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ALPINE ASH (*E. DELEGATENSIS* R.T. BAK)

FOR PLYWOOD PRODUCTION

BY

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FORESTRY COMMISSION OF NEW SOUTH WALES

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INTRODUCTION

This study is part of the programme established and carried out in the Plywood and Veneer Section, Wood Technology and Forest Research Division, Forestry Commission of New South Wales with a view to studying the peeling and gluing properties of alternative species to the previously used rainforest species in Australia.

The objective of this particular study was to investigate alpine ash (*E. delegatensis* R.T. Bak) for production of green veneer and its suitability for the manufacture of A-Bond (waterproof) structural plywood. There were two components to the study, namely peeling of veneer and gluing to produce plywood.

A. PEELING

MATERIAL

1. Timber

Alpine ash (*Eucalyptus delegatensis* R.T. Bak) is a large hardwood of the cold climate areas of Tasmania, eastern Victoria and south-eastern N.S.W. The sapwood is not clearly distinguishable and is about 25 to 50 mm wide in mature trees. Heartwood is pale pink or pale yellowish brown. Gum veins are common. Green density is about 1050 kg m^{-3} and air dry density about 620 kg m^{-3}. The timber needs much care in drying because of proneness to collapse and internal checking, as well as surface checking on the tangential surface. Shrinkage is about 4.5% radial, 8% tangential and, after reconditioning, is 3.5% radial, 6.5% tangential. Some mechanical properties of this species are listed in Table 1 (Bootle, 1983).

Table 1. Mechancial properties of alpine ash.

Modulus of rupture (MPa)		Modulus of elasticity (GPa)		Max crushing strength (MPa)		Impact Izod value (J)		Hardness (Janka) (kN)	
Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry
63	110	11	15	33	60	13	18	4.0	4.9

2. Log Selection and Origin

The billets were received from a stand of alpine ash situated at a height of 1150 m above sea level in Cpt. 27 Bago State Forest (N.S.W.). The area of 1200 ha from which the sample trees were taken represents a relatively uniform regrowth stand with a few large trees remaining. This area, fairly free of fire, was clearfelled in 1917 and naturally regenerated. In the 1957-58 logging, there was a group selection thinning with most trees about 71 cm diameter being removed.

Out of ten billets which were used in this trial, only one had a serious defect; other billets were sound and had good form. Sizes and volumes of the billets have been summarised in Table 2.

Table 2. Dimensions of alpine ash sample billets.

Billet No.	Length (mm)	Diameter Top (mm)	Diameter Butt (mm)	Mean centre diameter (mm)	Estimated volume (m^3)	Observations
1	1260	395	395	395	0.1544	Star checks,gum vein
2	1260	395	400	398	0.1568	Star checks
3	1260	395	400	398	0.1568	Star checks
4	1250	405	433	419	0.1724	Star checks
5	1275	408	425	417	0.1741	Star checks
6	1235	370	390	380	0.1401	Star checks,gum vein
7	1255	418	433	426	0.1789	Star checks
8	1265	378	385	382	0.1450	Star checks
9	1260	375	380	378	0.1414	Star checks
10	1260	360	378	369	0.1347	Decentralized pith, large knot, irregular shape of billet

3. *Equipment*

The peeling was carried out in the Plywood and Veneer Research Mill of the Wood Technology and Forest Research Division, equipped with a Precision Rotary Veneer "UROKO" lathe of 1850 mm, model REC-6 with double spindles, capable of producing veneer in a thickness range of 0.5 mm to 6.0 mm.

The continuing ribbon of peeled veneer was transported by the conveyor toward an automatic 2270 mm MATSUNAGA clipper, model MC-75 operating with a shear-cut system. Prior to final conversion into veneer, all billets were preheated in an insulated aluminium tank which was heated by means of a stainless steel coil filled with hot oil, pumped through an automatic gas fired heat-exchanger.

METHOD

Freshly cut billets were transported unbarked from the forest to mill site. Their ends were coated with wax emulsion to protect them against end-splitting. Prior to processing, all billets were debarked by axe and cross-cut by chainsaw to 1.25 m length in order to fit plywood assemblies into 1.2 x 1.2 m hot press. Before conversion the billets were heated. Three runs were necessary to heat all billets. In order to control the temperature at the edge of the core, a hole was drilled into the middle of each billet and a thermocouple was placed. To ensure the accurate reading of the temperature of the wood, the hole was patched with 340 Silicone Heat Sink Compound.

Whenever possible, all billets were peeled to the minimum core diameter which was limited by the lathe specifications. Lathe settings for 2.6 mm thick veneer were set as follows:

Horizontal gap	2.36 mm
Vertical gap	0.75 mm
Wedge angle	20^{o}
Cutting angle	20.5^{o}

In setting up the lathe, the horizontal nosebar alignment was checked with a dial indicator gauging block. To overcome damage to the knife edge, the anvil of the dial indicator was manufactured from nylon. The vertical nosebar setting and alignment were checked with feeler gauges.

After peeling, all material was clipped into sheets of 670 mm width, representing one half of a standard panel size for plywood manufacture. The measurements of variation in thickness of green veneer were taken to the nearest 0.01 mm with a micrometer at three points of veneer sheet length.

RESULTS

The temperatures measured at the edge of the core for three separate runs, are presented in Table 3.

Table 3. Temperatures measured at the edge of the core in alpine ash billets.

Billet No.	Heating time (h)	Billet temperature (^{0}C)
1	23	52
2	"	53
3	"	55
4	"	50
5	26	46
6	"	47
7	"	45
8	"	46
9	23.75	54
10	"	58

During the peeling process it was observed that all billets peeled in the range of temperatures between 45^{0}C and 58^{0}C produced a smooth and good quality veneer. Both the tightness and the uniformity of thickness of alpine ash veneer were good. The latter varied between 2.54 mm to 2.74 mm for green veneer. The yield of each billet in green veneer is provided in Table 4.

According to figures shown in Table 4, the estimated recovery of green veneer oscillated between 32% (billet with large knot) and 60%. These recoveries were based on the total length of veneer web clipped after rounding. Major defect portions and cores were deducted from this operation. The volume of veneer recovered as clipped was divided by the total original volume of each billet including core volume. It is important to realize that the recovery percentage in Table 4 does not correspond exactly to the recoveries as calculated in a commercial plymill, where most defect would be clipped out at the green clipper. A reasonable approximation to commercial recoveries might be obtained by multiplying the recovery percentages indicated in the report by a factor 0.85.

Table 4. Estimated recovery of 2.6 mm thick alpine ash veneer.

Billet No.	Clipper reading (Lin.m)	Core diameter (mm)	Estimated volume of core (m^3)	Estimated volume of core (%)	Calculated recovery (m^3)	Estimated recovery (%)	Observations
1	28	160	0.02412	16	0.08736	57	Outside veneer free of defects, inside gum veins, knots.
2	23	200	0.03769	24	0.07176	46	Core split by dogs, knots in veneer, veneer furry, end splits.
3	30	150	0.02121	14	0.09360	60	Veneer very smooth, free of defects.
4	27	175	0.02886	17	0.08424	49	
5	25	145	0.01982	11	0.07800	45	End splits.
6	22	170	0.02724	19	0.06864	49	Core split by dogs, smooth veneer, end splits, slightly furry.
7	26	150	0.02121	12	0.08112	45	Veneer smooth but slightly furry.
8	28	150	0.02121	15	0.08736	60	Good quality, smooth veneer.
9	28	150	0.02121	15	0.08736	62	Smooth veneer, few gum veins and knots close to core.
10	14	170	0.02724	20	0.04368	32	All sheets of veneer had a large knot.

B. ADHESIVE AND OVERLAY TESTS

DEFINITIONS AND EXPLANATORY NOTES

1. *Resin Formulation*

The basic value accepted naturally is the weight of the liquid resin before additives are mixed in, and this is taken as 100.0%.

2. *Wetting of Veneer*

The resin must wet the veneer used and it must wet it uniformly to give consistent gluing results.

3. *Rate of Spread*

This is one of the major parameters of gluing. It is recorded as grams per square metre of double glueline (gms per sq m DGL). Since it is common in the plywood industry in many parts of the world to define rate of spread as pounds of wet adhesive per 1,000 square feet of glueline, this value is also quoted for the convenience of the trade.

4. *Open Assembly Time*

The time elapsing between the lay-up of the glued assembly of veneers until the pack of assemblies is pressed in the pre-press is called the open assembly time. An excessive open assembly time permits the dry veneer to absorb an excessive percentage of the water from the resin mixture and the glueline is then too viscous to wet the interleaved dry veneers resulting in a faulty glue bond when the plywood is hot pressed. If the open assembly time is too short and insufficient water is absorbed from the veneer, blows can result in the hot press particularly when heavy spreads are used.

5. *Prepressing*

This operation transfers some of the wet glue to the dry veneers in contact with the centres which bear glue on both sides.

The pressure may be less or equal to hot press pressure. It is recorded in this report as kilograms per square centimetre and also as pounds per square inch, once again for the convenience of the industry.

A time function is also involved. Too short a time in the prepress can cause poor bonding in plywood when it is hot pressed. Past a certain time no further improvement in final bond quality occurs. The Commission plymill commonly uses a prepressing time of ten minutes but this is increased if poor "tack" is detected in veneer assemblies coming from the prepress.

6. *Tack*

The quality of tack is essential to presence of good handling quality in the assemblies of veneer from the prepress. It is observed by parting the veneer sheets with the fingers. A good tack enable sheets to be handled either manually or mechanically into the hot press. While it is important for manual handling, good tack is essential for mechanical handling.

7. *Closed Assembly Time*

This is recorded as a measure of the intrinsic property of the veneer in this regard as well as the suitability of the adhesive formulation together with the previous steps in the gluing operation.

Excessively short closed assembly times may lead to blows when heavy spreads are required with dense veneers. Excessively long assembly times can permit excessive water removal from the wet glueline by the dry veneer and weak bonds can result in the final plywood. Practical operations in a plymill are greatly assisted by formulation/veneer combinations that permit a wide range of closed assembly times.

8. *Hot Pressing*

In this operation, heat is transferred from heated platens which also transfer sufficient pressure to flatten the assembly of veneers and to bring the veneer faces carrying a now viscous layer of glue mixture into close contact to give a thin cured glueline. The resin component of the glue is cured and this is a heat energy effect so that either higher temperatures or longer pressing times will increase the degree of cure upon which the quality of the final bond depends. Higher temperatures increase the tendency for "blows".

The Commission hot press produces a plywood sheet 1.2 m x 1.2 m. In this series of tests, 140 ^{0}C was used as the platen surface temperature. The duration of the hot pressing for sheets of each thickness in the following preliminary tests was selected to be above the minimum for that thickness since the aim of these tests was to establish the quality of the gluebond and not to determine the minimum pressing times required.

ADHESIVE TEST PROGRAMME

A series of five glueing runs were carried out over a five month period. The results of final run would indicate any problems conferred upon the veneer with age. Veneer from Commission peelings and one peeling from a commercial lathe belonging to Australian Consolidated Industries at Tumut were used.

Two basic types of resin were used:

1. Liquid phenolic to give an "A" bond.

2. A liquid melamine/urea formulation which has been used successfully in the trade to manufacture a large volume of eucalypt plywood to produce a "B" bond

The four phenolic glue runs are reported is chronology sequence.
It is proposed to carry out "C" and "D" bond testing for alpine ash at a later date, but as a general rule eucalypts are readily glued with urea resins. The considerable detail is given to illustrate the wide range of test conditions covered in the gluing sub experiments listed below.

The small number of alpine ash samples tested in each test run is explained by the fact that alpine ash plywood was made in company with that of other species on each occasion.

GLUING RUN 1
"A" BOND. PHENOLIC RESIN 7300 M (HIGH MOISTURE)
17TH MAY, 1989
SAMPLES 5/62, 5/63 AND 5/68

1. *Veneer*

Alpine ash veneer from A.C.I. Tumut, 2.5 mm thick at an oven dried moisture content of 8% or less. This veneer was peeled at ambient temperature.

2. *Constructions*

Sheets 5/62 and 5/63 featured five ply construction to produce a nominal thickness of 12.5 mm, while sheet 5/68 was fabricated in seven ply to yield a nominal thickness of 17.5 mm.

3. *Adhesive Formulations*

Two formulations were tested, one with more extension than the other.

	First Formulation (sheets 5/60 and 5/66) (%)	Second Formulation (sheet 5/66) (%)
Resin 7300 M	100.0	100.0
Nut shell flour	8.5	6.8
Wheat flour	8.5	6.8
Water	12.2	9.5
Hardener	2.0	3.0
Total	131.2	126.1
Viscosity by modified Ford A Cup	= 29 secs	= 28 second

The formulations were smooth and free of lumps and wetted the veneer surfaces well.

The glue mixtures were applied in all cases with a conventional twin roller "Goldi" glue spreader of 1 metre width. This machine is in excellent condition and gives consistent rates of spread.

Rate of spread	=	411 g per sq m D.G.L.
	=	82 lb per M sq ft D.G.L.

4. *Prepressing Conditions*

The mill temperature was 17 ^{O}C

Open assembly time for 5/62 and 5/63	=	10 to 12 minutes
Open assembly time for 5/68	=	20 minutes
Prepressing time	=	10 minutes
Specific pressure for 5/62 and 5/63	=	16.7 kg per sq cm
	=	236 p.s.i.
Specific pressure for 5/68	=	9 kg per sq cm
	=	128 p.s.i.
Closed assembly time range for 5/62 and 5/63	=	18 to 77 minutes
Closed assembly time for 5/68	=	78 minutes

The sheets emerging from the prepress showed very good tack.

5. *Hot Pressing Conditions*

Hot press specific pressure for 5/62 and 5/63	=	12.25 kg per sq cm
	=	175 p.s.i.
Hot press specific pressure for 5/68	=	9.0 kg per sq cm
	=	128 p.s.i.
Platen temperature	=	140 ^{0}C
Press times for 5/62 and 5/63 (5 ply)	=	8 minutes
Press time for 5/68 (7 ply)	=	12 minutes

The pressed sheets were strip stacked to cool.

6. *Bond Testing*

Four samples were cut from each sheet on a grid pattern. One of these was chisel tested dry while the other three were heated continuously under pressure for six hours with complete immersion following which they were chisel tested wet in accordance with S.A.A. 2098.

7. *Results from Run 1*

The three sheets all passed both dry and A bond tests. Open assembly times were typical in ranging from 10 to 20 minutes. Prepress pressures were both low (9.0 kgs) sq cm and high (16.7 kg per sq cm). The closed assembly times tolerated were from typical to fairly long although the day was cool. The specific pressure in the hot press was low (9.0 kg per sq cm) to typical (12.25 kg per sq cm) for eucalypts.

8. *Conclusions from Run 1*

The alpine ash glued up well and tolerated a range of gluing conditions in respect to viscosity, rate of spread, open and closed assembly times, prepressing specific pressure, and hot press pressure.

Table 5. Run 1 - phenolic resin 7300 m - "A" bond. Samples 5/62, 5/63 and 5/68.

Sample	Construction and moisture content	Open assembly time (mins)	Prepr. time (mins)	Specific pressure (kg/sq cm)	Closed assembly time (mins)	Hot press temp (^{O}C)	Specific pressure (kg/sq cm)	Press time (mins)	Dry bond average (No.)	Wet bond average (No.)	Poorest bond type "A"	Comments
5/62	5 x 2.6 Alpine Ash MC < 6%	12	10	16.7	77	140	12.25	8	5.5(4)	6.6(12)	3.5	Spread 411 Pass "A"Bond
5/63	5 x 2.6 Alpine Ash MC < 6%	10	10	16.7	18	140	12.25	8	5.2(4)	7.0(12)	3.0	Spread 411 Pass "A"Bond
5/68	7 x 2.5 Alpine Ash ACI 8% - 6%	20	10	9.0	78	140	9.0	12	5.3(6)	7.7(18)	5.0	Spread 411 Pass "A"Bond

GLUING RUN 2
"A" BOND PHENOLIC RESIN SP900 (RADIATA TYPE)
2ND JUNE, 1989
SAMPLES 6/4 AND 6/6.

1. *Veneer*

The alpine ash veneer was 2.6 mm in thickness and was of good quality from Commission peeling. In contrast to the ACI plant run on this species, the Commission billets were heated which again represents a range of conditions. The moisture content of this veneer was 5% on an oven dry basis. The core veneers were radiata pine veneer 2.5 mm thick at 7% moisture content supplied from a commercial source.

2. *Construction*

Both sheets were composite five ply construction with 2.6 mm alpine ash faces and three layers of 2.5 mm radiata to give a nominal sheet thickness of 12.7 mm.

3. *Adhesive Formulation*

	(%)
Resin SP900	100.0
Walnut shell flour	9.6
Wheat flour	9.6
Water	11.5
Total	130.7

Viscosity by modified Ford A Cup	=	25 seconds
Rate of spread	=	450 g per sq m D.G.L.
	=	91 lb per M sq ft D.G.L.

The glue mixture was smooth and free of lumps and wetted all veneer surface well.

4. *Prepressing Conditions*

The mill temperature was only 14 ^{o}C so that due allowances would need to be made for higher temperatures.

Open assembly time range	=	11 to 16 minutes
Prepressing times	=	20 or 10 minutes
Specific pressure	=	12.25 or 10 kg per sq cm
	=	175 or 142 p.s.i.
Closed assembly time	=	140 minutes

Comments on tack ex the prepress: satisfactory

Note that sheet 6/4 required extra prepressing time due to the cold conditions.

5. *Hot Pressing Conditions*

Hot press specific pressure	=	12.25 kg per sq cm
	=	175 p.s.i.
Platen temperature	=	140 ^{0}C
Press time	=	8 minutes

The pressed sheets were strip stacked to cool.

6. *Bond Testing*

Bond testing following the standardized procedure detailed for Run 1. The results are given in Appendix II.

7. *Results from Run 2*

The two alpine ash/radiata pine composite sheets passed both the dry and A bonds. The results are given in Appendix 2.

8. *Conclusions from Run 2*

Alpine ash veneer produced good A bonds with this formulation when glued to radiata pine. This means that alpine ash can be used with radiata pine or as a substitute for it during routine plant production in a plymill based on radiata veneer.

Table 6. Run 2 - phenolic resin sp900 - "A" bond. Samples 6/4 and 6/6.

Sample	Construction and moisture content	Open assembly time (mins)	Prepr. time (mins)	Specific pressure (kg/sq cm)	Closed assembly time (mins)	Hot press temp (^{0}C)	Specific pressure (kg/sq cm)	Press time (mins)	Dry bond average (No.)	Wet bond average (No.)	Poorest bond type "A"	Comments
6/4	Alpine Ash 2.6 Rest 2.5 radiata MC < 6%	11	20	12.25	189	140	12.25	8	5.5(1)	5.6	3.5	Spread 450 Pass "A" Bond
6/6	Alpine Ash 2.6 Rest 2.5 radiata MC < 6%	16	10	10	140	140	12.25	8	7.7(1)	7.7	6.5	Spread 450 Pass "A" Bond

GLUING RUN 3
"A:" BOND. PHENOLIC RESIN SP900 (RADIATA TYPE)
23RD JUNE, 1989.
SAMPLES 6/30 TO 6/35

1. *Veneer*

As for Run 2, the veneer was good quality 2.6 mm alpine ash from the heated Commission peelings. Moisture content was 5% on an oven dry basis.

2. *Construction*

Five layers of 2.6 mm alpine ash were laid up to produce a nominal thickness of 13 mm.

3. *Adhesive Formulation*

The formulation was exactly the same as for Gluing Run 1, namely.

	(%)
Resin SP900	100.0
Nut shell flour	9.6
Wheat flour	9.6
Water	11.5
Total	130.7

Viscosity by modified Ford A Cup = 31 seconds.

This means that the mix was slightly more viscious than for Run 1.

Rate of spread = 409 gm per sq m D.G.L.
= 81 lb per M sq ft D.G.L.

This rate of spread was identical for that used in Run 1, and is the standard mix used in radiata plywood manufacture.

The mixture was once again smooth and free of lumps and wetted the veneer surface well.

4. *Prepressing Conditions*

The mill temperature at 16 ^{o}C was low so that account would need to be taken of this fact when planning production for warm days.

Open assembly time range	=	11 to 14 minutes
Prepressing time	=	10 minutes
Specific pressure	=	175 p.s.i.
Closed assembly time range	=	14 to 158 minutes
Closed assembly time range	=	14 to 158 minutes

The tack ex the prepress was good.

5. *Phenolic Overlay Film*

An overlay film (Formica serial No.72) was placed on both sides of the plywood between two accurately machined aluminium cawl plates each coated on the working face with a release agent. Each pack was then loaded into the single daylight hot press in turn and heated under pressure for the time required.

6. *Hot Pressing Conditions*

Hot press specific pressure	=	12.25 kg per sq cm
	=	175 p.s.i.
Platen temperature	=	140 °C
Press time	=	9 minutes

7. *Bond Testing*

Bond testing followed the standardized procedure detailed for Run 1. The results are given in Appendix 3.

8. *Results*

The six sheets all passed both the dry and "A" bond tests well. The rate of spread of 409 gms per sq. metre was adequate. The formulation tolerated closed assembly times of 14 to 158 minutes.

The results are given in Appendix 3.

9. *Overlay Testing*

The cured overlay film was knife tested with a peel test following the six hours heating under pressure. This test is more severe than boiling for six hours at atmospheric pressure.

10. *Overlay Results*

All six samples passed the overlay tests.

11. *Conclusions from Run 3*

Alpine ash will give consistent results with the standard radiata pine SP900 formulation. The spread required was only medium and at the temperature of 16 °C the formulation tolerated closed assembly times far longer than those required in commercial operation.

Table 7. Run 3 - phenolic resin sp900 - "A" bond. Samples 6/30 to 6/35.

Sample	Construction and moisture content	Open assembly time (mins)	Prepr. time (mins)	Specific pressure (kg/sq cm)	Closed assembly time (mins)	Hot press temp (°C)	Specific pressure (kg/sq cm)	Press time (mins)	Dry bond average (No.)	Wet bond average (No.)	Poorest bond type "A"	Comments
6/30	5 ply x 2.6 Alpine Ash MC 5%	14	10	12.25	38	140	12.25	9	7.8(4)	6.9(12)	5.5	Spread 409 Pass "A" Bond Formica 72 pass
6/31	5 ply x 2.6 Alpine Ash MC 5%	11	10	12.25	57	140	12.25	9	8.3(4)	7.4(12)	6.0	Spread 409 Pass "A" Bond Formica 72 pass
6/32	5 ply x 2.6 Alpine Ash MC 5%	9	10	12.25	14	140	12.25	9	8.1(4)	7.3(12)	4.0	Spread 409 Pass "A" Bond Formica 72 pass
6/33	5 ply x 2.6 Alpine Ash MC 5%	17	10	12.25	158	140	12.25	9	7.8(4)	7.4(12)	4.0	Spread 409 Pass "A" Bond Formica 72 pass
6/34	5 ply x 2.6 Alpine Ash MC 5%	14	10	12.25	143	140	12.25	9	8.1(4)	7.8(12)	5.5	Spread 409 Pass "A" Bond Formica 72 pass
6/35	5 ply x 2.6 Alpine Ash MC 5%	11	10	12.25	131	140	12.25	9	6.7(4)	6.6(12)	4.0	Spread 409 Pass "A" Bond Formica 72 pass

GLUING RUN 4
"A" BOND. PHENOLIC RESIN SP900 (RADIATA TYPE)
31ST OCTOBER, 1989.
SAMPLES 10/76 TO 10/80

1. *Veneer*

As in Runs 2 and 3, the veneer used in this run was good quality alpine ash 2.6 mm thick from Commission peeling in February 1989. The sub-experiment should detect if any gluing problem developed with age in alpine ash as happens with blackbutt.

2. *Construction*

All sheets were made in five ply construction of nominal thickness 13 mm.

3. *Adhesive Formulation*

This formulation is exactly the same as that used for Runs 2 and 3.

	(%)
Resin SP900	100.0
Nutshell	9.6
Wheaten flour	9.6
Water	11.5
Total	130.7

Viscosity by modified Ford A Cup	=	30 seconds
Rate of spread	=	406 gm per sq m D.G.L.
	=	81 lb per m D.G.L.

The mixture was smooth and free of lumps and wetted the veneer surface well.

4. *Prepressing Conditions*

The mill temperature was moderate at a figure of 23 ^{o}C.

Open assembly time range	=	10 to 20 minutes
Prepressing time	=	10 minutes
Specific pressure	=	12.25 kg per sq cm
	=	175 p.s.i.
Closed assembly time range	=	170 to 221 minutes

Comments on tack ex the prepress: very good.

5. *Hot Pressing Conditions*

Hot press specific pressure	=	12.25 kg per sq cm
Press platen temperature	=	140 ^{o}C
Press time	=	10 minutes

Type of pressure release: gradual by programming

6. *Bond Testing*

Bond testing followed the standardized procedure used for runs 1 to 4.

7. *Results*

All the five sheets made passed the dry bond with very good results and also passed the A bond with good to very good results. While open assembly times were typical of those in plant usage, the closed assembly times tolerated were very long for a phenolic formulation at 170 to 221 minutes. The results are summarized in Appendix 4.

8. *Conclusions From Test Run 4*

Alpine ash gave good plywood bonding at 5% with this typical radiata pine phenolic formulation. The formulation tolerated very long closed assembly times. The consistency of both dry and "A" bond results is to be noted.

Table 8. Run 4- phenolic resin sp900 - "A" bond. Samples 10/76 to 10/80.

Sample	Construction and moisture content	Open assembly time (mins)	Prepr. time (mins)	Specific pressure (kg/sq cm)	Closed assembly time (mins)	Hot press temp (^{O}C)	Specific pressure (kg/sq cm)	Press time (mins)	Dry bond average (No.)	Wet bond average (No.)	Poorest bond type "A"	Comments
10/76	5 x 2.6 Alpine Ash MC 6-8% (8 months old)	20	10	12.25	198	140	12.25	11	8.0(4)	7.7(12)	6.0(A)	Spread 406 Pass "A" Bond
10/77	5 x 2.6 Alpine Ash MC 6% (8 months old)	18	10	12.25	210	140	12.25	10	8.8(4)	7.6(12)	6(A)	Spread 406 Pass "A" Bond
10/78	5 x 2.6 Alpine Ash MC 6% (8 months old)	14	10	12.25	185	140	12.25	10	9.2(4)	8.6(12)	8(A)	Spread 406 Pass "A" Bond
10/79	5 x 2.6 Alpine Ash MC 6% (8 months old)	12	10	12.25	221	140	12.25	10	8.8(4)	8.8(12)	8(A)	Spread 406 Pass "A" Bond
10/80	5 x 2.6 Alpine Ash MC 6% (8 months old)	10	10	12.25	170	140	12.25	10	8.3(4)	8.3(12)	7(A)	Spread 406 Pass "A" Bond

GENERAL CONCLUSIONS FROM THE FOUR PHENOLIC TEST RUNS

1. The veneer produced from both cold and heated peeling gave good dry bonds and good "A" bonds.

2. Two basic types of phenolic resin were tested - namely a high moisture phenolic resin and a standard phenolic resin and both gave good results.

3. The formulations for the standard radiata pine resin tolerated some variation in proportions, a range in viscosities from 25 to 31 seconds and variations in rates of spread from 406 to 450 gm per sq metre

4. The alpine ash veneer in combination with the listed formulations performed satisfactorily with open assembly times generally typical of plant usage within a range of 10 to 20 minutes.

5. In a similar fashion the veneer/formulation combinations tolerated closed assembly times of 14 to 221 minutes. Since the longest assembly times occurred during a moderately warm day (23 ^{o}C) the combinations were flexible.

6. The prepress pressure ranged from 9 to 16 kg per sq cm, and still gave good results.

7. The sheets in the four runs were all hot - pressed at the same specific pressure of 12.25 kg per sq cm which would be a typical pressure for eucalypts.

8. There was no difficulty in gluing caused by storing the veneer in a closed plastic pack for eight months.

Overall the alpine ash veneer was very flexible in its requirements for successful gluing with phenolic adhesives.

GLUING RUN 5
A SINGLE RUN ON "B" BOND - MELAMINE/UREA RESIN WM 3294
11TH MAY, 1989.
SAMPLES 5/42 TO 5/44

1. *Veneer*

The veneer used in this experiment came from two sources. The first batch was from the original A.C.I peeling from unheated billets at Tumut in February 1989. The second batch was part of the high quality veneer peeled by the Commission in February, 1989.

The A.C.I. veneer was 2.5 mm thick and had a moisture content of 6 to 8%. The Commission veneer was 2.6 mm thick and had an ovendry moisture content of 6%.

2. *Construction*

The 2.5 mm A.C.I. veneer was made into five ply of a nominal 12.5 mm thickness, while the Commission 2.6 mm veneer was glued into five ply of a nominal 13.0 mm thickness.

3. *Adhesive Formulation*

The resin chosen was a melamine/urea combination marketed as resin WM 3294. The formulation detailed below has been used very successfully for gluing "B" bond plywood from species such as blackbutt and spotted gum in the plywood industry.

	(%)
WM 3294 resin	100.0
Wheat flour	25.0
Water	25.0
Hardener	2.0
Wet agent	0.2
Total	152.2%

Viscosity by modified Ford A Cup = 25 seconds

The mixture was smooth and free of lumps and wetted the veneer surface well.

Rate of spread	=	434 gm per sq m D.G.L.
	=	89 lb per M sq ft D.G.L.

4. *Prepressing Conditions*

The mill temperature was 25 ^{O}C.

Open assembly time range	=	12 to 21 minutes
Prepressing time	=	20 minutes
Specific pressure	=	9.1 to 12.25 kg per sq cm
	=	130 to 175 p.s.i.
Closed assembly time	=	140 minutes

The sheets emerging from the prepress showed good tack.

5. *Hot Pressing Conditions*

Hot press specific pressure	=	9.1 to 12.25 kg per sq cm
	=	130 to 175 p.s.i.
Platen temperature	=	140 ^{0}C
Press time	=	8 minutes

The press sheets were strip stacked to cool.

6. *Bond Testing*

Three samples were cut from each sheet on a grid pattern. One of these was chisel tested dry while two were boiled continuously for six hours with complete immersion following which they were chisel tested wet. All samples were evaluated for bond ratings under a 2 x lens with integral lighting.

7. *Test Results from "B". Bond Run*

All four sheets passed the dry bond test well and all four pass the "B" bond test also, according to S.A.A. 2098.

Open assembly times were fairly typical for the industry. The long prepressing times were used to improve tack in other sheets of other species prepressed at the same time, since the day was moderately cool.

The species tolerated a range of specific pressure from 9.1 to 12.25 kg per sq cm for both prepressing and hot pressing operations. The closed assembly times are long but this formulation tolerates long closed assembly times if needed.

The results are summarized in Appendix 5.

8. *Conclusions from "B" Bond Run only*

The alpine ash was flexible in its plywood production requirements. It gave good "B" bonds from heated or unheated billets. It tolerated a range of prepressing and hot pressing specific pressures, together with long closed assembly times.

Table 9. Run 5 - melamine/urea resin wm3294 - "B" bond. Samples 5/42 to 5/45.

Sample	Construction and moisture content	Open assembly time (mins)	Prepr. time (mins)	Specific pressure (kg/sq cm)	Closed assembly time (mins)	Hot press temp (^{0}C)	Specific pressure (kg/sq cm)	Press time (mins)	Dry bond average (No.)	Wet bond average (No.)	Poorest bond type "A"	Comments
5/42 Bond	5 x 2.5 Alpine Ash ACI MC 6-8%	21	10	12.25	9.1	140	9.1	8	9.1(4)	6.3(8)	3.5	Spread 434 Pass "B"
5/43 Bond	5 x 2.5 Alpine Ash ACI MC 6-8%	18	20	9.1	0	140	12.25	8	7.7(4)	6.3(8)	5.0	Spread 434 Pass "B"
5/44 Bond	5 x 2.6 Alpine Ash Commission MC 6%	15	30	12.25	26	140	12.25	8	8.2(4)	7.7(8)	6.5	Spread 434 Pass "B"
5/45	5 x 2.6 Alpine Ash Commission MC 6%	12	20	12.25	8	140	12.25	8	8.0(4)	8.4(8)	7.5	Spread 434 Pass "B" Bond

CONCLUSIONS

A. PEELING

On the basis of this preliminary investigation carried out on a limited number of billets it can be assumed that the veneer produced from alpine ash (*E. delegatensis* R.T. Bak) at given conditions is generally of good quality and uniform in thickness. This veneer can be successfully used as a face or core ply for the manufacture of structural plywood.

B. ADHESIVE AND OVERLAY TESTS

1. The alpine ash peeled well whether unheated as at A.C.I. or heated by the Commission. The veneer was relatively free of knots. With a modest amount of clipping and jointing, good faces would be obtainable. Even without sanding, the surface finish on the Commission veneer was very smooth, and the unsanded plywood was very smooth.

2. The veneer was easy to handle through standard plywood operations and was flat in nature. The veneer wetted well with two "A" bond resins and one "B" bond formulation. The species glued up to give good "A" bonds with either the standard radiata pine phenolic resin SP900 or the high moisture resin 7300 M.

3. The veneer could be successfully glued using spreads from moderate to fairly high and with viscosities ranging from 25 to 31 seconds. Alpine ash was reasonably tolerant of open assembly times and particularly tolerant of closed assembly times. The species tolerated a range of pre pressing and hot pressing specific pressures to still yield good plywood bonding.

4. The veneer produced good composite plywood in conjunction with commercial radiata pine veneer. Together with the fact that alpine ash will produce good "A" bond with the standard radiata formulation based on resin SP900, it means that alpine ash can be used interchangeably with radiata pine in standard commercial production. This makes it a potentially useful and valuable veneer species in a plymill based on radiata pine.

5. Alpine ash can also be overlaid with a phenolic paper (Formica) to give a good quality concrete formwork plywood that passes the appropriate standards.

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