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# FIELD TESTING OF WOOD PRESERVATIVES IN CANADA. XIV TERMITE TESTS IN ONTARIO

By

**P.I. Morris and J.K. Ingram**
**Forintek Canada Corp., 2665 East Mall, Vancouver, B. C. V6T 1W5**

## Abstract

Subterranean termites have become a major factor limiting the service life of wood products in southwestern Ontario. If preservative treatment can be demonstrated to deter termite attack, the market for treated wood products can be maintained and expanded. With the assistance of the town of Kincardine, Ontario, Forintek Canada Corp. set up a termite test in 1988. The material included commercially available red pine, lodgepole pine, jack pine, hemlock, white spruce, and mixed spruce-pine-fir. The preservatives were chromated copper arsenate (CCA-C), ammoniacal copper arsenate (ACA), and ammoniacal copper quat (ACQ). Both incised and unincised lumber was included in the tests where possible. Also used was CCA-treated hem-fir plywood.

The material was most recently inspected in 2003. Treated material was found to be generally performing well, with some pieces showing signs of superficial surface feeding, or cosmetic damage. Some samples with low assay retentions and preservative penetrations showed more than just trace nibbles, and termites appeared to have actually penetrated through the outer treated zone. Termite entry occurred in areas on the wood surface where defects may have facilitated such entry. Material that came close to meeting Canadian Standards Association O80 standards for ground contact generally suffered only minor damage.

In 1996, Forintek set up a test of borate-treated lumber above ground, protected from rain but exposed to termites. The material included hemlock and amabilis fir lumber treated with borate and chromated copper arsenate (CCA). After seven years of exposure, generally all of the treated material was found to be performing equally well, with some pieces showing residual signs of earlier superficial feeding or cosmetic damage. Attack was moderate on untreated controls.

## 1 Introduction

To sustain and expand markets for Canadian treated wood products in the termite-infested areas of southern Ontario, it must be demonstrated that wood treated to the requirements of the Canadian Standards Association (CSA) O80 standard will provide effective termite protection. The Eastern subterranean termite (*Reticulitermes flavipes* Kollar) is likely the most widespread and destructive termite species native to North America, and has gained a significant foothold since1929 (Kirby 1967) in parts of southwestern Ontario, including Metropolitan Toronto, Canada's most populous city. As the infestation in Ontario spreads, property losses resulting from termite attack continue to mount.

Although pressure treatment with wood preservatives is known to confer protection against termites, very little information exists on the performance of treated Canadian species. To fill this data gap, Forintek Canada Corp., with the assistance of the town of Kincardine, Ontario, initiated a termite test in 1988 using commercially available treated wood (Doyle 1992). Dr. J Kenneth Grace, at that time with the University of Toronto, provided invaluable assistance in evaluating the suitability of the site for termite testing. Results were reported after the 1996 evaluations (Morris and Motani 1997). This paper describes the performance of the test material after 15 years of exposure.

In late 1996, the test was expanded to include material out of ground contact. The preservative disodium octaborate tetrahydrate (DOT) is particularly effective at penetrating deeply into the relatively impermeable Canadian wood species. However, DOT is not fixed in wood and eventually leaches out in ground contact. For this reason, DOT's major commercial application is above ground, protected from liquid water.

A test method was designed to simulate sill plates on concrete foundations that were protected from the weather, but exposed to termites (Grace *et al.* 1995). Similar experiments are underway, using Japanese traditional sill plates (*dodai*), in Hawaii (Grace *et al.* 2001) and Japan (Tsunoda *et al.* 2002) where the Formosan subterranean termite (*Coptotermes formosanus* Shiraki) presents an extreme hazard. In the past few years this termite has become established in the southern United States, particularly Louisiana, where property losses have amounted to billions of dollars.

Results of the above-ground experiment were reported elsewhere after six years (Morris et al 2003) of field exposure. This report describes the performance of this test material after seven years of exposure.

## 2 Materials and Methods

### 2.1 Ground Contact Tests

Most of the wood for installation in the test plot was provided by Canadian wood treating plants. This material consisted of various commodities: nominal 2 x 4 inch (50 x 100 mm), 2 x 6 inch (50 x 150 mm), 4 x 4 inch (100 x 100 mm), and 6 x 6 inch (150 x 150 mm) pieces of four species (jack pine, red pine, lodgepole pine and white spruce) treated with either chromated copper arsenate (CCA-C) or ammoniacal copper arsenate (ACA) preservatives, reportedly to CSA requirements (CSA 1997a) for ground-contact applications. Incised as well as non-incised lumber was included. Samples of hem-fir plywood treated with CCA-C to CSA requirements (CSA 1997b), and one lot of hemlock (2 x 6 inch) treated with an experimental ammoniacal copper/quaternary ammonium compound (ACQ-B) preservative were also installed. Finally, along with the material provided by the industry specifically for this test, additional pieces of CCA-C-treated lumber (2 x 4 inch, 2 x 6 inch, 4 x 4 inch and 6 x 6 inch) were purchased at local lumber retailers to represent material available to the homeowner. This particular material could have been treated to either an above-ground (4.0 kg/$m^3$) or ground-contact (6.4 kg/$m^3$) specification. Also, since species identification was not carried out on every piece of this material, the species was simply reported as spruce-pine-fir (SPF).

For installation in the test plot, test specimens measuring 3 feet (0.91 m) in length were cut from each piece of treated lumber. The remaining length of the lumber was cut to provide a 1-foot (0.3-m) assay section and a 4-foot (1.22-m) end-matched piece for installation in Forintek's field test site at Petawawa (data not reported here). The white spruce and SPF installed at Kincardine were not replicated at Petawawa. Cores were removed from the assay section to determine treatment penetration and assay retention. Treatment penetrations were measured on the cores which were split longitudinally and sprayed with chrome azurol S solution to stain the treated zones (American Wood Preservers' Association 1997a). To determine assay retention, assay zones specified in the CSA O80.2 standard were cut from each core, combined for each set of replicates (termed a "lot"), then ground to 40 mesh in a Wiley mill. The resulting sawdust was analyzed for chromium, copper, and arsenic by energy dispersive x-ray spectrometry (American Wood Preservers' Association 1997b). Results were reported on an oxide basis.

The cut end of each piece of lumber intended for installation in the test plots was given two brush coatings of commercial copper naphthenate field-cut preservative, and each piece was labelled with a lot and sample number. The lumber was installed in the termite plot in an upright position approximately 18 inches (450 mm) into the soil, using a spacing of 24 inches (600 mm) between rows and about 18" (450 mm) between samples. Half of the pieces in each lot were planted with the pressure-treated ends down, while the remaining samples were placed with the cut and brush-treated ends down. Untreated controls consisted of red pine, jack pine, and white spruce (2 x 3 inch, 2 x 4 inch). The samples were installed in a randomized pattern throughout the test plot area. The row and position of each piece of test material were recorded and subsequently entered into a database.

The initial batch of test material (lot numbers 4245–4280) was installed in August 1988, filling all available space within the compound. To accommodate the remaining test material, Forintek asked Kincardine town council for permission to increase the size of the plot by extending the original fencing. The request was granted and the remaining test material (lot numbers 4283–4307) was installed in May 1989 in this annex.

Annually from 1989 to 1999, then again in 2003, test material at Kincardine was rated by visual examination for signs of termite attack. Each sample was carefully removed from the ground, examined, and assigned a rating using the 0–10 scale of the American Wood Preservers' Association (AWPA) given in Table 1. All ratings were subsequently entered into the database. In 1999, the stakes were reset to the appropriate depth, because frost heave over the years had gradually pushed them partially out of the ground.

*Table 1: Termite attack grading system*

| AWPA Rating | Description |
|---|---|
| 10 | Sound: surface grazing (nibbling) is permitted, but such cosmetic damage must be noted in the report. |
| 9 | Trace of attack: for example, surface erosion up to 5 mm deep, or up to two termite penetrations of up to 10 mm deep. |
| 7 | Moderate attack: for example, surface erosion over 5 mm, penetrations over 10 mm deep or ramifying tunnels present. |
| 4 | Heavy attack: for example, extensive tunneling of up to 50–75% of the cross-section. |
| 0 | Failure from termite attack. |

## 2.2 Above Ground Tests

Test specimens, 100 x 100 x 400 mm, were prepared from western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), Pacific silver fir (*Abies amabilis* (Dougl.) Forbes), and second growth western redcedar (*Thuja plicata* D. Donn.). Ten western hemlock pieces were selected from a large number of specimens pressure-treated with an aqueous solution of disodium octaborate tetrahydrate (DOT) to achieve a mean retention of 3.3 kg/m$^3$ $B_2O_3$ (1.4% boric acid equivalent, or BAE) in a 25-mm outer shell. This met the Canadian Standards Association (CSA) requirements for borate-treated lumber used for out-of-ground contact (CSA 1997a). Ten fir replicates through-treated to a mean of 2.5 kg/m$^3$ $B_2O_3$ (1.3% BAE) in the full cross-section were also selected. This material would have just failed the CSA retention requirement of 2.7 kg/m$^3$ $B_2O_3$. Ten hem-fir pieces were treated, to a mean retention of 3.2 kg/m$^3$ $B_2O_3$ (1.4% BAE) in a 25-mm outer shell, with a DOT solution to which 0.5% of didecyldimethylammonium chloride (DDAC) had been added to improve penetration.

To compare the performance of borate with that of another preservative, five hemlock and fir samples each were prepared from incised lumber pressure-treated with chromated copper arsenate (CCA-C) to retentions of 4.0 and 5.0 kg/m$^3$, respectively, and preservative penetrations of 10 mm or more. These CCA-treated samples met the CSA retention and penetration requirements for lumber exposed above-ground (CSA 1997b). The cut end of each CCA-treated piece of lumber was given a coating of commercial copper naphthenate field-cut preservative. Borate retentions were determined by mannitol titration (Winters, undated) and CCA was analyzed by energy dispersive x-ray spectrometry (American Wood Preservers' Association 1997). Ten untreated samples of western redcedar, a naturally durable species, were also included, along with five each of untreated hemlock and fir controls.

The test method (Grace *et al.* 1995) involved laying wood samples on top of hollow concrete blocks standing on the soil surface and then covering the structures with a box to protect them from rain and to maintain high humidity (Figure 1). There was no direct contact between the wood samples and the soil, other than that brought by the termites to construct shelter tubes. The covering boxes were constructed from CCA-treated plywood, 600 mm wide x 350 mm high x 1000 mm long with an open bottom. The inside and outside were painted with exterior primer and two coats of white paint to prevent excessive interior build-up of heat. Within each box, six hollow concrete blocks were placed directly onto the leveled soil in a 3 x 2 array, 50 mm apart.

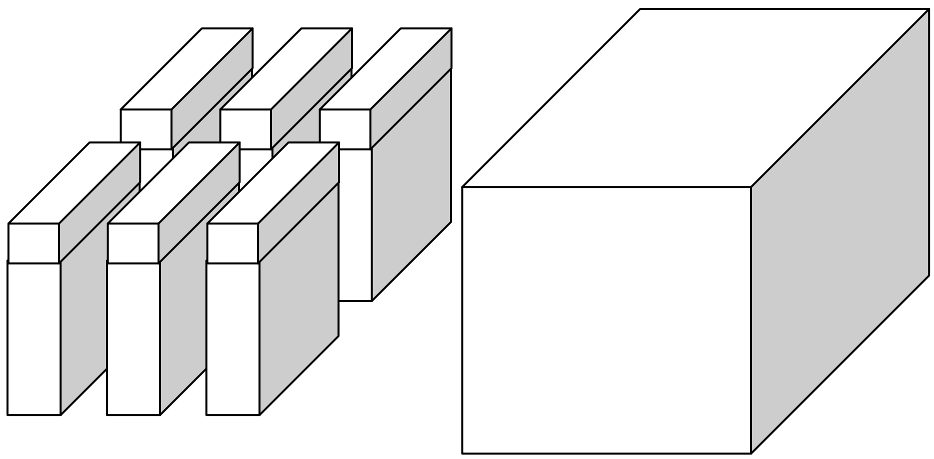


***Figure 1:*** ***Collection of test assemblies with cover box removed***

Through the two perforations in each block, 25 x 25 x 300 mm pine heartwood feeder stakes were hammered into the ground so that the top of the stake was within 2–5 mm of the top of the concrete block (Figure 2). The feeder stakes were prepared from moderately durable heartwood so that they would remain free from decay and mould long enough to be discovered by a foraging population of termites. In November 1996, one replicate from each treatment plus two of the untreated controls — a total of six samples — were placed in each of 10 test boxes. The test samples were situated one per block such that they covered the holes in the block but were not in direct contact with the feeder stake. This was to prevent direct tunneling by termites from the untreated wood stakes into the test samples. The position of each piece of test material was recorded and a database was prepared.

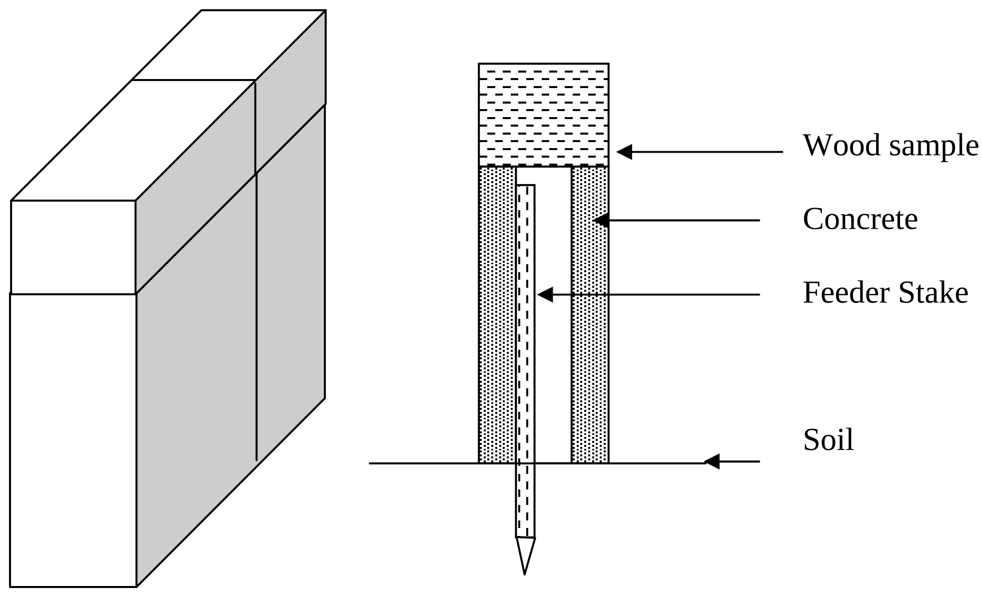



***Figure 2:*** ***Cross-section of test assembly.***

To encourage even distribution of termite attack throughout the test plot, feeder strips were installed in November 1998, linking the 10 individual test boxes. First, the concrete support blocks were lifted, leaving the feeder stakes in place. Small trenches, 25 mm deep, were then dug to join the feeder stakes of one test unit to those of adjacent units and to termite nests or bait stations. The pine heartwood feeder strips, 10 x 10 mm in size, were installed end-to-end in the trenches and covered with soil. After that, the support blocks, samples, and shelter boxes were replaced.

To monitor conditions inside the test assemblies, a HOBO data logger, programmed to record temperature and relative humidity once per hour, was installed on the interior north wall of one of the boxes in August 1999 and removed a year later. The data collected during that time were downloaded and summarized.

Test material was non-destructively rated on an annual basis using a visual examination for signs of termite attack. Each sample was carefully removed, examined, and assigned a rating on the 0–10 scale of the American Wood Preservers' Association (Table 1), before being replaced in the same location. All ratings were subsequently entered into the database.

# 3 Results and Discussion

## 3.1 Ground Contact Tests

At the time of the 2003 inspection, the original group of test material (lot numbers 4245–4280) had been in service for 15 years, while the second group located in the annex (lot numbers 4283–4307) had been in test for approximately 14 years and 4 months. Morris and Motani (1997) observed that activity in the annex area was comparable to that in the main plot, which had not been the case in 1992 (Doyle 1992). The 2003 ratings for termite attack and decay are given in Table 2, together with the percentage compliance of each lot with the 5-mm above-ground standard (CSA O80.32) and 10-mm ground contact (CSA O80.2) penetration requirements.

Heavy attack had occurred on the untreated controls, with mean ratings ranging from 0.0 to 2.3 for lumber and 0.0 for plywood (Table 2). Failure of the untreated samples was almost complete in the main test area, and attack of the controls in the annex had advanced considerably since the last inspection in 1999.

Most of the treated material was performing well, but some pieces were showing signs of surface grazing or more serious termite attack. In a few of the samples that had low assay retentions and preservative penetration, termites had entered the outer treated shell. Termite entry often occurred where defects such as checks may have facilitated it. In several cases, termites had tunneled directly through a thin treated zone to access the untreated interior.

Copper naphthenate field-cut preservative was also generally performing well, although, as in a small number of the pressure-treated ends, a few ends that were brush-treated with copper naphthenate had started to show signs of termite attack and end-grain decay. For the most part, there was no difference whether the treated end was up or down, indicating that this oil-based field-cut preservative is generally effective against termite attack.

Almost half (16 of the 33 lots) of the CCA-treated samples were in excellent condition, with mean ratings of 9.0 or more, reflecting just a trace of attack. Fourteen lots had mean ratings between 8.0 and 9.0, indicating a trace to moderate attack. Only three lots had mean ratings less than 8.0, and these lots were not incised. This overall good performance was achieved despite low compliance with the 10-mm or 5-mm penetration requirements in the CSA standards. Of the 11 incised CCA-treated lots, just two had a mean rating less than 9.0 (8.6 and 8.9). Of the 22 unincised CCA-treated lots, 15 had mean ratings less than 9.0. Two samples failed as a result of termite attack (rated 0); in both cases treatment was very poor, with CCA retention of 0.9 $kg/m^3$ and penetration of 2 mm. Three boards were rated 4 for heavy attack: two of these had CCA penetration of only 1 mm, and retentions of 0.9 and 1.9 $kg/m^3$.

Very little of the test material met the CSA O80 commodity standards. One lot of lodgepole pine (lot 4279) met the above-ground standard and had a mean rating of 9.3.

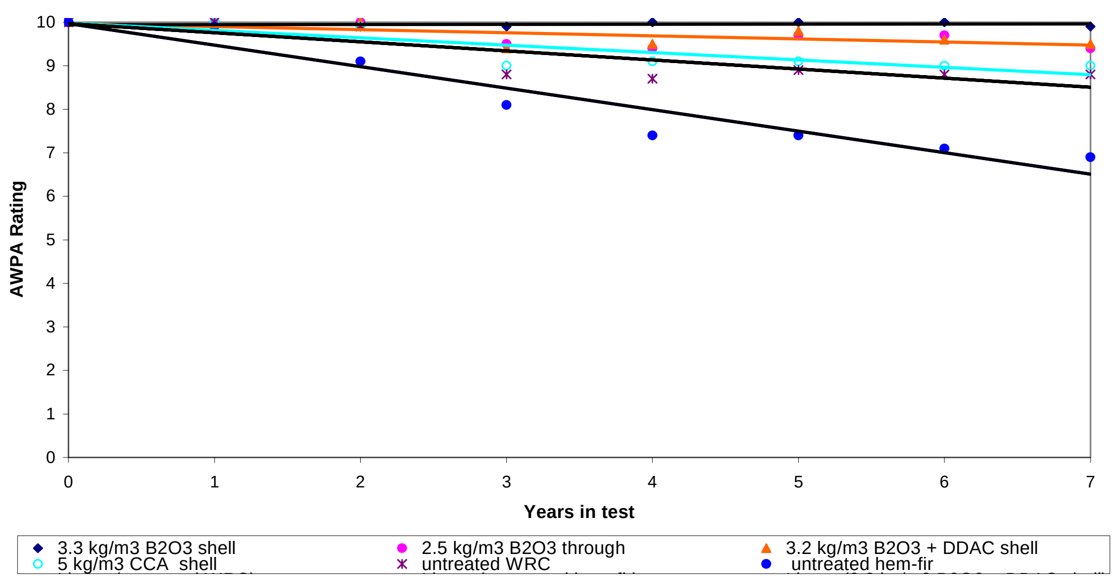
Four lots of red pine (lots 4287, 4289, 4290, and 4291) met the CSA O80.15 permanent wood foundation standard, and these had mean ratings of 9.0, 9.0, 8.8, and 9.0, respectively. Among the CCA-treated lots where the wood species was identified, almost all species had a similar range of mean ratings. The exception was jack pine, for which fewer lots of unincised material were installed.

All the unincised ACA-treated lumber had mean ratings of 9.2 or greater, possibly because at least 60% of every set had over 5 mm of preservative penetration. Eighty percent of the ACQ-B-treated hemlock had over 5 mm of penetration and a mean rating of 8.9. Residual ammonia in the ACA- and ACQ-B-treated lumber may also have played a role in repelling termite attack.

### 3.2 Above Ground Tests

After seven years, termite activity was relatively even among the 10 test boxes, and attack on the untreated controls was well established. Mean ratings for untreated wood ranged from 8.8 for the naturally durable western redcedar, to 7.4 for hemlock, and 6.4 for amabilis fir. The differences within the hem-fir group may be considered negligible since hemlock was deteriorating faster than amabilis fir up to year 4. Figure 3 shows linear fits to the depreciation data over seven years, although longer-term exposure may indicate that a linear model is inappropriate.

***Figure 3: Performance of above-ground protected samples at the Kincardine termite test plot after seven years' exposure***



No preservative-treated sample received a rating of less than 9 at the seven-year evaluation. Borate treatments performed as well as CCA treatments, with mean ratings of 9.0 or higher. At this stage, there was also no discernible difference between through- and shell-treatments with borate, or from the addition of DDAC.

Evaluations between years 2 and 4 overestimated the level of damage to treated material based on exploratory tunneling that appeared to penetrate the surface, particularly at incisions, on CCA-treated samples. Continued evaluations and probing with stiff wire revealed that these tunnels were shorter than the depth of preservative penetration and did not increase in depth with time. Grace *et al.* (2001) noted that neither DOT nor CCA is repellent to termites, so minor damage is expected.

Figure 4 illustrates that the relative humidity inside the boxes remains close to 100% virtually all year. As a result, condensation forms on the lid of some boxes and drips onto the samples. This might be creating a leaching hazard for the borate-treated samples, although no detrimental effects are yet apparent.

***Figure 4: Conditions inside Kincardine test box during 1999 – 2000***

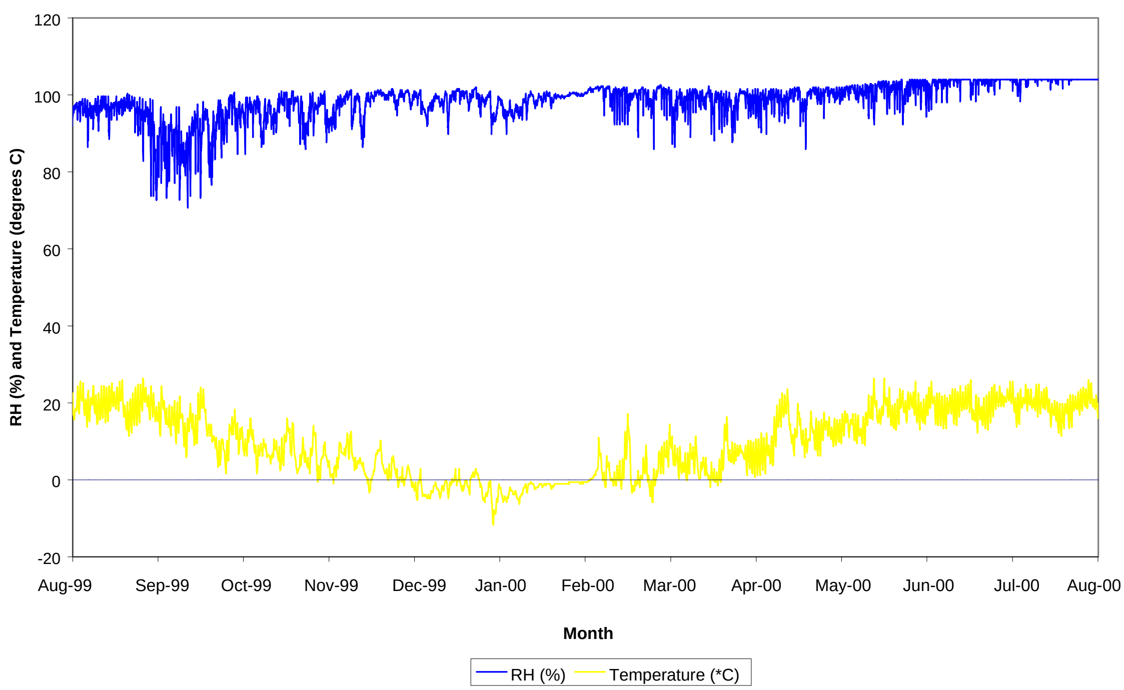


***Table 2: Performance of above-ground samples at the Kincardine termite test plot after seven years' exposure***

| Species | Treatment | Mean AWPA Rating |
|---|---|---|
| hem-fir | None | 6.8 |
| western redcedar | None | 8.8 |
| hemlock | 3.3 kg/m$^3$ $B_2O_3$ shell | 9.9 |
| amabilis fir | 2.5 kg/m$^3$ $B_2O_3$ through | 9.4 |
| hem-fir | 3.2 kg/m$^3$ $B_2O_3$ + DDAC shell | 9.5 |
| hem-fir | 4.5 kg/m$^3$ CCA shell | 9.0 |

In a parallel test situated at the Wood Research Institute in Kagoshima, Japan, where *C. formosanus* and *R. speratus* Kolbe are established, attack of untreated hem-fir after six years was more advanced that that seen at Kincardine, with mean ratings of 4.6 vs. 7.1 (Tsunoda *et al.* 2002). However, attack of preservative-treated samples was comparable to that found at the Canadian site. In Japan, samples shell- and through-treated to 2% BAE were rated 9.9 and 9.8, respectively; to 2% BAE/DDAC was rated 9.8; and to 4.0 kg/m$^3$ CCA was rated 9.7. In the other parallel test located in Waimanalo, Hawaii, where the climate is favourable to termite activity throughout the year, untreated hem-fir *dodai* (sill plates) were destroyed within one to two years (Grace *et al.* 2001). However, comparable preservative-treated material at this site was still in good condition after four years of exposure, with mean ratings of 9.2 or above.

## 4 Acknowledgements

Forintek Canada Corp. would like to thank its industry members, Natural Resources Canada, and the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, and Newfoundland and Labrador, for their guidance and financial support for this research.

## 5 Conclusions

- There is a high level of termite activity throughout the Kincardine plot area, shown by the severe attack on untreated controls.

- Lumber treated with CCA-C is susceptible to surface grazing — that is, cosmetic (non-structural) damage.

- Termites can penetrate through a CCA-C-treated shell if it is only a few millimetres deep, as a result of the surface grazing mentioned above.

- Commercial copper naphthenate field-cut preservative provides protection against termites.

- Treated lumber that meets or comes close to meeting the CSA O80 standards has suffered negligible damage from termites during 15 years of exposure, while poorly treated lumber has experienced notable failures.

- In Kincardine, Ontario, borate-treated lumber continues to perform as well as CCA-treated lumber after seven years' exposure to termites above-ground while protected from rain.

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## *Table 3: Performance of dimensional lumber in service at the Kincardine test plot*

| LOT # | COMMODITY DESCRIPTION | SIZE (inches) | SPECIES | NO. OF SAMPLES | AVERAGE ASSAY RETENTION ($kg/m^3$) | AVERAGE TREATMENT DEPTH mm (std dev) | % OF CORES WITH PENETRATIONS ≥5 mm | % OF CORES WITH PENETRATIONS ≥10 mm | AVERAGE RATINGS Kincardine termite |
|---|---|---|---|---|---|---|---|---|---|
| UNTREATED CONTROLS | | | | | | | | | |
| 4245 | PLYWOOD | 5/8 X 6 | hem-fir | 6 | - | - | - | - | 0.0 |
| 4254 | LUMBER | 2 X 4 | RP | 16 | - | - | - | - | 0.0 |
| 4255 | LUMBER | 2 X 4 | JP | 20 | - | - | - | - | 0.8 |
| 4280 | LUMBER | 2 X 4 | SPF | 6 | - | - | - | - | 1.3 |
| 4307 | LUMBER | 2 X 4 | RP | 10 | - | - | - | - | 2.2 |
| 4307S | LUMBER | 2 X 4, 2 X 3 | SPF | 20 | - | - | - | - | 2.3 |
| CCA-C-TREATED LUMBER | | | | | | | | | |
| 4256 | NON-INCISED | 2 X 4 | SPF | 6 | 0.9 | 2.3 (2.3) | 33 | 0 | 8.3 |
| 4257 | NON-INCISED | 2 X 4 | SPF | 6 | 1.8 | 3.7 (2.9) | 33 | 0 | 8.7 |
| 4258 | NON-INCISED | 2 X 4 | SPF | 6 | 5.9 | 11.3 (4.2) | 100 | 67 | 9.2 |
| 4259 | NON-INCISED | 2 X 6 | SPF | 4 | 4.4 | 7.0 (7.1) | 50 | 50 | 8.8 |
| 4260 | NON-INCISED | 2 X 6 | SPF | 4 | 0.9 | 2.0 (0.0) | 0 | 0 | 5.8 |
| 4261 | NON-INCISED | 2 X 6 | SPF | 4 | 1.1 | 3.5 (0.7) | 0 | 0 | 9.3 |
| 4262 | NON-INCISED | 4 X 4 | SPF | 4 | 1.5 | 8.5 (0.7) | 100 | 0 | 8.5 |
| 4263 | NON-INCISED | 4 X 4 | SPF | 6 | 0.5 | 1.0 (0.0) | 0 | 0 | 8.2 |
| 4264 | NON-INCISED | 4 X 4 | SPF | 6 | 6.1 | 9.7 (4.9) | 67 | 67 | 8.8 |
| 4265 | NON-INCISED | 6 X 6 | SPF | 4 | 5.9 | 4.0 (0.0) | 0 | 0 | 7.5 |
| 4266 | NON-INCISED | 6 X 6 | SPF | 4 | N/A | N/A | N/A | N/A | 9.3 |

| LOT # | COMMODITY DESCRIPTION | SIZE (inches) | SPECIES | NO. OF SAMPLES | AVERAGE ASSAY RETENTION ($kg/m^3$) | AVERAGE TREATMENT DEPTH mm (std dev) | % OF CORES WITH PENETRATIONS ≥5 mm | % OF CORES WITH PENETRATIONS ≥10 mm | AVERAGE RATINGS Kincardine termite |
|---|---|---|---|---|---|---|---|---|---|
| 4274 | NON-INCISED | 2 x 6 | LPP | 10 | 0.9 | 3.2 (1.8) | 20 | 0 | 7.4 |
| 4275 | NON-INCISED | 2 x 4 | LPP | 10 | 1.7 | 3.0 (2.9) | 20 | 0 | 8.6 |
| 4276 | NON-INCISED | 2 x 6 | LPP | 10 | 5.4 | 7.0 (6.9) | 40 | 40 | 8.6 |
| 4277 | NON-INCISED | 4 X 4 | LPP | 10 | 1.8 | 3.4 (3.9) | 20 | 20 | 8.3 |
| 4278 | INCISED (6 mm) | 4 X 4 | LPP | 10 | 5.9 | 10.0 (4.7) | 100 | 40 | 8.9 |
| 4279 | INCISED (13 mm) | 4 X 4 | LPP | 10 | 4.7 | 10.0 (1.9) | 100 | 80 | 9.3 |
| | | | | | | | | | |
| 4283 | INCISED | 6 X 6 | JP | 10 | 6.8 | 8.8 (4.2) | 90 | 30 | 9.3 |
| 4284 | INCISED (FT) | 2 x 6 | JP | 10 | 3.6 | 7.7 (4.6) | 60 | 40 | 9.1 |
| 4285 | NON-INCISED | 2 x 6 | JP | 10 | 4.2 | 4.7 (5.0) | 20 | 20 | 9.3 |
| 4286 | NON-INCISED | 2 x 4 | JP | 10 | 4.8 | 7.4 (5.2) | 60 | 20 | 9.2 |
| | | | | | | | | | |
| 4293 | NON-INCISED | 2 x 4 | S | 10 | 1.8 | 2.6 (2.7) | 10 | 10 | 9.1 |
| 4294 | NON-INCISED | 2 x 6 | S | 10 | 1.2 | 2.9 (4.3) | 10 | 10 | 9.4 |
| 4295 | NON-INCISED | 4 X 4 | S | 10 | 1.9 | 2.0 (1.5) | 10 | 0 | 8.0 |
| 4296 | INCISED (6 mm) | 4 X 4 | S | 10 | 2.7 | 1.3 (1.0) | 0 | 0 | 8.6 |
| 4297 | INCISED (13 mm) | 4 X 4 | S | 10 | 2.8 | 1.7 (1.3) | 10 | 0 | 9.1 |
| 4298 | INCISED (13 mm) | 6 X 6 | S | 5 | 4.8 | 3.6 (0.9) | 20 | 0 | 9.2 |
| | | | | | | | | | |
| 4287 | INCISED | 6 X 6 | RP | 10 | 9.7 | 14.8 (2.0) | 100 | 100 | 9.0 |
| 4288 | INCISED (FT) | 2 x 4 | RP | 10 | 3.5 | 6.3 (5.3) | 50 | 20 | 9.0 |
| 4289 | INCISED (FT) | 4 X 4 | RP | 10 | 10.0 | 13.5 (4.5) | 100 | 80 | 9.0 |
| 4290 | NON-INCISED | 4 X 4 | RP | 10 | 10.1 | 13.3 (3.9) | 90 | 90 | 8.8 |
| 4291 | INCISED | 4 X 4 | RP | 10 | 10.8 | 14.2 (3.3) | 100 | 80 | 9.0 |
| 4292 | NON-INCISED | 2 x 4 | RP | 10 | 2.9 | 6.8 (6.8) | 80 | 0 | 8.4 |

ACA-TREATED LUMBER

| LOT # | COMMODITY DESCRIPTION | SIZE (inches) | SPECIES | NO. OF SAMPLES | AVERAGE ASSAY RETENTION ($kg/m^3$) | AVERAGE TREATMENT DEPTH mm (std dev) | % OF CORES WITH PENETRATIONS ≥5 mm | ≥10 mm | AVERAGE RATINGS Kincardine termite |
|---|---|---|---|---|---|---|---|---|---|
| 4267 | NON-INCISED | 2 x 4 | RP | 10 | 10.2 | 15.0 (2.2) | 100 | 100 | 9.5 |
| 4268 | NON-INCISED | 2 x 4 | JP | 10 | 3.4 | 6.8 (4.6) | 60 | 20 | 9.6 |
| 4269 | NON-INCISED | 2 x 6 | RP | 10 | 4.2 | 8.2 (5.4) | 60 | 40 | 9.3 |
| 4270 | NON-INCISED | 2 x 6 | JP | 10 | 3.2 | 5.2 (2.3) | 60 | 0 | 9.2 |
| 4272 | NON-INCISED | 4 X 4 | RP | 10 | 6.2 | 8.2 (5.3) | 80 | 40 | 9.2 |
| 4273 | NON-INCISED | 4 X 4 | JP | 10 | 3.1 | 7.0 (5.2) | 60 | 20 | 9.4 |
| ACQ-B-TREATED LUMBER | | | | | | | | | |
| 4271 | NON-INCISED | 2 x 6 | hemlock | 10 | 1.5 | 7.4 (5.3) | 80 | 20 | 8.9 |
| CCA-C-TREATED PLYWOOD | | | | | | | | | |
| 4246-48 | | 5/8" X 6" | hem-fir | 12 | 8.4 - 9.9 | - | - | - | 9.3 |

NOTES:

Species: RP = red pine; JP = jack pine; SPF = spruce, pine, fir; LPP = lodgepole pine; S= white spruce.
Lot numbers 4256 – 4266 were selected randomly from local lumber retailers; all remaining treated material was provided by the wood-treating industry specifically for use in the test plot.

Lot number 4274 was treated to an above-ground specification (4.0 $kg/m^3$)

FT = Fine-tooth incisor.