RIGID BOARD INSULATION IN SOUTH CAROLINA: ITS IMPACT ON DAMAGE, INSPECTION AND CONTROL OF TERMITES (ISOPTERA: RHINOTERMITIDAE)

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ABSTRACT

A total of 225 pest control companies was randomly selected from the 315 members of the South Carolina Pest Control Association to determine their opinion on the impact of rigid board construction on termite control. Of those surveyed, 77% conducted inspections and/or treatments for subterranean termites (Isoptera: Rhinotermitidae, *Reticulitermes* and *Coptotermes spp.*) in South Carolina. The focus of survey questions was on demographics, occurrence of rigid board insulation, prevalence of rigid board insulation damage and structural damage, and treatment of structures when rigid board insulation was present. Results indicated termite infestations associated with rigid board insulation are not uncommon; 34% of the companies reported the presence of rigid board insulation on structures that have been treated or inspected for termites. Companies chose not to treat structures with rigid board insulation 43% of the time. Twenty-five percent (25%) of the companies reported damage to rigid board insulation due to insects other than termites. In addition, 12% of the respondents have been sued because of termite damage hidden by rigid board insulation. The primary recommendation to solve these problems is to remove a small gap of insulation, a vision strip, just above the soil level along the perimeter of a structure.

Key Words: Rigid board insulation, polystyrene, polyisocyanurate, *Reticulitermes* spp., *Coptotermes* spp.

RESUMEN

Una muestra de 225 compañías de control de plagas fue aleatoriamente seleccionada de entre los 315 miembos de la Asociación de Control de Plagas de Carolina del

Sur, para una encuesta en Febrero de 1994. De las compañías encuestadas que respondieron, el 77% se dedica a inspecciones o tratamientos para termites subterráneos (Isoptera: Rhinotermitidae, *Reticulitermes* y *Coptotermes* spp.) en Cariolina del Sur. El foco de las preguntas de la encuesta fue la demografía, aparición y prevalencia de daños en estructuras rígidas de aislamiento térmico, el daño estructural, y el tratamiento de las estructuras con aislamiento térmico rígido. Los resultados indicaron que las infestaciones de termites asociadas con estructuras rígidas de aislamiento térmico son comunes; el 34% de las compañías reportó la presencia de aislamiento térmico rígido en las estructuras que habían sido tratadas o inspeccionadas. Las compañías decidieron no tratar estructuras con aislamiento térmico rígido en el 43% de los casos. El 25% de las compañías reportó daños a estructuras rígidas de aislamiento térmico debido a otros insectos. En adición, el 12% de los que respondieron la encuesta había sido demandado debido a daños de termites ocultos por las estructuras rígidas de aislamiento térmico. La recomendación primaria para resolver estos problemas es quitar un pequeño pedazo del aislamiento, una banda de visión, justamente por encima del nivel del suelo a lo largo del perímetro de la estructura.

In the last few years, there has been an increasing awareness of the use of rigid board insulation to increase the energy efficiency of structures. Great concern has been expressed by Pest Control Operators (PCOs) with regard to their ability to properly inspect and treat these structures for subterranean termites (*Reticulitermes* spp. and *Coptotermes* spp.), and other insects to the extent that the National Pest Control Association has issued guidelines for its members (Kramer 1993). Problems with termite treatments in the presence of rigid board insulation have also recently gained attention in the literature (Guyette 1994).

Rigid board insulation, primarily foam board insulation, includes materials such as polystyrene (styrofoam) and polyisocyanurate. Rigid board insulation is used as a perimeter insulation around structures; the insulation is usually placed against the foundation walls on the exterior of the masonry structure hidden from view by skin coats such as wood, aluminum or vinyl siding, or stucco. When rigid board insulation is in direct contact with the ground, it is essentially the same as wood-to-ground contact. The presence of these materials creates a situation which is conducive to termite infestations because of continuous hidden pathways directly into the wooden members of a structure. This makes it extremely difficult for the PCO to visually inspect and treat for termites. In addition, these materials are associated with an increase in moisture levels, which allows for highly favorable conditions to harbor termites.

Rigid board is being used as insulation due to low costs and good energy saving qualities. In 1985, approximately 5% of the building stock contained rigid board insulation (Christian 1990). By 1992, 50% of new construction contained some rigid board insulation (Kramer 1993). Good thermal characteristics, as well as high strength-to-weight ratios, have increased the use of these materials (Strzepek 1990). However, the strength and hardness of the rigid board may also be adversely affected by termite excretions (Building Research Station 1966). Hickin (1971) reported that plastic materials do not serve as a source of nutrition for termites, and damage of these materials is from termites physically removing the rigid board from their path. Plastics and other materials are not passed through the digestive system, rather the bitten-off fragments are removed or incorporated into tunnels. Polystyrene is subject to severe termite damage (Gay & Wetherly 1969). Tests showed that exposed ends and edges are more prone to attack than flat or curved surfaces. Cracks, rough edges, holes, and other deviations may promote termite activity on plastic materials (Becker

1972). The Formosan subterranean termite, *Coptotermes formosanus* Shiraki, damaged soft styrene resins in building materials (Shimizu et al. 1970).

The purpose of this survey was to demonstrate problems associated with the presence of rigid board insulation in South Carolina, primarily with termites, but also other insects. Surveys were sent to owners, managers, PCOs, and other persons associated with pest control companies to gain their perspective on the extent to which the problem exists. Recommendations to solve these problems, compiled from survey responses, will be discussed.

Materials and Methods

A sample of 225 individuals was chosen from the 315 pest control companies belonging to the South Carolina Pest Control Association (SCPCA); a total of 775 companies are operating in South Carolina. Survey forms were mailed in February, 1994, in a timed and organized mailing strategy and numbered to facilitate identification of returned surveys. The survey requested information for 1993 only. One week following the initial mailing, a follow-up letter was sent as a reminder to complete and to return survey forms. Three weeks following the initial mailing, a repeat survey form was mailed to all non-respondents. At eight weeks, another survey form was mailed to all non-respondents. All analyses of the data were performed using SAS (SAS Institute 1985). Results are primarily descriptive statistics.

The content of questions consisted of four types: demographics, occurrence of rigid board insulation, prevalence of rigid board insulation damage and structural damage, and treatment of structures when rigid board insulation was present.

Results and Discussion

Demographics

Of 225 survey forms, 187 were returned (83%); of those, 173 (77%) represented respondents who conduct termite inspections and/or treatments. Respondents were stratified by three regions within the state; Piedmont (the upper northwest portion), Central (middle one-third portion), and Coastal (lower southeastern portion) (Fig. 1). These regions were selected based on climatic differences within the state. Of those respondents who performed termite inspections and/or treatments, 17% were in the Piedmont, 38% in the Central, and 40% in the Coastal regions, with 5% in combinations of the three regions.

Most respondents (73%) were owners of the pest control companies surveyed, suggesting that information obtained was reliable. The number of termite treatments and inspections performed, in addition to the number of technicians employed, can be found in Table 1. Most companies were relatively small with less than 5 termite technicians employed. However, this does not imply the operations were small, as evidenced from the number of inspections and treatments performed in a given year: over three-quarters (82%) of all the termite treatments were performed by companies with 5 or fewer technicians.

Occurrence of Rigid Board Insulation

The documented presence of rigid board insulation on structures treated or inspected for termites was reported by 34% of the companies. Of these companies, 17% reported rigid board insulation on structures in the Piedmont, 39% in the Central, and 39% in the Coastal regions, with 5% in combinations of the three regions. These

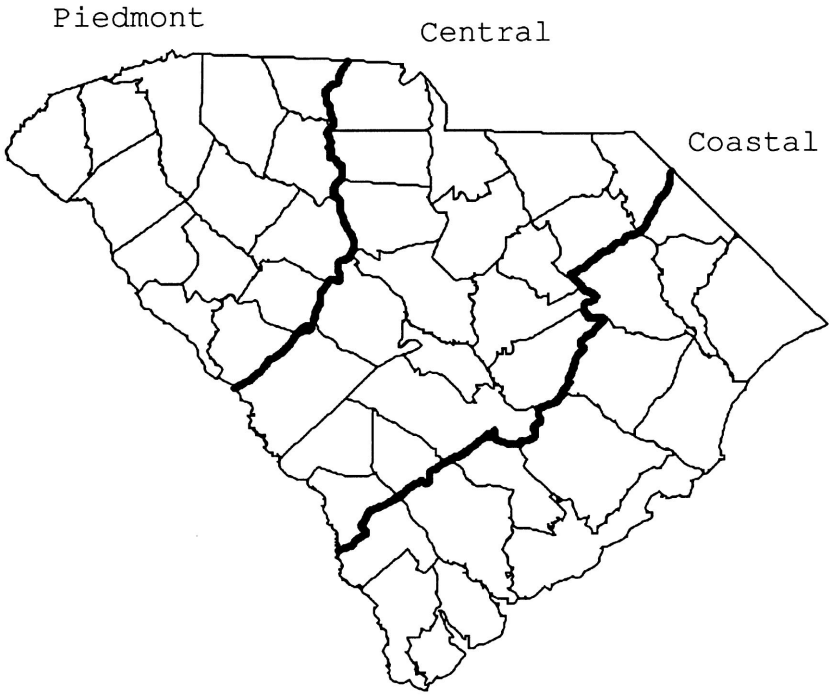

Figure 1. Regions of South Carolina.

values might not necessarily indicate the amount of new housing construction in each region, but certainly might reflect the increased termite pressures farther south.

As many as 81% of companies reported up to 10% of structures they treated and/or inspected for termites had rigid board insulation, and 2% of the companies reported greater than 75% of the structures had rigid board insulation. Rigid board insulation was reported to be installed above grade on structures by 41% of the companies, and below grade on structures by 59% of the companies.

Prevalence of Rigid Board Insulation Damage and Structural Damage

Eighty-one percent of the companies reported termite damage to rigid board insulation installed above grade in up to 10% of the structures they inspected. Seventy-two percent of the companies reported termite damage to rigid board insulation installed below grade in up to 10% of the structures they inspected, and 9% of the companies reported termite damage to rigid board insulation installed below grade in greater than 75% of the structures (Table 3).

Termite damage to the wooden structural members in the presence of rigid board insulation installed both above and below grade was reported by the occurrence on structures and percent time seen by companies (Table 4).

Excessive termite damage to rigid board insulation was seen by 10% of the companies, whereas moderate and slight damage to insulation was seen by 40% and 50% of the companies, respectively. Excessive termite damage to the wooden members of a

TABLE 1. PERCENTAGE OF TREATMENTS, INSPECTIONS, AND TECHNICIANS REPORTED BY RESPONDENTS AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Treatments		Inspections		Technicians	
Number	%	Number	%	Number	%
1-50	35	1-50	5	1-5	82
51-100	15	51-100	10	6-10	10
101-150	10	101-150	7	11-15	3
151-200	5	151-200	10	16-20	0
201-250	5	201-250	7	21-25	0
251-300	5	251-300	8	>25	5
>300	25	>300	53		

structure was seen by 30% of the companies; moderate and slight damage was seen by 40% and 30% of the companies, respectively.

The amounts of termite damage to rigid board insulation and wooden structural members, at various locations on a structure, was reported by mean percent damage (Table 5). The amount of damage in wooden members is positively correlated to the amount of damage seen in rigid board insulation in most locations throughout a structure (Table 6).

When the following foundation types were encountered, termite damage to rigid board insulation was present in the following amounts: monolithic slab (33%), supported slab (9%), floating slab (19%), basement (7%), crawlspace (23%), and any combination of one or more of the previous types (9%) (Table 7).

Twenty-five percent of the companies reported damage to rigid board insulation caused by insects other than termites. Carpenter ants were responsible for 87% of the damage, while other insects such as wasps (Sphecidae) and dermestids (Dermestidae) were to blame for the remaining 13% damage. These figures indicate that rigid board insulation is subject to damage on a wider scope than previously thought.

TABLE 2. PERCENTAGE OF TIME RIGID BOARD INSULATION DAMAGE DUE TO TERMITES WAS SEEN (ABOVE AND BELOW GRADE) BY RESPONDENTS, BY FREQUENCY OF OCCURRENCE ON STRUCTURES AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Above grade		Below grade	
Occurrence (%)	% Time Seen	Occurrence (%)	% Time Seen
1-10	81	1-10	72
11-25	15	11-25	10.5
26-50	4	26-50	3.5
51-75	0	51-75	5
>75	0	>75	9

TABLE 3. PERCENTAGE OF TIME STRUCTURAL DAMAGE DUE TO TERMITES WAS SEEN (ABOVE AND BELOW GRADE) BY RESPONDENTS, BY FREQUENCY OF OCCURRENCE ON STRUCTURES AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Above grade		Below grade	
Occurrence (%)	% Time Seen	Occurrence (%)	% Time Seen
1-10	76	1-10	74
11-25	12	11-25	15
26-50	8	26-50	4
51-75	0	51-75	0
>75	4	>75	7

Treatment When Rigid Board Insulation Was Present

Pest control companies chose to treat structures with rigid board insulation 57% of the time, compared to 43% that did not. Of those respondents that chose to treat termite-infested structures, 24% treated as they would any other structure and provided a guarantee, 33% treated but did not provide a guarantee, 31% removed insulation below grade (Table 7), and another 13% did something other than those options mentioned. Responses for the latter category were: trenched out below the insulation, treated, and backfilled; cut insulation off above grade and then sealed bottom of insulation; recommended that a qualified builder replace insulation and check structure for soundness; pretreated but did not know rigid board insulation was later installed; only treated if insulation was not below grade; modified guarantee such that company was not responsible for damage as a result of hidden entry through insulation; treated as result of having won a bid.

Of those respondents that chose not to treat structures, 34% believed the insulation created a situation conducive to termite infestation that was not treatable or correctable, 45% would not guarantee the treatment (Table 7), another 21% did something other than those options mentioned. Responses to the latter category in-

TABLE 4. MEAN PERCENT INSULATION AND STRUCTURAL DAMAGE DUE TO TERMITES AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Insulation			Structural		
Location	%	Std. Dev.	Location	%	Std. Dev.
Between grade level and footings	42.25	26.21	Between grade level and footings	9.20	4.82
Just below grade	9.50	5.23	Just below grade	12.75	5.99
At grade level	14.85	7.08	At grade level	20.13	18.11
Between grade level and sill plate	22.15	20.16	Between grade level and sill plate	28.61	23.65
Above the sill	11.25	6.35	Above the sill	29.31	14.21

TABLE 5. CORRELATION BETWEEN PERCENT OCCURRENCE OF INSULATION AND STRUCTURAL DAMAGE DUE TO TERMITES, USING PEARSON CORRELATION COEFFICIENTS (α=0.05) AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Location	Correlation Coefficient	p-Value
Between grade level and footings	0.2443	0.5598
Just below grade	0.7657	0.0037
At grade level	0.4725	0.1030
Between grade level and sill plate	0.6832	0.0006
Above the sill plate	0.5244	0.0658

cluded: customer did not want insulation removed; gave job to another company; recognized situation due to previous problems experienced with this type of insulation.

Trends show that PCOs generally do one of two things once rigid board is detected on a structure to be treated or inspected. They remove perimeter insulation just above the soil level in order to visually inspect for termites, or refuse to guarantee the treatment or treat the structure at all. Since only 25% of companies treated structures as they would any other, this suggests that the PCO is aware of the problem, but education is still necessary to inform those who do not know.

This survey will be a vital part of the process to inform PCOs. Although the problem is evident in South Carolina, it is not unique to this state alone. With the ever increasing government regulations on new housing, the problem will continue to grow. The real problem lies in the fact that rigid board is placed in a continuous fashion which does not allow for a proper inspection to take place. Insulation may be, and usually is, placed in contact with the soil and is often installed below grade, even extended down to the footings of a structure. The Model Energy Code (MEC) states the following for slab-on-grade floors, i.e. monolithic slab construction (abundantly present in South Carolina): "In climates below 6,000 annual Fahrenheit heating degree days (HDD), the insulation shall extend downward from the top of the slab for a minimum distance of 24 inches . . . greater than 6,000 annual Fahrenheit heating degree days (HDD), the insulation shall extend downward from the top of the slab for a minimum of 48 inches . . ." (Council of American Building Officials 1992). The MEC is essentially the standard regulation set and used for most building codes throughout

TABLE 6. PERCENT INSULATION DAMAGE DUE TO TERMITES, BY FOUNDATION TYPE AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Foundation	%	Std. Dev.
Monolithic slab	33.33	40.81
Supported slab	9.17	1.82
Floating slab	18.45	19.20
Basement	7.05	1.14
Crawlspace	22.62	19.49
Combination of above types	9.38	2.18

TABLE 7. TREATMENT OPTIONS AND THE PERCENTAGE OF COMPANIES THAT CHOSE TO TREAT STRUCTURES VERSUS NOT TREAT STRUCTURES AS ASSESSED BY A MAIL SURVEY OF MEMBER COMPANIES OF THE SOUTH CAROLINA PEST CONTROL ASSOCIATION, APRIL 1994, N=225.

Chose to treat	%	Chose not to treat	%
Treated as they would any other structure and provided a guarantee	24	Insulation created a situation conducive to termite infestation that was not treatable or correctable	34
Treated but did not provide a guarantee	33	Could not guarantee the treatment	45
Removed insulation below grade	31	Did something other than above options	21
Did something other than above options	13		

the country. Unfortunately, enforcement of codes in South Carolina is done on a voluntary basis only, within each county.

In either scenario, the government mandates that rigid board insulation be placed, not only in contact with the soil, but as deep as over 1 m below grade level. We believe that the physical removal of the rigid board just above grade level (a vision strip of 15 cm, for example) around the structure's perimeter would allow the PCO to detect termite activity, including the usual first signs - shelter tubes. Admittedly, there will be a thermal break (thermal short-circuit) caused by removing rigid board insulation, but we feel that the amount of material the termites are removing (the thermal loss as a result of termites) as they damage rigid board and structural members would warrant measures deemed necessary to correct the problem. In addition to the monetary loss of rigid board, the monetary loss of structural wooden members certainly is great, but precise figures are unavailable. The benefits of removing a small gap of insulation above grade level along the perimeter of structures would certainly outweigh the costs in the long run; additional insulation can be placed elsewhere in the structure to recoup the thermal loss from this adjustment.

Some rigid board manufacturers are investigating rigid board with the addition of inert chemical fillers such as disodium octaborate tetrahydrate (Kramer 1993). Although this could potentially exclude termites from damaging the materials, it would not necessarily deter termites from tunneling behind the materials where gaps in construction are present. Hidden termite entry once again would ensue.

We believe one final note is rather disturbing. Twelve percent of the respondents have been involved in litigation due to termite damage hidden by rigid board insulation. The majority of these companies, 57%, were from the Coastal region. The companies that belong to the SCPCA are among the best in South Carolina. Past experience with many of these companies demonstrates they are dedicated to their work and, therefore, less likely to be sued. This last number alone serves to illustrate the point that there is, indeed, a problem requiring attention at many levels, not just from the PCO.

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