

Feasibility of wood peeling process assisted by radiant energy.

1 / 15

Anna DUPLEIX
PhD student – First year



Professor Rémy MARCHAL¹



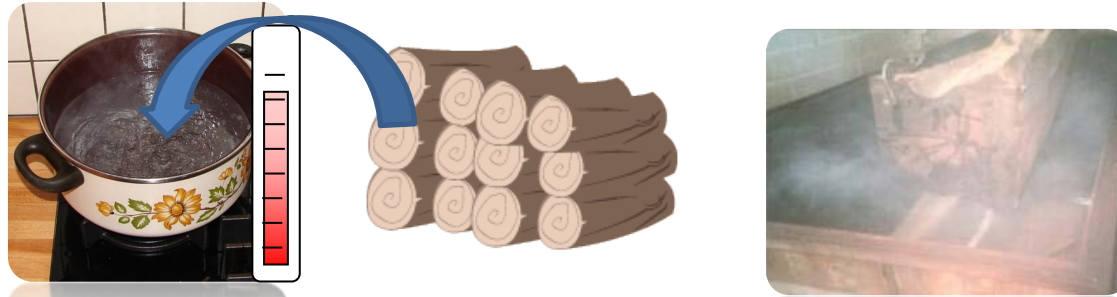
Professor Mark HUGHES²

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

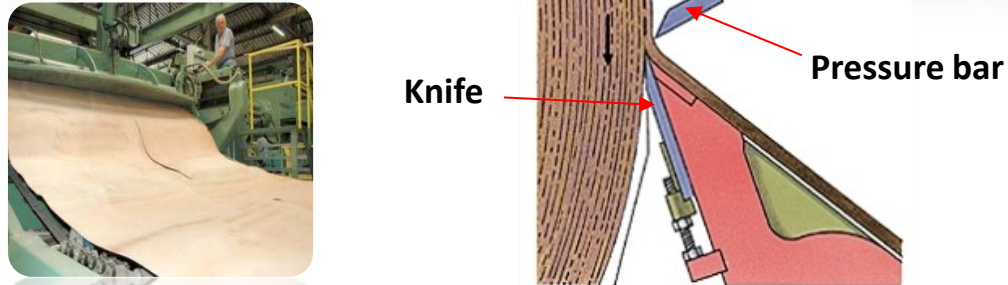
¹Arts&Métiers ParisTech Cluny, France; ²Aalto University, Helsinki, Finland ; ³Université de Bordeaux, France.

Peeling process: veneer production

Soaking



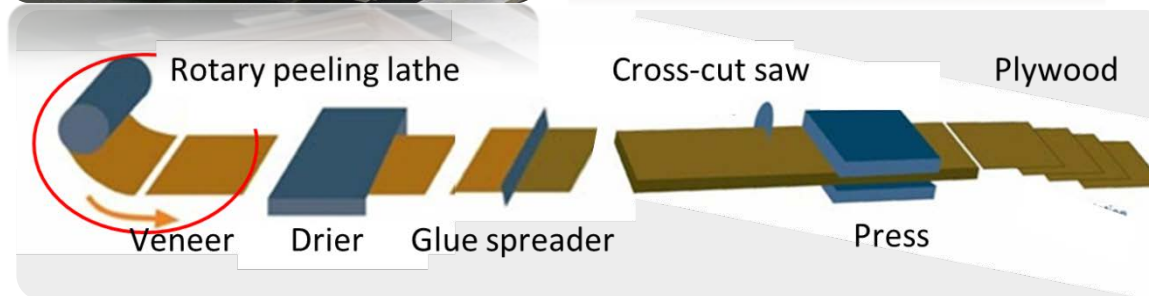
Peeling



Veneer



Plywood



Introduction

Model Principles

Simulation Results

Anna Duplex
COST Forum
March 2013

A?
Aalto University
School of Science

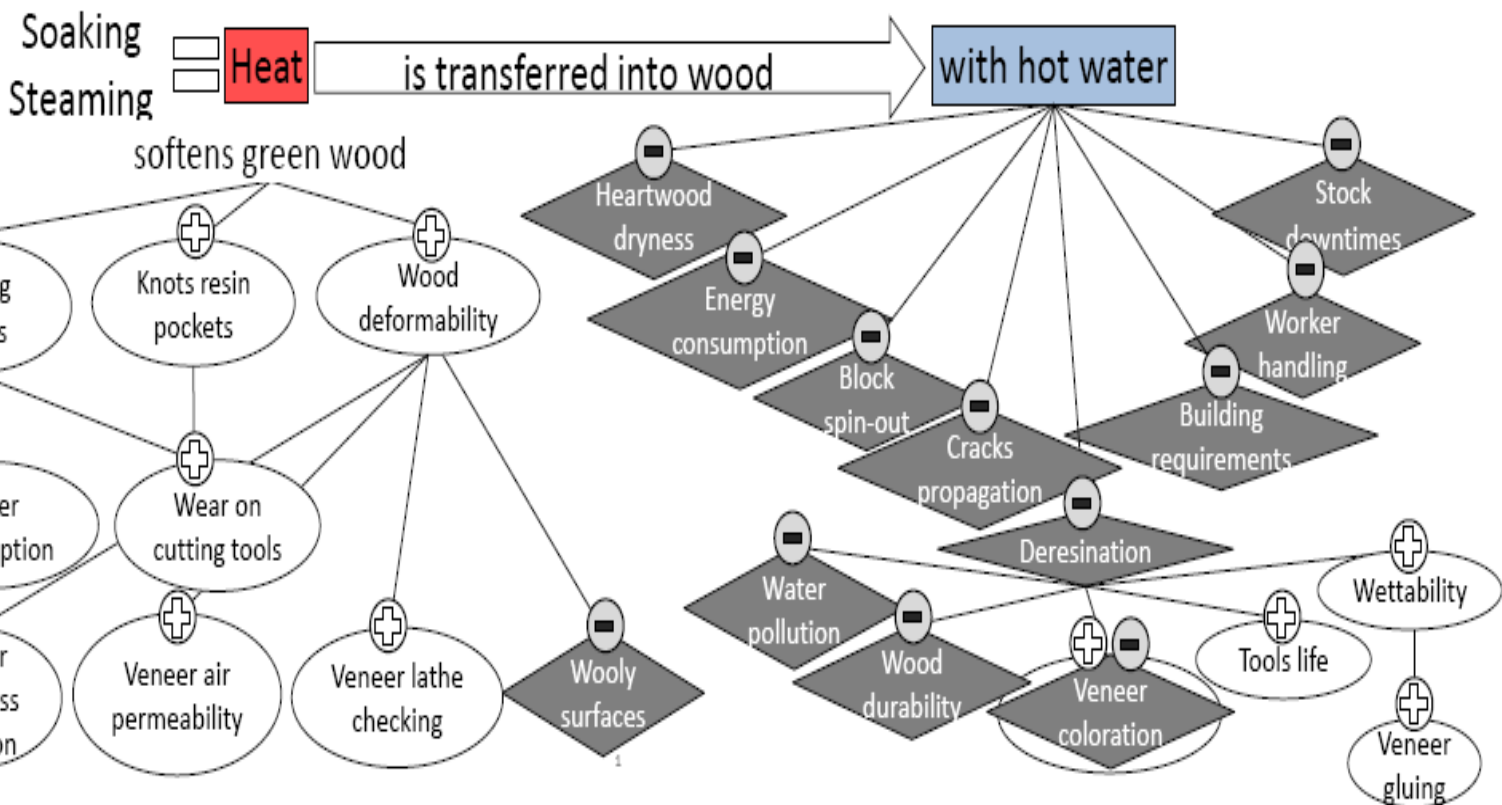
ARTS
ET MÉTIERS
ParisTech
Cluny

LaBoMaP
LABORATOIRE BOURGUIGNON
DES MATÉRIEAUX ET PROCÉDES

Why soaking?



Anna Duplex
COST Forum
March 2013



What is wood heating prior to peeling aimed at?

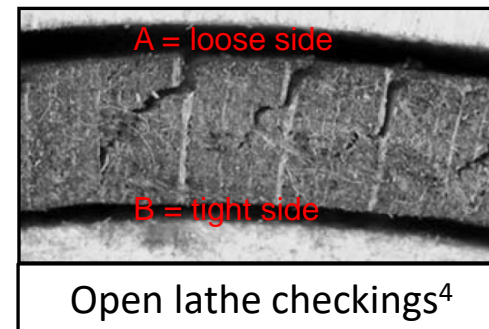
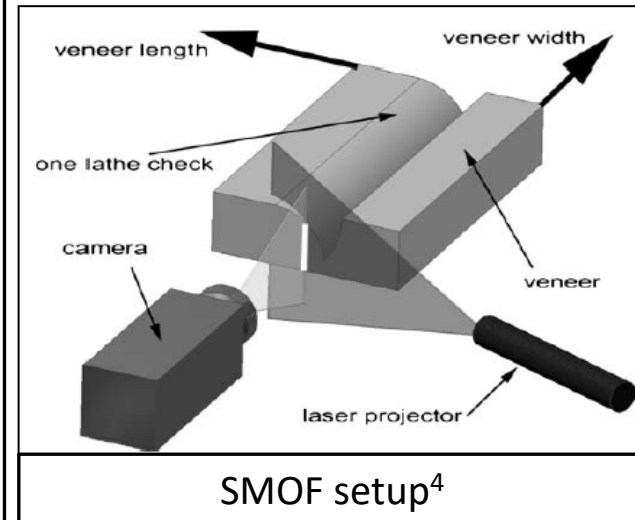
4 / 15

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



Peeling process

Soaking method

Alternative to soaking

Prospective work

Anna Duplex
COST Forum
March 2013

A?
Aalto University
School of Science

ARTS
ET MÉTIERS
ParisTech
Clusyl

LaBoMaP
LABORATOIRE BOURGUIGNON
DES MATÉRIEAUX ET PROCÉDÉS

To « soften » wood prior to peeling.

Alternative methods to heating wood prior to peeling avoiding soaking

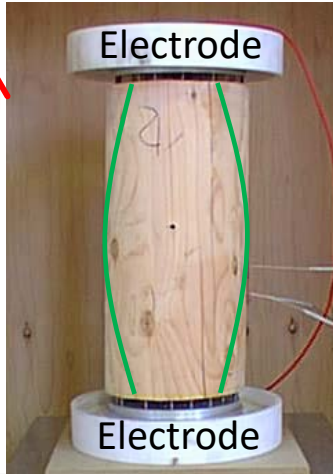


Volume heating

Electric ohmic heating

Microwave heating

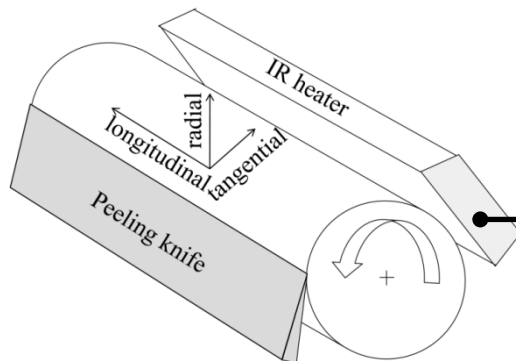
$U = 10 \text{ V/mm}$



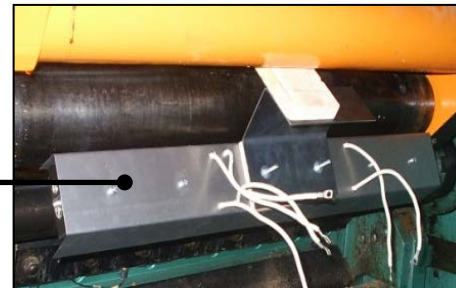
Wood does not need to be cooked for a long duration nor at boiling temperatures
Cell wall has to be brought at the required medium range temperature

Surface heating

Infrared heating (IR)



Infrared heater



Introduction

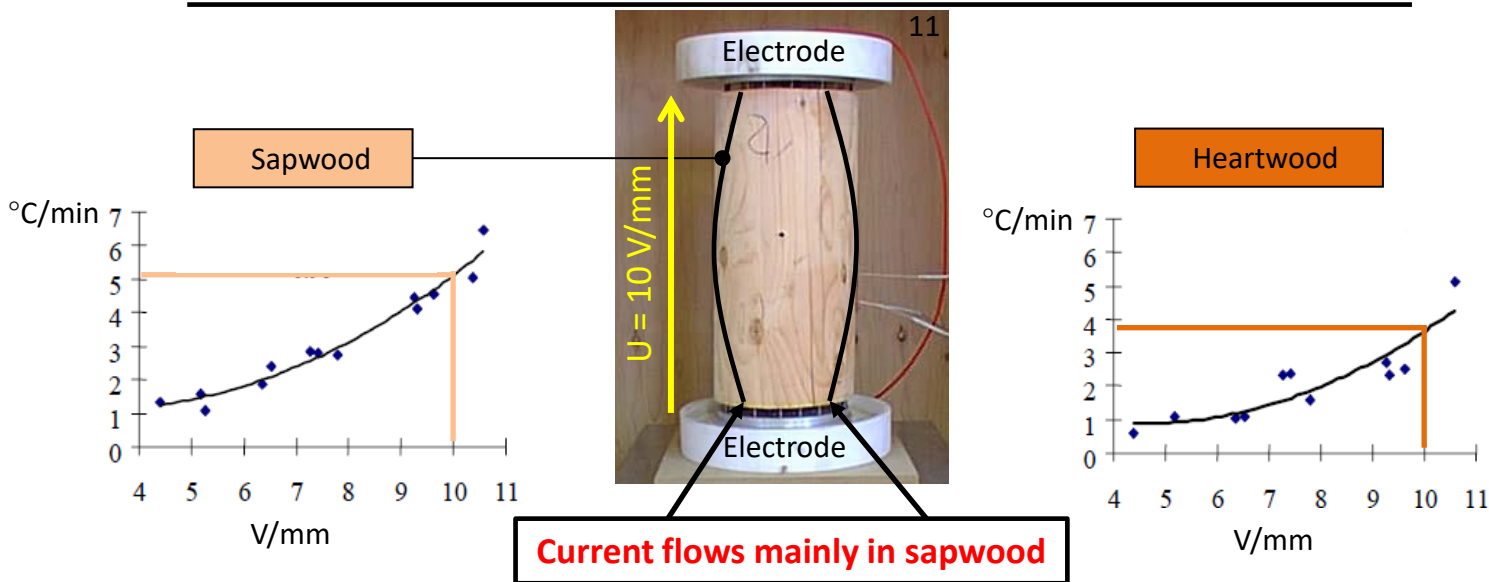
Model Principles

Simulation Results

Anna Duplex
COST Forum
March 2013

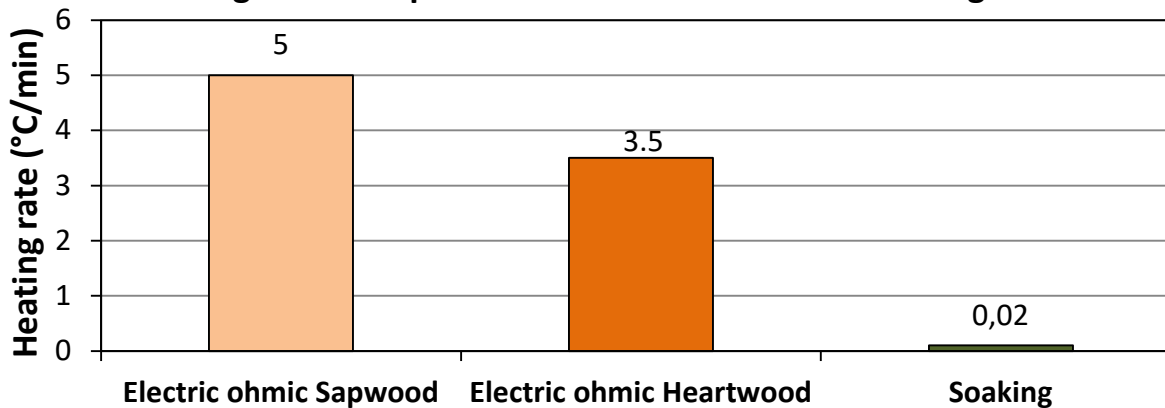


For **same veneer quality**, a **high heating rate** method.



- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

Heating rates comparison of electric ohmic and soaking methods



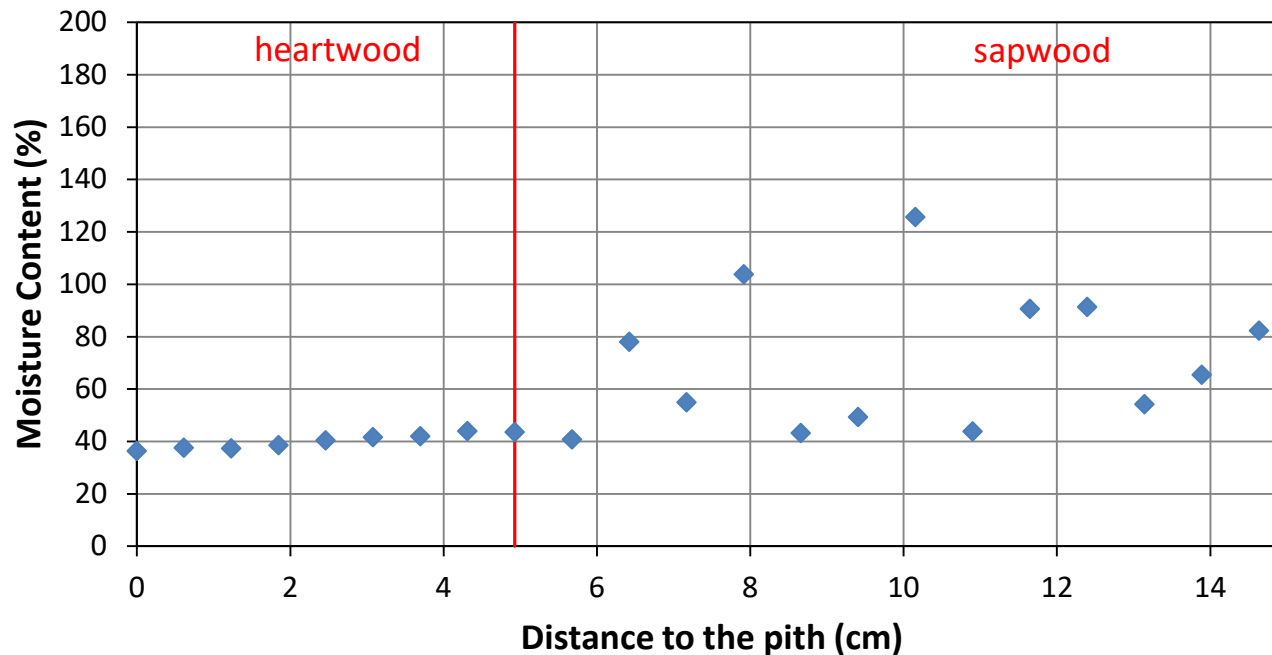
But **heterogeneous** and **requiring high voltages**.

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

Anna Duplex
COST Forum
March 2013



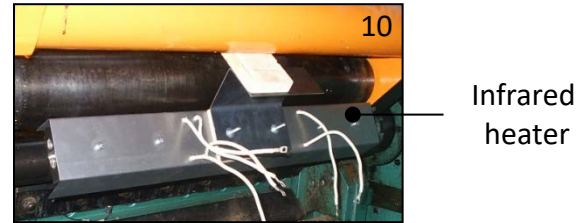
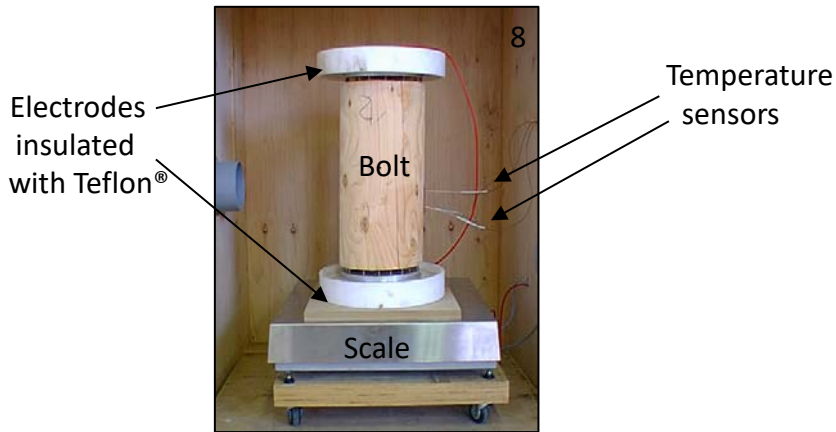
Previous trials on alternative methods to soaking Arts et Métiers ParisTech Cluny

Volume heating

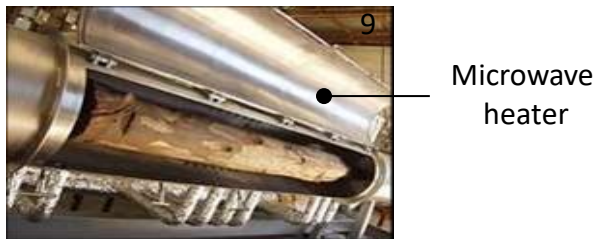
Surface heating

✓ Electric ohmic heating

✓ Infrared heating (IR)



✓ Microwave heating (MW)



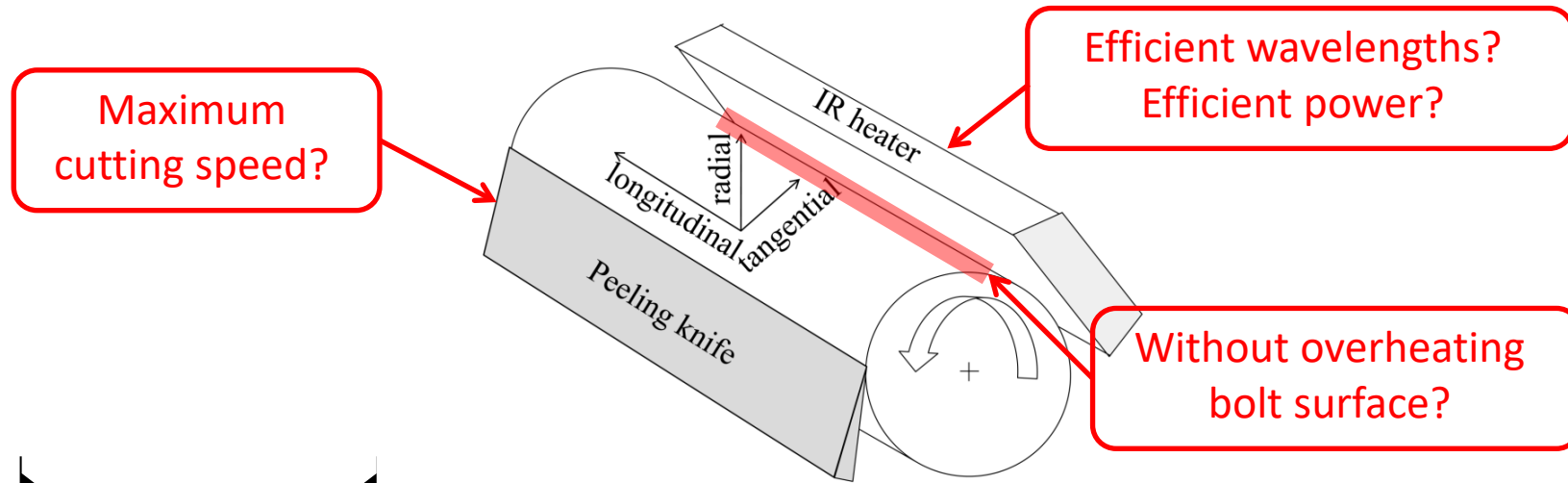
- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

Anna Duplex
COST Forum
March 2013



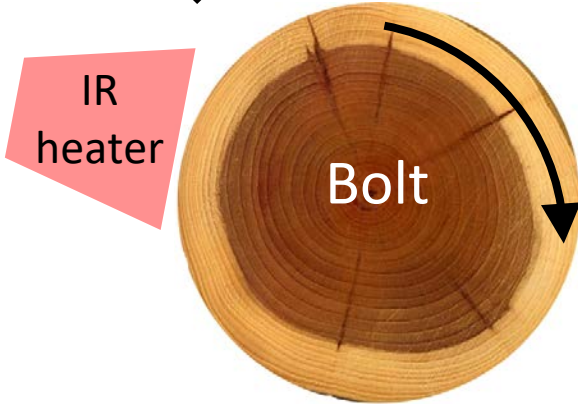
To heat wood prior to peeling.

Modelling in-line IR surface heating: principle



The answer here:

By numerical modelling of IR heating while peeling



Equations solver Comsol Multiphysics®

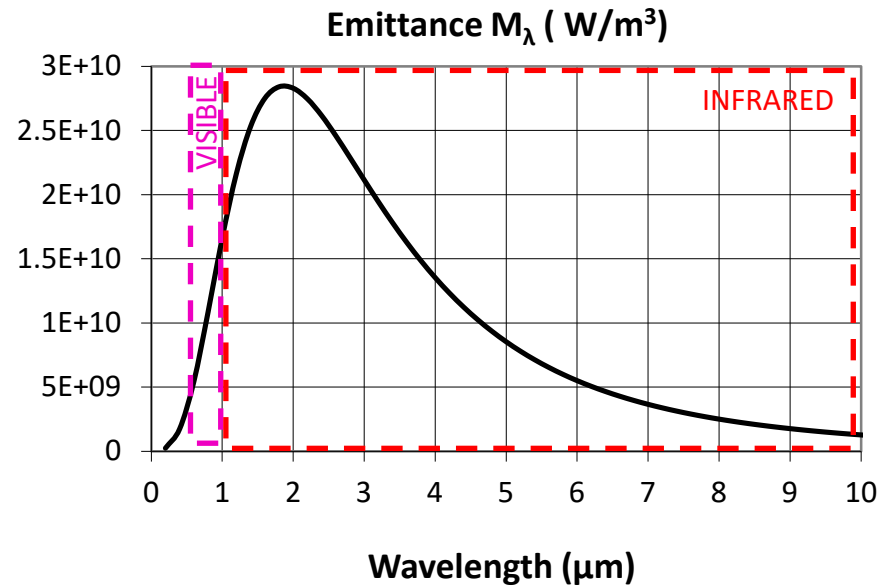
Procedure implemented under MatLab®

Interest of radiant energy

- ✓ Energy efficiency

$$M_{\lambda} = \frac{2\pi \cdot c^2 \cdot \lambda^5}{\frac{h \cdot c}{\lambda \cdot k \cdot T} \cdot 1}$$

Planck's law



- ✓ Radiation penetrates into green wood



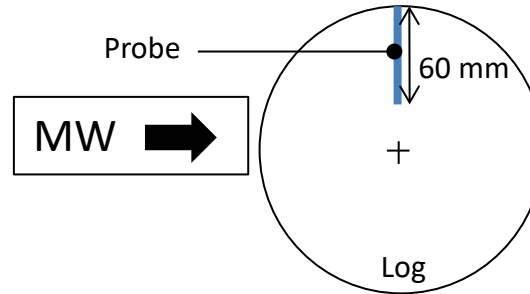
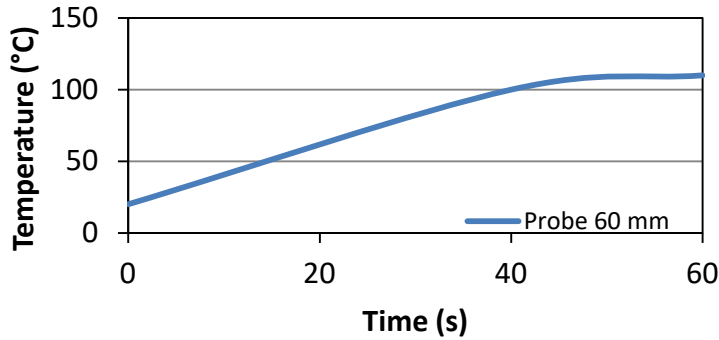
- Alternative to soaking
- Electric ohmic
- Microwave
- Infrared

Anna Duplex
COST Forum
March 2013

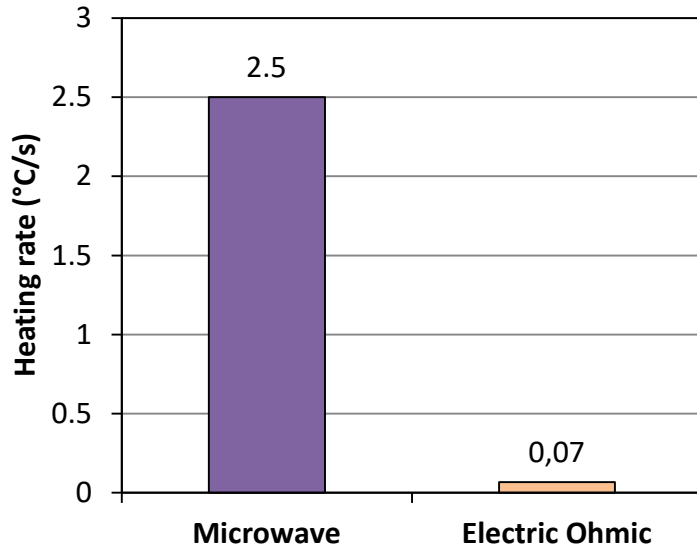




Log under MW heating (12 kW)



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

Anna Duplex
COST Forum
March 2013

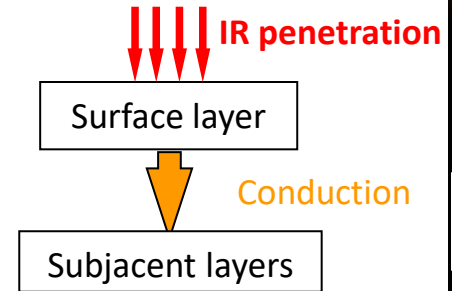
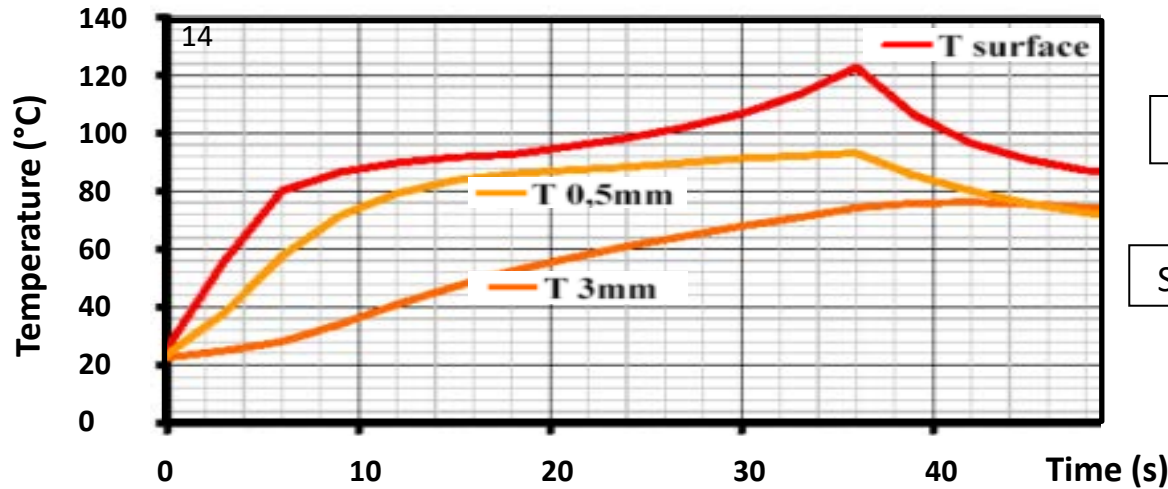


Looking for radiant energy heating easier to implement.

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

IR Surface heating

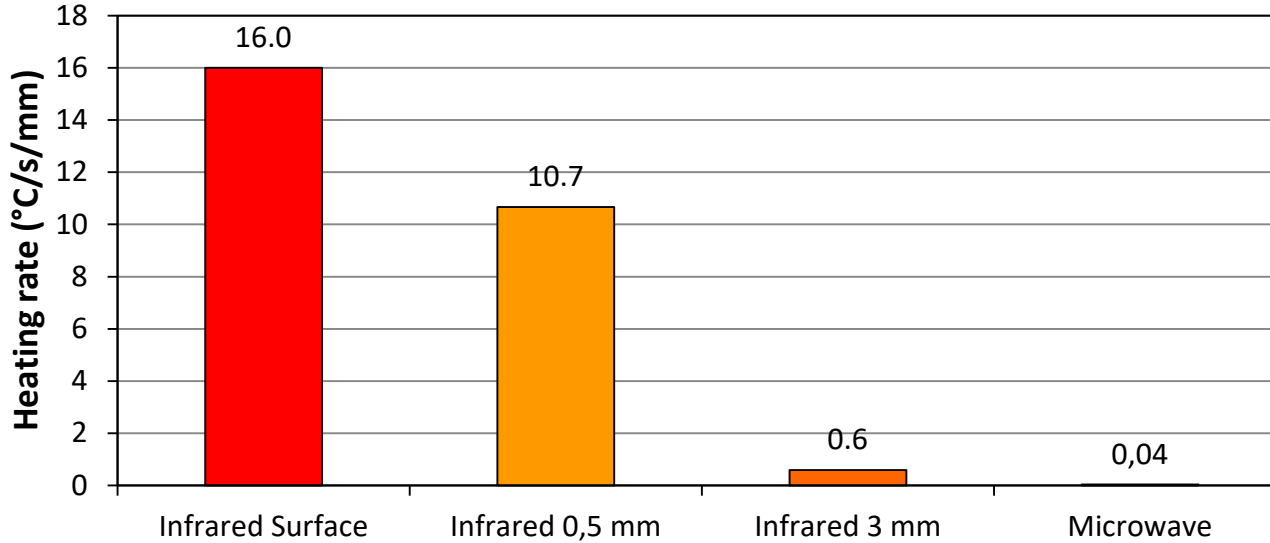
IR thermal kinetics



12 / 15

- Heating wood
- Electric ohmic
- Microwave
- Infrared

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



Rapid surface heating.

Sources: ¹⁴ CETIAT, 2003.

Anna Duplex
COST Forum
March 2013



Alternative methods to soaking



13 / 15

| | 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

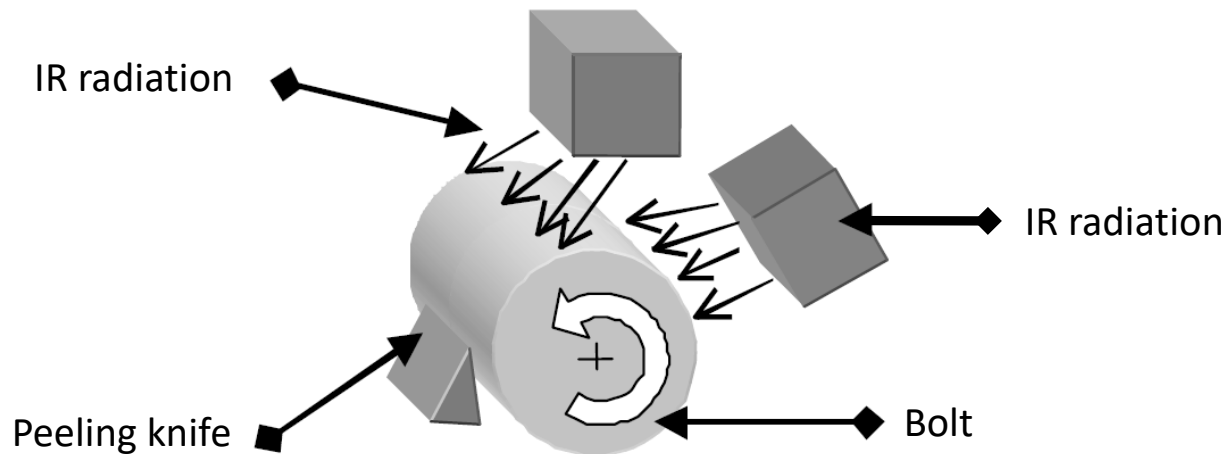
Anna Duplex
COST Forum
March 2013

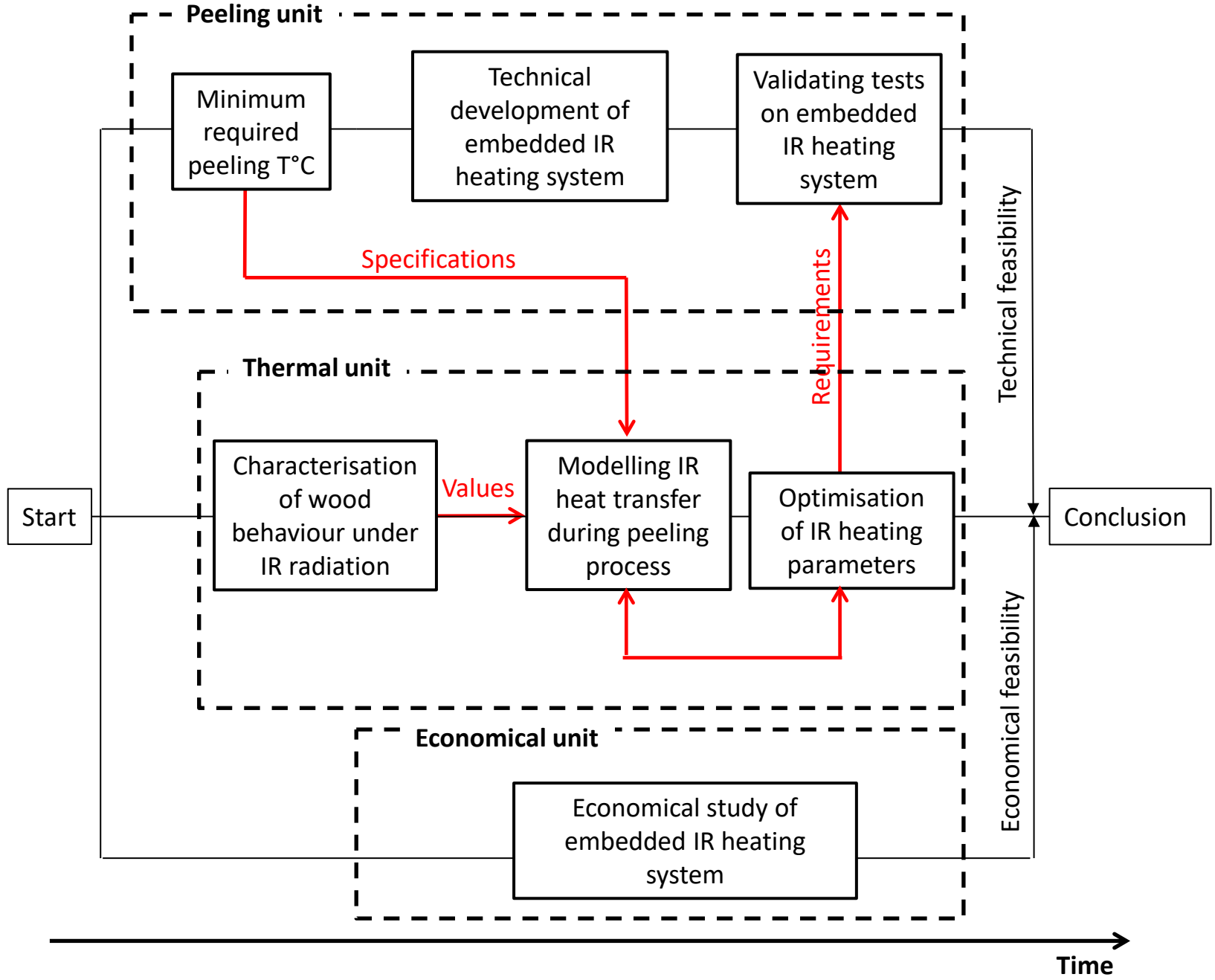


IR most suitable alternative method to heat wood prior to peeling.

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**





Peeling process

Soaking method

Alternative to soaking

Prospective work

Anna Duplex
COST Forum
March 2013



Feasibility of wood peeling process assisted by radiant energy.

16 / 15

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
