ForValueNet
ForêtValeur

UNIVERSITÉ LAVAL

Short-term and Time-dependent Behaviour of Wood-Plastic Composite Sandwich Panels

56th SWST International Convention, Austin, TX, June 9, 2013

New technology and marketing practices in natural fiber-based products

Brian Vezeau

Director: Alain Cloutier
Codirector: Denis Rodrigue

Outline

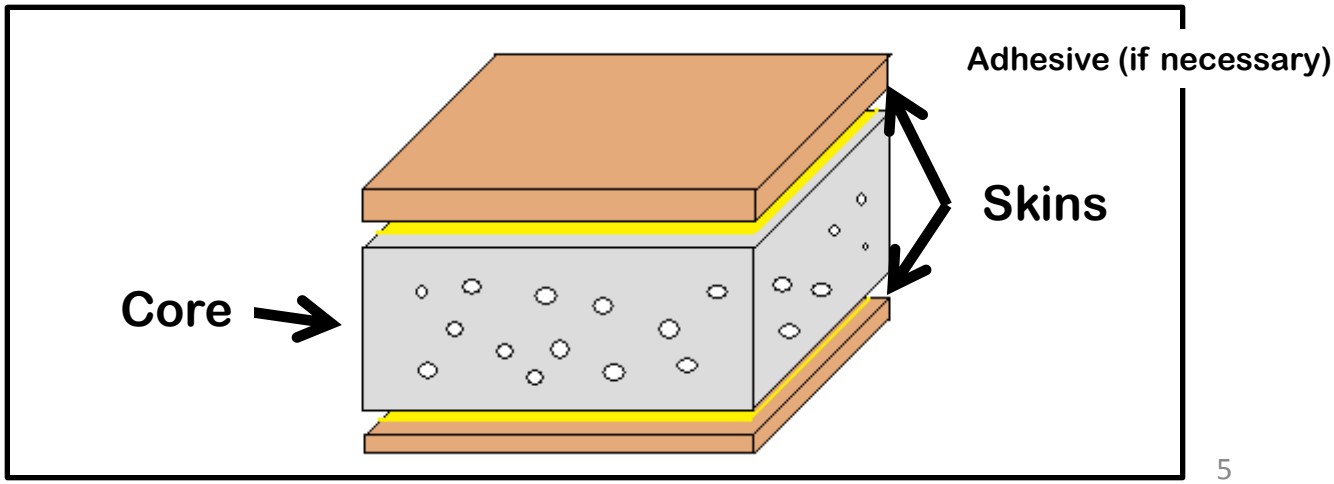
- Context
- Objective
- Experimental
- Results
- Conclusion
- Acknowledgements

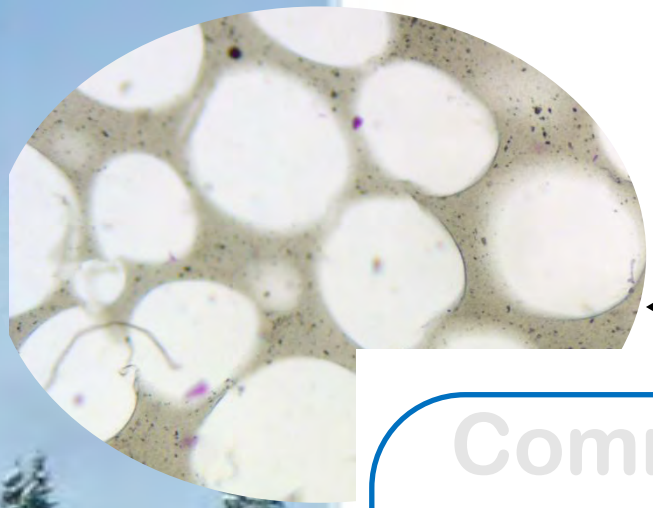
Context

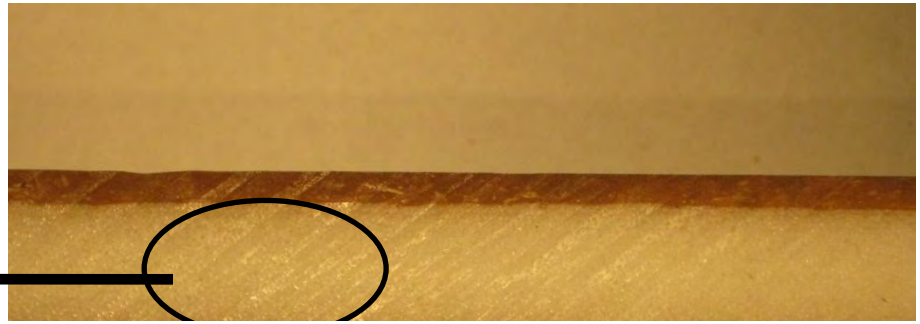
Objective

Sandwich structure: Composite made of a light weight material core which have weaker mechanical properties and two surface layers (skins) with superior mechanical properties

Best suited for bearing flexural load, this structure shows higher specific strength and specific stiffness



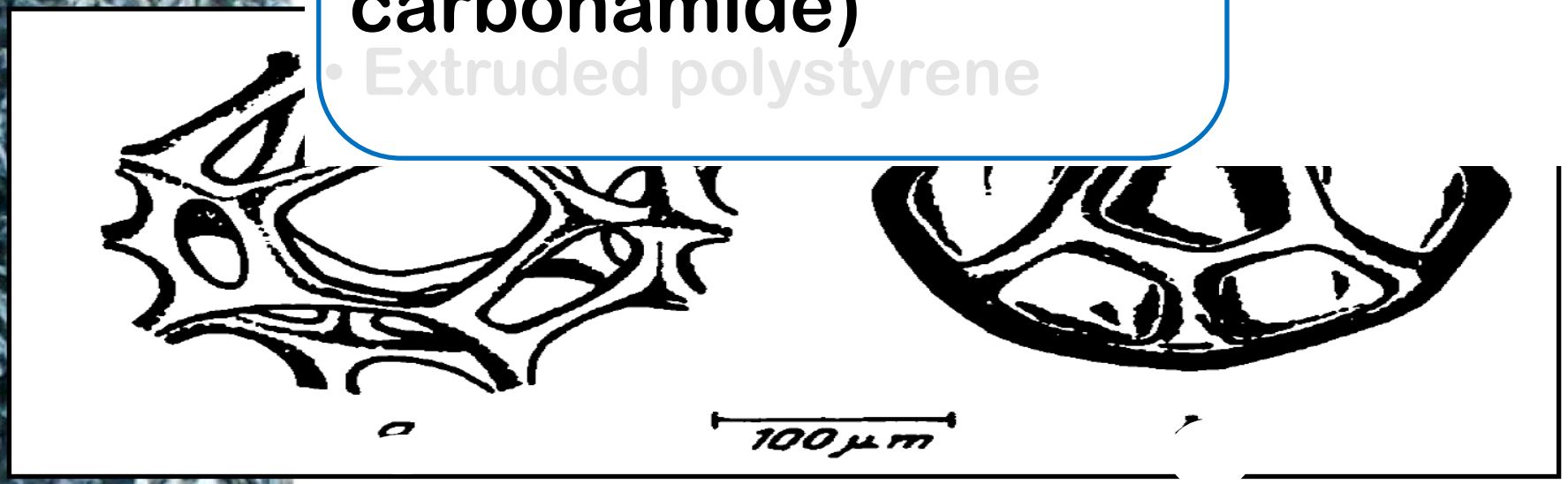




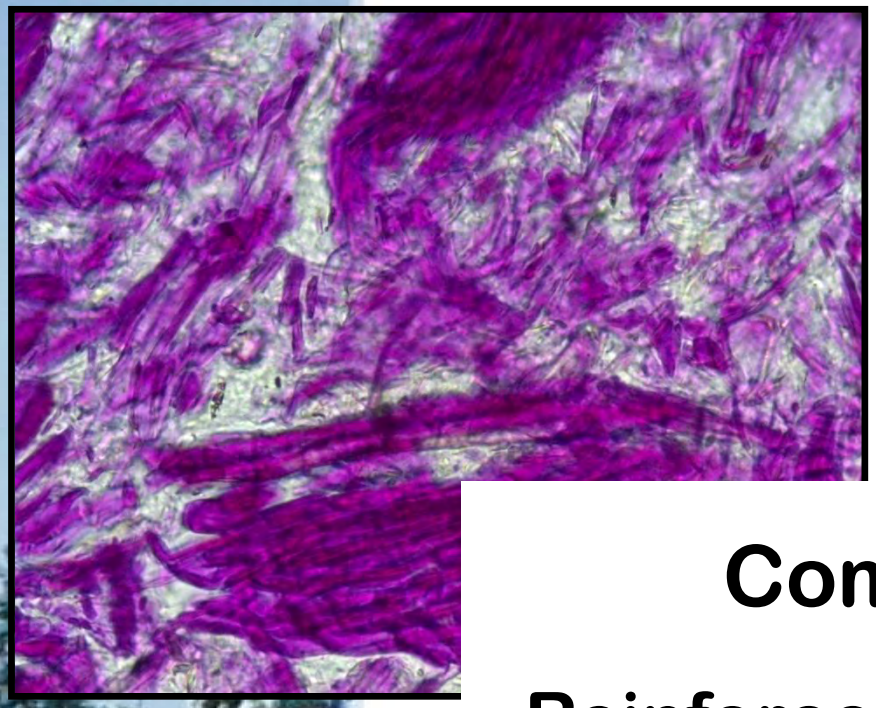
Common foamed core materials

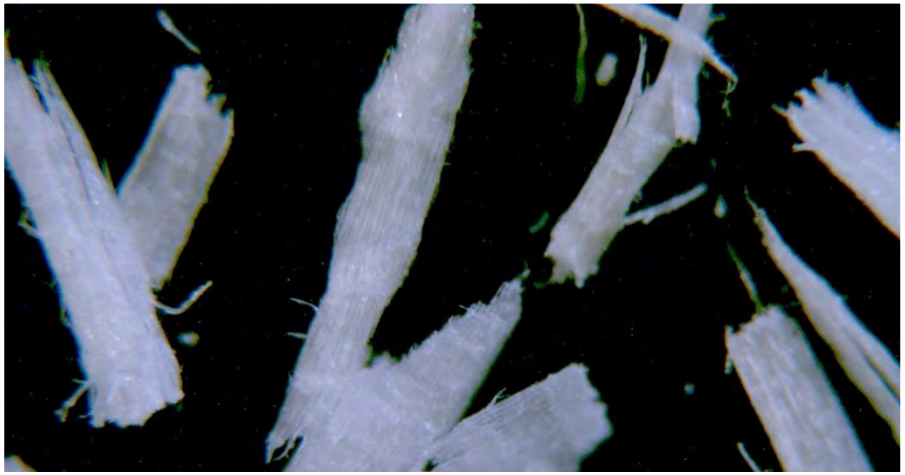
- Polyethylene (HDPE)
- Foaming agent (azodi-carbonamide)

- Two-component polyurethane
- Expanded polystyrene
- Extruded polystyrene



From Zhang, 2001





Skins poss
con

Common skin materials

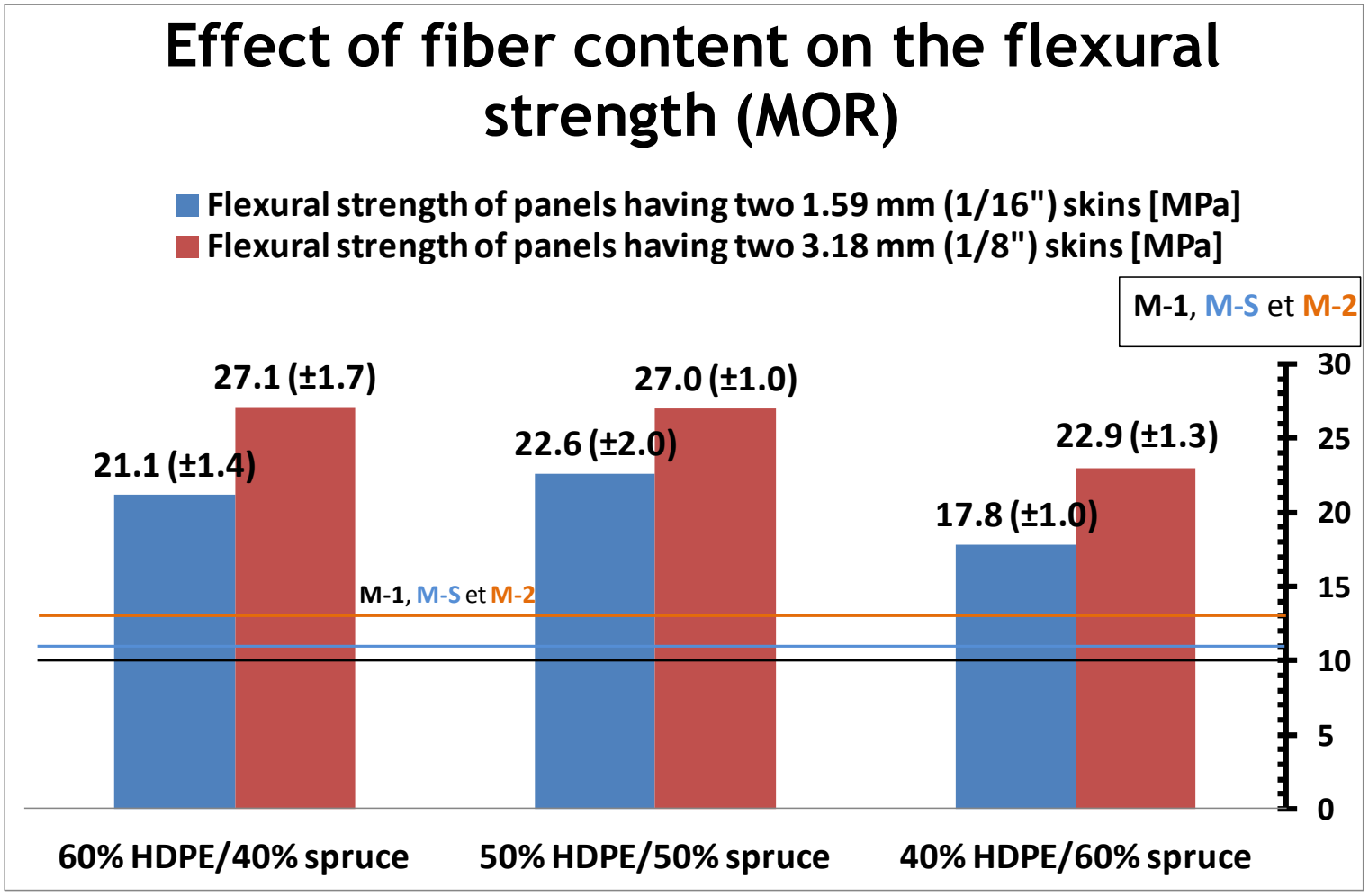
- Reinforced polymers
- Wood and wood composites
- Metal foils
- Various types of concrete

  - Polyethylene (HDPE)
  - 40-60 (%) spruce fibers
  - Maleated polyethylene

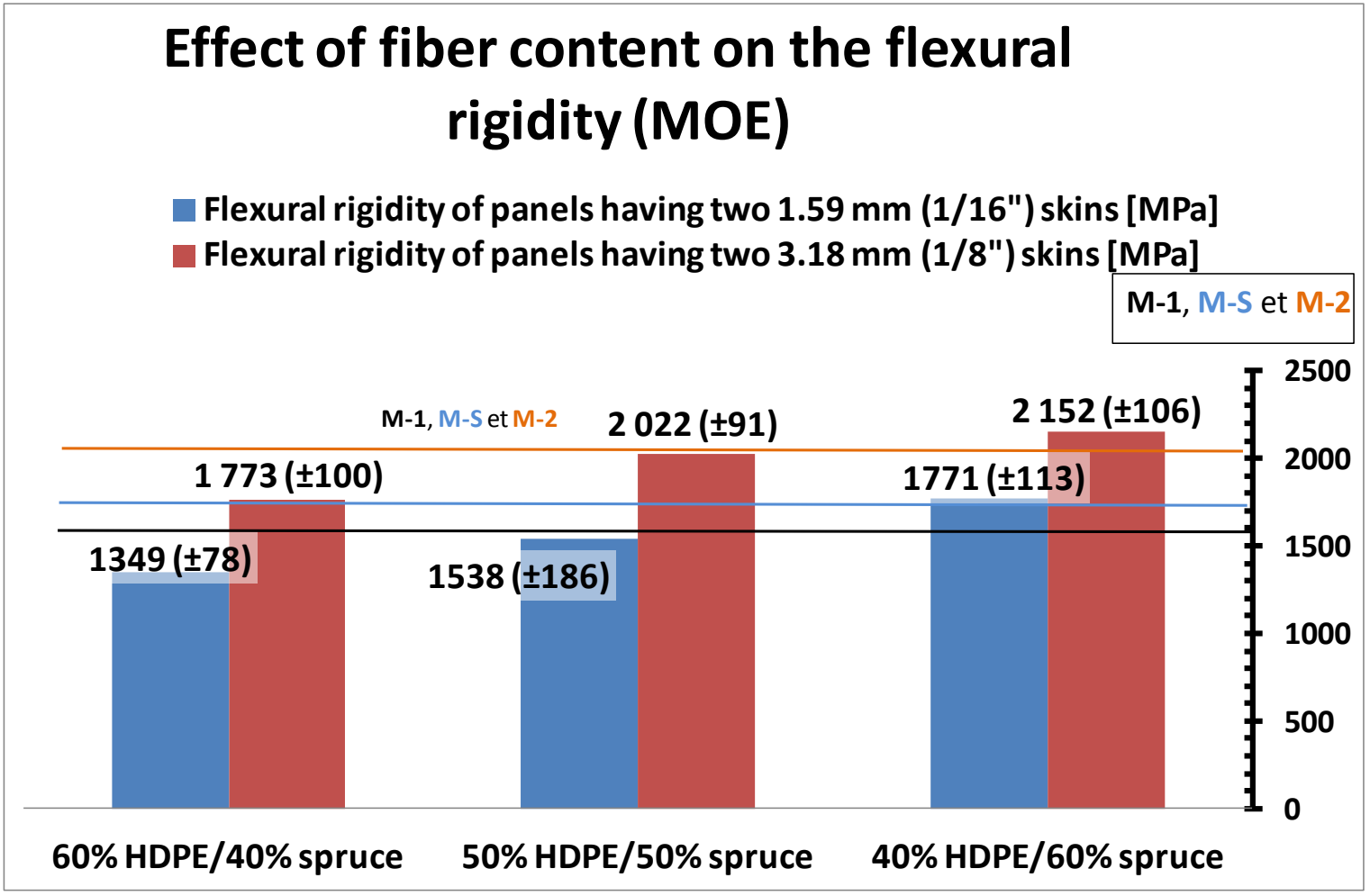
Experimental

Results

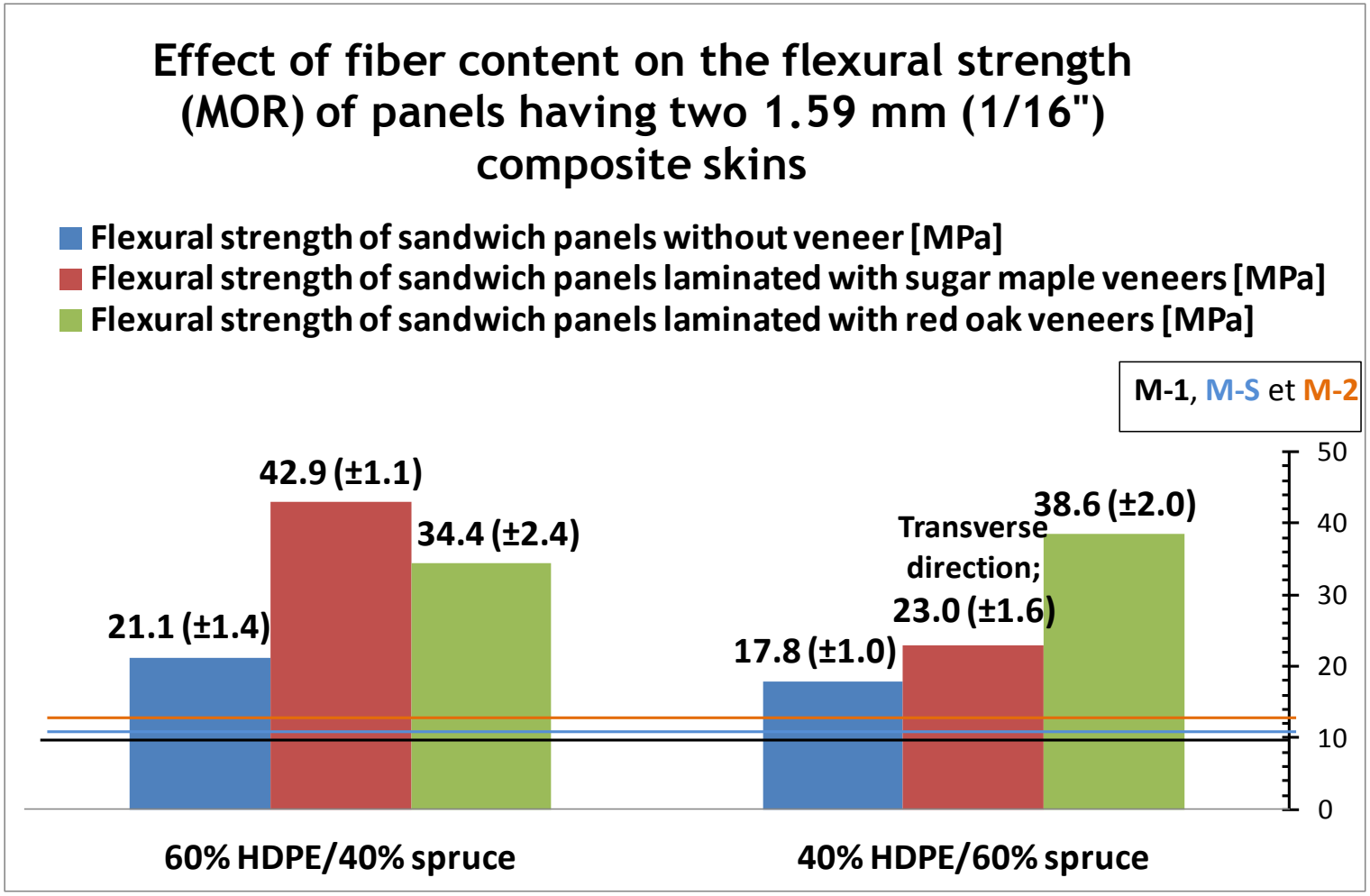
Flexural Properties by Three-Points Bending



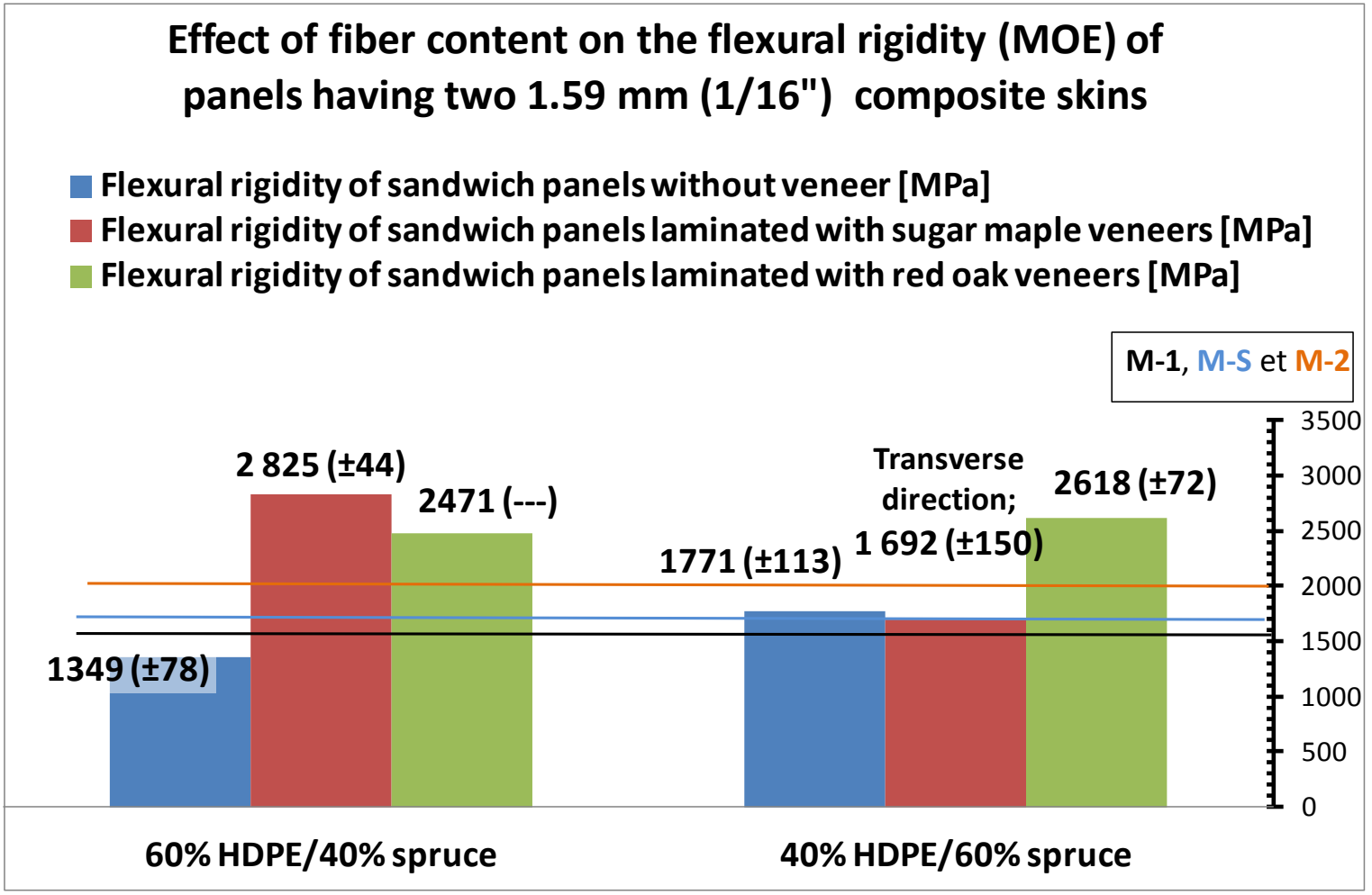
Flexural Properties by Three-Points Bending



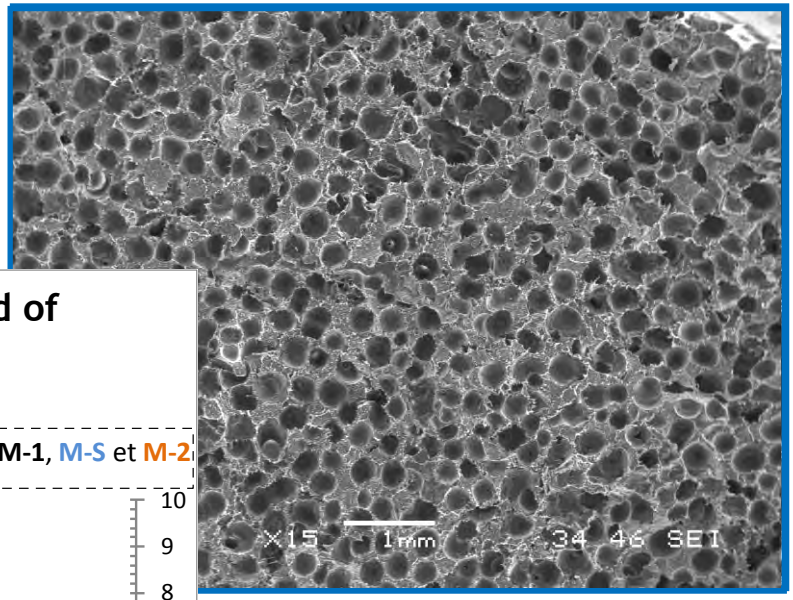
Flexural Properties by Three-Points Bending

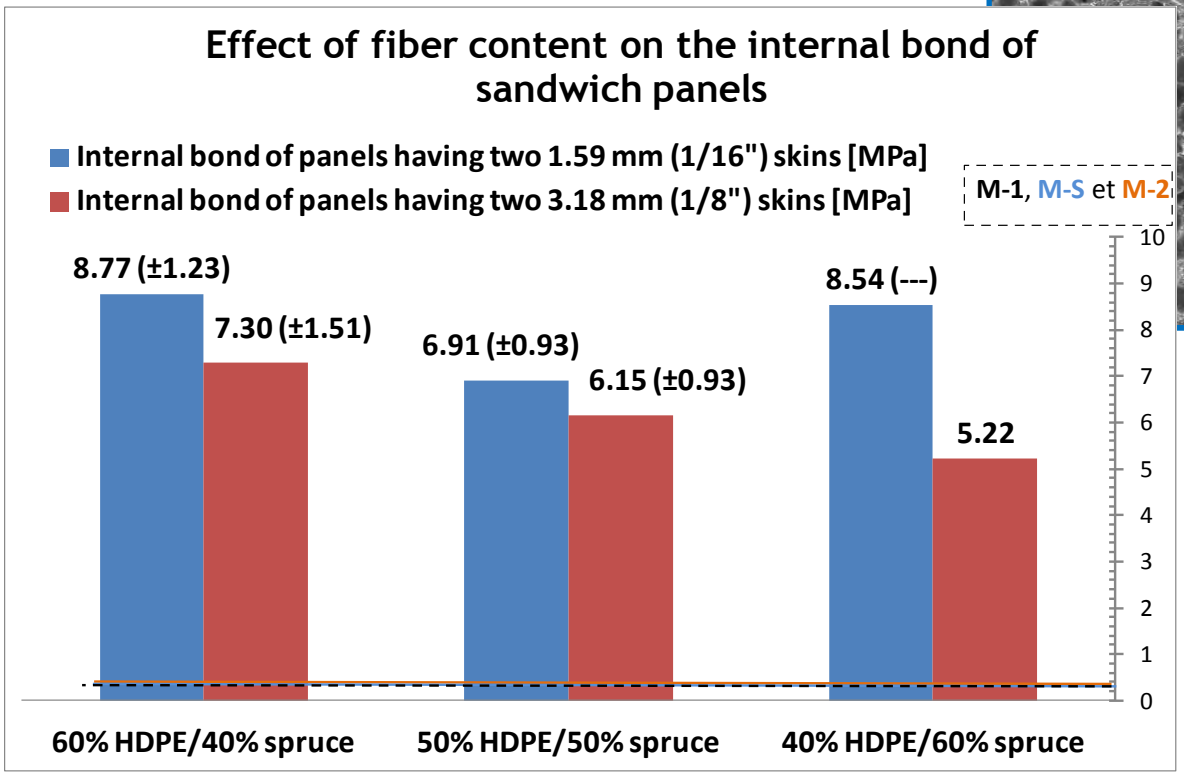


Flexural Properties by Three-Points Bending

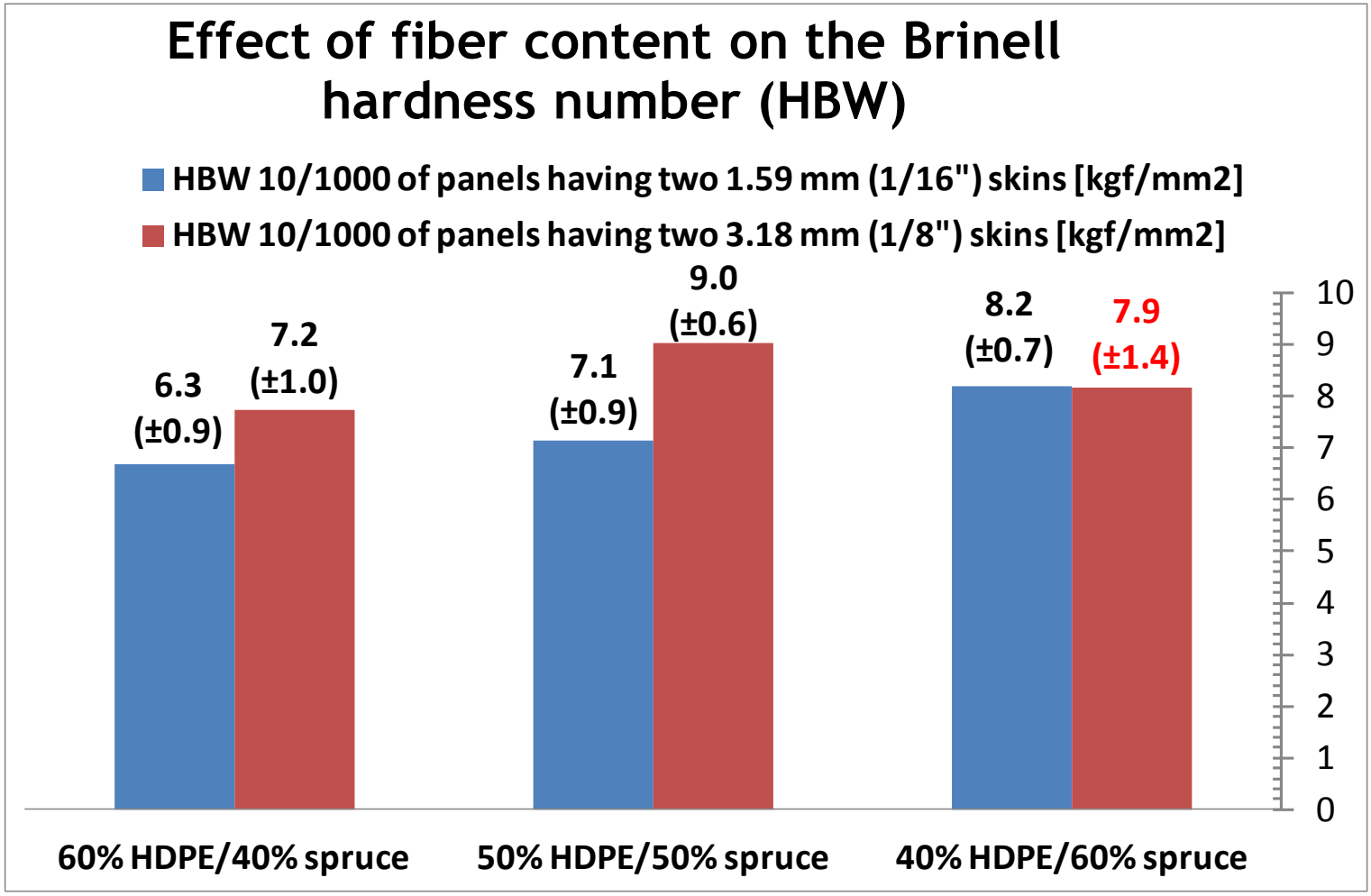


Internal bond

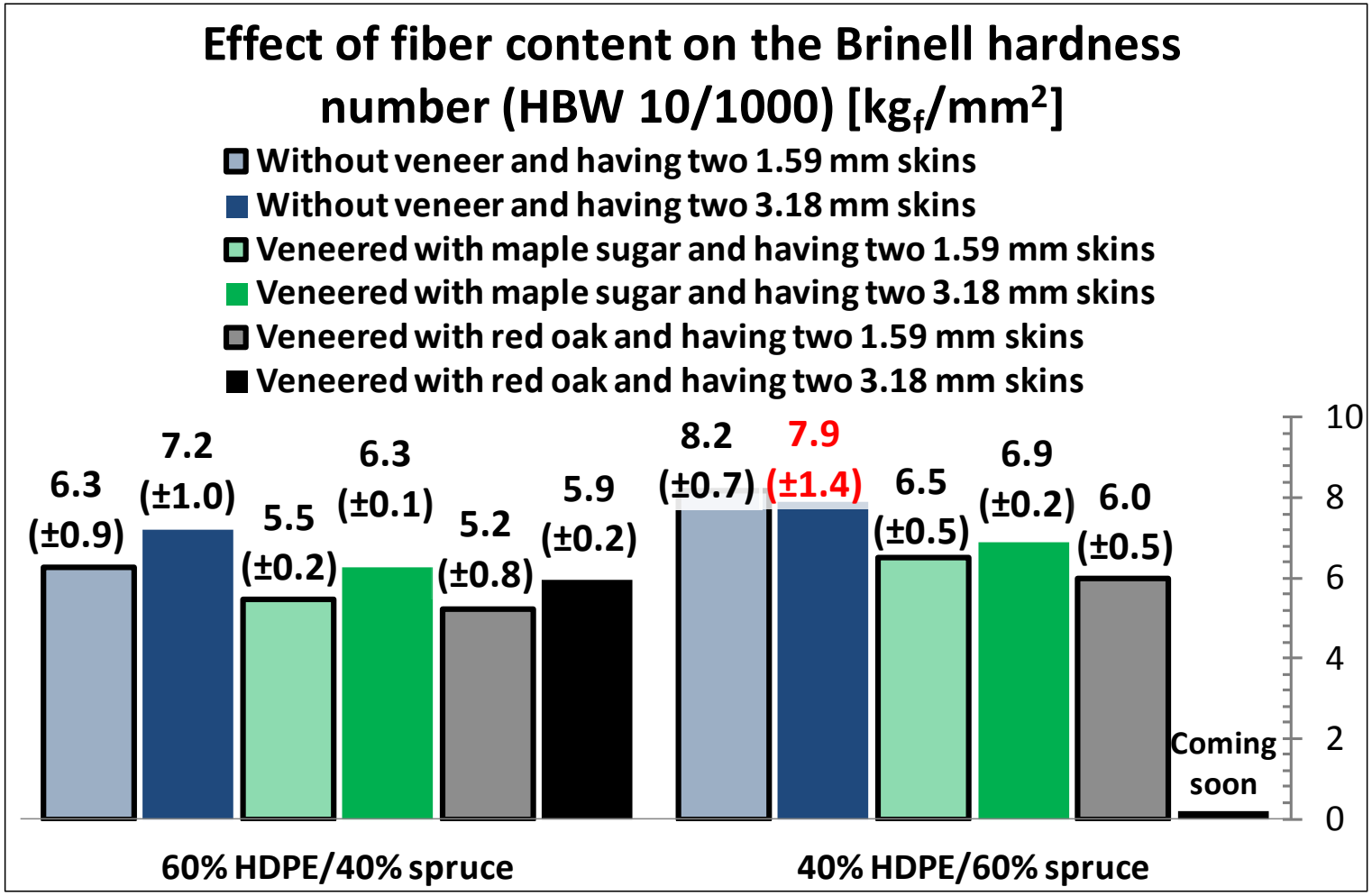




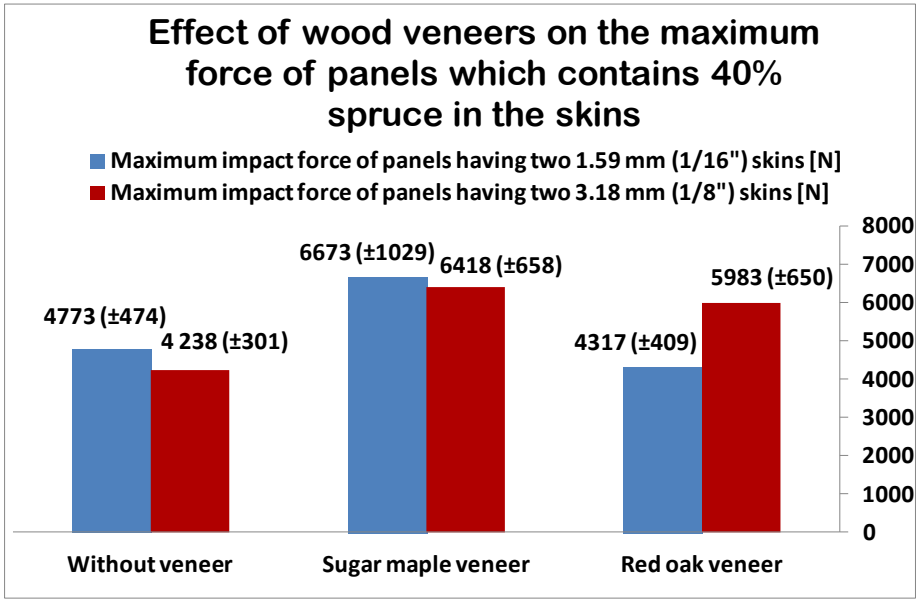
Brinell hardness number

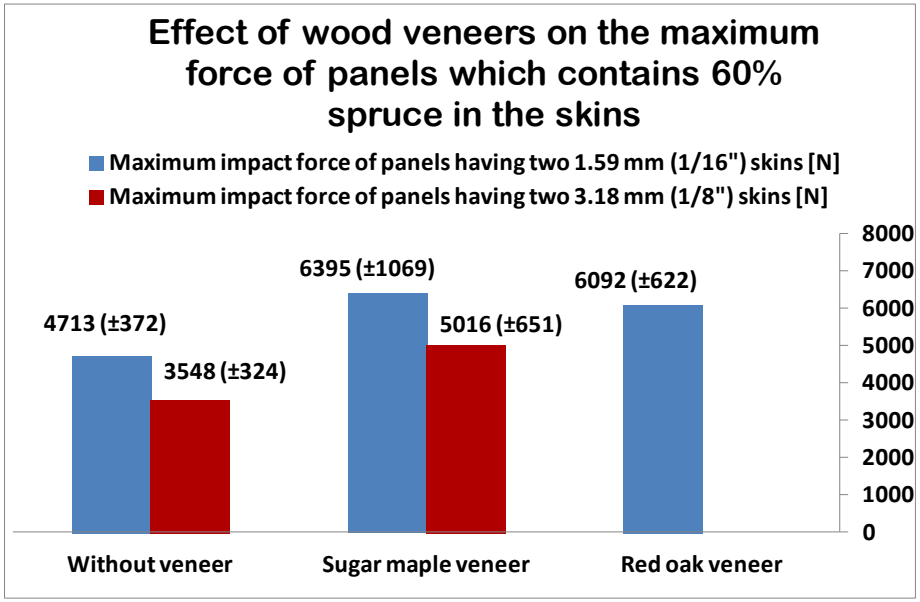


Brinell hardness number

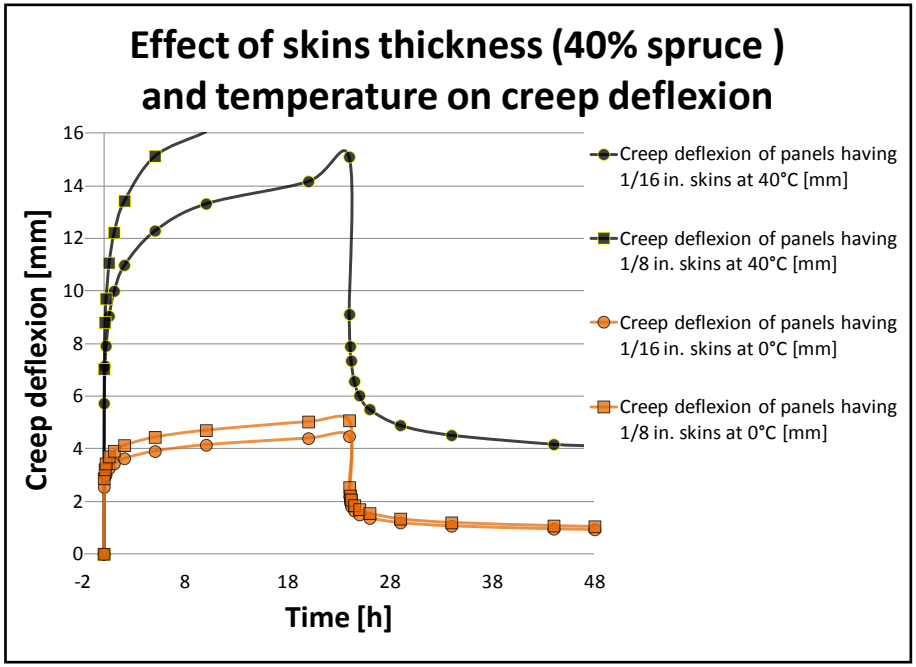


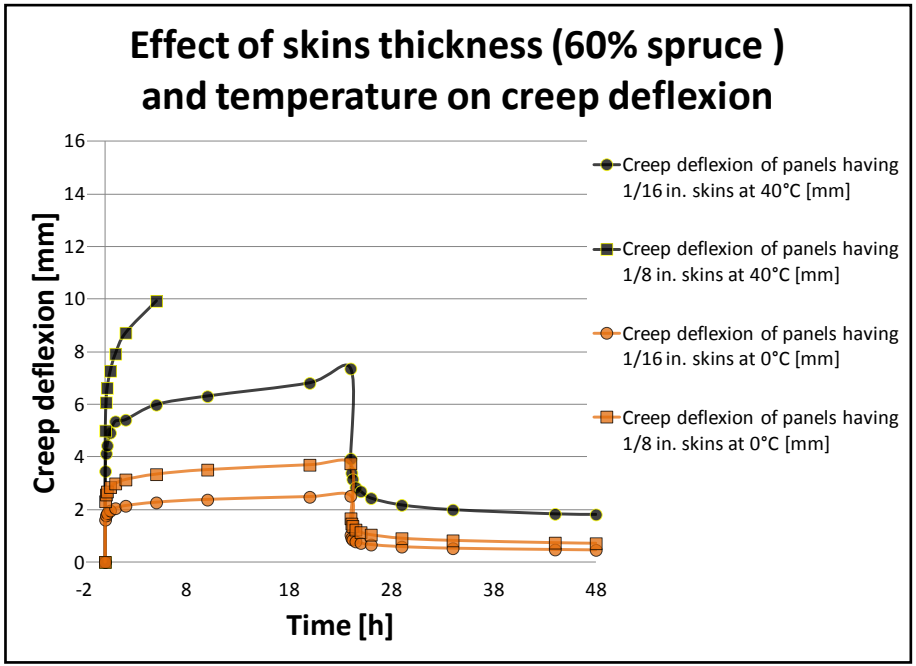
Maximum impact force recorded for 95 Joules impact energy

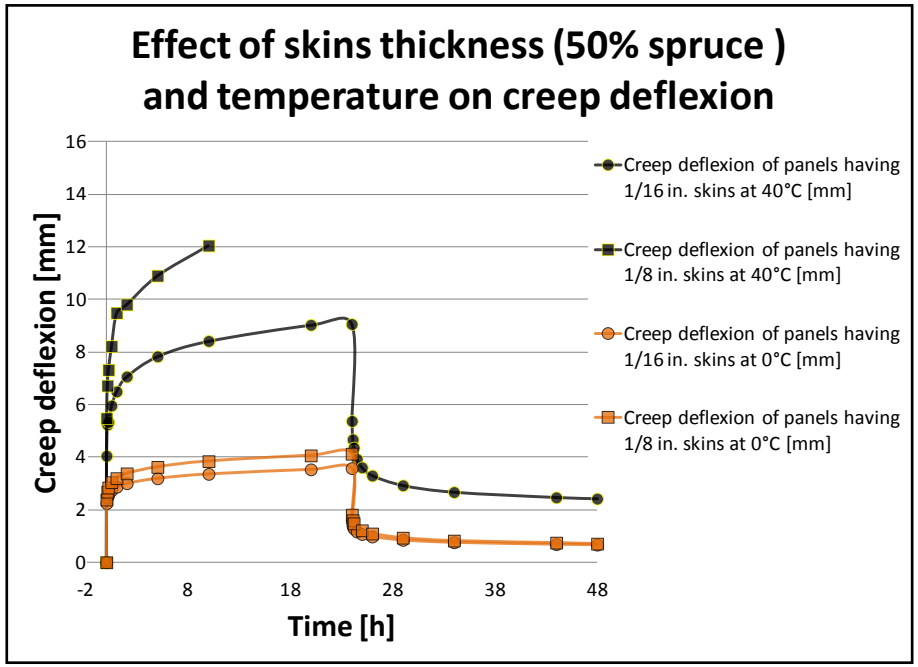




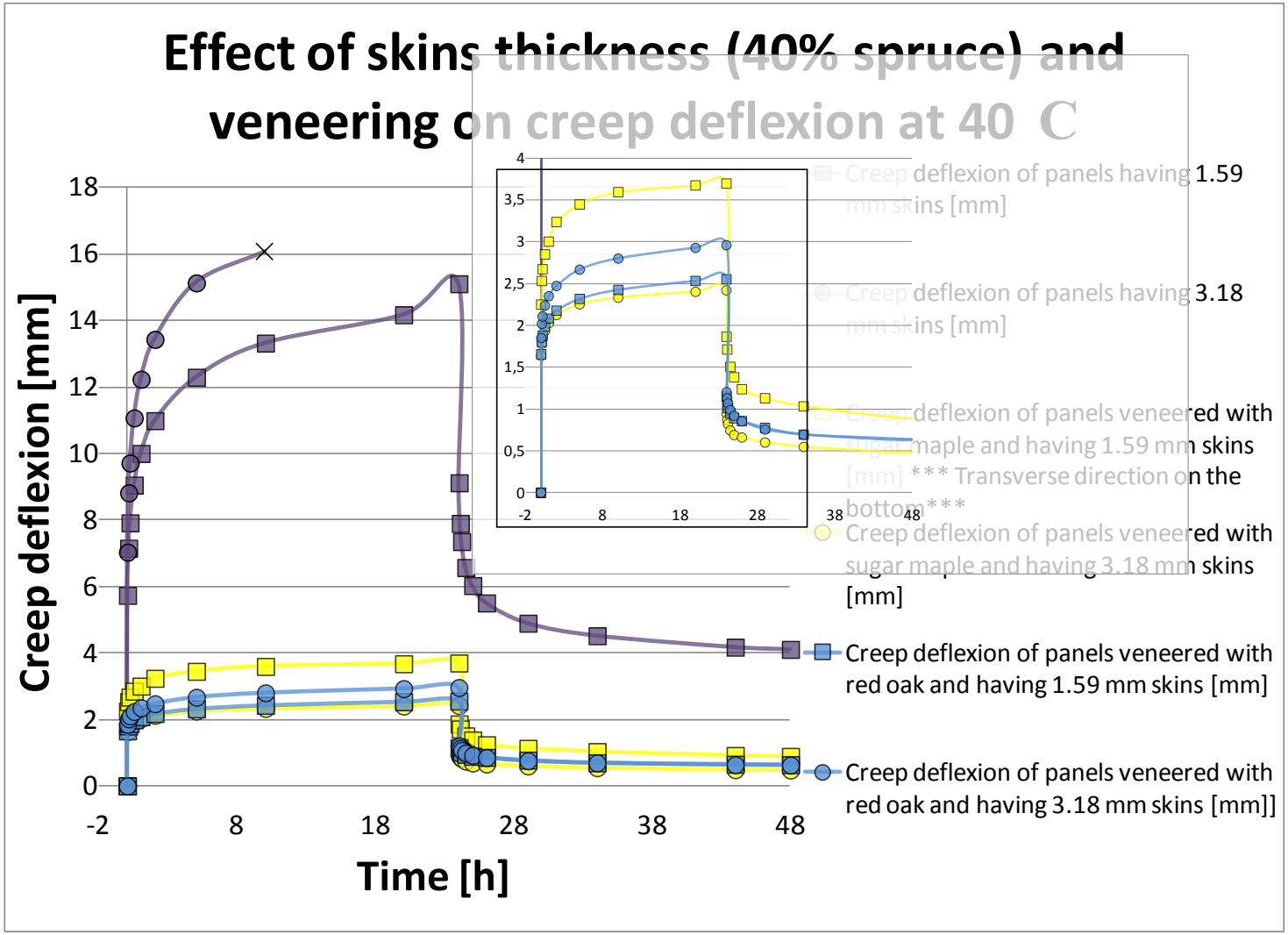
Creep Properties by Three-Points Bending







Creep Properties by Three-Points Bending



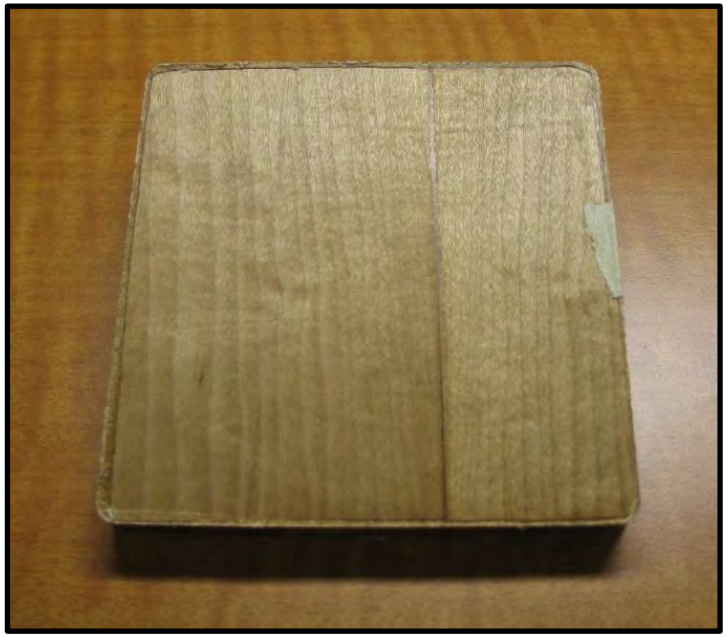
Conclusion

Composite structures veneered with wood

- 0.8 mm paper back sugar maple or red oak veneer were laminated successfully over top and bottom skins.
- The addition of wood veneer on both sides helps to increase flexural properties.
- The addition of wood veneer on both sides also allows to add more fibers in the skins without diminishing the elongation at break significantly.
- Maximum forces recorded (violent impact of 95 Joules) increase for sandwich panels laminated with veneers.
- The total and residual deflections in creep mode decrease when panels are laminated with veneers.

Acknowledgements

This study has been carried out with financial support from the Natural Sciences and Engineering Research Council of Canada granted to the ForValueNet network.



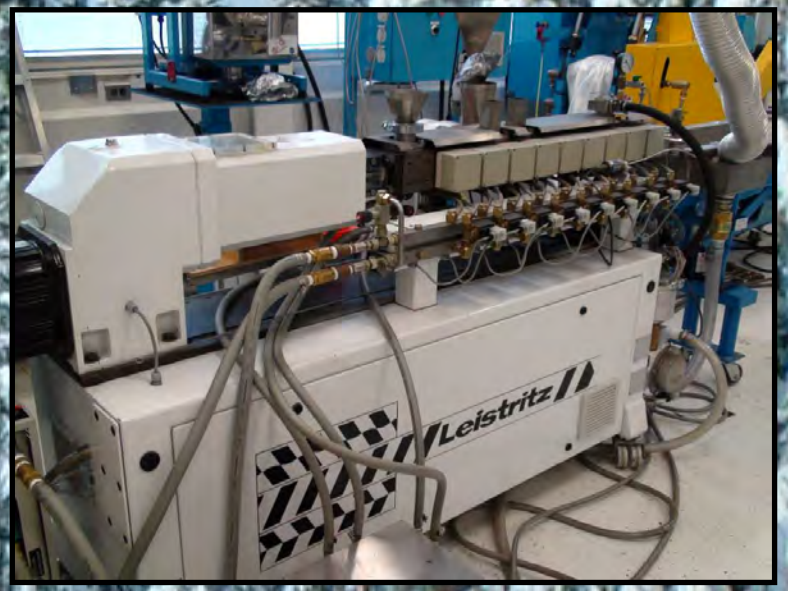
Wood-plastic composite skins

- Polyethylene (HDPE)
- 40-60 (%) spruce fibers
- Maleated polyethylene
- Other additives

Foamed polyethylene core

- Polyethylene (HDPE)
- Foaming agent (azodicarbonamide)
- Other additives

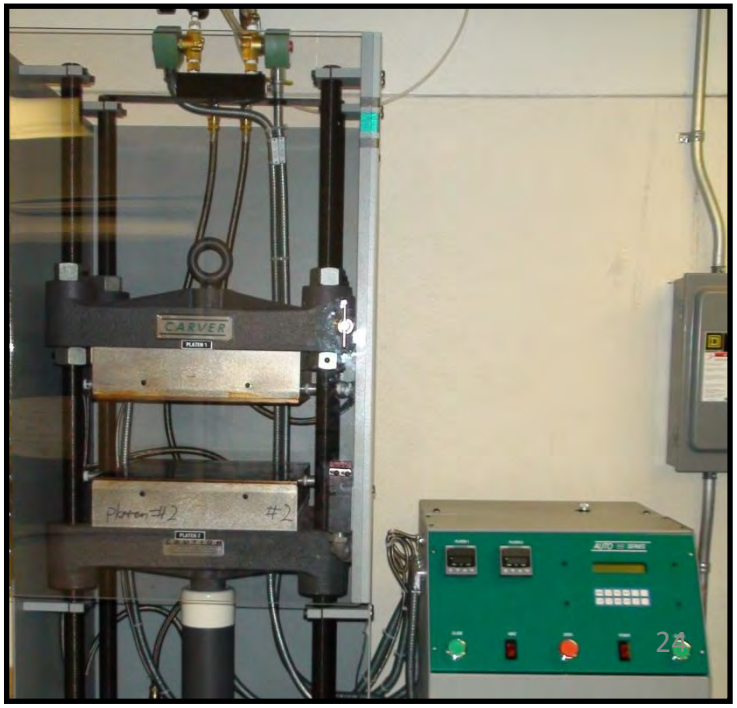
Melt compounding step



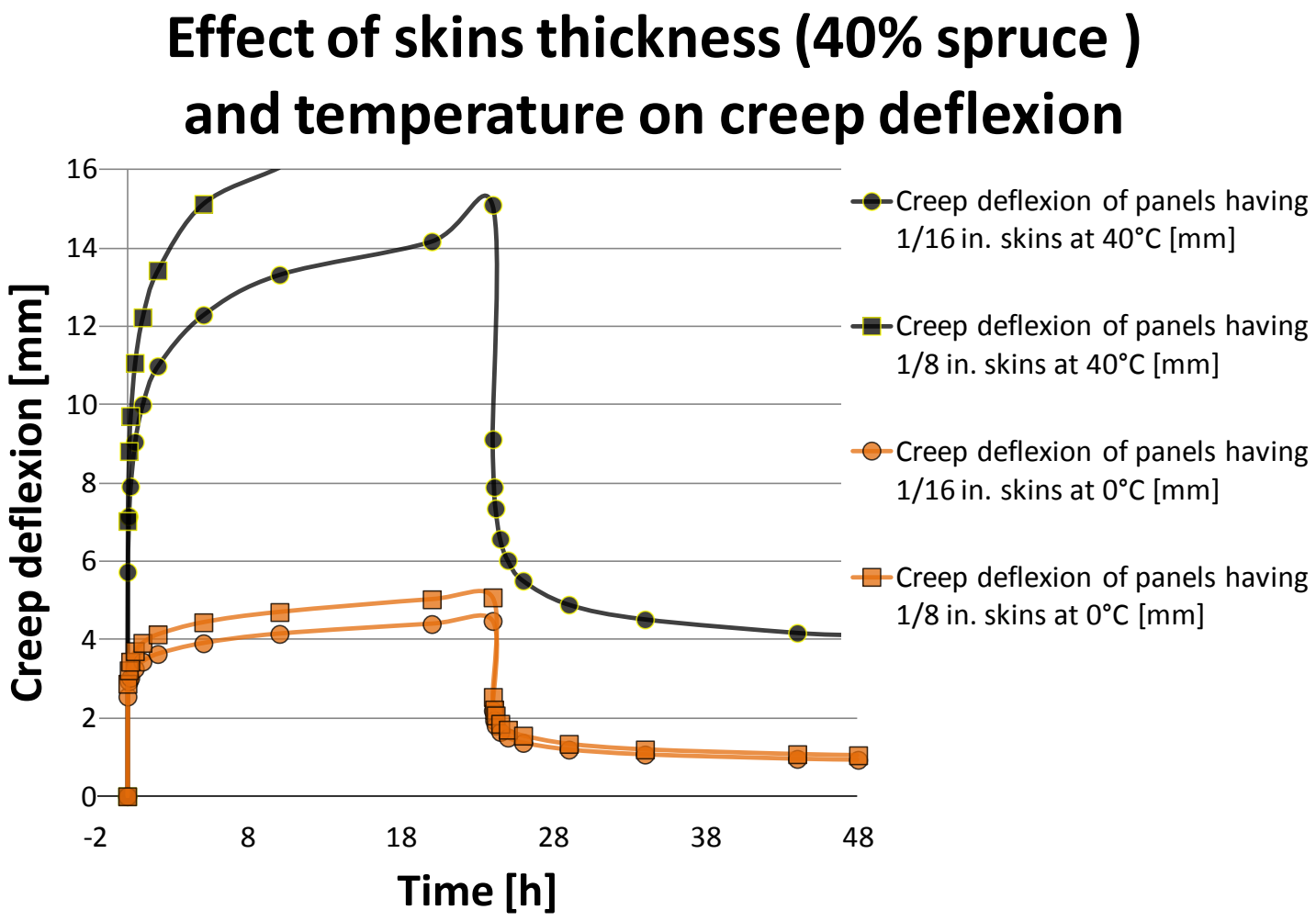
Blowing methodology of wood-plastic composite sandwich panel inside a hot press

1) Hot pressing of the three layers
2) Activation of the chemical blowing agent
3) Partial solidification (crystallisation) of the surface layers
4) Foaming of the foam core layer

Forming and foaming step

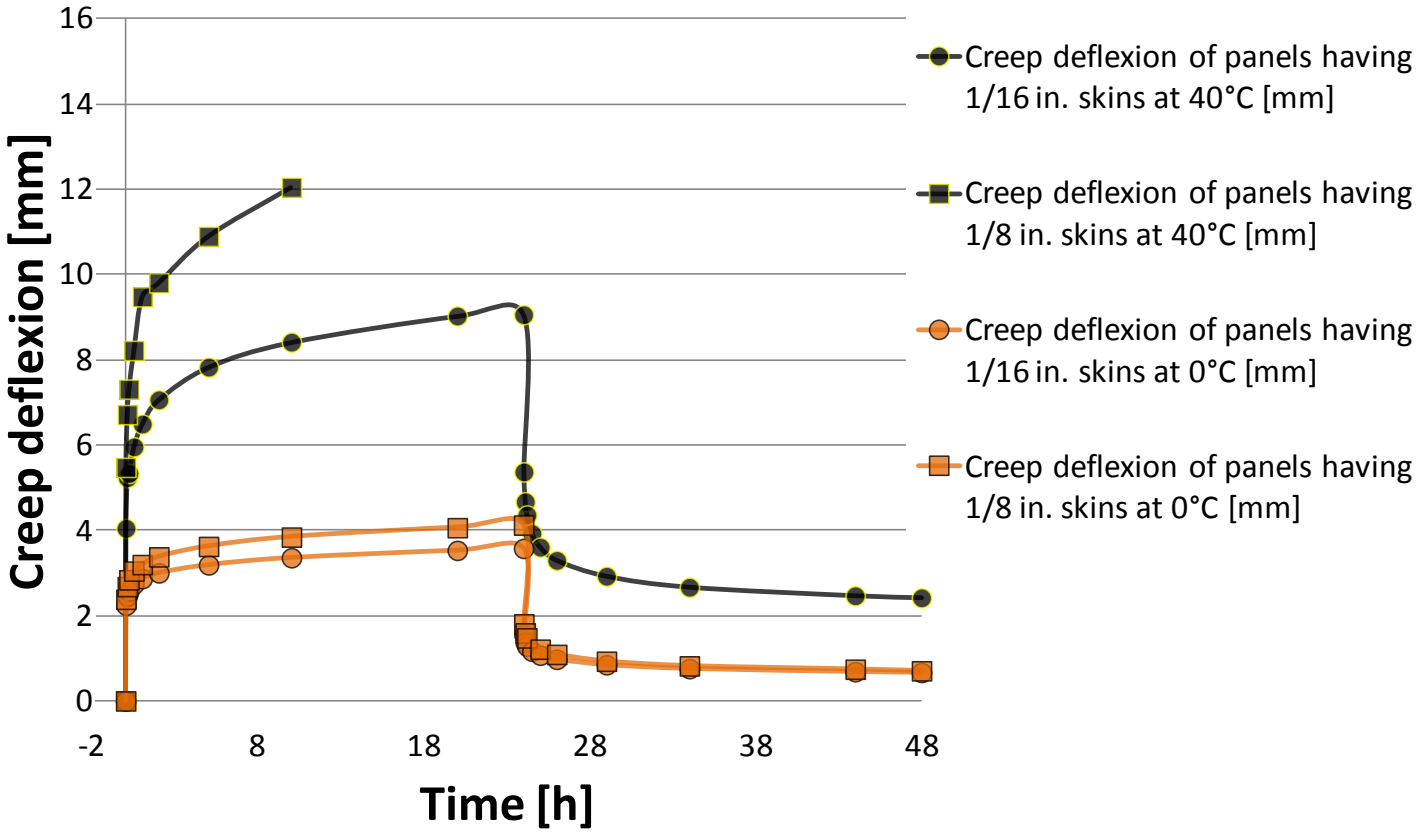


Creep Properties by Three-Points Bending



Creep Properties by Three-Points Bending

Effect of skins thickness (50% spruce) and temperature on creep deflexion



Creep Properties by Three-Points Bending