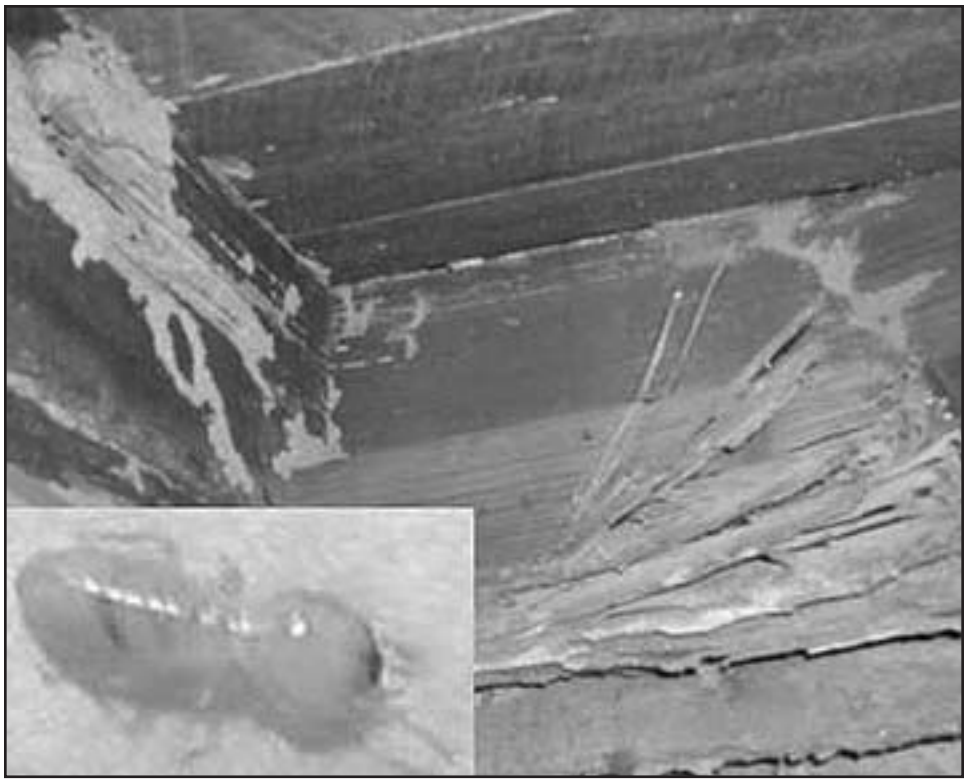
AG1154

Termite Prevention and Control Methods



UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

Cooperative Extension Service

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating

Termite Prevention and Control Methods

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Introduction

Termites cause extensive damage to buildings in Arkansas each year. Costly rebuilding is often necessary to repair their damage. On the other hand, if evidence of termites is found, there is no immediate cause for alarm. It usually takes several years for a building to become structurally weakened as a result of termite feeding.

Treatment During Construction

Chemical treatment of the soil around or under the foundation of buildings serves as one of the most important means of isolating a building from termites; it provides protection from termite attack for many years. Treatment is most effective when done before and during construction of the foundation and should be used in conjunction with good construction, not as a substitute for it. It is particularly important when using concrete slab-on-ground construction. To meet FHA termite-proofing requirements, follow the latest edition of the Housing and Urban Development (HUD) Minimum Property Standards.

Factors Affecting Termiticide Application

The soil type and its moisture content affect the penetration of pesticides. A soil fill accepts treatment best when it is damp, but not excessively wet or dry. If the soil is excessively wet, there is a chance of runoff, and the chemical will not penetrate the soil. In frozen or excessively dry soil, pesticide emulsions are repelled and puddling occurs, resulting in poor penetration and distribution of the termiticide. Check the label, most termiticide labels prohibit applications to be made into saturated or frozen soil.

Mechanical disturbance of treated soil breaks the continuity of the insecticide barrier and increases the possibility of termite penetration. The treatment of fill under slabs extends probably less than 2 inches deep, with the majority of the insecticide being in the top 3/4 inch. Therefore, very little disturbance to the treated soil can be tolerated. A freshly treated slab-foundation site should be protected with a polyethylene sheet or other waterproof material, unless the concrete is to be poured the day of the treatment. This protects the treatment from rain and evaporation. The final treatment on the outside of foundation walls should be done after all grading and other soil disturbances have been completed.

A termiticide is stable once it dries in the soil. Because the most commonly used termiticides are quite insoluble in water, leaching is not a problem. However, there is a slight risk of contaminating a well or other water supply if insecticides are applied to nearby soil that either contains layers of gravel or tends to crack severely during periods of drought. In these situations, the soil should not be treated with chemicals.

Methods of Application

The objective of applying a termiticide to soil is to provide an unbroken chemical barrier between the wood in the structure and termite colonies in the soil. Thus, the insecticide must be applied thoroughly and uniformly to block all routes of termite entry. Treatment is required around all pipes, utility conduits, foundations

and footings that contact the soil. Application procedures will depend on the soil type, grading, water table and presence of drainage tile and well location. The design of the structure, location of the colony, severity of infestations in the area and the termite species and its behavior must also be considered. The overall principle in termite control is to make it impossible for termites to move between their nests in the ground and the wood in the structure. If a portion of a structure remains unprotected, termites may still gain entrance to the building.

The rate at which the insecticide will be applied will depend greatly on the results of your site inspection. The site inspection will give you facts about the structure needed to make an application plan. The plan will consist of where applications will be made and how the treatment will be applied.

Three common methods of applying termiticides to soils are broadcast spraying, trenching and rodding.

Broadcast Spraying

A low-pressure broadcast spray may be used to apply termiticides as a preconstruction treatment only before slabs are poured. There are several other points to remember about broadcast spraying:

a) Use low nozzle pressure of 25 psi or less,
b) Do not treat the entire crawl space unless covered with untreated soil or barrier (see termiticide label) and
c) Do not treat areas intended for use as plenums.

Trenching

Trenching involves digging a narrow trench and then flooding it with a measured amount of insecticide. The trench must be right next to the face of the foundation wall or the masonry-work footing of any supporting posts or piers. The trench may not extend below the top of the footing of the foundation wall. The termiticide may be rodded into the soil at the bottom of the trench in addition to being mixed with the excavated soil as the soil is replaced in the trench.

Trenching varies with soil type and moisture. Some people suggest digging a shallow trench and then rodding the soil below to reach the depth of the footings. The trench should be slightly deeper next to the foundation so that the chemical flows against the foundation instead of away from it. On an incline, the trench is constructed in a stair-step fashion to prevent the termiticide from flowing down the incline. In wet or tightly packed soils, it is difficult to obtain the needed penetration with the trenching method. Sandy or loose soils can be treated satisfactorily under normal circumstances.

Apply the prescribed label rate of the termiticide emulsion for each 10 linear feet of trench for each foot of depth from grade to footing along the entire length of the trench. Be sure to treat the soil thoroughly as it is returned to the trench. Break up lumps and clods of soil and treat every few inches of depth as the soil is being replaced.

In general, soil and termiticide are mixed in the following manner: After the soil is removed from the trench, some of the termiticide, but not all, is poured into the trench. Some, but not all, of the soil is then backfilled into the trench and mixed thoroughly with the termiticide. Continue alternately adding termiticide and soil, and mixing thoroughly, until the trench is filled. The objective is to obtain even treatment of all the soil in the trench, so take care to combine termiticide and soil in the proper proportions as you fill the trench. Trenching should be done by two people, one to apply the termiticide and the other to add the soil to the trench and mix it with the termiticide. Both people must be certified applicators.

If you think that a foundation may leak if termiticide is poured into the trench, you may spread the excavated soil onto a tarp and add termiticide directly to the soil on the tarp. Again, only treat some of the soil at any one time. Mix it thoroughly with the termiticide and

backfill it into the trench. Proceed until all the soil has been treated and placed back in the trench.

When the trenching operation is completed, cover the treated soil with approximately 1 inch of untreated soil; this will reduce risk of exposure of residents and pets to the treated soil.

Rodding

Rodding the soil is believed by many to be the simplest method of application. The pesticide is applied through hollow steel tubes inserted vertically or horizontally into the soil. A rod is usually made of a pipe, 1/2 inch in diameter and about 4 feet long, with a handle and shutoff valve at one end. The other end is fitted with a perforated tip to disperse the liquid laterally as well as downwards.

Penetration of the ground surface may be aided by wetting down the soil before inserting the rod. After rod penetration has begun, chemical flow can start and will aid in the passage of the rod to 3 or more feet necessary to soak the soil at the footings. Always move the rod slowly, allowing the chemical to spread. Never push down and then bring up the treatment rod. Apply the suggested label rate for each 10 linear feet per foot of depth to the top of the footings.

Spacing of rodding varies with soil conditions. Usually, penetration is made every 12 inches, but can sometimes be as close as every 6 inches in clay and as much as 18 inches in sand. The objective is to place the insertion points close enough together to provide overlapping of the application; this ensures there will be no untreated gaps. Angling the rod slightly toward the foundation directs the flow against it. The rod insertion points should be parallel to the foundation.

Slab-On-Ground Buildings

This type of construction is best treated as a pretreatment. Soon after the gravel or dirt fill has been made and tamped, spray the soil with termiticide before the concrete slab is poured. Use a low-pressure (25 psi), coarse spray to avoid misting and drift.

Horizontal Barriers

Apply the label rate of diluted chemical for each 10 square feet over the entire under-slab area, and also under any attached porches, terraces, carports and garages where the fill consists of soil or unwashed gravel (Figure 1).

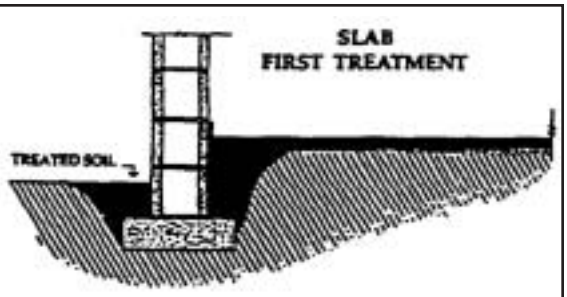

Figure 1. Chemical treatment of the fill material prior to pouring a concrete slab protects wood in the building from termite attack.

Apply the recommended amount of diluted chemical for each 10 square feet to those areas where the fill is washed gravel or other coarse absorbent material such as cinders.

Vertical Barriers

Dig a trench 6 to 8 inches wide along the outside of the foundation, including porches and patio. Where the top of the footing is more than 12 inches deep, large volumes of chemical are required. For proper application, make holes about 12 inches apart in the bottom of the trench to the top of the footing, using a crowbar, metal rod or grouting rod. These holes permit better distribution of the chemical by providing access to the soil at depths below the trench. The holes may need to be closer together in hard-packed clay soils than in sandy soils. Apply the label-indicated rate of diluted chemical for each 10 linear feet of trench for each foot of depth from grade to footing. Refill the trench with the excavated soil, mixing it with the pesticide as described earlier (Figure 2).

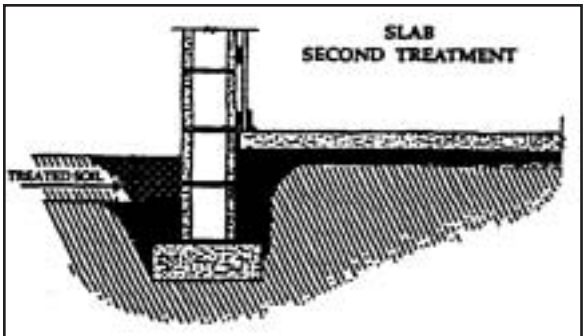

Figure 2. Application of a chemical to soil around the foundation.

Hollow Block Foundation/ Voids in Masonry

The general procedure is to drill holes in the blocks at least 1 to 2 feet above the footing or as close to outside grade level as possible but not above the top of an interior slab. Chemical should be injected to form a continuous barrier and every void should be treated. Apply the label rate of diluted chemical for each 10 linear feet of wall or foundation so that it reaches the footing.

Crawl Space Houses

Crawl spaces are low, less than 3 feet high, and usually have exposed soil. This type of construction is common in many parts of the country, particularly where basements are common. The exposed soil, short distance to floor joists and sills and unkempt nature make crawl spaces an ideal portal for termites to find and infest the wood in a structure and for swarmers to escape the nest. The termiticide selected should produce little or no odor; exposed treated soil in a crawl space can become a smelly nuisance.

Mechanical Alterations

Remove any pieces of wood left on top of the soil; contractors will often leave construction debris in crawl spaces. Capping the soil with a layer of concrete will prevent swarmers from emerging. Treat the soil before the cap is poured to form an effective barrier. The crawl space should be vented to help minimize moisture and odor build-ups. It is recommended that the total area of vents be equal to 1/150 of the total area of the crawl space. A crawl space with vents placed on at least two of the outside walls and close to the corners will have few dead-air pockets.

Soil Treatments

Treat the soil adjacent to the foundation walls by digging a trench 6 to 8 inches wide along the inside of the foundation (Figure 3). Apply the correct amount of diluted termiticide for each 10 linear feet of trench for each foot of depth from grade to the footing. Where the top of the footing is more than 12 inches deep and thus large volumes of termiticide must be applied, make holes about 12 inches apart in the bottom of the trench to the top of the footing, using a crowbar, metal rod or grouting rod. These holes permit better distribution of the termiticide by providing access to the soil at depths below the trench. The holes may need to be closer together in hard-packed clay soils than in light sandy soils. Refill the trench with the excavated soil, mixing it with the pesticide.

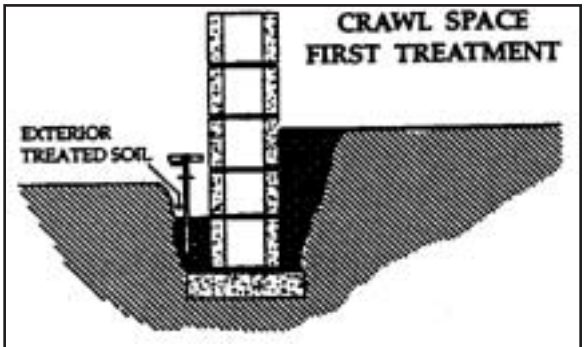

Figure 3. Preconstruction treatment of inside and outside foundation perimeter.

Create a horizontal barrier across the surface of the crawl space by applying the label rate of diluted termiticides for each 10 square feet over the entire surface area. Apply the suggested quantity of diluted termiticide for each 10 square feet to those areas where the fill is washed gravel or other coarse absorbent

material such as cinders. If buried wood cannot be removed, inject the termiticide under the soil surface near the wood. Cover the treated soil with a layer of untreated soil or polyethylene sheeting. Be sure the sheeting is sealed to the foundation wall by weighing it down with untreated soil or gravel. Overlap the edges of the sheeting and seal them by covering with clean soil or gravel.

Dig a trench 6 to 8 inches wide along the outside of the foundation, including areas such as porches and patios. When the top of the footing is more than 12 inches below the surface, rod to the top of the footing (Figure 3). The holes should be spaced about 12 inches apart to provide a continuous chemical barrier. They may need to be closer together in hard-packed clay soils than in light sandy soils. Apply the correct amount of diluted chemical for each 10 linear feet of trench per foot of depth from grade to footing. After rodding the soil from the bottom of the trench to the top of the footing, refill the trench with the soil, thoroughly mixing the soil and termiticide (Figure 4).

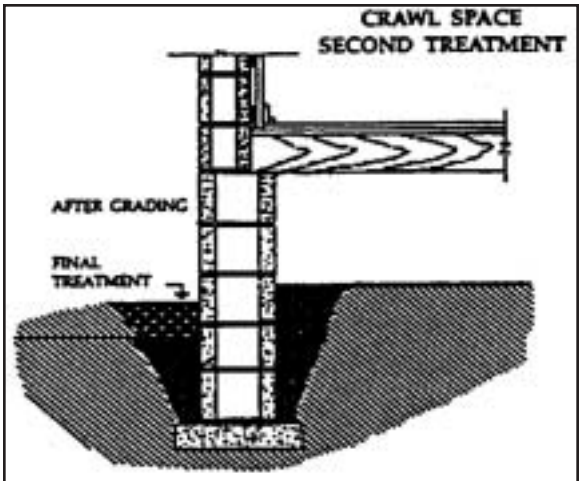

Figure 4. Second treatment after the final grading.

Full-Basement Houses

The application of a termiticide to a typical house with a basement is done in the same manner as that recommended for slab-on-ground construction.

Soil around the foundation, piers, utility lines and load-bearing walls must be treated with termiticide by rodding or trenching. For normal soil and moisture conditions, when footings are 4 to 6 feet deep, dig the trench at least 2 to 3 feet deep. Apply the indicated quantity of termiticide for each 10 linear feet of trench for each foot of depth from grade to the footing along the entire length of the trench.

Where there are hollow block foundations or voids in masonry foundations, these should be treated with the appropriate amount of termiticide for each 10 linear feet of wall, at or near the footing. Overlap these patterns of application to make a continuous chemical barrier in the voids. The termiticide must be applied so it will reach the top of the footing.

Prior to laying the slabs, apply the termiticide with a low-pressure, coarse spray to the fill to create a horizontal barrier just as with the slab-on-ground house.

Special Note: If the concrete slab cannot be poured the same day, cover the treated soil with a waterproof cover such as polyethylene sheeting. This will protect the treatment from adverse weather.

Treatment of Existing Termite Infestations

Ridding existing structures of termite infestations, plus making them resistant to future infestation, is a major goal of termite control. Generally, buildings become infested because, during construction, little or no attention was paid to the preventive measures that would have made the structures resistant to termites. It is in such buildings that termites cause heavy damage each year.

To control termite infestations in existing buildings, observe the same principles that are recommended for the prevention of infestation during the construction of new buildings. That is, eliminate conditions that favor the development of termite colonies in the soil and

conditions that permit the passage of termites from the soil to the woodwork of the building. This is important, because termites in the woodwork of a building die if they are prevented from maintaining contact with the soil or other sources of moisture.

Inspection

Each job should start with a thorough inspection. Such an inspection and record keeping will help you avoid legal entanglements, provide proper explanation of the needed work to the owner, help you price the job properly and help you or your employees do the job properly.

For a proper inspection, you need a strong light, a sharp probing tool (e.g., ice pick, leather awl or screwdriver), a tape measure, coveralls, a hard hat, kneepads, graph paper and inspection sheets. A moisture meter may be helpful. Specially trained termite-detection dogs have been useful in locating difficult-to-find colonies. A sketch drawn to scale showing the structure's ground area is very helpful in planning the work and should be kept in your files. It should show all details for treatment and should include the location and spread of the infestation found.

The inspection of both inside and outside walls for termite shelter tubes should be carried out carefully, particularly when the tubes are near soil or in basements or crawl spaces. Check for the presence of swarmers or their shed wings.

Tapping exposed wood by hitting along the grain is also necessary, particularly if foundation walls are of hollow-block construction. Termites frequently enter wood through the voids in the blocks and are very hard to detect. Soundings will tell you where the wood has been damaged or if the wood is easily damaged. If either occurs, probe further for tunnels or the brown, pasty substance called mastic that termites leave.

Many other pests, including insects and fungi, damage wood. You should be able to distinguish damage caused by termites from that caused by these other wood-destroying pests; this is essential if you are to correctly assess a situation and properly advise your customer.

Walls constructed of stone, concrete, cinder blocks, hollow tile or brick may develop cracks through which termites can pass to sills and other wood members. Carefully inspect such walls. Earth-filled porches and steps account for more cases of termite attack than any other building feature.

Check wood paneling and other wall finishings on basement walls, wood partition walls and other wood construction in the basement, which extends from masonry to the sills or joists.

Note plumbing and utility fixture entrances and passages through the basement floor and the foundation.

Determine the presence of wells, whether driven or dug, and their distance from the building.

Investigate and make records of springs, sumps, drainage tiles or anything which might be contaminated or transport pesticides away from the treatment area.

Even if an infestation is found, the inspection should be complete and thorough to ensure all points of entry and damage have been found. A light infestation may escape detection even with careful inspection.

Measure inside and outside to make sure that there are no hidden or blind rooms or double walls.

You and your customer should discuss the report and agree on a course of action. If chemical control is warranted, remember that termiticides used to prevent subterranean termite infestations may also be used to control existing infestations in buildings. The purpose of chemical control is to form vertical and horizontal barriers of treated soil between termites in the soil and voids in the structure. We will now discuss some ways of controlling termites by chemical treatment in existing buildings.

Again, many of the same principles recommended for preventing infestations apply to chemical control of existing infestations. In addition to controlling existing termites, you want to provide a continuous chemical barrier against future termite attack. Greater caution is required, however, because of the presence of plumbing, ductwork and electrical wiring, and because the building is probably occupied by people and/or pets. During application, you should have an assistant constantly checking for leaks in the basement or other areas where termiticides should not enter.

Slab-On-Ground Houses

Termite infestations in houses built with a slab on the ground present serious control problems. It is difficult to place chemicals in the soil beneath such floors, where they will be effective. Applications can be made by subslab injection or trenching or both. Treat along the outside of the foundation and, where necessary, just beneath the slab on the inside of foundation walls. Treatment may also be required just beneath the slab along both sides of interior footing and supported walls, along one side of interior partitions and along all crack and expansion joints.

One way to do this is to drill a series of vertical holes, about 1/2 inch in diameter, through the concrete slab close to the points where the termites are or where they may be entering. Space the holes about 6 inches away from the wall and approximately 18 inches apart to ensure a continuous chemical barrier of the underlying soil (Figure 5).

Do not apply termiticides until you have identified the location of heat or air conditioning ducts, vents, water and sewer lines and electrical conduits. Extreme caution must be taken to avoid contaminating these structural elements and airways. If termiticides were injected into duct systems, the residents of the household may be subject to long-term inhalation exposure to the insecticides.

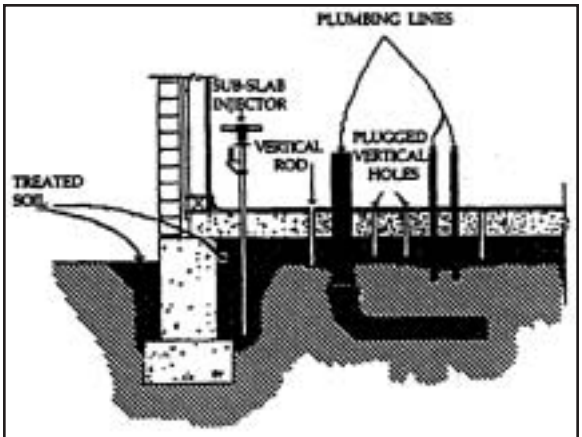

Figure 5. Treatment under concrete slab with vertical rodding at joints, cracks and openings around plumbing.

Another method of slab treatment is to drill through the exterior foundation walls to the soil just underneath the slab. You then introduce the chemical through these holes. This method, most often needed under bathrooms or kitchens, is complicated and requires the use of horizontal rods (Figure 6).

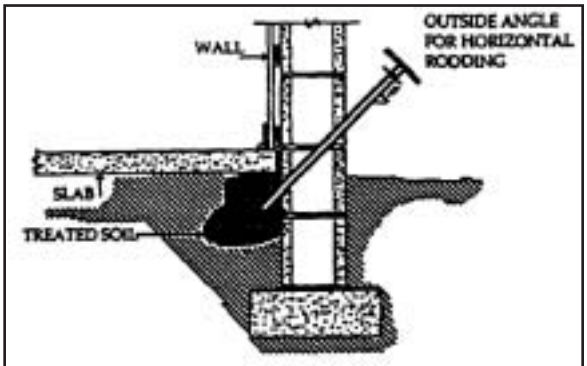

Figure 6. Horizontal rodding through exterior wall.

Take extra caution to prevent drilling into plumbing, electrical outlets or heating ducts that may be imbedded in concrete. Injection of termiticides into these areas must be avoided.

For shallow foundations (1 foot deep or less), dig a trench 6 inches wide along the outside of the foundation wall. Do not dig

below the bottom of the foundation. Apply the emulsion to the trench at the recommended label rate for each 10 linear feet and return the soil to the trench.

For foundations deeper than 1 foot, use the rates given for basement houses later in this publication.

Structures with Ducts in the Slab

Applying a termiticide to an existing structure with intraslab or subslab air circulation ducts must be done with great care. Intraslab ducts are completely encased in the slab (Figure 7). The ducts of a subslab system rest on a vapor barrier, with the concrete poured on top (Figure 8). Take extra precautions when treating a structure with one of these systems; puncturing a duct or allowing termiticide to leak into these ducts results in serious problems. If a mistake is made, there are corrective measures. However, they are expensive and the applicator may never be able to alleviate the customer's fears.

When inspecting for termites in a structure with air ducts in the slab, you should include some additional procedures. Try to obtain a diagram or blueprint of the duct systems. Determine what the ducts are constructed of and how tight the joints are. Make measurements of the depth, width and location of the ducts. Inspect the ducts carefully, using a mirror and a flashlight, for soil deposits and evidence of

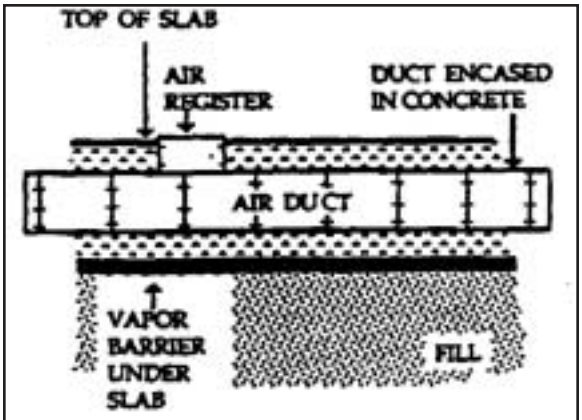

Figure 7. Intraslab air duct system.

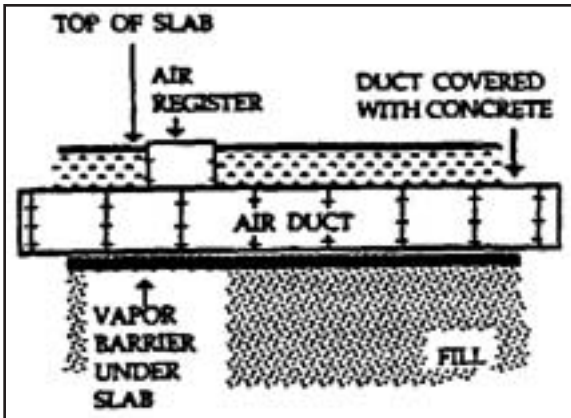

Figure 8. Subslab air duct system.

breaks in the ducts. Swarmers coming from the ducts also indicate a break in the integrity of the ductwork. Discuss evidence of breaks in the ductwork with the homeowner, as this may lead to termiticide leakage.

The termiticide needs to be applied beneath the slab, under or around the ducts. Special tools – subslab injectors – are made for injecting the chemical beneath the slab. They are available with a rubber seal that presses against the sides of the hole drilled in the concrete to avoid leakage up on top of the slab. The holes should be drilled carefully (Figure 9) and must not puncture the ducts. The chemical should be applied at reduced pressure to keep the chemical from being forced into the ducts. Rather than using a subslab injector, you may choose to apply the chemical by gravity feed for an additional margin of safety.

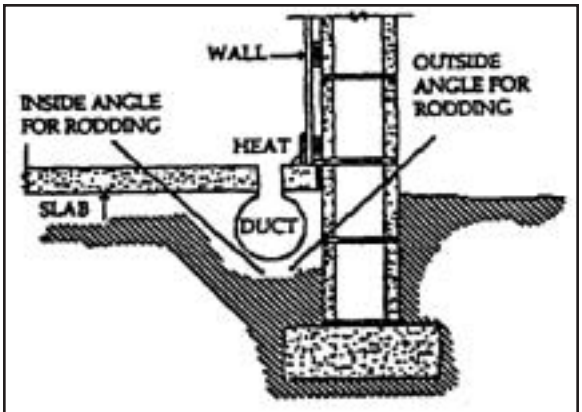

Figure 9. Subslab perimeter heat duct showing the angles needed to rod the termiticide.

During and after treatment, check the ducts for signs of the termiticide. Turn on the heating system and check for odors. If you detect an odor, turn the system off and determine the source of the odor. Leakage in the ducts must be removed. If the odor is from the moist soil, it may persist for several days. The applicator must refer to the termiticide manufacturer for cleanup and odor-deactivation procedures.

Raised Cement Porches, Terraces, Entrance Slabs, Sidewalks and Driveways

All of these that are either filled with soil or on the soil must have the soil adjacent to the foundation treated to control infestations. Treatment may be carried out by drilling through the concrete or tunneling under the concrete next to the foundation wall. No untreated soil should come in contact with any wooden portion of the structure. Holes should be drilled 12 to 18 inches apart, but in some soils 30 to 36 inches is not uncommon. Thorough treatment of the soil along the foundation is the goal.

Crawl-Space Houses

Buildings with crawl spaces usually can be treated easily and effectively. In general, the following procedures can be used.

Dig trenches 6 to 8 inches wide adjacent to and around all piers and along both the inside and outside of all foundation walls. For poured concrete foundations, the trench need be only 3 to 4 inches deep. For brick and hollow block masonry foundations, it should be at least 12 inches deep. Where the footing is more than 12 inches deep, make crowbar, pipe or rod holes about 1 foot apart and extend them from the bottom of the trench to the footing. This will prevent termites from gaining hidden entry to the building through voids in these types of foundations. The trench should not be dug below the foundation. Rods shorter than the normal (3- or 4-foot) can be used. Cover treated soil with a layer of untreated soil or another suitable barrier such as polyethylene sheeting.

Piers, chimney bases and utility entrances should also be treated. Treatment at the label rate for each 10 linear feet for each foot of depth will soak the soil for thorough coverage. If the trench is deep, apply the chemical to alternate layers of soil, each about 6 inches thick. Do not make overall broadcast applications in crawl spaces of existing structures.

Basement Houses

Where footings are greater than 1 foot of depth from the grade to the bottom of the foundation, application can be made by trenching or rodding or both at the suggested rate of emulsion for each 10 linear feet per foot of depth. Treat along the outside of foundation walls and, if necessary, beneath the basement floor along the inside of foundation walls as well as along interior load-bearing walls, conduits and piers.

Foundations with Holes, Cracks, Voids or of Stone or Rubble

Stone and rubble foundations, found mainly in older structures, are particularly susceptible to termite attack primarily because of gaps between the stones. The gaps may never have been filled with mortar or the mortar may have deteriorated. Termites can exploit these gaps and tunnel within the wall. A second hazard often associated with these foundations is that the floor joists may be close to the fill, as in the crawl space, or embedded in the foundation. A third condition that an applicator may find is a porch or crawl space without ventilation, which results in damp soil and an ideal hidden location for tubes being built up from the soil to the joists.

Mechanical Alterations

Mechanical alterations may consist of several important repairs. Use mortar to seal gaps between the stones. This sealing operation may go as far as completely facing the wall. Build an access door to inaccessible areas. Install ventilation louvers. Remove soil if it is too close to joists. If there is structural damage, use treated wood when making repairs.

Termiticide Treatments

Interior (soil under the floor) and exterior termiticide application down to the footing is essential. When conducting soil treatments on the exterior, you must be careful that the foundation will not allow seepage into the structure. If you are not confident the foundation will hold the termiticide, do not rod or flood a trench. Trenching, treating the excavated soil and then shoveling the treated backfill into the trench will lower the risk of chemical seepage into critical areas of the structure. Even so, an assistant should be inside looking for leaks during the application. Rodding at the bottom of the trench may be necessary to reach the footing; however, inject the termiticide under low pressure. Treating foundations and wall voids is not recommended as it may lead directly to seepage.

Multiple Brick, Concrete Blocks, Hollow Tile, Etc.

All of these are common and must be horizontally drilled. Holes must be placed in the mortar joints to obtain necessary chemical penetration.

Brick foundations that are at least two bricks thick have headers – bricks laid at right angles periodically – that can stop the flow of a termiticide. Basement construction of multiple-brick foundations should be treated below grade level from the inside and above grade level from the outside. Holes placed every 16 inches at the end of every two stretchers – bricks laid with the 8-inch side out – are adequate. It may be necessary to treat each section of the foundation under conditions such as heavy infestation, moisture problems or construction features.

The voids in hollow-tile walls run horizontally, so a chemical treatment cannot reach below the point where you treat. Do not drill through the tile directly, for it is easily cracked. A thorough grade-level pesticide application to obtain good soil coverage on both sides of the foundation (i.e., where there is a crawl space) is one of the best methods of treatment. This is also true for fieldstone foundations. Little can be done to treat voids, so complete treatment of the soil is of the utmost importance. Fieldstone foundations must be patched and all cracks and voids must be filled before treatment; still, the soil must be removed, treated on a tarp and then backfilled into the trench.

Houses with Wells, Cisterns, Springs, High Water Table or Near Ponds, Lakes or Streams

It is your responsibility to apply the termiticide without contaminating water supplies. Take special precautions if wells, cisterns or springs are located near the treatment area. You should know the restrictions placed on termiticide application by state or local pesticide regulations regarding the minimum acceptable distance between wells and sources of pollution. You must comply with these regulations and label directions for the chemical being used.

The insecticides presently used move very little once they are deposited on the soil and the emulsion has dried. Movement is usually the result of the emulsion flooding through underground channels, such as those left by old tree roots, through soil that tends to crack severely during periods of drought or through rock crevices.

Faulty wells are probably the most common cause of contamination. These faults permit surface water to enter the well, usually along the supply pipes that lead into the dwelling. Wells may be constructed in a variety of ways. Casing material is an important factor to consider. Wells may be cased with steel tubing, stone, concrete or even drainage tiles.

Older wells are particularly vulnerable to contamination because the casing may have deteriorated and thus may no longer seal the well from contamination. This is a particular problem with stone-, concrete- and tile-cased wells, which are poorly sealed to begin with.

Because it is difficult for the PMP to detect defective well construction or a faulty well, request the well be tested for coliform bacteria by the health department prior to treatment. A positive test indicates that surface runoff is entering the well. This also indicates that the termiticide may also enter the well and the application should not be made.

The well's location, distance from the structure, depth and location of the supply line must all be recorded during the pretreatment inspection. It is especially important to ask about the location of water wells and cisterns, because the well may be buried and cannot be seen. The inspection should determine runoff patterns, note the slope of the land and the location of paved surfaces. This is especially important if the treatment is to take place uphill of the well, because most shallow groundwater flows in roughly the same direction as the land slopes.

The soil type and permeability, seasonal height of water tables and depth of foundation footings need to be known. The permeability of soils and seasonal height of water tables can sometimes be obtained from the U.S. Department of Agriculture's (USDA) soil surveys for individual counties. If there are no published surveys available for a particular site, representatives of the USDA Soil Conservation Service may have detailed site information from mapping work in progress. Local well drillers, drainage contractors and builders are good sources of information of the depth of the water table.

Some important information published in soil surveys includes the permeability of soils to a depth of 5 feet, the soil texture (amount of gravel, sand, silt and clay typically found in soils) and the percent organic matter found in soils. Generally, the coarser the soil (that is, the more sand and gravel found in the soil), the more permeable it will be. Conversely, the more organic matter in soil, the more it will hold water.

Treatment Procedures Near the Well and Supply Lines

The soil nearest the well should not be treated by rodding even under reduced pressure. Trench the soil along the foundation and apply the termiticide solution at the recommended rates. Mix the termiticides with the loose soil as you refill the trench.

An alternative method requires removing the soil from the trench and placing it on a waterproof tarp. Apply the termiticide to the soil on the tarp and mix. The treated backfill is then placed back into the trench. You could also line the trench with polyethylene prior to replacing the treated backfill. The polyethylene lining is another method of preventing movement of the termiticide during an application. Cover all treated soil according to label directions.

Extreme care is needed when applying a termiticide around the water supply line. The termiticide may follow the pipe and reach the well. Uncover the supply pipe from the structure out toward the well for a short distance so that seepage along the pipe can be detected. Use the treated backfill or the polyethylene lining application technique to apply the termiticide along the foundation near the supply pipe.

Be especially careful to apply only the amount of chemical needed and apply it slowly enough to let the soil hold it. Do not treat soil that is water-saturated or frozen. Avoid flooding and runoff.

Finally, it may not be possible to solve the customer's problem safely with a termiticide application. Consider mechanical alterations to the structure to the extent it is economically feasible.

Treatment of Odors

The most common complaint about termite treatments is the chemical odor that may linger afterwards. Although the chemicals themselves have little odor, the solvents, emulsifiers, impurities and related compounds in the formulation can create odors that will often disturb the customer. Under various conditions these odors can be strong, offensive and long lasting, a situation that leads to many problems, complaints and even lawsuits.

Clients should be informed that there may be some odors associated with the treatment for three or four days. To prevent odor build-up when treating structures, the structure must be ventilated. Windows and doors should be open, and fans can be used to circulate air. Air conditioners should be turned off, and close off upstairs doors when possible.

Seal any uncapped masonry voids before or immediately after treatment. Aerosol foam insulation, strips of roofing material or tarpaper anchored by roofing cement or solid bricks or caps can be used to seal the voids.

Crawl spaces pose special problems. Install vents if they are not present. If there is excess moisture or dampness, postpone treatments until the soil dries. If a clump of soil squeezed in your hand retains its shape without flaking or falling apart, the soil is probably too wet. Remember, most labels have strong statements about treating wet or frozen soil. The excess moisture causes the odors to linger for several days. Treated soil can be covered with a layer of untreated soil, and vapor barriers can be placed over treated soil. There are also masking or odor reducing products that can be added to the spray tank.

Caulk, fill or seal openings through the floor of a crawl space, such as plumbing, air vents and bath traps. Take special care if there is a furnace or ductwork in the crawl space. All ductwork must be sealed, and some types of systems may not be treatable without major odor problems. If ductwork is accidentally treated with one of the new termiticides, there are ways of decontaminating the site, but they are very expensive. If you have any concern with a potential odor problem, seek additional help before treatment, and explain the problem to the customer.

Operate pumps at pressures between 25 to 50 psi to minimize splashing. Plug all holes after injection, and seal all visible cracks in basement or masonry walls. It is a good practice to have an assistant inside a basement to warn of any seepage problems. Use dehumidifiers in basements to remove moisture and speed drying. For extreme odor problems, activated charcoal filters can be placed on ventilating fans or in the furnace and ducts.

Pesticides for Termite Control

Pyrethroids

The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellant to termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes and gardens. Some examples include bifenthrin, cyfluthrin, cypermethrin, deltamethrin and permethrin.

They may be applied alone or in combination with other insecticides. Pyrethroids are formulated as ECs, WPs, Gs and aerosols.

Although certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route, systemic toxicity by inhalation and dermal absorption is low. There have been very few systemic poisonings of humans by pyrethroids. Although limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible. Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney.

In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to "sunburn" sensation of the face and especially the eyelids. Sweating, exposure to sun or heat and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours. For first aid, wash with soap and water to remove as much residue as possible, and then apply a Vitamin E oil preparation or cream to the affected area.

Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano-groups: fenvalerate, cypermethrin and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or microencapsulated formulation.

Borates

Borate is a generic term for compounds containing the elements boron and oxygen. Boron never occurs alone naturally, but as calcium and sodium borate ores in several places in the world.

Borax and other sodium borates are used in numerous products such as laundry additives, eye drops, fertilizers and insecticides. While its toxic mechanisms are not fully understood, boron is very toxic to insects and decay fungi that commonly damage wood in structures. However, at low levels boron is only minimally toxic, and perhaps beneficial, to humans, other mammals and growing plants. Use of borate-treated wood for construction of homes and their wood-based contents appears to offer many advantages to today's environmentally sensitive world.

Unlike most other wood preservatives and organic insecticides that penetrate best in dry wood, borates are diffusible chemicals (they penetrate unseasoned wood by diffusion, a natural process). Wood moisture content and method and length of storage are the primary factors affecting penetration by diffusion.

Properly done, diffusion treatments permit deep penetration of large timbers and refractory (difficult-to-treat) wood species that cannot be treated well by pressure. The diffusible property of borates can be manipulated in many ways; suitable application methods range from complex automated industrial processes to simple brush or injection treatments. Application methods include momentary immersion by bulk dipping; pressure or combination pressure/diffusion treatment; treatment of composite boards and laminated products by treatment of the "wood finish," hot and cold dip treatments and long soaking periods; spray or brush-on treatments with borate slurries or pastes; and placement of fused borate rods in holes drilled in wood already in use.

Organophosphates and Carbamates

These are two very large families of insecticides. Indeed, they have been the primary insecticides for the past 25 to 30 years. They range in toxicity from slightly to highly

toxic. They are formulated in all kinds of ways from highly concentrated ECs to very dilute G formulations.

These insecticide families are similar in their modes of action. They are all nervous system poisons. Insects and all other animals, including humans, have nervous systems that are susceptible. Both insecticide families are efficiently absorbed by inhalation, ingestion and skin penetration. To a degree, the extent of poisoning depends on the rate at which the pesticide is absorbed. Organophosphates break down chiefly by hydrolysis in the liver; rates of hydrolysis vary widely from one compound to another. With certain organophosphates whose breakdown is relatively slow, significant amounts may be temporarily stored in body fat.

The organophosphates and carbamates replaced the chlorinated hydrocarbons (e.g., chlordane, aldrin and heptachlor) for all uses, including termite control. Examples of organophosphates are chlorpyrifos for termite control and diazinon for other household pests. An example of a carbamate is carbaryl (Sevin®), also used for household and lawn pests. The pyrethroids are gaining significantly in some aspects of termite control.

Nicotinoids

Nicotinoids are similar to and modeled after the natural nicotine. Imidacloprid is an example of this type of chemistry that is used as a termiticide. Imidacloprid was introduced in Europe and Japan in 1990 and first registered in the U.S. in 1992. Imidacloprid acts on the central nervous system of termites, causing irreversible blockage of postsynaptic nicotinergic acetylcholine receptors. Imidacloprid is registered for use as a termiticide under the name Premise®. It is non-repellent to termites and has contact activity as well as activity as a stomach poison.

Pyrroles

Chlorfenapyr is the only termiticide from the pyrrole family of chemistry and is active primarily as a stomach poison with some contact activity. It is also non-repellent to termites. Chlorfenapyr is registered as a termiticide under the tradename Phantom®. Chlorfenapyr acts on the mitochondria of cells and uncouples or inhibits oxidative phosphorylation, preventing the formation of the crucial energy molecule adenosine triphosphate (ATP). As a result, energy production in the cells shuts down, resulting in cellular and, ultimately, termite death.

Fiproles (or Phenylpyrazoles)

Fipronil is the only insecticide in this new class, introduced in 1990 and registered in the U.S. in 1996. It is marketed as a termiticide under the tradename Termidor®. This termiticide is a non-repellent material with contact and stomach activity. Fipronil works by blocking the gamma-aminobutyric acid (GABA) regulated chloride channel in neurons, thus disrupting the activity of the insect's central nervous system.

Insect Growth Regulators

An insect growth regulator (IGR) is a synthetic chemical that mimics insect hormones. Hormones regulate a wide array of body and growth (physiological) functions. Some examples include interfering with molting, interfering with pupal emergence, and interfering with body wall formation.

IGRs are often specific for an insect species or group of very closely related species. They often have delayed effects because they are taken into the insect and "stored" until the insect reaches the right growth stage. This may range from days to weeks or even months. For example, if the IGR stops the insect from

molting, and a given insect is exposed just after a molt, it would continue to function normally until the next molt before dying.

In the case of termite control, the slow action of the IGR allows the chemical to be widely spread throughout the colony as the termite workers feed and groom each other.

The IGRs are, in general, environmentally safe and have very low mammalian toxicity. Some examples include noviflumuron, hexaflumuron, pyriproxyfen and methoprene.

Biological Agents

Biological control agents, such as disease causing fungi and bacteria and parasitic nematodes, are being studied as possible termite control or termite reduction options. In some cases these agents are released into the soil and in other cases they are injected into the above-ground termite galleries. As with all new methods of control, more research is needed to determine the advantages and limitations of such organisms. *Bacillus thuringiensis* or B.t. is an example of a commonly used biological control agent.

Bait Technology and Application

There are several termite baits on the market that add to the arsenal of tools available for managing termite populations and protecting structures. Baits work on the principle that foraging termites will feed on a treated cellulose material, which eventually kills the termites and possibly the colony. The toxic material in the bait must kill slowly enough to allow foraging termites to return to the colony and spread the bait through food sharing (trophallaxis). Because dead termites repel other termites, the toxic material also must kill slowly enough so that dead termites do not accumulate near the bait.

Baits control a colony locally – either eliminating it or suppressing it to the point that it no longer damages a structure. To be successful, the products must be non-repellent, slow acting and readily consumed by termites. There are three main types of bait products available.

1. Ingested toxicants or stomach poisons
2. Biotermiticides or microbes
3. Insect growth regulators (IGRs)

Each type has unique features and is used differently in termite control programs. Ingested toxicants have the quickest effect. However, dose dependency and learned avoidance may limit this type of product to termite reduction in localized areas.

Biotermiticide, which is derived from fungi, bacteria or nematodes, is injected into active gallery sites. It then develops on the infected foraging termites and spreads among the colony. Suitable temperature and moisture, early detection and avoidance are factors that determine this treatment's success. It may provide localized area control or, with optimum conditions, may suppress a colony.

Among the insect growth regulators are juvenile hormone analogs (JHA), juvenile hormone mimics (JHM) and chitin synthesis inhibitors (CSI). These products disrupt the termites by causing a specific response or behavior within the colony or by blocking the molting process. Remember that all insects, including termites, have an exoskeleton made primarily of chitin. In order to grow, they must periodically shed their chitinous exoskeletons and form new ones. This process is called molting. A chitin synthesis inhibitor slowly builds up in the termite and, the next time a molt should occur, prevents proper formation of the cuticle. IGRs are the slowest of the bait types but have greater impact on the colony.

Some of the major baits available to the pest control industry are discussed below. Note their use for either colony elimination or for colony suppression.

Commercial Baiting Products

Sentricon™ System

Sentricon™ System, developed by Dow AgroSciences for professional use, combines monitoring with the use of permanent stations. Stations are installed in areas where termites exist and around the perimeter of a structure and in the yard. Each station contains a wood stake and must be periodically monitored for termite activity.

After termites attack, the wood is removed and replaced with a bait tube. Termites from the wood must be transferred to the bait tube, which is left in the station until termite activity ceases. Then the bait tubes are replaced with new wood stakes and monitoring for new infestations resumes.

Thus, the Sentricon™ System protects property through an integrated program of monitoring, baiting when termites are present and resuming monitoring when termites are no longer present. The active ingredient in the Sentricon™ System is hexaflumuron, a chitin synthesis inhibitor. The philosophy behind the Sentricon™ System is that foraging pseudergates will feed on the bait, return to the colony and pass the bait to other colony members through trophallaxis. Dow AgroSciences claims that with the Sentricon™ System, colony elimination is possible.

FirstLine™ Termite Bait Stations

FMC Corporation manufactures bait stations for suppression of subterranean termite colonies. The FirstLine™ aboveground termite bait station is applied directly to active termite infestations. It is placed above ground, inside or outside, at the leading edge of active termite mud tubes. Another product, the FirstLine™ GT in-ground bait station, is placed in the ground in areas conducive to termite attack and acts as a first line of defense against termite invasion of a structure. There are two types of these in-ground bait stations. One type has wood stakes for monitoring the presence of termites. The other type has cardboard treated with sulfluramid. Bait stations are placed in areas where termites are present or very close to monitoring stations that have been attacked by termites.

The active ingredient in FirstLine™ termite bait stations is sulfluramid, a slow-acting stomach poison. The philosophy behind the FirstLine™ products is that many termites will feed on the bait and over time will die. Research with these bait stations demonstrates that reduction of the termite population is possible, but not elimination.

FMC Corporation also markets Interceptor™, an on-the-wall application. This product is placed over a termite tube. The tube is broken open to allow termites to have access to the bait. The active ingredient is sulfluramid.

Exterra® Termite Interception and Baiting System

Ensystex Incorporated manufactures a termite baiting system called Exterra® Termite Interception and Baiting System. The in-ground stations are designed to permit visual inspection without removing or disturbing the stations. The chitin synthesis inhibitor diflubenzuron (Labyrinth®) is the active ingredient in the bait matrix, a shredded paper towel material.

Subterfuge® Termite Bait

BASF manufactures Subterfuge® termite bait with hydramethylnon as the active ingredient mixed into bait matrix. This baiting system places the active ingredient in the

ground at the same time the station is placed in the ground. Hydramethylnon is a member of the amidinohydrazone family of chemistry and is primarily active as a stomach poison. It is also non-repellent to termites. It works on the mitochondria of cells and ultimately shuts down energy production, resulting in death in a mannar similar to chlorfenapyr.

BioBlast™

An example of a biotermiticide is BioBlast™, manufactured by EcoScience. BioBlast™ is an EPA registered wettable powder containing live spores of the insect killing fungus *Metarhizium anisopliae*. This product is injected into the termite galleries. The spores germinate, penetrate the cuticles of termites and kill them. Spores are carried throughout the colony in a manner known as "horizontal transfer." BioBlast™ controls termites in localized areas if conditions are right for the fungus to grow.

Bait Technology Summary

When deciding whether or not to use baits, it is important to remember that this is a relatively new technology. Baits are still being evaluated and their long-term success is unproven. However, the concept of controlling termites with baits is promising. You, the termite control professional, must determine which approach, colony elimination or suppression, will succeed in each situation.

Baits may require from a few weeks to several months to control termites, depending on such factors as the product selected, application timing, the time to discovery by the termites, the amount of feeding the colony does, colony size and other control measures used.

Baits fit well in an integrated pest management (IPM) control program, along with eliminating conditions conducive to termite infestation, judicious use of liquid soil products as a spot or limited barrier application and use of wood treatment products. An IPM program will require more frequent visits to the site for monitoring and to provide ongoing service. Applicators are strongly encouraged to familiarize themselves with bait technology and future products.

TERMITE CONTROL MEASURES

Pesticide	Actual Chemical Wanted		Method of Application	Remarks
	Spray	Dust		
*bifenthrin (Biflex, Talstar TC)	0.06 to 0.12%	——	Soil adjacent to the house foundation must be thoroughly soaked with the insecticide to form an effective chemical barrier. Dig a "V"-shaped trench against the foundation wall at least 1 foot deep but no wider than 6 inches. The treatment should be made within 6 inches of the wall. Apply the treatment into the trench according to label directions. The "fill in" soil should also be thoroughly treated. Also, treat the soil under concrete slabs next to the foundations and in the hollow openings of concrete blocks or other material in the foundation. Concrete floors, patios, walks, etc., should be drilled at specific intervals and the chemical injected under pressure. Refer to **Circular 6, Arkansas Pest Contol Law, Act 488 of 1975, as amended** for specific requirements. Be careful not to damage heat pipes, vapor barriers, etc., located under the slab. Dursban is labeled for preconstruction treatment only.	**Termite control is usually a job for the licensed pest management professional because home-owners seldom have the training, experience or equipment to perform the job effectively.** The basic principle of termite control is to break the pest's contact between the wood and soil. Sanitation and structural control measures should be given high priority. Follow label directions. The use of any termite baiting system should be given careful consideration prior to purchase. Success with any system requires thoughtful installation and diligent monitoring by an experienced pest management professional, backed by a responsible pest control firm.
*bifenthrin (Biflex, Talstar TC)	0.06 to 0.12%	——		
boric acid (Borid)	——	99%		
*chlorfenapyr (Phantom)	0.25 to 0.125%	——		
Fchlorpyrifos Dursban Equity EC Tenure EC	 0.5 to 1.0% 0.75 to 1.0% 0.75 to 1.0%	——		
*cyfluthrin (Tempo)	0.05 to 0.1%	0.1%		
*cypermethrin Demon TC Prevail FT	 1.0% 0.25 to 1.0%	——		
*deltamethrin (Suspend SC)	0.06%	——		
*diflubenzuron Exterra/Labyrinth Outpost		 Bait system Bait system		
disodium octaborate tetrahydrateborate Bora-Care Tim-Bor Termitrol	 16 to 23% 10 to 15% ——	 —— —— Bait system		
*fenvalerate (Tribute EC)	0.5 to 1%	——		
*fipronil (Termidor)	0.06 to 0.125%	——		
*hexaflumuron (Sentricon System)	——	Bait system		
*hydramethylnon (Subterfuge)		Bait system		
*imidacloprid (Premise)	0.05 to 0.1%			
*permethrin (Dragnet, Flee, Prelude, Torpedo)	0.5 to 2%	——		
sulfluramid *FirstLine Spectracide/Terminate	 	 Bait system Bait system		
*tralomethrin (Saga)	0.06%	——		

F=Some formulations are Restricted Use, see label for details. **Follow label directions.** **Compounds not listed in order of preference.**
*=Restricted Use

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