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Ph.D. thesis (2022-2025)
LGP2 (Q. Charlier, J. Bras)

Manufacturing of bio-based materials using ultra-sonic compression molding

Élaboration de matériaux biosourcés par compression ultrasonore

MatBio

Context / Objectives

Manufacturing of 100% biosourced materials

Environmental footprint reduction

Bio-sourced materials can have a significant environmental impact :

- Use of petroleum-based resins (wood panels)
- High energy consumption during production (papers and boards)
- Low recyclability (bio-based composites)

New process and material development

1. Use of Bio-waste as raw material in order to get into a *circular economy model*
2. Dry process in order to *reduce water and energy consumption*
3. Manufacturing of molded composites via powder compression using ultrasonic vibrations

→ 100% Composite materials made derived from cellulosic fibers and natural binder (lignin and others)

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Methods

Ultrasonic compression

High frequency acoustic vibration under compression

Compaction of dry powder into bulk Composites materials

Figure : Ultrasonic Press - Sonimat

Characterization methods

Analysis :

- *Microstructural*
- *Resistance to water and humidity*
- *Thermal and insulation properties*
- *Mechanical properties*
- *Energy consumption*

Impact assessment

Multicriteria analysis to associate material properties and energy footprint

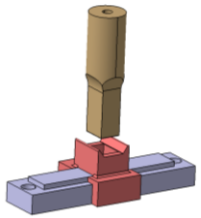
Toward scale up (TRL 4+)

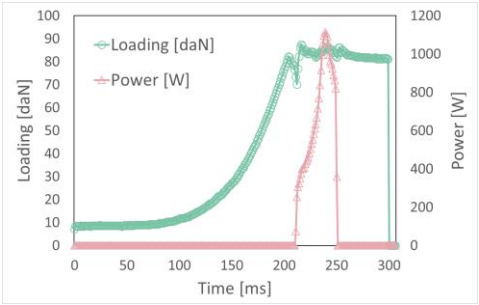
Life Cycle Assessment

Results

Key process parameters :

- Power and transmitted energy
- Pressure





Process development :

- Molds (for dry materials)
- Spring tooling system for US molding
- Temperature monitoring

In-situ monitoring of material formation

Key raw material characteristics :

- Influence of chemical composition
- Shape and Size of bio-elements
- Influence of humidity content

Conference:
David M. Et al. (2023), Journée Nationale sur les Composites (JNC). *Besançon*