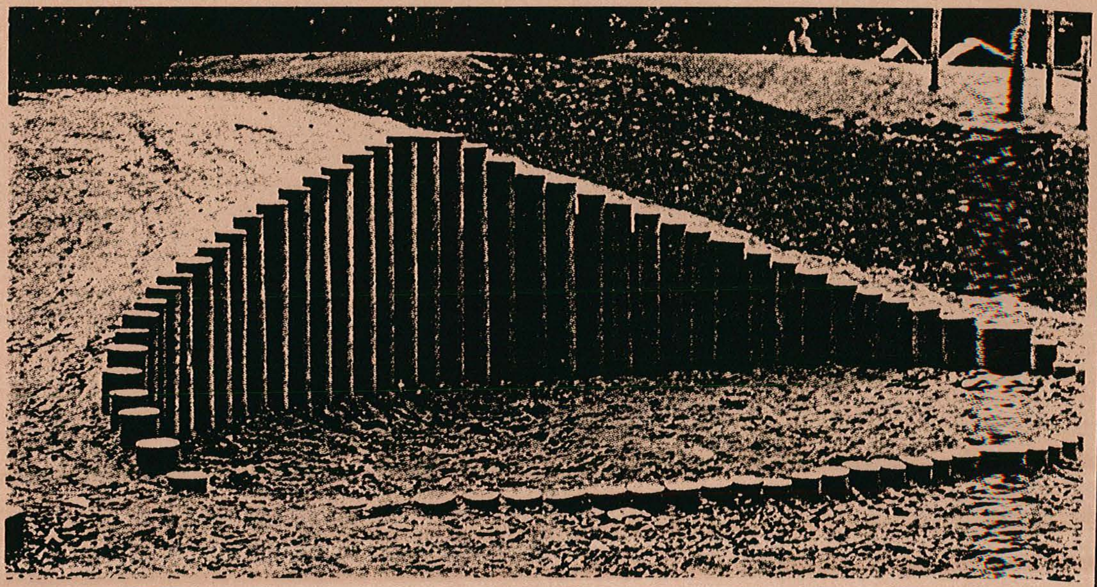
Small Eucalypt Processing

Penetration of Copper-Chrome-Arsenic Preservative into Regrowth Jarrah Posts

by G.K. Brennan



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SUMMARY

The sapwood zone in regrowth jarrah (*Eucalyptus marginata* Donn ex Sm.), although narrow, can contribute more than half the strength when jarrah is used for posts of small diameter. Treatment with copper-chrome-arsenic (C.C.A.) preservative increases resistance to fungal or insect attack in the sapwood zone, but the preservative does not penetrate the heartwood.

In the study described, a starch test was shown to be marginally more effective than visual assessment of the sapwood band in predicting the depth of C.C.A. penetration, based on copper penetration. However, the method is unlikely to have commercial application because the differences found were small, although statistically significant.

INTRODUCTION

Strength and durability are the two major properties of timber. In the structural use of timber, sapwood and heartwood have similar strength, but there are differences in their resistance to attack by fungi or insects. Sapwood is far more susceptible than heartwood to attack, due in part to its higher starch content. Heartwood contains high concentrations of extractives toxic to fungi, and has vessels occluded by tyloses which impede fungal growth (Tamblyn 1978). A major review of sapwood and heartwood by Bamber and Fukazawa (1985) discusses the subject in detail. Durability ratings of different species are based on in-ground testing of samples of outer heartwood, usually obtained from the butt log which contains the most durable wood in the tree (Thornton *et al.* 1983).

The change from sapwood to heartwood occurs gradually through a layer of cells of variable width, the transition zone, whose properties are gradational between sapwood and heartwood (Chattaway 1952). The boundary between sapwood and heartwood may be difficult to define visually. Sapwood can be identified using a starch test by applying a solution of 0.1 per cent dimethylbromide ether (Standards Association of Australia 1980). Some starch is generally found in the transition zone.

When high durability timbers were readily available, they were used untreated as poles, piles, or posts. If calculation of design stresses was necessary the sapwood width was excluded. With increasing scarcity of the more durable species, lower durability species with sapwood included have been used after treatment with chemical preservatives. The sapwood band provides strength, but it must be treated to a standard retention to provide resistance to fungal or insect attack. Heartwood is generally inpenetrable.

The width of the sapwood band tends to be constant within a species (Hillis 1978), so its contribution to strength decreases with increasing overall diameter of the pole, pile or post. Tamblyn (1978) stated that the percentage (p) of total strength contributed by treated sapwood of depth (t)mm can be calculated for a pole of diameter (D)mm at groundline from the equation.

$$p = 100\ [1 - (1 - 2t/D)^4]$$

When considering small diameter timbers such as posts, irrespective of the durability of the heartwood, a band of sapwood made durable by preservation is obviously essential to provide strength in-service.

Jarrah is a naturally durable species (durability class 2), based on tests of the outer heartwood of mature trees (Standards Association of Australia 1980). There is increasing dependence on the regrowth jarrah resource with its smaller trees, and durability of the heartwood of regrowth requires assessment. It is suggested that if regrowth jarrah is pressure treated with preservative a wide band of treated sapwood is an advantage for regrowth jarrah posts, and any reduction in the natural durability of the heartwood would be less of a problem.

The present study was designed to determine whether visual assessment of sapwood width could be used to estimate the amount of copper-chrome-arsenic (C.C.A.) preservative which would penetrate into the sapwood of regrowth jarrah posts, or whether the starch test was necessary to identify the sapwood/heartwood boundary. This could allow pre-sorting of posts before preservative treatment, because treatment may be ineffective with a narrow treated sapwood band.

MATERIALS AND METHODS

Twelve jarrah fence posts 1.8 m long and about 15 cm diameter were obtained from an area thinned for wood production in Dwellingup District, about 80 km SE of Perth. The posts were debarked and dried to below fibre saturation point. At this stage, each end of the posts was docked, and the mean diameter at both small and large ends was measured.

The width of sapwood was measured at four positions on the small end, and four on the large end on the freshly sawn surface (i.e. eight measurements per log) using visual assessment of the sapwood/heartwood boundary based on colour differences.

The starch indicator 0.1 per cent dimethylbromide ether was then applied at the same measurement positions on each post, identifying the boundary by a colour change from yellow to red at the sapwood/heartwood boundary, and the sapwood width remeasured. Measurement points and identification numbers were recorded on metal tags.

The posts were transported to Bunnings Ltd's treatment plant at Mundijong, and treated with C.C.A. preservative to a retention of 12 kg/m^3, using the full cell method.

After treatment, the posts were dried for two weeks to avoid smearing effects when a 4 cm section was docked from each end and penetration assessed. The chromazural S test for the presence of copper (Standards Association of Australia 1980) was used to determine the depth of C.C.A. penetration at the four relative positions on each end of each post. The presence of copper is indicated by a blue stain.

Regression analysis was used to determine the relationship between visual assessment of sapwood and the penetration of C.C.A. preservative, and between assessment after the starch tests and C.C.A. penetration.

RESULTS

The mean small end diameter of the posts was 150 mm, with a standard deviation of 21 mm. Mean values and standard deviations for the measurements of sapwood depth from visual assessment, assessment following starch tests, and following C.C.A. treatment are given in Table 1. Statistical comparisons are given in Table 2.

Table 1

Means and standard deviations for measurement of sapwood depth visually, following a starch test, and following C.C.A. treatment.

Treatment	No. of Measurements	Sapwood depth (mm)	
		Mean	S.D.
Visual	96	16.0	3.7
Following starch test	96	15.8	3.6
Following C.C.A. treatment	96	15.1	3.4

Table 2

Mean differences, t-values for comparing depth of sapwood visually, following a starch test, and following C.C.A. treatment.

Treatment comparisons	d.f.	Mean diff (mm)	t-value
Sapwood depth (mm) (visual method) **vs** sapwood depth (mm) (Starch test)	23	0.1	0.16 N.S.
Sapwood depth (mm) (visual method) **vs** depth of C.C.A. penetration (mm)	23	0.8	1.80 N.S.
Sapwood depth (mm) (starch test) **vs** depth of C.C.A. penetration (mm)	23	0.7	2.89 **

The depth of C.C.A. penetration was predicted from visual assessment of sapwood depth or starch test assessment by regression analysis.

For visual assessment, the regression equation calculated was

$$y = 5.761 + 0.586x \qquad r = 0.61 \qquad (p - < 0.001)$$

where y = C.C.A. penetration (mm) and x = visual estimate of sapwood depths (mm). The 95 per cent confidence limits are shown in Figure 1 (a).

For starch test assessment, the regression equation calculated was:

$$y = 2.665 + 0.784x \qquad r = 0.91 \qquad (p - < 0.001)$$

where y = C.C.A. penetration (mm), and x = depth of sapwood (mm) estimated from the starch tests. Again, the 95 per cent confidence limits are shown (Figure 1(b)).

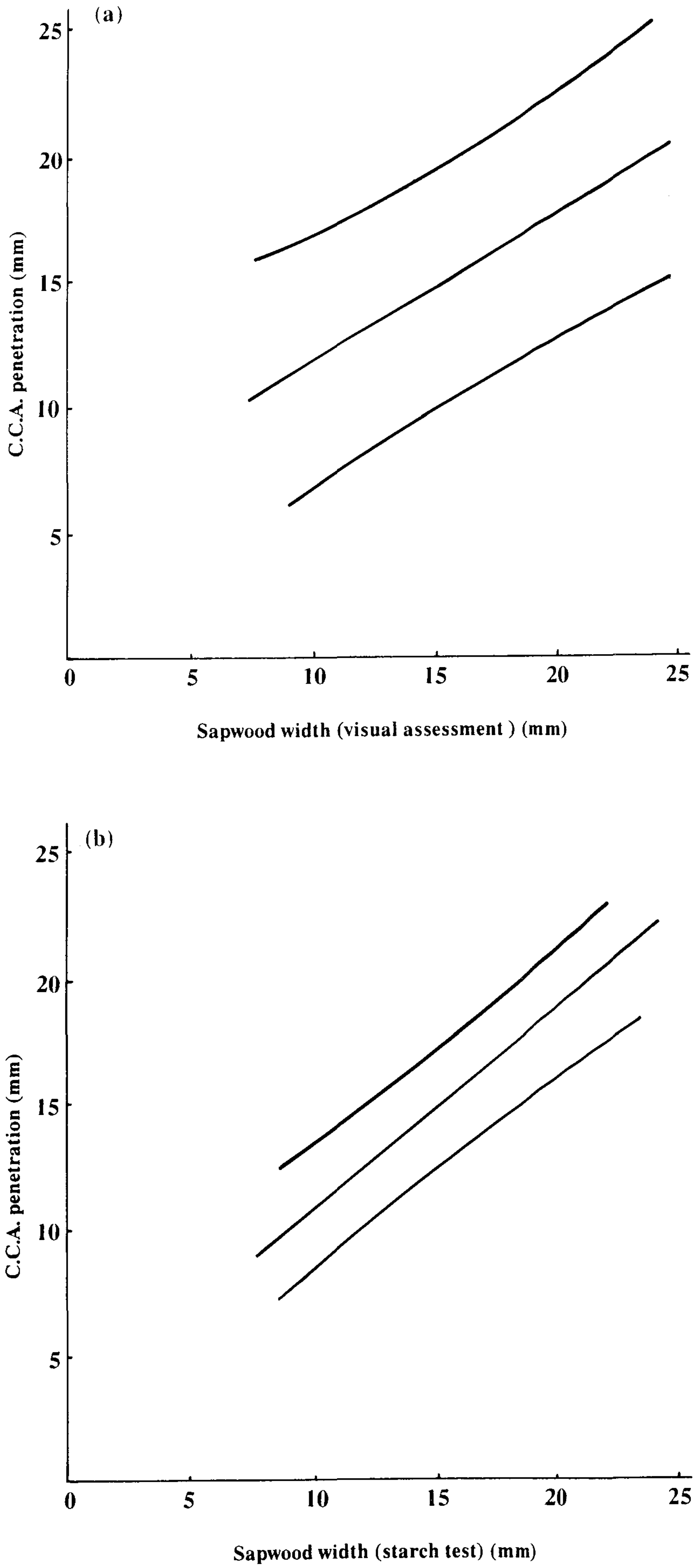

Figure 1

Confidence limits (95%) for predicting C.C.A. penetration in jarrah regrowth sapwood by either (a) visual means of (b) following a starch test.

DISCUSSION

The sapwood band in jarrah is narrow compared with other eucalypt species and tends to be uniform in width, as shown by the data in Table 1. The standard deviations are reasonably small for a mean sapwood width of 15 mm in posts ranging from 130 to 190 mm small end diameter under bark.

However, the data may indicate the presence of a transition zone which varies in width in different trees, but microscopic examination would be necessary. A narrow band of sapwood treated with C.C.A. preservative presumably gives less protection against fungal and insect attack than a wider treated band. Eucalypt sapwood is subject to splitting, which could leave the transition zone exposed.

Visual assessment of the sapwood width was less effective than measuring sapwood following the starch test, when predicting C.C.A. penetration (Figs 1a and 1b). The confidence limits given in the Figures indicated the relative variation.

With the small cross-sectional area in posts it is important that this band of durable treated wood is available, because it can provide more than half the strength of the post (Tamblyn 1978). Using Tamblyn's formula as discussed previously, the percentage of total strength contributed by treated sapwood was 59.2 per cent, based on mean log diameter and mean C.C.A. penetration. However, the results suggest that pre-sorting of jarrah regrowth posts before C.C.A. treatment, to identify the individuals with sapwood width likely to result in less than optimum penetration, is presumably not a commercial proposition because of the small differences found.

ACKNOWLEDGEMENTS

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REFERENCES

Bamber, R.K. and Fukazawa, K. (1985). Sapwood and heartwood: A review. Forest Products Abstracts 8(9): 265-278.

Chattaway, M.M. (1952). The sapwood-heartwood transition. *Australian Forestry* 16(1): 25-34.

Hillis, W.E. (1978). Wood quality and utilization. In: *Eucalypts for Wood Production*. (Eds. Hillis, W.E. and Brown, A.G.). C.S.I.R.O.

Standards Association of Australia (1980). Preservative treatment for sawn timber, veneer and plywood. AS 1604-1980.

Tamblyn, N.E. (1978). Preservation and preserved wood. In : *Eucalypts for Wood Production*. (Eds. Hillis, W.E. and Brown, A.G.). C.S.I.R.O.

Thornton, J.D, Walters, N.E.M. and Saunders, I.W. (1983). An in-ground natural durability field test of Australian timbers and exotic reference species. Material U. Organismen 18 (1983a):27-49.