TERMITE INFESTATIONS IN RIGID BOARD INSULATION: PROBLEMS AND SOLUTIONS

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Abstract - Rigid board insulations, including polystyrenes, polyisocyanurates and others, are used as standard building materials. In the past decade problems developed with subterranean termites entering structures, undetected, when rigid board insulation was installed as a continuous sheet beginning below grade. Subterranean termites can tunnel through the insulation to reach the wooden portions of the structure, while hidden from view. We conducted research to assess the extent of the problem, develop guidelines for inspections, and proposed changes to construction practices. More than 12% of the pest control operators in South Carolina (USA) had been involved in litigation because of inspections that failed to detect termite presence. Further, when evaluating vulnerable points of entry by subterranean termites into structures having rigid board insulation installed below grade, the focus of damage was unpredictable 58% of the time. The problem occurred most often (78%) in homes that were four to seven years old. In laboratory investigations of insecticide-treated product, termites tunneled between the treated product and a mock foundation wall. Proposals were made to modify building codes to prohibit the installation of rigid board insulations below grade in areas of the country where the probability of subterranean termite infestation is very high. In the United States, this encompasses most of the southeast and portions of California. Within the past four years, building codes have been approved which effect the Standard Building Code, the CABO One and Two Family Dwelling Codes, and the Model Energy Code. Solutions to problems of subterranean termites entering rigid board insulation are under investigation. Currently research is being conducted on products that may provide an adequate physical barrier between the soil and the structure.
Key words - Isoptera, termite control, building codes

INTRODUCTION

The energy crisis of 35 years ago, stimulated an increase in the development of energy conversation technology that significantly impacted use rates. One of the most valuable methods of energy conservation has been the use of high density building insulation. Energy efficient insulation products are responsible for reducing energy consumption more than any other single factor, and are widely used in commercial and residential construction. Among the most widely used products is foam plastics or rigid board insulation (RBI), made of extruded or expanded polystyrene and polyisocyanurate. Installation of these insulation products is variable, but often they are placed against the foundation wall of structures so that part of the insulation is below grade. It is common in colder climates for the insulation to be placed down to the footing, with energy codes recommending placement at or below the known frost line. Another more recent use of RBI products is a building style using an insulated concrete form (ICF) which is manufactured as a reinforced form stacked and placed to frame the exterior of the structure. Once in place, concrete is then poured into the ICFs which remain as an integral part of the finished structure, providing both interior and exterior insulation. With both RBI and ICF systems, siding, imitation stucco, or other finishes are applied to the exterior of the structure. While these products having justifiably found a place in more than 50% of all new construction (Strzepek, 1990), there are severe problems with subterranean termites gaining undetected access to structures with below grade insulation. Even energy specialists who promoted using RBI products, recognized that hidden access to a structure by subterranean termites may be detrimental (Christian, 1990). Unfortunately, solutions to resolve subterranean termite infestations in RBI have not yet been proven.

Subterranean termite infestations in rigid board insulation are well documented (Kramer, 1993; Guyette, 1994; Smith and Zungoli 1995a, 1995b; Pinto, 1996; Rambo, 1998). There is no evidence that termites are gaining any nutritional benefit from RBI. No RBI was found in the frass of termites removed from insulation, though they tunneled extensively leaving sawdust behind (Hicken, 1971; Smith, 1995).

Proceedings of the 3rd International Conference on Urban Pests.
Wm H. Robinson, F. Rettich and G.W. Rambo (editors). 1999.

In 1993, discussions between the pest control industry, and RBI manufacturers and energy specialists concerning alternative building practices were not productive. Any change in installation of RBI to allow for an adequate visual inspection for subterranean termites by pest control operators (PCOs) was considered too serious an energy loss by groups representing RBI manufacturers and energy specialists. As a result, the National Pest Control Association (NPCA) issued interim guidelines to their membership on how to handle treatment of structures with below grade installation of RBI (Kramer, 1993). Recommendations in the guidelines specified that PCOs should view RBI to soil contact in the same manner as wood to soil contact, and to remove insulation in contact with the soil. In cases where removal could not be accomplished, the NPCA recommended that pest control operators refuse the job.

At the time the NPCA issued their guidelines for treatment of structures with below grade installation of RBI, we began a research program at Clemson University in South Carolina (USA) to define the extent of the problem, gain an understanding of how to detect the problem, and to determine if certain types of products were more termite ”resistant” than others. What follows are the results of that research, an accounting of the building code changes that resulted from collaboration with the pest control industry and regulatory specialists, and some potential solutions being investigated.

Defining the problem

In South Carolina alone, 12% of the pest control companies responding to a survey, had been involved in litigation due to undetected subterranean termite problems in RBIs (Smith and Zungoli, 1995a). Initially, PCOs were unaware of the added risk of subterranean termite infestations in structures with below grade RBI. Damage to insulation was below the soil line 42% of the time and between the soil line and the sill plate 22% of the time. However, structural damage was at the soil line (20%), between the soil line and sill (29%), and above the sill (29%). Insects other than termites also infest these insulations. Twenty-five percent of the companies reported infestations of Sphecidae, Dermestidae and Formicidae. Of these, 87% were infestations of carpenter ants. High numbers of solitary bees can also occur in RBI (Zungoli, unpublished data). Ground contact is not necessary for such infestations to occur. Many companies (43%) elected not to treat structures with below grade insulation primarily because they could not correct or treat the termite conducive conditions or they could not guarantee their work (Smith and Zungoli, 1995a).

Analysis of the location of subterranean termite infestations in homes with below grade RBI were conducted to develop inspection guidelines for PCOs. In structural inspections of 50 houses in coastal South Carolina (USA) with both below grade insulation and a history of undetected subterranean termite problems, RBI was not visible in 82% of the structures (Smith and Zungoli, 1995b). The mean age of structures at the time of termite detection was five years old. Damage was first detected in the majority of the inspected structures at four (12%), five (42%), six (12%) and seven years (12%) after construction. Whereas, in most structures with a subterranean termite infestation, damage often is concentrated in areas with excessive moisture (i.e., water drainage areas) or areas where treatment is difficult to achieve (i.e., fireplaces, dirt-filled porches, etc.), in structures with RBI placed below grade, most of the damage (58%) was randomly located throughout the structure. Therefore, development of guidelines for PCOs, beyond procedures already practiced, was not possible.

In the final phase of the research at Clemson University, seven brands of RBI were evaluated in a laboratory study to determine if some types of RBI were termite resistant, i.e., did subterranean termites avoid tunneling into certain types of products (Smith, 1995). Products tested included examples of expanded and extruded polystyrene, and polyisocyanurate. One product, an expanded polystyrene, had a borate incorporated into it at the time of manufacturing. After six months, there were no significant differences in tunneling by termites among any of the products tested. Even the borate treated product had tunneling that was not significantly different from other products. Barlow (1996) reported similar results in a study evaluating several concentrations of zinc borate in expanded polystyrene panels. In his study, time to 100% termite mortality decreased in proportion to increasing levels of boron. However, no level of borate was effective in achieving 100% mortality before extensive or complete penetration of foam occurred.

Additionally, in the Clemson study, other factors caused concern. There was a significant difference of 0.3% in volume of water absorption and in mean percent R-value loss in some products examined (Smith, 1995). While these latter findings are not conclusive in determining degree, they do indicate that when RBI is used by termites for tunneling, the insulative qualities for which it has been selected are reduced.

Building Codes

The research results from the Clemson study indicated that below grade installation of RBI products increased the risk of subterranean termite infestations, and further increased the risk of termite infestations being undetected due to the hidden nature of the damage. With the energy industry and RBI manufacturers reluctant to acknowledge the problem or to change installation practices, changes in building codes were inevitable. However, many codes that promoted and mandated the use of RBI below grade were relatively recent. For example, at the urging of the Department of Energy, the Energy Policy Act of 1992 was passed mandating that by 1994 residential buildings should be in compliance with the Model Energy Code (MEC) (Council of American Building Officials, 1992). The MEC required that RBI be placed below the soil line and sometimes down to the footing. The Energy Policy Act was variably enforced from state to state depending on state and local-jurisdiction approved building codes, but all government-built residential structures had to comply. This put many structures at risk. However, just as the Act was being enforced, a Negative Ballot was submitted to alter the MEC (Edwards, 1994). The Negative Ballot passed, allowing builders in climates above 6,000 annual Fahrenheit heating degree days to keep RBI above the soil line without being in violation of the MEC (Council of American Building Officials, 1995). The areas in which those climatic conditions exist encompass most of the southern United States from one coast to the other.

Other building codes were also being challenged in areas of the United States where the hazard of subterranean termite damage is very heavy as delineated by the U.S. Forest Service (Beal *et al.*, 1989). A 1996 proposal to the Standard Building Code specifying that "foam plastics …shall not be installed below grade on foundation walls or below grade on the exterior of slab foundations" and "… clearance between earth and foam plastics applied to the exterior wall shall not be less than 6 inches (Zungoli *et al.*, 1996), " received positive reviews from the pest control and building industry and negative reviews from the plastics industry. Despite the controversy, the proposal was adopted (Southern Building Code Congress International, 1997). The Standard Building Code is most often followed for commercial construction.

The building codes governing most residential building are the CABO One-and Two-Family Dwelling Codes. A proposal similar to the one submitted for the Standard Building Code was submitted for consideration at the code hearings. After much debate, the proposal was accepted and is now part of the International One-and Two-Family Dwelling Code (International Code Council, 1998).

The building code changes were very controversial, yet, in the end, all involved came together to discuss the best next step to take. The first course of action was to clarify the code changes. Because those of us involved with the proposals were not familiar with standard code language or with all of the repercussions of the changes, it was necessary to "clean-up" the new codes. This was done through an ad hoc termite committee of the Southern Building Code Congress International (SBCCI). In the end there were some exceptions made to the code that included buildings that had no structural wood, and buildings with insulation on the interior side of basement walls only (SBCCI Ad hoc Committee, 1998). The SBCCI also proposed a mechanism for accepting further exceptions to codes governing installation of below grade insulation should methods for protecting both structural wood and insulation be developed. Any new technology will be handled by submitting a compliance report through SBCCI's regular channels that will be evaluated by a qualified reviewer.

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Building in the United States is regulated by three model codes that are sometimes in conflict with each other. CABO, the Council of American Building Officials, was incorporated into the International Code Council (ICC) in November 1997. This move is a precursor to all other code bodies in the United States joining the ICC to develop national codes that will not have regional boundaries. Thus, other code changes may occur in the future.

Technology to protect structural wood and insulation

Currently there are no code approved solutions to prevent termite damage to structural wood with below grade insulation. The goal of any solution is mandated to protect both the structure and the insulation. The latter mandate protects the energy efficiency of a building as well as the structural integrity. No traditional termiticide treatments have been effective in protecting a structure from a subterranean termite invasion when RBI is placed below grade. Termite bait technology may prove to be a good deterrent, but pest control firms are unlikely to provide a warranty when the inability to inspect a structure is still at issue. Currently, the most promising methods of protecting both structure and insulation are physical barriers used beneath structures to exclude subterranean termites. Termi-Mesh™, a marine grade stainless steel mesh, has been used in Australia for several years (Kard, 1998). There are approximately 35,000 structures in place in Australia. The U.S. Forest Service has been testing the stainless steel mesh in the United States since 1993, and after five years Kard (1999) reported 100% success as a barrier to subterranean termites. This stainless steel mesh is approved for use in Hawaii (USA) for new construction and post-construction remediation (Reinhardt and Yates, 1995).

Other pre-construction barriers to prevent subterranean termite infestation, types of pesticide impregnated sheeting, are under investigation by two termiticide manufacturers, AgrEvo and Zeneca (Potter, 1999). Both companies report that their products will be available within approximately two years. The AgrEvo product, Kordon TMB, is a multilayered polyethylene "sandwich" with a layer of deltamethrin impregnated material in the middle. If installed properly, AgrEvo is currently plans to provide a 10-year warranty against subterranean termite infestation. Less information is available for the Zeneca product, Impasse, but like Kordon, TMB, it will be a multi-layered plastic with a termiticide impregnated into the middle layer. Impasse is expected to offer 20-years or more of protection against subterranean termites. The termiticide used in the Zeneca product has not been announced. Both products will also serve as a moisture barrier, and the Zeneca product also will promise radon protection (Potter, 1999).

Efforts on the parts of the pest control industry, chemical industry, termite researchers, builders, code officials, the energy industry, and the plastics industry must focus on multiple goals. While resolving problems of subterranean termite infestations in rigid board insulations, the solution(s) must deny termites access to both the insulation and structure while maintaining the integrity of an energy efficient building.

ACKNOWLEDGMENTS

I wish to acknowledge the good work of Brian Smith who conducted most of the Clemson University research reported in this paper as part of his graduate program. I also wish to acknowledge others who worked with me on building code changes: Tom Fortson, Neil Ogg, Wayne Shirley, and Jim Wright.

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