N O T E

Demonstration Project Reporting Detection of Subterranean Termite (Blattodea: Rhinotermitidae) Infestation and Spray Polyurethane Foam[1]

Brian Forschler[2]

Department of Entomology, University of Georgia, Athens, Georgia 30602 USA

J. Entomol. Sci. 57(1): 138–144 (January 2022)

Key Words *Reticulitermes virginicus,* Spray Polyurethane Foam, termite visual inspections

Pest management professionals (PMPs) conducting inspections in the southeastern United States encountered Spray Polyurethane Foam (SPF) insulation in attics and crawlspaces as promoted by the Spray Polyurethane Foam Alliance (SPFA), http://www.sprayfoam.org/, and approved in building codes (American Chemical Council 2009, https://polyurethane.americanchemistry.com/Resources-and-Document-Library/10525.pdf. Last accessed 15 July 2021). PMPs began cancelling pest control contracts with customers who retrofitted existing structures using SPF because the insulation prevented visual inspections for termites and other wood-destroying organisms. The Georgia (USA) Structural Pest Control Commission (GSPCC), therefore, issued a Public Notice to inform consumers of the benefits and risks of SPF applied to homes (GSPCC 2018, http://agr.georgia.gov/Data/Sites/1/media/ag_plantindustry/structural_pestcontrol/structural_pest_control_commission/files/Notice-18-04-Spray-Foam-Insulation-and-Pest-Management.pdf. Last accessed 15 July 2021). Media coverage resulting from the notice prompted a meeting of stakeholders in January 2019 for the purpose of discussing termite inspections, SPF, and consumer education (PCT February, October 2019, http://magazine.pctonline.com/article/february-2019/foam-friend-or-foe.aspx and http://magazine.pctonline.com/article/october-2019/update-spray-foam–termite-protection.aspx. Last accessed 15 July 2021).

Subsequent to those events, a termite swarm was reported in the River Basin Building on the University of Georgia campus in Athens on 30 April 2019. A visual inspection found an infestation of *Reticulitermes virginicus* (Banks) (Blattodea: Rhinotermitidae) in the crawlspace. The River Basin building, a cinderblock structure, was constructed on a concrete slab with a crawlspace (approximately 36 m^2) in the northeast corner defined by a wall approximately 2-m high with wood

[1]Received 4 August 2021; accepted for publication 17 August 2021.
[2]Corresponding author (email: bfor@uga.edu).

framing for the floor supports. The infestation prompted a Demonstration Project aimed at examining termite detection technology in conjunction with SPF.

Five inspectors accessed the crawlspace on three dates (16 and 17 July and 15 August 2019) with instructions to provide information relevant to completing the National Pest Management Association (NPMA)-33 wood-destroying insect inspection form (NPMA 2020, https://npmapestworld.org/default/assets/File/Resource%20Center/Technical/Changes%20To%20Revised%20NPMA%2033%20Form.pdf. Last accessed 15 July 2021) and marking specific locales of subterranean termite activity with laminated red-arrow cards. The locations indicated in Tables 2 and 3 were areas where termite activity was noted and agreed upon by all inspectors and applied with SPF. Location numbers indicate the approximate distance, in feet, along the north foundation wall with 0 being closest to the crawlspace entrance and 20 the western-most corner (Tables 2, 3). Inspectors provided data from visual inspection as well as a number of additional tools including moisture meters (MM) such as the resistance, surface-reading types, Ryobi (E49MM01 [digital readout in %], Hiroshima, Japan), the Tramex Moisture Encounter (scale from 10–20%) (Tramex, Orlando, FL), and Protimeter MMS2 (digital readout in %) (St. Marys, PA), in addition to the subsurface, pin-type meters Protimeter Mini BLD2001 (scale from 6–30%) and Delmhorst Instrument Co. PC-3 (light-up scale from 8–30% in 2% increments) (Towaco, NJ). Two different infrared cameras (IR) a Protec IT 100 (Protec Equipment, Dallas, TX) and a FLIR E6 Teledyne FLIR (Thousand Oakes, CA). There were three device types represented by one manufacturer including a microwave motion detector with moisture sensors (MMD), Termatrac T3i All Sensor, Radar Technology and Moisture sensors using both Direct & Relative Omni-Directional Technology (digital readout in %) (Australia Pty Ltd, Newport Beach, CA), a laser-thermometer (General IRT207, General Tool Co, Cincinnati, OH), and a video probe (XLVU Videoprobe, Baker Hughes, Houston, TX) (Table 1). Inspectors were instructed to refrain from destructive sampling until the third inspection to reduce the potential for altering the distribution of the infestation. On 16 July, after the initial inspection, two types of SPF (5–7 cm of closed- and 15–20 cm of open-cell) were applied side-by-side to six locations that all inspectors agreed showed termite activity. The crawlspace was re-inspected on 17 July (e.g., 24 h after application of SPF) by all inspectors with the same equipment. A third inspection on 15 August was followed by removal of the SPF and recording additional data resulting from the final destructive sampling inspection.

The number of sites with identifiable termite activity varied by inspector between days, with the one exception (Inspector #4), and ranged from 5 to 14 (Table 1). In light of the instructions to refrain from destructive sampling, none of the visual inspections provided evidence of live termites during the first two inspections even from shelter tubes that had a 3-mm section removed and observed over the course of 1 h. Surface temperatures on the block wall and structural lumber varied by 1.9°C and on foam by 0.9°C with no pattern related to signs of termite activity (Table 2).

Three sites identified by Inspector #2 using the IR on the first inspection included two shelter tubes and damaged wood on a face plate (Table 1). Those indications of termite activity were, after discussions with all inspectors, not considered in the following inspections because those signs could be visibly identified without the IR (Table 1). Therefore, no areas of termite activity were identified solely by the IR on exposed wood, block, or SPF during any inspections.

Table 1. Equipment used by inspector and number of locations associated with observation of termite activity by inspection date and inspector/method.

		Number of Red Arrows Indicating Termite Activity		
		July 16	July 17	
Inspector	Inspection Equipment and Descriptions	Pre-SPF Application	No SPF	On SPF
Inspector #1	Moisture meters; Ryobi, and Protimeter Mini	14	14	0
Inspector #2	IR camera; FLIR E6	3*	0	0
Inspector #3	Termatrac T3i; motion detection and moisture sensors	6	11	6
Inspector #4	IR camera; Protec IT 100	5	5	0
	Moisture meter; Protimeter and Videoprobe			
Inspector #5	Laser thermometer;	10	9	0
	Moisture meters; Tramex and Delmhorst PC-3			

IR, infrared camera; SPF, Spray Polyurethane Foam.
* The initial IR inspection by #2 identified locations that were visible (i.e., shelter tubes on block wall) and, therefore, not an independent confirmation of activity. The July 17 inspections ignored such obvious signs.

Moisture readings obtained by a specific device on the concrete block foundation wall, floor joists, headers, and sill wood provided a consistent range of values during both July inspections although the values varied between devices (Table 2). All instruments afforded a range of 14–30% moisture at all locations with the exception of the Protimeter MMS2 on hollow block and the Ryobi which, in general, provided consistently higher readings per location than the other meters (Table 2). Most MM readings on the SPF ranged from 0–8%, whereas the Ryobi MM had a higher upper range of 16% (Table 3).

The MMD moisture readings on foam were consistently higher than the other MMs with a range from 4–26% (Table 3). The MMD recorded movement through the SPF at six locations including shelter tubes at locations 0 and 20 as well as beams and sill plate at locations 5, 15, and 30, but not 25.

Visual inspection of the recently applied SPF did not reveal signs of termite activity (July inspections; Table 1). There was one location during the August inspections that provided visual evidence of termite activity identified as discolored SPF resulting from termite gallery construction. Destructive sampling (e.g., removal of SPF and probing the wood) revealed live termites in galleries construction in both types of SPF, the sill, and beams at locations 5 and 15, but not 25 or 30.

Table 2. Moisture/temperature recorded on block or wood by instrument, location and date.

	Location 0 (on block)			Location 5 (on wood beam)			Location 5 (on wood sill)		
Moisture-Meter Type	**July 16**	**July 17**	**Aug 15**	**July 16**	**July 17**	**Aug 15 under SPF**	**July 16**	**July 17**	**Aug 15 under SPF**
Delmhorst	26	26	30+	20	20	20/28	20	20	24/30+
Protimeter	30+	30+	14–17*	20	19–22	20/30+	24	24	24/30+
Protimeter 2	100	68	NA	18–20	18–20	NA	25–30	17–20	NA
Tramex	20+	20+	17.5	20+	20+	20+/20+	20+	20+	20+/20+
Ryobi	50	50	33	30	30	26/100	22	22	34/100
Termatrac	25–26	26	30+	19	19	30+/18	25	25	30+/23
Laser temperature °C	27.2	25.9	26.7	26.6	26.8	28.2/27.4	26.4	26.3	27.4/26.8

NA, not applicable; SPF, Spray Polyurethane Foam.
* All numbers with an en dash indicate the range of values obtained from 2-to-5 readings within a 0.9-m surface area while single values indicate no variability in those multiple readings.
** Values in boldface italics were obtained on the wood surface that had been covered by the foam.
+ Device was at the maximum value.

Interestingly, when SPF was removed from shelter tubes on the block wall (locations 0 and 20), live termites were observed in the tubes with no evidence they entered the foam from those shelter tubes. Surface temperatures on wood varied by 1.9°C and on foam 0.9°C with no pattern related to signs of termite activity (Tables 2, 3). IRs were not able to detect anomalies associated with subterranean termites on SPF or nearby, not-exposed wood (Table 1). MM readings on wood, by device, were within the range of values from 1 month earlier with the exception of the MMD that provided higher % moisture readings than the previous month (Table 2). All devices, except the MMD, recorded higher % wood moisture in the wood that had been under SPF (Table 2). In addition, destructive sampling using the flexible borescope at locations 5 and 15 verified termite activity and could distinguish infested and not-infested SPF. Locations 25 and 30 are not in the Tables because there were no live termites found during the August inspection at those locations.

This compilation of observations supported two intuitive statements. First, a visual inspection of wood is not possible if covered with SPF. Second, the findings from a visual-only inspection for subterranean termites are subject to the inspectors' interpretation. Three inspectors (Inspectors 1, 4, and 5; Table 1) conducted industry standard visual inspections without sounding and probing to identify 5–14 "areas" affected by termites. Those discrepancies can be explained by the oblique instructions given to each inspector to identify "an area affected." One inspector could place 3–4 "red arrows" in a section where another might place only one

Table 2. Extended.

Location 20 (on block)			Location 15 (on wood beam)			Location 15 (on wood sill)		
July 16	July 17	Aug 15	July 16	July 17	Aug 15/ *under SPF***	July 16	July 17	Aug 15/ *under SPF***
20	20	24	20	20	20/***28***	20	20	24/***30***+
17	17	15–18	22	22	22/***28***	24	24	22/***30***+
100	100	NA	18–20	18	NA	25–30	25–30	NA
20+	20+	18	20+	20+	20+/***20***+	20+	20+	20+/***20***+
33	33	51	26	26	24/***100***	34	34	32–34/***100***
25	25	30+	18	18	30+/***27***	24	24	30+/***25***
26.3	26.4	27.3	26.6	26.8	26.8/***26.3***	26.5	26.4	26.3/***26.2***

illustrating the importance of word choice and definitions in pest management (Cira et al. 2019, Amer. Entomol. 65:258–267).

Conclusions drawn from these observational and instrument data must be framed within the parameters that defined the crawlspace. The variability in the MMs moisture readings was disconcerting, but consistency within devices highlight the relative nature of such data. The MM and IR were unable to consistently identify signs of termite infestation and certainly not *through* the SPF insulation. The wood in the crawlspace had above-normal wood moisture as indicated by visual inspection of mold on the structural lumber, wet soil on the floor, and lowest MM reading of 14% (Table 2). Those wet-wood conditions reduced the ability of MM to identify that portion of wood moisture attributable to subterranean termite activity. Likewise, the narrow range of surface temperatures (Tables 2, 3) in the crawlspace limited the ability of IR to separate termite activity from background sources or causes. The ability of the MMD to detect termite activity through both types, and depths, of SPF is a promising harbinger of the future for novel technologies applied to termite detection. This demonstration project clearly confirmed the value of visual inspection and probing to identify an active subterranean termite structural infestation and illuminated a number of noteworthy findings although it could not address all the conditions attendant to, or equipment available for, identifying subterranean termite structural infestations. Additional research under varying conditions should be conducted to see how these same or other termite detection devices perform. This note discusses the outcome from the observations reported by volunteers that converged on this site in July and August of 2019 and additional details can be found in a report provided to the GSPCC (GSPCC 2019, http://agr.georgia.gov/Data/Sites/1/media/ag_plantindustry/structural_pest_control/structural_pest_control_commission/files/

Table 3. Moisture/temperature recorded on SPF by location, instrument and date.

Moisture-Meter Type	Location 0 on SPF (on block)		Location 5 on SPF (on wood beam)		Location 5 on SPF (on wood sill)		Location 20 on SPF (on block)		Location 15 on SPF (on wood beam)		Location 15 on SPF (on wood sill)	
	July 17	Aug 15	July 17	Aug 15	July 17	Aug 15	July 17	Aug 15	July 17	Aug 15	July 17	Aug 15
Delmhorst	0	0	0	0	0	0	0	0	0	0	0	0
Protimeter	1	0	2–4	2	0–2	0	3–6	0	3–6	0	3–6	0
Protimeter 2	4–6	NA	4–6	NA	4–6	NA	4	NA	4–8	NA	4–8	NA
Tramex	0	0	0	0	0	0	0	0	0	0	0	0
Ryobi	0	8–16	0	12	0	14	0	0	0	16	0	0
Trematrac	4–11	14–20	4–11	7–26	4–11	12–20	4–11	9–15	4–11	0–16	4–11	14
Laser temp °C	26.7	26.5–27	26.4	27.80	26.5	27.10	26.5	26.5–27	26.5	26.9	26.4	27

NA, not applicable; SPF, Spray Polyurethane Foam.

Spray-Polyurethane-Foam-Termite-Detection-Demo-Project.pdf. Last accessed 15 July 2021).

Acknowledgments. Sincere thanks to all who donated their time, equipment, and expertise during this demonstration especially, Rick Bell of Arrow Exterminators, Atlanta, GA; Heath Knudsen and David Eubanks of Flexible Pest Services, Loganville, GA; Ed Freytag of New Orleans Mosquito and Termite Control Board, New Orleans, LA; Rick Wakenigg of Termatrac LLC, Newport Beach, CA; and Ryan Drueke and Josh Nichol of Foam South LLC, Cumming, GA.