



LBTU
Faculty of Forest and
Environmental Sciences



GLUABILITY OF THERMALLY MODIFIED BIRCH (*BETULA PENDULA* ROTH.), ASPEN (*POPULUS TREMULA* L.), AND POPLAR (*POPULUS X CANADENSIS* MOENCH) VENEERS USING COMMERCIAL ADHESIVES

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INTRODUCTION

- 53% of Latvia's area is covered by forests
- Birch (*Betula pendula* Roth.) is the most common species, accounting for 30% of the forested land.
- Aspen (*Populus tremula* L.) makes up to 7% of Latvia's forests. Fast growing species, particularly its hybrid varieties.
- Poplar (*Populus x canadensis* Moench) is a natural hybrid, originally selected in France, fast growing.
- Wood thermal modification – thermal treatment (150°-240°C) to enhance its properties, including durability and water resistance.



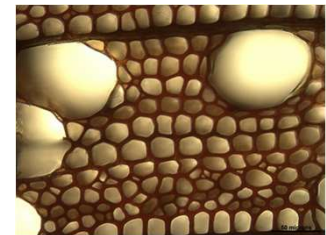
https://en.wikipedia.org/wiki/Betula_pendula



https://lv.wikipedia.org/wiki/Parast%C4%81_apse



https://en.wikipedia.org/wiki/Populus_%C3%97_canadensis





RESEARCH OBJECTIVE

This study aims to assess the bonding performance of plywood manufactured from thermally modified veneers—treated by two different methods—using phenol formaldehyde resin, melamine urea formaldehyde resin, hybrid polymer and polyurethane commercially available glues



WTT



TV



MATERIALS

- Aspen, birch, and poplar veneers were rotary-cut for the study and thermally modified in water steam environment at 160°C for 50 minutes
- Aspen, birch, and poplar veneers were rotary-cut for the study and thermally modified in reduced pressure:
 - 160°C for 50 min
 - 204°C for 120 min
 - 214°C for 120 min
 - 217°C for 180 min
 - 218°C for 30 min
- Phenol formaldehyde resin (SFŽ-3014), melamine urea formaldehyde resin (Casco Adhesives MUF system 1257/7557), hybrid polymer glue (Soudal HB Construct), and polyurethane glue (PURBOND HB S159)



<https://intanwijaya.com/products/phenol-formaldehyde-resin/>

PF



<http://www.soudal.eu/soudalweb/productDetail.aspx?w=&p=282&ID=4403>

HB



MANUFACTURING AND TESTING METHODS

- Three-layer plywood samples were obtained after pressing the veneers at a temperature of 215 °C and pressure of 1.4 MPa and maintaining the pressure for 5 minutes
- Plywood performance indicators were determined using three pre-treatment methods:
 - 24h: Immersion in water at 20±3 °C for 24 hours
 - 4h+16h+4h+1h: Immersion in boiling water for 4 hours, drying in a ventilated oven at 60±3 °C for 16 hours, repeated boiling water immersion for 4 hours, followed by cooling in water at 20±3 °C for 1 hour.
 - 72h+1h: Immersion in boiling water for 72±1 hours, followed by cooling in water at 20±3 °C for 1 hour.
- Tensile—shear strength in MPa and cohesive wood failure in percentage according to standard EN 314-1:2004 were determined, and conformity with bonding Class 3 according to EN 314-2:1993 was evaluated.





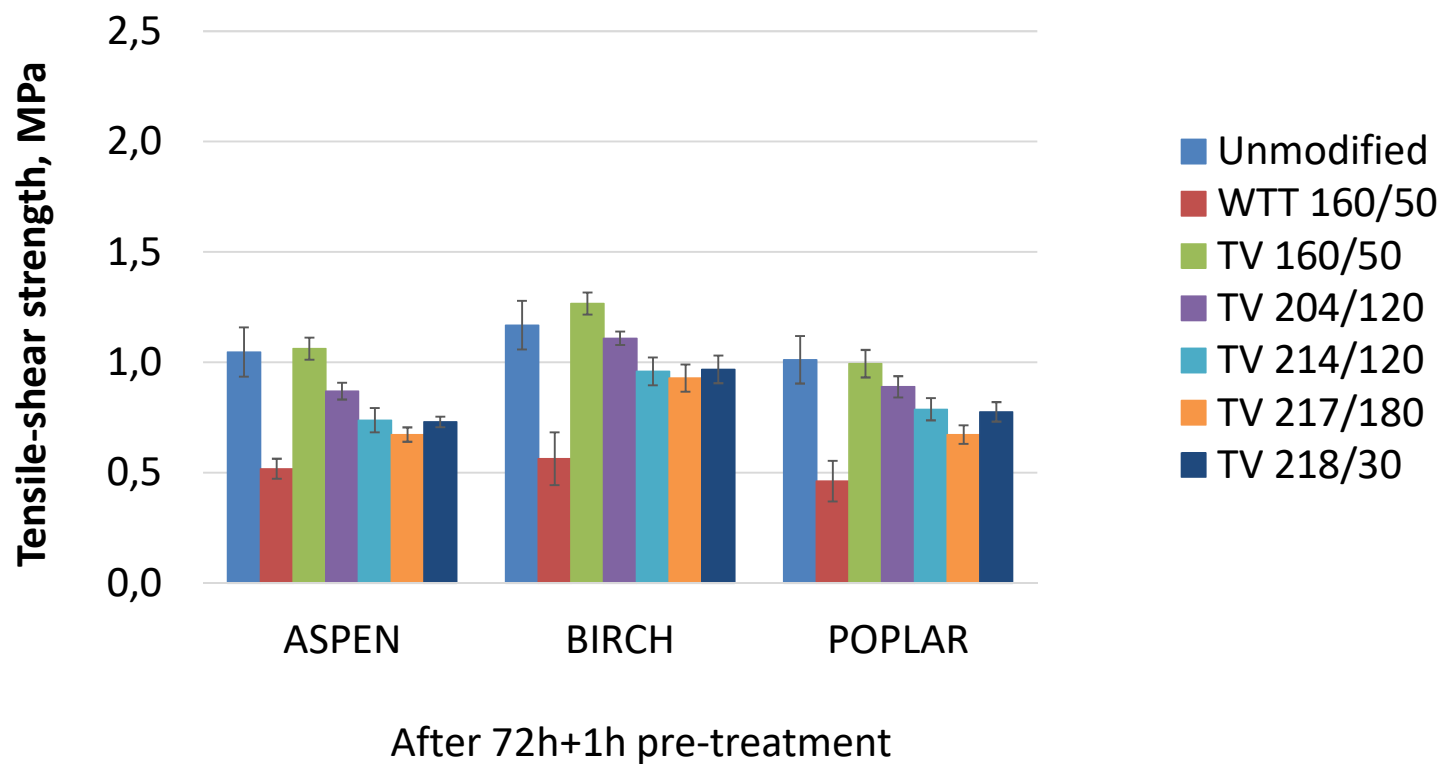
GLUE CONSUMPTION RESULTS

Glue	Consumption, g/m ²		Deviation, %
	Nominal, g/m ²	Actual±SD, g/m ²	
PF	150	156±11	4.0
HB	300	317±13	5.7
MUF	340	343±16	0.9
PUR	150	162±15	8.0



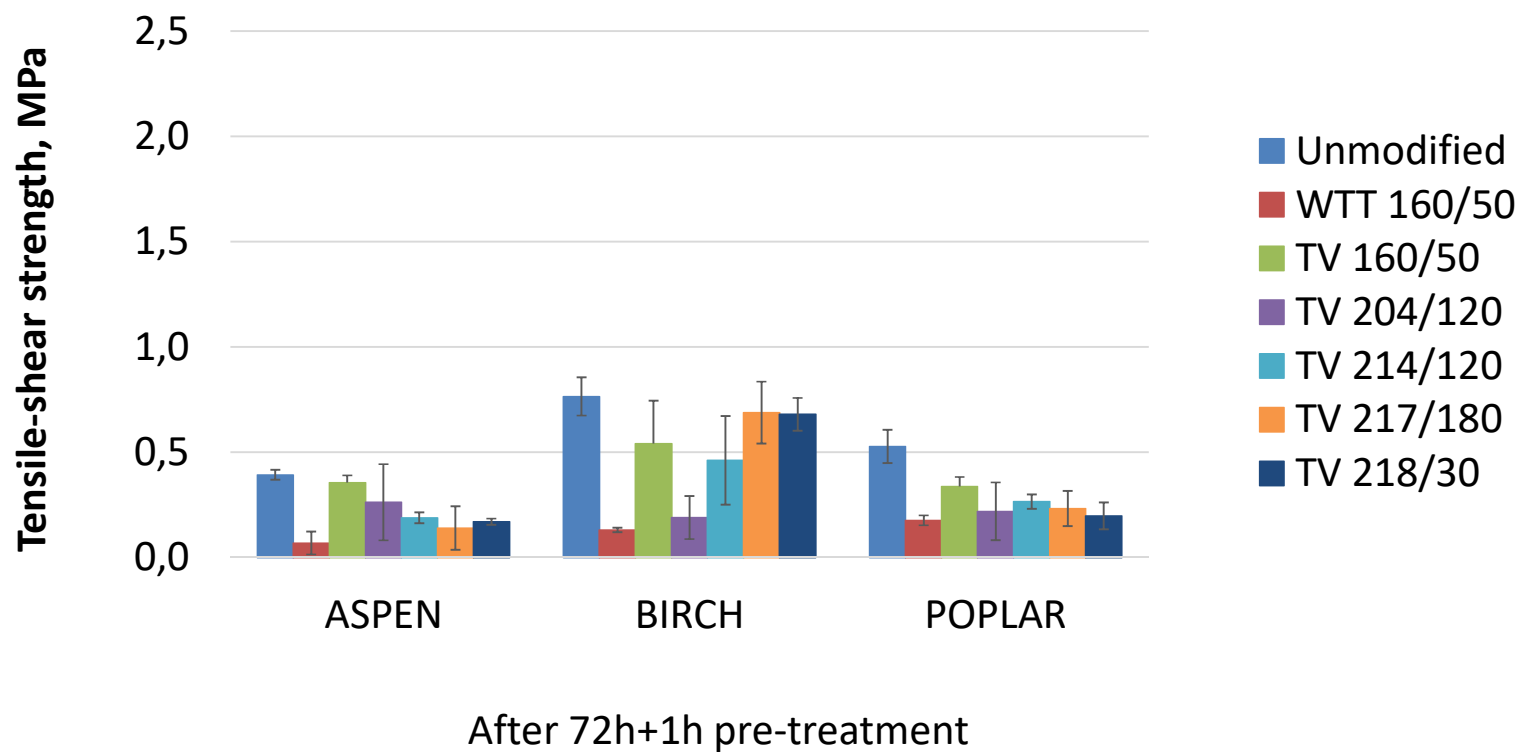
COMPRESSION RATIO

Glue	Compression ratio, %		
	Aspen	Birch	Poplar
PF	15.3±7.1	12.4±6.1	37.4±1.8
HB	2.7±2.6	0.3±1.3	2.5±4.0
MUF	3.8±3.5	0.0±1.0	4.7±2.1
PUR	2.1±2.2	0.2±0.5	3.0±1.0



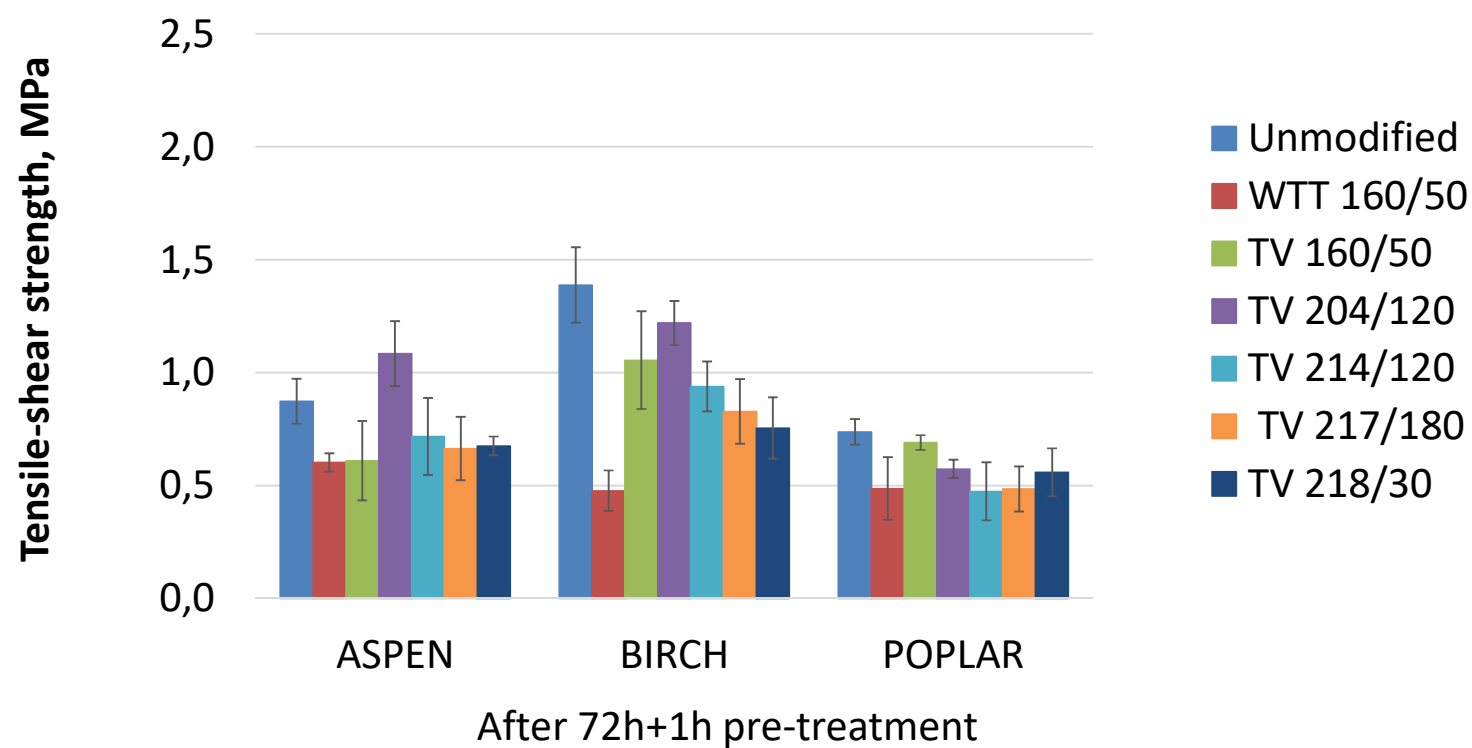


HB ADHESIVE GLUABILITY



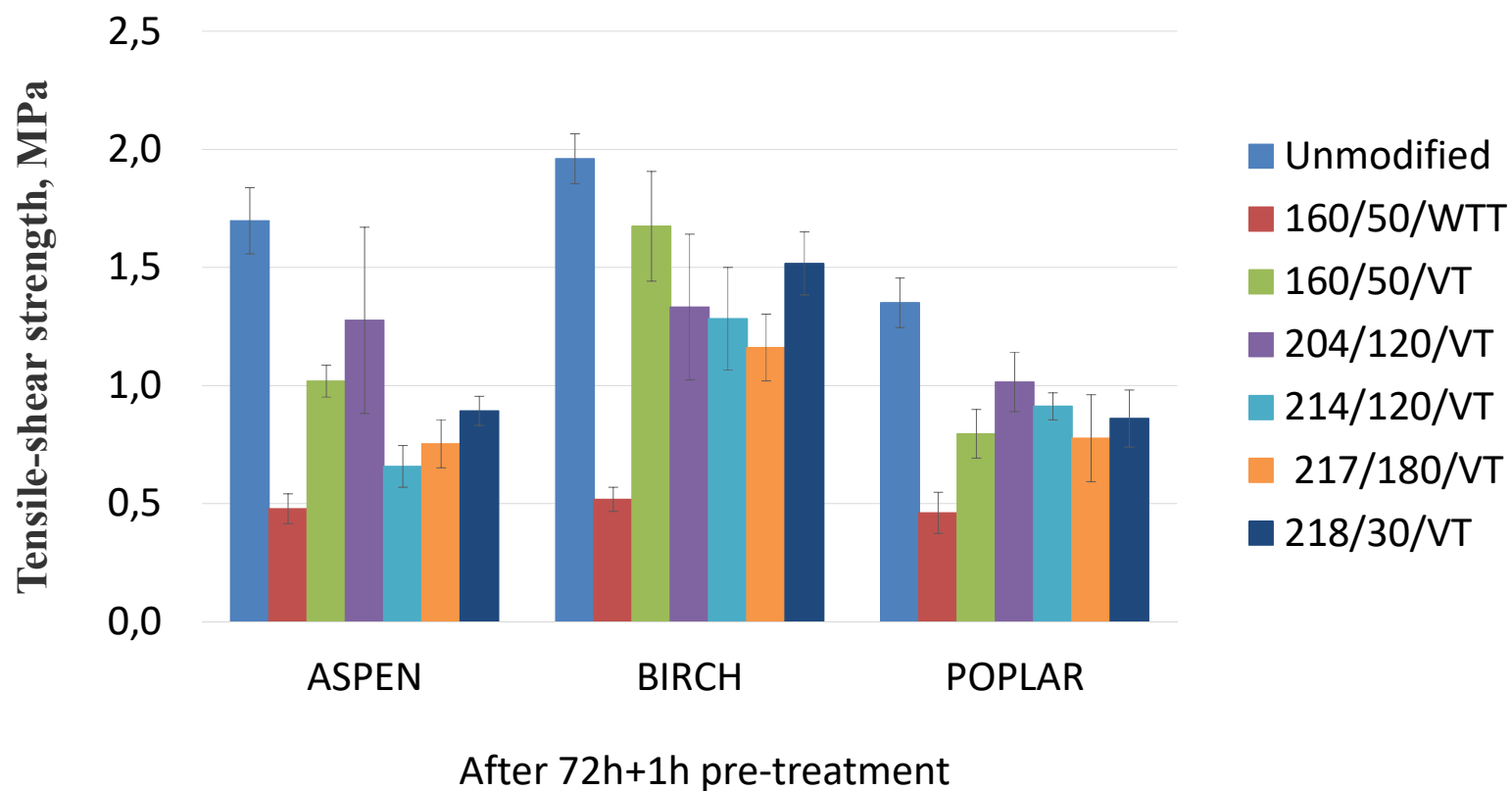


MUF ADHESIVE GLUABILITY





PUR ADHESIVE GLUABILITY





1. Veneers thermally modified in a vacuum environment under identical modification conditions exhibit 50% higher shear strength compared to veneers thermally modified in a water steam environment and are therefore more suitable for plywood production
2. Increased pressing temperature enhances the plywood compression ratio. When using phenol formaldehyde resin adhesive under elevated temperatures, the compaction rate reaches $15.3 \pm 7.1\%$ for aspen, $12.4 \pm 6.1\%$ for birch and $37.4 \pm 1.8\%$ for poplar, whereas with other adhesives used at room temperature, the compression ratio is only 0.3-4.7%.



3. The most suitable adhesives for manufacturing plywood intended for bonding Class 3 (outdoor use) from thermally modified veneers are phenol formaldehyde resin adhesive and polyurethane adhesive
4. After 72h+1h PT, the highest shear strength (1.96 ± 0.11 MPa) was observed in plywood made from non-thermally modified birch veneers bonded with polyurethane adhesive, with wood failure of 73%.
5. Birch veneers thermally modified in a vacuum environment under the modification regime TV 218/30 and poplar veneers modified under the regime TV 214/120 are the most suitable for plywood production when using polyurethane adhesive.



THANK YOU!

This research was conducted within the Latvian State research program project No. VPP-ZM-VRILLA-2024/2-0002 “Innovation in Forest Management and Value Chain for Latvia's Growth: New Forest Services, Products and Technologies (Forest4LV)”.

