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LCA LABORATOIRE DE CHIMIE AGRO-INDUSTRIELLE

AM AGROMAT

GdR MBS MATÉRIAUX de CONSTRUCTION BIOSOURCÉS

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Co-products of sunflower cultivation, a promising source of biostimulatory molecules and construction materials

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Introduction

- **FACCE SURPLUS** call, European Union.
- Project duration: 42 months.
 - ◆ From April, 2020 to September, 2023.
- Main objective of the project:

To create a value chain of sunflower biomass.
- Working methodology:
 - ◆ Extraction of bioactive ingredients from sunflower co-products (i.e., stalks and heads) through extrusion.
 - Use of the extracts as ecologically-friendly agricultural products.
 - ◆ Obtaining bio-based construction materials from the remaining fibrous solid.
 - Generating economical value with a lower environmental footprint.

BioSUNmulant

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Sunflower biomass fractionation

Sunflower biomass → (1) TSE fractionation → Extrudate → Bio-based materials (WP7)

Aqueous solvent → (2) Centrifugation → Clarified filtrate → (3) Freeze-drying → Freeze-dried extract (SE)

Filtrate → (2) Centrifugation → Foot

Cleextral Evolum HT 53 (up to 100 kg/h)

TSE = twin-screw extrusion.

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Hot pressing of RS

- Molding conditions tested:
 - ◆ Mold temperature: 180°C, and 200°C.
 - ◆ Applied pressure: 10 MPa, 20 MPa, and 30 MPa.
 - ◆ Molding time: 1 min, 2 min, and 3 min
- Addition of sunflower protein isolate (SPI) as an exogenous natural binder:
 - ◆ Isolate obtained from industrial cake:
 - Alkaline extraction (denaturing conditions) plus isoelectric precipitation.
 - Protein content: 96% dry matter.

→ Cohesive formaldehyde-free boards.

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Conclusions about self-bonded boards

- Cohesive self-bonded panels produced from the only solid raffinate.
 - ◆ Contribution of proteins, hemicelluloses, lignins and residual water-solubles to binding.
- Influence of thermpressing conditions on the board's properties:
 - ◆ Increase with the applied pressure and the molding time.
 - ◆ Increase with the mold temperature at 30 MPa applied pressure.
- Optimal molding conditions:
 - ◆ 200°C mold temperature.
 - ◆ 30 MPa applied pressure.
 - ◆ 3 min molding time.

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Conclusions about boards with SPI

- Adding SPI makes optimal board much more mechanically resistant.
 - ◆ +111% for flexural strength.
- 1,270±17 kg/m³ density → **Hardboard.**
- **Type P2 board according to NF EN 312.**
 - ◆ Interior fittings (including furniture) used in dry environment.

Characteristic	Optimal board	Recommendation ¹
Flexural strength (MPa)	37.3±0.7	13 min
Elastic modulus (GPa)	4.6±0.2	1.8 min
Internal bond strength (MPa)	0.85±0.02	0.45 min
Shore D surface hardness (°)	68±2	None

¹ NF EN 312 standard.

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Dry fractionation scheme of RS

RS → Mechanical sieving → Bigger fraction (long fibers) > 1 mm → Compression molding → Low-density insulation blocks (3)

RS → Mechanical sieving → Smaller fraction (fines) < 1 mm → Twin-screw compounding → Extrudable and injectable fiber-polymer composites (4)

Starchy binder + Water → Compression molding

Low pressure, ambient temperature

Bioplastics (PLA, PHAs, etc.)

- Pots for plants.
- Tutors for plants.
- Window openings.
- Exterior decking.
- Etc.

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Conclusions about insulation blocks

- Low-cost compression molding process with very low pressure (100 kPa) applied at ambient temperature.
- Use of a starchy binder with physical curing as natural adhesive.
- Possible applications in the building sector.
- For equivalent thermal resistance as expanded polystyrene (1.56 m² K/W), need for a thicker insulation block:
 - ◆ 7.6 cm instead of 5 cm (i.e., + 51%).

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