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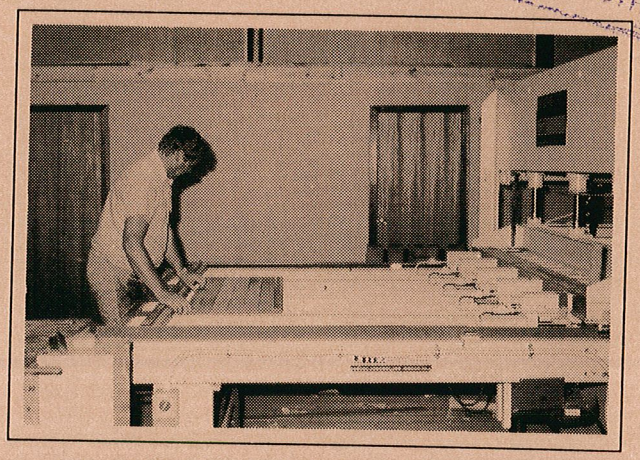

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Wood Utilisation Research Centre
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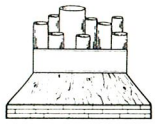

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This report is part of a program of industrial research and development aimed at establishing techniques and developing equipment to allow processing of small eucalypt regrowth logs in a commercially viable manner, particularly with a view to use in high quality furniture. The research program is funded jointly by the Commonwealth Government under a Public Interest Project, the Department of Conservation and Land Management, and the Western Australian timber industry.

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SUMMARY

Five adhesives were assessed for use in manufacturing edge-jointed blanks (or panels) from regrowth jarrah (*Eucalyptus marginata* Donn ex Sm.) and karri (*E. diversicolor* F. Muell).

Urea formaldehyde, melamine fortified urea formaldehyde, resorcinol formaldehyde, and melamine formaldehyde showed no significant differences in percentage wood failure from a dry cleavage test, but polyvinylacetate had significantly less wood failures. The percentage wood failure in regrowth jarrah and karri was not significantly different, and end and centre samples gave similar results.

Further tests on long term performance of these adhesives are required.

INTRODUCTION

Regrowth eucalypts will supply an increasing volume of timber to the Australian furniture market as supplies of mature timber decrease in the next fifty years. The major eucalypt species used for furniture manufacture in Western Australia is jarrah (*Eucalyptus marginata* Donn ex Sm.), but karri (*E. diversicolor* F. Muell.) has potential. The resource will be mainly small diameter logs, which results in small-dimensioned timber being milled.

The Western Australian furniture industry uses large quantities of small-dimensioned wood components. Challis (1989) surveyed furniture manufacturers in Perth to determine the dimensions of solid jarrah timber being used. While a large proportion of this timber is in short lengths and small cross sections, there are considerable advantages in using furniture blanks. Furniture blanks are solid pieces of wood, edge-jointed together to form one solid panel to increase the efficiency of the manufacturing process. Large stable cross-sections are produced from which several furniture components can be cut, reducing overall waste. These blanks are widely used by the furniture industry in the U.S.A. (Araman *et al.* 1982).

It is essential to select the most suitable adhesive to ensure a high strength permanent bond. Adhesives currently used by the furniture manufacturing and joinery industry in Western Australia were selected for their suitability in mature jarrah. However, research by the Department of CALM's Wood Utilisation Research Centre has indicated that some wood properties of regrowth eucalypts may be different to those from mature trees.

Thermosetting formaldehyde adhesives which require heating for fast curing give flexibility for processing schedules. This trial was designed to assess four thermosetting and one PVA adhesives currently used by the Western Australian furniture industry for gluing mature jarrah , and to select the adhesive best suited for edge gluing regrowth jarrah and karri for manufacture of furniture blanks. Jarrah has an air dry density of 820 kg/m^3 and is widely used for furniture manufacture. It is considered to represent other dense eucalypts which are moderately difficult to glue. Karri has an air dry density of 900 kg/m^3 and is considered more difficult to glue than jarrah.

MATERIALS AND METHODS

The research to select the most suitable of a range of commercially available adhesives for edge-jointing of regrowth jarrah furniture blanks was conducted at the Wood Utilisation Research Centre at Harvey.

Five adhesives were selected as representing those most commonly used by the furniture industry in Western Australia. They were:

urea formaldehyde ('Grasp')
melamine fortified urea formaldehyde (Selleys 308)
resorcinol formaldehyde
melamine formaldehyde
cross-linked P.V.A. (Control)

The dry dressed regrowth jarrah used to construct the panels came from 60-year-old trees from the Inglehope Plots near Dwellingup, and the karri from 10 - 55-year-old stands in Manjimup, Pemberton or Walpole. The wood was dried to below equilibrium moisture content, and subsequently dressed and graded to Wood Utilisation Research Centre Grading Rules, and stored under stable mild conditions. Clear and feature grade materials were used, and moisture contents ranged from 8 to 12 per cent.

Twenty five panels 900 mm x 350 mm (five boards wide) were constructed, five using each adhesive, and using the same manufacturing procedures and similar environmental conditions. Each edge was dressed immediately prior to gluing, allowing a maximum time of 1 hour between dressing and gluing. An 'Orma' Glue Press with an oil-heated platen was set at 90^{o}C with downward pressure of 1500 p.s.i. (10.3 MPa) and lateral pressure of 250 p.s.i. (1.7 MPa). Curing time was 6 min.

A 50 mm wide strip was cut from one end and from the centre of each panel, to give eight glue lines for testing. Each glue line was broken apart, following the requirements of the AS1328-1987 dry cleavage test (Standards Association of Australia 1987). The percentage of wood failure compared with adhesive failure was estimated for each glue line.

The data were analysed using analysis of variance with an arcsin square root transformation to correct for non-normality.

RESULTS AND DISCUSSION

The mean and standard deviation values for percentage wood failure (Table 1) indicated that four of the five adhesives tested (urea formaldehyde, melamine fortified urea formaldehyde, resorcinol formaldehyde, and melamine formaldehyde) gave very good results from the dry cleavage test. The polyvinylacetate adhesive could not be recommended.

The large standard deviations presumably resulted from variations in wood quality, because factors such as the shelf life of the adhesive does not affect individual glue lines within a panel. The effect of sapwood on percentage wood failure may need evaluation in future trials. Each edge was dressed within an hour before gluing process, and the automatic glue press applied constant horizontal and vertical pressure for the same time.

Analysis of variance results in Table 2 confirmed the basic data given in Table 1. The only significant factor was adhesive type (p=0.001). There were no significant differences between species (regrowth jarrah and karri), between location in panel (end vs centre), between panels and between joints in a panel.

Table 1

Adhesive effects on percentage wood failure in edge-glued regrowth jarrah and karri (twenty samples each from end and centre of the panel)

		Wood failure %			
		End		Centre	
Species	Adhesive *	Mean	SD	Mean	SD
Jarrah	UF	94.5	7.4	88.0	21.9
	MFUF	84.6	24.4	86.3	21.9
	RF	82.6.	30.6	87.7	19.4
	MF	82.7	26.0	83.8	27.2
	PVA	11.9	23.2	4.3	13.4
Karri	UF	88.5	20.7	89.7	18.0
	MFUF	88.0	20.7	89.7	18.0
	RF	91.3	12.1	92.2	18.4
	MF	86.2	24.7	84.8	26.1
	PVA	15.0	28.3	3.5	6.1

* UF = urea formaldehyde
MFUF = melamine fortified urea formaldehyde
RF = resorcinol formaldehyde
MF = melamine formaldehyde
PVA = polyvinylacetate

Table 2

Analyses of arcsin (square root) percentage wood failure) for five different adhesives tested for edge-gluing regrowth jarrah and karri

Treatment	d.f.	F value	Prob > F
Species	1	1.2	0.285
Adhesive	4	98.7	0.001
Location (end vs centre)	1	0.5	0.487
Panel	4	1.6	0.186
Joints	3	0.7	0.551
Error	386		
	399		

The similar results for regrowth jarrah and karri are of particular interest, because mature karri timber has a reputation in the local timber industry for being difficult to glue. This is presumably due to a high extractive content and interaction between the acidic wood and any alkaline based adhesives. Both regrowth jarrah and karri are paler in colour than mature wood, implying lower extractive contents, and hence fewer gluing problems. Another theory is that gluing in the industry has been carried out at higher moisture contents when jarrah joints are more tolerant than karri joints.

The lack of any significant difference in percentage wood failure between end and centre of the panels confirm that quality assurance testing can use a section taken from the end. The absence of any significant differences between panels and between joints in a panel, were expected because of the manufacturing methods, although previous comment was made on the large standard deviations.

The dry cleavage test is a useful guide to the efficiency of different adhesives for gluing a particular species. Long term strength and stability also must be assessed, and testing will continue using three of the four adhesives which performed best (i.e. urea formaldehyde, melamine fortified urea formaldehyde, and resorcinol formaldehyde). This decision was based on previous experience (e.g. melamine formaldehyde is more suitable for particleboard manufacture) as well as the results of the trial. Urea formaldehyde and resorcinol formaldehyde are particularly easy to mix and apply, and have a good workable pot life of at least twenty minutes.

The wet cleavage tests described in AS1328 (Standards Association of Australia 1987) will complement the dry cleavage test in future trials. A further possibility is to use boiling tests, applicable to testing gluelines in plywood, as given in AS2098 (Standards Association of Australia 1977).

Other adhesives will be tested as they become available. A pilot study at Harvey using allopathic resin emulsion produced poor results of 6.9 per cent wood failure. Cross-linked PVC's are apparently susceptible to creep effects in the timber, while isocyanates have a toxicity problem, which tends to preclude their use (Hillis, personal communication)[1].

Further research on gluing regrowth jarrah and karri is important because value-adding by seasoning and subsequent processing is a stated objective of CALM's Timber Strategy (Department of Conservation and Land Management 1987). Gluing is seen as an essential process in the overall utilisation of small trees.

[1]Dr W.E. Hillis, Consultant. 12 Lindsay Street, McKinnon Victoria 3204.

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