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Ph.D. thesis (2021-2024)
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Use of twin screw extruder (TSE) for innovative cellulose based packaging by thermocompression

Utilisation de l'extrusion biVis pour obtenir des emballages celluloseux innovants par thermocompression

Context / Objectives

Single Use Plastic Directives and PPWR

1st of January 2022 plastic bags, packaging for fruits and vegetable, tea bag not biodegradable



1st of January 2025, non recyclable packagings of styrenic polymere, microwaved plastic food packaging

Existing solutions

Cellulose molded fibers

Dry molded fibers

Thermocompressed molded fibers

→ Specific properties brought by coating or a lamination of a petroleum based polymer

Limits in recyclability



Industrial context

- Looking for energy efficient alternative processes to produce microfibrillated cellulose (mfc)
- Growing interest in thermocompressed molded cellulose

Funded by:



In collaboration with CTP

Methods

Produce new recyclable cellulosic packagings with high specific properties.

Formulation by TSE

Produce cellulosic material at high concentration



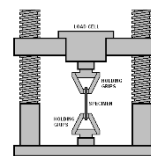
Pulp distribution

- Rheological study of highly concentrated suspension. (20-50%wt)
- Water vacuum before thermocompression



Thermocompression and applications

- Optimisation
- 2D and 3D object
- Mechanical, barrier tests
- Application

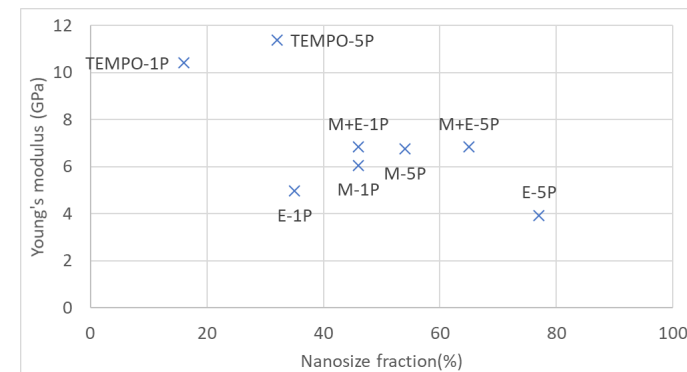


Results

- Experimental model of friction forces in TSE during nanofibrillation

$$\dot{E}_{f,i} = q_m \cdot c p_m \cdot (T_i - T_{i-1}) - \dot{E}_{c,i}$$

- Impact of pretreatments on TSE-CNF quality and TSE process



→ Combination of enzymatic hydrolysis and refining results in:

- Stable process (torque, mass flow, temperature, solid content)
- Higher quality index¹

1- Desmayses *et al.* « A New Quality Index for Benchmarking of Different Cellulose Nanofibrils ». *Carbohydrate Polymers* 174 (15 octobre 2017)

