

Evaluation of Wood Preservatives Using Crushing Strength

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ABSTRACT

Laboratory evaluation of pentachlorophenol as a wood preservative by the weight loss method was compared with the reduction in crushing strength method. Both methods gave similar results, but

incubation periods of at least 6 weeks were necessary to obtain results comparable with those previously published. *Phytopathology* 61:182-183.

Additional key words: *Lenzites trabea*, *Pinus* sp.

Loss in wt is the commonly used measure in laboratory evaluation of wood preservatives. Other methods involving loss in strength (2, 7), amount of oxygen used (6), amount of carbon dioxide produced (9), or inhibition of spore germination (8) have also been proposed. Because the wt loss method is relatively simple to carry out and is in general use in laboratories throughout the world, it should be used as the standard to judge other methods.

This study was undertaken to compare the evaluation of wood preservatives by the reduction in crushing strength method (10) with the ASTM standard soil-block method (1).

METHODS.—Test specimens were obtained from southern pine (*Pinus* sp.) sapwood and consisted of 1.9-cm cubes cut serially from 1.9 × 1.9-cm boards. Two hundred inoculation chambers were prepared, using 8-oz square bottles half filled with a substrate of moist soil topped by a pine feeder block. The brown-rot fungus, *Lenzites trabea* (Fr.) Pers., Madison isolate 617, was allowed to grow for 2 weeks on the feeder blocks in half of the bottles before the test cubes were inoculated by placing them on the fungus mat, one to a bottle. The noninoculated blocks were placed in sterile bottles (1). Paired blocks were assigned at random to each treatment concn of preservative and incubation time. Blocks were treated in 5% pentachlorophenol diluted with toluene to give a series of retentions as described in the standard method (1). The treated and check blocks were conditioned for 2 weeks in an incubation room with temp automatically maintained at 26.7 C and 70% relative humidity. After conditioning, each block was placed in a standard decay test bottle prepared according to ASTM standards (1) and incubated for 2, 4, 6, or 8 weeks. At the end of each incubation period, the cubes were removed from the bottles, the surface mycelium was wiped off, and wt loss due to decay determined after conditioning at 26.7 C and 70% relative humidity (1). After incubation, the cubes were tested in radial compression and their modulus of elasticity (MOE), stress at proportional limit (PL), and stress at 5% compression strain were recorded from the load-deflection diagrams (5). All cubes were brought to a moisture content above the fiber saturation point before conducting the compression tests. A machine speed of 0.1 cm/min was used in the application of compression stress.

The differences in wt, MOE, PL, and stress at 5% compression strain for each pair of matched decayed and control cubes were determined and the per cent loss was calculated. Five pairs of cubes were used for each concn and incubation time.

RESULTS.—Results of a test using retentions of dry pentachlorophenol of 0, 1.12, 2.88, and 3.04 kg/m³ incubated with *Lenzites trabea* for 2 weeks indicate a threshold value [highest concn that will permit decay (3)] below 1.12 kg/m³ using either wt loss or strength reduction (Fig. 1). Although this test indicated that strength reduction gave as good an indication of the threshold as wt loss, the values were much lower than those usually obtained when the wt loss method is used with longer incubation times (4).

Table 1 shows the results after using concn of dry pentachlorophenol of 0, 0.32, 0.48, 0.96, and 2.08 kg/m³ for incubation periods of 2, 4, 6, and 8 weeks. Using Duncan's line intersect method (3), these data indicate a threshold less than 0.96 kg/m³ after 2 and 4 weeks' incubation, as found in the first trial using either strength loss or wt loss. However, after 6 or 8 weeks' incubation the threshold was shown to have increased to just less than 2.08 kg/m³. Again there were no important differences in threshold between strength loss and weight loss.

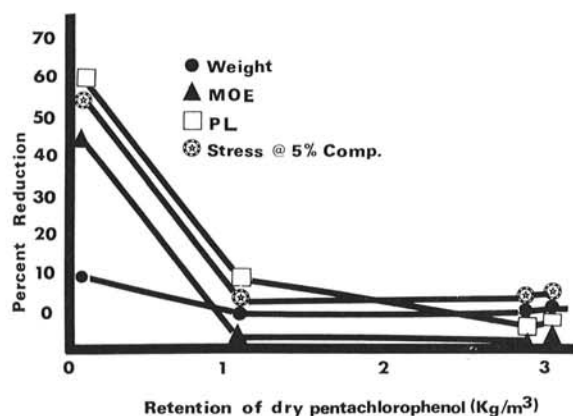


Fig. 1. Reduction in wt and compression strength of southern pine sapwood treated with various amounts of pentachlorophenol and incubated with *Lenzites trabea* for 2 weeks.

TABLE 1. Effect of pentachlorophenol^a on decay of southern pine blocks by *Lenzites trabea* during four incubation periods^b

Property	Preservative retention in kg/m ³				
	0	0.32	0.48	0.96	2.08
% ^c					
			2 weeks' incubation		
Wt loss	9.9	13.5	8.6	0.7	0.1
Reduction MOE	49.7	56.2	47.2	11.7	2.6
Reduction PL	54.7	67.8	56.0	17.1	+0.5
Reduction stress @ 5% comp.	51.8	63.2	46.9	6.7	0.7
			4 weeks' incubation		
Wt loss	30.4	23.0	25.9	0.1	0.1
Reduction MOE	65.8	83.5	85.7	21.4	5.7
Reduction PL	70.1	88.7	90.7	+8.4	+0.5
Reduction stress @ 5% comp.	67.5	82.4	89.8	3.4	4.4
			6 weeks' incubation		
Wt loss	28.3	31.9	31.5	14.5	0.3
Reduction MOE	75.3	88.1	90.5	41.9	1.4
Reduction PL	62.2	94.5	93.0	56.3	0.1
Reduction stress @ 5% comp.	61.2	91.7	91.9	40.2	4.6
			8 weeks' incubation		
Wt loss	35.9	51.9	33.3	21.2	0.2
Reduction MOE	84.2	93.8	84.9	79.8	+1.9
Reduction PL	75.8	97.5	93.1	76.7	7.6
Reduction stress @ 5% comp.	74.5	97.8	91.5	74.6	4.2

^a Pentachlorophenol 5% by wt in petroleum diluted with toluene. Retention expressed as kg/m³ of dry chemical.

^b Each loss is an average result for five pairs of blocks.

^c MOE = Modulus of elasticity; PL = proportional limit; comp. = compression.

DISCUSSION.—These data indicate that reduction in crushing strength is as good an indicator of threshold values as is loss in wt.

Incubation time, as has been pointed out by other workers (4, 6, 9), is very important. In this study, incubation times of 2 or 4 weeks gave low threshold values. Extension of incubation time to 6 or 8 weeks gave threshold values in agreement with those previously published (4, 6, 9). It seems probable that concn of pentachlorophenol below the threshold value delay colonization of the block by the test fungus, but with time the toxic action is overcome and decay takes place. Strength is reduced much faster than wt loss as decay progresses, and therefore may be a better measure for the evaluation of wood preservatives than wt loss when using the soil-block method. The reduction in crushing strength method, however, is not so easy to carry out as the wt loss method.

It is noticeable in Table 1 that low concn of pentachlorophenol cause losses in wt and strength greater than when no preservative is present. Analysis of variance shows that these differences are not significant; however, this trend may be an indication of a slight stimulatory effect of sublethal doses as has been pointed out by Duncan (3).

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