Glueing European Hardwoods for Load Bearing Timber Structures

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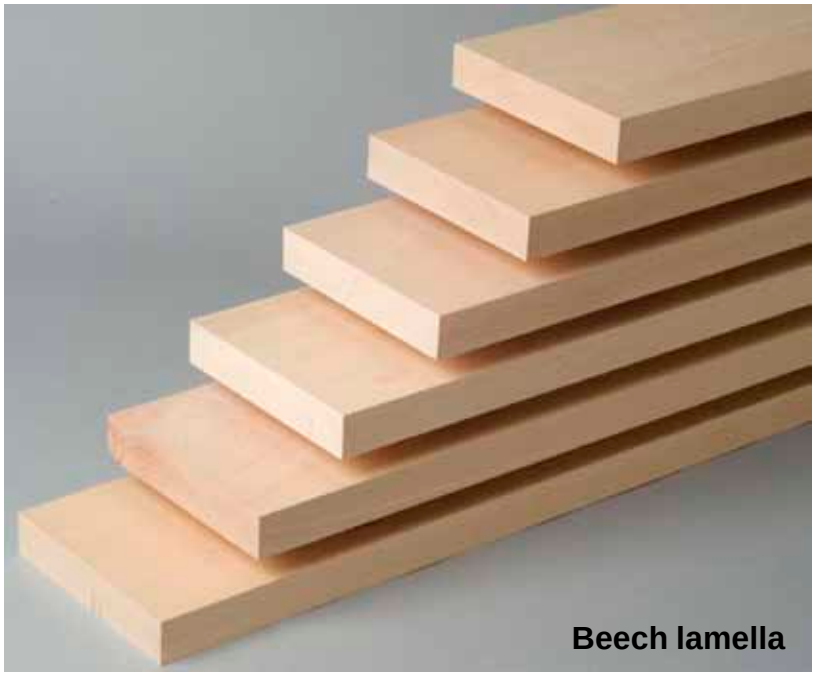
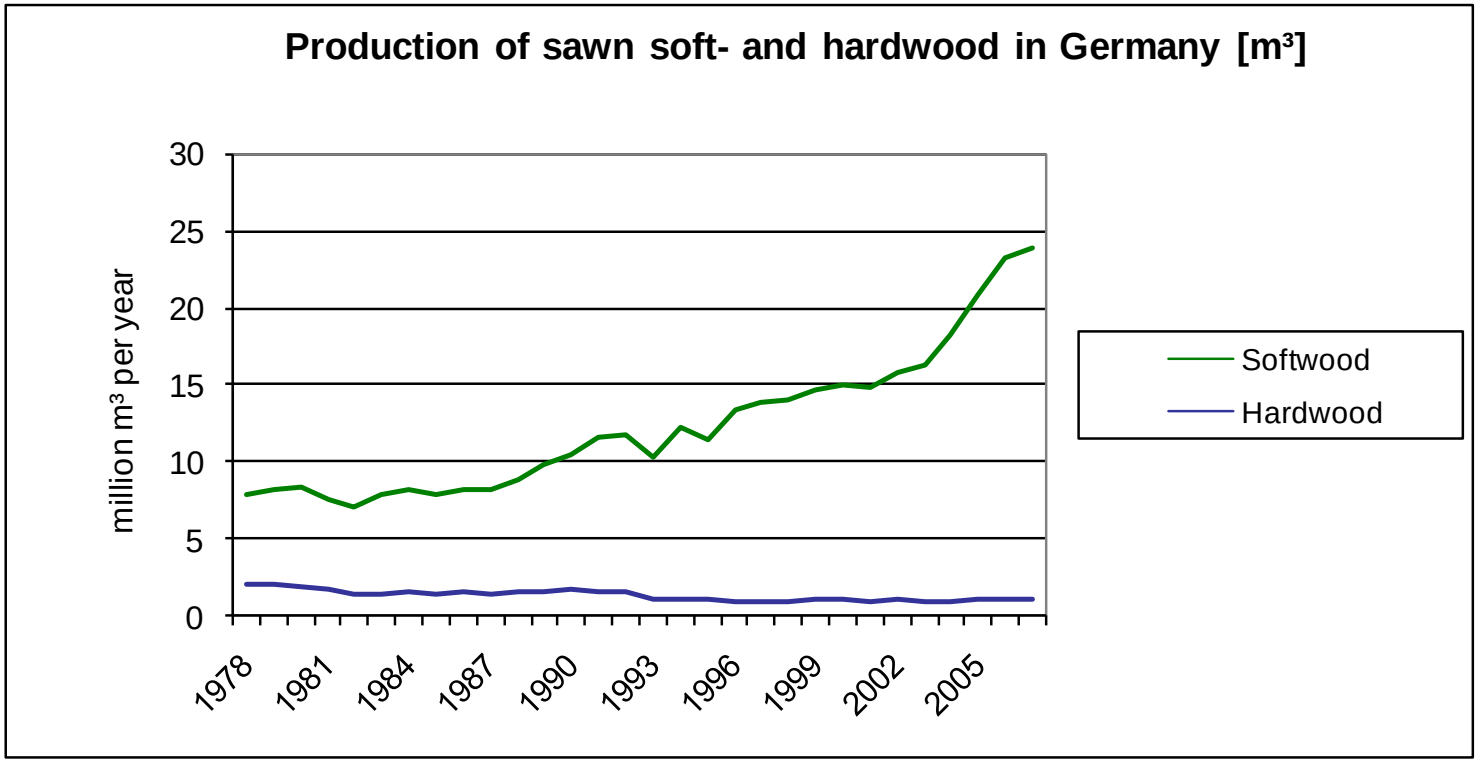
Outline

- Introduction & Background
- Objectives
- Material and Methods
- Results
- Conclusions and Summary


Beech lamella

Introduction & Background



- Lack of utilization for hardwoods
- Synchronous increase of growing stock of broadleaves

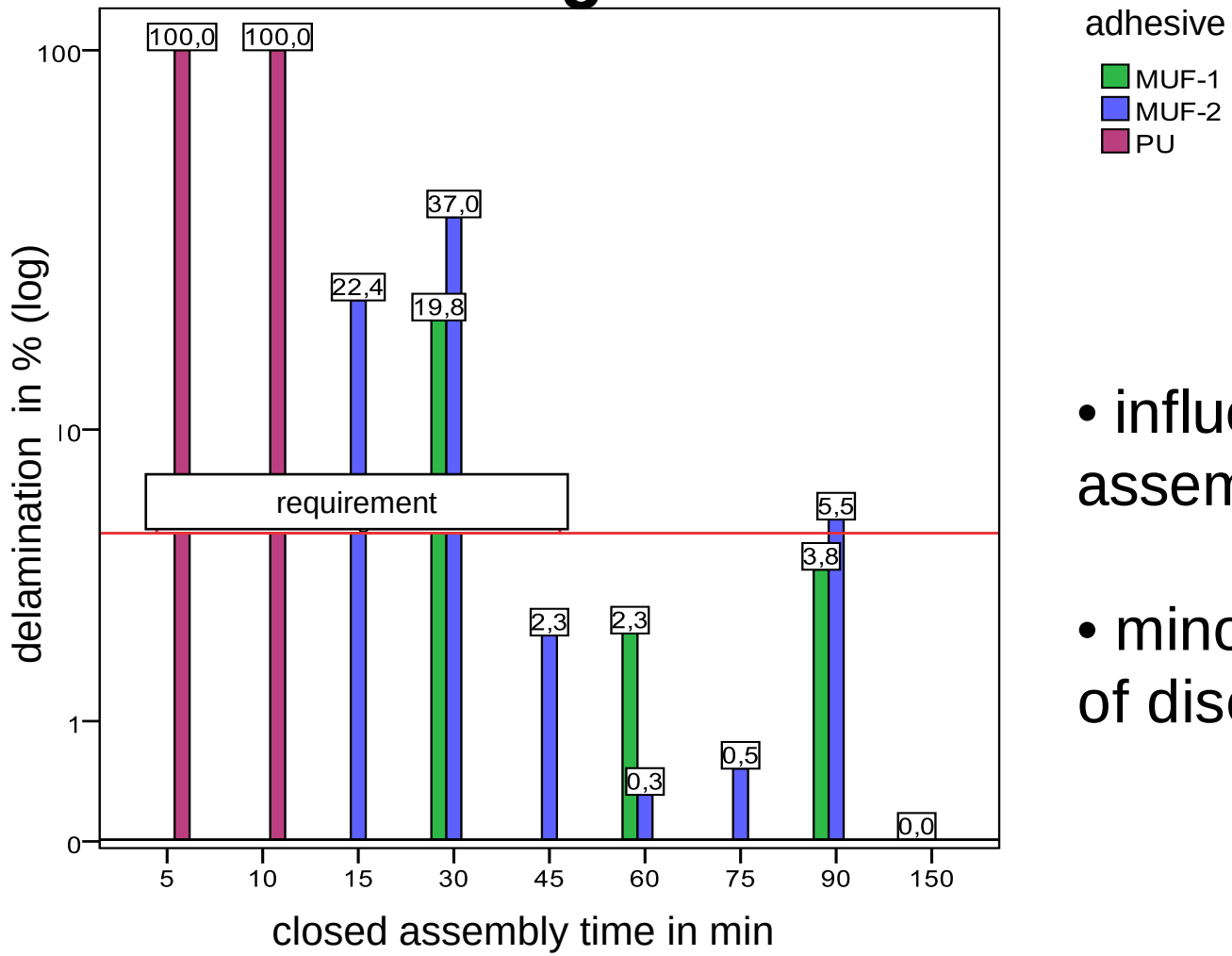
Introduction & Background

- Egner and Kolb (1966)
- Gehri (1984)
- Glos and Lederer (2000)
- Frühwald et al. (2003)
- Blaß and Frese (2005)

glueing of beech:
reliable and durable
bond lines (EN 302-2)

- Aicher and Reinhardt (2006)
- Schmidt et al. (2010)

Introduction & Background

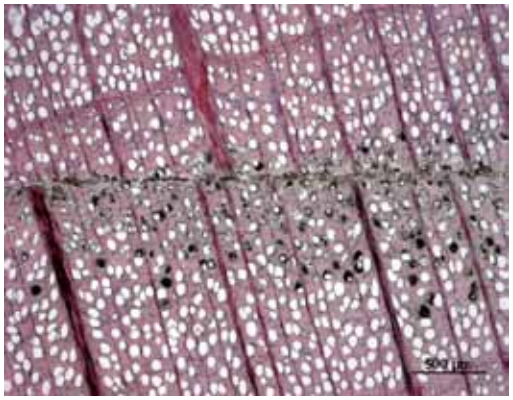


- influence of assembly time
- minor influence of discoloration

Schmidt, M.; Glos, P. Wegener, G. (2010) Verklebung von Buchenholz für tragende Holzbauteile. European Journal of Wood and Wood Products Volume 68, Nr.1 S.43-57

Introduction & Background

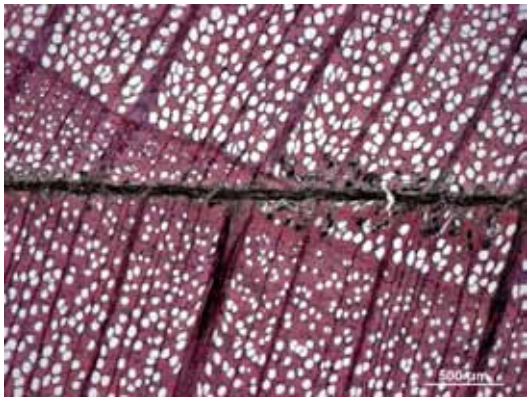
Light-optical micrograph examinations revealed significant differences



assembly time 15 min

delamination 100 %

scale: 500 µm



assembly time 45 min

delamination 0%

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Introduction & Background

Curing of acid catalyzed MUF-adhesives is influenced by wood characteristics:

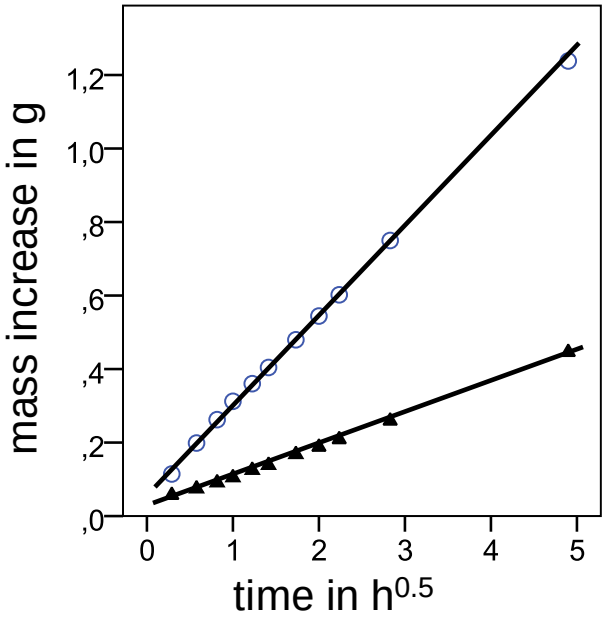
- water absorption
- pH (surface)
- buffering capacity towards acid

Objectives

- Wood characteristics inter- and intraspecific differences:
  - water absorption [Obj.1]
  - pH on the surface of adherends [Obj.2]
  - buffering capacity [Obj.3]

- Development of a new method for monitoring real-time curing behavior and the interaction with wood species [Obj.4]

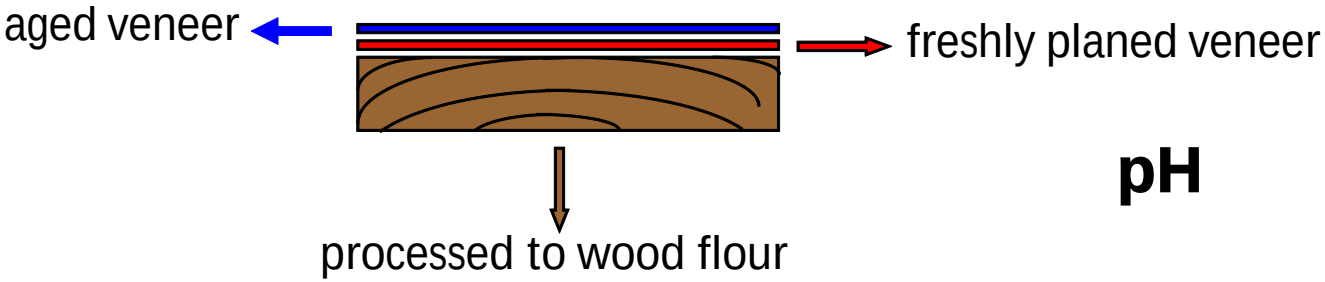
Material and Methods [Obj.1]

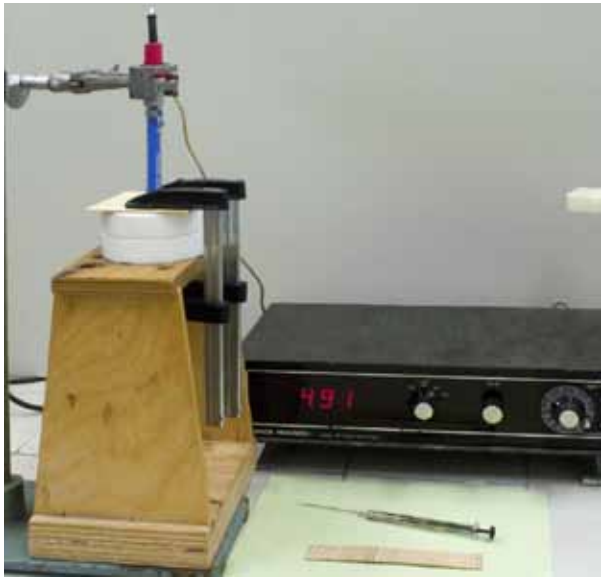


Water absorption coefficients
(EN ISO 15148)

- surface 100 cm²
- 24 h storage in total
- mass increase 11 periods
- target value: slope of regression
- 173 specimens
  - Beech 100 (colored 36)
  - Ash 63 (colored 24)
  - Spruce 10

Material and Methods [Obj.2]

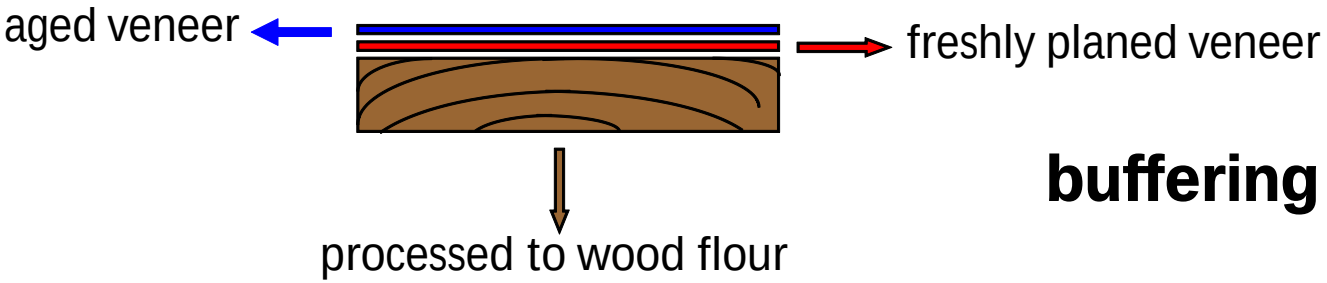




pH

- surface
- flat membrane electrode
- cold water extractives
- 51 specimens
  - Beech 35 (colored 20)
  - Ash 11 (colored 6)
  - Spruce 5

Material and Methods [Obj.3]



buffering capacity

- cold water extractives
- automatic dispenser (0.5 ml)
- titration 1 mmol HCl to pH 3
- 51 specimens
  - Beech 35 (colored 20)
  - Ash 11 (colored 6)
  - Spruce 5

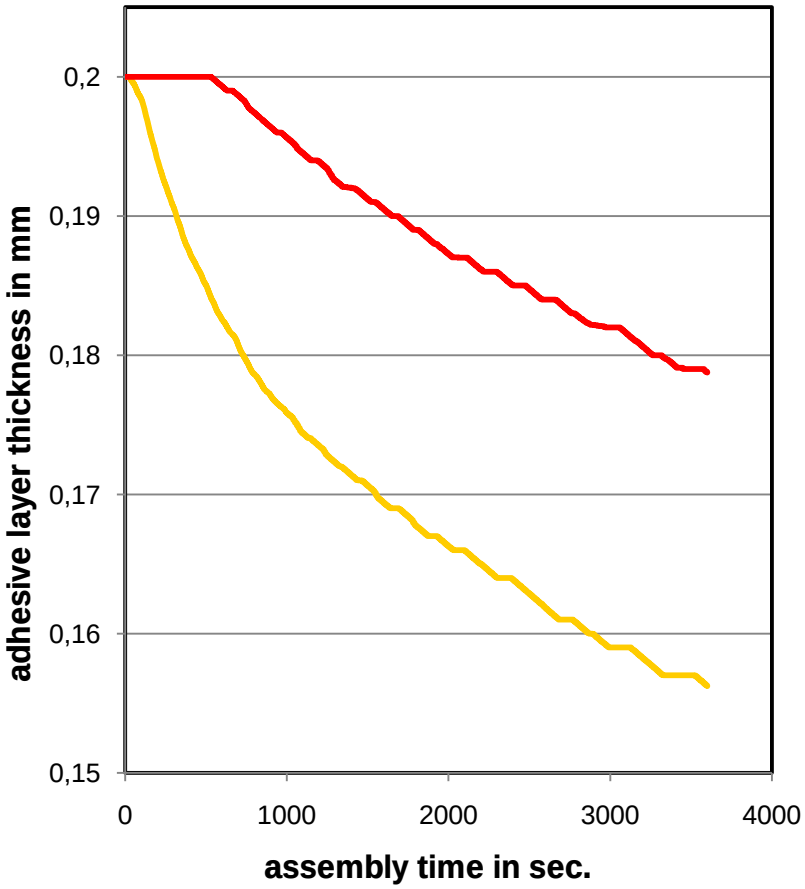
Material and Methods [Obj.4]

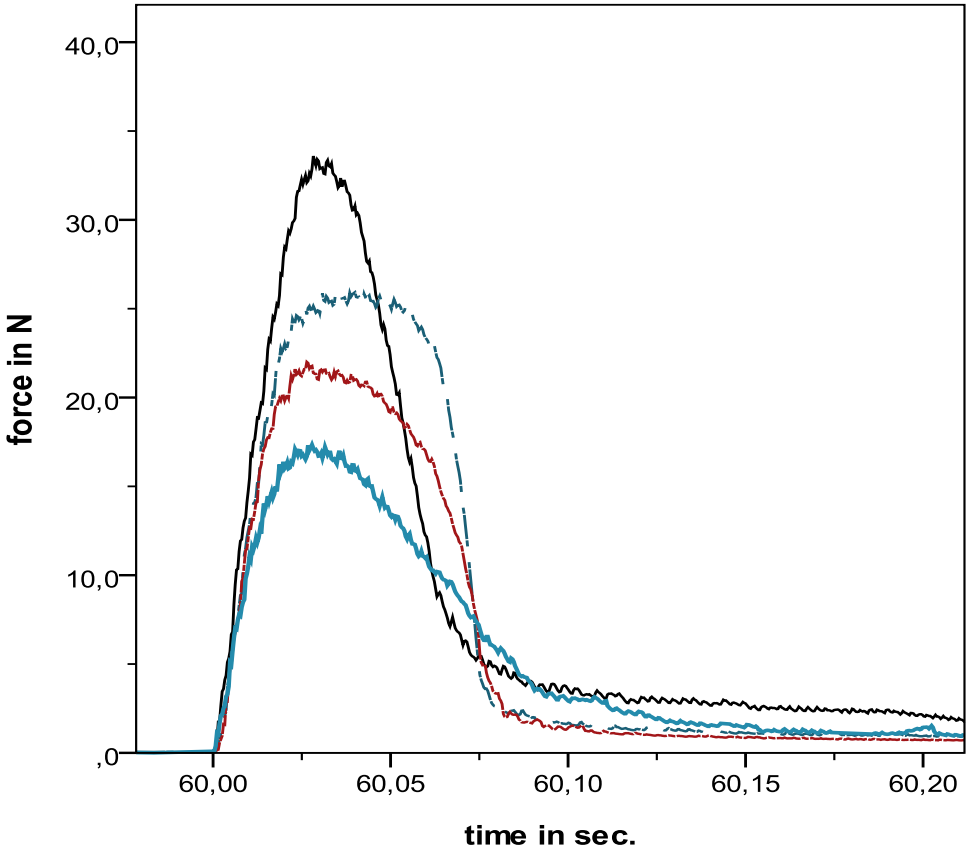
New method: modified tack test

- two adherends (base plate, probe)
- predefined adhesive layer thickness
- varying closed assembly time
- target values:
  - decrease of adhesive layer
  - required max. tensile force F_{max}
  - dissipated energy *w* for debonding

Schmidt, M; Knorz, M.; Wilmes,B. (2010) Novel method for monitoring real-time curing behaviour. Wood Science and Technology. Volume 44, Nr. 3 S. 407-420

Material and Methods [Obj.4]





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Results – modified tack-test [Obj.4]

assembly time in min	wood species	n	decrease adhesive layer in µm	F_{max} in N	w in J
30	Beech	6	43.4	16.7	1.3
	Beech colored	8	24.1	11.4	1.3
	Ash	3	25.6	6.9	1.1
	Ash colored	3	15.2	5.8	0.9
	Spruce	6	26.1	17.9	1.3
60	Beech	7	52.4	37.6	6.1
	Beech colored	9	33.9	33.6	6.1
	Ash	3	31.8	17.5	3.0
	Ash colored	2	20.3	13.8	2.1
	Spruce	6	36.7	27.4	4.1

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Conclusions and Summary

- Wood characteristics inter- and intraspecific differences:
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Conclusions and Summary

water absorption: beech, ash, spruce

accelerate — significant influence of discoloration

pH: ash, beech, spruce

retard

buffering capacity: ash, beech, spruce

retard

modified tack-test: beech, ash, spruce
significant influence of discoloration

Conclusions and Summary

- The assumption of a retarded curing of MUF adhesives - induced by Beech and Ash could not be verified

- Obviously other effects are predominant – applied pressure is up to 100% higher

  => excessive squeeze out of adhesive and / or deep penetration into the tissue

Acknowledgement

Bayerischen Staatsministerium für Ernährung, Landwirtschaft und Forsten