

**CENTRE INTERNATIONAL DE RECHERCHE
AGRONOMIQUE ET DE DEVELOPPEMENT**

**REPORT OF MISSION
TERMITE IN EGYPT
MARCH 1 – 5, 2008, CAIRO, EGYPT**

Dr Nadine Amusant



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I. Termites, generality

I-1- Introduction

Termites are small white to tan, sometimes black colored insects that live in social group or colonies and are composed of very different looking individuals called castes. Termites belong to the order Isoptera and there are more than 2,600 different species. They are social insects and live in colonies. However, most of this diversity can be lumped into four distinct groups: dampwood, drywood, subterranean, and arboreal/mound builders. Dampwood termites are very restricted in their distribution. They derive their name from the fact that they live and feed in very moist wood, especially stumps and fallen trees on the forest floor. Drywood termites are common on most continents. They do not require contact with moisture or soil. Subterranean termites are very numerous in many parts of the world and live and breed in soil, sometimes many meters deep. Some subterranean termites may construct nests in trees or other above ground locations. Lastly, some mound builders are capable of building earthen towers 8 meters or more in height. Termite mound, which from their sheer size or numbers often can dominate landscapes, are common in Africa, Australia, Southeast Asia, and parts of South America. Termite mounds are not found in North America or Europe.

In Egypt, drywood and subterranean termites pose the greatest threat to structures. Though the wide desert and steppe of North Africa, four families of the Isoptera occurred: Kalotermitidae, Hodotermitidae, Rhinotermitidae and Termitidae. Termites in Egypt have been in existence since time immemorial, they include 11 species as follows:

Subterranean termites

- *Anacanthotermes ochraceus* Burs (Hodotermitidae): it is mostly found in Lower Egypt. It feeds mainly on wheat or rice straw from green bricks of which rural houses are made. Its attacks timbers or any cellulotyc material. It is restricted to soils with clay or alluvium and low moisture content.
- *Psamotermes fuscofemorales* Sjoested (Rhinotermitidae), *Psamotermes asswanensis* Sjoestedi (Rhinotermitidae), *Psamotermes hypostoma* Sjoestedi (Rhinotermitidae): the above mentioned three species are synonymous.
- *Psamotermes allocerus* Sjoestedi, (Rhinotermitidae): the *Psamotermes* occurs in Upper Egypt to Aswan. It destroys rural and urban buildings. It attacks trees as Tamaris, date palm, acacia. It prefers moamy soil of clay and sand low moisture.
- *Amitermes desertorum* Desneux (Termitidae) : this mound buidling termite occurs in Egypt. Many trees in Giza, aswan, as in the Eastern desert are severly attacked with this species, as date palm, acacia, tamarisk, egyptian small lime, sisso, bombax and entrolobium, emery tree. Damage by this Arabic, sisso, olive, fig tree termite mostly results in breakdown or death of the infested trees.
- *Microcerotermes eugnathus* Silv. (Termitidae), it was recorded at the Northern Western coast of Egypt, damaging human dwelling and attacking trees as gum, coast she oak and vine. Workers forage though covered passages on infested surfaces, as within the stem of plants.

Drywood termites

- *Cryptotermes brevis* Walker (Kalotermitidae): this species is exotic, as it termed West Indian termites. It was recorded in Giza-Egypt, and spread gradually by furniture exchange, where it has reported from other several governorates. They are very destructive for wood and dry cellulotyc materials
- *Kalotermes flavicollis* Fabricius (Kalotermitidae): it widely distributed in Lower Egypt, attacking casuarinas, Egyptian willow, ficus and mulberry previously infested with borers.
- *Kalotermes sinaicus* Kemner (Kalotermitidae) this termites was recorded in 1932 attacking railways sleepers on the Mediterranean coast of Synai-Egypt and attacking shrubs and tree stumps as casurina, the redwood fig, acacia and tamaris trees.

I-2- Control of termites in Egypt

The conventional methods of prevention and control of termites in Egypt could be summarized as follows:

Control Drywood termites

There are several methods to control the destructive activity of these termites according the choice of preventive or curative action of the treatment:

Pretreatment by using brushing with preservatives as phosphorous compounds (chlorpyrophos, phenthioate, triazophos), pyrethroid or inorganic material like copper and fluoride salts.

Treatment by using brushing, spraying by pressure or non-pressure processes injection and fumigation are methods of treating the Drywood termites. The preservative should be injected accurately in infested woods as wood-works, furniture, floors then brushing or spraying all the exposed surfaces with the solution. Another method: fumigation is run on using bromide methyl like biocide.

Control subterranean termites

- Pretreatment: there several practices to control the termites: (1) Protection with chemical barriers around buildings to protect the building in an infested area from the termite attack. (2) Protection with chemical barrier or spraying could be applied before construction. In concrete constructions basics should be treated with termicide to avoid infestation. (3) Protection of woods used in construction indoors as windows, doors, ceiling or woodworks could be accomplish by brushing or spraying with preservative.
- Treatments: the treatment are no so different of the pre-treatment: (1) Chemical barriers as mentioned above are applied around infested buildings. (2) Treatments of the infested soil, it possible to use toxic baits for safe treatment. (3) For infested wood, the injection of preservative in several holes can be used.

II- Object of the mission

The object of the mission was:

- Participation at the symposium on "Termite in Egypt", Cairo 1st march 2008.
- Visit and assessment of an infested building.
- Visit of an experimental field test at Ismailia.

III – Report of the mission

📅 01/03/2008

Arrival to Cairo on 01/03/08 at 22h 00 and reception by the Egyptian delegation of the BLAFE.

📅 Le 02/03/2008

Welcome by Dr Yousry Mohamed A. El-Sebay of the Department of «Wood Borers and Termite Research» from the Plant Protection Research Institute (Cairo) and organizer of the symposium «**Termite in Egypt**».

The main objective of the conference was to discuss about the termites: description of termites in Egypt, damages in agriculture, buildings and wooden structures, methods for controlling the termites and pest management. The language of the symposium was Arabic, so it was difficult to get to the heart of the matter.

The scientific community, representative of agriculture ministry, representative of the company Syngenta were present.

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Table 1: List of met researchers

III.1 Content of the speech

My speech was about «**Termites and Pest control**»: presentation of different methods to eradicate or to control the propagation of termites. The presentation was divided in five parts (Annex 0):

Part 1: Detection and Identification

Subterranean termites feed on wood materials and have strict moisture requirements. With these characteristics in mind, a lot can be done to prevent an infestation by eliminating the food and moisture resources in their environment. Signs of subterranean termite infestations include evidence of soil and tunnels and swarming of winged forms. Drywood termite infestations are usually obvious by the presence of characteristic dry pellets in wood or on horizontal surfaces beneath infested wood. Swarming of winged termites occurs seasonally. Darkening or blistering of wood in structures is another indication of an infestation; wood in damaged areas is typically thin and easily punctured with a knife or screwdriver. Visual searches are the most frequent means for detecting termite infestations in structures.

More modern innovations for improving termite detection include odor detectors, feeding-sensitive devices (acoustic emission), fiber optics, microwaves technology and infrared cameras. However, some of these technologies are experimental, and most are expensive and have limited availability. No detection technology is 100% effective in all circumstances. Using a combination of different technologies for detecting the presence of termites is the best approach.

Part 2: Prevention

There are many steps that can be taken to prevent termite damage/infestations. Before applying a preservative treatment, it is important to prevent the attack of termites: the process begins even before a builder starts to work on a house. The way in which homes are built impacts on the likelihood of termite invasion. During construction, we often create conditions that are conducive to termites or may allow them to enter the house unseen. There are a number of steps that can be taken during renovations and new construction to help reduce the likelihood of termite problems. Take care of the design of the building by avoid moisture content of humidity around the foundation, avoid contact between the wooden parts of the house foundation and the soil, crawl spaces should be accessible, well ventilated and high enough to deter termites. Remove wood debris, dead trees, stumps, and roots near the structure. Inspections must be done regularly and a good inspection includes looking not only for termites, but also for conditions conducive to their activity.

The choice of durable species against termites can be used to control termite attack. Some species like *Cupressus sempervirens*, *Calophyllum inophyllum*, *Thuja plicata*, *Bocoa prouacensis*, *Aspidosperma album*, *Tabebuia* sp, *Dipteryx* spp, *Chamaecyparis*, *nootkatensis*, *Thuja plicata*, *Thuja occidentali*. This approach is economical, easy to apply and safe against human health and environment.

- Preventive treatment

In areas with termites, preventive treatments before building are essential to provide an effective protection against subterranean termites.

- Preservative-treated Timber Products

There is a wide range of panel products and structural lumber with several insecticides added that are available as a management option (annexe 1). Termite susceptible wood can be turned into a termite resistant material by treating it with chemical toxicants (wood preservatives) that inhibit feeding by termites, and often growth of wood-degrading microorganisms. Use of such timber can be effective and economical for some situations. Drawbacks for wood treatment include harmful effects to applicators and the environment, depending on the active ingredients and solvents used, type of application equipment and training given to applicators.

Guarantee of the treatment: 10 years.

- Termiticide applications to Soil and non-soil Substrates (Annex 3)

This technique controls subterranean termite infestation by preventing the termite colony in the soil from entering the structure. Before construction, it is possible to apply treatment in soil in order to protect the structure for at least 5 years. The insecticide must be applied to both the inside and outside of the foundation, inside the concrete slabs, around piers, chimney bases, pipes, conduits and any other structures in contact with the soil. The applied dose is 5 l/m² or 150 l/m³ in France.

There are two general categories of termiticides that are differentiated by how termite tunneling is affected when they encounter an effective soil treatment. The first category is referred to as a "Repellent Termiticide" (eg. pyrethroids). "Repellent Termiticides" do not kill termites because they are able to detect the soil treatment. Since the termites are able to detect the treated soil, they do not tunnel into the

treated soil barrier. The other category is referred as a "Non-Repellent Termiticide: the termites are unable to detect the treated soil. Since they continue to tunnel freely through the treated soil they become exposed to the "Non Repellent Termiticide" by contact or ingestion and will die. Both "Repellent" and "Non-repellent" termiticides have proven satisfactory for making effective barriers when applied properly.

Guarantee of the treatment: 5 years.

- Physical Barriers (Termi-mesh, Termi-glass, Granitgard....)

Physical barrier is a termite barrier to protect the soil with little to no risk of pesticide exposure to the occupants. These physical barriers are designed to force activity of subterranean termites out into the open, where it can be detected during routine inspections of buildings and appropriate action taken. Physical barriers fall broadly into two types: graded particles and sheet materials. Particle barriers can be produced from sand, crushed rocks such as granite and basalt or crushed glass and consist of specific particle sizes that prevent termite tunneling when installed under or around foundation elements or penetrating conduits and pipes. These methods are largely applied in Japan, USA, and Australia. Annex 2 presents different available physical barriers.

Guarantee of the treatment: 10 years.

- Physico-chemical barrier

This physico-chemical barrier is a French invention by the CECIL Company. They have developed a revolutionary preventive process against termites: TERMIFILM, a high resistance polyethylene film which has received an active insecticide material. TERMIFILM intervene between the base of the future building and the soil where termites live.

Guarantee of the treatment: 10 years.

- Baiting Systems

Baits for subterranean termites are commercially available in a number of countries (Annex 4). This method of controlling termites is very appealing because it does not require extensive site preparation and uses significantly lower amounts of toxicant than soil treatment. For example, baiting systems may use 1,000-fold less pesticide than a typical soil treatment for a similarly sized structure. Key features of this treatment strategy involve the use of systems (bait stations) to aggregate termites to a few points close to the outside or inside of the structure and application of toxicants either to the food matrix in the stations or directly to the termites (dusts). Termites carry the active back to the nest where it is passed along to nestmates via mutual food exchange or grooming. Thus, bait technology targets the termite colony, although depending on circumstances, only reduction of the population may be achieved. Active ingredients have to be slow-acting, non repellent chemicals to allow for uptake of significant amounts of the toxicant and transfer to nestmates.

Guarantee of the treatment: 5 years.

- Other methods:

MASA (Methyl Alkenoate Succinic Anhydride)¹ is a derivative of rapeseed oil, obtained after chemical reaction with an anhydride. Wood treatment is carry out in an autoclave to ensure the improved penetration of ASAM. During wood treatment, MASA transforms cellulose into a cellulose ester that timber-boring insects cannot consume because they do not have appropriate digestive enzymes. Thus MASA is not an insecticide, but acts by depriving insects of their food, cellulose. During treatment, the oily MASA solution fills the wood alveoli and prevents swelling, thanks to its hydrophobic properties. A french campany (Sté Lapeyre) has developed an innovative treatment called "Wood Protect" based on this chemical process which uses natural and non-toxic reagents.

Other eco-friendly wood treatment exist, a Belgium patented process Wood Bliss that consists in applying a product which crystallise in the wood, thus preventing insects to access to wood fibres. The product contains no pesticide or fungicide.

Furfurylation of wood (modification of wood with furfuryl alcohol resin) and the result is a highly branched and cross-linked furan polymer grafted to wood cell wall polymers² . The Norwegian company Wood Polymerisation Technologies AS developed new processes which have become commercialise.

Part 3: Remedial Termite control

In most of the cases, the strategy selected is the same of those used to prevent attack of termites (baiting system, wood treatment, exterior and interior soil treatment, wall treatment with chemicals, physical barrier ...). The majority of treatments involve injection of a termiticide around the entire perimeter of the foundation and under the slab (called a full treatment) or may only require a partial treatment of the perimeter if the infestation is very localized. Some termiticides can be sprayed if the infestations are suited to this type of treatment.

- Space Fumigation

Space fumigation (Annex 5) involves the introduction of a toxic gas inside a structure sealed inside a tarpaulin, or into or around an isolated area or object infested with subterranean termite aerial nesters, arboreal nests, and drywood termites. These gases must be used with extreme care, because they are extremely toxic to humans, as well as other animals, and plants. Improper or careless use can result in death or injury. Fumigants treat all termite infestations or colonies simultaneously, and have high levels of efficacy, if correctly applied. Major issues to consider with the use of fumigants include the difficulty of installing tarpaulins to

¹ Elisabeth Boredon. Masa A new wood treatment product. Science and Technology in France. May 24, 2006.

² Westin, M. Lande, S., and Schneider, M. (2003). Furfurylation of wood-process properties and commercial production. Proceedings of the first European Conference on Wood modification, Ghent, Belgium, 289-306.

contain the gas within the structure, determining the proper dosage, the need to protect food items and certain furnishings in the structure, and the lack of residual control. Additional considerations with fumigant use are the need to vacate structures for 2 to 3 days for treatment and ventilation, and the possible damage to roofs caused by dragging tarpaulins or the activity of workmen. Methyl bromide¹ is a commonly used fumigant. However, issues involving the atmospheric ozone layer, odour in some household materials after treatment, and long aeration times for fumigated structures have limited the use of this fumigant. Methyl bromide¹ is scheduled for phase out for international use in several years.

- Thermal Control

There are four thermal options available for termite management (Annex 6), although mostly for drywood termites. They include electricity, heat from propane heaters, excessive cold from liquid nitrogen, and excessive heat from microwaves. Many questions remain on their effectiveness and safety to humans and building materials. Additional research will be needed before these methods are used on a larger international scale. All of these thermal techniques have limited availability.

- Biological Control

Experimental efforts have been made to control termites (mostly subterranean and arboreal nesters) using biological control agents, including fungi, nematodes, and argentine ants (Annex 7). Biological control is the use of other life forms (e.g., insects, nematodes, fungi, or microbes) to control pest insects. Although predators, parasites, and pathogens have been shown to control other insect pests, their efficacy for termites is only just beginning to be explored. The use of the treatment is experimental and commercially limited.

Part 4: Termite and situation in Europe

Europe has the smallest number of termite species in comparison with the other populated continents. Fewer than 10 species have been identified in natural habitats. *Reticulitermes* is the most common genus encountered. It is widespread around the Mediterranean (Spain, France, Italy, Balkans, and Greece) and Black Sea (Turkey, Rumania, and Ukraine). Termiticide applications are particularly challenging in Europe due to high density of buildings, type of construction, and historic age of many buildings. Termiticides used today are primarily organophosphates and pyrethroids, chemicals products that affect GABA receptors, such as imidacloprid and fipronil: they are used to treat wood, wall, and baits. There are considerable differences between termite species in behaviour and susceptibility to chemical barrier treatments.

Part 5: Termite and legal requirement in France and Europe

The objective of the law “**Termite Law N° 99-471³**” of 8 June 1999 was to protect the purchasers and owners of buildings against the xylophagous termites and other

³ Loi Termite n° 99-741 – JO

insects ordering that each property sold in that area infected needs to have a termite survey, prevent further dissemination, reduce or eradicate termite population in urban areas.

After declaration of termites presence to the mayor of every municipality, the préfet delimitate an infested area at departmental level by decree. The mayor enjoins the building owners to have termite inspections done by specialized experts and in case of termite presence the treatment have be done by specialised companies. In officially infested area demolition waste has to be treated against termites on site previous to any transportation.

A decree n°2006-591 – may 2006 gives new building code to improve the protection against the xylophagous termites and other insects. New building should be termite proof (physical and chemical barriers) and only treated or durable wood should be used for construction.

Since November 2007, soil treatment by chemical is forbidden, physical barriers are more adapted⁴.

European directive 98/8/CE

The Biocidal Products Directive 98/8/EC (BPD)⁵ seeks to establish a high level of protection for humans and the environment, and to eliminate barriers to trade by harmonizing the processes involved in placing biocidal products on the European market. But it will also dramatically transform the biocidal industry, since it will have far-reaching effects on those who produce, distribute and use active substances. The BPD describes biocides as chemical preparations containing one or more active substances that are intended to control harmful organisms by either chemical or biological means. Wood preservative are in the group 8 Under the BPD, the system of approval requires two regulatory submissions before a biocidal product can be marketed: the first on the active substances, and the second on the formulated biocidal products. Each requires a dossier per product type that contains information on its biocidal efficacy, toxicological and ecotoxicological properties, etc. CEFIC has compiled a provisional list of existing active substances for the European Chemical Bureau (ECB). A draft of this non-exhaustive list is published on the ECB Biocides web site.

After evaluation, authorization for the continuous marketing of the active substance will be granted only in those product types, for which the substance is notified and approved. Therefore, it is important to ensure that all existing and substantiated product types have been identified. Once a substance is notified, it may be marketed freely for the product types specified in the notification until such time as authorities require a full dossier for approval and inclusion in the positive list of the Biocides Directive.

⁴ Décret n°2006-1653 du 21 décembre 2006

⁵ <http://europa.eu.int/comm/environment/biocides/index.htm>

Le 03/03/08

The visit of an infested house was cancelled. The visit was replaced by a meeting with Dr Yousry El Sebay at the Plant Protection Research Institute. I presented the activities of the CIRAD research Unit: "Tropical Forest Products".

The objectives of the Unit:

- Obtaining and transferring knowledge required for more efficient use of environment-friendly timber products to promote sustainable management of forest resource,
- Development of products and processes tailored to the specific technological features of forest products from tropical region,
- Improving methods for analysing and predicting wood product quality,
- Contributing to the economic development of stakeholders in the timber sector in developing countries.

Expertises activities of the Unit:

- Wood anatomy and systematics
- Physics and mechanic
- Natural durability and preservation
- Quality control metrology
- Xylometry, non destructive control
- Scientific and technical expertise
- Wood product economic and marketing
- Wood processing techniques

I 'm including in the Laboratory of Wood Preservation

The laboratory of Wood Preservation worked with the formulator of biocides, it has been accredited by COFRAC (French committee of Accreditation) for six tests of wood and wood products according several European standards (EN 113- EN 118- EN 117- EN 73 – EN 84 – XP ENV 12038, Annex 9).

Human resources of the Laboratory of Wood Preservation: 2 researchers, 2 technicians, 1 metrologist, 1 head quality.

The projects of the Lab:

- Use of durable wood species for manufacturing termite resistant oriented strand boards panels.
- Secondary metabolites and mechanism of durability in the Teak.
- Method for assessing the natural durability of multi-species plywood
- Development of an oleotermic outdoor wood treatment process whereby wood is soaked in vegetable oil.
- Promote the use secondary metabolite like biocide.

The Research Department of Dr El Sebay is involved into activities about biological control. It will be interesting to develop complementary project with our research unit and I will contact him for further discussion.

📌 Le 04.03.08

Visit of an experimental field test at the Faculty of Agriculture (Ismailia) where two field tests were conducted:

- *Study the behavior of termite and demography (Reticulitermes sp.)*

Objective: Establish method to determine distribution, ecological and demographic characteristics of *Reticulitermes* colonies at Ismailia.

Principle: cellulose bait (paper rolls) were placed every 50 cm on the field test of 10 x 10 meters. The termite and consumption rate and the repartition of the caste have been recorded every month in order to collect information about termite installation.

Expected results: Map the distribution of invasive termite species in Ismailia and evaluation of the impact of their comparative biology and behaviour on control and further spread of these species.

- *Control of the efficacy of soil treatment against termites*

Objective: Evaluate the efficacy, longevity, and behavioural mode of action of soil insecticides applied for termite control.

Principle: a concrete slabs were installed on a treated soil with termicide. A space was maintained to place cardboard cellulose bait in the middle of the slab in order to control the presence of termites. The baits were control every month.

Expected results: Evaluate the resistance of novel preservatives to termite attack. Isolate and characterize chemicals that affect termite feeding and foraging behaviour or cause mortality and investigate their mode of action.

Recommendation:

The field tests carried out are very interesting and allow to collect new information about the biology of termite and relation with biocide. Being non destructive, baits provide the added advantage of repeated sampling for temporal comparisons. I have two remarks that it will be interesting to take into account for the interpretation of the results:

- The cardboard baits are placed at the same place of guava trees, what is the impact of these trees on the installation of the termites,


- The assays about the soil treatments are not very far from the tests on the demography of termites: what is the impact of the soil on the population of termites with the first assay.

IV- CONCLUSIONS


The legal requirements between France and Egypt are different and researchers and authorities were particularly interested by new alternatives in replacement of traditional treatment methods like chemical soil treatment.

This mission was the opportunity to meet the team of Dr El Sebay and we will stay in contact to discuss about the possibility to develop cooperation.

ANNEX




TERMITES AND PEST CONTROL




Dr Nadine Amusant
Agricultural Research for Developing Countries

Generality



- ✱ Isoptera
- ✱ 7 families
- ✱ 281 genus
- ✱ 2600 species





Termites as pest

Timbers, buildings, crops, trees

3

Termite and human

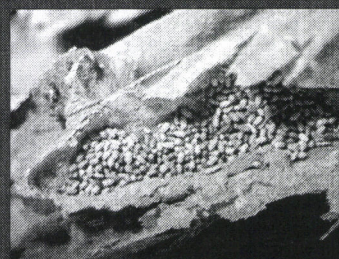
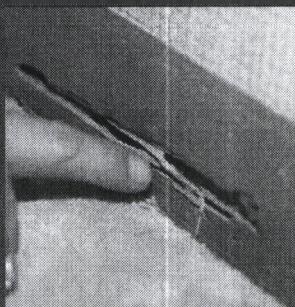


Create damage to building and wooden structure.

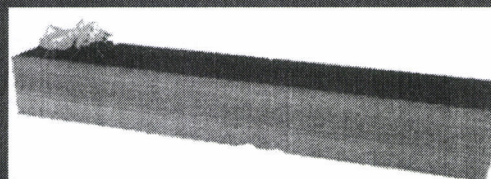
Undetected until the timbers are severely damaged and exhibit surface changes.

4

- ☀️ Swarmers, wings
- ☀️ Tubes over foundation walls, floor
- ☀️ Damage wood
- ☀️ Faecal pellets



Prevention



Design of building



Avoid moisture accumulation near the foundation.



Avoid contact between the wooden parts of the house foundation and the soil.

Design of building



Crawl spaces should be accessible, well ventilated and high enough to deter termites.



Design of building



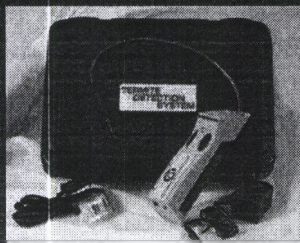
- ✱ Avoid moisture accumulation near the foundation.
- ✱ Avoid contact between the wooden parts of the house foundation and the soil.
- ✱ Crawl spaces should be accessible, well ventilated and high enough to deter termites.
- ✱ Remove wood debris, dead trees, stumps, and roots near the structure.

Annual inspection checklist



- ✱ Water is directed away from the foundation.
- ✱ Wood and other cellulose materials (including mulch) are away from the foundation.
- ✱ The crawl space is relatively dry.
- ✱ Regularly inspect cracks or joints in concrete slabs for evidence of termites.

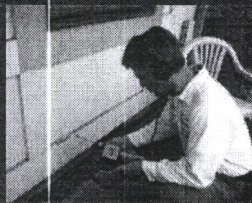
Termite detection system



The CO₂ Termite Detector detects active termites in the walls, under a slab or any space.

Based on an innovative infrared absorption sensing cell, which is extremely selective to carbon dioxide.

Detection technics



★ Termite acoustic detection detect feeding movement of the termite.

★ Micro waves: detection of the movement of the termite.

★ Termite detection dog: trained termite dog can detect termites behind walls making them closer to 95% to 97% accurate.

Preventive treatment



13

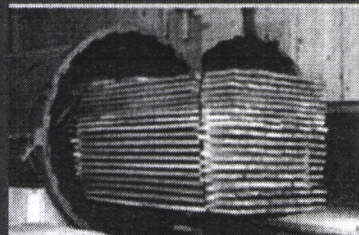
Durable species

- ✱ Sugi (*Cryptomeria japonica*)
- ✱ Kamani (*Calophyllum inophyllum*)
- ✱ Cypress (*Chamaecyparis nookatensis*)
- ✱ Western red cedar (*Thuja plicata*)...

Treated wood

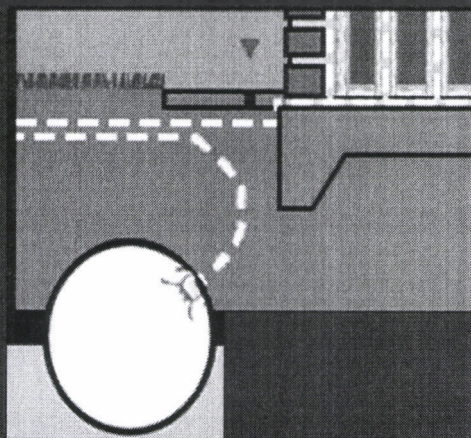


- ✱ Surface treated wood (brushing, spraying).
- ✱ Pressure treated wood.

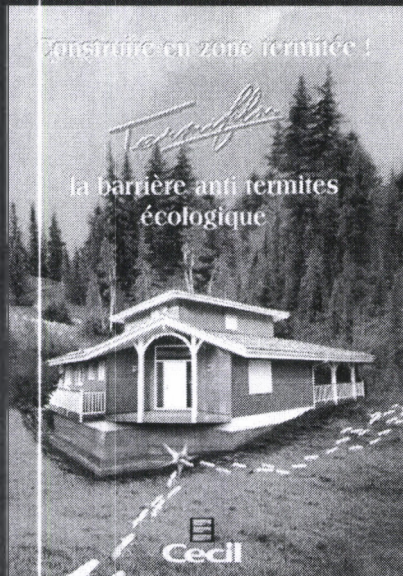


Barrier - chemical treatment

15



Physico-chemical barrier

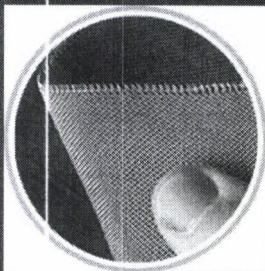


Principle: termicide fixed on polyethylene film.

Properties: repellent and lethal by contact

Physical barrier- Termi mesh

17



Principle: non-corroding, stainless-steel mesh with small gaps, placed before pouring the concrete floor pad.



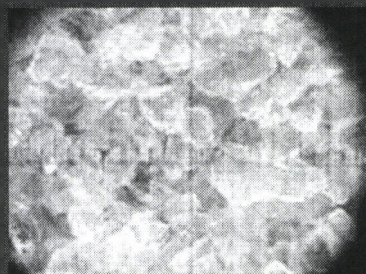
Advantage: chemical free, effective, 10 years guarantee.

Physical barrier- Termiglass



Principle: crushed glass forms (1 -3 mm).

Advantage: chemical free, effective, > 10 years guarantee, cost.



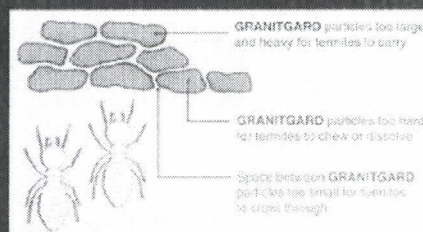
19

Physical barrier - Granitgard



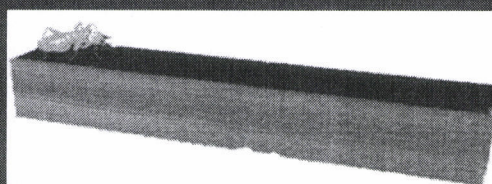
Principles: graded and shaped granitgard stones particles used in combination with durable resistant termite strip shielding material.

Advantage: chemical free, effective, 10 years guarantee, cost



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Remedial control Curative treatment



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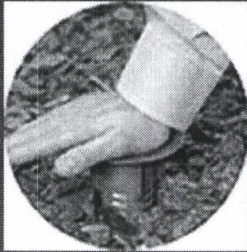
Bait system

Principle: Foraging termites consume the bait and share it with their nestmates → gradual decline in termite numbers.



22

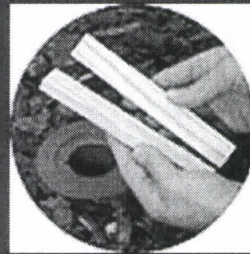
Bait system



1- attract



Treated bait



2/ Control termite activity

Bait system



☀ Drawback: slow acting, regular control, cost (6000 \$), professional operator

☀ Advantage: efficacious, biocide eco-friendly, 5 years guarantee.

Other treatments



- ☀ Microwaves
- ☀ Chemical Fumigation (drywood termite)
- ☀ Electricity
- ☀ Freezing (-20°C)
- ☀ Heat (50°C)

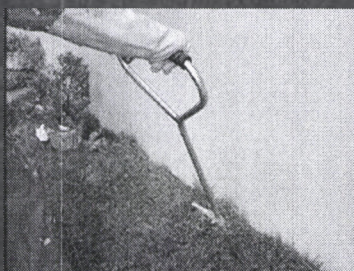


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Chemical treatment



- ☀ Treatment of the crawl space
- ☀ Treatment of the external ground
- ☀ Treatment of the internal and external masonry walls



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Wood preservatives



- ☀ Metallic salts
CCA, CCB, CFB ...
- ☀ Synthetic products
Organophoric, pyrethrinoid, phenypyrazol....
- ☀ Ammonium quaternary salts
Ammoniacal copper arseniate (ACQ), copper azole (AC).

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Wood preservatives



- ☀ Natural products
Linseed oil, neem oil, Insect killer (coco oil, geraniol, glycerin), patine d'Indien ...
- ☀ Bore salts
Boric acid, borax.
- ☀ ASAM
Rapeseed oil + anhydrid succinite alkenoate methyl.

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Biological treatment agents



Nematodes



Fungi *Metarhizium anisopliae* (Bio-Blast®)

Spodoptera littoralis (virus from cotton leaf worm).

Advantages: Safe for people, plants, and non targeted organisms

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Termite and legal requirement in France and Europe

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THANK YOU FOR YOUR ATTENTION

Annex 1: List of biocides

Types	Specifics/Mode of Action	Considerations
Ammoniacal Copper Quat (ACQ)	Metabolic poison	Apply to subterranean, arboreal, and drywood termites.
Chrommated copper arsenate (CCA)	Metabolic poison	Apply to subterranean, arboreal, and drywood termites
Copper Naphthenate	Metabolic poison	Apply to subterranean, arboreal, and drywood termites
Azole		Apply to subterranean
Zinc Napthenate	Metabolic poison	Apply to subterranean, arboreal, and drywood termites
carbamate	Metabolic poison	Apply to subterranean
Organophosphoré	Metabolic poison	Apply to subterranean, arboreal, and drywood termites
Copper Azole	Metabolic poison	Little published data.
Creosote Oil	Metabolic poison	Being phased out
Disodium Octaborate tetrahydrate (DOT)	Metabolic poison	Apply to subterranean, arboreal, and drywood termites
Extract of Azidirachtin	Repellant, Metabolic poison	Published information limited.
Neem Oil	Repellant, Metabolic poison	Published information limited.
Silica Gel	Repellant, very toxic metabolic poison	Environmentally very persistent, being phased out.
Cresote	Repellant and very toxic metabolic poison	Being phased out.

Annex 2: List of physical Barriers

Active Ingredient	Mode of Action	Application/ Considerations
Concrete Slab	Exclusion	Has to be produced to certain specifications; joints and penetrations require additional protective measures. Wide range of materials and systems used, see below.
Graded Particles		
Sand	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.
crushed rock, granites and basalts	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.
Glass	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.
Solid Sheet Material		
high grade stainless steel	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.
marine grade aluminium	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.
certain plastics	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.
Woven Stainless Steel Mesh		
high grade stainless steel	Exclusion	These barriers can be breached and bridged over by foraging mud tunnels.

Remark: All physical barriers in this table apply to subterranean termites. The above barriers do not apply to drywood termites..

Annex 3: Termicides used in Soil or other Carriers

Active Ingredient	Mode of Action	Application/Considerations
Chemical Applied to Soil or Foam		
Repellent		
Bifenthrin	Repellent and toxic, sodium ion channel inhibitor	Applied as sprays or via reticulation systems (enclosed tubing). Termites can detect chemical and move from treated areas. Lethal effects are not passed among colony members.
Cyfluthrin	Repellent and toxic, sodium ion channel inhibitor	
Cypermethrin	Repellent and toxic, sodium ion channel inhibitor	
Fenitrothion	Toxicant, cholinesterase inhibitor	
Fenvalerate	Repellent and toxic, sodium ion channel inhibitor	
Phenthiolate	Toxicant, cholinesterase inhibitor	
Permethrin	Repellent and toxic, sodium ion channel inhibitor	
Silafluofen	Repellent and toxic, sodium ion channel inhibitor	
Triazophos	Toxicant, cholinesterase inhibitor	
Tralomethrin	Repellent and toxic, sodium ion channel inhibitor	
Zeta-cypermethrin	Repellent and toxic, sodium ion channel inhibitor	
Non repellent		
Chlorpyrifos	Toxicant, cholinesterase inhibitor	Application as above. Termites unable to detect chemical. Lethal effects are delayed and may be passed among colony members.
Imidacloprid	Toxicant, non-repellent; nicotinamide inhibitor	
Fipronil	Toxicant, non-repellent; GABA inhibitor	
Chlorphenapyr	Toxicant	
Thiome	Toxicant	
Chemicals Applied as foams to soil or wood.	Many of the same active ingredients mentioned above.	Apply to subterranean, arboreal nesters, and drywood termites
Chemicals Applied as Synthetic Fibre Matting or Plastic Lamine Sheets		
Deltamethrin	Repellent and toxic,	Acts as more chemical than

	sodium ion channel inhibitor	physical barrier. Apply to subterranean termites.
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Remark: Soil treatments can be breached and bridged over by subterranean termite foraging mud tunnels. For drywood termites, the toxicant must be applied to tunnels used by foragers to be effective; if missed, the termites will not die.

Annex 4: Bait technology

Active Ingredient	Mode of Action	Application/ Considerations
Disflubenzuron	Chitin synthesis inhibitor	In food matrix
Chlorflurazuron	Chitin synthesis inhibitor	In food matrix
Hexaflumuron	Chitin synthesis inhibitor	In food matrix
Triflumuron	Chitin synthesis inhibitor	Dust
Disodium octoborate tetrahydrate	Metabolic toxin	In food matrix/dust
Arsenic trioxide	Metabolic toxin	Dust
Hydramethylnon	Metabolic inhibitor	In food matrix
Sulfluramid	Metabolic Inhibitor	In food matrix
Biocontrol Agents		
Fungus: spores, mycelium.	Grows through cuticle and utilizes entire termite body	Also biocontrol system (see Table 9). Use as bait and soil treatment is experimental.
Nematodes: infective stages	Invade; carry bacterium which produces lethal toxins	Bait system is experimental

Remark: There are no commercially available baits for drywood termites

Annex 5: Fumigants

Active Ingredient	Mode of Action	Application/ Considerations
Carbon Dioxide	Asphyxiant	All of these gases are very toxic and require evacuation of structure prior to treatment.
Methyl bromide	Metabolic poison	
Phosphine	Metabolic poison	
Sulfuryl fluoride	Metabolic poison	

Remark: Determination of the termite pest (subterranean, arboreal or drywood) is necessary before proceeding on with the information in this table.

Annex 6: Thermal treatment.

Active Ingredient	Mode of Action	Application/ Considerations
Electricity	Electric shock is best guess.	All have limited effectiveness and safety data and also limited in use.
Heat	Denature proteins using high temperatures via propane heaters.	
Liquid Nitrogen	Disruption of cellular membranes using very low temperatures.	
Microwave	Denature proteins using high temperatures via microwaves.	

Annex 7: Biocontrol treatment.

Active Ingredient	Mode of Action	Application/ Considerations
Fungus: spores, mycelium.	Grows through cuticle and utilize entire termite body	Bait systems (see Table 6); soil treatments; experimental and limited commercial
Nematodes: infective stages	Invade; carry bacterium which produces lethal toxins	Bait systems; experimental
Ants	Predator	Opportunistic; not suitable for targeted applications

Annex 8: List of standards

EN 113. AFNOR (1996). Produits de préservation du bois - Méthode d'essai pour déterminer l'efficacité protectrice vis-à-vis des champignons basidiomycètes lignivores - Détermination du seuil d'efficacité

EN 118. AFNOR (2005). Produits de préservation des bois - Détermination de l'action préventive contre les espèces de Reticulitermes (termites européens) (méthodes de laboratoire)

EN 117. AFNOR (2005). Produit de préservation du bois - Détermination du seuil d'efficacité contre les espèces Reticulitermes (termites européens) (Méthode de laboratoire)

EN 73. AFNOR (1998). Produits de préservation des bois - Épreuves de vieillissement accéléré des bois traités avant essais biologiques - Épreuve d'évaporation

EN 84. AFNOR (1997). Produits de préservation du bois - Épreuves de vieillissement accéléré des bois traités avant essais biologiques - Épreuve de délavage

XP ENV 12038. AFNOR (2003). Durabilité du bois et des matériaux dérivés du bois
Durabilité du bois et des matériaux dérivés du bois – Panneaux à base de bois - Méthode d'essai pour déterminer la résistance aux champignons basidiomycètes lignivores
Méthode d'essai pour déterminer la résistance aux champignons basidiomycètes lignivores

Annex 9: List of my relevant publications

F. Mellouki, F. N. Amusant, F. El hanbali, M. Akssira (2006). La durabilité naturelle et potentialités d'utilisation des extractibles comme matières actives entrant dans la composition des produits de traitement du bois. Troisième école des sciences et technologies du bois. 8-10 Dec 2005.64-

F. El hanbali, N. Amusant, F. Mellouki, M. Akssira, C. Baudasse. (2006) Potentialité d'utilisation des huiles essentielles de Juniperus dans la lutte antitermite. Coloquio internacional sobre sabinas esnbrales (genero Juniperus) – Ecologia gestion florestal sostenible. 34-26 mi 2006 à Soria. 325-327.

F. El hanbali, N. Amusant, F. Mellouki, M. Akssira, C. Baudasse. (2007) Potentiality of use extracts from Tetracelis articulata like biocide against wood destroying organisms: termites. The international research group on wood preservation. 38th Annual Meeting. Jackson Lacke Lodge, Wyoming, USA 20-24 May 2007. IRG/WP/0730419.

F. El Hanbali, N. Amusant, M. Akssira, F. Mellouki. (2007). Activité Antitermite de l'Huile Essentielle du Bois de Tetracelis articulata. 5th Andalusian Spanish Moroccan meeting on natural products chemistry. Octobre 2007 (Espagne).