

Investigation on bonding properties of modified birch veneers using ABES machine

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Short Term Scientific Mission

Host:

Department of Forest Products Technology Aalto University
School of Chemical Technology Helsinki, Finland

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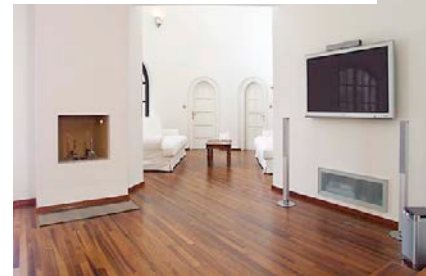


Glued wood products



Modified Wood

- Biological durability
- Dimensional stability
- Hardness
- Weathering resistance of wood



Wood after modification

Changes in chemical, physical and structural properties



(e.g. less polarity, less porosity...)



Change the strength of adhesive

Aim of research

Investigation on:

1. Bonding properties of modified birch veneers glued with hot curing PF adhesive using automated bond evaluation system (ABES).
2. Feasibility of using ABES for evaluation of bonding characteristics of coldest adhesives (PVAc, EPI and PU_{1k})

Experimental-wood material/modifications

- Heat treated birch veneers (180 and 220 °C)
- Melamine treated birch veneers (20% conc)
- Furfurylated birch veneers (FA 70%)



Thermal treatment of Birch veneers



180 C°

Step	Temperature	Moisture level in oven	Time
1	80 C°	...	1/2 h
2	80 C°	...	1/2 h
3	120 C°	.....	1 h
4	150 C°	.....	1 h
5	180 C°	.....	3 h
6	150 C°	.....	1 h
7	120 C°	.....	1 h
8	80 C°	...	1/2 h
9	80 C°	...	1/2 h

220 C°

Step	Temperature	Moisture level in oven	Time
1	80 C°	...	1 h
2	120 C°	.....	1 h
3	150 C°	.....	1 h
4	180 C°	.....	1 h
5	200 C°	.....	1 h
6	220 C°	.....	3 h
7	180 C°	.....	1 h
8	120 C°	.....	1 h
9	80 C°	...	1 h

Melamine treatment

Impregnation with 20% NMM

Vacuum (30min/60 mbar)



Soaking veneers in solution (2h)



1 day – leaving out of solution (drying
at room temp)



Drying / curing

40C° (18h)

60C° (6h)

120C° (3h)

Furfurylation (Keboney)

Treatment solution: FA 70%



Vacuum (30min)



Pressure (30min/7.6 bar)

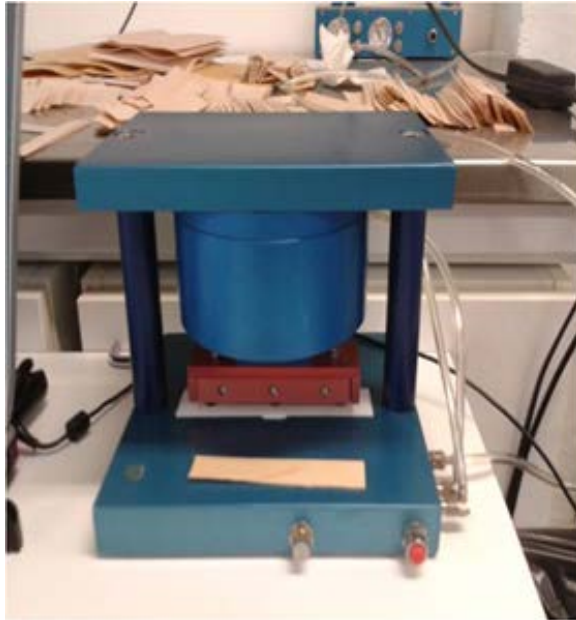


Curing temperature/time: 110°C/over a night

Experimental-adhesive

Property	Adhesive			
	Hot curing	coldset		
	PF	EPI	PU	PVAc
Solids, %	49	60	99	49
Brookfield viscosity (20°C), MPa	300	9,400*	10,500	5,000*
Density, g/cm ³	-	1.50	1.15	1.04
pH	12	7.0	-	5.2

Experimental-Method



sample cutter - for cutting 20 mm x 115 mm strips

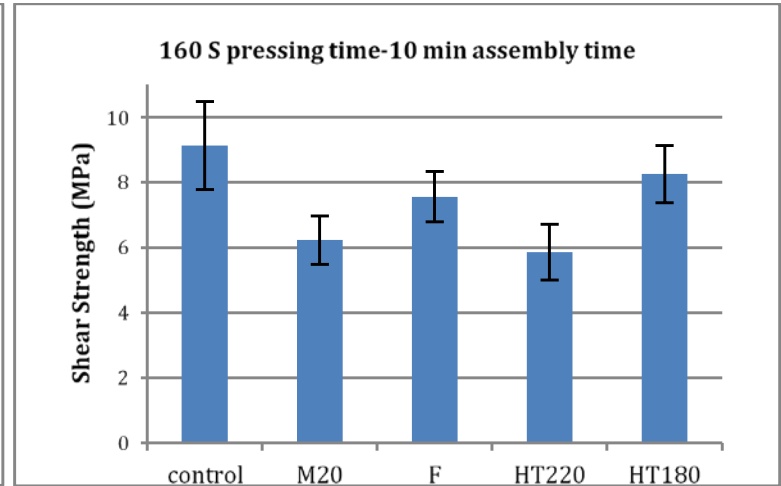
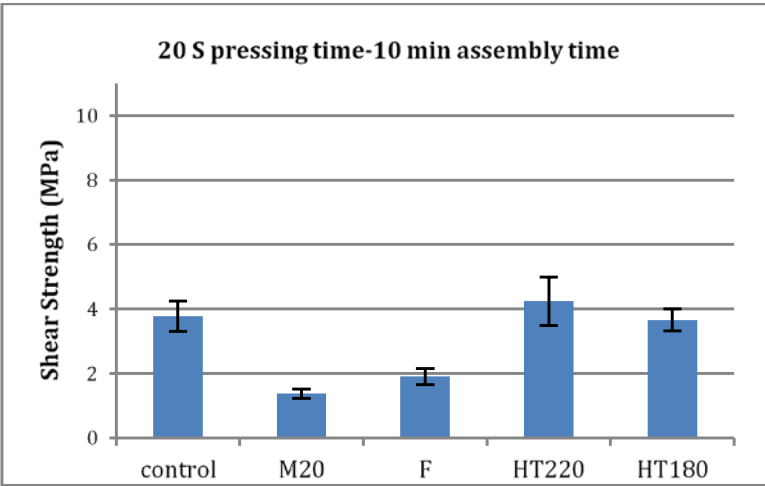
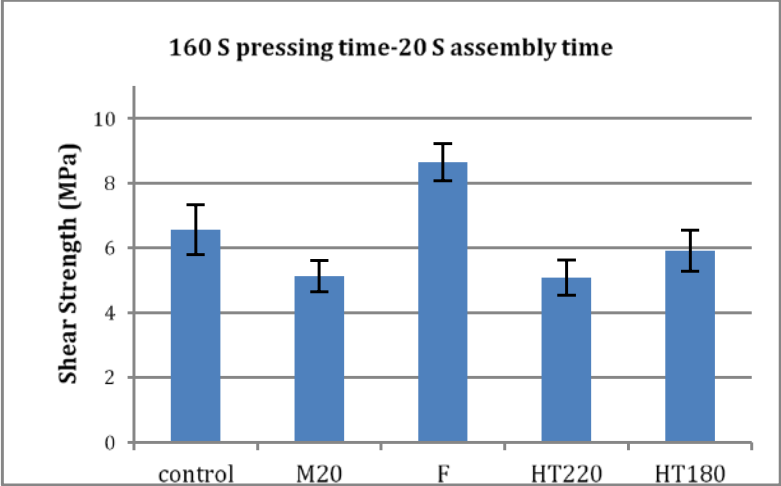
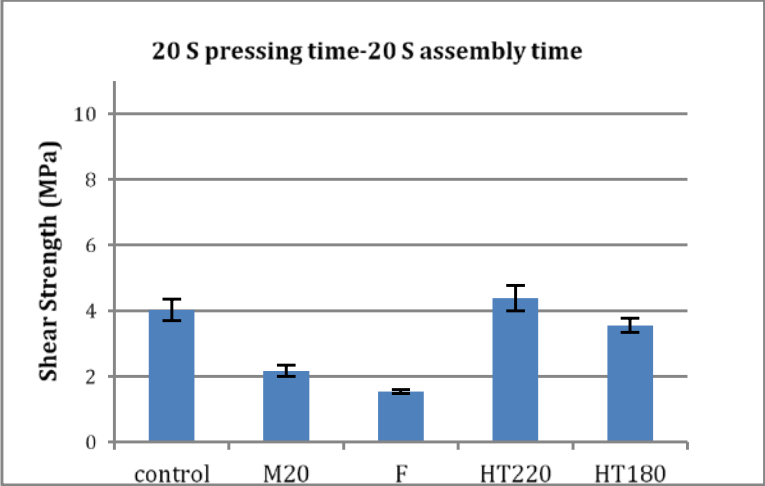


ABES

Experimental-Testing parameters

	Hot curing glue [PF]	Cold set glues
Measured value[MPa]	shear strength	shear strength
Applied pressure [N/mm²]	2	2
Application amount of glue [g/m²]	100	200
curing temperature [°C]	130	20
Bond area [mm²]	4 x 20	4 x 20
Pressing time [S]	20, 160	20, 90, 300
Assembly time [S]	20, 600 [=10m]	20

Results-PF



Results-PU

PU_{1k} → 3-4h pressing time

“not recommended for
studying with ABES”



Results-Coldset glues (PVAc and EPI)

Shear strength (ST) for control, melamine treated (M20), furfurylated (F) and heat treated samples at 180°C (HT180) and 220°C (HT220) samples glued with **PVAc**.

Press time (S)		control	M20	F	HT220	HT180
20	ST (MPa)	0.92	0.09	0.08	0.57	0.85
	SD	0.21	0.01	0.01	0.24	0.14
90	ST (MPa)	2.76	0.44	0.37	1.31	2.67
	SD	0.24	0.19	0.11	0.22	0.07
300	ST (MPa)	5.93	0.77	1.66	1.91	4.55
	SD	0.17	0.35	0.15	0.33	0.31

Conclusion

- ABES, a suitable device to study bonding properties of modified veneers

PF

- Increasing assembly time had no effect on bonding after short pressing time
- Increasing pressing time was more effective on bonding of furfurylated & melamine treated veneers in both assembly times
- Under long press time (even by short assembly), furfurylated veneers showed an acceptable bonding strength

Coldset glues

- Among coldset adhesives, PVAc is recommended for study with ABES

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Thank you for your
attention!