

Feasibility of wood peeling process assisted by radiant energy.

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Anna DUPLEIX
PhD student – First year



Professor Rémy MARCHAL¹



Professor Mark HUGHES²

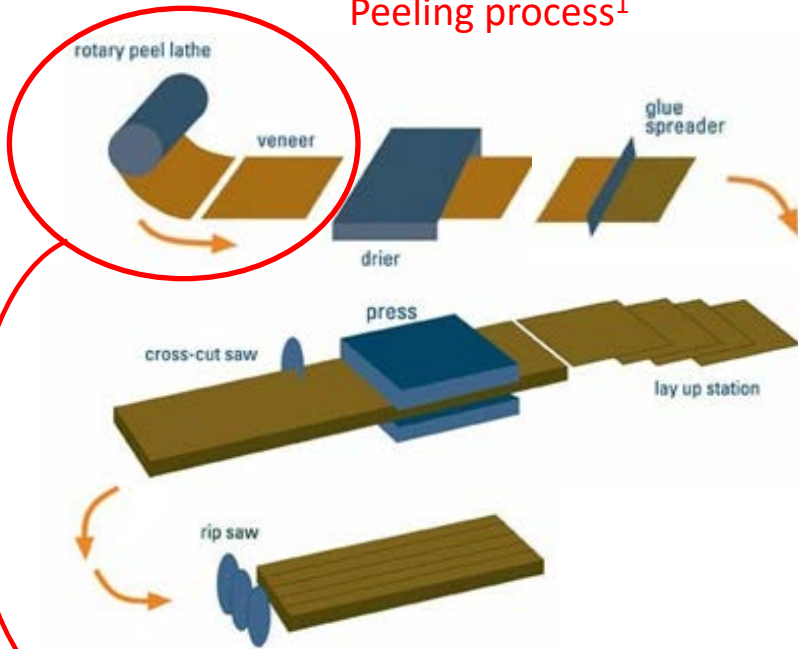
Joint supervisors: Dr Louis-Etienne DENAUD¹
Dr Andrezj KUSIAK³
Dr Frédéric Rossi¹

¹Arts&Métiers ParisTech Cluny, France; ²Aalto University, Helsinki, Finland ; ³Université de Bordeaux, France.

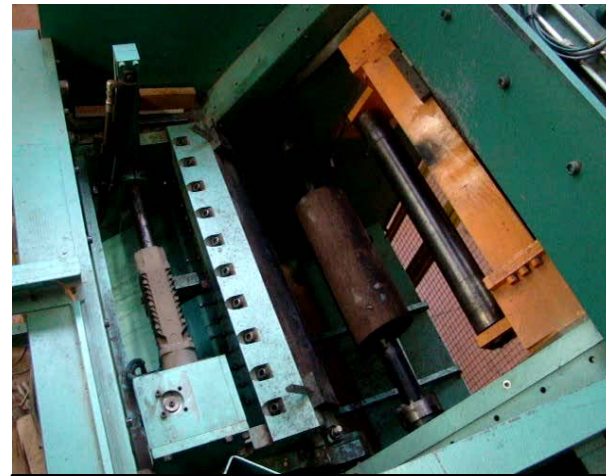
A high-value added process.

A high production rate.

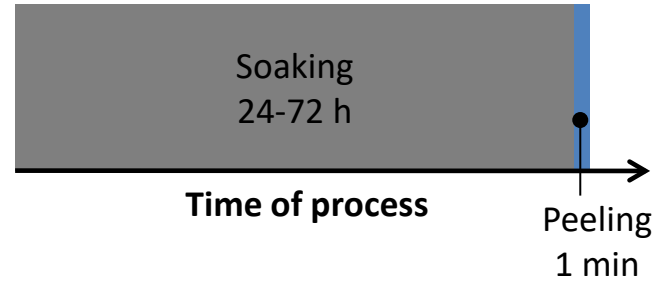
Peeling process¹



Thickness = 0.5 to 10 mm



v = 1 to 10 m/s



Soaking
24-72 h

Peeling
1 min



Peeling process

Soaking method

Alternative to soaking

Prospective work

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Slow down by log preparation.

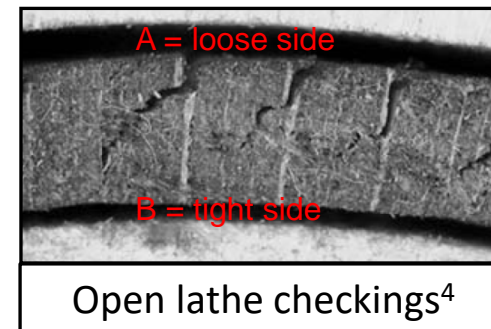
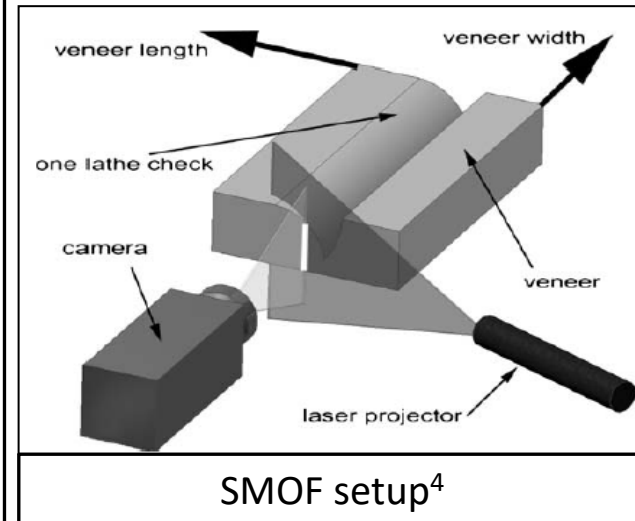
What is wood heating prior to peeling aimed at?

Improving veneer surface quality

- ✓ to fluidise resin pockets
- ✓ to soften lignin and knots
- ✓ to facilitate peeling of shavings
- ✓ to reduce the risk of lathe checkings

Lowering cutting efforts

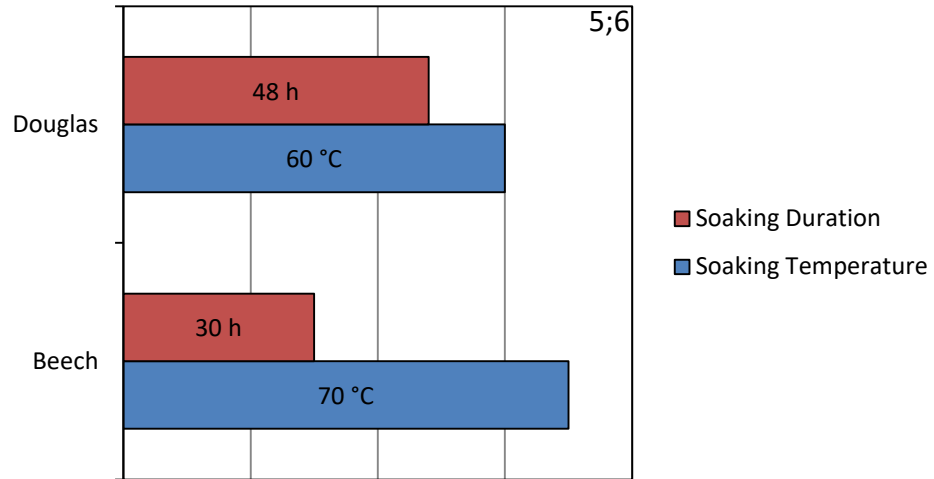
- ✓ to increase wood deformability
- ✓ to reduce applied power
- ✓ to limitate wear of the cutting tools



To « soften » wood prior to peeling.

Soaking: a traditional method

Aim of soaking: To heat bolts in the whole volume.



Severe drawbacks in terms of

Cost	Yield	Veneer quality
<ul style="list-style-type: none"> ✓ Energy efficiency ✓ Water pollution ✓ Facilities requirements 	<ul style="list-style-type: none"> ✓ Stock downtimes ✓ Wood cohesion ✓ Handling 	<ul style="list-style-type: none"> ✓ Coloration ✓ Durability ✓ Wooly surface

But time-consuming, empirical and imperfect.

Peeling process

Soaking method

Alternative to soaking

Prospective work

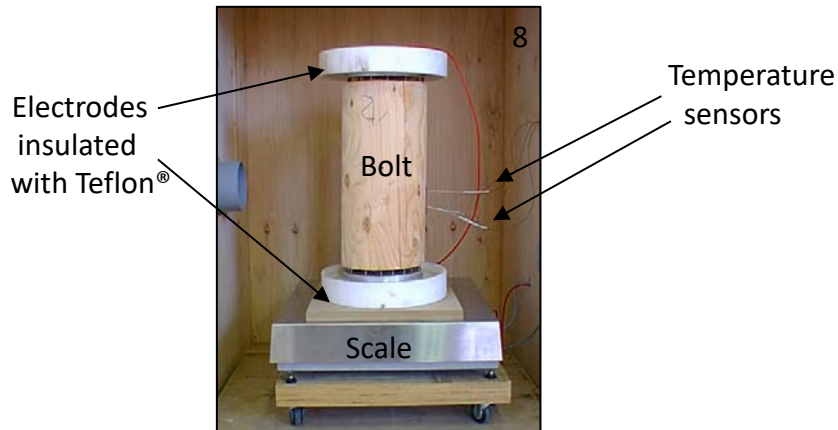
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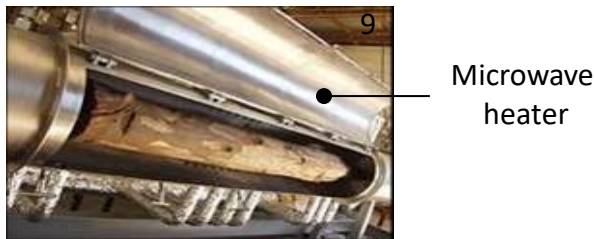
Previous trials on alternative methods to soaking Arts et Métiers ParisTech Cluny

Volume heating

✓ Electric ohmic heating

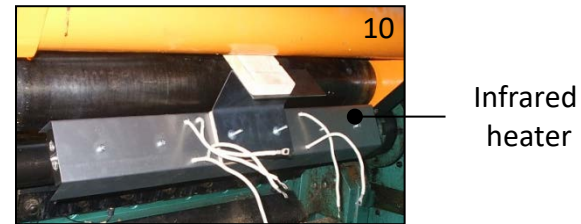


✓ Microwave heating (MW)



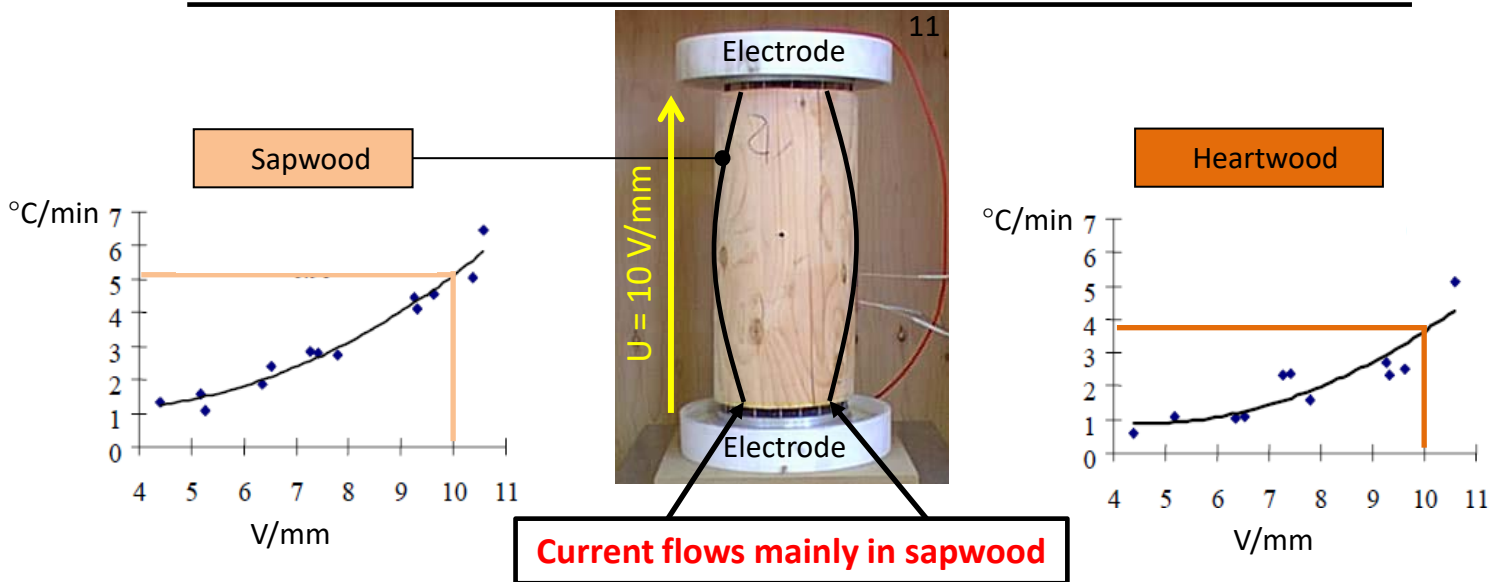
Surface heating

✓ Infrared heating (IR)

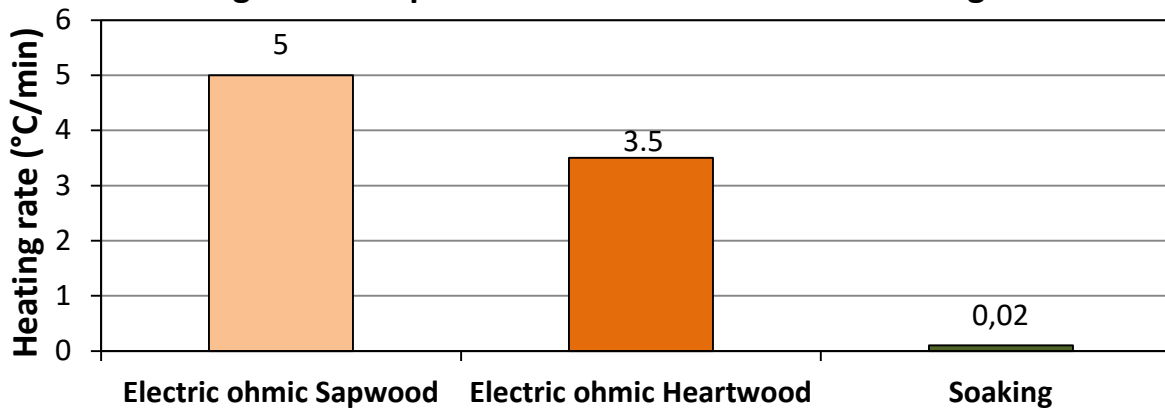


To heat wood prior to peeling.

For **same veneer quality**, a **high heating rate** method.



Heating rates comparison of electric ohmic and soaking methods



But **heterogeneous** and **requiring high voltages**.

- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

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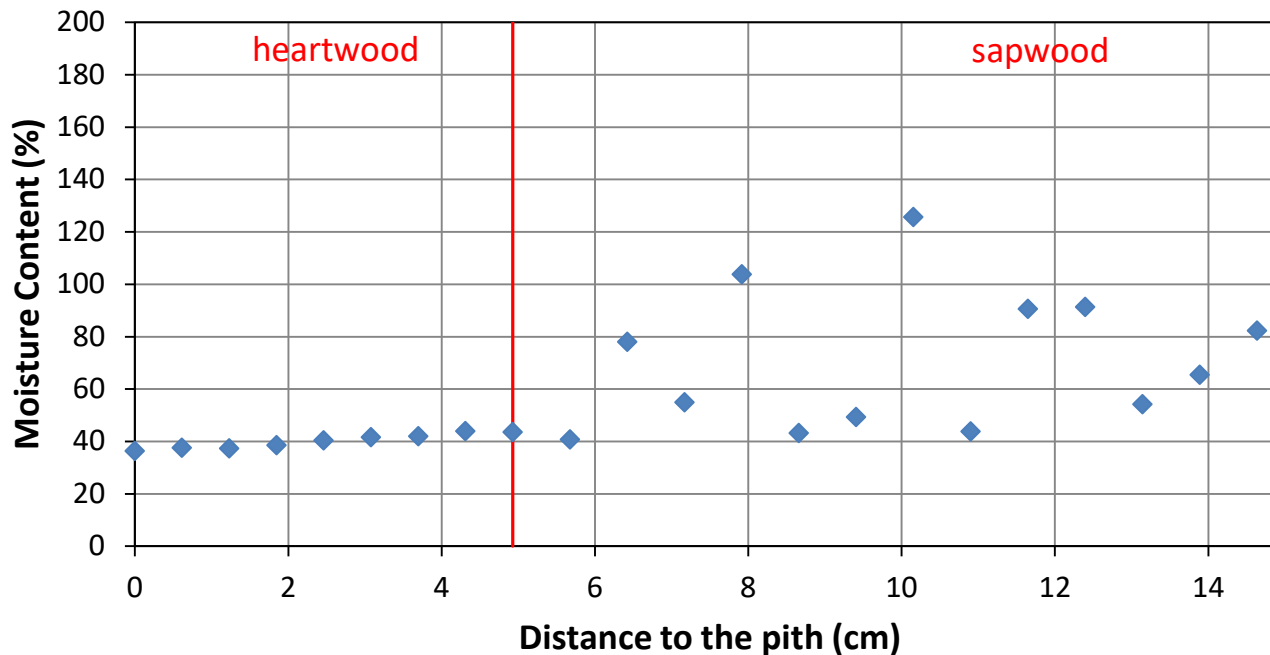


Sources: ¹¹ Marchal, R. et al., 2000-2004.

Learning from volume electric ohmic heating.

- 1 Wood does not need to be "cooked" to "soften" as required by peeling.
- 2 Using water as vector of heat produces heterogeneous heating.

Hygrometry of Douglas-fir bolts after soaking (48h, 60 °C)



How to heat wood without using water as a vector of heat?



- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

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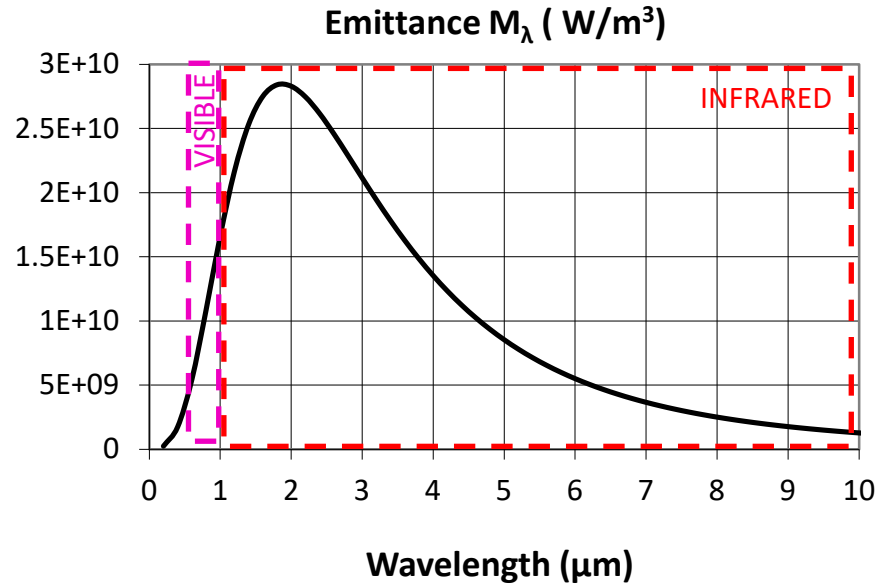


Interest of radiant energy



- ✓ Energy efficiency

$M_{\lambda} = \frac{2\pi \cdot c^2 \cdot \lambda^5}{h \cdot c \cdot e^{\lambda \cdot k \cdot T}} \cdot 1$
Planck's law



- ✓ Radiation penetrates into green wood

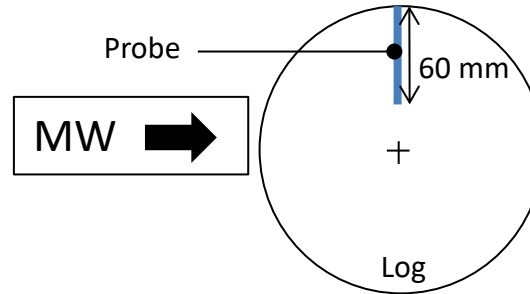
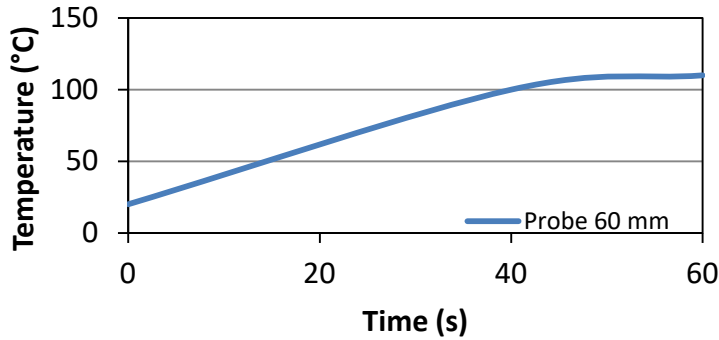
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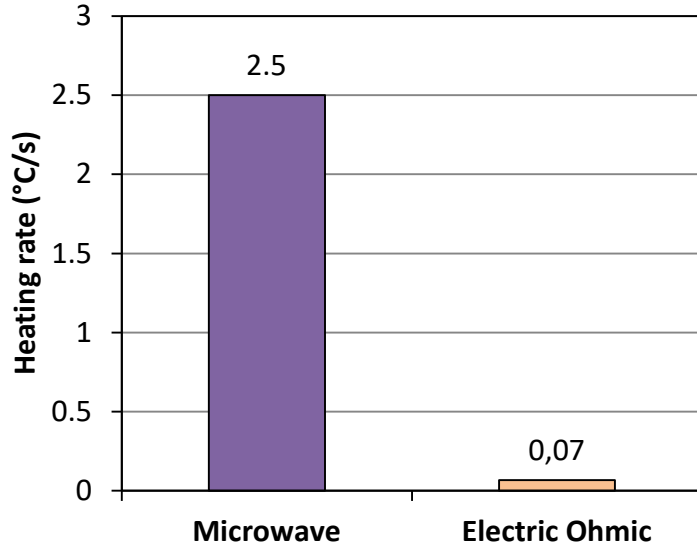




Log under MW heating (12 kW)



Comparison of heating rates to heartwood of MW and electric ohmic methods



Coaxial cables and waveguides from electric generator to MW applicator.

- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

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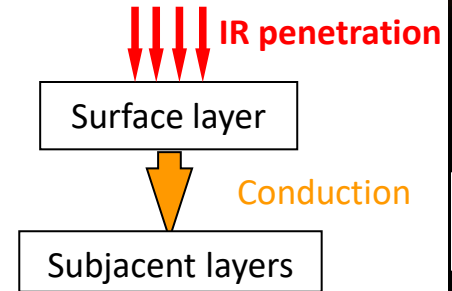
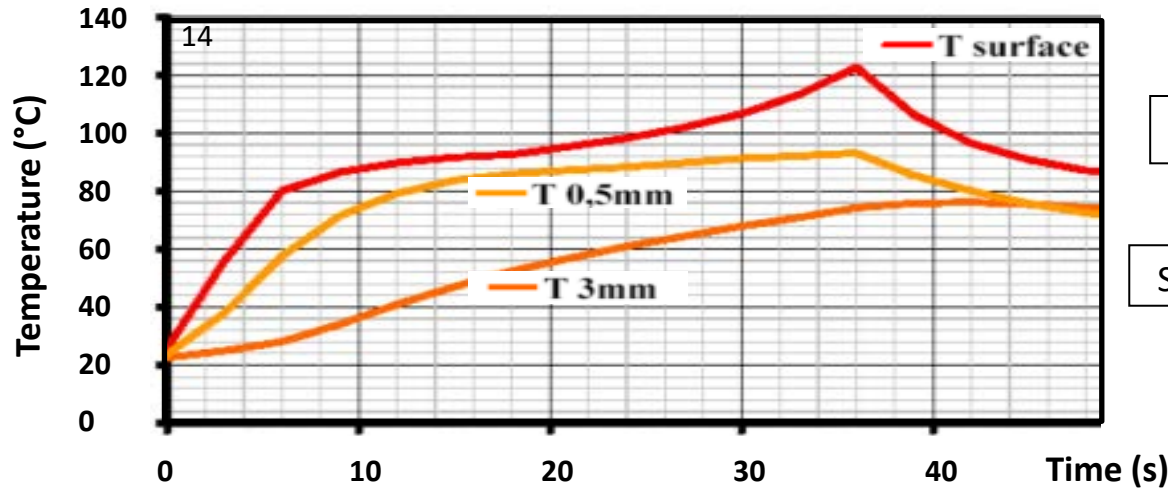


Looking for radiant energy heating easier to implement.

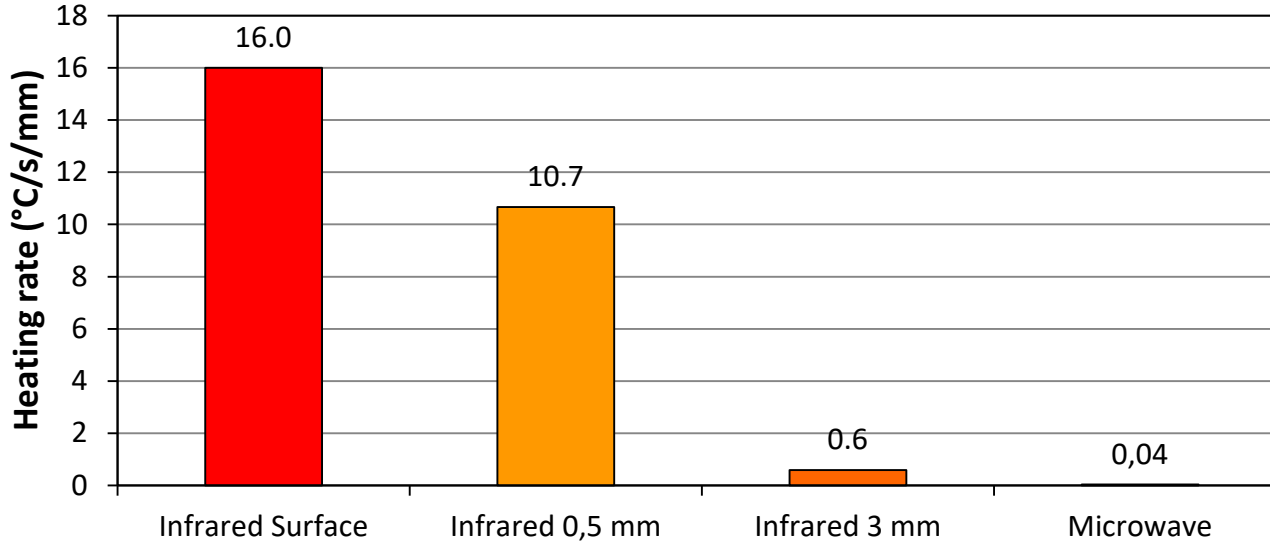
Sources: ¹²Torgonikov et al., 2010; ¹³University of Melbourne.

IR Surface heating

IR thermal kinetics



Heating rates comparison of IR and MW to reach 80 °C



Rapid surface heating.



Heating wood

Electric ohmic

Microwave

Infrared

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Alternative methods to soaking



	Advantages	Drawbacks
Electric ohmic heating	- rapidity	- requiring high voltages
Microwave heating	- rapidity - energy efficiency	- complexity of technology
Infrared heating	- rapidity - easiness of implementation	- penetration depth

- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

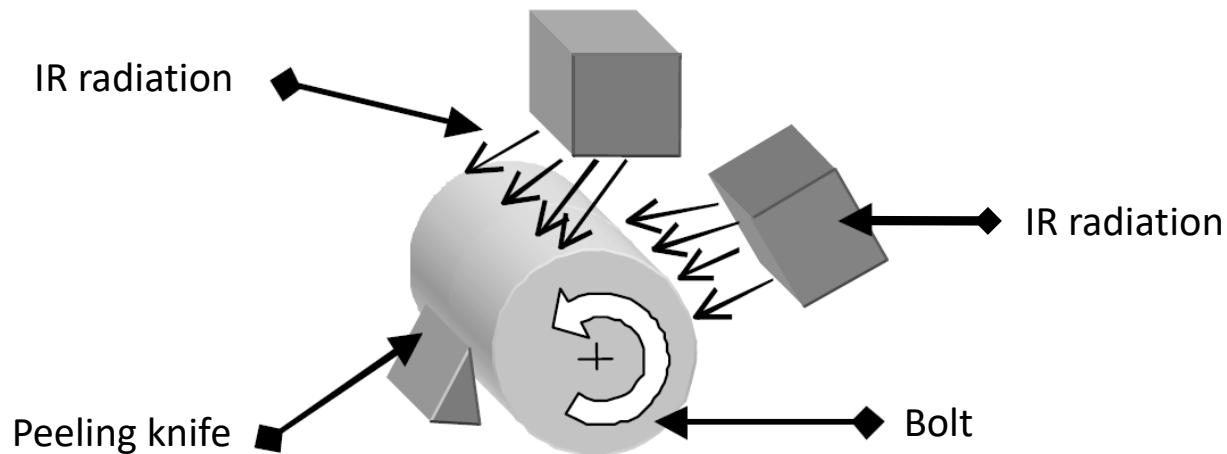
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IR most suitable alternative method to heat wood prior to peeling.

Aim of research: to develop **on-line** IR heating system

- ✓ **directly embedded** on the peeling lathe
- ✓ to heat **wood surface while peeling**
- ✓ activated when peeling comes to **heartwood**



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Peeling
process

Soaking
method

Alternative to
soaking

Prospective
work

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A?
Aalto University
School of Science

**ARTS
ET MÉTIERS**
ParisTech
Cluj

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LABORATOIRE BOURGUIGNON
DES MATÉRIAUX ET PROCÉDÉS

Study of the influence of heating temperatures on peeling.




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Species

- Douglas-fir
- Beech
- Spruce
- Birch


Process parameters



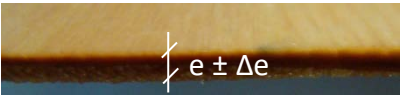
$V = 1 \text{ m/s}$
 $B_p = 5\%$
 $e = 3 \text{ mm}$

Veneer quality assessment

Checks index (fuitometer)

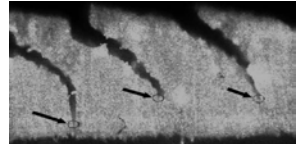


Veneer thickness




$e \pm \Delta e$

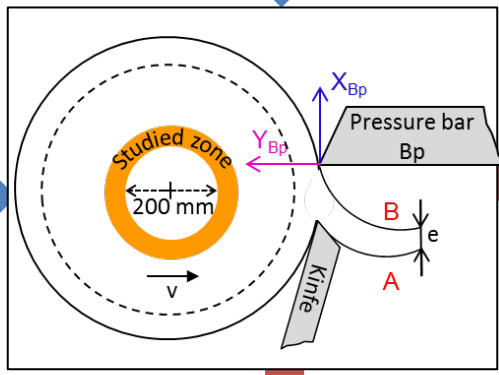
Checks frequency and depth (SMOF)



Heating bolts by soaking



70°C
 60°C
 50°C
 45°C
 40°C
 35°C
 30°C
 20°C



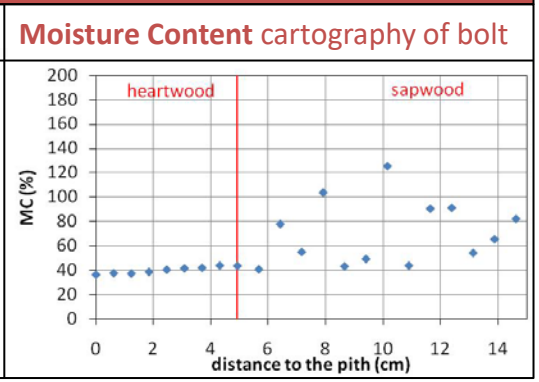
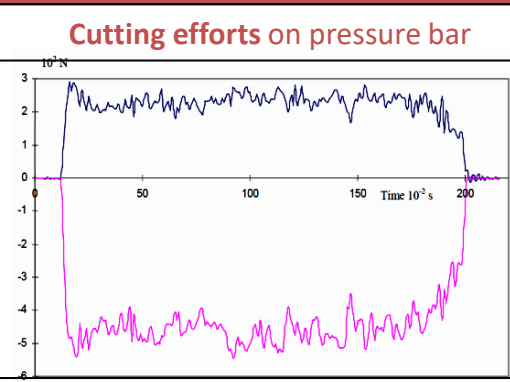
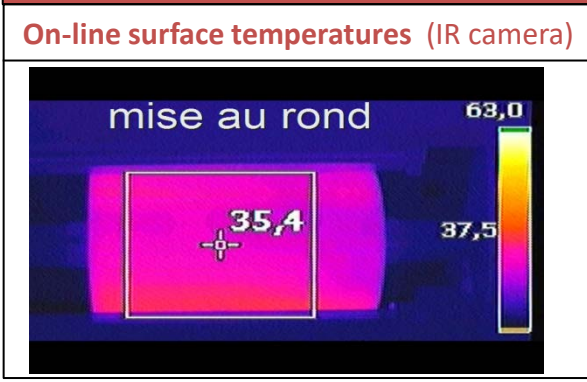
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Process assessment

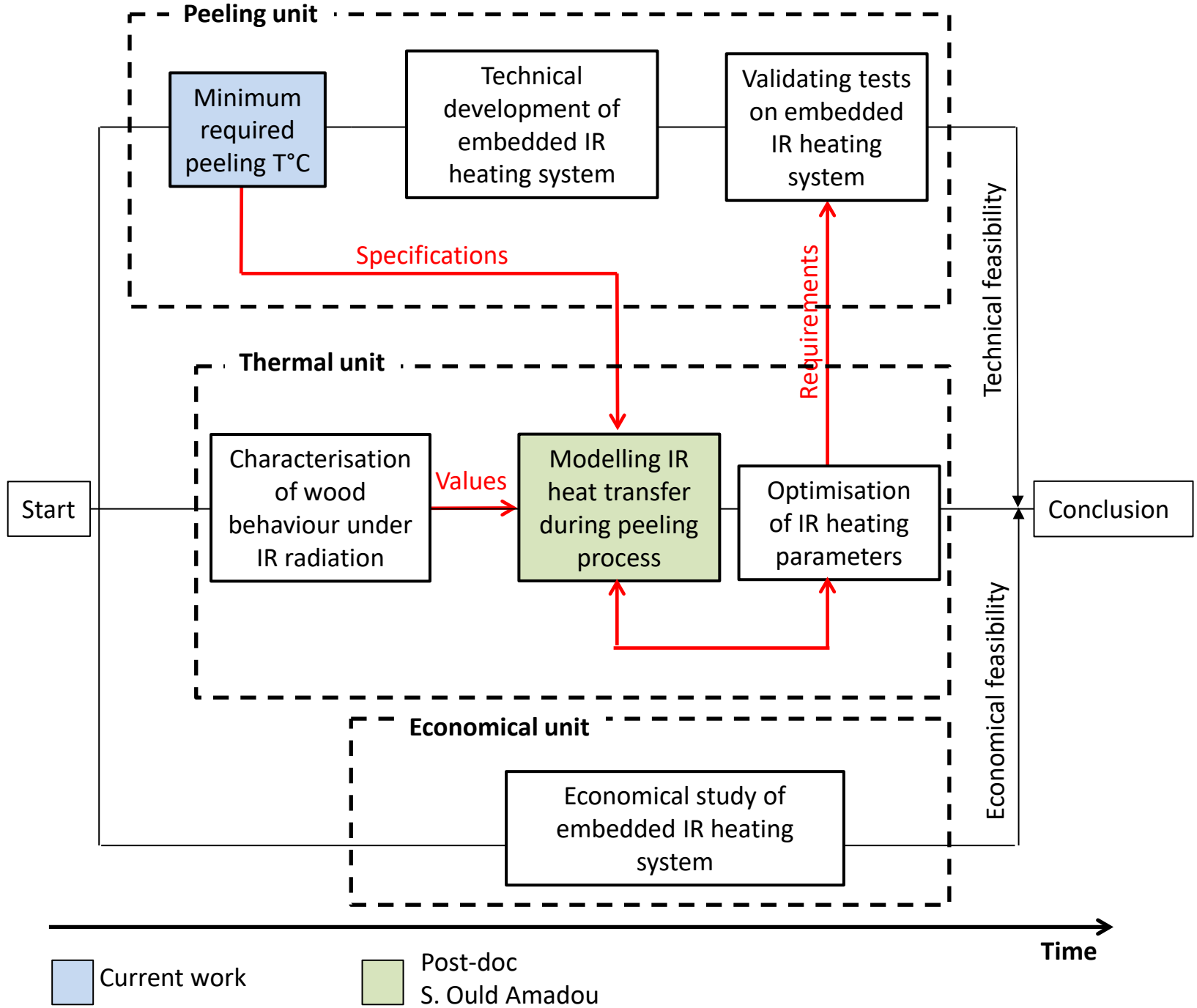


Objectives To lower heating temperatures in compromise with veneer surface quality.

Results Target temperatures for modelling.

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Anna DUPLEIX

PhD student – October 2010

Thank you for your attention.



Professor Rémy MARCHAL
Arts&Métiers ParisTech Cluny, France



Professor Mark HUGHES
Aalto University, Helsinki, Finland
