Enhancing the bondability of wood veneers through surface activation treatment

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Why surface treatment of veneer?

- Why do we talk about the enhancing of the bonding ability of veneer?
- Aren't we satisfied with the strength of plywood?
- Is the bonding ability of veneer not sufficient enough?
- If the veneer is glued together poorly, then which factors lead to this?
- What should be done to improve the bonding ability of veneer?
- Is any special preparation of veneers before gluing necessary?

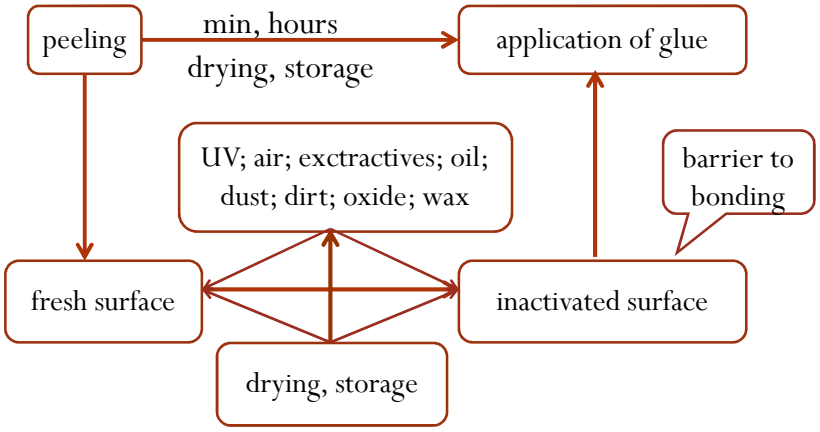
Plywood manufacturing process

- Sub-processes of the plywood manufacturing process:

Soaking → peeling → drying → sorting → gluing → laying-up → hot pressing

- Existing manufacturing process does not provide the preparation of veneer surface before glue application

Surface inactivation process of veneer



Wood veneer

- High surface roughness
- Surface porosity variation
- Thickness variation
- Moisture content variation

+ External Contamination + Self-Contamination

Ways of eliminating disadvantages (in practice)

- overdrying of veneer
- higher pressure of pressing 1,8-2,2 MPa
- greater consumption of glue 150-200 g/m^2

Rules for effective bonding:

- good wetting
- strong attractive interactions between the adhesive and the substrate

To satisfy these rules:

- the surface of the substrate must be clean, reasonably smooth, and chemically receptive to the chosen adhesive
- the adhesive should be applied immediately after the surface treatment (only fresh surfaces should be used)

Surface treatment of veneer

- Sub-processes of the plywood manufacturing process:

soaking → peeling → drying → sorting → gluing → laying-up → hot pressing

Surface treatment

What is expected from surface treatment?

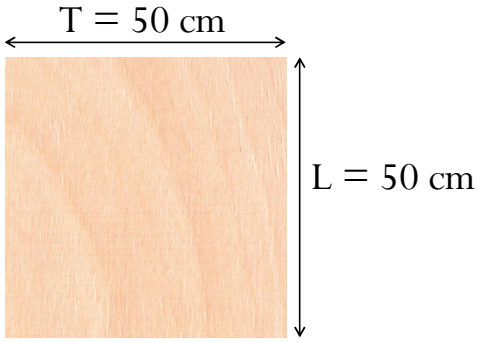
- improving reactivity of the wood surface
- reduction of pressure, temperature and time of pressing
- less glue consumption

Objective

- to enhance the bondability of wood veneers through surface activation treatment by using different chemical agents

Materials

Birch (*Betula pubescens*) veneers

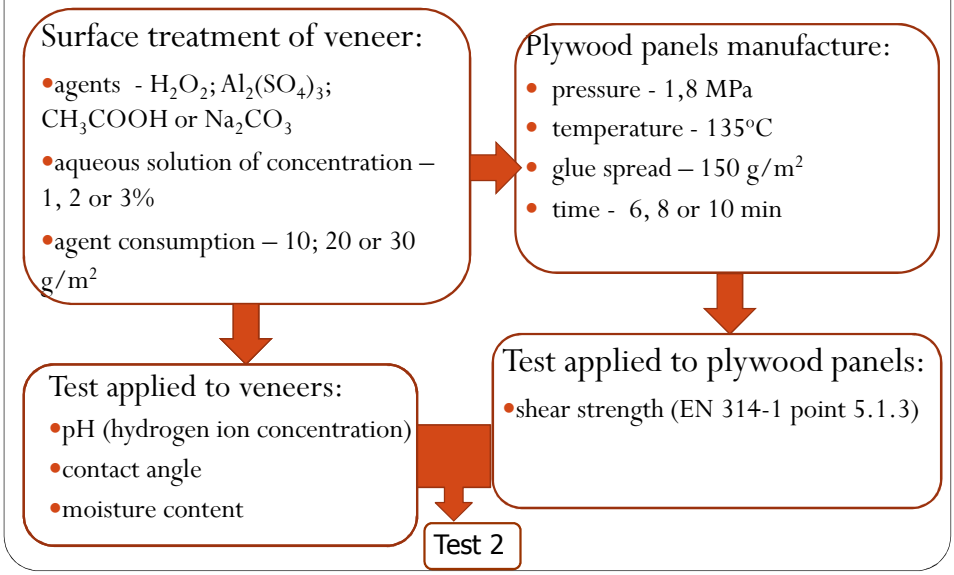


- thickness of 1,5 mm
- moisture content of 6%

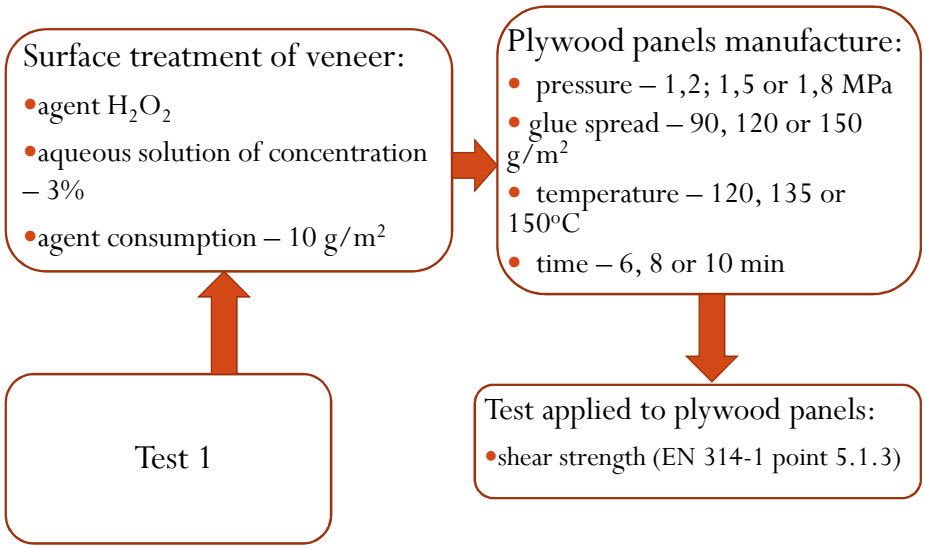
Materials

- Commercial phenol formaldehyde glue resin
- Hydrogen peroxide H_2O_2
- Aluminium persulfate $Al_2(SO_4)_3$
- Acetic acid CH_3COOH
- Sodium carbonate Na_2CO_3

Methods – Test 1



Methods – Test 2



Moisture content of treated veneer

MC non-treated veneer	MC_{10}	MC_{20}	MC_{30}
6	8	10	12

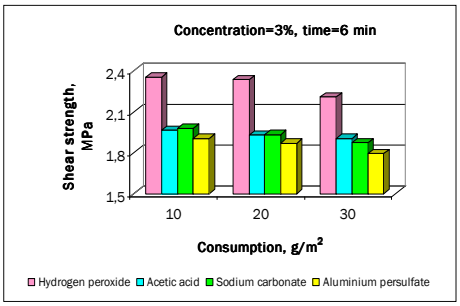
10, 20, 30 – consumption of the chemical agents (in g/m²)

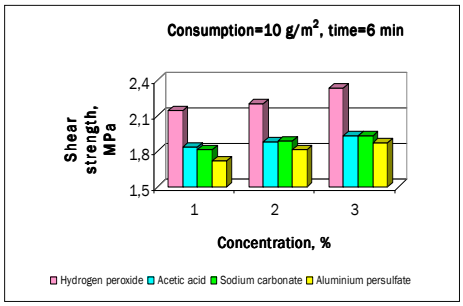
Contact angle

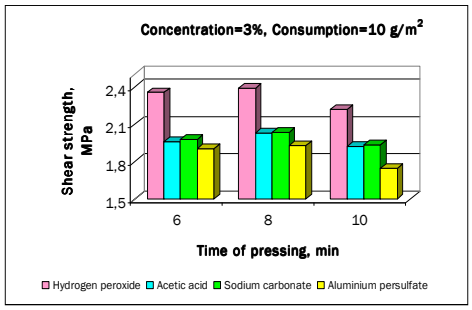
Concent-ration of solution, %	Consump-tion, g/m^2	H_2O_2	CH_3COOH	Na_2CO_3	$Al_2(SO_4)_3$
		Contact angle			
1	10	47,1	47,3	47,4	48,2
	20	41,5	42,3	37,8	41,8
	30	36,7	37,3	35,2	35,9
2	10	46,9	46,4	47,3	47,3
	20	40,4	40,6	40,6	40,9
	30	36,3	35,9	34,5	35,0
3	10	46,0	45,1	48,2	47,0
	20	39,2	38,3	39,0	40,0
	30	35,4	35,3	34,5	34,1

untreated veneer – contact angle=53,5

Shear strength of plywood – Test 1

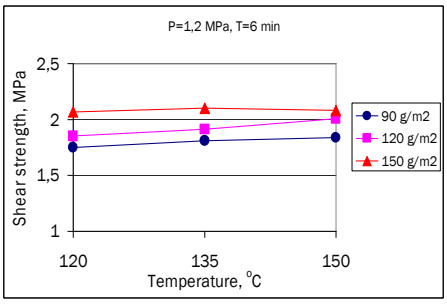


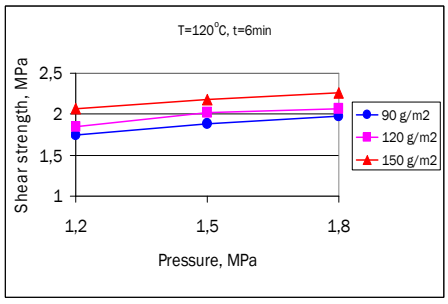




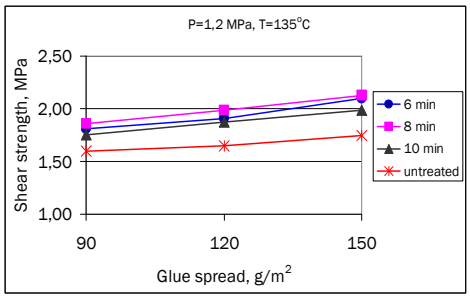
Shear strength of panels using non-treated veneer surface = 1,6 MPa

Shear strength of plywood – Test 2





agent H_2O_2
3% concentration solution
10 g/m^2 consumption



Conclusions

- The bondability of veneer was enhanced when the surface of birch veneers before glue application was chemically treated.
- The surface activation treatment of veneer allows lowering both glue spread from 150 to 90 g/m^2 (a 40 % reduction), and pressure from 1,8 to 1,2 MPa (a 33 % reduction), and temperature from 150 to 120°C (a 20% reduction).
- The shear strength obtained for the tested plywood meets EN 314-1 requirements.
- Results found in this study would provide some benefit for more efficient use of adhesive to manufacture plywood and LVL panels with enhanced performance.

Thank you for your attention!