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

INTRODUCTION

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 CO2:
- Modification of the polymer properties (especially, decrease of the viscosity and the \( T_g \))
- Creation of porosity

MATERIALS AND METHODS

scCO\(_2\) assisted extrusion
- Single-screw extruder (Scamex, France)
- \( D=30 \) mm and \( L/D=37 \)
- \( T_1 \) to \( T_4 \) : 160, 180, 180 and 160\(^\circ\)C
- Blend of 95% PLA with 5% starch

PLA from NaturePlast (PLE001)
- Semi-crystalline (\( T_g \approx 60\)°C; \( T_m \approx 150\)°C)
- Low D-lactic acid content

Native corn starch from Roquette
- Lost at drying \( \approx 13\% \)

RESULTS

Thermal analysis with 3 mL/min scCO\(_2\)
- \( \chi_c \) crystallinity with \( T_5 \) and \( T_6 \)
- Highest porosity \( \Rightarrow \) highest crystallinity

<table>
<thead>
<tr>
<th>Sample</th>
<th>( T_g ) (°C)</th>
<th>( T_{cc} ) (°C)</th>
<th>( \Delta H_{cc} ) (J/g)</th>
<th>( T_m ) (°C)</th>
<th>( \Delta H_m ) (J/g)</th>
<th>( \chi_c ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLA raw</td>
<td>59</td>
<td>104</td>
<td>12.4</td>
<td>146</td>
<td>12.4</td>
<td>0</td>
</tr>
<tr>
<td>Foam of PLA (110°C)</td>
<td>59</td>
<td>78</td>
<td>11.5</td>
<td>150</td>
<td>29.4</td>
<td>19</td>
</tr>
<tr>
<td>Foam of PLA (105°C)</td>
<td>58</td>
<td>73</td>
<td>5.2</td>
<td>148</td>
<td>31.5</td>
<td>28</td>
</tr>
</tbody>
</table>

CONCLUSION

Production of foams with a porosity up to 95%
- Increased crystallinity with the addition of scCO\(_2\)
- Perspectives: more tests for the blend (PLA/starch) with decreasing temperatures \( T_5 \) and \( T_6 \) and increasing scCO\(_2\)