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Ph.D. thesis (2024-2027)
LGP2 (J. Bras; Q. Charlier)

Dry processing methods to manufacture low environmental-footprint bio-based materials

Fabrication en voie sèche de matériaux biosourcés à empreinte environnementale diminuée

MatBio

Context / Objectives

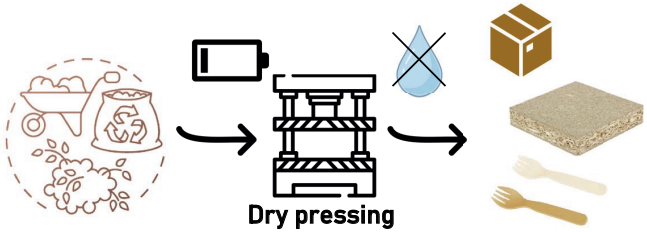
1 Environmental issues
Plastic industry

- **CO2 emission**
- **Not biodegradable** so a lot of wastes finds itself in landfill or ocean (6900 Mt[1])

2 Disadvantage of current biobased solutions

- Hight **energy and water consumption**
- The use of **petroleum-based adhesives**
- **Low biodegradability** or recyclability for bioplastics

Goal : Substitute plastic by producing material form biomasses with more sustainable dry processes that uses less energy, less water, no petroleum based adhesives and that can leads to biodegradable solutions !



Understanding adhesion phenomena is key

[1]Tony R. Walker et al. Trends in Analytical Chemistry 2023

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Methods

Lignocellulosic material

- Wood industry by products
  ⮑ *For circular economy*
- "Pure material"
  ⮑ *To control and understand*

Functionalization and additives

- Biobased polymers
- Green chemistry
- Initial porous structure
  ⮑ To tune the mechanical properties

⮑Different type of material shaping (powder, fiber, particle)

Dry process

- Thermocompression
- Ultrasonic compression molding

⮑Different process parameters

⮑Adjust **input parameters** to tailor final properties

Iterative work

Multi-criteria analysis
Creation of a global performance index

Performance

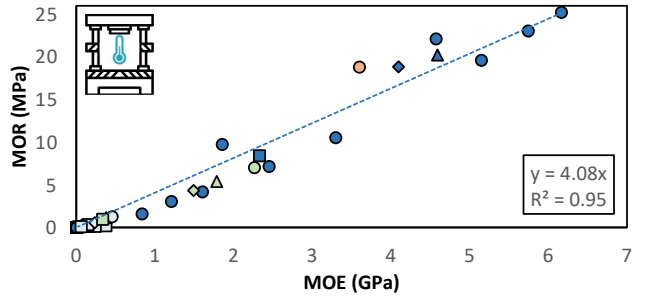
- Mechanical properties
- Thermal properties
- Surface roughness
- Water resistance

Environmental

- Biodegradability
- Dry recyclability
- Fragmentability
- LCA

Results

Mechanical properties as function of process parameters



Three distinct material states