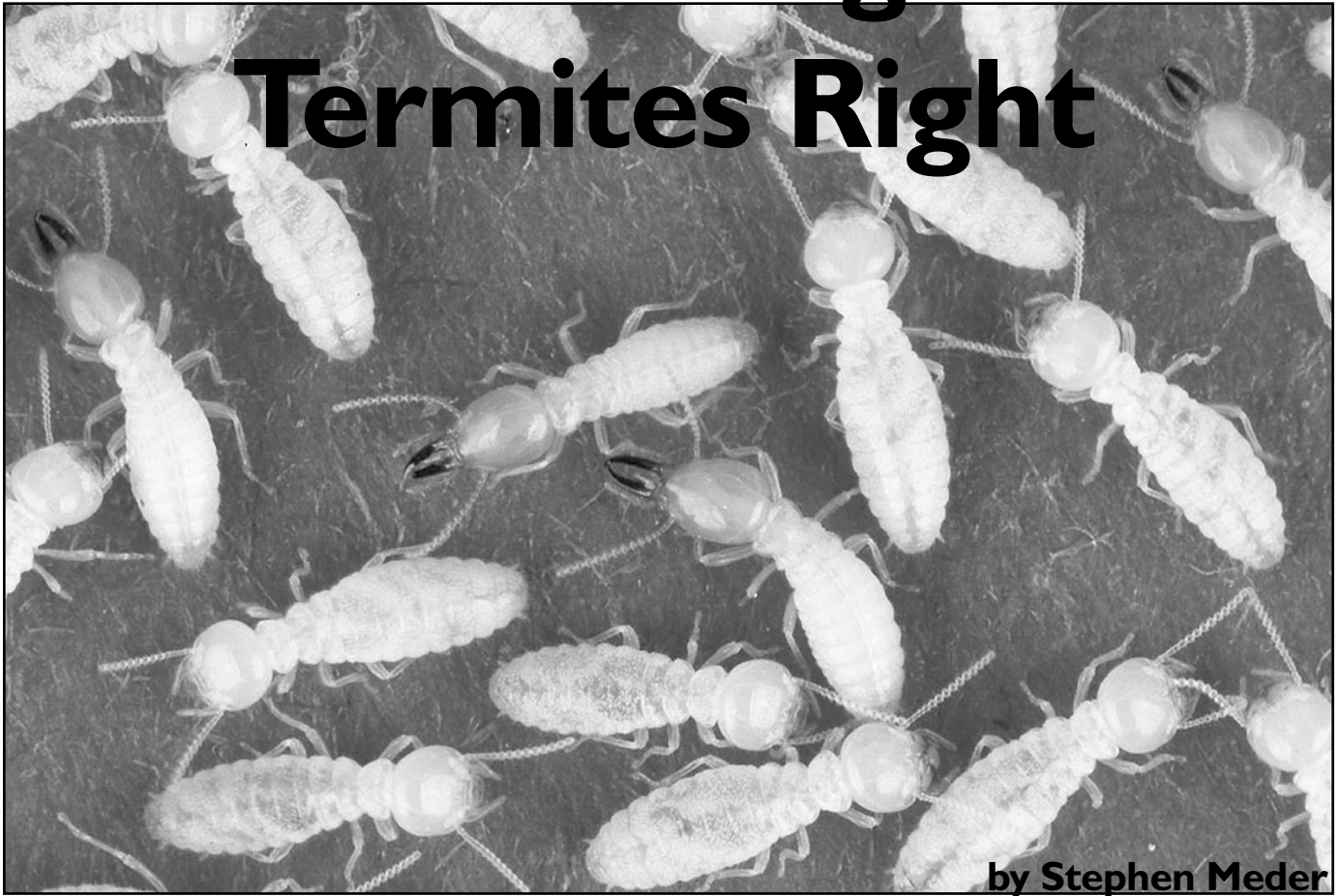


# Treating

# Termites Right



by Stephen Meder

**From designing them out of houses to stopping them from molting, there's a wealth of healthier ways to get rid of them.**

**T**ermites wreak far more damage to buildings than any other insect species. Annual destruction from termites is estimated to be close to \$1 billion nationally. In Hawaii alone, the cost of preventing, controlling, and repairing termite damage approaches \$100 million annually.

Until recently, most effective termite treatments have been toxic—less so to humans than to the pests, but dangerous nevertheless. Although I know of no studies definitely linking these chemical treatments to human health problems, anecdotal evidence certainly

suggests such a link. In one instance, the occupant of a recently remodeled house in Texas had to move out after she developed a host of baffling symptoms, including numbness on her left side, memory loss, speech impairment, and fatigue. The usual suspects, such as volatile organic compounds, were tested to no effect. It wasn't until a soil sample turned up extremely high levels of chlordane that the likely agent became apparent. The property had been treated for a termite infestation during the remodeling phase. A new duct run had been installed to a sun-

room, and no return path was available. After the return problem was addressed and the crawlspace sealed, the owner was able to move back in.

While chemical treatments are the obvious, and often the easiest, approach to controlling termites, newer strategies that are safe to workers, inhabitants, and the environment are well worth any extra effort involved. The more environmentally benign methods developed to control termite damage in Hawaii that I will describe below can be adapted to other tropical and subtropical regions—such as the Gulf states—

where these pernicious pests also reign. These approaches to controlling termites are part of a larger strategy of preventing pollution, reducing energy and resource demand, and creating healthier buildings and environments.

## Voracious Eaters

Termites have a place in nature. They ingest dead organic matter and recycle its nutrients through the soil. The built environment reshapes the organic feedstock from the termites' natural environment but does not significantly alter its content (see "A Termite Primer," p. 29).

The Formosan termite is the subterranean variety most commonly found in Hawaii. It is much more prolific, difficult to detect, and voracious than any other type of termite in the region. Formosan termites destroyed a new home built on the ridges in Honolulu within just two years. Though they were spotted during the construction phase, they were ignored. By the time the owners moved in and called in an expert, the damage was too extensive for remediation. The house had to be torn down and rebuilt. In another instance, a remodel job on the windward side of Oahu, Formosan termites infested the roof beams and hollowed them out within three years. I myself have put redwood decking material directly on the ground, as a temporary walking surface, and found that within two months the wood was completely infested and substantially damaged.

## Designing for Prevention

Chemical treatment of the soil surrounding a building site is the most common first line of defense against termites, but the physical barriers described below can produce the same results and are much less dangerous to human health. The best way to mitigate termite damage is to design them out of the building from the start (see Table 1). Separating the building from the ground and choosing construction materials that are not susceptible to termite infestation and damage are required steps in any termite prevention plan.

## Chemical Ground Treatment

In the past, chlordane was the chemical of choice. It was generally effective at deterring termites, but it was deemed too toxic to humans and was removed from the market in the 1980s. Since then, less toxic solutions have been applied. These solutions are believed to be less harmful to people, but are also a less effective barrier to termites. They need to be reapplied every five to seven years—a more frequent dosing schedule than chlordane required. All of these ground treatments must be applied under certain very particular conditions for maximum effectiveness.

In the early 1990s, the University of Hawaii's Department of Entomology tested five of the ground treatment chemicals that are most commonly used in Hawaii. The chemicals, followed by their trade names are: chlorpyrifos (Dursban TC), cypermethrin (Demon TC), fenvalerate (Tribute), isophenphos (Pryfon), and permethrin (Dragnet FT). Chlordane (Goldcrest C-100) was also tested as a control chemical. Some of these chemicals were tested over a period of ten years; others were added only during the last two or three years of the study. The test sites were located at a variety of elevations; these experienced small differences in temperature but greater differences in moisture level. The study found that the

**Table 1. Control Methods by Project Phase**

Project Phase	Control Method
Demolition	<p>Clear all debris, especially organic matter such as wood scraps, cardboard, and paper.</p> <p>Thoroughly remove all roots when clearing vegetation; termites will infest decaying matter in the ground.</p> <p>Inspect lot for termites while lot is clear.</p>
Design	<p>Design with materials that are impervious or unattractive to termites, such as concrete and steel.</p> <p>Use methods or combination of methods that will effectively control termites for each particular project.</p> <p>Match wood treatment with specific design application.</p> <p>Match wood treatment with specific wood.</p> <p>Match ground treatment with specific soil conditions.</p> <p>Specify that all field cuts of lumber get hand treated.</p> <p>Use termite control methods that are worker-, inhabitant-, and environment-friendly.</p> <p>Keep drainage flow away from building.</p> <p>Keep plantings 24 in away from building perimeter.</p> <p>Do not allow wrapped pipes to extend from ground to building.</p> <p>Form BTB and/or wire mesh barriers around all slab penetrations.</p>
Construction	<p>Follow termite control design specifications.</p> <p>Reinforce worker safety in termite control strategies.</p> <p>Treat field lumber cuts and holes with brush-on wood treatment.</p> <p>Practice constant on-site diligence against termite activity and opportunities.</p> <p>Protect BTB from contamination during construction.</p> <p>Do not install infested material.</p>
Maintenance	<p>Make regular visual inspections.</p> <p>Use in-ground termite monitors.</p> <p>Use removable baseboards, if possible.</p> <p>Keep water and vegetation away from building.</p> <p>Do not disturb chemical ground treatment.</p> <p>Do not attract swarming termites. Turn off lights when termites are swarming.</p> <p>If termites enter house by swarming, locate entry and seal it off.</p> <p>Kill termites that have landed from swarms. They are preparing to nest.</p>

choice of chemical must take into account the conditions in which the chemical will be deposited. Factors such as soil type, temperature, and available moisture must be carefully considered.

In addition, several other factors must be considered to ensure the effectiveness of the chemical soil treatment. First, the chemical soil treatment must go into dry soil. When applied to a typically dry soil, the chemical must have at least 24 hours of drying time. Drying allows the chemical to bond to the soil. This keeps the protective barrier in place and prevents the treatment from leeching. Second, the treated soil layer must be protected by the slab, gravel, or surface soil layer. If the treated layer is exposed to ultraviolet rays, its effectiveness is seriously diminished. Further disruptions to the treated layer—such as excavations for plantings or construction—will also undermine the effectiveness of a chemical barrier. For all of these reasons, physical barriers are a much better choice for termite prevention.

## Physical Barriers

Two types of physical barrier are used in Hawaii to stop the ground attack of termites: the basaltic termite barrier and the wire mesh barrier.

The basaltic termite barrier (BTB) is basalt rock crushed to a particle size of 1.6 to 2.5 millimeters (mm). Grains of this size are too big for the termites to move aside and too small for them to get between. A minimum 4-inch layer of BTB is placed under and around the foundation slab and all footings. The crushed rock forms a nontoxic, impenetrable barrier between the ground and the building. It forces the termites to go around the barrier, exposing them to detection and eradication. The efficacy of this system is dependent upon proper installation: The BTB layer must not be contaminated with dirt or construction dust.

The wire mesh system, originally developed in Australia, is currently gaining popularity in Hawaii. The trade name is Termi-Mesh. This nonchemical

termite control system utilizes a marine-grade stainless steel screen, with openings of 0.66 mm x 0.45 mm, as a physical termite barrier. These apertures are too small for the subterranean termite to penetrate. Again, installation is the key to the success or failure of the system. The mesh must be seamlessly applied as a continuous barrier under the slab, under cold joints, over concrete block, and around all plumbing and electrical penetrations. It can also be used as a socklike protective wrap around the base of in-ground posts. This has been found to be a very effective, benign barrier. It has an impressive repair warranty, but it is very expensive.

At present, the Honolulu building code requires all structural wood members to be chemically treated for termites. The ground treatment in new construction must be either a chemical or a BTB. Remedially, chemical ground treatment is more common, but BTB can also be an effective remedial strategy, especially around pipe penetrations.

**Table 2. Wood Treatments**

Chemical Treatment	Description	Advantages	Disadvantages	Recommendations
ACZA (ammoniacal copper zinc arsenate)	Dark blue, high-pressure ammonia-borne chemicals. Permanently bonds with wood.	Good protection. Takes stain and paint. Only treatment recommended for ground or water contact.	Toxic, splotchy, does not take light stain, has strong odor. Must be incised, difficult heartwood penetration,* not used on glue laminated wood products (glulams).	Retention:** 0.4 pcf Assay zone:*** 2x — 1/32–3/4 in 4x — 1/32–1 in Kiln dry before treating.
CCA (copper chromium arsenic compound) wolmanized, osmose	Common green, high-pressure, water-borne solution.	Treatment very visible, incising helps penetration, permanently bonds to wood.	Toxic, low penetration, not applied to glulams, needs field-treated end cuts.	Retention: 0.5 pcf Assay zone: 2x — 1/32–3/4 in 4x — 1/32–1 in Kiln dry before treating.
DOT (disodium octaborate) Tim-Bor, Hi-Bor	Often has blue or reddish tint, water-borne, soluble, high-pressure chemical with good penetration.	Environmentally safe, not toxic, no odor, good penetration, even in Douglas fir; does not require incising.	Does not form permanent bond, cannot be exposed to standing water, not used on glulams.	Retention: 0.4 pcf Assay zone: 2x — 1/32–3/4 in 4x — 1/32–1 in Do not kiln dry before treating.
Tribicide II (chlorpyrifos and polyphase)	Clear, high-pressure, or dipped mineral spirit (oil borne) solution.	Good for glulams, no discoloration, no odor, good penetration, can take finish.	Not for soil or water contact, toxic, expensive.	Retention: 0.5 pcf Assay zone: 2x — 1/32–3/4 in 4x — 1/32–1 in

\*Penetration: Depth to which chemical penetrates. \*\*Retention: Amount of chemical that remains in wood after treatment, in lb ft<sup>3</sup>. (pcf). \*\*\*Assay Zone: Depth of sample to which measurement is taken. %/10 in is standard.

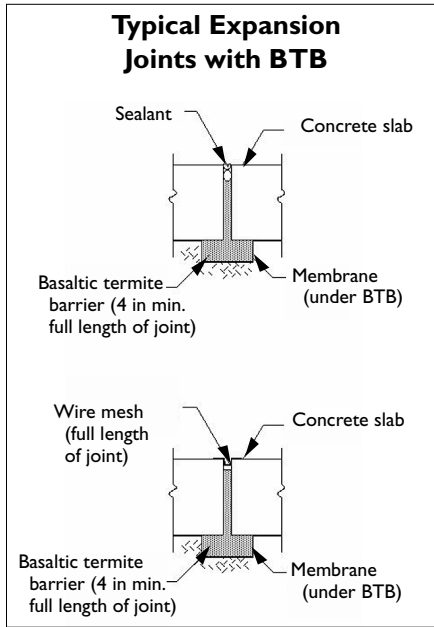


Figure 1. Properly installed basaltic termite barriers provide a non-toxic alternative to chemical ground treatments.

## Foundations

The foundation is the next line of defense against termites. It must be made as impenetrable as possible and should be of concrete rather than concrete block. In concrete block, the grout used to fill the cell cavities shrinks and leaves a void between itself and the cell wall. These spaces provide channels for the termites to travel through, undetected, from the ground up into the building structure. Poured concrete does not pose this problem, but this means that insulating concrete forms cannot be used. Cracks as small as 1/32 inch can be avenues for termites. If concrete block is used, shrinkage cracks should be filled to eliminate termite entry points (see Figure 1). Pro Poxy is a thick epoxy material that can be used to fill cracks, increasing the line of resistance against termite penetration.

Metal tie-downs, which are embedded in grout to fill concrete block cells, also develop shrinkage cracks around them. These points provide termites with entry opportunities and should also be sealed. Galvanized metal termite pans should be used to separate foundations from wooden structures, such as the framing members (see Figure 2).

In climates with greater temperature swings than in Hawaii, metallic termite

pans could exhibit greater expansion and contraction due to the metal's thermal coefficient of expansion. This could crack the epoxy top coating over the pan and allow openings for termite penetration. In this case, it would be better to cap the concrete block with poured concrete. Keep in mind that poured concrete is always preferred over a concrete block foundation wall.

Subterranean termites can crawl through cracks in slabs—and often do. Pouring slabs that will not crack is the best method of preventing this.

## Wood Treatment

After the foundation, the next level of defense is to treat the wood used in the building's construction. Damaged wood should be replaced with properly treated new wood or with steel framing.

There are two means of chemically pressure-treating wood for termite resistance. These are water-borne treatments and oil-borne treatments (see



CMU cells filled with grout shrink, creating termite highways to the floor structure. The cells must be sealed with Pro Poxy or a similar sealant.

Table 2). Different species of construction lumber react differently with the various chemical treatments, so it's important to match lumber species with the most effective chemical treatment. Water-borne treatments are generally considered to be more effective, because they kill more termites than do oil-borne treatments. However, they also have a disadvantage: The infused water may swell the wood, which can exacerbate warping and checking. Water-borne treatments should not be applied to wood that will be used for interior trim.

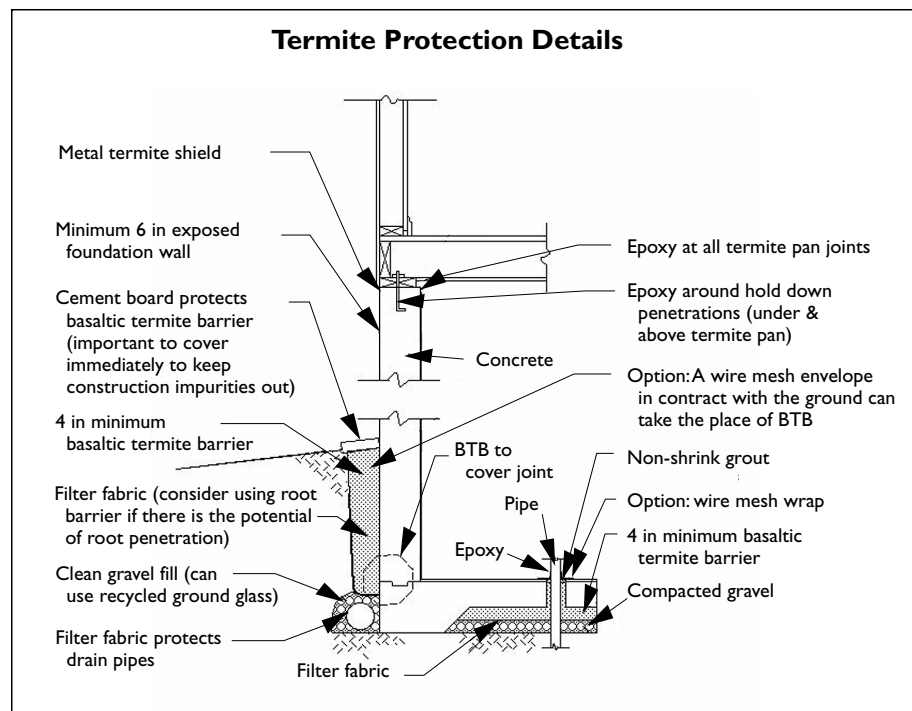


Figure 2. Galvanized metal termite pans separate the foundation from the wooden framing members.

Oil-borne treatments are effective in killing drywood termites but are less effective in killing Formosan termites. The most common oil-borne treatment is Tribucide. Oil-borne treatments do not swell the wood.

The comparative benefits of the various pressure treatments are as follows:

Plywood, especially rotary cut plywood, thoroughly absorbs water-borne treatment. Exterior-grade plywood must be used as interior-grade plywood will delaminate. A retention of .25 lb/ft<sup>3</sup> (pcf) for ammoniacal copper zinc arsenate (ACZA) and copper chromium arsenic compound (CCA) and .45 pcf for disodium octaborate (DOT) is recommended.

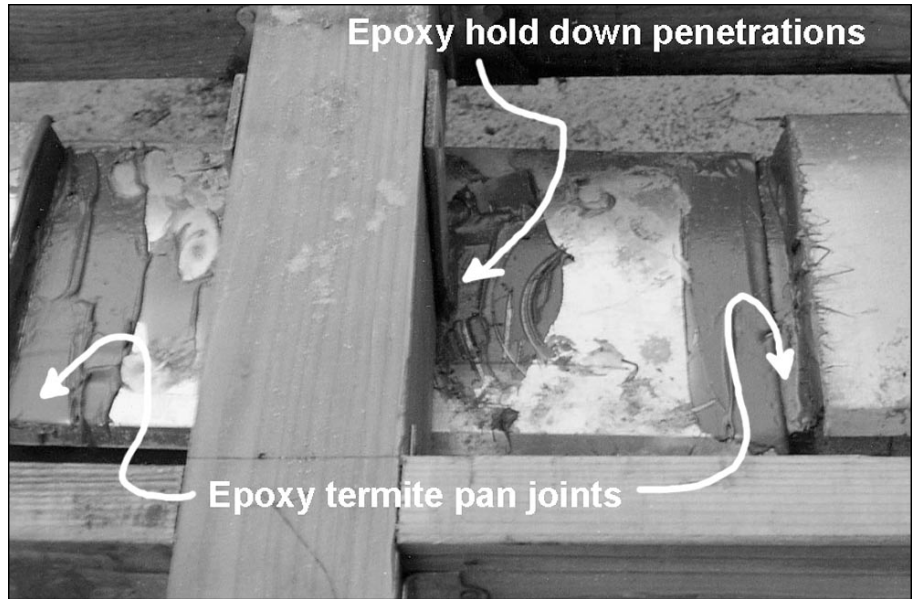
ACZA, CCA, and DOT all penetrate the softer woods well. Southern pine, being largely sapwood, gets excellent penetration, whereas Douglas fir lumber, which is mostly heartwood, is penetrated well by DOT, moderately well by ACZA, and very poorly by CCA. For ACZA and CCA, boards must be incised to improve penetration. Deep incising helps to meet the industry standards in Coastal Douglas fir, but this scoring method diminishes resistance to bending, thus reducing an important benefit of this species.

Proper installation of treated lumber is critical to its success at resisting termites. Since CCA and ACZA penetration produces only a shallow perimeter barrier, any cuts or holes that are made in CCA- or ACZA-treated lumber must be field-treated to seal off the exposed wood. This can be done either by dipping cut ends in a bucket of the solution, allowing the capillary action to draw the chemical into the exposed pores, or by generously brushing the solution onto the cuts or holes. This field process must be faithfully executed to ensure protection. To protect themselves, contractors must take every necessary precaution to minimize contact with the chemicals.

With the exception of DOT, which is basically boric acid, most of these treatments are made from harmful chemicals and thus pose health and disposal problems. Ingestion of these materials would pose a health risk.

### Baiting Systems

Baiting systems are not toxic to humans or to the environment. Only



Sealing the joints where a metal termite pan connects with the top of a CMU wall and at any other wall penetrations with Pro Poxy sealant adds an additional layer of protection against termite entry.

small amounts of insecticide are used. The chemical is kept from human or environmental contact and is ingested only by the foraging termites. These systems are marketed in Hawaii under the trade names of Exterra, FirstLine, and Sentricon.

There are two types of baiting stations: aboveground and in-ground. Aboveground stations remediate and prevent subterranean infestations. In-ground stations are set up in two stages—monitoring and baiting. To monitor for termite activity, small plastic baskets containing untreated softwood are placed in the top 1 ft of soil around the perimeter of the

building at about 12-ft foot intervals. If termites are present, they will usually bite the softwood. The monitoring station can be checked periodically for this activity by simply lifting off the lid and inspecting the contents.

Once a hit has occurred, the softwood block is exchanged for a piece of wood treated with a chitin synthesis inhibitor chemical, such as hexaflumuron. The foraging worker termites ingest this chemical and return to the nest. The nestbound young termites are not equipped to digest food for themselves. The returning workers feed them regurgitated, predigested material. If the food transferred to the young is hexaflumuron, it will inhibit their ability to molt and will eventually kill them. The baiting process is effective, but it may take a few months to wipe out a large colony. If damage continues longer than this, subterranean termites from unaffected colonies may be in the structure. Dr. Kenneth Gates and others at the University of Hawaii's Department of Entomology are currently developing a DNA identification method that will differentiate termites from different colonies. This new method will be a very valuable tool in the quest to eradicate termites from several colonies at once.

The aboveground stations are remedial only. They are placed at points



Formosan termite alates, also known as swarmers, captured on a sticky trap used to monitor populations.

within the building where infestations have already been discovered. They work, in all other ways, exactly as the in-ground systems do.

## Removable Baseboards

A Hawaii-based company has developed another integrated pest management technique for both new construction and remediation. The bottom 3 inches of interior drywall is removed, exposing the framing. Baseboards designed and manufactured for this purpose are then attached to a clip system covering the area of cut-away drywall. This system allows the homeowner or inspector to investigate for the presence of termites. The product trade name is Snap On Baseboards.



STEPHEN MEDER

Houses tented for drywood termite fumigation are a common sight in Hawaii.

## Termite Control in Existing Buildings

Reconstruction is the most difficult way to control termites. Often, at this

point, the damage is already done. There are some techniques that can be applied to make existing foundations less inviting to termites, and there is

always the technique of last resort: fumigation.

Pipe penetrations through slabs where the ground was not properly

## A Termite Primer

In order to choose the appropriate method for controlling termites, it is critical to know what kind of termite one is dealing with. There are two basic types of termite in the Hawaiian Islands: drywood and subterranean. The West Indian termite (*Cryptotermes brevis*) is the most damaging of the drywood varieties. But its destructive potential does not come close to the devastation produced by its subterranean cousin, the Formosan termite (*Coptotermes formosanus*) which was introduced to Hawaii from China through the sandalwood trade in the middle of the nineteenth century.

### Drywood Termites

Both drywood and subterranean termites swarm, but the drywood termite builds its nest in wood, and the subterranean termite nests in the soil. Drywood varieties, such as the West Indian termite, develop small, slow-growing colonies. A mature drywood colony numbers only about ten thousand—it is 1,000 times smaller than a fully developed Formosan colony. West Indian termites prefer a diet of hardwood, but they are not averse to softwood meals of construction lumber.

Careful observation of termite feeding patterns will indicate whether observed damage is from drywood or subterranean termites. Drywoods forage across the grain, eating through the annual growth rings. Subterranean termites run along the grain, clearing the wood fiber from between the growth rings. Evidence of drywood infestation is a myriad of small (kickout) holes in the surface of the wood. Through these openings, the bugs expel piles of fecal pellets, known as frass, which resemble coffee grounds. The color of the frass varies from very light to very dark depending on the termites' diet. The color does not depend on the species of termite.

An accumulation of frass below a hole usually indicates live-termite activity. Drywood termites don't require as much moisture as subterranean termites; they don't build mud tunnels; and unlike their subterranean cousins, they can be controlled through spot treatment and fumigation.

### Subterranean Termites

As their name suggests, subterranean termites typically nest underground. They are hard to detect, and they generate colonies that can approach populations of ten million. They have been found as deep as 40 ft below the surface, and they can establish a network of subcolonies, making complete eradication much more difficult. A well-fed Formosan queen can live for 20 years and can lay 2,000 eggs each day. Subterranean termites require a constant source of moisture. They can obtain the necessary moisture from areas of very high humidity, air conditioning condensation, and soil wetness around their colonies. The best way to detect subterranean infestation is by spotting the mud tunnels the workers build to protect themselves from dehydration as they carry out their destructive duties.

Both the subterranean and the drywood termites can be transported to new locations in building materials. This enables them to spread and establish new colonies. Subterranean termites occasionally establish aboveground "aerial" colonies in protected areas. Aerial colonies are built when cellulose and moisture from leaky plumbing, roofs, and so forth are available, and a nest can be created in a safe, enclosed area. Aerial colonies have been found in wall, floor, and roof cavities and packed around tubs and plumbing. Once a water source is located and the nest is established, subterranean termites rarely have trouble finding food within the building.