attacks by *Coptototermes subterranean termites.*

6- Metropolitan France

The test was set up on April 1994 and was the first field trial undertaken to validate the protective effectiveness of TERMIFILM®.

The test site is located on the Ile d'Oléron, in the forest of Saint-Trojan-Les-Bains (ONF site).

The test TERMIFILM® was installed directly on the ground. The test area was naturally infested by *Reticulitermes flavipes* and displayed high termite activity. Nine test devices are monitored (8 with TERMIFILM® and one control without any termite protection). In each test device, small planks of maritime pine and blocks of scots pine were used to provide a potential source of food to termites.

Two test devices are installed only with TERMIFILM® :

- Device 1 : 1- 4 holes in TERMIFILM® on a median line,
- Device 2: 2- 16 holes in TERMIFILM® in a rectangular grid.

Results and discussion

1- Australia

At the annual inspection, the experimental units were carefully lifted and examined for signs of damage to the TERMIFILM®. The bait wood was inspected and termite damage noted.

The results of inspections carried out for the period 1999 to 2004 follows:

- Termite activity and pressure by the target species on the experimental units was high at the tropical Darwin, Northern Territory and subtropical Brisbane, Queensland, sites with a number of non-target subterranean termite pest species also present around the TERMIFILM experimental units.
- Control units with untreated TERMIFILM® were penetrated by *Mastotermes darwiniensis* after two or three years, by the mound-building form of *Coptotermes acinaciformis* (Darwin) within the first year and the tree-nesting form (Brisbane) within one to two years.
- Bait wood was not replaced after the inspection following three years of exposure to termites (2002). The TERMIFILM® units remained in situ exposing the TERMIFILMTERMIFILM continuously to the local climate and soil conditions at both the tropical and subtropical sites. After inspection in 2004 (five years), bait wood was re-installed under the experimental units.
- All TERMIFILM® experimental units resisted termite attack and remained intact in the fifth year after they were exposed to termite pressure.
- The repellent effect of the insecticidal active ingredient contained in TERMIFILM® was clearly evident in the trials at all sites and against all target species of termite. Termites consumed much of the bait wood underneath the TERMIFILM® sheets. Although the tape was not termite resistant, it also was not attacked by termites, no doubt due to the repellency of the permethrin treatment in TERMIFILM®.

2- United States

Eight annual inspections were made since 1998 with the eighth inspection made between February and September 2006. A summary of results is presented below:

Table 1: Percentage of TERMIFILM® barriers penetrated by subterranean termites for (A) concrete slab, (B) concrete block, and (C) controls the eighth year in field tests (2006) of TERMIFILM®

Sample	Arizona (2006)		Florida (2006)		Mississippi (2006)		South Carolina (2006)	
A. Concrete slab								
TERMIFILM® control unit	0		0		10		10	
TERMIFILM® 1% permethrin	0		10*		0		0	
CS[1]	10		0		30		0	
B. Concrete block								
Treatment	Center control block	Barrier penetrated	Center control block	Barrier penetrated	Center control block	Barrier penetrated	Center control block	Barrier penetrated
TERMIFILM® control unit	70	0	10	0	50	0	20	0
TERMIFILM® 1% permethrin	30	0	80	0	60	0	30	0
Controls								
CS[2]	50		70		60		20	

[1]6-mil-thick plastic polyethylene sheet vapor barrier only, not cut

[2]6-mil-thick plastic polyethylene sheet vapor barrier only, cut

*1% TERMIFILM barrier was cracked and brittle in all 10 concrete slabs in 2006

Table 2: Cumulative percentage (1999-2006) of TERMIFILM® barriers penetrated by subterranean termites for (A) concrete slab, (B) concrete block, and (C) controls attacked a four study sites

Sample	Arizona (2006)		Florida (2006)		Mississippi (2006)		South Carolina (2006)	
A. Concrete slab								
TERMIFILM® control unit	10		0		10		0	
TERMIFILM® 1% permethrin	10*		10		0		0	
CS[1]	0		0		0		30	
B. Concrete block								
Treatment	Center control block	Barrier penetrated	Center control block	Barrier penetrated	Center control block	Barrier penetrated	Center control block	Barrier penetrated
TERMIFILM® control unit	80	10	100	0	100	20	70	0
TERMIFILM® 1% permethrin	80	0	100	0	100	0	80	0
Controls								
CS[3]	50		100		100		100	
CB :no barrier, bare soil	80		100		100		90	

[1]6-mil-thick plastic polyethylene sheet vapor barrier only, not cut

[2]6-mil-thick plastic polyethylene sheet vapor barrier only, cut

*1% TERMIFILM barrier was cracked and brittle in all 10 concrete slabs in 2006

These trials demonstrate that TERMIFILM® is a potentially effective candidate for termite control in the United States.

3- South Africa

A forty-two month survey was carried out on the 12th of January 2001 to determine if TERMIFILM® was still effective.The results obtained are given in Table 4:

Table 3: 42 Month observation in South Africa field trial - TERMIFILM®

Sample	Repli-cates	Position of baits specimens and termite activity						Number of bait specimens attacked	Remarks
		A	B	C	D	E	F		
TERMIFILM®	1	Na	Na	Na	Na	Na	Na	0	Replicate 1 : Fungi on bait samples
	2	Na	Na	Na	Na	Na	Na	0	
	3	Na	Na	Na	Na	Na	Na	0	Replicate 2 : Dead beetles
	4	Na	Na	Na	Na	Na	Na	0	
Untreated control	1	Va	Va	Va	Va	Va	Va	6	Replicate 2: Fungi on bait samples
	2	Na	Na	Na	Na	Na	Na	0	
	3	Va	Wa	Va	Wa	Wa	Wa	6	
	4	Va	Va	Va	Va	Va	Va	6	
Legends: Va=very active; Sa=slightly active;Wa=were active; Na=not active; Td=totally destroyed									

The biological efficacy of TERMIFILM® was proven against termite attack from *Microtermes sp.*, *Microcerotermes sp.*, *Allodontermes sp.* and *Odontotermes transvaalensis*.

4- Thailand

The TERMIFILM® plastic barrier prevented subterranean termite attack in Thailand in the field trial for three years. The results (Table 4) at three years revealed no damage in treatment areas while the control was one hundred percent destroyed. Therefore the efficacy of TERMIFILM® was proven.

Table 4: Result Thailand Field trial of percentage of damages - TERMIFILM®

Sample	Percentage of destruction				Average percentage (%)
	Replication				
	1	2	3	4	
TERMIFILM® 1% Permethrin	0.00	0.00	0.00	0.00	0.00
Control	100.00	100.00	100.00	100.00	100.00

5- *French Guyana*

Inspections done in the period 1997-2005 revealed no trace of attack by insect or termites, and no fungal attack (frequency of inspection: one time per year).

Table 5: Results of efficacy of TERMIFILM® in the six sites in French Guyana

Sites	Kobe Control sample 1	Kobe Control sample 2	Poplar Control sample 1	Poplar Control Sample 2	Kobe with TERMIFILM®
1	No termites	No termites	Presence of termites	Presence of termites	No termites
2	Presence of termites	Presence of termites	Presence of termites	Presence of termites	No termites
3	Presence of termites	Presence of termites	Presence of termites	Presence of termites	No termites
4	Presence of termites	Presence of termites	Presence of termites	Presence of termites	Presence of termites
5	Presence of termites	Presence of termites	Presence of termites	Presence of termites	No termites
6	Presence of termites	Presence of termites	Presence of termites	Presence of termites	Presence of termites

The tests made on site 1 were inconclusive on the efficacy of TERMIFILM® because none of the Kobe control samples were attacked by termites. Whereas the five others studied sites, a termite presence was noticed on some of the samples. Depending on the site, between twenty-five and eighty percent of the control samples were attacked. TERMIFILM® seemed to be efficient because at the six-month period, at five sites there was no attack on the TERMIFILM® protected samples.
The presence of termites on the Kobe sample with TERMIFILM® was certainly due to leaf-drop which covered the ground which allowed termites to reach the wood posts put in a soil with TERMIFILM®. No termite attack was noticed at the site SIMKO in the village SARAMACA at Kourou.

6- Metropolitan France

The date of the last visit was May 2015 twenty-one years after the installation of the test. During this inspection, the inside of the unprotected control device appeared colonized by termites. In the two devices, no evidence of termite activity was found. No mud tunnels on the foundation walls. A lot of termite activity was observed during the inspection. , TERMIFILM® protected the wood specimens from termite attacks in the devices after twenty-one years of exposure.

Conclusions

TERMIFILM®, a permethrin-treated physico-chemical barrier, has an original and unique composition that can insure more than twenty-one years of termite protection for buildings in addition to waterproofing. The efficacy of the repellent product TERMIFILM® has been proven by laboratory tests and field tests in all regions invaded by termites: Europe, South Pacific Ocean, Indian Ocean, South-East Asia, Caribbean and Australia. The tox-ecotox profile of TERMIFILM® is classified as a non-dangerous product for humans and the environment.

References

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