

Densification of Wood Veneers Under the Effect of Heat, Steam and Pressure

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Outline

Background

Objectives

Material and Methods

- Material
- Densification treatment

Results

- Wood density
- Wood hygroscopicity
- Wood swelling
- Tension and bending properties
- Hardness
- Wood color

Conclusions

Future Work

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Background

- Thermo-mechanical densification of wood has been used for many years;
- Dimensional stability is a problem;
- Renewed interest in thermo-hygromechanical (THM) densification (Kutnar et al. 2008; Fukuta et al. 2007; Kamke 2006; Navi and Girardet 2000; Ito et al. 1998);
- Densification done so far with the THM process is done in closed systems.

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Objectives

1. Develop the thermo-hygro-mechanical (THM) densification process for aspen (*Populus tremuloides*) veneers in a steam injection press;
2. Determine the physical and mechanical properties of THM densified aspen veneers.

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Material and Methods

Material

- Aspen (*Populus tremuloides*) veneers from the Temlam LVL plant located in Amos, Québec, Canada;
- Veneer nominal thickness: 3.2 mm; Conditioned at 20°C and 50% RH.

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Material and Methods

Methods – Steam injection press



862 mm x 862 mm hot press

Steam injection holes

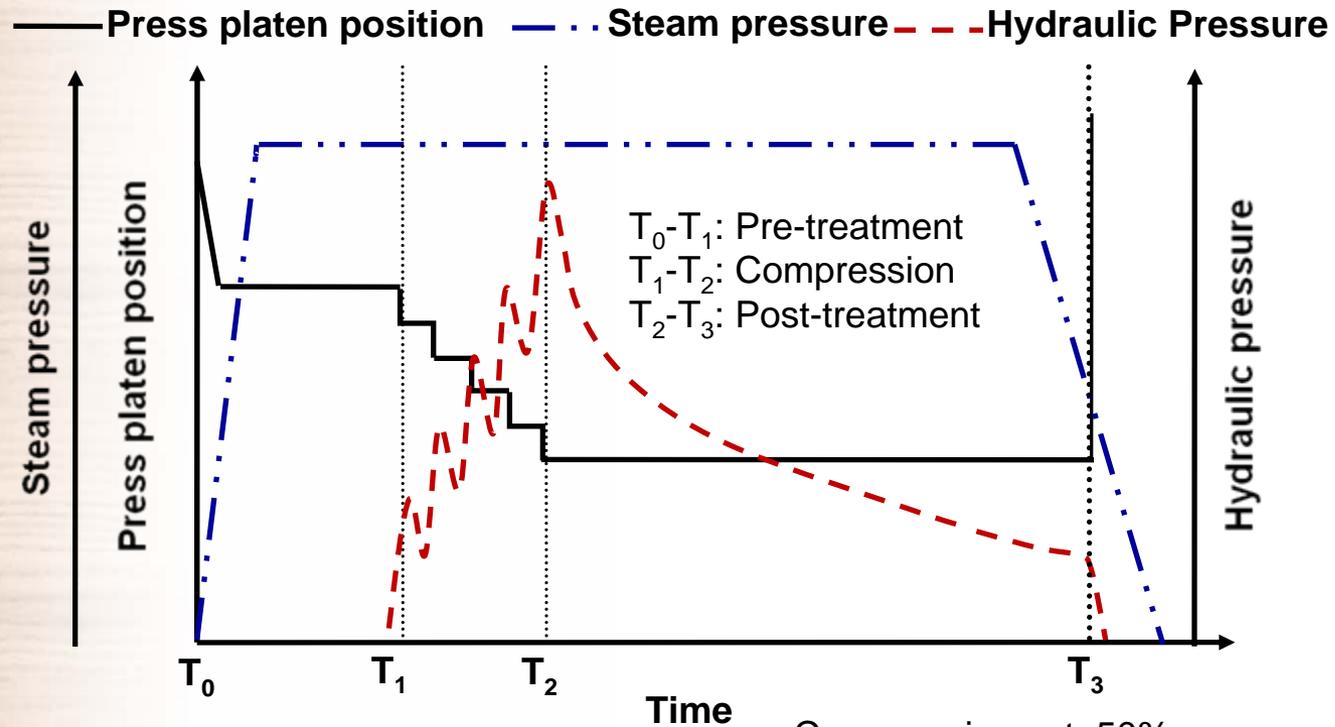


Press platen

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Material and Methods

Methods – Densification process



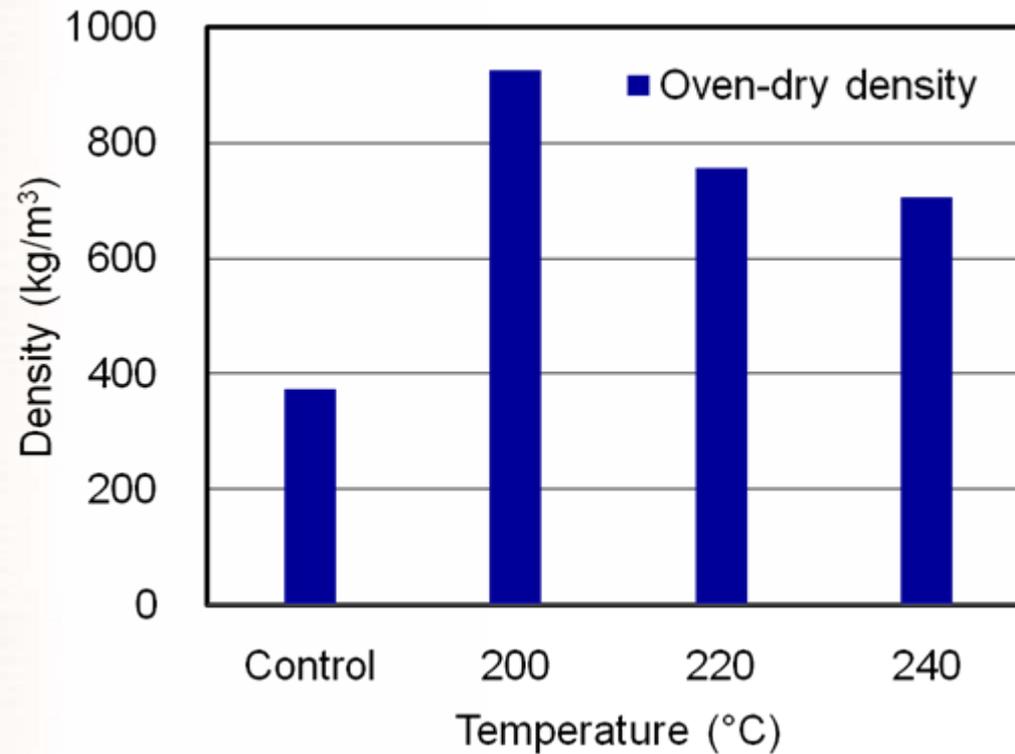
Compression set: 50%

Maximum hydraulic pressure: 5 to 9 MPa

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Results

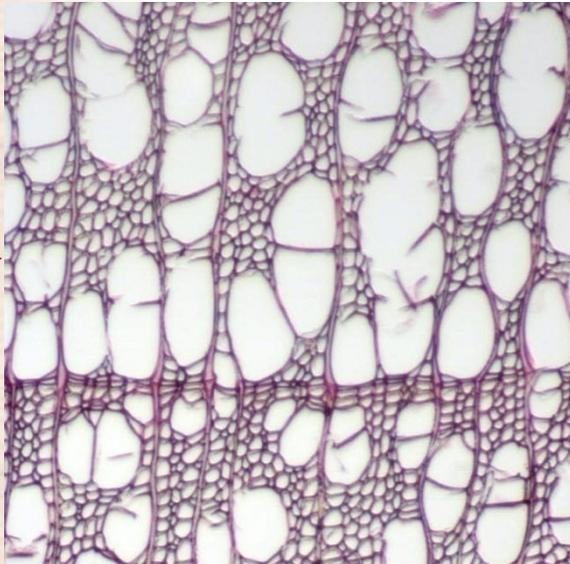
Effect on Wood Density



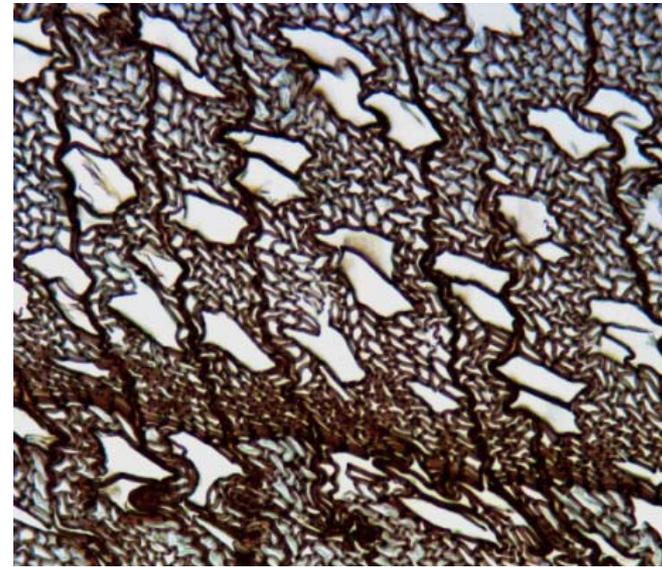
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Results

Effect on Wood Structure



Not densified, 100X

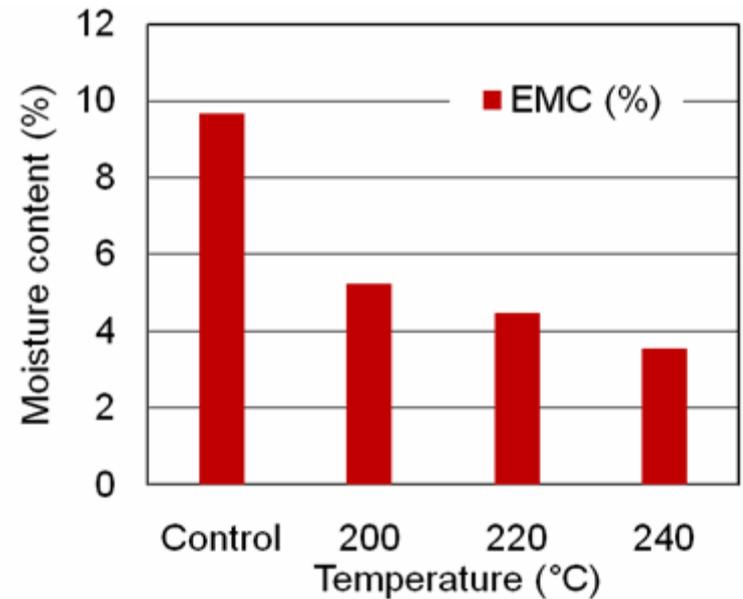
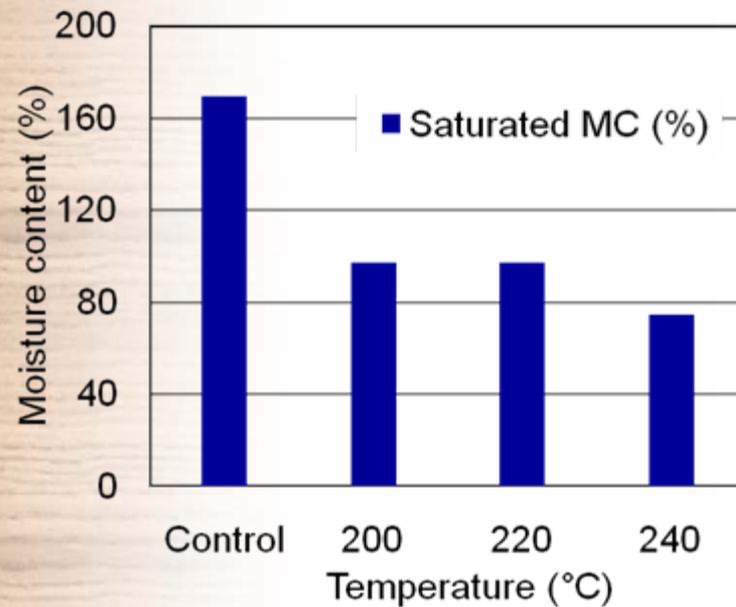


Densified, 100X

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Results

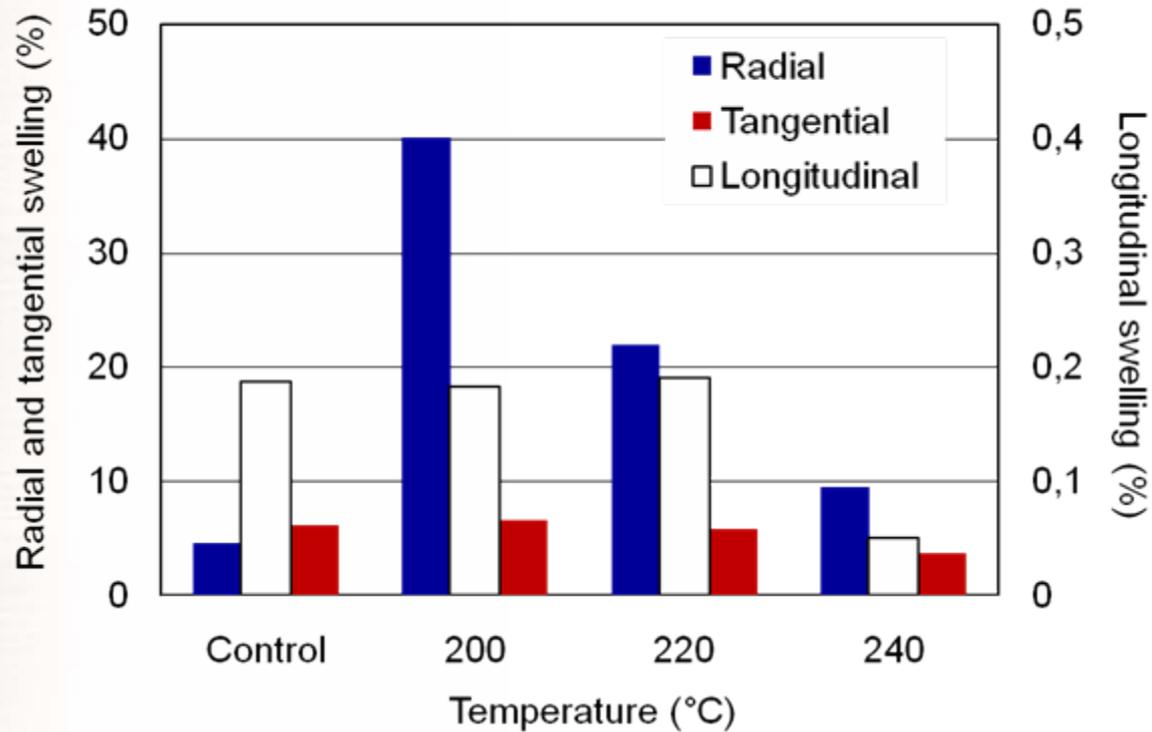
Effect on Wood Hygroscopicity



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Results

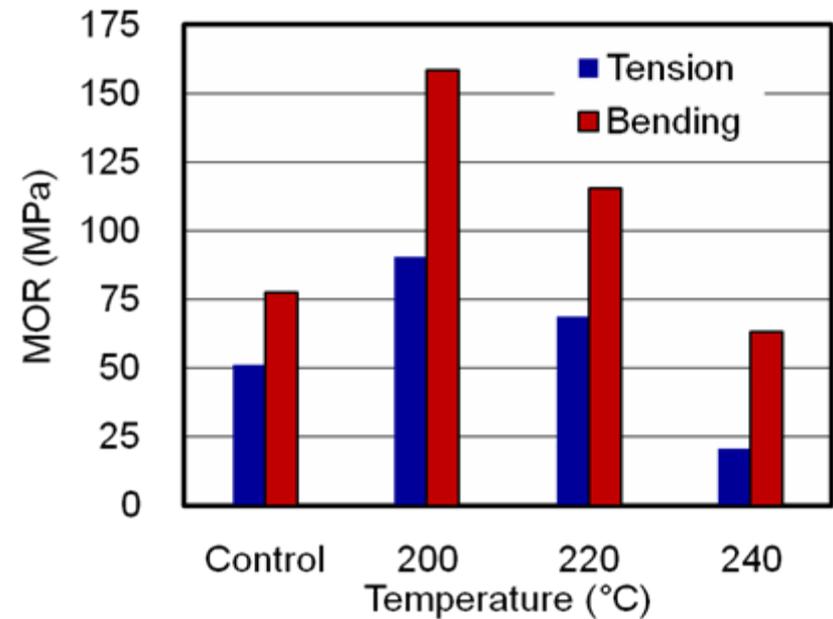
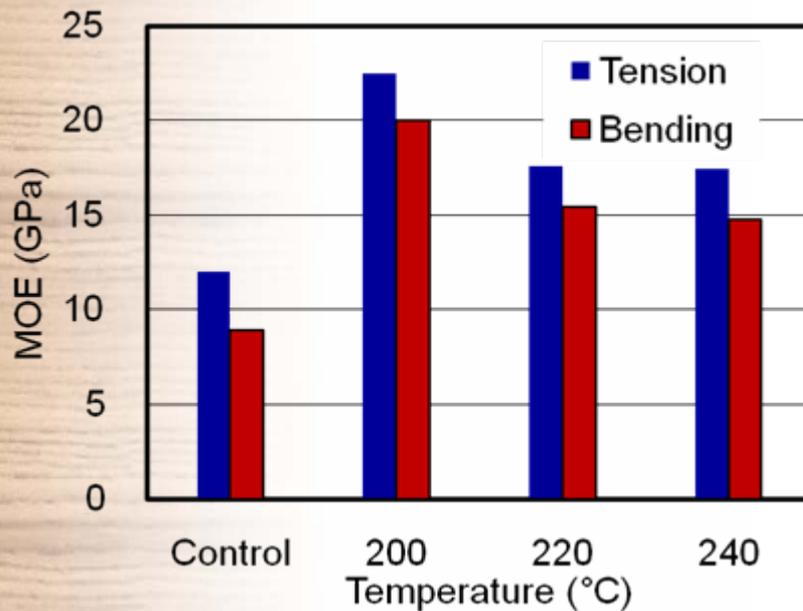
Effect on Wood Swelling



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Results

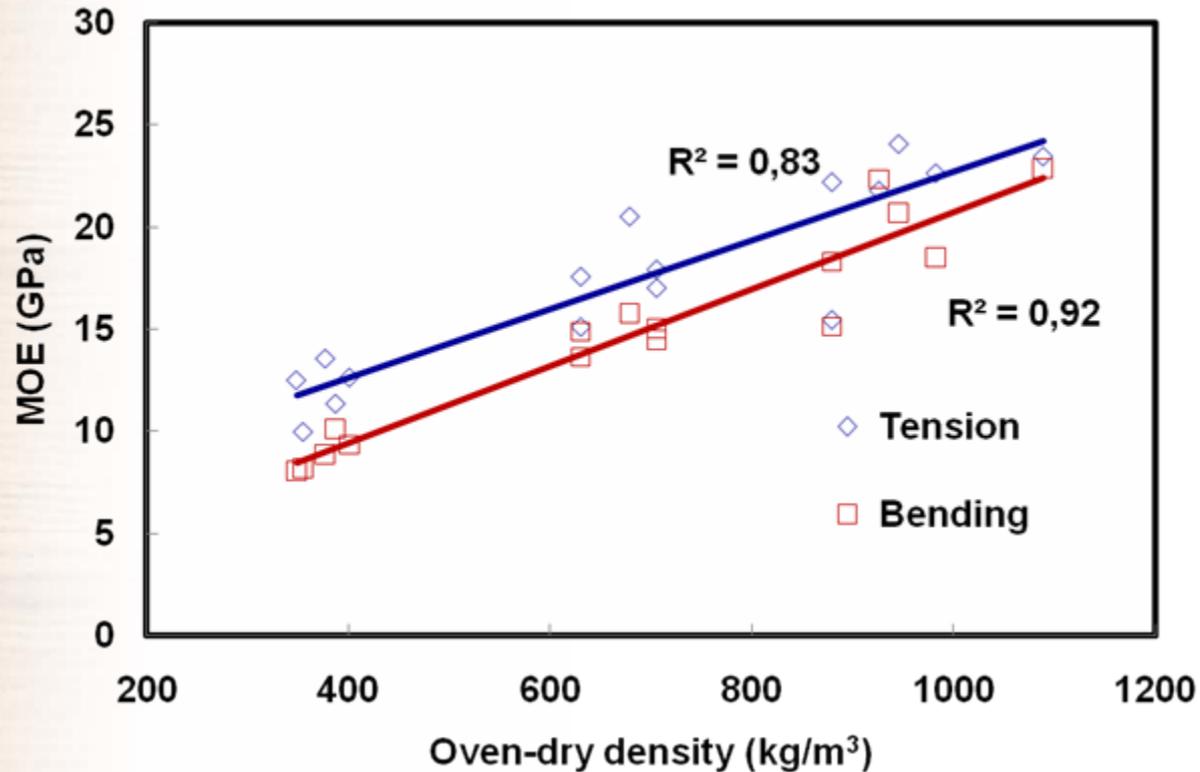
Effect on Tension and Bending Properties



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Results

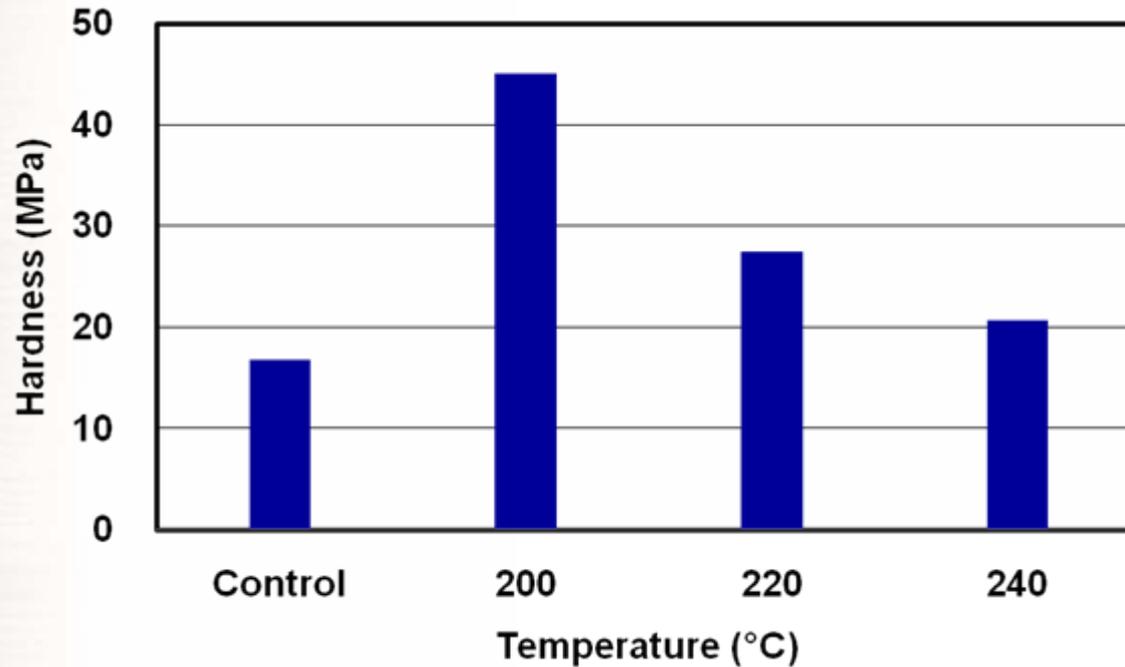
Effect on Tension and Bending Properties



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Results

Effect on Brinell Hardness



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Results

Effect on Wood Color



Control

200°C

220°C

240°C

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Conclusions

- Significant increase in density due to buckling of fibers and vessel cell walls;
- Reduced saturated MC and EMC;
- Radial swelling including compression set recovery after water soaking was 40% higher for densified wood at 200°C compared to the control. It decreased for wood densified at 220 and 240°C;
- MOE and MOR in tension and bending and hardness were twice as much as the control at 200°C but decreased at higher temperatures;
- Significant effect on wood color;
- The results presented are preliminary. The project is on-going.

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Future Work

- Improve dimensional stability of densified wood;
- Investigate temperatures lower than 200°C;
- Consider hybrid poplars and higher quality hardwoods (sugar maple);
- Consider plywoods made of densified veneers;

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Le Centre de recherche sur le bois

- New building dedicated to research and teaching in wood science;
- Building made out of wood;
- 5000 m² (54 000 ft²);
- 18 laboratories;
- Three classrooms of 30 seats;
- One conference room of 80 seats;
- One meeting room of 20 seats;
- Cost: 22 million \$CAD;
- Equipement: 8 million \$CAD;



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**Thank you
Merci
Muchas gracias**

**Questions
Preguntas**

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