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## Preparation of PLA/starch foams by an extrusion process

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## INTRODUCTION

### Authors

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since the 01/10/2014)

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### Partners

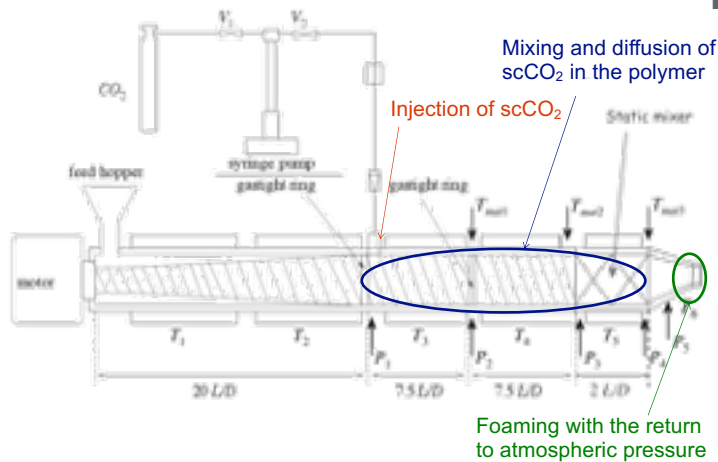


#### Interest of foaming a blend of PLA/starch :

- Biobased, biocompatible and biodegradable polymers
- Reduce the cost and the density
- Improve the barrier properties and the crystallinity

#### Interest of extrusion assisted by supercritical CO<sub>2</sub> :

- Modification of the polymer properties (especially, decrease of the viscosity and the T<sub>g</sub>)
- Creation of porosity



## MATERIALS AND METHODS

#### scCO<sub>2</sub> assisted extrusion

- Single-screw extruder (Scamex, France)
- D=30 mm and L/D=37
- T<sub>1</sub> to T<sub>4</sub> : 160, 180, 180 and 160°C
- Blend of 95% PLA with 5% starch

#### PLA from NaturePlast (PLE001)

- Semi-crystalline (T<sub>g</sub>≈60°C; T<sub>m</sub>≈150°C)
- Low D-lactic acid content

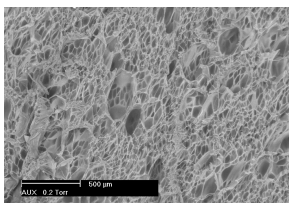
#### Native corn starch from Roquette

- Lost at drying ≈13%

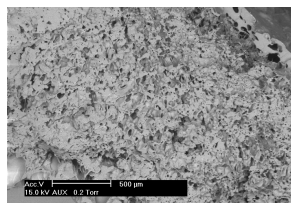
## RESULTS

#### Morphology with 3 mL/min scCO<sub>2</sub>

- Uniform structure for the PLA
- Coarse structure for the blend (higher T<sub>5</sub> and T<sub>6</sub>)



100% PLA



95% PLA + 5% starch

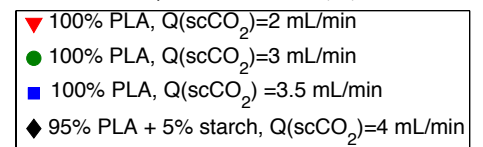
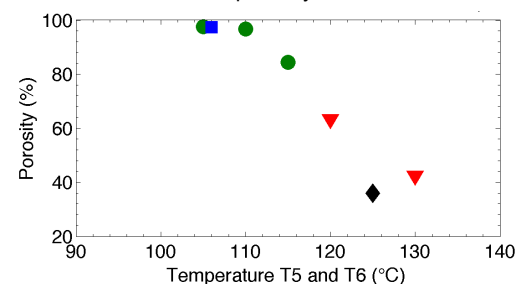
#### Thermal analysis with 3 mL/min scCO<sub>2</sub>

- ↗ crystallinity with T<sub>5</sub> and T<sub>6</sub> ↘
- Highest porosity ⇒ highest crystallinity

Sample	T <sub>g</sub> (°C)	T <sub>cc</sub> (°C)	ΔH <sub>cc</sub> (J/g)	T <sub>m</sub> (°C)	ΔH <sub>m</sub> (J/g)	X <sub>c</sub> (%)
PLA raw	59	104	12.4	146	12.4	0
Foam of PLA (110°C)	59	78	11.5	150	29.4	19
Foam of PLA (105°C)	58	73	5.2	148	31.5	28

#### Porosity

- Up to 95%
- ↗ with T<sub>5</sub> and T<sub>6</sub> ↘
- ↗ with scCO<sub>2</sub> ↗
- Lower porosity for the blend



## CONCLUSION

- Production of foams with a porosity up to 95%
- Increased crystallinity with the addition of scCO<sub>2</sub>
- Perspectives : more tests for the blend (PLA/starch) with decreasing temperatures T<sub>5</sub> and T<sub>6</sub> and increasing scCO<sub>2</sub>