TREATABILITY OF WESTERN WHITE SPRUCE WITH AMMONIACAL PRESERVATIVES

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ABSTRACT

The current American standard requires a minimum incision density for western white spruce and Engelmann spruce, but not for any other species. This requirement was based on the available data on the treatability of the western spruces with chromated copper arsenate. This preservative does not penetrate spruce as well as the ammoniacal preservatives. It therefore seemed likely that high-density incising may not be required when using the ammoniacal preservatives. End-matched samples of spruce from six sawmills were single-density- or double-density-incised and commercially treated with one of two preservatives, Ammoniacal Copper Quat (ACQ) or Ammoniacal Copper Citrate (ACcit). Both double-density and single-density-incised lumber from all six mills treated with both preservatives met the American Wood Preservers' Association AWPA C2 standard. Conventional incision densities of around 6000 incisions per square meter were more than adequate to meet the standard.

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INTRODUCTION

The object of this study was to develop the data to support the exclusion of ammoniacal preservative systems from the current high-density incising requirement for western white spruce in American Wood Preservers' Association (AWPA) C2 standard. Western white spruce (*Picea glauca* [Moench] Voss) and Engelmann spruce (*Picea Engelmanii* Parry) have been listed in the AWPA C2 standard since 1991, but they have a notation that other species groups do not have. This notation states that "Incising patterns of sufficiently high density (a minimum of 750 incisions per square foot) and depth to obtain the required uniformity of penetration will be required". This requirement was based on the available data on the treatability of western white spruce with chromated copper arsenate (De Lissa 1987; Morris, Lam, and Mackay 1990). Incisors capable of such incision densities are not widely used in North America at present. Consequently, this notation would discourage the use of the western spruces.

There is a resurgence of interest in ammoniacal preservatives and this could be of great benefit for the treatment of spruce. A review of the literature, presented to support the inclusion of these spruce species in the standard, showed that ammoniacal preservatives could penetrate more readily than CCA (Morris 1990). The information was, however, inadequate to demonstrate that high- density incising was unnecessary. A study was, therefore, undertaken to determine whether conventional incision densities would be adequate to treat western spruce. If this were the case the notation in the AWPA C2 standard could be changed to exclude ammoniacal preservatives.

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METHODS

Sixty kiln-dried 12 ft (3.6 m) nominal 2 x 6 inch western spruce (a mixture of white spruce and Engelmann spruce) boards were collected from each of six Alberta sawmills. The sawmills supplying the wood were Atlas Lumber in Blairmore (Mill A), Boucher Brothers in Nampa (Mill B), Canfor in Grande Prairie (Mill C), Mostowich Lumber in Fox Creek (Mill M), Spray Lake in Cochrane (Mill S), and Weyerhaeuser in Grande Cache (Mill W). The wood was delivered to the Forintek laboratory in Vancouver, B.C., at which time the species of each board was verified as spruce. Each board was cut into two end-matched samples which were labelled with the mill code, incising code, and sample numbers 1-60.

They were then taken to B.C. Clean Wood Preservers Ltd. in Surrey, B.C., where one sample from each board was single-density-incised (5860 incisions/m^2), and the other half was double-density-incised (11720 incisions/m^2). After incising, 40 pieces per mill were selected for treatment. Twenty pieces per mill, single-density and double-density-incised, were shipped to J.H. Baxter in Oregon for treatment with ammoniacal copper quat (ACQ). The treating cycle used was 2.0 hours vacuum, 10.0 hours pressure at 830 kPa (120 psi), and 3.0 hours of post-vacuum, with a 2.7% ACQ solution.

Similarly, 20 pieces per mill, single-density and double-density-incised, were treated with ammoniacal copper citrate by B.C. Clean Wood Preservers Ltd. The treating cycle used was 1.0 hour vacuum, 6.0 hours pressure at 860-1035 kPa (125-150 psi), and 0.17 hour of post-vacuum, with a 2.1% ammoniacal copper citrate (ACcit) solution.

After treatment, all material was returned to Forintek in Vancouver and air-dried. Core samples were then taken from between incisions in the centre of the heartwood face of each board. Each core was cut to 16 mm in length and split longitudinally. One half was sprayed with chrome azurol S, a copper indicator, and the depth of copper penetration was measured. A mean penetration for the 20 cores per mill and incising pattern was calculated. For each set of 20, the other core halves were combined and ground to 40 mesh sawdust, 0.4 g of which was combined with 0.1 g of cellulose powder and pressed into a pellet. These pellets were analyzed for copper using an energy dispersive x-ray fluorescence spectrometer. Analytical results were corrected for matrix effects and internment interferences. The ACQ retention was calculated by multiplying the copper retention by 2.0. The ACcit retention was calculated by multiplying the copper oxide retention by 1.5. Results were converted from a weight/weight to a weight/volume basis (kg/m^3) using the specific gravity of western white spruce.

RESULTS AND DISCUSSION

All copper citrate-treated cores, from both single-density and double-density-incised boards, contained over 10 mm of copper penetration (Table 1). Furthermore 70%, or more, of the copper citrate samples contained $\geq$13 mm of penetration. All but two of the ACQ-treated cores contained over 10 mm of copper penetration, and at least 95% of the ACQ-treated samples contained over 13 mm of copper penetration (Table 2). There was no difference in penetration achieved between single-density and double-density-incised pieces with either copper citrate or ACQ (Tables 1 and 2). No comparison can be made between ACQ and ACcit with respect to

TABLE 1 **Ammoniacal Copper Citrate Treatment Results**

Mill	Incising Pattern	Penetration (mm) % ≥ 10 mm	% ≥ 13 mm	mean	(std. dev.)	Retention (kg/m³) CuO	ACcit
A	single	100	95	15.0	(1.4)	5.6	9.6
	double	100	75	14.4	(2.5)	6.7	11.5
B	single	100	100	15.1	(1.2)	5.7	9.7
	double	100	75	13.9	(1.8)	6.7	11.5
C	single	100	85	14.5	(1.6)	5.9	10.1
	double	100	80	14.8	(1.8)	9.0	15.4
M	single	100	80	14.4	(2.1)	6.5	11.1
	double	100	85	14.2	(2.1)	6.5	11.1
S	single	100	80	14.5	(1.6)	5.7	9.7
	double	100	95	15.2	(1.4)	5.9	10.1
W	single	100	70	14.2	(2.3)	5.4	9.2
	double	100	100	15.6	(0.7)	7.8	13.3

TABLE 2 **Ammoniacal Copper Quat Treatment Results**

Mill	Incising Pattern	Penetration (mm) % ≥ 10 mm	% ≥ 13 mm	mean	(std. dev.)	Retention (kg/m³) CuO	ACQ
A	single	100	100	16.0	(0.0)	11.2	16.8
	double	100	100	16.0	(0.0)	9.6	14.4
B	single	100	100	16.0	(0.0)	9.8	14.7
	double	100	100	16.0	(0.0)	9.8	14.7
C	single	100	95	15.8	(1.1)	9.1	13.6
	double	100	95	15.7	(1.3)	9.0	13.5
M	single	100	100	16.0	(0.0)	9.1	13.6
	double	100	95	15.8	(0.9)	7.1	10.6
S	single	100	100	16.0	(0.0)	8.4	12.6
	double	95	95	15.6	(1.8)	9.6	14.4
W	single	100	100	15.9	(0.4)	8.5	12.8
	double	95	95	15.5	(2.2)	6.8	10.2

the penetration or retention data because different treating plants and different processes were used for the two preservatives. Furthermore there was no end-matching between the material sent to J.H. Baxter and that retained at B.C. Clean Wood Preservers.

The ACcit retention in double-density-incised pieces was the same or better than in single-density-incised samples. Retentions expressed in terms of copper citrate, for all mills and both incising patterns, met the ground-contact requirement of 6.4 kg/m^3 (0.40 pcf). Indeed, all but one of the sets met the AWPA permanent wood foundation requirement of 9.6 kg/m^3 (0.60 pcf). Similarly, the ACQ retentions of both single-density and double-density-incised boards met the ground-contact standard of 6.4 kg/m^3 (0.40 pcf), and also met the PWF standard of 9.6 kg/m^3 (0.60 pcf).

The degree to which the standards were exceeded for both preservative retention and penetration suggests that pressure periods of less than 6.0 hours may be quite sufficient. These results are consistent with those of previous studies (Krzyzewski 1977; Morris 1990) which demonstrated that conventionally incised spruce can be treated to meet the AWPA standards using ammoniacal copper arsenate.

CONCLUSIONS

Western spruce can be treated to meet the penetration and retention requirements of the AWPA for ground-contact by the use of single-density incising and copper-based ammoniacal preservatives.

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