Liquefied Wood as an Adhesive

Milan Šernek, Associate professor

and

Aleš Ugovšek, Graduate student

Department of Wood Science and Technology

Biotechnical Faculty, University of Ljubljana, SLOVENIA

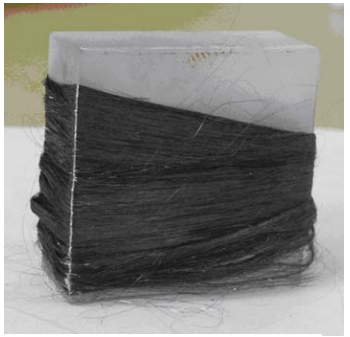
INTRODUCTION

LIQUEFIED WOOD

- Product of thermochemical reaction
- **Wood particles**
- **Solvent/reagent** (polyhidric alcohols, phenol, ionic liquids, cyclic carbonates, dibasic esters)
- **Catalyst** (acid, base)

APPLICATION OF LIQUEFIED WOOD

- Polyurethane foams
- Phenolic resins
- Carbon fibers
- Coatings
- Adhesives



Ash cup

Oil filler cap (prototype)

Delivery pipe insulator (prototype)

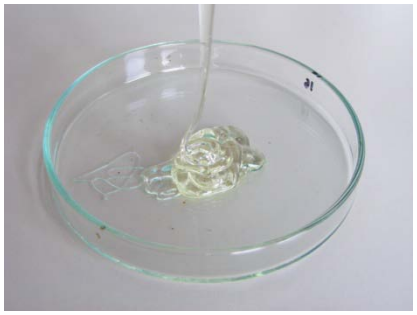
ADHESIVES & LIQUEFIED WOOD

- Combination with synthetic adhesives

  (UF, MUF, PF)

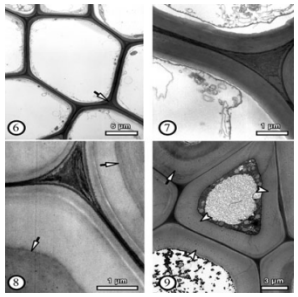
- Synthesis of polymers (epoxy, polyurethane, polyesters)

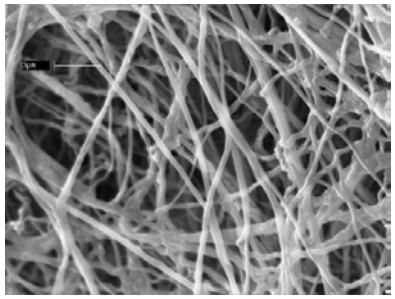
- Independent component



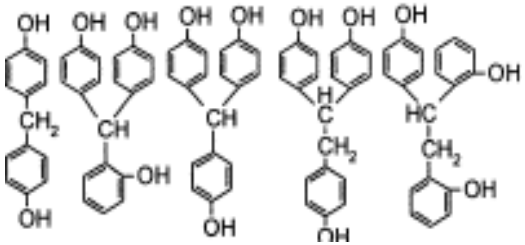
PROCESS OF WOOD LIQUEFACTION

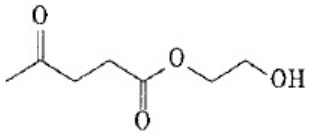
1. Degradation of basic wood components





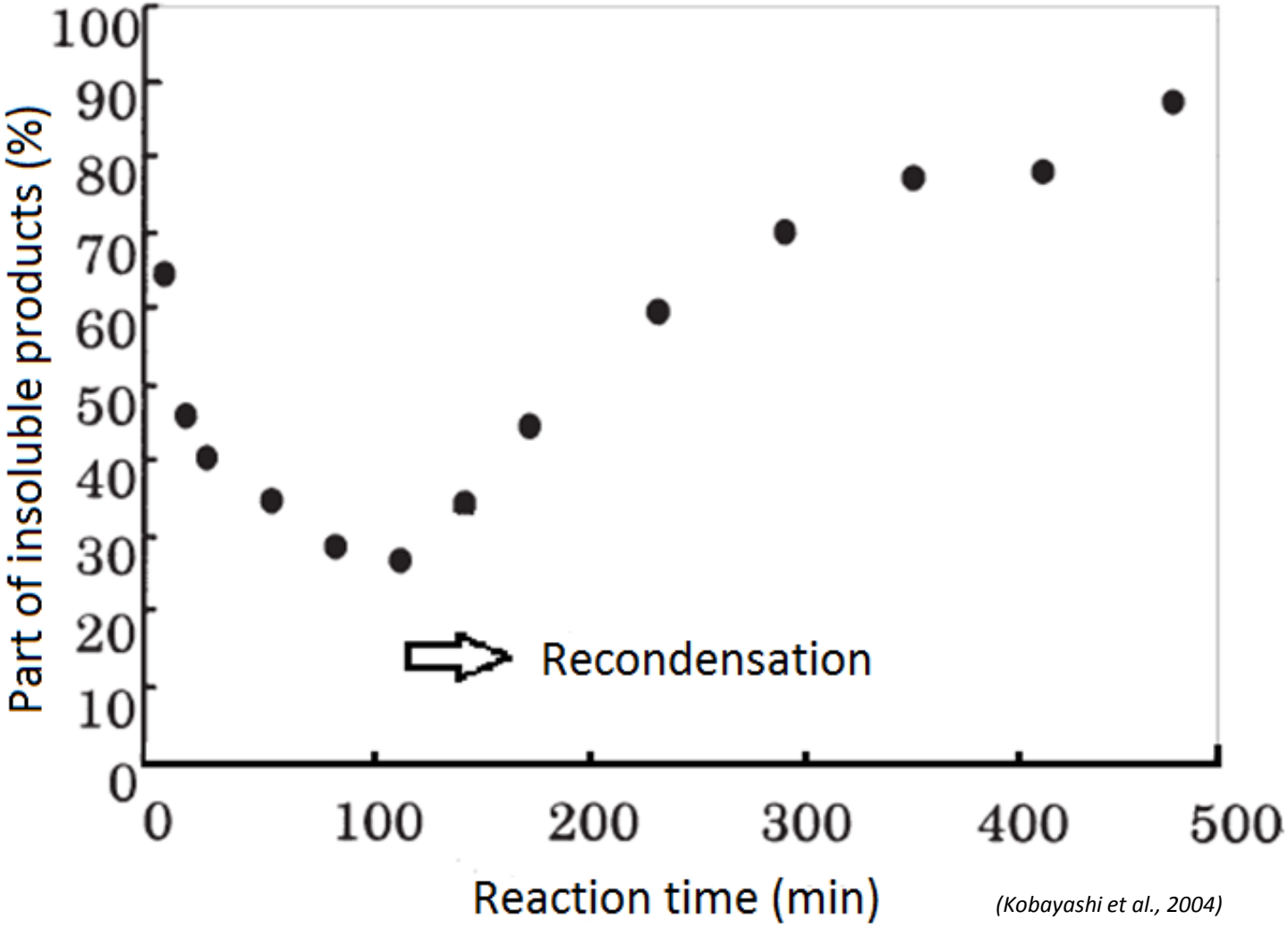
2. Phase of “intermediates” formation





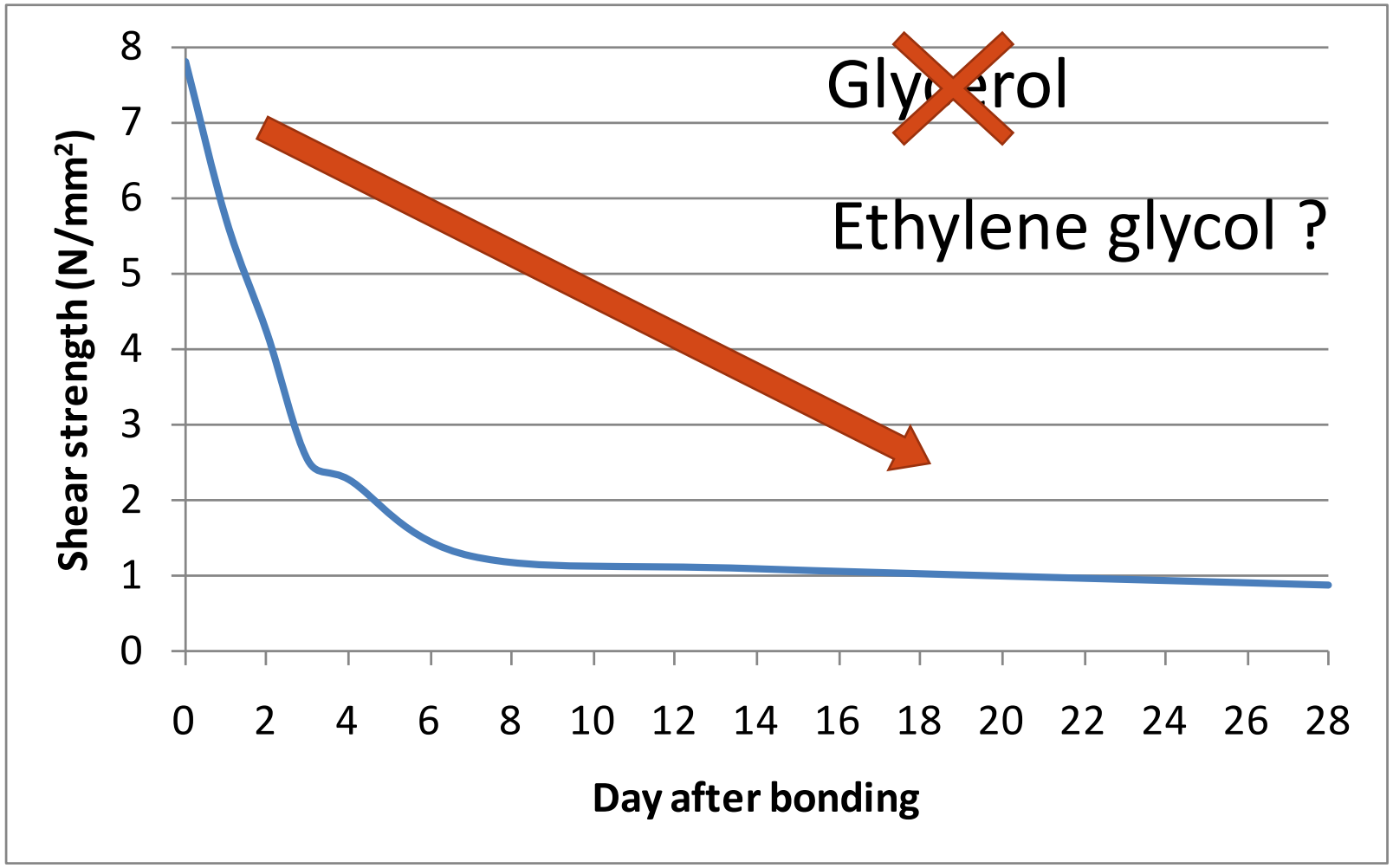
3. Recondensation

PROCESS OF WOOD LIQUEFACTION



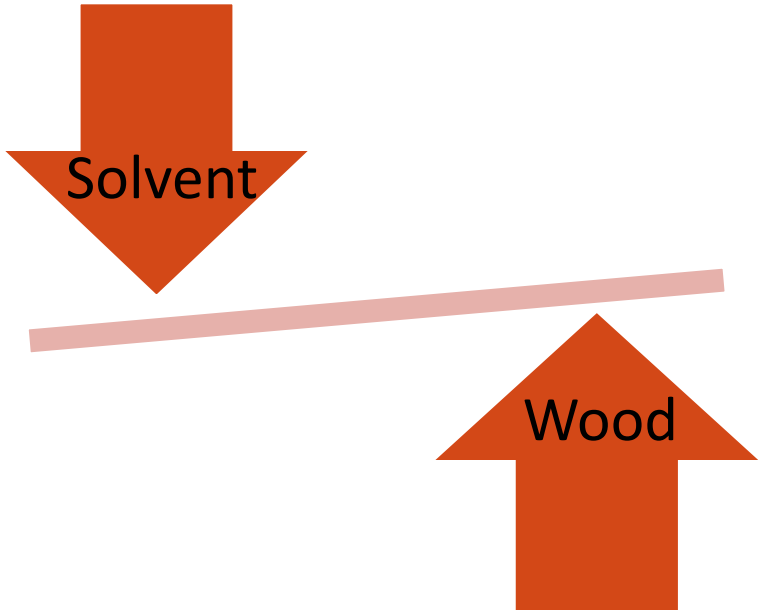
(Kobayashi et al., 2004)

PROBLEMS SO FAR…



PROBLEMS SO FAR…

- Wood/solvent ratio: **1/3**



- Wood/solvent ratio: **1/1**

MATERIAL AND METHODS

WOOD LIQUEFACTION

BLACK POPLAR (1 part), ETHYLENE GLYCOL (3 parts), SULPHURIC ACID (3 % on EG mass)

↓ liquefaction (180 °C, 120 min)

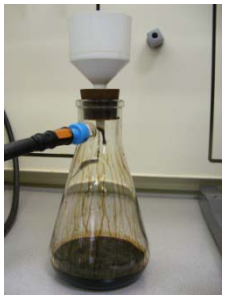
LIQUEFIED WOOD 1:3 (non-filtered)

↓ filtration and evaporation of 1,4-dioxane (55 °C, reduced pressure)

LIQUEFIED WOOD 1:3 (filtered)

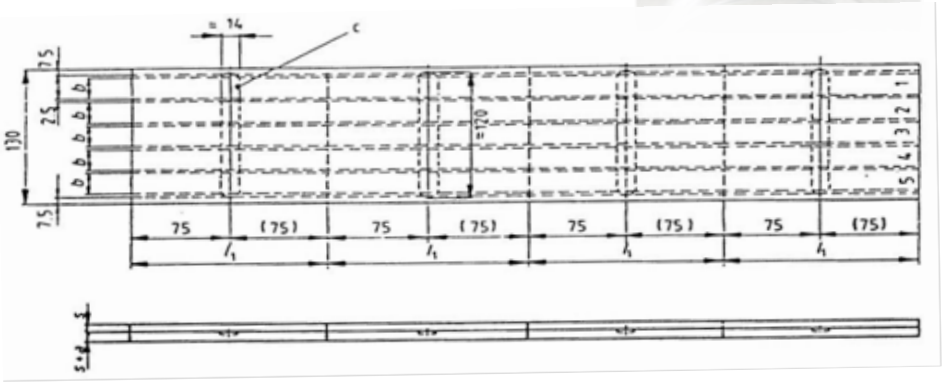
↓ evaporation of EG (120 °C, reduced pressure)

LIQUEFIED WOOD 1:1



WOOD BONDING

- Standard EN 12765:
  - beech 2 x 5 mm
- LW, 200 g/m^2
- Specific pressure: 0,6 MPa



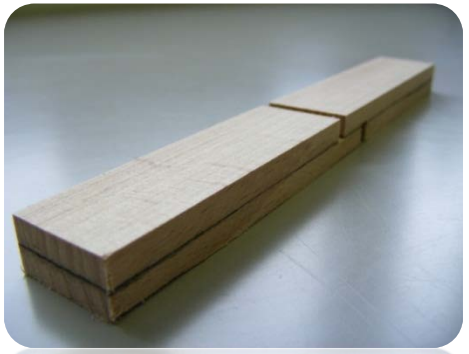
- Different temperatures (15 min)

  120, 150, 180, 200 and 220 °C

- Different press times (180 °C)

  6, 9, 12, 15 and 18 minutes

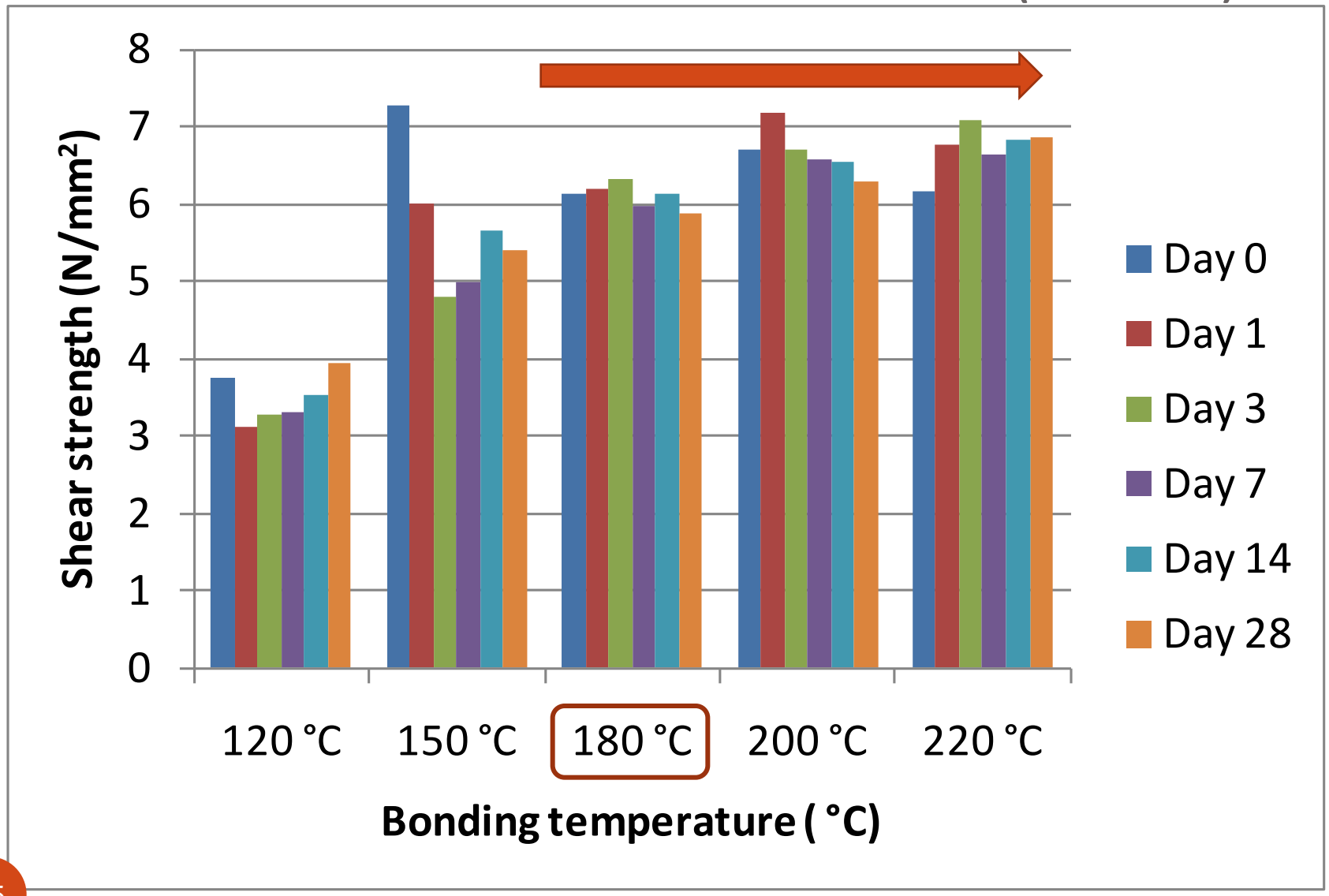
SPECIMEN TESTING



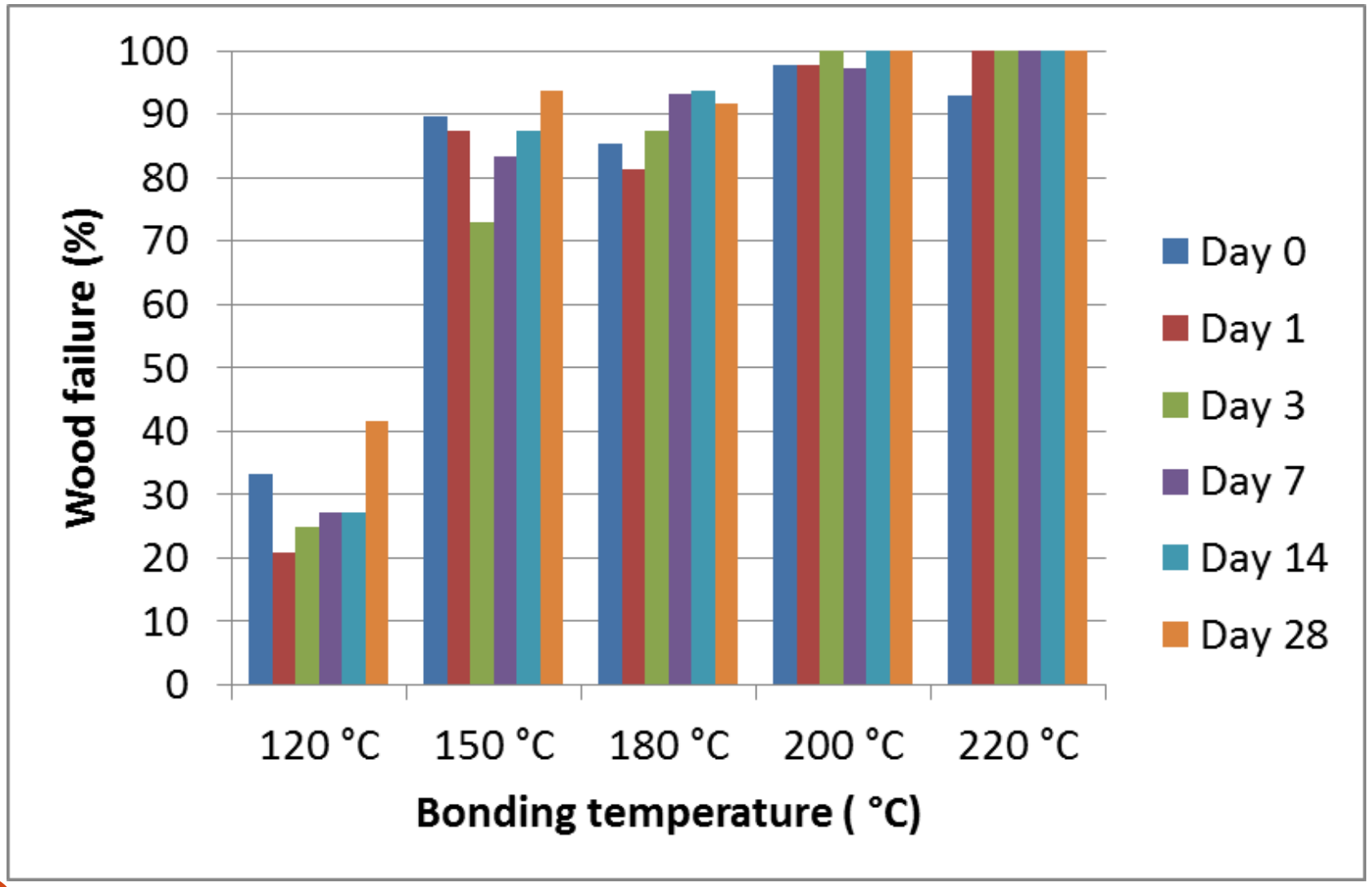
- **0, 1, 3, 7, 14 and 28 days after bonding**
- Average shear strength of 10 specimens
- Standard: EN 205

RESULTS

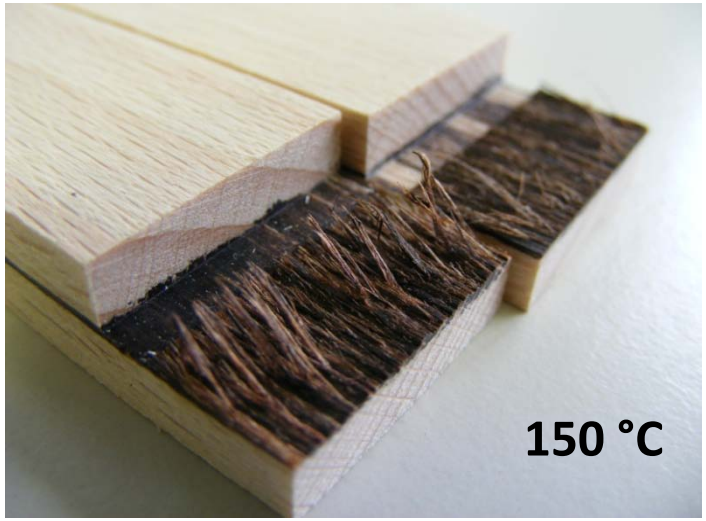
INFLUENCE OF PRESS TEMPERATURE (15 min)

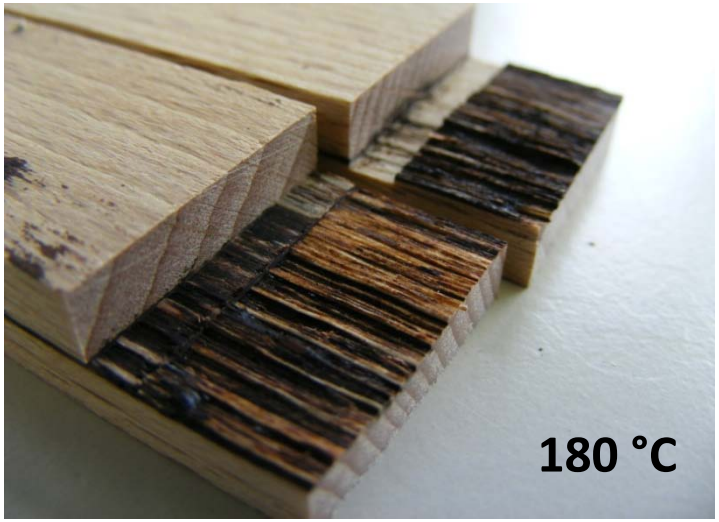


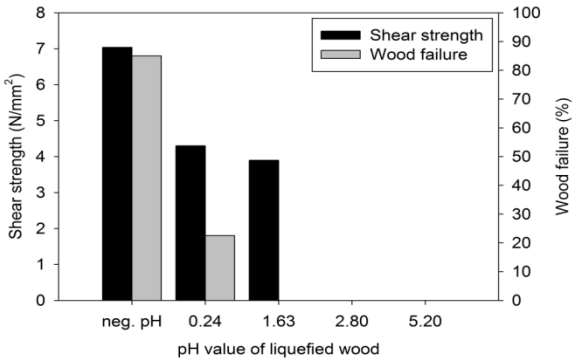
INFLUENCE OF PRESS TEMPERATURE (15 min)

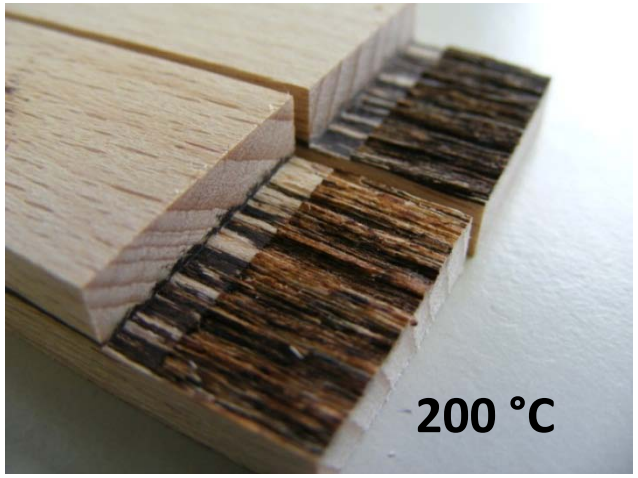


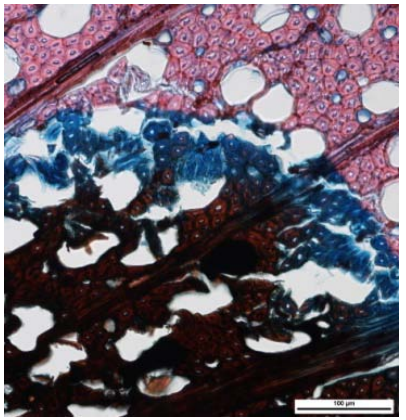
WOOD FAILURE AND SURFACE DAMAGE



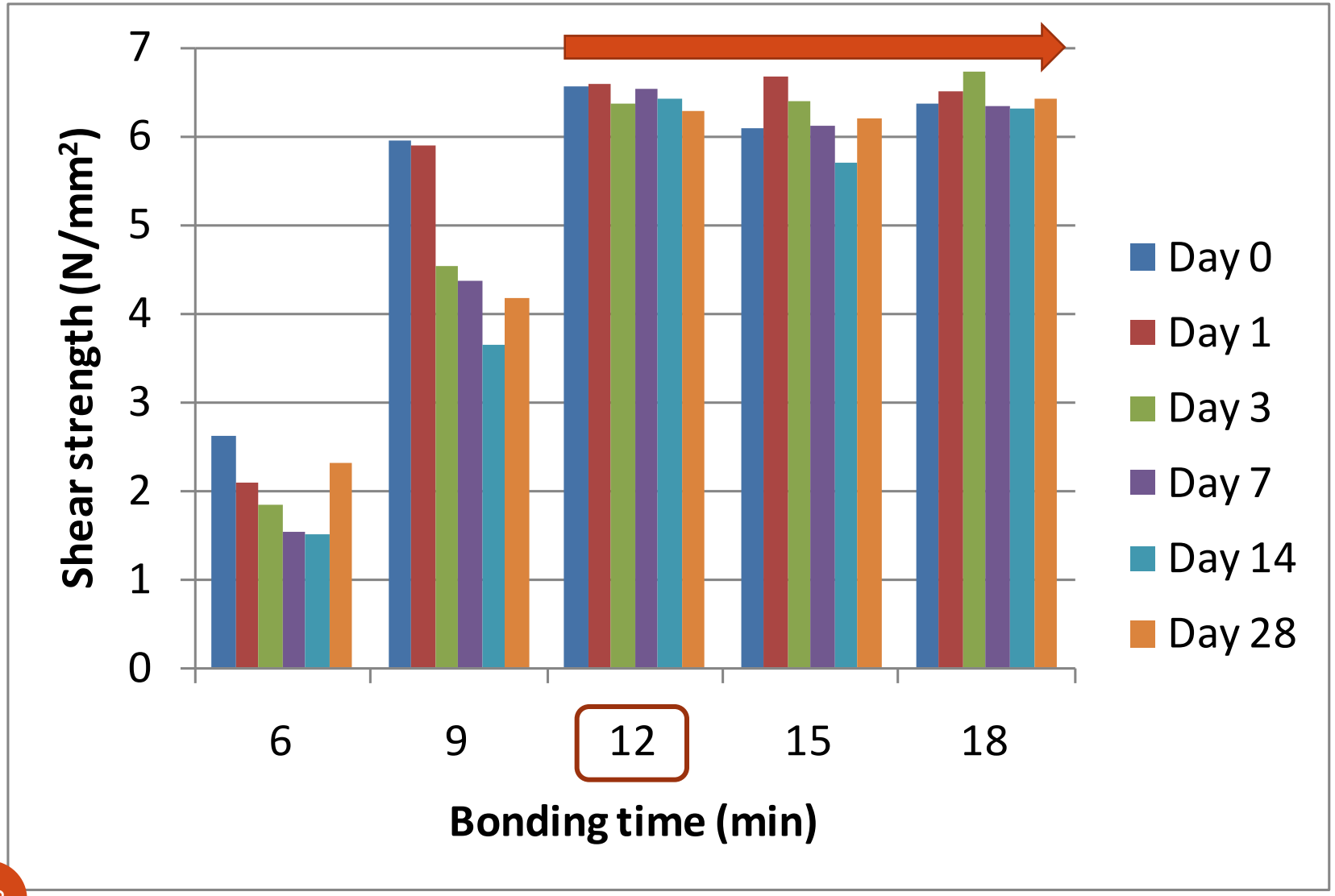








INFLUENCE OF PRESS TIME (180 °C)



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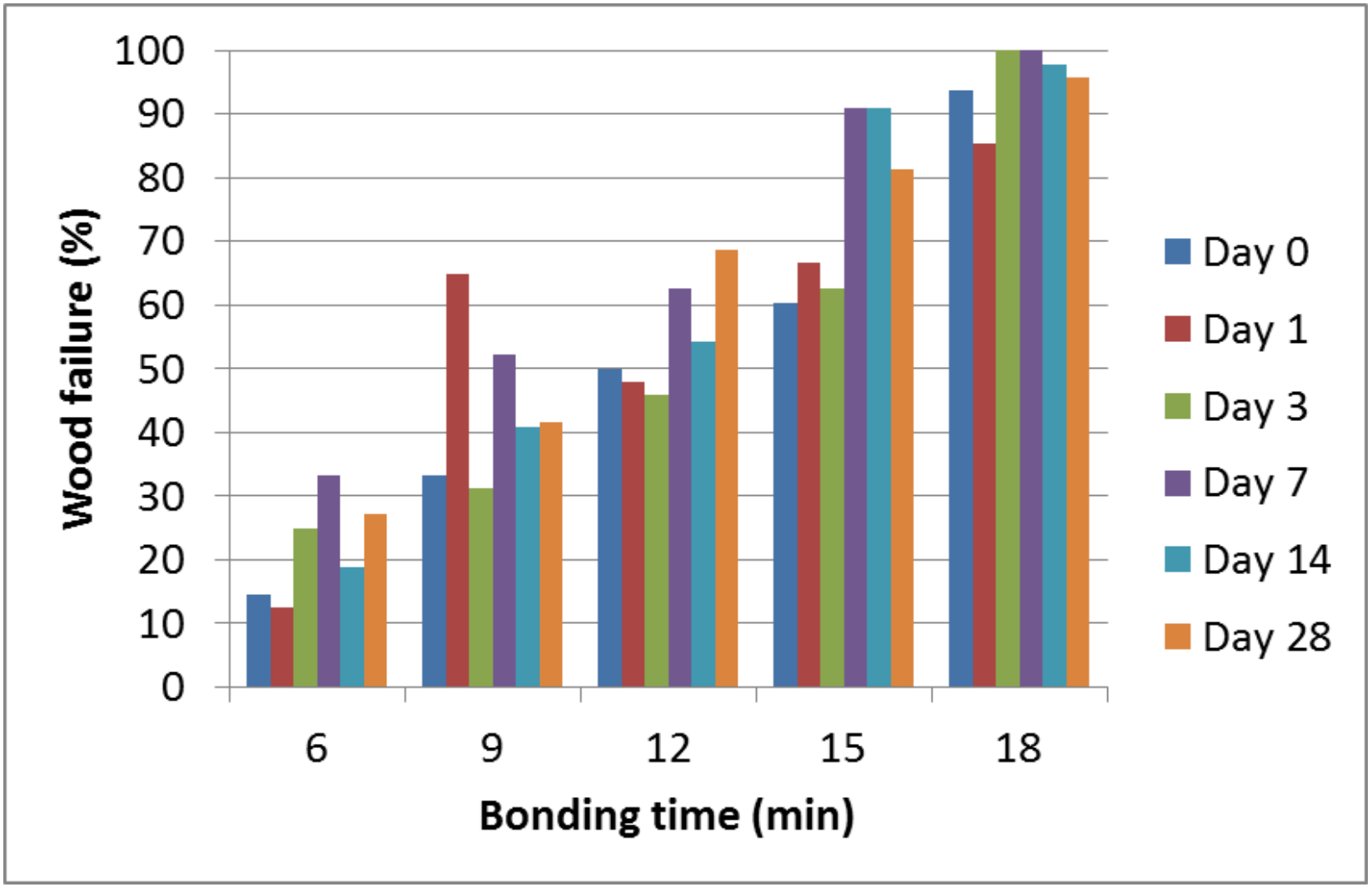


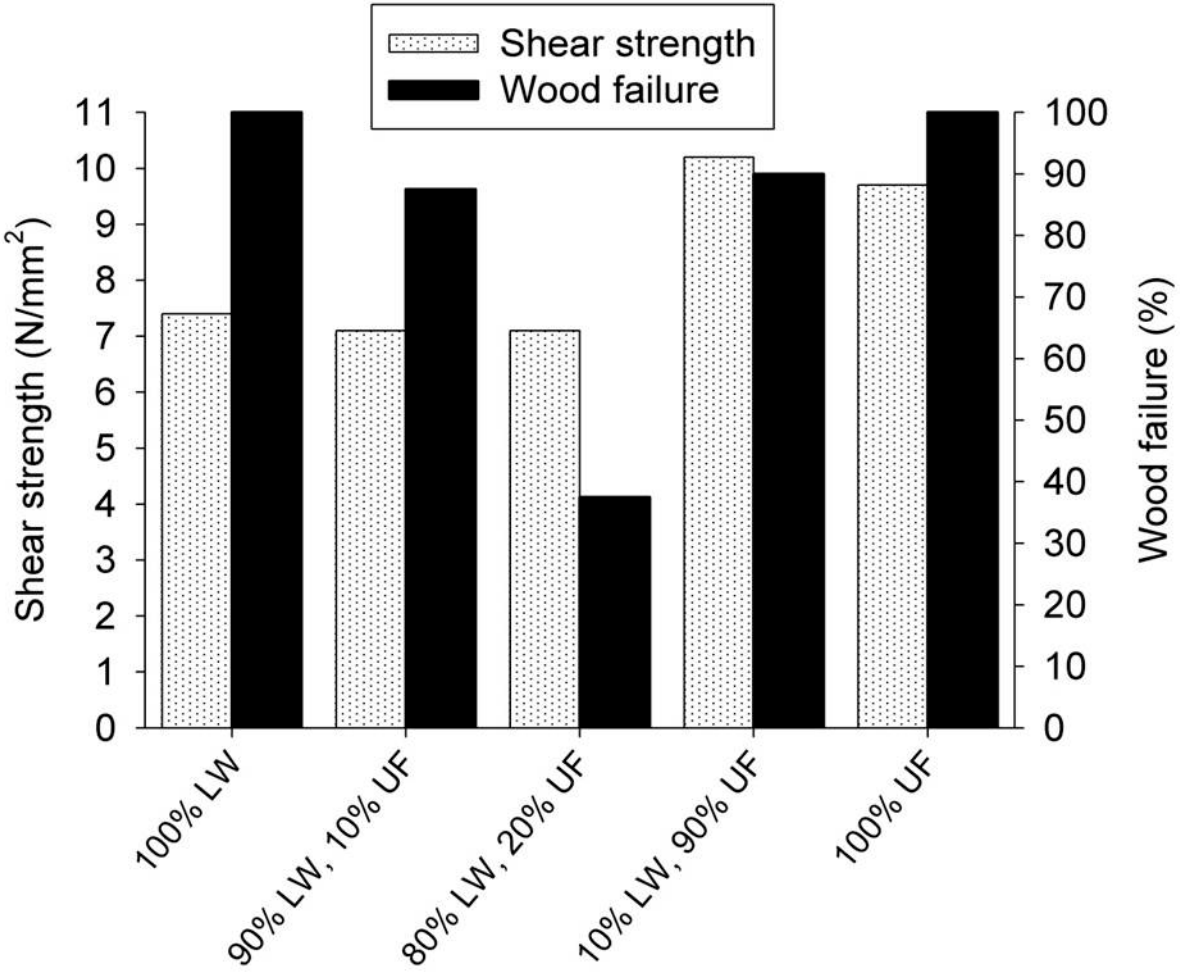
CONCLUSIONS

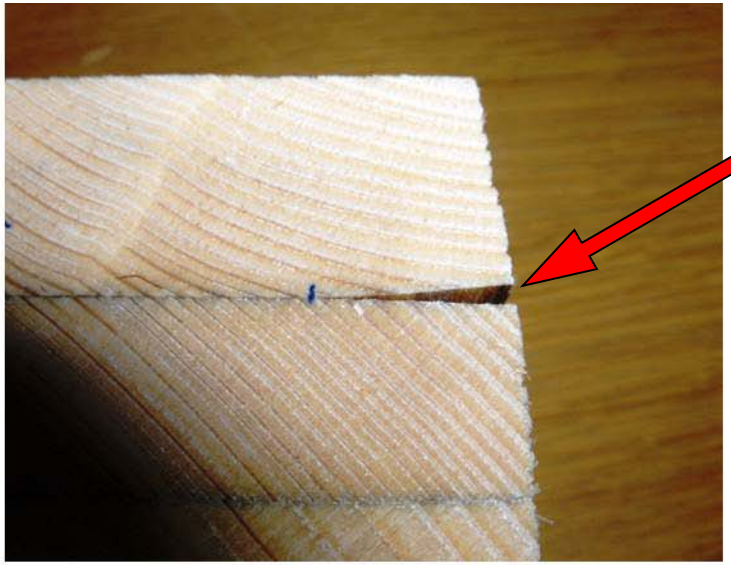
- Press temperature of **180 °C** and press time of **12 minutes** are suitable for bonding wood with liquefied wood (EG:WOOD = 1:1).

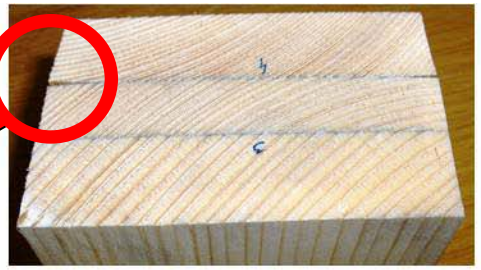
- Shear strength values **did not attain standard requirements**, but did not decrease during exposure to standard climate.

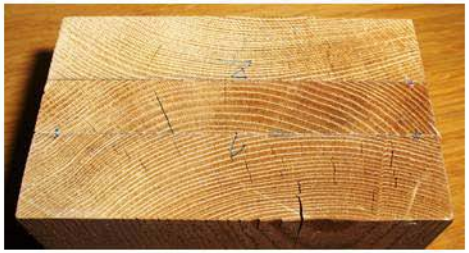
- **High wood failure** despite relatively low shear strength values (**6-7 N/mm²**).

LW + UF (180°C, 15 min)







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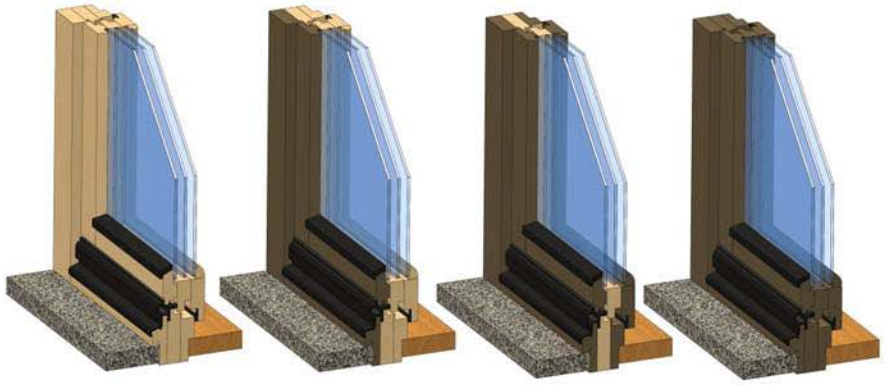

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Thank you!
Hvala!