PRESERVING PINE FENCE POSTS FROM SIX-YEAR-OLD FARM SHELTERBELTS

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SUMMARY

Maritime pine (*Pinus pinaster* Ait.) and radiata pine (*P. radiata* D. Don) posts cut from 6-year-old trees growing in shelterbelts at Allanooka, 50 km south of Geraldton were treated with high temperature creosote (HTC) or copper-chrome-arsenic (CCA). A combination of hot and cold bath and cold soaking non-pressure technique was used to treat half the posts with HTC, and the others were treated with CCA to hazard level 4 by Koppers Australia, using vacuum/pressure impregnation.

High creosote retentions were achieved in the butts of maritime pine posts (301 $kg.m^{-3}$) and radiata pine (453 $kg.m^{-3}$), with retentions three to four times the hazard level 4 minimum requirement specified in AS 1604 - 1993. Chemical analysis showed all HTC samples passed the H4 and H5 retention requirements, with most samples two to three times the required retention. All CCA samples passed the H4 requirement, and two thirds passed H5 with the remaining third just failing H5.

Preservative costs in this trial for 100 mm s.e.d.u.b. posts were $4.48/post for maritime pine and $3.30/post for radiata pine. Plant, labour and posts (if not readily available to the land owner) would be additional costs. In comparison the retail price in the south west of a similar size CCA treated pine post is approximately $6.90, based on purchasing a bundle of posts. Reducing the creosote uptake to the minimum requirement, would reduce chemical costs, however, long term durability may also be reduced.

INTRODUCTION

Many land owners are planting trees on their properties for landcare reasons (e.g. preventing wind and soil erosion, protection of stock and crops, and amenity reasons). Obtaining wood products (e.g. poles and posts) from their plantings is an added benefit.

The use of round timber products such as posts and poles is widespread. The main drawback in using these products in-ground contact, is that untreated sapwood, and heartwood of low natural durability (eg. pine), will be attacked in a short time by fungi and insects, which will significantly reduce strength. This problem can be overcome in most timbers by impregnating the sapwood with a wood preservative, thereby creating a protective envelope around the impermeable heartwood. In general, penetration of a few millimetres only is achieved in the heartwood, but the overall service life may be extended to 30 years or more.

Conventionally, timbers are classified by CSIRO into four durability classes according to their relative natural resistance to biological attack of the outer heartwood when in ground contact. Maritime pine (*Pinus pinaster* Ait.) and radiata pine (*P. radiata* D. Don) used in this trial are rated as Class 4, that is timbers of low natural durability which last up to 8 years, not much longer than untreated sapwood used in ground contact.

Copper-chrome-arsenic (CCA) is the most widely used preservative for treating fence posts. However, CCA is available only to commercial treatment plants, which must adhere to waste disposal and chemical storage restrictions imposed by the relevant authorities, but the most effective treatment method is vacuum/pressure impregnation using a pressure cylinder.

The aim of this trial was to determine the most effective method for treating fence posts with high temperature creosote (HTC), using on-farm techniques. Creosote has been successfully used for many years throughout the world, and was used in this trial because of its low cost, availability and past performance.

METHODS

Forty-two maritime pine and 42 radiata pine posts, 90 to 115 mm small end diameter under bark (s.e.d.u.b.) and 1.7 to 2.0 m long, were cut from 6-year-old trees growing in shelterbelts adjacent to Allanooka Springs Road, Allanooka, approximately 65 km south - east of Geraldton. The trees were planted in 1986 at about 480 stems.ha^{-1} and a 1990 thinning reduced this to about 440 stems.ha^{-1} (except rows 1 and 2 which are about 360 stem.ha^{-1}). This wide spacing resulted in large branches and swelling at the whorls. In 1991 the trees were pruned to 10 cm diameter over bark, however, many large branches had already developed, which restricts future utilisation for sawn timber and posts.

Trees were fallen between 4 and 6 October 1992, delivered to the Wood Utilisation Research Centre in Harvey on 16 October, and debarked at Koppers' Picton plant using a mechanical debarker on 22 October. Debarking required two passes through the debarker owing to large knots, whorls, butt swellings and taper, which took three times the normal production time for plantation grown posts. After debarking, the quality of the posts was as good as the standard posts produced from south-west plantations. Any excessive bark blistering and resin accumulation caused by sunburn was noted, as this could affect preservative uptake. Radiata pine is known to be particularly susceptible to these features when grown north of Perth.

As a control, half the posts were treated with CCA by Koppers, to compare the long term durability of the HTC treated posts. Posts required for CCA treatment were dried to below fibre saturation point (f.s.p.) or 25 per cent moisture content, which took approximately 6 weeks. The remaining posts were returned to W.U.R.C. and placed in chamber 3 of the Mark II solar kilns to dry to below f.s.p. before treatment with HTC. After 12 days all posts were below f.s.p. (mean moisture content 19.4 per cent) and suitable for treatment by the hot and cold bath method.

Preparation

Prior to treatment all posts had small and large end diameters under bark and sapwood diameter measured in four positions, then sapwood and total log volume were calculated. The mass of the radiata pine posts before and after treatment was recorded to determine uptake by mass gain as well as volume of creosote used. Air-dry densities and initial moisture contents were assessed on 10 maritime pine and 12 radiata pine posts before treatment. Immediately before treatment, 20 mm was removed from the ends of each post as the end grain can become blocked with resin and dirt, restricting the longitudinal movement of creosote.

Equipment

The treatment vessel used for butt treatment was a 205 L drum with the top removed, and placed on an electric base plate, specially designed to be fitted inside the rim of the drum. This drum is of sufficient height to treat the 760 mm butt section. Creosote is flammable, therefore it is recommended that an electric base plate or immersion heater is used under the drum instead of an open fire.

A 205 L drum extended to about 1300 mm is required to treat the crown, as posts are generally 1.8 m long. Steel mesh was cut and placed in the base of both drums, to elevate the posts off the bottom of the drum and allow better absorption of creosote above any sediment. Posts were tightly packed into the drums, therefore no weights were required to prevent flotation. Low density species e.g. pine and young eucalypts, have a tendency to float if not adequately restrained. All treatment was conducted under shelter in an open-sided shed, which allows air movement to dispel fumes. Cover is required because rain combining with creosote can cause sludging which restricts preservative penetration and also results in inaccurate uptake measurements. Drainage troughs were made by cutting a drum in half lengthwise and placing the sections adjacent to leaning rails to support the posts while draining.

Butt treatment

The butt ends were treated by the hot and cold bath method. This process involves heating posts in hot creosote to drive out any air in the posts, followed by cooling overnight in the treatment drum, when atmospheric pressure assists capillary forces in moving the liquid to replace the air driven out (Dale 1967). Moisture contents at treatment were approximately 11 per cent.

Treatment schedules for maritime pine and radiata pine are listed below.

Treatment	Temperature (°C)	Time (hours)
Maritime pine		
Hot cycle	80	1.5
	97	2.0
Hold at 115°C	115	1.0
for 1 h.		4.5
Cold cycle	104	1.0
(overnight	72	2.0
cool)	23	14.5
		17.0
Radiata pine		
Hot cycle		
	105	1.5
Hold at 112°C	112	1.0
for 1 h.		2.5
Cold cycle	105	1.5
(overnight		2.0
cool)		16.0
		19.5

The maritime pine and radiata pine schedules involved heating the HTC to 80°C or 105°C respectively, before placing the butt ends of the posts into the drum of hot creosote.

During the cold cycle creosote is absorbed into the posts, causing the preservative level to drop. Additional creosote was added to keep the level at approximately 800 mm to enable the posts to be adequately treated to at least 760 mm from the butt.

The CSIRO Division of Forest Products (1961) recommended a sapwood retention of 160 $kg.m^{-3}$ (146 $L.m^{-3}$) for the butt ends and between 48 to 64 $kg.m^{-3}$ (44 to 58 $L.m^{-3}$) for the crown. The volume of HTC required to achieve these retentions was estimated, from sapwood volume estimates. When the butts have absorbed this volume of HTC (estimated from the reduced creosote level in the drum) the posts were removed, and excess creosote drained into troughs, measured and returned to the treatment drum. This amount was subtracted from the initial calculation to give the actual volume of HTC absorbed by the butts.

Two or three sample posts per batch were cross-cut at 100 mm, 300 mm, 450 mm, 600 mm, 700 mm and 760 mm from the butt and then split longitudinally with an axe. A visual assessment of the pattern and distribution of creosote treatment on both the transverse and radial longitudinal sections was used to determine if

retreatment was required. Very high retentions were indicated, confirming the calculated retentions as estimated by both weight gain and drop in the HTC level in the drum, therefore no retreatment was required. Photographic records were taken of transverse and radial longitudinal sections.

The radiata pine posts were also individually weighed and had retentions estimated by the butts, crowns and total post mass gains.

Crown treatment

After butt treatment, posts were inverted and placed in an extended 205 L drum (approx 1300 mm high) to allow the full length of the post to be treated. Crown treatment involved cold soaking instead of hot and cold bath because only a light treatment is required. Based on the sapwood volume and the required retention, the amount of HTC needed to treat the crowns was calculated. Maritime pine posts required two days and radiata pine posts three days soaking to adequately treat the crown sections. After crown treatment posts were removed and any excess preservative was drained, measured and returned to the treatment drum.

CCA treatment

Posts were treated by Koppers Australia to hazard level 4 which is for a moderate biological hazard e.g. fence posts, using CCA oxide (Tanalith CP) at a solution concentration of 12.9 per cent. Treatment time was 3 h. After a fixation period of three to four days the posts were returned to W.U.R.C., tagged and despatched with the creosote treated posts to Allanooka.

Chemical analysis.

Two 20 mm diameter cores were taken from the groundline position (760 mm from the butt) of six CCA-treated posts (three maritime pine and three radiata pine) for chemical analysis by the Queensland Department of Primary Industries Forest Service. Arsenic, copper, chromium and total element retentions (in per cent mass/mass and $kg.m^{-3}$) and depth of penetration were determined. Two sample cores taken 600 mm from the butt of similar creosote-treated posts were also chemically analysed. Creosote retentions in per cent mass/mass and $kg.m^{-3}$ and depth of penetration were determined. Analysis for both CCA and creosote was done according to AS 1605 - 1974 (Standards Association of Australia 1974).

Post identification

Following treatment with CCA or creosote, posts were tagged as follows:

Maritime pine :	creosote	P 1 to P16
	CCA	P17 to P42
Radiata pine :	creosote	R 1 to R19
	CCA	R20 to R42

Posts have been placed in-service at Mr Roston and Helen Vince's property at Allanooka to assess long term durability.

RESULTS AND DISCUSSION

Air-dry density and moisture content

The air-dry densities and moisture contents for maritime pine and radiata pine posts before treatment are listed in the Table below.

Species	Air -dry density ($kg.m^{-3}$)			Moisture content (%)		
	Mean	S.D.	95 % Conf. Lim.	Mean	S.D.	95 % Conf. Lim.
Maritime pine	425	28	383 - 488	11.3	0.6	10.2 - 12.1
Radiata pine	380	30	332 - 421	10.5	0.6	9.7 - 11.5

Kingston and Risdon (1961) quoted a mean air-dry density (after reconditioning) for maritime pine grown in Western Australia of 596 $kg.m^{-3}$, S.D. 83.6 $kg.m^{-3}$ and 95 per cent confidence limits of 513 $kg.m^{-3}$ to 681 $kg.m^{-3}$, and for 10 to 20-year-old radiata pine mean air-dry density of 485 $kg.m^{-3}$ S.D. 41.1 $kg.m^{-3}$ and 95 per cent confidence limits of 394 $kg.m^{-3}$ to 578 $kg.m^{-3}$.

Air-dry densities recorded in this trial are lower than those published by Kingston and Risdon (1961) because the posts contain only juvenile wood. Juvenile wood is produced in the first ten to twelve years of growth and contains a lot more earlywood than latewood so has a lower density than mature wood. This lower density indicates thin cell walls and large air spaces within cells, which would allow a greater uptake of preservative. Moisture contents before treatment were below f.s.p., therefore no free water is in the cell cavities, which would increase preservative uptake.

Butt and crown retentions

A higher butt retention was achieved for the maritime pine batch compared with the radiata pine batch. Both species had similar densities, moisture contents and

treatment schedules, except the maritime pine schedule used a temperature of 115°C for one hour whereas the radiata pine schedule used a temperature range of 106°C to 112°C for one hour. This slightly higher temperature may have allowed greater air expansion/contraction in the hot and cold bath cycles, resulting in a higher uptake of creosote. In addition, 25 per cent of the radiata pine posts had patches of resin accumulation associated with sunburnt sections of the post, which would have reduced the HTC uptake into these posts, by the resin crystallising on the surface and blocking radial movement of creosote into the sapwood. Long term durability testing (by using the posts in service) will determine if incomplete treatment on areas affected by sunburn is a problem.

CSIRO (1961) recommended a sapwood retention of 160 $kg.m^{-3}$ (146 $L.m^{-3}$) for the butt and between 48 to 64 $kg.m^{-3}$ (44 to 58 $L.m^{-3}$) for the crown. AS-1604 1993 (Standards Australia 1993) specifies a minimum of 106 $kg.m^{-3}$ for H4 and 130 $kg.m^{-3}$ for H5 when treating softwoods, and the preservative needs to penetrate all the sapwood. Both batches satisfied these retention and penetration requirements. Maritime pine had 2.8 and radiata pine 1.9 times the recommended CSIRO butt retentions, which resulted in higher preservative costs, but long term durability is likely to be enhanced.

Crown treatments only took two days for maritime pine and three days for radiata pine to be effectively treated, and retentions were approximately twice the CSIRO requirements. The effectiveness of cold soaking indicated that butts could also be treated by cold soaking instead of the faster and generally more effective hot and cold bath method. Other species of low density could also be treated by cold soaking instead of hot and cold bath, provided the moisture contents are below f.s.p.

The drop in the level of HTC while treating posts in this trial in a 205 L treatment drum indicated the following uptake rates;

Maritime pine

butt - one litre per 9 mm drop

crown - one litre per 7.5 mm drop

Radiata pine

butt - one litre per 11 mm drop

crown - one litre per 8 mm drop

Table 1

Post dimensions, preservative uptake and cost of treating six-year-old maritime pine and radiata pine posts with high temperature creosote.

Species	No. of posts treated	Mean sedub (cm)	Total sapwood volume (m^3)	Total log volume (m^3)	Preservative uptake (L)									Preservative costs ($)		
					Butt			Crown			Post					
					Total batch	Per post	Per m^3	Total batch	Per post	Per m^3	Total batch	Per post	Per m^3	Per litre	Per post	Per m^3
Maritime pine	17	10	0.27	0.27	48.0	2.8	414 ($L.m^{-3}$) 453 ($kg.m^{-3}$)	17.1	1.0	111.0 (L/m^3) 122 (kg/m^3)	65.1	3.8	240 ($L.m^{-3}$) 264 ($kg.m^3$)	* 1.18	4.48	283
Radiata pine	20	10	0.33	0.33	39.0	2.0	275 ($L.m^{-3}$) 301 ($kg.m^{-3}$)	16.7	0.8	89 ($L.m^{-3}$) 97 ($kg.m^3$)	55.7	2.8	169 ($L.m^{-3}$) 185 ($kg.m^3$)	1.18	3.30	199

Note:

* Preservative cost/litre (excluding sales tax) is based on October 1993 prices for purchasing a pallet of four 205 L drums (ex Perth). This price will increase approximately 5 per cent if only one drum is purchased, owing to a higher transport cost.

Post length is 1.8 m.

Converting from $L.m^{-3}$ to $kg.m^{-3}$ multiply by 1.095 (density of HTC at 20°C).

Retentions are based on sapwood volume (m^3).

This drop will vary with post size and sapwood volume.

A land owner treating fast grown pine posts similar to those treated in this trial (0.3 m^3 sapwood) to the CSIRO retentions would require 18.4 L for the butt and 8.9 L for the crowns. This represents a drop in the creosote level while a batch of posts are immersed of 184 mm (butts) and 70 mm (crowns). This method can be used as an alternative to the 'top up method' referred to later in determining when the correct amount of creosote has been absorbed. However, with this method, the level of HTC in the drum must be maintained at a high enough level to allow radial movement of creosote into the butt to at least the groundline position (760 mm). When cold soaking the crowns, the full section needs to be treated otherwise an untreated section will occur in the middle of the post, unless the level of creosote is high enough to allow complete coverage. The 'top-up method' allows the creosote level to be maintained at a set level and ensures no untreated gaps occur.

Retention determined by mass gain -radiata pine

Retentions of individual radiata pine posts (butt, crown and full length) were determined by mass gain. This was determined by subtracting the treated mass from the untreated mass and dividing by the volume treated. The moisture content before and after treatment needs to be considered in the calculation, however, only before treatment moisture contents were determined and therefore moisture content was not used in calculating retentions. A method for calculating retentions is outlined in Markstrom and Gjovik (1992), where moisture contents of five sample posts are taken before and after treatment.

Retentions for radiata pine posts based on mass gain for the butt, crown and full length are listed below.

Retention ($kg.m^{-3}$)								
Butt			**Crown**			**Full length**		
Mean	**S.D.**	**Range**	**Mean**	**S.D.**	**Range**	**Mean**	**S.D.**	**Range**
290	53	201-379	117	20	88- 148	195	30	143-248

Comparison of the methods used to determine HTC retentions

Comparison of mean retentions ($kg.m^{-3}$) calculated by three different methods are listed below.

Species	Drop in creosote level			Mass gain			Chemical analysis
	Butt	Crown	Full length	Butt	Crown	Full length	Butt
Maritime pine	453	122	264	-	-	-	317.5
Radiata pine	301	97	185	290	117	195	216.3

Note:

The mass gain method was only used to assess retentions in radiata pine posts.
Only sample cores from the butt sections of three maritime pine and three radiata pine posts were chemically analysed for retention.

All three methods have errors. Measuring the drop in the creosote with posts immersed requires reading a dip-stick to the nearest millimetre, but owing to the large surface area of the treatment drum a difference of one or two millimetres leads to inaccuracies. For example, in this trial, while treating maritime pine, a difference of
2 mm would result in an error of 225 ml. Measurements needed to be taken at similar temperatures because of the amount of creosote expansion experienced at different temperatures. Measurements before and after treatment were not always taken at the same temperature. Inaccuracies can occur in determining log and sapwood volume, particularly sapwood volume because generally the boundary between sapwood and heartwood is very difficult to see in posts cut from young trees. However, the young posts treated in this trial contained all sapwood.

The mass gain method is the more accurate method because individual posts are weighed before and after treatment, and any additional weight gain is the result of preservative uptake. Theoretically moisture loss during treatment is a factor that needs to be taken into account when determining preservative retentions. Only a slight moisture loss would have occurred, as the before treatment moisture contents were approximately 11 per cent, therefore were disregarded in this trial. Chemical analysis was based on sampling three posts per batch and the retention for the butt section was determined by two small 20 mm diameter cores taken at

one position. The result of analysis of retention at that position would be very accurate but only an indication of the whole butt section.

Comparing the level drop and weight gain methods for estimating HTC retentions of the butt sections for radiata pine indicated that there was very little difference in retentions, however, chemical analysis showed a much lower retention. The same situation occurred in maritime pine where chemical analysis also showed a lower retention. The ratio of retention determined by chemical analysis compared to level drops is 1 : 1.42 for maritime pine and 1 : 1.39 for radiata pine, indicating consistencies in both methods for determining retentions.

The uptake of creosote can be reduced by removing the posts when the required amount has been absorbed by the butts in the cold cycle. CSIRO (1955) described the 'top-up method', which involves:

a) Estimating the amount of preservative that a batch of posts should absorb during butt or crown treatment (based on sapwood volume).
b) Measuring this quantity of preservative into a container.
c) Marking on a dip-stick the level of the preservative in the drum at the beginning of the butt treatment (use a metal dip-stick because the creosote will be absorbed into a dry wooden stick, leading to errors).
d) Ensuring the level is approximately 775 mm (which is above the critical level of 760 mm), but at least 75 mm below the top of the drum, to allow for expansion when heated.
e) As the treatment proceeds adding measured quantities of creosote from the container to the drum, bringing the level back to the original.
f) When all the preservative from the container has been used, treatment is complete.

CCA vacuum/pressure impregnation

Australian Standard AS1604 - 1993 requires a minimum of 0.63 per cent mass/mass retention of total CCA active elements for hazard level 4 which is equivalent to 9.0 $kg.m^{-3}$ (salt) or 5.4 $kg.m^{-3}$ (oxide). For hazard level 5 a minimum retention of 1.0 per cent mass/mass (equivalent to 14.8 $kg.m^{-3}$ (salt) or 9.1 $kg.m^{-3}$ (oxide)) is required. Individual pieces within the charge need to be two-thirds the charge retention. The overall charge retention was 10.1 $kg.m^{-3}$ and individual posts were greater than two-thirds the charge retention, which satisfies the requirements for both H4 and H5.

Table 2

Retentions of CCA and creosote (HTC) for six-year-old maritime pine and radiata pine posts at 760 mm or 600 mm from the butt.

Sample No.	Chemical retention (% mass/mass)					Chemical retention ($kg.m^{-3}$)	
	Copper	Chrom-ium	Arsenic	Total CCA element s	Creosote	CCA oxide	Creosote
P1	0.245	0.404	0.436	1.085		7.5	
P2	0.220	0.355	0.394	0.969		6.7	
P3	0.197	0.317	0.365	0.879		6.1	
R1	0.308	0.457	0.501	1.266		7.8	
R2	0.333	0.490	0.542	1.365		8.4	
R3	0.295	0.456	0.506	1.257		7.7	
P9	-	-	-	-	74.7	-	317.8
P11	-	-	-	-	59.8	-	254.4
P15	-	-	-	-	89.5	-	380.8
R5	-	-	-	-	68.6	-	260.1
R19	-	-	-	-	58.0	-	219.8
R20	-	-	-	-	44.5	-	168.9

Notes:

1). CCA (oxide) retention in $kg.m^{-3}$ is determined by

$$\text{Piece retention } (kg.m^{-3}) = (\%\text{ total elements}) \times 1.62 \times \frac{\text{density}}{100}$$

2) Creosote retention in $kg.m^{-3}$ is determined by

$$\text{Piece retention } (kg.m^{-3}) = (\%\text{ total elements}) \times \frac{\text{density}}{100}$$

3). Mean air-dry densities determined in this trial were :
maritime pine - 425 $kg.m^{-3}$
radiata pine - 380 $kg.m^{-3}$
(AS-1604 - 1992 uses an air-dry density of 530 $kg.m^{-3}$ for softwoods).

4). AS 1604 - 1993 gives CCA salt retentions ($kg.m^{-3}$). To convert oxide retentions to salt retentions multiply by 1.7.

5). Sample numbers starting with P = maritime pine
Sample numbers starting with R = radiata pine

Pine is classified as a natural durability class 4. According to Hazard level 4 in AS-1604-1993 the preservative shall penetrate all the sapwood, and not less than 10 mm from any surface of exposed heartwood. All samples assessed in this trial passed this penetration requirement.

For softwoods, hazard level 4 (H4) required a retention of 0.63 per cent mass/mass for CCA and 20 per cent mass/mass for creosote and Hazard level (H5) requires 1.0 per cent mass/mass for CCA and 24.5 per cent mass/mass for creosote. All CCA samples passed the H4 requirement and two thirds passed H5 with the remaining third just failing H5. All HTC samples passed the H4 and H5 retention requirements, with most samples two to three times the required retention.

Costs

High temperature creosote is available from Koppers-Hickson Timber Protection Pty Ltd in the eastern states in 205 L drums and cost $241.70 or $1.18/L (excluding sales tax) based on purchasing a pallet of 4 drums (October 1993 prices ex Perth). This price will increase by approximately 5 per cent if only one drum is purchased, owing to a higher transport cost from the eastern states. Preservative costs in this trial for 100 mm s.e.d.u.b. posts were $4.48/post for maritime pine and $3.30/post for radiata pine, and transport, plant, labour and posts (if not readily available to the land owner) would be additional costs. Reducing the creosote uptake to the minimum requirements of either CSIRO Division of Forest Products or AS - 1604, would reduce chemical cost, however, long term durability may also be reduced. The retail price in the south west of a similar size CCA treated pine post is approx $6.90 (based on purchasing a bundle of posts).

Trials conducted by the CSIRO in the 1950s found that pine posts with sapwood thickness over 25 mm require 1.64 L/post for 100 mm butt diameter posts and 2.04 L/post for 125 mm butt diameter posts (CSIRO 1955). Based on a October 1993 price (ex Perth) of $1.18/L posts would cost $1.94 and $2.41 respectively. Eucalypts with narrower sapwood bands would take up less creosote and preservative cost would be between $1.35 and $1.45 per post, based on cost data from the CSIRO Division of Forest Products (CSIRO 1961).

Alternatively land owners can get their posts treated at one of the three commercial treatment plants in the south-west. These plants are located at Picton (Koppers Australia), Bridgetown (Timber Treaters) and Mundijong (Bunnings Forest Products). Koppers Australia charge $160/$m^3$ ($95/$m^3$ for treatment and $65/$m^3$ for debarking and preparation) for treating pine

fence posts (B. Duff personal communication). The other two south-west plants have similar costs. Using a commercial treatment plant the land owner would have the additional cost of harvesting and transport to and from the treatment plant.

Durability in-service

Regular assessments, initially every one to two years for the first five years, then every three to five years, will indicate the performance of the posts in-service. This will give a comparison between the posts treated with creosote, using on-farm techniques and CCA treated posts, treated in an industrial process by vacuum/pressure impregnation.

The overall post condition, whether it is still serviceable, and the reason/s for any post failures will be recorded. Assessment will be done by manually pushing each post, with the assessor maintaining a uniform loading. A close inspection of the posts below ground line, after scraping away the soil, will indicate the presence of any fungal or insect attack. Any damage to the exposed section of the post from weathering or mechanical damage will also be recorded.

Mr. Brian Duff, Koppers Australia Pty Ltd, Picton W.A.

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