Measuring green wood thermal properties to simulate veneer production by ir-heating
Anna Dupleix, Andrzej Kusiak, Remy Marchal, Laurent Bleron, Louis Etienne Denaud, Frederic Rossi

To cite this version:
Anna Dupleix, Andrzej Kusiak, Remy Marchal, Laurent Bleron, Louis Etienne Denaud, et al.. Measuring green wood thermal properties to simulate veneer production by ir-heating. IUFRO Conference Division 5 Forest Products, Technical session 5.02.00, Jul 2012, Estoril, Portugal. hal-02100456

HAL Id: hal-02100456
https://hal.archives-ouvertes.fr/hal-02100456
Submitted on 15 Apr 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
MEASURING GREEN WOOD THERMAL PROPERTIES TO SIMULATE VENEER PRODUCTION BY IR-HEATING

DUPLEIX A.1, KUSIAK A.2, MARCHAL R.1, DENAUD L.1, BLERON L.1, ROSSI F.1

CURRENT VENEER MANUFACTURING PROCESS

- SOAKING
- PEELING
- PLYWOOD

THERMAL SIMULATION OF FUTURE EMBEDDED IN-LINE IR HEATING SYSTEM

PROJECT BACKGROUND

- SOAKING
- REPLACING SOAKING
- NUMEROUS DRAWBACKS

THE QUESTION

HOW QUICKLY CAN THE HEAT ABSORBED BY THE SURFACE BE TRANSFERRED DEEP INTO WET WOOD BY CONDUCTION?

Heat transfer modelling equations

\[
Q_{\text{rad}} = h(T_{\text{ext}} - T) + \sigma(T_{\text{ext}}^{4} - T^{4})
\]

\[
\rho C_{p} \frac{\partial T}{\partial t} = \lambda \nabla^{2} T
\]

\[
T_{\text{ext}} = I_{0} \sigma T_{\text{bol}}^{4} \frac{1}{\beta}
\]

THE QUESTION

HOW QUICKLY CAN THE HEAT ABSORBED BY THE SURFACE BE TRANSFERRED DEEP INTO WET WOOD BY CONDUCTION?

Heat transfer modelling equations

\[
Q_{\text{rad}} = h(T_{\text{ext}} - T) + \sigma(T_{\text{ext}}^{4} - T^{4})
\]

\[
\rho C_{p} \frac{\partial T}{\partial t} = \lambda \nabla^{2} T
\]

\[
T_{\text{ext}} = I_{0} \sigma T_{\text{bol}}^{4} \frac{1}{\beta}
\]

MEASURING WET WOOD THERMAL CHARACTERISTICS USING HOTDISK® TRANSIENT METHOD TO FEED THE MODEL WITH PARAMETERS FUNCTION OF MC

APPROACH

- Measuring green wood thermal properties to simulate veneer production by IR-heating
- In collaboration with LaBoMaP, Arts et Metiers ParisTech, rue Porte de Paris 71250 Cluny France
- In collaboration with I2M, Arts et Métiers ParisTech, Esplanade des Arts et Métiers, 33405 Talence Cedex France

RESULTS

- Heat capacity $C_p$ (kJ/kg.K)
- Transversal conductivity $\lambda_t$ (W/m.K)
- Thermal diffusivity $\kappa$ (mm²/s)

- $C_p$ increases with MC
- $\lambda_t$ increases with MC
- $\kappa$ decreases with MC

- The wetter wood, the more energy is required to heat it
- Wet wood diffuses heat more rapidly than dry wood
- Linear evolutions of $\lambda$, $C_p$ and $\kappa$ with MC provide equations to predict the thermal values function of MC

NEXT?

To integrate green wood optical properties: emissivity, transmittivity, absorptivity = f(source wavelength) to account for any volumic IR penetration

\[
Q_{\text{rad}} = h(T_{\text{ext}} - T) + \sigma(T_{\text{ext}}^{4} - T^{4})
\]

\[
\rho C_{p} \frac{\partial T}{\partial t} = \lambda \nabla^{2} T
\]

\[
T_{\text{ext}} = I_{0} \sigma T_{\text{bol}}^{4} \frac{1}{\beta}
\]

Contact: anna.dupleix@ensam.eu