TREATMENT OF PINUS SYLVESTRIS POSTS WITH A CCA PRESERVATIVE

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ABSTRACT

Ten posts of New Zealand-grown **Pinus sylvestris** L. (Scots pine) were treated with a copper-chrome-arsenate (CCA) preservative by the Bethell process, to the Timber Preservation Authority (TPA) Commodity Specification C3 at a commercial plant.

Analysis of discs taken from the treated posts showed that all samples exceeded the minimum TPA requirements for copper penetration and retention in the sapwood zone. There was no significant difference between actual copper retentions (by analysis) and theoretical retentions calculated from solution uptakes and solution strength, which indicates that Scots pine is a very satisfactory species for treatment with CCA preservatives.

INTRODUCTION

Scots pine has not been widely established in the Nelson area; currently there are some 26 ha of pure stands and some 70 ha in mixtures. However, it is considered to have a potentially important role in the silviculture of Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) in this region. Douglas fir has been established mainly in pure stands, but to provide self-thinning stands or intermediate yields (depending on the species used), or because of tree stock shortages at the time of planting, stands of mixed species have also been established. Secondary species that have been established in Golden Downs State Forest include Corsican pine (*Pinus nigra* ssp. laricio (Poiret) Maire), ponderosa pine (*P. ponderosa* Laws.), lodgepole pine (*P. contorta* Dougl.) and, since 1976, Scots pine. Scots pine is currently favoured over the other secondary species because of its much lower susceptibility to *Dothistroma pini* Hulbary (Kershaw *et al.* 1979).

In the Nelson area, where there are no facilities for treatment of roundwood with oil-borne preservatives, it would be an advantage if the secondary species used could be pressure treated with a CCA preservative to the retentions required for ground contact, and used as post and pole material. Although overseas-grown Scots pine has been credited with a treatability rating of "permeable" for the sapwood and "moderately resistant" for the heartwood (Purslow & Redding 1978) no published data are available on the treatability ratings for that grown in New Zealand (P. Vinden pers. comm.), and so a pilot trial was carried out.

METHODS

As there were no stands of post size available, three 48-year-old trees from Compartment 66 of Golden Downs State Forest (alt. 365 m) were felled and 10 posts (Table 1) were cut from the upper portions of the stems. The end 100–150 mm were discarded and a 25-mm-thick disc was taken from each post for evaluation of sapwood properties (Table 2). The densities were determined gravimetrically from a diametric strip cut from each disc, and the sapwood/heartwood boundary was delineated with the aid of the azo-dye test (TPA 1980).

TABLE 1—Post dimensions and volumes (dried, peeled)

Post No.	Diameter (mm)		Length (m)	Volume (m^3)
	Large end	Small end		
1	109	103	2.22	0.020
2	178	166	2.37	0.055
3	95	91	2.23	0.015
4	131	130	2.21	0.030
5	156	147	2.18	0.039
6	152	135	2.32	0.038
7	113	100	2.31	0.021
8	136	125	2.27	0.030
9	146	142	2.30	0.037
10	124	113	2.20	0.024
Av.	134	125	2.26	0.030

TABLE 2—Sapwood data

Post No.	Density (kg/m^3)		Moisture content (%)		Sapwood depth (mm)	Sapwood proportion (%)	No. rings per cm
	Green	Basic	Green	Dried			
1	1018	364	180	10.0	56	99	2.7
2	1015	382	166	17.2	56	81	5.0
3	975	456	113	9.8	53	99	4.6
4	1007	443	127	14.8	40	81	5.7
5	1032	378	173	17.0	64	88	4.1
6	1012	455	122	14.3	39	75	5.9
7	1040	435	139	12.3	44	92	5.5
8	1029	369	179	12.3	59	98	2.9
9	987	363	172	14.7	68	98	2.9
10	1046	443	136	12.3	35	74	4.3
Av.	1016	409	151	13.5	51	88	4.4

The posts were delivered to a commercial post and pole processor where they were combined with a charge of ponderosa pine for debarking and low-temperature kiln drying at 46°C for 12 days. After drying, their dimensions were recorded (Table 1) and their moisture contents assessed using an electrical resistance moisture meter, equipped with 38-mm insulated probes (average moisture content 13.5%, range 9.8–17.2% (Table 2)). Volumes (Table 1) were calculated using Smalian's formula, and the total volume treated was 0.309 m^3.

The posts were incorporated into a charge of radiata pine (*Pinus radiata* D. Don) (average moisture content 20%) at a commercial treatment plant and pressure treated by the Bethell process, using a proprietary CCA preservative, to TPA Commodity Specification C3. The solution concentration was 1.90% commercial salt and total treatment time was 2 hours 15 min (a 3% overcharge resulted). Vacuum/pressure cycles are given in Table 3.

TABLE 3—Treatment schedule

Cycle	Gauge pressure (kPa)	Time to achieve gauge pressure (min)	Held for (min)
Initial vacuum	-85	15	5
Pressure	1400	20	85
Final vacuum	-85	10	0

After the treatment, discs were cut at 450 mm from the large end (groundline) and at 600 mm from the small end of each post and sent to the Forest Research Institute (FRI), Rotorua, where copper penetration in the sapwood zone was determined by the rubeanic acid test (TPA 1980) and retention by X-ray spectrometry.

RESULTS

All samples complied with the TPA requirements for copper penetration, i.e., 75% of the sapwood depth with a minimum depth of 10 mm.

The copper retentions achieved are given in Table 4 where sample A refers to the groundline section and sample B to the section taken at 600 mm from the small end. The theoretical copper retention (Table 5) was calculated for each post on the basis of a solution concentration of 1.90%, using basic densities and moisture contents (dried) from Table 2.

The following statistical analyses were carried out in the knowledge that, as the 10 posts were obtained from three trees, there would be an age effect and strong tree effect. Consequently the results of the analyses should be regarded as indicative only.

Comparison of copper retentions in samples A and B

The test of the difference in means was used to compare copper retentions in sample A and sample B for each post. A 't' value of 0.480 (for 18 degrees of freedom) resulted which was not significant at the 0.05 level of probability, indicating even treatment along the length of the post.

TABLE 4—Copper retentions (% oven-dried weight)

Post No.	Sample A	Sample B	Average
1	0.40	0.38	0.39
2	0.39	0.37	0.38
3	0.26	0.34	0.30
4	0.23	0.27	0.25
5	0.40	0.42	0.41
6	0.26	0.21	0.23
7	0.29	0.29	0.29
8	0.38	0.39	0.38
9	0.40	0.44	0.42
10	0.23	0.29	0.26
Av.	0.32	0.34	0.33

TABLE 5—Theoretical absorptions and copper retentions

Post No.	Theoretical absorption (l/m^3)	Retention salt (kg/m^3)	Copper (kg/m^3)	Copper retention (% o.d.w.)	
				Theoretical	Actual
1	720.81	13.69	1.62	0.44	0.39
2	679.50	12.91	1.52	0.40	0.38
3	651.16	12.37	1.46	0.32	0.30
4	638.96	12.14	1.43	0.32	0.25
5	683.61	12.99	1.53	0.41	0.41
6	631.45	12.00	1.42	0.31	0.23
7	656.35	12.47	1.47	0.34	0.29
8	708.49	13.46	1.59	0.43	0.38
9	704.52	13.39	1.58	0.44	0.42
10	650.03	12.35	1.46	0.33	0.26
Av.	671.98	12.77	1.51	0.37	0.33

o.d.w. = oven-dried weight

Comparison of theoretical and actual retentions

A 't'-test for difference in means between the theoretical and actual copper retentions (Table 5) showed no significant difference at $p = 0.05$ ('t' = 1.502 for 18 d.f.).

Relationship between basic density and copper retention

The variation between posts in average copper retention that could be attributed to differences in sapwood basic density was tested. The linear regression

Cu ret. % = 1.01914 – 0.00168 basic density (kg/m^3) ($r = -0.94$)

was significant at $p = 0.01$.

DISCUSSION AND CONCLUSIONS

The retention zone for TPA Commodity Specification C3 for material treated by the Bethell process is the outer 2–25 mm of the sapwood. The minimum specified loading of each preservative element in this zone for the proprietary preservative used is 0.13% Cu, 0.17% Cr, and 0.20% As. For ground contact uses, fungal attack is the major hazard and so the copper component is analysed first. Compliance with the TPA specification can be achieved in one of two ways:

(a) If the copper component is 0.18% or greater, then the sample complies and analysis of the other two elements is not required. If the copper analysis is below 0.13% then the sample fails.

(b) If the copper component falls between 0.13% and 0.17%, then the chrome and arsenic elements are analysed to determine if the total active elements are equal to, or greater than, 0.66%; if so, the sample passes provided the chrome and arsenic elements also meet the minimum loadings of 0.17% and 0.20% respectively. If they do not, the sample fails.

All the samples in this trial had an average copper retention exceeding 0.18% (Table 4), and the lowest individual sample (Post 6, Sample B) exceeded this by almost one-sixth.

Chemical analyses carried out at FRI have shown that, with an average solution concentration of 1.98%, copper retentions in the range 0.21–0.33% (average 0.28%) are usually obtained for radiata pine post material grown in the Waimea County, Nelson region (N. H. O. Cummins pers. comm.). This material, which would otherwise be used for pulpwood, has a basic density range 369–428 kg/m^3 (average 394 kg/m^3) (D. J. Cown pers. comm.) and such densities are closely comparable with those of the Scots pine posts (Table 2). However, the Scots pine copper retentions (Table 4) are considerably higher than the general level achieved for radiata pine using similar solution concentrations. This could not be explained from the data collected. It might have been expected that the level of retention in the Scots pine posts had been unduly influenced by their low moisture contents, but no discernible trend was apparent when the moisture contents determined at the large and small ends were plotted against the sample A and B retentions respectively. (The moisture contents were low because, as the drying characteristics of Scots pine in relation to radiata pine were not known, the posts were dried with ponderosa pine, a slower drying species. It now appears the Scots pine drying rate would be comparable with that of radiata pine.)

Although the average value of actual copper retention (0.33%) was lower than the theoretical average (0.37%) (Table 5), this difference was not statistically significant, confirming that a very good standard of treatment had been achieved.

Only a small sample (10 posts from three trees) of New Zealand-grown Scots pine post material was studied, but the results indicate that the sapwood is amenable to preservative treatment by the Bethell process and a "permeable" treatability rating (as for overseas-grown material) would seem appropriate. Clearly, before any definite conclusions can be drawn concerning the treatability of New Zealand-grown Scots pine, further samples with as wide a range of basic densities as possible would need to be treated.

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