INSECT-PROOFING DURING BUILDING CONSTRUCTION

W. EBELING · R. E. WAGNER · D. A. REIERSON

STRUCTURAL AND HOUSEHOLD PEST CONTROL in the United States requires annual expenditures of hundreds of millions of dollars and the services of 27,000 licensed pest control operators. Preventive measures against structural and household pests should be taken during the construction of a building, because such measures are most effective and economical at that time. Preventive measures fall into two general categories, depending on whether they are directed against (1) subterranean termites, which invade a building from colonies in the soil and which first attack in the substructure; or (2) a number of other insect species that spend either all or a considerable part of their life in the attic, wall voids, or in other enclosed spaces in various parts of the building. Construction procedures and other measures to prevent insect attack and damage differ considerably depending on which of the groups of pests they are directed against.

Termites

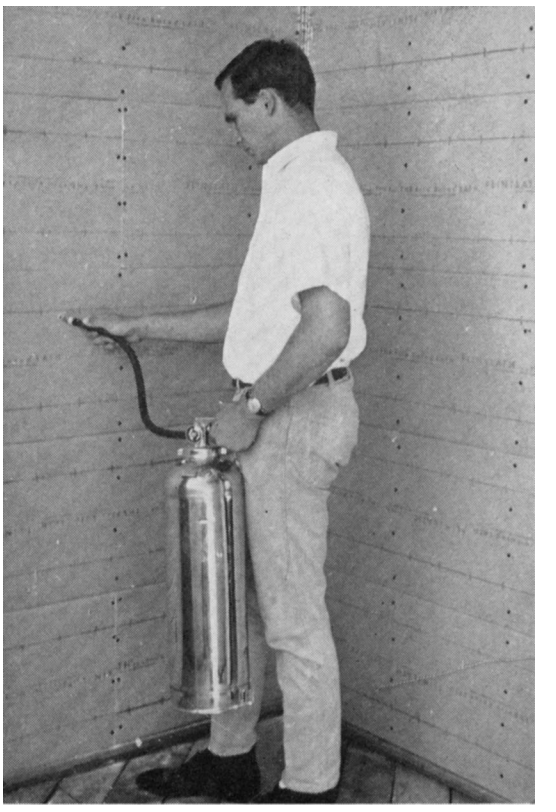
Soil treatment consists of applying dilute emulsions of insecticides to the soil (see photo). The insecticides and dosages to be used are those recommended by federal, state, and industry agencies. The greatest sources of experimental evidence of efficiency of soil treatment have been the investigations of the Southern Forest Experiment Station of the Forest Service, U. S. Department of Agriculture. These investigations showed that currently recommended dosages of certain chlorinated hydrocarbons formed a completely effective barrier against subterranean termites for a period of 18 years in heavily infested forest soil in Mississippi, and may continue to be effective for many more years. The pest control industry has successfully used soil treatment for many years.

Currently recommended insecticides, and concentrations include 0.5 per cent aldrin, dieldrin, or heptachlor, or 1 per cent chlordane. The dosage of dilute emulsion recommended is 1 gallon per 10 sq ft as an overall treatment where slab and attached porches are to be poured, 4 gallons per 10 linear ft along foundation walls, and 2 gallons per 10 linear ft in the voids of all unit masonry foundation walls or piers. Specific instructions for treatment for slab-on-ground, raised-foundation, and basement construction may be obtained in publications of the federal or state agricultural experiment stations or among the technical releases of the National Pest Control Association.

Prevention

Some household pests, including cockroaches, silverfish, odorous house ants, plaster beetles (Lathrididae), psocids, and rat mites, spend all or a major part of their time in hidden areas of a house such as the attic, wall voids, soffit voids, or in voids under cabinets or built-in appliances. In larger apartment and commercial buildings these pests often live also in suspended ceilings, hidden radiators, underfloor raceways for electrical and telephone wiring, elevator shafts, and in other hidden floor-to-floor and room-to-room passageways. Other pests such as

Gravel on which concrete slab is to be poured, and pipe and forms, are sprayed with a long-lasting residual insecticide in photo below. Pressurized water-type fire extinguisher used for wall applications of dusts for insect-proofing during construction.



Insect proofing at the time of construction offers new challenge and opportunity to the building and pest control industries. It provides the opportunity for prevention, which is generally less expensive and always more satisfactory than cure. Some insects such as house flies and mosquitoes are not amenable to control by this method—their control is primarily a community or regional problem. Some other insects such as ants, sowbugs, fleas and clover mites, may gain entry into buildings through areas where they don't have to cross the inorganic powders applied during construction. Nevertheless, insect proofing during construction provides the means by which a high degree of long-term control of certain important structural and household pests can be effected.

drywood termites, carpenter ants, Argentine and other ants, and wood wasps (Siricidae), may crawl over the inner surfaces of these voids in search of nesting sites or to reach the "living space" of the building. When leaving their larval tunnels in the studs, wood wasps enter and leave the wall voids through the wall plaster. Both types of pests may succumb to an insecticide applied uniformly over surfaces that are likely to become infested. Insecticides can be most rapidly and thoroughly applied as dust formulations. Also an insecticide deposited as a dust rather than as a spray is less likely to be lost by penetration into the treated substrate (wood, Masonite, plaster, brick, etc.) and therefore it possesses longer residual efficacy.

Inorganic dusts

Ideally an insecticide dust applied to areas in which it can remain indefinitely should be inorganic, for such a dust, since it cannot be lost by decomposition, may be able to indefinitely eliminate structural voids as harborage and breeding places for cryptobiotic insects. With this goal in mind a procedure was developed for blowing an inorganic desiccant dust into attics for prevention of drywood termites, *Incisitermes minor*. Desiccant dusts kill insects by absorbing a portion of the thin protective layer of lipid that covers the entire body surface of an insect (with most insects this consists of a hard wax, averaging about 0.25 micron in thickness, but cockroaches are covered with a mobile grease about 0.6 micron thick). When the lipid layer is removed, a lethal rate of water loss results. Drywood termites most commonly enter into houses via the attic. A thin film of desiccating dust over the entire inside surface of an attic prevents them from even attempting to attack the dusted wood, and in fact they die within a few hours.

In 1958 a fluorinated silica aerogel which later became known as Dri-die 67, was found to be the most highly insecticidal of the desiccating dusts and is now widely used by termite operators for the control of drywood termites. No other desiccant is known to have such high insecticidal activity and such low bulk density as Dri-die 67. The dust is blown into attics, usually from the crawl hole, at the rate of 1 lb per 1000 sq ft of attic space. It may be applied with an electric blower or water-type fire extinguisher. The dust is usually applied after a fumigation, or after other treatment for drywood termites to prevent further infestation. The Dri-die 67 cannot destroy the termites in their galleries in the wood—this must be done by other types of treatment such as fumigation—but it can prevent the winged reproductives which leave the infested wood in the fall months, or those which enter the attic from the outside, from establishing new colonies in the attic. Even though not all the termites are killed in their galleries by a treatment, the proliferation of colonies within the attic will be prevented.

The practice of protecting exposed wood members of a structure from attack by drywood termites by applying a film of Dri-die dust was extended to include the treatment of wall voids, soffit voids, and voids under cabinets and built-in appliances at the time of construction. Special equipment was designed to blow the dust into these voids. Dri-die can be blown under built-in ranges and refrigerators as a protection against cockroaches, silverfish, and other cryptobiotic insects. Against cockroaches Dri-die works mainly as a repellent, because most of these insects will avoid contact with the dust. However, treated areas are thus eliminated as harborage and breeding places for this important pest.

Boric acid

Recent work has shown the superiority of boric acid powder for cockroach prevention when applied at the time of construction. Boric acid has been the least repellent to cockroaches of all powders tested. The insects will repeatedly enter deposits of boric acid and, if the boric acid is thoroughly applied, they can be satisfactorily controlled. (See *California Agriculture*, Feb. 1969.) Like Dri-die, boric acid powder is inorganic and its insecticidal action will continue as long as it is left in place and remains dry. The application of boric acid is particularly appropriate in areas of a building in which cockroaches are expected to be the principal pest.

The application of dust into voids and enclosed places at the time of construction can be done with a water-type fire extinguisher that is now commercially available. The entire contents (3 gallons) of the extinguisher can be blown out with one pressurization with air to 100 p.s.i. This kind of blower generates air of

Ground-level frame duplexes at Ventura Town House were also insect-proofed at time of construction (see cover photo).

enough velocity and volume to dust attics as well as wall or subcabinet voids.

When dusting wall voids that have no insulation or fire blocks, one should inject the dust upward from about 4 or 5 ft above the floor level through ½-inch holes made in the plaster lath with a small geologists' pick (see photo). When fire blocks are present, the dust should be applied from any convenient level below the blocks. The dust is deposited on the underside of the ceiling plate or fire block and on all other surfaces between the two studs, leaving the heaviest deposit on the floor plate. By directing the dust downward from approximately the 3-ft level, the floor plate can be covered despite insulation in the walls.

The outer wall can be effectively treated by making holes through the building paper and blowing the dust into the wall voids from the outside.

Usually 1¼ lbs of Dri-die is required per 1,000 sq ft of structure. A ½-inch hole should be drilled at the top of each kick panel under cabinets, and the subcabinet voids, as well as spaces under any built-in appliances, should be dusted liberally, bringing the total amount of dust used to about 1½ lbs per 1,000 sq ft of floor space. In residential construction the attic should also be dusted, using 1 lb per 1,000 sq ft. Where boric acid is applied, greater quantities are required because of the much greater bulk density of this powder.

Apartment application

Some modification of the above procedure is necessary for "drywall" construction. An example is the insect preventive measures that were taken in Ventura, California, at the time of the construction of the Ventura TowneHouse. The TowneHouse consists of 331 apartments in a seven-story concrete building and 10 one-story, wood-frame apartment buildings (see photo). Holes were drilled for the injection of dust only along the lines where sheets of drywall (sheetrock) were joined. The junctures of the sheets were taped over after the dust was applied.

In addition to the wall voids, the voids under cabinets were dusted through holes drilled at the top of the kick panels. The holes were concealed by the horizontal extension of the floor of the cabinet over these panels. Dust was also blown through the usual access panels into the enclosed area around the bathtub which contains the utility pipes. Dust was also applied under built-in ranges and refrigerators which are generally very attractive areas for cockroaches. A layer of dust under and behind these appliances will eliminate them as harborage and breeding places.

The seven-story concrete building (see photo) contains a large kitchen, storage room, and dining room. Dri-die was applied wherever possible during construction. However, the many structures and appliances later brought into these rooms offered harborage for cockroaches so they were also treated with boric acid powder.

Complete program

Soil treatment and insect proofing of buildings have been described as two distinct procedures because equipment, insecticides, and methods of application are quite distinct in these two types of "built-in" pest control. However, most pest control operators have, or can readily obtain, the necessary equipment and they have ready access to the insecticides required. The two procedures should be combined into a complete program of insect proofing at the time of construction to eliminate, or at least reduce, the severity of a wide variety of insect problems. Occasionally localized pest problems may occur in an insect-proofed building. For example, if the refrigerator and range are not built in, a protective layer of dust cannot be applied under these appliances during construction. Cockroaches accidentally introduced in cartons or packages containing foods or beverages, or by various other means, may then become established. However, treatment of such infestations is much simpler and more effective if the principal harborage and breeding places for these insects have already been treated with an inorganic insecticide dust at the time of construction.

The prevalence of the cockroach as a household pest poses the question as to whether boric acid powder should be used instead of Dri-die in hidden areas. Dri-die is the more insecticidal powder against the largest number of pests; but boric acid has the advantage of being much less repellent to cockroaches. As a result, a greater number of insects will enter areas dusted with boric acid and be killed. Treated areas are not only eliminated as harborage and breeding places, as with Dri-die, but are effective traps that substantially deplete the cockroach population in the "living space" of a building. It is possible that boric acid might be as effective as Dri-die against a wide range of insects. For example, a minute film of boric acid on wood will prevent drywood termite attack. In areas where cockroaches can be expected to be a dominant problem, Dri-die should probably be applied only in attics and wall voids, to keep cockroaches from living and breeding in these areas and to prevent them from moving from room to room or apartment to apartment through the wall voids. Boric acid would be most effective in such places as sub-cabinet voids, under built-in ranges and refrigerators, under pallets and behind piles of boxes in storage rooms, and on the shelves of cabinets, pantries, and closets.

In the seven-story apartment complex shown in the photo, the "insect-proofing" with Dri-die was completed in November 1964. Boric acid powder was applied later in the kitchen and storeroom under and behind appliances and cabinets, under pallets in the storeroom, and in the pit under the dumb waiter (although it had been previously treated with Dri-die). In the nearly five years since construction, the kitchen-storage room area has been free of any noticeable infestation of cockroaches.

Cockroaches

During 1967 and 1968 cockroaches were found in seven apartments in the apartment building and were treated. The cockroaches apparently gained access to the apartments through the trash chute that connects each floor of the building to a basement trash room. Cockroaches were found in the trash room, which had not been treated at the time of construction. Many opportunities existed for dusting this room under pallets and in subcabinet voids, behind piles of boxes, etc. The room was treated with boric acid in September 1968 and no new infestations have been reported since that treatment.

The almost complete absence of cockroaches in this apartment complex during a period of nearly five years is particularly significant in view of the rapidity with which these insects normally infest such buildings. Cockroaches are generally considered to be the first inhabitants of any new building—arriving to feed on the remains of the lunches of the construction workers. However, the only insects that have presented a problem in this apartment-house complex have been Argentine ants and sowbugs which come in from the outside, particularly under sliding doors. These have been controlled by the gardener.

Insect proofing of a restaurant in Santa Ana during construction was strikingly successful using only boric acid. Nine pounds of boric acid was applied in July,

1968. Powder has since been reapplied when it was occasionally removed in cleaning operations, or when it became wet, but this minimal maintenance program has resulted in satisfactory control.

Several treatments

Insect proofing requires several trips to the construction site. To control subterranean termites, soil should be treated before the foundation is poured. In the case of slab-on-ground foundations a single treatment may be sufficient if a monolithic slab foundation is poured. Two treatments may be necessary if the footing and the remainder of the slab are poured in two separate operations. Another treatment should be made just before the concrete cap is poured on earth-filled extensions of the foundation such as steps, stoops, porches, patios, terraces, etc. Approximately half of the subterranean termite infestations originate under earth-filled extensions of the foundations; the termites gain entry to wood structures through cracks that eventually appear between the concrete caps and the main foundation. For raised-foundation construction, another insecticide application should be made after floor construction is complete and after wood scraps are cleared out from under the building. At this point the area under the floor should also be treated.

Dust should be blown into the wall voids during the interval between the installation of the plaster lath or drywall and the plastering or taping operations. It is the only procedure in which timing is a critical factor. The remainder of the insect-proofing operation is best done after construction is complete and before the final cleanup. The pest control operations must be scheduled at appropriate times during construction operations in order to obtain thorough treatment. An agreement on this point should be a part of the pest control operator's contract with the builder and construction firm. In certain buildings or in localities where cockroach infestation is practically certain and where the range and refrigerator are not built in at the time of construction, boric acid powder should be applied under these appliances when they are installed.

Walter Ebeling is Entomologist and Professor; Robert E. Wagner is Associate Specialist; and Donald A. Reierson is Laboratory Technician, Department of Agricultural Sciences, University of California, Los Angeles.

CROOKED CALF DISEASE

CARL W. RIMBEY

Crooked calf characteristics shown above include enlarged knees on the front legs which are bent forward. The neck also is not natural and shows some effects of this malady.

LUPINE—CROOKED CALF TEST, RAMELLI RANCH
PLUMAS COUNTY

Cow No.	Date born	Description
758	March 15th	Very crooked legs, back—died at birth
515	March 20th	Very crooked legs and back—died at birth
111	March 26th	Very crooked back & legs—died at birth
Ear Tag 42	March 11th	Crooked front legs—Average
211	March 13th	Crooked front legs—Average
908	March 13th	Crooked front legs—Average
201	March 28th	Crooked front legs—Average—Died April 17
312	March 14th	Crooked front legs (great) and slight back
772	March 21st	Very crooked front legs
016	March 20th	Crooked front legs—Average
221	March 15th	Right front leg crooked
410	March 25th	Both front legs crooked—Average
773	April 1st	Both front legs crooked—Slight
921	March 22nd	Right front leg crooked—Very
774	March 15th	Left front leg crooked—Sidewinder
907	March 29th	Both front legs crooked—Slight

CROOKED CALF DISEASE has been a problem in the northeast mountain counties of California for many years. Calves are born with this malady and it is demonstrated by malformations of bones in the animal which have a severe to slight crippling effect. Calves may have twisted backs or necks, twisted or bowed legs, cleft palates or combinations of all of these effects.

For years it has been felt that the lupine plant, when eaten during certain stages of pregnancy, is causing this disease. Ranchers of the area have changed their breeding season and moved their cattle from pastures which they know are contributing to the problem, to reduce the number of calves affected. A test was designed in 1967 on the Ted Ramelli Ranch, Plumas County, to determine whether the lupine was in fact causing the crooked calf disease. This ranch had a history of crooked calves, with as many as 25 per cent of a calf crop showing some stages of this malady.

Plumas ranch

The Ramelli Ranch is located in Sierra Valley of Plumas County with a summer range 10 miles north of the ranch. The summer range lies west of Frenchman Reservoir and is heavily infested with lupine. The cattle were pastured in this area from July 1 to September 30 of the 1967 grazing season. Elevation of this range is around 6,000 ft. Part of the range is privately owned while the remainder is under U. S. Forest Service permit. The privately owned field was inspected in May, 1967, and a low-grow-