

LABORATORY OF WOOD TECHNOLOGY (UGENT-WOODLAB)

Xiuping Jiang, Jan Van den Bulcke , Liselotte De Ligne and Joris Van Acker

NATURAL DURABILITY AND MOISTURE DYNAMICS OF POPLAR-CLT FOR GREEN BUILDINGS

The importance of using Poplar (benchmarking with spruce) for CLT

In recent decades, the interest for building taller all-timber structures using engineered timber materials such as cross-laminated timber (CLT) has increased substantially, especially in the framework of sustainable use of resources and the positive carbon footprint of wood materials. The specific structure of CLT panels improves the dimensional stability, bending strength and other mechanical properties, thus enabling its use as load-bearing elements in various constructions.

Especially in Europe, mainly spruce (*Picea abies*) is used for this purpose, while other wood species have been largely overlooked. Poplar, for example, is considered a potential species to be used in CLT as a substitute of spruce. Poplar is of interest as fast-growing tree species providing lightweight material. It is a majorly important tree species in planted forests and agroforestry worldwide.

However, since poplar in general has a very low natural durability, we need to acquire sufficient knowledge on its behavior when incorporated in CLT. Within this project, we will therefore focus on moisture dynamics, which are in direct relation to the fungal susceptibility and thus decay resistance and service life of the product. We will investigate the moisture sorption properties (including e.g., equilibrium moisture content, water sorption properties) of unmodified and modified poplar products, and test the fungal susceptibility as well, aiming at incorporation in CLT products. We also prospect the use of state-of-the-art X-ray CT scanning for non-destructive assessment for poplar and thermally modified poplar for its natural durability and provide extra insight in microstructural changes for the treatments considered. The continuous moisture measurement (CMM) is used for an outdoor performance of poplar (CLT) against weathering and the data is used for hygrothermal simulation in Delphin for the risk prediction for in realistic circumstances. The overall objective is to integrate data on the potential of poplar CLT and provide guidance on a fit-for-purpose approach for application in green building applications.



Moisture dynamics based on lab tests

Moisture sorption properties were investigated using dynamic vapor sorption (DVS). These results are essential to understand the moisture dynamics of poplar and thermally modified poplar for service life estimation. Spruce is included as a benchmark, as it is often used for CLT.

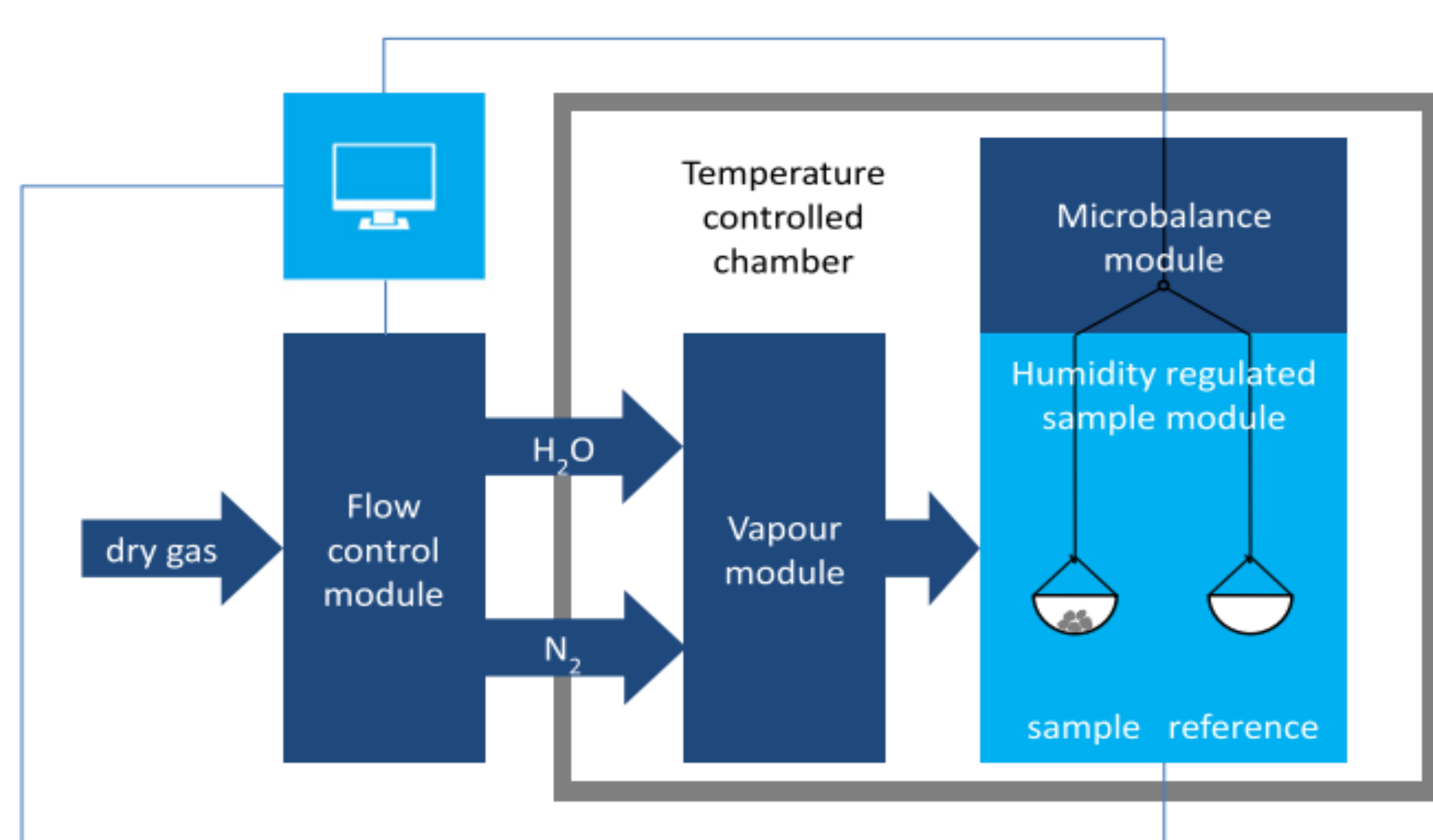


Figure 1. Dynamic vapor sorption (DVS) measurement

Natural durability based on X-ray CT scan

X-ray CT scanning, as a non-destructive methodology, gives extra insights in the fungal degradation inside the wooden blocks over time. The results showed that degradation led to a significant decrease in total density, particularly after 2 weeks, when degradation began to occur extensively.

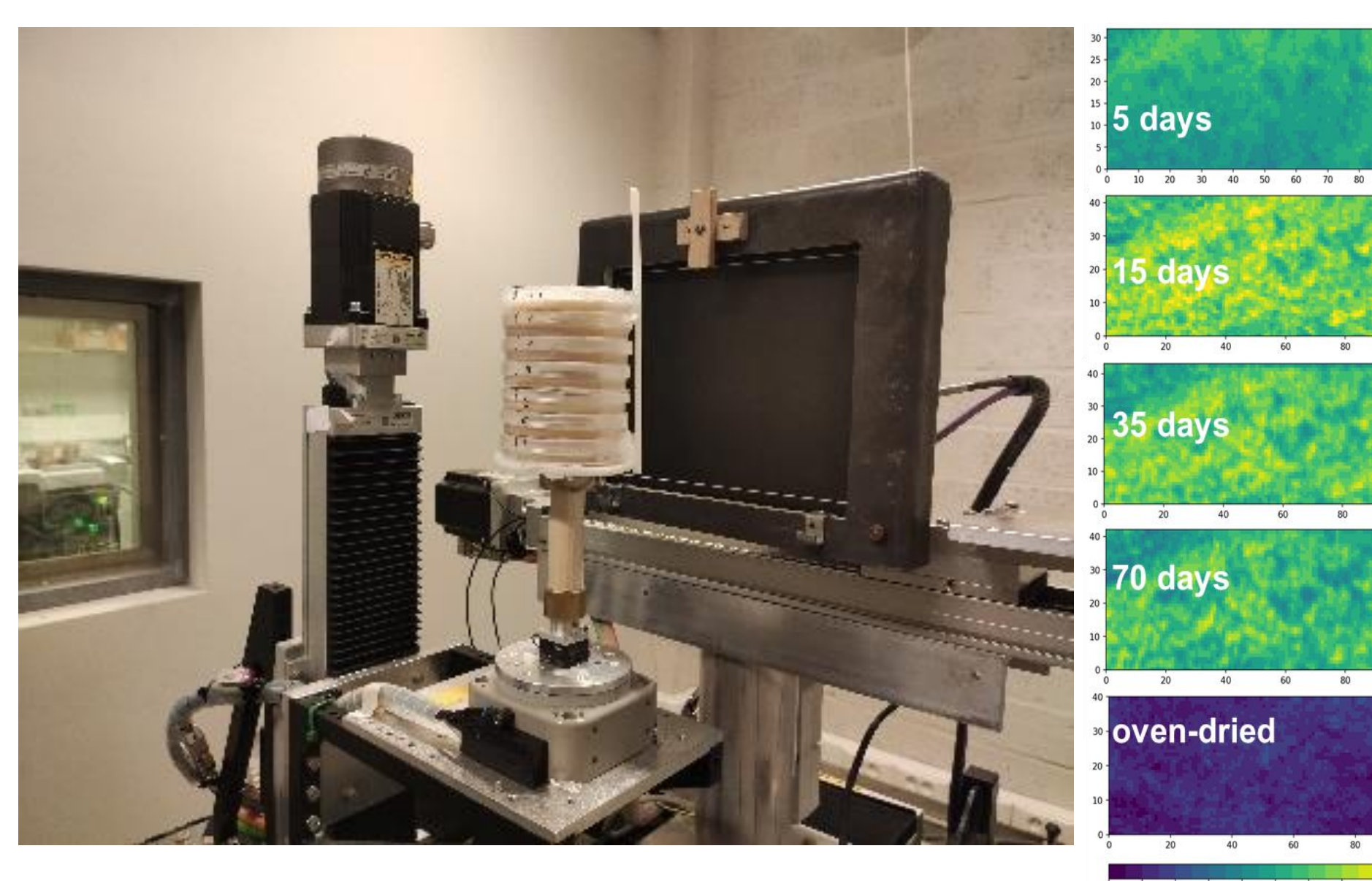


Figure 2. X-ray CT set up and an examples of mean density of a typical low-density poplar mini-block with the colour scale indicating the density levels.

Outdoor exposure

Wooden samples are exposed to the outdoor climate, their weight and the weather data are measured continuously. Hygrothermal simulations in Delphin 6 are then used to investigate how wet a poplar (CLT) panel gets during construction under realistic critical conditions and how it is able to dry during the construction.



Figure 3. Hygrothermal simulation



Figure 4. Continuous moisture measurement (CMM) set-up

About me

Doctoral researcher specialized in natural durability and moisture dynamics of poplar and poplar-CLT. I started my PhD at UGent-Woodlab in November 2019, my research goal is to optimize the use of poplar in engineered wood products (EWPs) e.g., cross-laminated timber (CLT). This could bring new opportunities for poplar to be used in sustainable constructions.



Contact

Xiuping.jiang@ugent.be
<http://www.woodlab.be>

Ghent University- WoodLab

@WoodLabG

UGent-Woodlab