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The Effect of Incising Process on Copper-Chromium-Arsenic Retention in *Scodocarpus Borneensis* and *Kokoon*a Spp

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Abstract

Knifes incising were used as a pretreatment technique in increasing the Copper-Chromium-Arsenic (CCA) uptake and retention of two timber species of Mata Ulat (Kokoona spp). and Kulim (Scodocarpus borneensis). These timbers are difficult to treat with preservatives. The average chemical uptake of these timbers is below 80 l/m^3. Wood samples of 4 cm x 10 cm x 210 cm were used in this study. They were first kiln dried to 20% moisture content, then incised prior to treatment with 8% (CCA) preservative solution using full cell processes at 200 psi for 2 hours. The effectiveness of the incising technique was evaluated by comparing the CCA retention of the incised samples with that of the control without incising. The response of these timbers towards incising technique showed an improvement in absorption and penetration, where the improvement in preservatives uptake for Kokoona spp. was 24 % and for Scodocarpus borneens is 75%.

Keywords: CCA, Incising, Full-cell process, Refractory timber, Chemical uptake

1. Introduction

The use of preservative-treated refractory timber such as Kulim (*Scorodocarpus borneensis*) and Mata Ulat (*Kokoona* spp.) is limited in the construction industries of Malaysia. The main reason for this is their unamenability characteristic to preservative treatment. Unlike easily treated timber like Kempas (*Koompassia malaccencis*) or Keruing (*Dipterocarpus* spp.), these timbers are difficult to be treated with preservative and thus considered as 'refractory" (Singh et al. 1989). When treated with CCA using full-cell process following an existing standard schedule (Anon., 1991), the results were disappointing and their preservative uptake was very minimal.

Kulim is a Standard Malaysian Name for the timber of *Scorodocarpus borneensis* which is a Medium Hardwood. The timber has an average density of 835 kg/m^3. The timber has shallowly to deeply interlocked grains with moderately fine and even texture. Their vessels are medium-sized with simple perforation and wood parenchyma is exclusively apotracheal (Menon, 1967).

Mata Ulat, a medium hardwood , is known botanically as *Kookona* spp. The timber is heavy to very heavy with air dry density ranging from 880-1040 kg/m^3. The grain is shallowly interlocked. Texture is very fine and slightly uneven due to the presence of the extremely broadband of parenchyma. Vessels are moderately numerous to numerous, unevenly distributed, and have a tendency to arrange into groups. Wood parenchyma present in abundant quantities as broad conspicuous terminal bands which are often enastomosing or ending abruptly (Menon, 1967). The vessel features for both species of Kulim and Mata Ulat are shown Table 1.

Numerous attempts to improve treat ability of refractory timber species to chemical preservative have been made. Incising is one of the most effective and the least costly methods of improving the treat ability of timber (Anderson et al. 1997). It is a mechanical process in which steel knives are used to make longitudinal incisions into the four sawn faces of lumber or timber. Incisions range normally in depth from 5 cm for dimension lumber to 25 cm for large timbers.

Incising the process causes the wood cells to rupture mechanically at periodic intervals, along and across the piece, so that the timber is rendered sufficiently porous to permit the flow of liquids into the incised wood (Dahlan, 1999). Greater surface exposed, created by incising to have potential to increase both penetration and preservative uptake by the timber.

Although incising dramatically improves preservative penetration and distribution, it also reduces strength of the treated timber (Kass, 1974; Lamm and Morris, 1991; Perrin, 1978). However it is generally agreed that the strength loss is beneficial in the long run since the increase in treatability provides a substantial increase in service life when compared to that of un-incised refractory material.

Regardless of whether water-borne or oil-borne type preservative treatment is being used, incising is required by AWPA Standard when treating the difficult to treat species (Jerrold 1996). In Japan, preservative treating plants that are authorized by the Japanese Agricultural Standard (JAS), must be equipped with an incising machine (Kashiwazaki, 1987). In Malaysia, although incising of timber piles and railway sleepers is specified in the Malaysian Standards MS 822: 1983(Anon, 1983) and MS 734: 1981 (Anon, 1981), none of these timbers are ever incised prior to preservative treatment for the simple reason that there are no incising machines available commercially in Malaysia (Dahlan, 1999).

This study was undertaken with the objective in improving preservative penetration and uptakes by selected Malaysian refractory timber *Scorodocarpus borneensis* and *Kokoona* spp. through incising process.

2. Materials and Methods

2.1 Materials

Two (2) commercial timber species were used in the study, 1). Kulim (*Scorodocarpus borneensis*) and, 2). Mata Ulat (*Kokoona* spp.). Another local species Kempas (*Koompasia malaccensis*) was used as a control. The samples containing both sapwood and heartwood were obtained from timber supplier in Selangor. Twenty four un-planed timber samples for each species of sizes 210 cm x 4cm x 10 cm were selected for the study and divided into 2 groups of 12 samples. The first group was incised and the second were used as controls (un-incised). Moisture content of all incised timber before preservative treatment was maintained below 25% and was determined using an electrical resistance moisture meter.

2.2 Incising Technique

Wood samples were incised at an incising density of 4,000 incisions/m^2, using Koshi Wood Incisor Machine (see Figure 1). The samples were incised using knife-like teeth incising machine (see Figure 2) measuring 12 mm in length and 2.5 mm in width and the incision pattern is shown in Figure 3. All samples except the controls were incised to a depth of about 7 to 8 mm on all sides of their surfaces approximately parallel with the grain of the wood. All the timbers were incised in dry condition.

2.3 Treatment Process

Samples were kept to a constant weight prior to treatment. They were then pressure-treated with 8% CCA solution at a commercial treatment plant using full cell process. The CCA net dry salt retention (NDSR) were calculated using the following formula.

$$\text{NDSR (kg/m}^3\text{)} = \frac{\text{Uptake (l)}}{\text{Volume (m}^3\text{)}} \times \frac{\text{Treating solution concentration}}{100} \quad (1)$$

After treatment, the samples were labeled with stickers and stored outdoors under cover for 15 days to allow for chemical fixation to take place.

2.4 Penetration Test

After fixation, 1 cm thick slices were cut at 50 cm from the end length of the samples and the freshly cut surfaces were sprayed with chemical reagent Chrome Azurol S to detect the presence of preservative. Penetration analysis was done in accordance with Anderson *et al* work (1997) and Anon. (1991)

3. Results and Discussion

The results of the study are tabulated in Tables 2 and 3. The illustrations of the results are showed in Figure 4. The results show that incising process improved the chemicals uptake of the treatment solution. Overall depth of penetration of the preservative in the sample varied for both species (see Table 2). In the incised Kulim, the improvement of depth

of penetration in comparison to un-incised Kulim, was 150 % from 0.28 cm to 0.70 cm while Mata Ulat shows higher penetration in both incised and un-incised sample with slightly lower value from 1.70 cm for un-incised sample to 2.40 cm for incised sample representing an increase of 41%. For incised samples, greater concentration of CCA (darker and heavy color stain) associated with the incising holes was noted, whereas in wood more distant from the holes, reduced level of intensity were apparent. In the un-incised samples, only limited penetration of the outer surface was observed, except where portion of sapwood had been inadvertently included at samples edges.

The effects of the incising on preservative uptake were analyzed to assess the effectiveness of incising technique and are summarized in Table 3a. Incised Kulim achieved higher preservative uptake (11.16 kg/m^3) in comparison to un-incised Kulim (6.38 kg/m^3). Incised mata ulat also shows similar trends with higher preservative uptake (21.31 kg/m^3) compared to un-incised Mata Ulat (17.26 kg/m^3). The increase in the percentage of CCA retention for incised samples range from 75% for Kulim to 24% for Mata Ulat. Higher percentage results in increased of preservative uptake in the timber of incised sample show that there is a direct correlation with depth of penetration. Figure 4 illustrates preservative uptake and its percentage improvements in treated sample.

Incising appears to have not much effect on preservative uptake in Mata Ulat, although from the picture it was clear to see the effect of the greater preservative uptake in the incised sample. This difference is not significant based on analysis of varians, ANOVA single factor (see Table 3b). However in Kulim, this difference is statistically significant based on analysis of varians, ANOVA- single factor (see Table 3c). It was also noted that, un-incised mata ulat can achieve a nearly similar level of preservative uptake to that of the control (kempas). This is shown by the analysis of varians ANOVA - single factor (see Table 3d).

Generally, the result indicates that there was general improvement in preservative penetration of incised samples for all species. Usually with this process, the wood cells are ruptured mechanically at periodic intervals, along and across the piece, so that the timber is rendered sufficiently porous to permit the flow of liquids into the incised wood. This also will increase the surface area of timber and amenability for chemical treatment.

There were a great deal of variability in the effectiveness of incising technique in improving CCA retention of different species used in the study. This could be due to differences in the wood density of different species, the structure of cell wall, size of cell which make up the wood and the quantity of extractives presence in each species (Kandau,1997). The higher the difference in value of the penetration and preservative uptake in Mata Ulat and Kulim could also be due to the presence of large amount of sapwood in the incised and un-incised sample of Mata Ulat.

The present work did not consider the possible effects of incising on mechanical properties of timber, an area which needs investigating. Wide incisions were produced by the incising knife used, but can be improved with the use of better mechanical incisor technique. Surface damage was minimal and general appearance of timber was little affected. For most products, roughening of surfaces and minor strength reduction if any, are not too serious, and are compensated for better preservative uptake and retention in timber and improved long term protection (Ruddick, 1985). Further studies to include variable incising parameter are underway to develop a predictive incising-effects model based on preservative treatment, strength effect, incising density, and incising depth.

4. Conclusions

Incising processes improved chemicals uptakes and penetration in both refractory timber species of *Kokoona* spp and *Scorodocarpus borneensis*. In view of the shortage supply of the commonly utilize timber species for construction and heavy duty application, refractory wood can use as an alternative but with improving in preservatives uptake and retention. Incising processes has proven to improve preservative penetration or treat ability of refractory species. Incised kulim achieved higher preservative uptake (11.16 kg/m^3) in comparison to un-incised Kulim (6.38 kg/m^3). Incised Mata Ulat also shows similar trends with higher preservative uptake (21.31 kg/m^3) in comparison to un-incised Mata Ulat (17.26 kg/m^3). The increase in the percentage of CCA retention for incised samples ranges from 75% for Kulim to 24% for Mata Ulat Higher percentage results in increased of preservative uptake in the timber of incised sample show that there is a direct correlation with depth of penetration.

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Table 1. Vessel Features of Kulim and Mata Ulat

	Characteristic	
	Kulim	Mata Ulat
1.	Moderately small to medium size	Small size
2.	Moderately numerous to numerous	Moderately numerous to numerous
3.	Very few as solitary, mostly in radial pairs or multiples	Exclusively solitary
4.	Simple perforation	Simple perforation
5.	Tyloses abundant	Tyloses absent

Table 2. Depth of Penetration of CCA in Treated Kulim and Mata Ulat Samples.

Sample	Average Depth of penetration (cm)		% Improvement in penetration
	Incised	Control	
Kulim	0.70	0.28	150
Mata ulat	2.40	1.70	41

Table 3a. Average Preservative Uptake in Treated Kulim and Mata Ulat Ulat Samples

Sample	Density (kg/m^3)	CCA Retention (kg/m^3)		% Improvement
		Incised	Control	in penetration
Kulim *(Scodocarpus borneensis)*	617-860	11.16 (4.79)[1] (42.90)[2]	6.38 (5.06)[1] (79.27)[2]	74.8
Mata Ulat (*Kokoon*a spp).	885-990	21.31 (5.66)[1] (26.54)[2]	17.26 (9.41)[1] (54.55)[2]	23.5
Control [3]	850-993	21.53 (10.08)[1] (46.84)[2]	n.a[4]	0

[1]: Standard deviation

[2]: Relative standard deviation

[3]: Treated kempas (*koompassia malaccensis*) unincised

[4]: not applicable

Table 3b. Statistical Analysis of Variance (ANOVA), Differences in Average Retention of CCA in Incised and Unincised (control) Kulim

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	136.88	1	136.88	5.17	0.03	4.30
Within Groups	582.88	22	26.49			

Table 3c. Statistical Analysis of Variance (ANOVA), Differences in Average Retention of CCA in Incised and Unincised Mata Ulat

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	98.59	1	98.59	1.50	0.23	4.30
Within Groups	1447.52	22	65.80			

Table 3d. Satistical Analysis of Variance (ANOVA), Differences in Average Retention of CCA in Incised Mata Ulat and Unincised Kempas

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.42	1	0.42	0.01	0.92	4.41
Within Groups	705.02	18	39.17			

Figure 1. Koshi Wood Incising machine

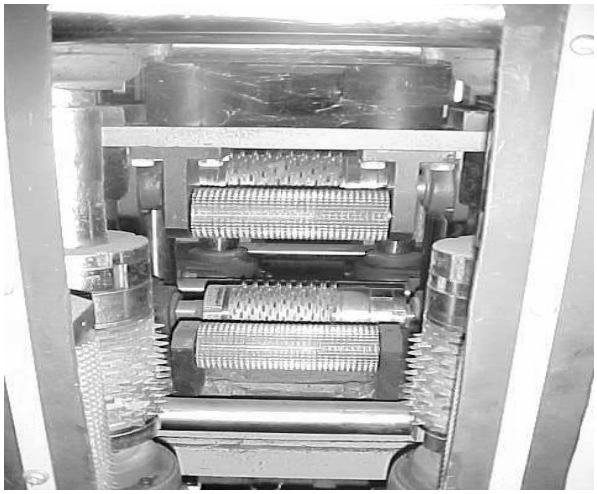

Figure 2. Incising instrument: knife

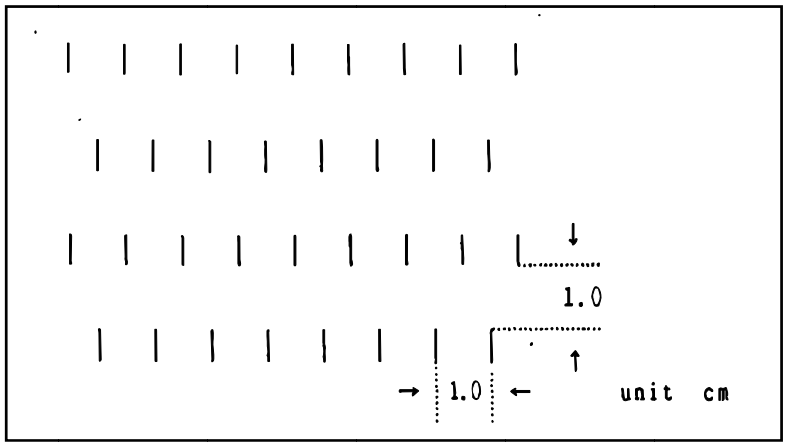

Figure 3. Knife Incising Pattern

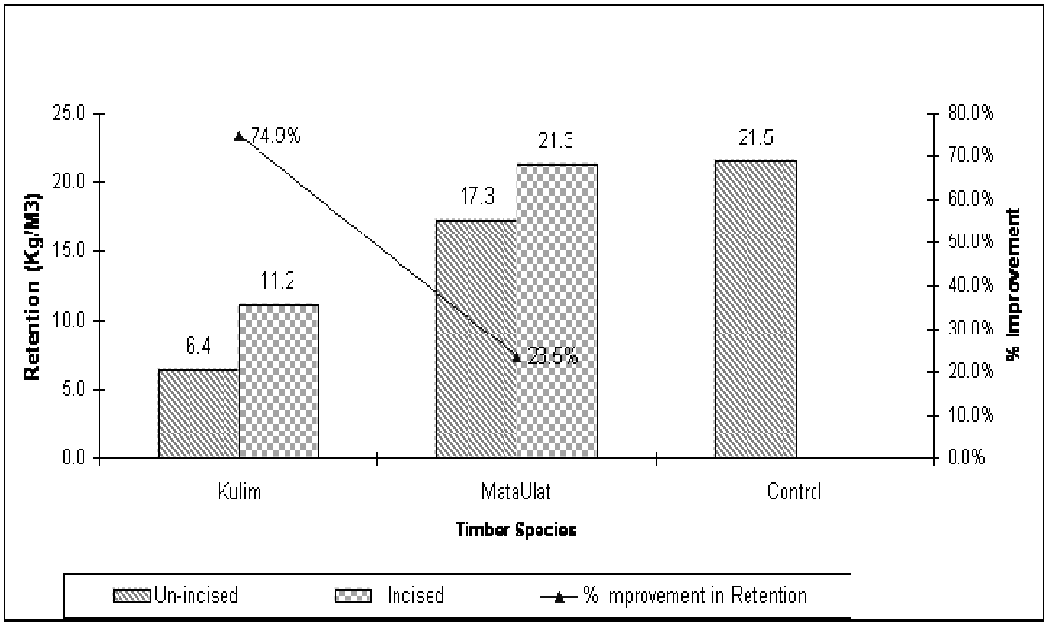

Figure 4. Retention of CCA in Incised & Un-incised (control) sample and Percentage Improvement in chemical uptake