

UQ Fire Project #2019.01

RELEVANCE OF BIOMASS CHARACTERIZATION IN THE MECHANICAL PROPERTIES OF TIMBER AND BAMBOO DURING FIRE

Advisory Team

Dr Luis Yerman (l.yerman@uq.edu.au)

Keywords

Timber, bamboo, fire performance, physico-chemical characterization

Background and motivation

Timber and bamboo are gaining more and more attention in the building environment due to its aesthetic, sustainability, rapid construction, lightweight and low-cost. Architects, developers, and engineers aim at expanding the use of timber and/or bamboo for load-bearing elements used in building structures without compromising the fire safety of such buildings. When lignocellulose based materials, such as timber and bamboo, are exposed to fire, these combust and can ultimately contribute to the fuel load in the compartment or to sustained burning after burnout of the contents inside the room in fire.

This situation represents a paradigm shift in the way we design fire safe load-bearing, structural systems. The analysis of and the reason why the assessment of the thermal degradation of those materials is extremely relevant. The correlation between the thermo-chemical degradation and the biomass composition (moisture, volatiles, fixed carbon, ash, and chemical composition) is key to understand the burning behaviour of materials like timber or bamboo. Outcomes of this study will provide a fundamental approach to understand the degradation of the mechanical performance by investigating the biomass composition.

Research objectives

The goal of this research project is to characterize different timber and bamboo products that are used in the construction industry; and find correlations between: (1) thermal degradation, (2) burning behaviour, and (3) reduction in mechanical capacity.

Methodology

This project will consist of two stages:

1. *Biomass characterization* – physicochemical characterization by means of elemental (ICP) and proximate analysis (moisture, volatiles, fixed carbon and ashes), thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC).
2. *Dynamic mechanical analysis* aimed at understanding the mechanical degradation of timber and bamboo and find correlations with between thermo-chemical degradation and degradation of the mechanical performance.

Recommended literature

- [1] Uribe, B. E. B. and O. A. Ayala (2015). "Characterization of three wood species (Oak, Teak and Chanul) before and after heat treatment." *Journal of the Indian Academy of Wood Science* 12(1): 54-62. [\[link\]](#)
- [2] Liu, Z., Jiang, Z., Cai, Z., Fei, B., Yu, Y., Liu, X., & #039. (2012). Dynamic mechanical thermal analysis of Moso bamboo (*phyllostachys heterocycla*) at different moisture content. *BioResources*, 7(2). [\[link\]](#)