# PILODYN EVALUATION OF TREATED WAFERBOARD IN FIELD EXPOSURE[1]

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ABSTRACT

Samples of preservative-treated aspen waferboard exposed outdoors for 30 months were compared using pin penetrations of the 6-Joule Pilodyn. These results correlated well with rankings of treatment performance based on more laborious standard mechanical tests, and demonstrate the potential for use of the Pilodyn as a tool to evaluate wood composites in test exposures with minimal destruction.

*Keywords:* Pilodyn, waferboard, preservatives, strength tests, field exposure.

## INTRODUCTION

Selected wood preservative systems that performed well in extensive laboratory tests of aspen waferboard (Hall et al. 1982; Schmidt et al. 1983) were tested in outdoor exposure plots at the Harrison Experimental Forest, Gulfport, MS, and the University of Minnesota, St. Paul, MN. After 30 months' exposure, experimental panels were removed and inspected for degradation and tested for mechanical properties (Schmidt et al. 1987) to compare treatment performance. As an additional attempt to quantify panel deterioration and rank treatment performances, 6-Joule Pilodyn (Proceq Sa-Zurich, Switzerland) pin penetrations were recorded and analyzed for comparison with results from more laborious mechanical tests.

The Pilodyn is a hand-held cylinder which drives a steel pin with a known spring force when triggered and was originally developed to estimate soft rot in wood poles (Fries-Hansen 1978; Leightley 1982). It has been used successfully in a variety of wood-testing applications including determination of tree density (Cown 1978; Taylor, 1981), density variations in particleboard (Booker 1983), and assessment of wood stakes in field tests (Hedley et al. 1980).

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TABLE 1. *Treatments of aspen waferboard in field exposure.*

| | |
|---|---|
| UNT | No treatment, 3% resin solids. |
| CFW | Aqueous copper and fluorine mixture mixed with wax emulsion and applied during furnish preparation (0.98% active solids retention; 3% powdered resin solids). |
| CFR | Aqueous copper and fluorine mixture mixed with liquid resin during furnish preparation (0.7% active solids retention; 3% resin solids). |
| ACA | Ammonical copper arsenate mixed with wax emulsion and applied during furnish preparation (0.61% active solids [4 kg/m³]; 3% resin solids). |
| TBTO | Tributyl tin oxide and monochloronapthelene mixed with liquid resin and applied during furnish preparation (board 1.4% by weight of stock soln; 3% resin solids). |
| IPBC | Dip of finished panel for 3 min in 3-iodo-2-pro-pynyl butyl carbamate (0.03% solids retention; 3% powdered resin solids; test fence only). |
| CU8 | Dip of finished panel in copper-8-quinolinolate (0.03% solids retention; 3% powdered resin solids; test fence only). |

## MATERIALS AND METHODS

Experimental panels were made from aspen (*Populus tremuloides* Michx.) wafers, emulsified wax, and liquid or powdered resole phenolic resins and were pressed at 210 C and 3.5 MPa to a nominal density of 673 $kg/m^3$ (details in Hall et al. 1982). The preservatives used and their methods of incorporation are in Table 1. Panels (580 mm × 700 mm × 16 mm thick) were edge-sealed and placed on test fences (45°S) or buried to one-half their height on-edge in soil. As only fungicide performance was sought in these trials, the soil used to seat the panels was treated with chlorpyrifos to prevent termite attack. After 30 months, half of the number of panels were removed for further evaluations (as per ASTM D 1037 1981) and equilibrated at 22 C and 50% RH. Static bending strips (430 mm × 76 mm) at 6.3% MC (dry-weight basis) cut from the test panels were placed flat on a sound piece of waferboard and tested at 5 equidistant points centered along their length with the 6-J Pilodyn using a 2.5-mm dia pin. Six such strips were tested for each treatment on the test fence at each site; four strips were tested from both above-ground portions as well as below-ground portions for each treatment at each burial test site. These strips were then tested for modulus of rupture (MOR) and elasticity (MOE), and subsequently, 50-mm × 50-mm squares were cut from the strips and tested in compression parallel to the face (CPF) of the samples as an estimate of internal bond (IB) (Schmidt et al. 1983). Pilodyn pin

TABLE 2. *Pilodyn pin penetrations (mm) into bending strips of treated aspen waferboard exposed 30 months outdoors.*

| Fence exposure | | Above ground | | Below ground | |
|---|---|---|---|---|---|
| TBTO | 10.2 a* | TBTO | 10.4 a** | CFW | 15.6 ab** |
| CFR | 10.1 ab | UNT | 10.3 a | CFR | 15.5 ab |
| UNT | 9.9 ab | CFR | 9.8 ab | UNT | 15.3 ab |
| CU8 | 9.5 ab | ACA | 9.5 ab | TBTO | 14.1 b |
| IPBC | 9.3 ab | CFW | 8.9 b | ACA | 10.4 c |
| CFW | 9.0 ab | | | | |
| ACA | 8.9 b | | | | |

* Each value the average of 60 pin penetrations from 12 strips; both exposure sites combined; values not followed by the same letter are statistically different ($\alpha$ = 0.05).
** Each value the average of 40 pin penetrations from 8 strips; both exposure sites combined ($\alpha$ = 0.01).

TABLE 3. *Ranking and comparisons among preservative treatments of exposed aspen waferboard based on modulus of rupture (MOR) and load at failure in compression parallel to the face (CPF).*

| Exposure | Trt | Load CPF (kg) | Trt | MOR (MPa) |
|---|---|---|---|---|
| Fence* | TBTO | 807 | CFR | 16.1 |
| | IPBC | 880 | TBTO | 17.8 |
| | CFW | 884 | CFW | 18.2 |
| | CFR | 930 | UNT | 18.4 |
| | UNT | 939 | IPBC | 18.9 |
| | CU8 | 975 | ACA | 19.7 |
| | ACA | 1,030 | CU8 | 20.5 |
| Above ground line** | CFR | 717 b | CFR | 17.0 a |
| | TBTO | 748 b | TBTO | 19.4 a |
| | UNT | 830 b | UNT | 19.5 a |
| | ACA | 975 a | ACA | 19.6 a |
| | CFW | 984 a | CFW | 20.4 a |
| Below ground line** | UNT | 239 a | UNT | 3.9 a |
| | CFW | 314 ab | CFW | 6.8 a |
| | CFR | 334 ab | CFR | 7.5 a |
| | TBTO | 405 ab | TBTO | 8.2 a |
| | ACA | 748 c | ACA | 18.7 b |

* Statistical comparisons not made as only single panel tested for each treatment.
** Values not followed by the same letter are significantly different ($\alpha = 0.05$; Protected LSD).

penetrations (in mm) were analyzed by standard analysis of variance and means of treatments were compared using Tukey's multiple range test (Guenther 1964).

## RESULTS AND DISCUSSION

Ranking of treatments and statistical comparisons based on Pilodyn pin penetrations are in Table 2. Differences in performance among panels were small in above-ground exposures (test fence and aerial portions of half-buried panels), but panels containing ACA and CFW were most resistant to pin penetration, while those with TBTO, CFR, or no preservative (UNT) had highest penetration values. In the below-ground portions, ACA boards were significantly better protected against deterioration than other treatments with TBTO ranked second, and the CFW, CFR, and UNT performances poorest.

A comparison of the Pilodyn ranking with results from mechanical tests (Table 3—data from Schmidt et al. 1987) shows great similarity. Paralleling the Pilodyn data, the CPF values averaged over both sites show ACA and TBTO to be the best and worst performers, respectively, on the test fence (statistical comparisons not done as only 1 panel removed from each fence). In above-ground portions of half-buried panels, the CPF test was more likely to show statistical differences among treatment performance than MOR, and indicated CFW and ACA significantly stronger to crushing than the rest. As did the Pilodyn results for below-ground evaluations, the CPF and MOR tests likewise selected ACA as a statistically superior treatment, with TBTO second best.

Use of the Pilodyn has shown promise as a way to quantify strength loss of test stakes caused by decay and eliminate observer bias in visual assessments (Hedley and Naish 1980), and has allowed ranking of treatment performance in this trial of aspen waferboards. Though depth of penetration is affected to a small degree by moisture content of wood (Smith and Morrell 1985), the ability of the pin to penetrate a number of wafers and apparently detect density differences related to deterioration of panel properties may make it useful as a field tool to test composites with minimal destruction. It would seem also to be useful in detecting internal voids caused by termite excavation invisible from the surface. It is planned to use Pilodyn readings on the remaining test panels at the time of removal for final evaluation at 5 yr to better judge the benefit of this tool in wood composite field evaluations.

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