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Ph.D. thesis (2024-2027)
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Multiscale Characterization of the Hygro-Mechanics of the Fiber Mats

Caractérisations multi-échelle de l'hygro-mécanique des matelas fibreux

BioChip MatBio

Context

Packaging industry

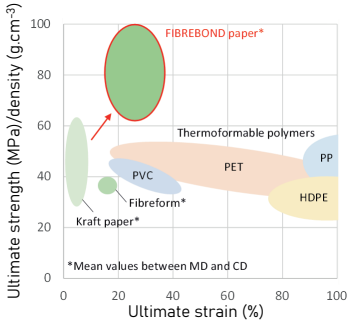
140 MT of non-degradable petroleum based polymers worldwide in 2021.

Paper

It is an **alternative** but is strongly limited by its **weak ductility**.

To face the growing demand while limiting its environmental impact**, the paper industry must reduce its consumption of energy, water and raw materials.**

Paper should be:
- **stronger**,
- **extensible,**
- **lower basis weight**



Funded by: anr® FiberBond ANR 2024-2028

Objectives

Goal of this project

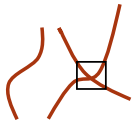
Get a better understanding of the inter-fiber bonds behavior and its impact on paper hygro-mechanical properties using a multiscale approach. This is done using different fiber morphology and fiber mat density.

Study paper at different scale

- **Macro scale**: paper sheet

- **Meso scale**: fiber network

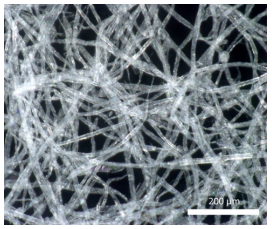
- **Micro scale**: fibers and fiber bonds



Methods

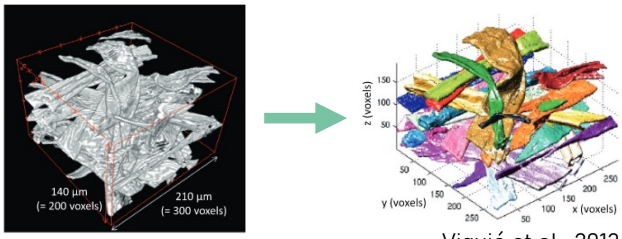
Model sample

6 g.m^{-2} handsheets samples made from various pulp using a Rapid Köthen and 1 µm mesh wire



X-ray microtomography and segmentation

Allows for the 3D reconstruction and labeling of samples to study 3 scales at the same time: Fiber network, individual fibers and the fiber contacts.



Viguié et al., 2013

In-situ hygro-mechanical testing

Mechanical testing done using a micro-press under a climatic chamber while being scanned by X-ray microtomography. Allows for a morphological and mechanical characterization at different humidity.