DEFINING DRYING BEHAVIOUR OF HARDWOODS







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Impact Objectives

- Characterise the drying behaviour of *Eucalyptus nitens* sawn boards by assessing the variability of the wood properties
- Optimise the drying behaviour, collapse, drying stresses, internal and surface checks during multiple-kiln drying technologies
- Utilise the results to produce improvements in solid wood products

Defining drying behaviour of hardwoods

Dr Rubén A. Ananías and Research Associates Linette Salvo and Víctor Sepúlveda share their latest research on the drying of Eucalyptus nitens, which is expected to enhance the productivity of wood industries on a national scale



Dr Ruhén A Ananías

Can you talk a little about your current research and who makes up the team?

MSc Linette Salvo

RAA: Our current research is 'Drying of *Eucalvptus nitens* for solid wood products'. and our major achievement has been the study of the collapse phenomena and related drying properties in order to better understand their effect on the drying of Chilean hardwood species. In this research we are introducing new technological alternatives for the drying of *E. nitens* in order to improve the drying aptitude and use it as solid wood, allowing significant improvements in productivity of regional and national wood industries. Our research group working on the *E. nitens* drying behaviour project comprises myself, Carlos Salinas, Linette Salvo and Víctor Sepulveda.

What is the key goal of this work?

VS: The aim of our research project is to develop drying programmes on *E. nitens* wood, through a multidisciplinary and interdisciplinary approach in innovation and development for impacting the capabilities in drying of Chilean manufacturing wood industries, with a focus on producing better wood solid products.



MSc Víctor Sepúlveda

in drying and related heat and mass transport processes on wood. Regarding the

advanced research

drying behaviour of E. nitens, we are finding that the frequency of internal checks is significantly conditioned by wood density and that also this last one is significantly dependent of the anatomical characteristics.

When it comes to conventional drying methods, we have measured the drying stresses and evaluated the mechano-sorption behaviour, then in the current study, we have observed in the first stage of drying of flatsawn wood that drying stresses in tension at the wood surface were higher and in late stages of drying the compression-stresses tended to increase to the maximum magnitude.

Can you discuss the methodologies you are proposing to use for this research? Are you using any state-of-the-art tools or special equipment?

LS: Wood properties are evaluated through the analysis of images with the software Wincell and measurements profile of apparent density, total ring-width and latewood ring-width is executed using technologies such as X-Ray Ring Tree Analyzer. The characterisation of wood properties provides some physical aspects that could contribute to understanding the drying behaviour, and related drying defects such as internal checking and collapse.

What are some of the challenges you have faced during the implementation of this research?

VS: The drying aptitude of *E. nitens* is conditioned by their physical and anatomical properties. E. nitens is difficult to dry, mainly because of the high incidence of internal checking and collapse. It dries considerably slower than radiata pine, and even with longer drying times these drying defects are usually higher in most boards.

Have you had any results so far on defining the drying behaviour of E. nitens sawn boards for solid wood that you are particularly pleased with?

LS: We have been studying details of the anatomical structure and wood physicals properties in families of E. nitens. In relation to the anatomical properties (vessel diameter and frequency, fibre cell wall thickness and diameter) and wood density in *E. nitens*, we have found that internal checking was higher in the transition-zone between core-wood and lateral-wood.

Which topics do you plan to investigate in the near future?

VS: The research lines that our team wants to develop cover: biological, mathematical, mechanical, thermal, energy and alternative drying processes of wood. In this last line of research we are introducing in Chile the Radiofrequency vaccum (RFV) drying for performing the drying of Eucalyptus nitens for solid wood products.

A focus on the new technologies for drying hardwoods

of the hardwood, with a view to helping enhance wood products, through new drying technologies

Eucalyptus nitens (E. nitens) is a hardwood that was introduced into Chile. There are limitations in its usefulness for products manufacturing at present and a need for its properties to be more thoroughly explored. Dr Rubén A Ananías of the University of Bío-Bío, Chile, is the Principal Investigator on the Drying behavior of *E. nitens* for solid wood' project, which is currently underway.

The aim of the project is to characterise the drying behaviour of *E. nitens* sawn boards, and to do this the team is assessing the variability of the properties of the wood, including density, along with drying properties such as moisture content, shrinkage and strains. The last, to be able to introduce new technologies for drying E. nitens for solid wood products. The researchers have seen success in enhancing knowledge about these properties and have expanded into the area of the Radio-frequency vaccum processes of wood. 'Through scientific research over the last 10 years, we have deepened knowledge of the properties of wood in relation to drying; in particular, the effect of collapse and the behaviour of *E. nitens*,' outlines Ananías. 'More recently, we are investigating the Radiofrequency vaccum processes of *E. nitens*, with the aim of improving the use of these woods in lumber construction, in components with

AN INTERESTING INTERRELATIONSHIP With wood of lower basic density tending to be associated with higher internal checks, the researchers posited that this interrelationship could be used to compare the performance of E. nitens trees for solid wood products. 'Regarding the shrinkage and collapse of

high structural requirements.'



RFV drying of E. nitens juvenile wood for solid wood products.

between *E. nitens* trees,' highlights Salvo. 'The transversal shrinkage and collapse core-wood to lateral-wood), despite the fact and collapse were found in the transitionwood zone.'

The team also observed higher transversal shrinkage in the transition wood of some trees, which was reinforced by a high level of transverse collapse found in the same trees. 'On collapse of *E. nitens*, exploratory results seem to confirm that pieces that were cut from the transition zone between the centre and the periphery of the tree (transition wood) were more susceptible to collapse,' observes Sepúlveda. 'On average, collapse in transition wood was approximately 50 per cent higher than the collapse observed in wood cut from the centre and the periphery of the trees.' Also we are finding that the drying-stresses behavior support the tendency for surface checks, internal intra-ring checks and collapse drying stresses, tending to improve the drying during the drying of E. nitens juvenile wood.

> With the project having been underway for a four-year period at this point, key findings are a characterisation of wood in terms of its anatomical and physical properties to define the drying aptitude of *E. nitens* families, and the optimisation of drying processes of wood through the modelling of the drying kinetics. Using new technologies, we are finding that collapse is relatively low during the RFV drying of E. nitens, and therefore it is reduced the intensity of the internal intra-ring checking, highlights Ananías.

technology will enable wood producers and often environmentally damaging hardwoods species with less costly and sustainably managed eucalyptus wood for solid wood products.

'In addition, exhibitions are held where

Research on Eucalyptus nitens at the University of Bío-Bío, Chile, is exploring the drying behaviour

E. nitens, we showed variations of shrinkage and collapse from core-wood to lateral-wood tended to increase with radial position (from that sometimes higher transversal shrinkage

If all goes to plan, the team hopes the new around the world to begin replacing expensive

Results of the research are being shared via scientific articles, congresses and seminars. the results are disclosed to the different industries that participate in our research,' Sepúlveda says.

Looking ahead, the team will pursue more lines of investigation, including exploring the thermal modification of wood and deepen on the radio-frequency vaccum processes of hardwoods. They hope their research will assist in improving energy efficiency and producing better wood and wood-based products.

Project Insights

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BIO

Professor Dr Rubén A. Ananías has an extensive work in teaching and research on drying of hardwoods and he is a Fellow of the International Academy of Wood Science. Currently he is the leader of the research on 'Drying of *Eucalyptus nitens* for solid wood products'. His major achievement has been the research on collapse phenomena and related drying properties to better understand the effect of drying on Chilean hardwood species, allowing significant improvements in productivity of regional and national wood industries.





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